Tidally driven sediment transport pathways around the Sea Palling Breakwaters, Norfolk

A thesis submitted to the
School of Environmental Sciences
at the University of East Anglia
in partial fulfilment of the requirements
for the degree of
Doctor of Philosophy

Roger Phillips

April 2010

Abstract

This research aimed to identify and quantify tidally driven sediment transport pathways within and around the shore parallel breakwater system at Sea Palling, Norfolk. The tidal contribution to the sediment budgets of the region shoreward of the breakwaters was investigated to evaluate any net increase or decrease of sediment volume. The hydrodynamic model TELEMAC2D was tested over this coastal region of complex bathymetry and coastal structures. Lagrangian measurements of currents were used to test model simulations to increase confidence in model output.

TELEMAC2D was calibrated and validated using LEACOAST2 field measurements to simulate tidal currents and water levels around the nine shore parallel breakwaters at Sea Palling. Bed roughness was tuned and the effect of using one uniform roughness and an increased roughness over nodes associated to reef positions was evaluated. A uniform roughness over the whole domain of $k_s = 0.3$ (Nikuradse roughness coefficient) was found to give the best results.

Radar and GPS trackable drifters were designed and built to measure water particle pathways around the breakwater system. Floats fitted with GPS receivers were not limited by range. Their reduced freeboard allowed their use in a wider range of wind speeds than the radar floats, although on-board data capture made float retrieval crucial. A Lagrangian dataset was established from GPS and radar drifter experiments and used to assess confidence which could be applied to the numerical model using the FORTRAN subroutine FLOT within TELEMAC2D simulations.

Model performance statistics showed “good” or “excellent” current speeds were found shoreward of the breakwaters. Current speeds and water levels were used to drive a sediment transport model to identify tidally-driven sediment transport pathways throughout the system and establish the tidal contribution to the sediment budgets of the beaches inshore of the breakwaters. Phase one is experiencing a net loss in sediment volume of 14 400 $m^3 y^{-1}$, predominantly driven by losses over tombolo 8 leaving phase one and entering phase two. Phase two is fairly stable, experiencing a small net increase in sediment volume (1 000 $m^3 y^{-1}$); sediment input from tombolo 8 is greater than losses between breakwater 13 and the shore. The Sea Palling system as a whole is experiencing a net loss of sediment due to tides-only of 13 500 $m^3 y^{-1}$.

To my very strong and loving wife,

Josie Phillips

Thank you

Acknowledgements

I am very grateful to the Engineering and Physical Sciences Research Council who funded this work as part of the LEACOAST 2 research project.

I would firstly like to thank Professor Chris Vincent for his supervision, guidance and encouragement though every stage of this research project. His time and understanding support has been invaluable and I have really appreciated it. I am also very grateful to Dr Tony Dolphin, Dr John Bacon, Dr Iain McDonald and Dr Clare Coughlan for their encouragement and guidance throughout.

I would like to thank all of the LEACOAST 2 project partners, particularly Dr Paul Bell at the Proudman Oceanographic Laboratory for his time and effort with the X-band radar and my float tracking experiments.

Thank you James Parker at Gardline Ltd, for providing me with AWAC data at Horsey and Walcott. My sincere thanks go to all those who have given up their time to help me with field work. Thank you Mum for the numerous occasions you sat on the back of a quad bike with me. Thank you Mum, Dad, Erica, Paula, Josie, Keith and Xanthe Phillips, Chris Vincent, John Bacon, Estelle Dumont, Iain Fairley, Mathilde Belhache, Angélique Roubi for getting wet and cold helping deploy and retrieve drifters from small boats in winter and summer.

I would like to thank Iain, Clare, Karen, Hyo-Bong and all those who have shared an office with me over the past years for your support, encouragement and happy working environment. Special thanks to Iain for all of the coffee, hot chocolate encouragement and advice you have applied me with over the last two years!

Lastly I would like to thank Josie for the continued support and motivation she has given me through a very difficult time in her life. Thank you Josie also for reading every word within this thesis!

Contents

List of Figures

List of Tables

1 Introduction

This PhD is funded as part of the EPSRC (Engineering and Physical Sciences Research Council) research project LEACOAST2 (Section 1.1). This studentship was attached to the University of East Anglia (UEA) who was responsible for the field work component to the project. As a consequence, the author played a practical role in the collection of project field data. These were supplemented with extra measurements made for the primary purpose of this PhD.

1.1 LEACOAST2 project introduction

The EPSRC funded LEACOAST2 research project was a collaboration between the University of Liverpool (UL), UEA, and the University of Plymouth (UP), and, Proudman Oceanographic Laboratory (POL) and British Oceanographic Data Centre (BODC) who were sub-contracted to the project for field measurements and data management. Project partners included the end users, Halcrow Maritime (HAL) and HR Wallingford (HRW) who gained parallel funding to incorporate project results into national design guidelines. This parallel project was funded by the Department for Environment Food and Rural Affairs (DEFRA) and the Environment Agency (EA) (Pan, 2008).

The main objective of the LEACOAST2 project was to evaluate the effects of shore-parallel breakwaters (the term breakwater and reef are used interchangeably in this thesis) in tidal conditions on coastal morphology over time scales of years and space scales of kilometres. The project used a combination of deterministic and probabilistic modelling and involved the collection of a new hydrodynamic and morphological dataset. The research built on results from the previous LEACOAST project investigating the storm scale impacts of shore-parallel breakwaters (Pan, 2008).

The study made use of both existing field and model data and engineering experience, as well as newly acquired field data from the nine segmented shore-parallel breakwaters at Sea Palling, Norfolk.

Specifically, the LEACOAST2 research focused on:

1. Modelling work (UL):
    i. Further development of process models to include additional processes, such as over-topping, wave streaming and effect of bound waves.
    ii. Undertaking a model sensitivity study for developing a best minimum process model and improved aggregation approaches for medium-term prediction.
    iii. Developing and testing probabilistic/engineering morphological models for long-term prediction.
2. Field work (UEA, UP, POL):
    i. Collection of extensive hydrodynamic and morphodynamic measurements.
    ii. Conduction of bathymetric surveys of the area to provide detailed information for model testing and validation, and to identify sediment transport pathways under the influence of a group of nearshore structures.
    iii. Conduction of long-term monitoring of coastline evolution using advanced video and radar techniques to provide valuable insight into the morphodynamics of tidal environments protected by shore-parallel breakwaters, boundary conditions, calibration and validation data for new numerical models.
    iv. Provision of data to improve a conceptual model of how the shore-parallel breakwaters at Sea Palling operate and interact with local and artificial sediment sources as well as their interaction with adjacent areas for better coastal management.
    v. Provision of data to improve the existing design guidelines.

The study area of LEACOAST2 covered a 6 km long stretch of coastline including the up-drift beaches north-west of the breakwater system, the four larger breakwaters of phase one, the five lower crested breakwaters of phase two and the down drift zone as far as Horsey to the south-east (Figure 1.1).

Figure 1.1: Sea Palling location map, (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service).

In order to study sediment transport pathways and interactions with shore-parallel breakwaters over longer temporal and spatial scales the project combined process-based numerical models developed by UL with additional physical processes, engineering level models at UEA and probabilistic approaches via 1 to n-line models developed at UP. A new field program incorporated the advanced new acoustic, radar and video monitoring equipment with nearshore point measurements and frequent beach and nearshore bathymetric surveys.

1.2 Thesis introduction

This thesis aims to identify and quantify tidal sediment transport pathways around the breakwater system at Sea Palling. The hydrodynamic model TELEMAC2D is used to simulate the tidal currents and water-levels over an area of ~5.5 km along-shore and 2.2 km offshore, which encompasses most of the area covered by the LEACOAST2 project (Section 1.1). By applying simulated currents and water-depths to standard sediment transport models, sediment transport rates can be calculated for each node in the model. This work aims to use these calculations to assess the sediment budgets of the local area within the breakwater system and identify transport pathways over the whole domain over a one year timescale. Modelling is limited to tides only conditions, although transport pathways identified are likely to be similar to those when waves are small (< 0.5 m). The magnitude of transport, and therefore sediment budgets would not be expected to be similar when waves are considered.

This thesis is attached to the LEACOAST2 research project (Section 1.1) which should provide an abundance of calibration measurements to compare modelled simulations to. Regular bathymetry surveys and availability of forcing data from measurements at Horsey and Walcott (described in Section 3.2.3) enable model simulations to be forced with concurrent data to which it is tested against. Supplementary measurements made by the author add to the available calibration data to increase the confidence that can be applied to model results. The full research objectives for this thesis can be found in Section 1.3.

The use of a numerical model allows understanding gained through measurements made at singular locations to be extended over a much larger area. By using the high quality field measurements made at positions around the breakwaters as part of the LEACOAST2 project, a properly calibrated and validated model can be set up to investigate how the system responds to tidal forcing. In this way simulations can give information for areas where there are no measurements and help understanding of how the system works overall. Numerical models are widely used in this way but this research presents methods for gaining increased confidence in model performance which may be applicable to many other modelling studies. A fairly inexpensive and simple methodology is presented for tracking water particles through the system using GPS and radar, and making direct comparisons to model simulations to asses model performance.

1.3 Thesis aims and objectives

The aims and objectives this thesis aims to address are:

1. To test the hydrodynamic model TELEMAC2D over a coastal region of complex bathymetry and coastal structures.
2. To make Lagrangian measurements of currents to test the predictions of numerical model output.
3. To identify tidally-driven sediment transport pathways around the breakwaters at Sea Palling.
4. To investigate the tidal contribution to the sediment budgets of the region shoreward of the breakwaters (to evaluate if there is a net increase or decrease of sediment volume).
   a. Within phase one
   b. Within phase two
   c. Within phase one and two combined

Further sub-objectives were defined as a requirement to be able to achieve the main objectives.

1. Set up a modelling methodology using TELEMAC2D which accurately simulates tidal currents over the area of interest.
2. Test the model at locations where data were collected as part of the LEACOAST2 project, to assess the accuracy of simulations.
3. Consider the increased frictional effects of the rubble mound breakwaters.
4. Measure confidence in model performance, particularly where complex flow patterns are predicted by the Lagrangian current dataset.
5. Apply appropriate sediment transport models to currents generated by tides as simulated by TELEMAC2D.
6. Assess sediment transport patterns over spring tides, neap tides and over a longer time period in order to gain an understanding of the long-term contribution of tidally-driven sediment transport.
7. Compare results to those available in the literature.

2 History and background

2.1 Background to coastal processes in East Anglia

The East Anglian coastline is vulnerable to flooding and has a long history of coastal protection works. The frontage between Happisburgh and Winterton is particularly at risk due to its exposure to waves from the north-west through to the south-east. Waves approaching from the north can be extremely large due to their almost unlimited fetch of the North Sea (Figure 2.1).

Figure 2.1: Waves at Sea Palling looking south-east (photo from Halcrow, 2008)

Figure 2.2: Flooding at Sea Palling 1953 (photo from Halcrow, 2008)

Catastrophic tidal inundation has been recorded since medieval times. One of the worst recorded events was in 1287 when 180 people died and areas affected were as far as 5 km from the coast, reaching Hickling. More recently, in the floods of 1953 almost 100 000 hectares of Eastern England were flooded and 307 people drowned, seven of these in the village of Sea Palling (Figure 2.2).

The low lying hinterland is agricultural land with small farms and villages. The frontage and hinterland also includes international sites of high environmental value (a candidate Special Area of Conservation (cSAC), Special Protection Area (SPA), Ramsar site and Sites of Special Scientific Interest (SSSI)) (Halcrow, 2002b) .

2.2 Description of coastal geomorphology

The Norfolk coastline can be described in three sections; the barrier islands and swash aligned beaches to the north, the cliffs, and the drift aligned beaches and nesses to the south (Figure 2.3).

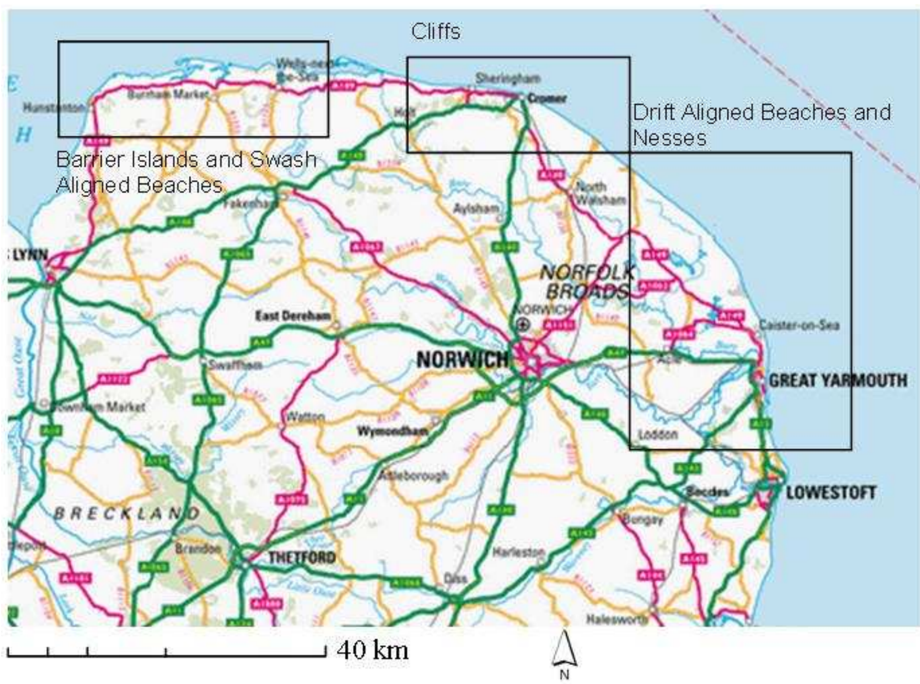


Figure 2.3: The Norfolk coastline. Barrier islands and swash aligned beaches to the north, cliffs and drift aligned beaches and nesses to the south. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

The barrier islands of North Norfolk are a high energy coast due to exposure to the large fetch of the North Sea (Clayton, 1976). Beaches are swash aligned and backed by dunes which break wave attack at high tides. Between islands and locally in front of them are large areas of intertidal sand. In some of these quieter environments marshes have been allowed to grow and at Holkham considerable areas have been reclaimed (Clayton, 1976).

Cliffs of 10 - 65 m exist along the 27 km stretch of coastline between Weybourne (Figure 2.4) and Happisburgh (Figure 2.5) in North-East Norfolk (Lee, 2008).

The cliffs have an average height of 25 m with sections between Cromer and Overstrand (Figure 2.6) reaching 65 m (Clayton, 1989). Cliffs consist dominantly of Quaternary sands and gravel of a range of ages. These are poorly lithified and so easy to erode (Clayton, 1989; Lee, 2008; Moorlock et al., 2000).

Figure 2.4: Cliff at Weybourne (Image copyright Ashley Dace)

Figure 2.5:Happisburgh cliffs (image copyright Jim Whiteside)

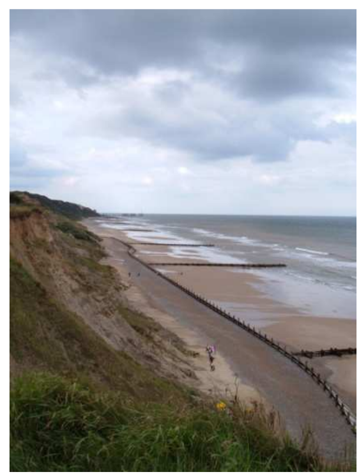


Figure 2.6: Cliff at Overstrand (Image copyright Martin Pearman)

Till cliffs around Happisburgh (Figure 2.5) are lower, and further south towards Winterton the beaches are backed by sand dunes with increasing width. Dunes around Waxham are about 50 m wide and increase to over 500 m at Winterton (Clayton, 1989). These beaches are made up of several metres of alluvium and glaciofluvial deposits of sand and shingle up to 50 mm in diameter (Halcrow, 1988) and are based on peat and clay. Beaches here are drift aligned and face north-east. This section of coastline is relatively linear with no shelter, beaches are open to wave attack from a large range of directions making them vulnerable to erosion and flooding (Figure 2.11) (Clayton, 1989). Sea Palling was a particular weak point due to both its exposure to destructive waves and being backed by a lower, weaker section of dune.

Gentle outcrops nose eastwards into the North Sea at several points along the East Anglian coast. These low sandy features often backed by an extensive dune belt are known as nesses (Clayton, 1976). Winterton Ness, 10 km south-east from Sea Palling, is the most northerly of five ness features on the coast of Norfolk and Suffolk. Accreted sand at Winterton has taken the form of sand ridges which have grown out some distance from the former cliff line, which runs southward to Scratby and Caister. Winterton Ness marks a change in the orientation of coastline to a more north-south alignment. The ness has migrated to the south since the beginning of the last century with a recent northward movement related to a change in the configuration of the offshore bank and associated flood channel (HR Wallingford, 2002 see appendix 11).

2.3 Cliff erosion

In some areas the coastline has retreated at a rate of up to 32 m y^{-1} (Dolphin et al., under review) due to the ease of Norfolk's Quaternary deposits to be worked by wave action (Clayton, 1976). Cambers (1976) used published maps to confirm that the average rate of retreat of the cliffs from 1880 to 1967 was 0.9 m y^{-1}. Historical accounts including the Domesday book (1086 as cited in Clayton, 1989) record former villages now missing through erosion which suggest this rate of erosion is likely to have persisted for the last 900 years. It is noted that since the waves incident on this coastline have succeeded in pushing the cliffs back 1-2 km over the past 900 years, they have created the offshore ramp. To keep a consistent ramp gradient after 1 m of cliff erodes, the level of the ramp would need to reduce by 1.5 mm. For this offshore deepening to be possible over a period when sea-level change was small, it is likely to have been a feature of the entire period since 5000 years BP when sea-level rose to within a metre or two of the position it has held ever since (Clayton, 1989). It is likely that these cliffs have been eroding at the present rate for some 5000 years (Cambers, 1976) supplying ~400000 $m^3 y^{-1}$ of sand (Clayton, 1989) to the region's beaches.

In 1845 a sea wall was built in Cromer, but it is only since the end of the Second World War, and especially the flooding in 1953 that defences have been constructed along most of the cliffed coast. In 1983 over 70 % of the cliffs were defended, which reduced the sediment supply by 70 -75 % (Clayton, 1989) causing a sediment deficiency to down-drift beaches. Clayton used McCave's (1978) average rate of sediment movement to show that the effect of reducing sediment supply would have an effect 25 km along the coast to Sea Palling by 1989. He reported that the beach levels in 1989 around Happisburgh and Sea Palling were the lowest they have been in the last 5000 years. In the early 1990s beach levels at Sea Palling were so low that the sea wall foundations were exposed and vulnerable to undermining and collapse.

Urgent action was required to protect the sea wall at Sea Palling and prevent coastal inundation. The construction of a series of beach management structures including nine offshore breakwaters at Sea Palling was identified as the preferred protection option (Halcrow, 2008). Although initially 20 breakwaters were planned nine were built between 1994 and 1997 (Section 2.8). Subsequently coastal management strategies have been reassessed and defending the cliffed coastline from erosion is no longer considered to be cost effective.

By the 1990s wooden revetments designed to dissipate wave energy and act to reduce cliff erosion had fallen into disrepair, in some cases the revetments were dissembled for safety reasons (Dolphin et al., under review) resulting in rapid erosion. Dolphin et al. (under review) analysed annual aerial photographic surveys between Happisburgh and Horsey (1991 – 2005). They digitised instantaneous shorelines and corrected for tidal levels using beach slopes and the water-level at the time the photograph was taken. They found highest average retreat rates of 7.9 m y^{-1} just south of Happisburgh in areas where revetments had failed or been disassembled. Regions protected by ageing revetments showed retreat rates of 2.2 – 4.0 m y^{-1}. Highest retreat rates were observed one to two years after revetment loss. Rapid retreat (32 m y^{-1}) was identified just south-east of Happisburgh in 1997 one year after revetments failed. Retreat was exacerbated by increased storm activity and storm surges during this period.

2.4 Sediment transport pathways

Vincent (1979) identified sediment sources and calculated estimates of longshore transport of material around the Norfolk coast (Figure 2.7). He used wind data and wave refraction diagrams to calculate offshore wave heights which were used to drive a longshore sediment transport model. The East Anglian Coastal Research Programme used a wave observer network over Norfolk, Suffolk and Essex to calculate estimates of longshore transport rates and pathways (Cambers, 1975; Onyett and Simmonds, 1982). A diverging transport pathway was identified, moving sediment away from the North Norfolk cliffs around Cromer both to the north-west and the south-east (Cambers 1975; Vincent 1979; Clayton, McCave et al. 1982; Onyett and Simmonds 1982; Clayton 1993)

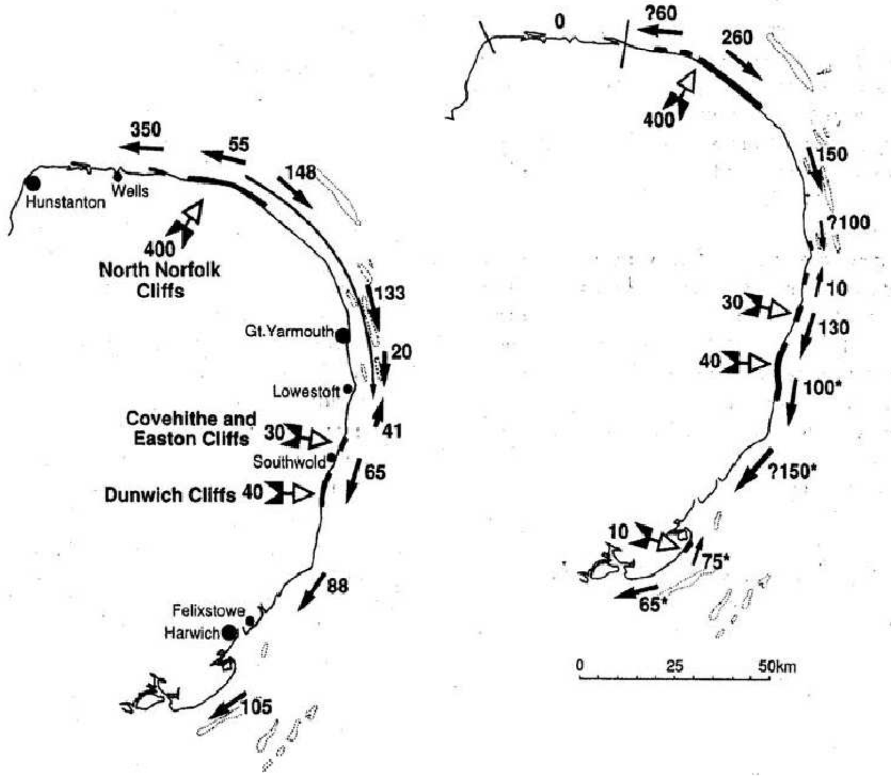


Figure 2.7: The East Anglian sand budget. Cliff inputs and littoral drift (values x 10^3 m^3y^{-1}). On left: Computed net longshore sand transport values over 13 years (1964-1976) as computed by Vincent (1979). To right: Most probable values derived from examination of gross values and net values for longshore transport over varying periods of time, using both computed values and those calculated from wave observer observations, 1974 – 1979. These are regarded as relatively reliable values (over a period of 20 years or more), but for those marked "?" the value remains uncertain, although the direction is certain. The asterisks note theoretical values not reached due to lack of sand and / or lack of exposed beach at all states of tide. The main offshore banks are indicated on both maps (from Clayton, 1993).

Erosion of the North Norfolk cliffs is reported to supply 400 000 – 500 000 $m^3 y^{-1}$ of sediment to the surrounding beaches (Cambers, 1975; Cambers, 1976; Clayton, 1989; Onyett and Simmonds, 1982; Vincent, 1979). Two thirds of eroded material is sand and gravel (Cambers, 1976; Lee et al., 2004) which feeds beaches over 60 km down drift via littoral drift (Cambers, 1976).

Dolphin et al. (under review) estimate an average annual input of 60 000 m^3 of sediment to the beaches down drift from the Happisburgh cliffs. They estimate 24 000 – 36 000 m^3 of this is sand assuming a 40 – 60% sand composition (Lee et al., 2004). This section of cliff undefended can be expected to contribute 10 000 - 15 000 $m^3 y^{-1}$ (Dolphin et al., under review) using estimates of long-term cliff retreat rates for this area of Eastern England (Clayton, 1989).

2.4.1 Swash aligned beaches to the north

The littoral drift on the North Norfolk coast is in a westward direction (Cambers, 1973; Cambers, 1975; Clayton, 1993; Clayton et al., 1982; Craig-Smith, 1973; McCave, 1978; Onyett and Simmonds, 1982; Vincent, 1979). McCave (1978) shows sand coarsening in the direction of drift; away from the North-East Norfolk cliffs, both to the west and the east. He found that sediment up to 700 m offshore from the low tide mark is finer and suggested that sediment on the beach face coarsens in direction of drift due to the effect of winnowing. The further along the drift path the more chance finer sediments have had to be winnowed offshore by waves. He also suggested that some fines could be winnowed to the back-shore via wind action. Finer material is moved locally offshore by tidal currents in a complex arrangement of submerged sandbanks. The volume of the sandbanks provide a check on the concept that these cliffs have been eroding for several thousand years, as their volume is in the same order of magnitude as sediment eroded over this timescale.

2.4.2 Cliffs

Carr (1981) argues that there are local reversals in drift direction between Holkham and Blakeney. Carr (1981) declares this reverse trend suggests some doubts of sediment coarsening away from cliff sources. Alternatively sediments are moving onshore in this area. Carr (1981) points out that Vincent (1979) found error in his model in this area. Vincent's model suggested more sediment moving than is available by cliff source, also suggestive of an onshore movement of sediment. This view is supported by Shih-Chaio and Evans (1992) who looked at beach and offshore sands to identify boundaries of different compositions.

2.5 Drift aligned beaches

Most studies agree that the direction of littoral drift at beaches east of Cromer; Happisburgh to Gt. Yarmouth is to the south-east (Cambers, 1973; Cambers, 1975; Clayton et al., 1982; Craig-Smith, 1973; HR Wallingford, 2002; Onyett and Simmonds, 1982; Vincent, 1979). There is variability in the estimates of net annual transport magnitude between Happisburgh and Horsey; Cambers (1975) estimated 1 000 000 $m^3 y^{-1}$, Vincent (1979), 148 000 $m^3 y^{-1}$, Onyett and Simmonds (1982), 230 000 $m^3 y^{-1}$, Halcrow (1991), 200 000 $m^3 y^{-1}$, Halcrow (1996) 400 000 $m^3 y^{-1}$ and (2002a) 90 000 $m^3 y^{-1}$, HR Wallingford (2002), > 300 000 $m^3 y^{-1}$, and Wang and Reeve (2010) estimated 154 000 $m^3 y^{-1}$. These studies all used similar cliff recession rates, although the longshore sediment transport rates are quite different. The sediment budget may vary considerably when different time scales, and techniques are used (Park, 2007).

2.5.1 Nesses to the south

Nesses are localised accumulations of sand which project from the coastline in cuspate form (Robinson, 1966). McCave (1978) suggests that fine sediment winnowed out along the drift path is moved offshore by tidal currents to the banks attached to the end of the nesses. McCave (1978) supported by Carr (1981) believe that nesses are sediment sinks rather than sources. Although Robinson (1966) believed that nesses provide a source of sediment to surrounding beaches. Robinson comments that nesses tend to migrate along the coast and display phases of rapid development. He reported that Winterton Ness moved 0.8 km south between 1827 and 1883. More recently Halcrow (2002a) described the ness moving northward; Benacre Ness in Suffolk has been moving north for centuries.

2.6 Sea defences; Happisburgh to Winterton

The first construction works on the frontage between Happisburgh and Winterton was in 1939 (Taylor and Marsden, 1983) after a breach at Horsey caused a flood in 1938. Concrete sand bags were laid to construct sections of wall between Eccles and Castle Farm, and at Horsey to just north of Winterton (Figure 1.1).

A breach at Sea Palling occurred in the storm of 1953 killing seven people in the village. Flooding occurred throughout Eastern England killing a total of 307 people. The 1953 floods resulted in the creation of the Waverley Committee which initiated the East Coast Flood Warning Service. Sea defences in vulnerable areas were upgraded and raised to a foot above the 1953 storm water-level. 8.3 km of reinforced concrete sea wall was built between Castle Farm and Waxham (map in Figure 2.11). The concrete bag wall was repaired after its severe damage during the flooding. The reinforced sea wall was extended from Waxham to Horsey by 1958. Additions were made to the groyne system south of Horsey in the 1960s and between Eccles and Castle Farm in the 1970s. Storms in 1976 and 1978 caused further damage to the concrete bag wall. The reinforced concrete sea wall was extended from Castle Farm to Eccles in the 1980s and south from Horsey in the late 1980s. Since 1989 there has been a continuous reinforced sea wall from Eccles Cart Gap through to a point 0.7 km north of Beach Road, Winterton (Halcrow, 1995a).

The reinforced concrete sea wall requires high beach levels to prevent it from failure. The beach is highly volatile and the shortage of sediment supply from up-drift beaches results in low beach levels which threatens the sea wall (Halcrow, 2002a).

In the early 1990s localised regions of the beach had been stripped of sand, exposing the underlying clay base. The integrity of the sea wall in such locations was considered to be unacceptable; most notably between Eccles and Sea Palling (Halcrow, 1995b). Urgent works were deemed necessary to protect the sea wall; a rock revetment was built at the toe of the wall foundations. This provided passive resistance and reduced wave energy at the sea wall base (Halcrow, 1995b). This formed part of the first stage of the Happisburgh to Winterton Sea Defence Strategy which was conceived in 1991 to protect the 14 km of coastline (Section 2.6 below). There was to be a long-term commitment to beach management by way of sediment recharge and phased construction of a series of offshore rock armour breakwaters; to be implemented over a twenty year period (Halcrow, 2002a). An earlier sea defence strategy provided by British Maritime Technology (BMT) recommended the construction of a series of fishtail groynes. After an independent technical audit by Halcrow in 1991 it was demonstrated that the fishtail groyne scheme would not be as effective as an offshore breakwater scheme. Fishtail groynes would not provide the same level of wave protection to the beach and such long groynes would be severely obstructive to longshore drift (Halcrow, 2002a).

2.7 Shore-parallel breakwaters

Shore-parallel breakwaters are detached from the shoreline. Detached breakwaters can be built as a series, in order to protect a longer stretch of coastline. When breakwaters are constructed as a series they are often referred to as 'segmented breakwaters'. There are several parameters which need careful consideration whilst designing segmented breakwaters; the gap distance between breakwaters segments, the length of the breakwaters, and the distance offshore.

Detached breakwaters act to shelter areas of beach, by altering the wave and current climate, reducing wave energy reaching the beach in their lee. The result of which enhances sedimentation patterns and allows the shoreline to prograde seaward behind the breakwater; forming bulges in the planform. Bulges in the beach planform are called 'salients' and a 'tombolo' is formed when sediment builds up to such an extent that the shoreline reaches the structure. Breakwaters are often built to maintain a strong, wide beach whilst not interrupting along-shore sediment transport trends. Generally the desired result is the formation of a salient, as this allows along-shore movement of sediment between the breakwater and shore. The formation of a tombolo can act similarly to a 'T' groyne by blocking nearshore sediment transport and promoting rip currents through the gaps. Groynes can deflect beach material into deepwater offshore, whereas breakwaters help to build and maintain material on the beach (Komar, 1998). Breakwaters have a very high cost of construction and design criteria are not well-established.

Fulford (1985) describes how breakwaters reflect or dissipate incident wave energy and transmit energy at the breakwater ends via diffraction. Energy can also be transmitted into the shadow zone behind the breakwater by wave overtopping. Reduced wave energy in the lee of the breakwater reduces sediment erosion and transport. The capability of waves to move sediment is a function of the wave height squared, which means that even a small reduction in wave height can have a significant effect on erosion and sediment transport. Fulford (1985) demonstrates that if wave height is reduced to 70 % of its original height, the sediment transported will be reduced to 49 % of its original capacity. He comments that flatter waves are more constructive and cause accretion at the beach. He also notes that sediment transported from other areas is likely to be deposited here. The shore protection manual (CERC, 1984) describes the evolution of the shoreline response to detached breakwaters as primarily controlled by wave diffraction during average wave conditions. When incident wave crests break parallel to the breakwater, waves diffract around the breakwater ends. These diffracted waves transport sediment from unsheltered areas into the lee of the breakwater. This will continue until the shoreline is parallel to the diffracted waves. The combination of waves diffracting around the end of a breakwater and refracting over a sloping bed results in circulating currents inside the embayment. A gradient of breaking wave height along the beach is created; larger waves in exposed areas behind gaps and smaller waves in the sheltered areas behind breakwaters. This along-shore gradient in wave height creates an along-shore gradient in wave set up. This drives an along-shore current, flowing from areas where mean water-level is higher to areas where mean water-level is lower (Gourlay, 1981).

Pilarczyk and Zeidler (1996) document that offshore breakwaters perform successfully in low to moderate wave conditions. Wave breaking on the structure resulting in energy dissipation and wave height attenuation, reduces the run-up height and amount of overtopping at sea walls. Some wave energy is reflected back offshore.

Fulford (1985) recommends low crested breakwaters for areas that are sediment starved. The breakwater holds material on the beach whilst the low crest allows wave overtopping; salient rather than tombolo formation allows sediment transport to down-drift beaches. Fulford also suggests the use of permeable materials to allow some wave energy to penetrate the structure reaching its lee. Fulford discusses the need to assess the level of shore protection desired. If down-drift beaches rely on an along-shore sediment supply it is important to not allow tombolos to form. By potentially blocking a sediment transport path, the formation of a tombolo can significantly increase beach volume. Salients or cuspate spits can allow sediment to drift inshore of the breakwater system; widening the beach but not causing a sediment deficiency down-drift.

Harris and Herbich (1986) showed that sand could accumulate or be eroded behind both breakwaters and gaps depending on their geometries. They suggest that steep waves promote salient rather than tombolo growth, however can also cause erosion behind breakwater gaps. Herbich (1989) concludes that breakwaters are ineffective for beach augmentation however have been successful in halting further beach erosion provided sufficient beach material. If extra re-nourished material is needed, these structures will retain it on the beach. Thomalla and Vincent (2003) comment that the breakwaters at Sea Palling were successfully retaining recharged material on the beach.

2.7.1 Breakwater parameters

Relationships have been established between different parameters by means of physical model tests, numerical modelling and the investigation of previously constructed systems. Where equations and relationships have been referenced from the literature, variable names have been adjusted in order to keep them uniform in this thesis.

2.7.1.1 Single breakwaters

The ratio of breakwater length to offshore distance has been found to be the most important relationship controlling sedimentation in the lee of a single breakwater (Axe et al., 1996; Hsu and Silvester, 1990; Suh and Dalrymple, 1987). Hsu and Silvester (1990) used data from several prototype schemes as well as physical and numerical modelling tests to investigate the shoreline response to single offshore breakwaters. Axe et al. (1996) suggest categorising shoreline response to banded values of the ratio of breakwater length to offshore distance; tombolos start to form between 0.67 and 2.5, salients form between 0.5 and 1.5 and there is no response when the ratio is less than 0.5. There are many other factors influencing beach response to a breakwater, these include sediment characteristics, structure properties of the breakwater and the wave climate.

2.7.1.2 Segmented breakwaters

Shoreline response prediction is more difficult for multiple offshore breakwaters. The breakwater crest height and length of gap between breakwaters control the amount of wave energy reaching the lee of the structure. The ratio of the gap width to incident wavelength or relative gap width controls wave diffraction. Where gap width is large compared to the incident wavelength the breakwaters act as an individual structure. Shoreline response is governed by both breakwaters only where gap length is small (Axe et al., 1996).

There have been many studies investigating shoreline response found behind breakwaters with varying geometries. The ratio of breakwater length to distance offshore has been found to be an important factor controlling sedimentation, as this ratio increases sediment volumes behind breakwaters have been found to increase (Dally and Pope, 1986; Harris and Herbich, 1986; Herbich, 1989; Rosati, 1990). Another important relationship is the ratio between the breakwater length and distance between breakwaters. In general, as this ratio increases sedimentation in the breakwater lee increases (Ahrens and Cox, 1990; Harris and Herbich, 1986; Pope and Dean, 1986).

Suh and Dalrymple (1987) undertook small-scale model tests using a circular wave basin that simulates regular waves incident at a fixed angle on a long straight shoreline. They tested differing breakwater geometries in order to simulate the beach response. They presented Equation 2.1 to fit these data.

Equation 2.1: Suh and Dalrymple's (1987) beach response equation

$$L_{SA} = 14.8\left(\frac{L_G^*}{L_S^{*2}}\right)\exp\left[-2.83\left(\frac{L_G^*}{L_S^{*2}}\right)^{\frac{1}{2}}\right]$$

L_{SA} is the salient length, L_G is gap length, L_S is breakwater length and * represents values non-dimensionalised with respect to the offshore distance. They found that salient development increases as L_G^* / L_S^{*2} decreases until L_G^* / L_S^{*2} reaches about 0.5 after which salient development decreases rapidly. They found that salient development in the field is greater than in the laboratory for the same value of L_G^* / L_S^{*2} or L_S^*.

Rosati (1990) used data from five breakwater projects in the US to compare different predicted beach response using various empirical relationships. She found that deposition generally increased as the ratio of structure length to distance offshore increased. She concluded that the accuracy of the predicted response was at best fair.

Harris and Herbich (1986) examined the effects of distance offshore (X), breakwater length (L_S) and gap length (L_G). They found that generally sand volumes increase as X/ L_S decreases. Tombolos typically form when X/ L_S is less than 1. Sand volumes generally increase as L_G / L_S decreases.

Herbich (1989) carried out additional model studies and found that when X/ L_S < 1 tombolos are found, X/ L_S > 1 salients are found, and when X/ L_S > 2 breakwaters are ineffective for beach augmentation. He also found that after construction of a breakwater system ca. 50 % of sand volume is deposited in the first year, and a steady state is reached after 4 - 5 years. He points out that the incident wave steepness is also important. Steep waves, typically during storms promote salient development and cause erosion behind breakwater gaps. Only small changes in the shoreline occur from low steepness waves.

Dally and Pope (1986) suggested limits of structure length, distance offshore and breakwater spacing based on the beach planform desired and length of beach to be protected.

$L_S / X = 1.5 to 2$ tombolo forms behind single breakwater.

$L_S / X = 1.5, L \leq L_G \leq L_S$ tombolo forms behind multiple breakwaters.

$L_S / X = 0.5 to 0.67$ salient forms behind single and multiple breakwaters.

Dally and Pope recommend $L_S / X < 0.125$ for a multiple breakwater system to provide uniform protection over a long stretch of coastline. This allows diffracted waves to re-orientate themselves via refraction before they reach the shoreline.

Pope and Dean (1986) stated that "beach response is a direct result of the amount of wave energy reaching the lee of the breakwater segments". They suggest that the wave energy reaching the lee of the structure (E) can be considered to be a function of the incident wave energy at the structure (W*), the structure configuration or planform (S*), and the wave transmission characteristics of the structure cross-section (T*) (Equation 2.2).

Equation 2.2: Wave energy reaching the lee of a structure (Pope and Dean, 1986)

$$E = f(W^*, S^*, T^*) .$$

Pope and Dean (1986) evaluated a number of dimensionless parameters in order to test the influence of structure configuration and the beach response. The ratio of breakwater length to gap length (L_S/L_G) was found to be an excellent parameter for defining the capability of the structure plan to block incident wave energy. The ratio of the average distance of the structure from the effective shoreline to the average water-depth at the structure, ($\overline{X}/d_s$) represents the influence of the structure location in affecting shoaling and diffraction of the incident wave energy.

Pope and Dean (1986) show beach response is directly related to the wave energy which reaches the lee of the structures. Prototype data is displayed relative to dimensionless parameters; breakwater length to gap length (L_S/L_G) and offshore distance to the water-depth at the structure (X/d_s) in Figure 2.8.

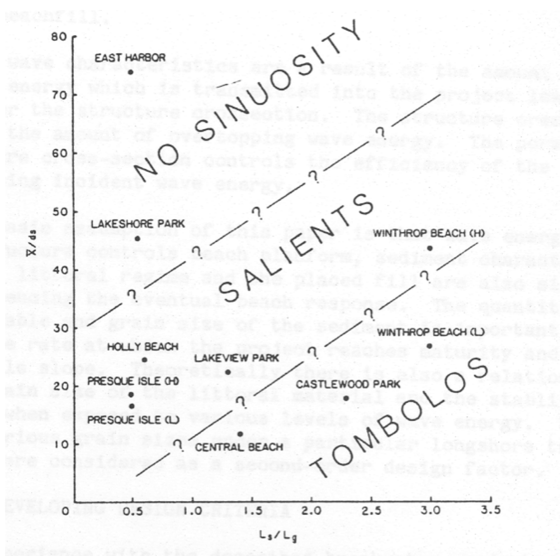


Figure 2.8: Dimensionless plot of United States segmented breakwater projects relative to structure configuration (from Pope and Dean, 1986).

Ahrens and Cox (1990) developed a beach response index (I_s) to be predicted based on a relationship of the ratio of breakwater length (L_S) to the offshore distance (X) (Equation 2.3).

Equation 2.3: Beach response index (Ahrens and Cox, 1990).

$$I_s = \exp(1.72 - 0.41(L_S / X))$$

They specified the following values of I_s:

I_s = 1 Permanent Tombolo

I_s = 2 Periodic Tombolo

I_s = 3 Well developed salients

I_s = 4 Subdued salients

I_s = 5 No sinuosity

Hallermeier (1983) recommended water-depth to guide the positioning of breakwater systems and suggested Equation 2.4 for calculating the depth for salient formation.

Equation 2.4: Hallermeier's (1983) depth for salient formation.

$d_{sa} = \frac{2.9H_e}{\sqrt{(S-1)}} - \frac{110H_e^2}{(S-1)gT_e^2}$, where d_{sa} is the annual seaward limit of the littoral zone, H_e is the deepwater wave height exceeded 12hours per year, S is the ratio of sediment to fluid density, g is the acceleration of gravity and T_e is the wave period corresponding to the wave height.

McCormick (1993) used a different approach which included the effect of wave direction and wavelength to calculate planform and volume of salients behind multiple breakwaters. He observed that the shape of the equilibrium shoreline tends to be elliptic with the foci at, or on, a line through the end of the breakwater. Based on this observation he developed an empirical analysis of shoreline response. The major and minor axes of the ellipse are functions of the ratio of the deepwater steepness and the slope of the bed. The prediction of salients rather than tombolos is based on the extent of the two emerging ellipses at each side of a breakwater and the width of the tombolo is defined by the intersection of the two shorelines with the longshore axis. If the centre of the breakwater is taken as the origin of the coordinate system, and the incident wave angle is zero, the equation of the shoreline is given by Equation 2.5.

Equation 2.5: McCormick's (1993) shoreline equation.

$$\frac{(y \pm h)^2}{a^2} + \frac{x^2}{b^2} = 1$$

h is the distance from the centre of the breakwater to the centre of the ellipse, a is the semi major axis and b is the semi minor axis.

Table 2.1 summarises the different limits for the ratio of breakwater length to distance offshore discussed above. Tombolos are predicted when this ratio is greater than 0.8 – 2.5; salients predicted when the ratio is between 0.33 – 1.5; and no response for values less than 0.17 - 0.8.

Author	**Tombolo L_B/X**	**Salient L_B/X**	**Limited Response L_B/X**
Inman and Frautschy (1966)	-	-	$0.33 > L_B/X$
Noble (1978)	-	-	$0.17 > L_B/X$
Gourlay (1981)	$L_B/X \geq 0.8$	$0.8 > L_B/X$	-
Nir (1982)	-	-	$0.5 > L_B/X$
CERC (1984)	$L_B/X \geq 2$	$1 > L_B/X$	-
Dally and Pope (1986)	$L_B/X \geq 1.5$	$1.5 > L_B/X > 0.5$	$0.5 \geq L_B/X$
Suh & Dalrymple (1987) (single breakwater)	$L_B/X \geq 1$	$1 > L_B/X$	-
Herbich (1989)	$L_B/X \geq 1$	$1 > L_B/X > 0.5$	$0.5 \geq L_B/X$
Ahrens & Cox (1990)	$L_B/X > 2.5$	$1.5 > L_B/X > 0.8$	$0.8 \geq L_B/X$
Hsu and Silvester (1990)	$L_B/X \geq 1.33$	$1.33 > L_B/X$	-
Bricio et al. (2008)	$L_B/X \geq 1.3$	$1.3 > L_B/X > 0.5$	$0.5 \geq L_B/X$

Table 2.1: Breakwater geometry limits for shoreline response (adapted from Bricio et al., 2008; Thomalla, 1999).

2.7.2 Breakwaters in the UK

The main differences with shore-parallel breakwaters in the UK and in other areas of the world like the US and in the Mediterranean is the difference in tidal range. Sea Palling has a tidal range of ~3 m and Elmer, West Sussex has a tidal range of > 5 m. This creates problems in placing the breakwaters. Important design criteria include depth of water at breakwater and distance offshore which both vary in a tidal environment.

The eight shore-parallel breakwaters constructed at Elmer beach, Littlehampton were completed in 1993 and was the first large scale use of breakwaters to protect a shingle beach (King et al., 2000). Breakwater gap lengths vary to give decreasing protection along the drift line, in order to give a smooth transition from areas protected by breakwaters through to open beaches.

The scheme has worked well at retaining shingle material on the beach and successfully avoided inundation during a severe storm event in 1996 (King et al., 2000). Beaches down-drift are likely to have been affected as both aerial and profile data suggest net losses over the time the breakwaters have been in place. This has necessitated the Environment Agency to conduct sediment recycling work twice yearly since 1993. Between 1993 and 2000 ~100 000 m^3 of material has been recycled from down-drift sources. This is contrary to the results of physical model tests which predicted no undue down-drift effects. Physical modelling of the sand component of sediment on the beach was considered not possible at Elmer due to scaling difficulties.

2.8 Breakwaters at Sea Palling

As part of the Happisburgh to Winterton Sea Defence Strategy to protect 14 km of coastline a series of offshore breakwaters were constructed at Sea Palling. A phased construction of 20 breakwaters was planned although only nine were completed (Figure 2.9) (Halcrow, 2002a). A strategic monitoring program was also put into place to assess sediment bypassing. An extension of the NRA's (National Rivers Authority now the Environment Agency) monitoring strategy was implemented by way of biannual shore normal profiles every 50 m between Cart Gap and Warren Farm (Figure 2.11).

Breakwater design was determined on the basis of a desk study undertaken by Delft (1995). Breakwaters were to be constructed 275 m from the sea wall on the offshore bar (which is 250 to 300 m from the sea wall). It was anticipated that locating the breakwaters on the bar would enhance the function of the bar to reduce wave energy at the shoreline and allowed construction in shallower water (Thomalla, 1999). The objective was to limit wave transmission to 60 % during storms, whilst still allowing an average of at least 40 % during normal conditions (Halcrow, 1991). The desired response from the breakwater installation was the formation of salients (Fleming and Hamer, 2000; Halcrow, 1991).

Figure 2.9: Nine shore parallel breakwaters at Sea Palling (photo from Halcrow, 2008).

Figure 2.10: Section of rock revetment at toe of sea wall, Eccles (photo from Halcrow, 2002a).

Between 1993 and 1995 four breakwaters were completed under the first stage of the sea defence strategy (phase one breakwaters 5 – 8, Figure 2.11). This first stage also included the construction of rock revetments and sediment recharge to stabilise the vulnerable sea wall (an example of toe protection can be seen in Figure 2.10). The original strategy recommended a review prior to each major construction phase of sea defences. The first strategy review in 1996 confirmed that offshore breakwaters combined with beach management measures were still the preferred option (Halcrow, 2002a).

The second stage of the strategy included the construction of a further five breakwaters (phase two breakwaters 9 – 13, Figure 2.11) and sediment recharge. Groyne replacement, beach recharge and additional rock toe protection was undertaken separately in 1999 – 2002 (Halcrow, 2002a).

A summary of works undertaken as part of the Happisburgh to Winterton Sea Defence Strategy can be found in Table 2.2.

Stage of Work	Description	Status
Strategy	*Establish sea defence strategy*	*Completed 1991*
Stage 1 Works	Construct breakwaters 5 to 8	Constructed 1993/1995
Emergency Works	Recharge to south of breakwaters (300 000m^3)	Constructed 1996
Strategy Review Stage 2	*Review performance of strategy and identify way forward*	*Completed 1996*
Stage 2 Works	Construct breakwaters 9 to 13 Recharge between breakwaters and to south (1.2 million m^3)	Constructed 1996/ 1997
Intermediate Works phase one	Replace groynes north of breakwater 5	Constructed 1999
Intermediate Works phase two	Extend groynes at Eccles using rock armour	Constructed 2002
Intermediate Works phase 3	Recharge north of breakwater 5 and south of breakwater 13 (0.9 million m^3)	Constructed 2000
Intermediate Works phase 4	1.4 km of rock revetment south of breakwater 13	Constructed 1999/2000
Strategy Review Stage 3	*Review performance of strategy and identify way forward*	*Completed in draft 2002. Put on hold until after the next SMP, became out of date* -
SMP	*Shore line management plan confirmed 'hold the line' in the short / medium term*	*Completed 2006*
Strategy PAR Stage 3b	*Emergency work required to prevent breach within 5 years. Next strategy review in 2010*	*Completed in 2008.* -
Stage 3 Works	Beach recharge and groyne replacement	To be implemented 2008 to 2010

Table 2.2: Summary of Happisburgh to Winterton strategy stages (adapted from Halcrow, 2002a; Halcrow, 2008)

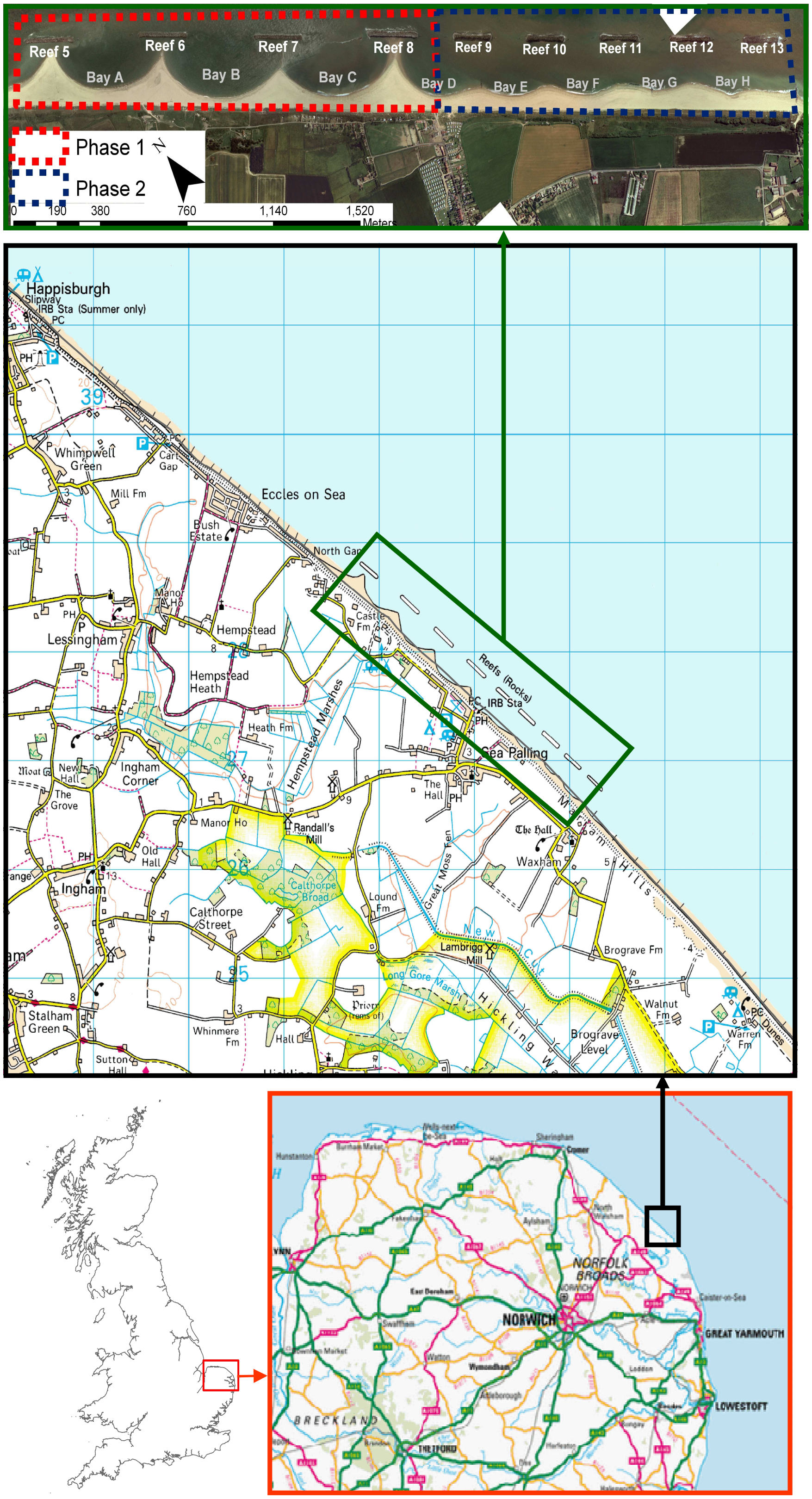


Figure 2.11: Location of the phase one and two Sea Palling breakwaters, Norfolk, UK (including breakwater numbers). (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

2.8.1 Phase one breakwaters

The first four breakwaters (breakwaters 5 - 8) from the north-eastern end are referred to as the "phase one breakwaters" (Figure 2.11) and were constructed during stage 1 works between 1993 – 1995 at Sea Palling (Halcrow, 2002a). These breakwaters are 275 m from the sea wall, are 250 m long and there is a gap of 250 m between successive structures. Their crest height is to a level of + 3 m AOD (Above Ordnance Datum) (Bacon, 2005).

The shoreline response to the phase one breakwaters is the evolution of tidal tombolos. The tombolo, emergent at low tide effectively blocks sediment transport during the lower phases of the tidal cycle. The breakwaters themselves are surface piercing at all levels of tidal stage; their crest level is approximately 1.3 m above the MHWS level (Bacon, 2005).

2.8.2 Phase two breakwaters

The phase two breakwaters (breakwaters 9 -13) (Figure 2.11) were constructed during the second stage between 1996 – 1997 (Halcrow, 2002a). These breakwaters are shorter, lower and have smaller gaps than those in phase one. The last breakwater (breakwater 13) is lower still and wider, with the aim of reducing sediment starvation to down-drift beaches. These breakwaters are 275 m from the sea wall, 200 m long and there is a gap of 160 m between structures. Their crest height is to a level of + 1.3 m AOD (+ 1.0 m AOD for breakwater 13) (Bacon, 2005).

2.9 Overview of morphological development at Sea Palling

Before breakwater construction the beach volume was extremely volatile (Thomalla and Vincent, 2003). During construction salients rapidly formed behind the breakwaters, typical of a shore-parallel breakwater system (Figure 2.12). The longshore bar between breakwaters disappeared after five months, which increased wave energy entering the embayments (Thomalla and Vincent, 2003). Thomalla and Vincent report significant erosion and the development of a steep reflective beach behind breakwater gaps. Rock armour and extra sediment recharge was placed in the most affected areas; ~1.3 Mm^3 of sand were pumped behind breakwaters 5 – 8 in 1996. Following this injection of sediment, continued accretion occurred behind breakwaters forming tidal tombolos. The scheme appeared to be working very well at retaining material on the beach but the extent of the tombolos suggest little or no sediment was being transported past the breakwaters to the east (Thomalla and Vincent, 2003). Contrary to King et al. (1996), who found that beach levels at Elmer remained fairly constant six months after completion, Thomalla and Vincent (2003) observed a continuing increase in beach volume suggesting the system was not yet in equilibrium.

2.9.1 Shoreline analysis of morphology development pre, during and post breakwater construction.

Environment Agency profile data was used by the author to analysis shoreline position and morphological development during and post breakwater construction (Figure 2.12).

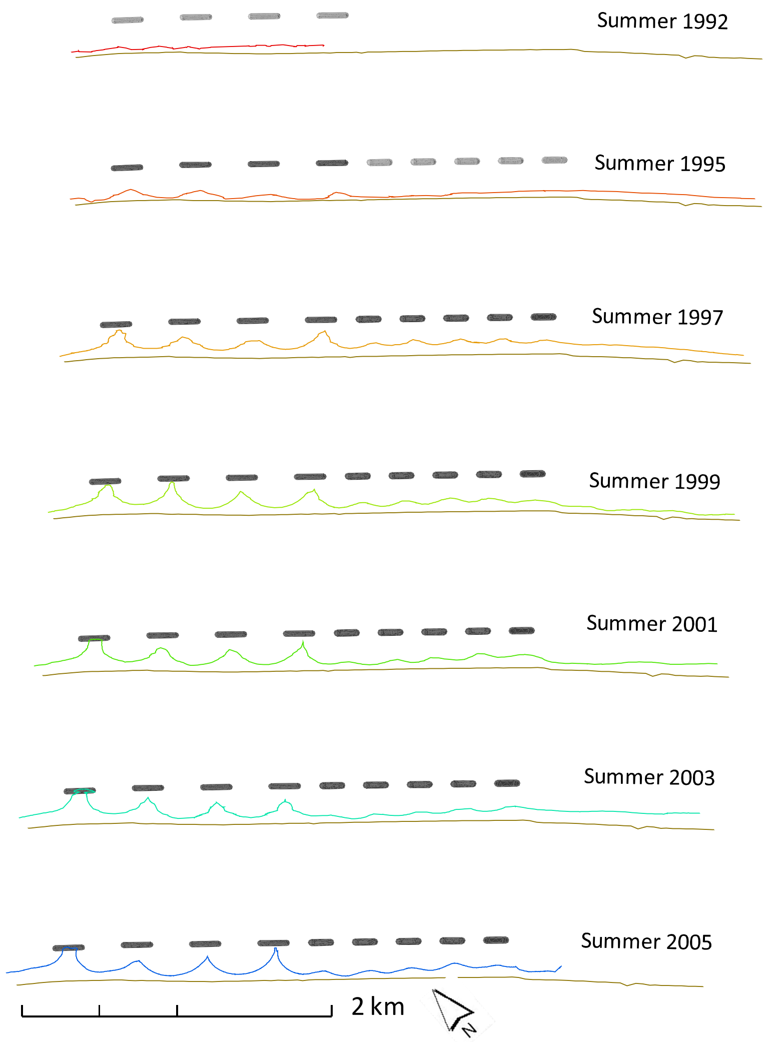


Figure 2.12: Shoreline at Sea Palling during and after breakwater construction, from Environment Agency profile data. Shoreline represented by the 0 m contour. Brown line indicates the position of the sea wall. Breakwaters included in grey (light grey before construction – to show their positon).

The shoreline is represented by the 0 m ODN contour; Figure 2.12 shows shorelines between 1992 and 2005. The brown line in each figure illustrates the position of the sea wall at the back of the beach. The 1992 (red) shoreline clearly identifies the narrow beach representative of low beach volumes before breakwater construction. The 1995 (orange) shoreline identifies the rapid development of salients in each breakwater lee after phase one construction. Considerable increase in beach volume can be seen by 1997 by the significant seaward migration of the shoreline, both behind breakwaters and to the south. There is also evidence of the rapid development of salients behind the recently completed phase two breakwaters. This is after two recharge events of 300 000 m^3 to the south of the last breakwater and 1 300 000 m^3 between breakwaters. It is clear from the 1999 shoreline that sediment is retained within the breakwater system well, however beach volumes down-drift to the south, diminish rapidly. The 2001 shoreline shows wider beaches to the north and south in response to 450 000 m^3 recharge in each area. Beach material has accumulated to such an extent that a tombolo exists behind breakwater 5 at all states of tide. The sediment blockage caused by the presence of this tombolo may be responsible for the decay of tidal tombolos down-drift, most notably behind the second breakwater (breakwater 6) in the 2003 and 2005 shorelines (Figure 2.11 for breakwater numbers). There was a recharge of 800 000 m^3 to the south of the breakwater system in 2003 / 2004 but this is not identifiable in the shoreline analysis due to absence of data in this region during the 2005 survey.

Dolphin et al. (under review) found the beaches 50 – 500 m north of the breakwater scheme to have grown steadily since 1995 as sediment transported by littoral drift has built up in front of the breakwater system. The fastest accretion rates were in 1996 / 1997 when the salient behind breakwater 5 grew into a tall tombolo.

Dolphin et al. (under review) found that all but the first and last embayment (A and H, Figure 2.11) are eroding at rates of between 1.3 m y^{-1} and 6 m y^{-1}. Bays A and H have been accreting since 1995, probably due to a process of sediment trapping from littoral drift to the south during northerly waves and north during easterly waves (Dolphin et al., under review). They found shoreline erosion rates within embayments to increase the further embayments were from the ends of the system. This pattern was also found to be true of the tombolos and salients following sediment recharge in 1997. The largest and prograding tombolos and salients were found toward the ends of the breakwater system and those toward the centre were found to be eroding at increasing rates.

Dolphin et al. (under review) show that it is highly likely that sediment is bypassing the breakwater system from the northern end. Storage as a result of accretion is small when compared to the published supply of material to the northern end, which indicates sediment bypassing the central sections of the breakwater system.

Beaches to the south were reasonably stable prior to breakwater construction but post construction a reduced sediment supply resulted in their retreat. Large shoreline advances of up to 90 m were observed following sediment recharge to these beaches, but retention times were short and shorelines retreated 50 - 100 % of shoreline advance in some places in the following 1 – 2 years.

2.9.2 Storm response

During storms, wave activity generally removes sediment from the beach face and deposition occurs in embayment floors (Dolphin et al., 2004; Fairley et al., 2009a). Dolphin et al. (2004) found that only when intense wave activity lasted for more than 5 – 6 days was a net loss of sediment from the breakwater system observed. Tombolo flanks were found to be highly volatile (Dolphin et al., 2004) and migrate down-drift during storm events (Dolphin et al., 2004; Fairley et al., 2009a).

Dolphin et al. (2004) looked at storm scale effects of the Sea Palling breakwater system as part of the LEACOAST project. Sea Palling is exposed to waves approaching from the north-north-west through to the south-east. Significant wave heights of up to 3 m and wave periods of 5 - 10 s were measured in the winters of 2002/3 and 2003/4 (Dolphin et al., 2004).

Dolphin et al. (2004) presented the results obtained from 44 days in the winter of 2003 during which time two large storms occurred. They conducted beach and bathymetry surveys, measured the hydrodynamics and calculated beach volumes. For both storms investigated, a surge was observed which raised the water-level by 1 - 1.5 m. After each storm, a period of low-wave activity persisted with the wave orbital speeds exceeding sand entrainment thresholds. Dolphin et al. (2004) found the first storm removed material from the back beach where it was deposited on the beach face. They calculated no net sediment volume reduction. The north-west flanks of each tombolo were severely eroded, while accretion occurred in the sheltered south-east facing tombolo flanks, forming an asymmetric tidal tombolo. During the following storm, waves were dissipated over a low gradient beach. More material was removed from the beach face than was made available from the back-shore during the first storm implying an offshore transport. Despite the large magnitude of both storms, net erosion required 5 - 6 days of intense wave activity (Dolphin et al., 2004). The asymmetry of tidal tombolos was found to increase further during the second storm. 31 days of low-wave heights persisted after the second storm. Waves were lower, however wave orbital speed was often greater than the critical wave orbital speed and hence sand entrainment was predicted. Dolphin et al. (2004) observed accretion across all morphological zones during this period implying onshore transport of sediment from outside the breakwaters and the symmetric shape of tombolos prior to the first storm was restored.

The migration of the tombolo crest and centre of mass towards the south-east during storms confirm south-easterly transport during northerly storms. The same arguments (tombolo migration indicating transport direction) are unlikely to be the case when the tombolo returns to a symmetric form after a storm (Dolphin et al., 2004). Bacon et al. (2004) show that ebb flow to the north-west is weak and restricted by emergent tombolos, to only a few hours on each tide. This suggests net north-westerly sediment transport is unlikely. It is more likely that the previous eroded tombolo flanks are infilled by sediments moving onshore through the breakwater gap.

Fairley et al. (2009a) used an Argus camera installation at Sea Palling (Section 3.2.5) and a numerical modelling system (MIKE21) to investigate the morphological response to northerly, easterly and north-easterly wave events. Like Dolphin et al. (2004), Fairley et al. (2009a) observed along-shore movement of tombolos in down-drift directions. They found a similar movement to the phase two salients but to a lesser extent. Fairley et al. (2009a) found no along-shore movement of morphological features during shore normal incident waves. Fairley et al. (2009a) observed a north-westward migration of tombolo crests during easterly wave events. Numerical modelling suggested an anticlockwise gyre exists in phase one embayments, although transport magnitude was found to be greater toward the sheltered region than away from it (Fairley et al., 2009a). Fairley et al. (2009a) show how sediment can be taken from the up-drift side of one tombolo round the embayment and accumulate on the down-drift side of the next. They also suggest the existence of a double gyre during shore normal wave events, where the south-eastern gyre has a larger radius than the north-western. Again, this results in more transport toward the sheltered region on the north-western side of the tombolo.

2.9.3 Tidal contribution

The asymmetric nature of the tide at Sea Palling and the presence of the tidally emergent tombolos behind the phase one breakwaters combine to give a net flux of sediment toward the south-east. During the high water (HW) phase of the tide, strong tidal currents entrain sediment from submerged tombolo surfaces and drive a pulse of sand towards the south-east. During the low water (LW) ebb phase, the tombolos are emergent and block return transport (Bacon et al., 2007).

Bacon (2005) estimated a tidally-driven (with wave stirring) sediment transport of ~40 000 m^3y^{-1} through the phase one breakwaters toward the south-east. He describes this as modest when compared to longshore littoral transport rates predicted prior to breakwater construction; estimates vary between 90 000 m^3 y^{-1} (Halcrow, 2002a) and > 300 000 m^3 y^{-1} (HR Wallingford, 2002), but represents a continuous background value which storms or surges will add to. A component of Bacon's 40 000 m^3y^{-1} may be lost between breakwaters but much of it will enter phase two (Bacon et al., 2007).

2.9.3.1 Tidal currents experienced at Sea Palling

Tidal action is an important physical process in the North Sea, dominated by the semi-diurnal principle lunar component (M_2), although other components are present to a lesser extent (ABP, 1996).

Numerical models have shown the M_2 tidal wave to propagate counter-clockwise around various amphidromic points (where tidal range is zero) within the North

Sea (Figure 2.13) (ABP, 1996). The close proximity of Sea Palling to two amphidromic points results in a complex tidal regime (Halcrow, 2002a) and the resultant offshore flow is highly rectilinear (McCave, 1971). Sea Palling experiences a progressive tidal wave although there is a transition through ‘irregular tides’ to a standing wave regime on the Suffolk coast further south (Bacon, 2005).

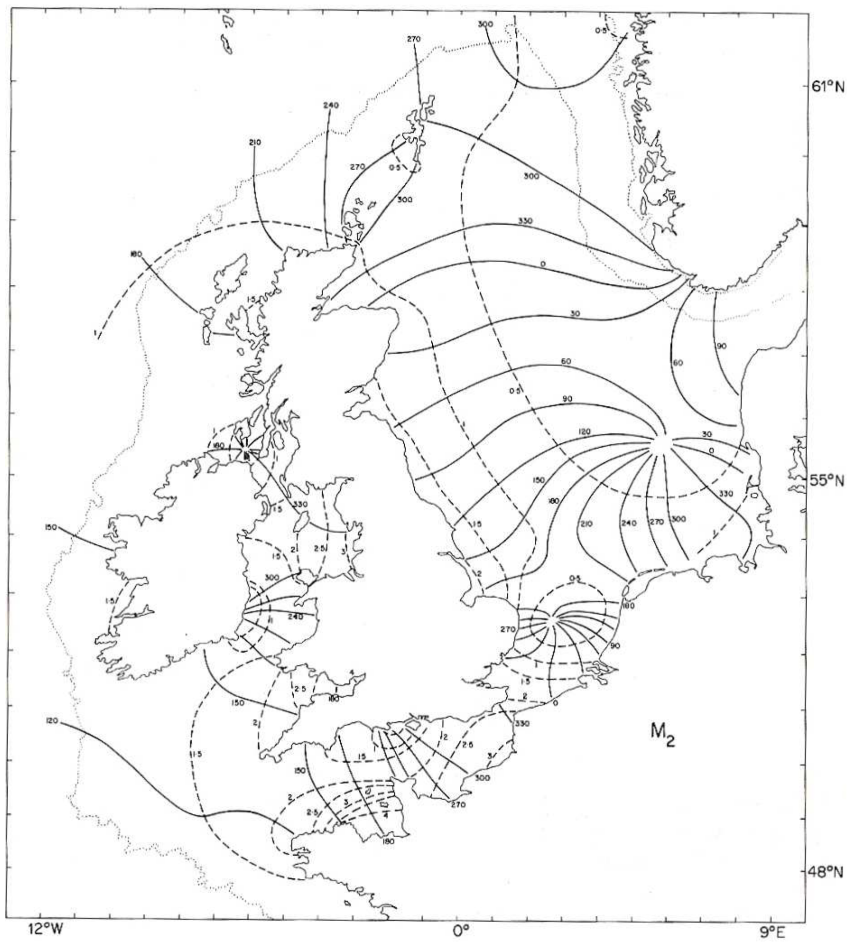


Figure 2.13 Co-tidal chart showing M_2 tides of the north-west European continental shelf from observations. Dashed = co-amplitude lines, solid = co-tidal lines (from Howarth and Pugh, 1983 cited in Pugh, 1987).

Tidal currents are shore-parallel at Sea Palling and are towards the south-east during the high water stage of tide (flood) and toward the north-west during the low water stage of tide (ebb). Peak currents are observed about an hour before high and low water. The duration of the flood tide is shorter than the ebb, although its magnitude is marginally greater. The overall effect of these non-linear tidal harmonics is an asymmetry in the transport of water towards the south-east (Bacon, 2005). The magnitude of tidal currents in the offshore (~2 km) reaches ~1.4 ms^{-1} and ~1 ms^{-1} in areas near breakwaters (Bacon, 2005).

The tidal range at Sea Palling is 3 m during mean spring tides and 1.3 m during mean neap tides. +1.7 m AOD at Mean High Water Springs (MHWS) to -1.3 m AOD at Mean Low Water Springs (MLWS). Chart datum is approximately 1.83 m below AOD at Winterton Ness (Halcrow, 2002a).

2.9.3.2 Tidal current modelling over phase one breakwaters

Bacon et al. (2004) looked at the interactions between the along-shore progressive wave tide and the tidal tombolos existing in the lee of the phase one shore-parallel breakwaters at Sea Palling. They used the TELEMAC2D and ARTEMIS hydrodynamic models to simulate tidal flows throughout the phase one system and wave conditions over tombolo 7.

Bacon et al. (2004) predicted that the tidal currents have the capacity to remove an average of between 70 m^3 and 300 m^3 from the tombolo during spring tides. They found that losses were likely to occur six or seven tides either side of the peak spring tide and negligible change is predicted during the 10 tides over the lowest neap tides. Their survey results and volumetric analysis showed losses of 50 m^3 to 100 m^3 per tide. Periods of higher wave heights act to rebuild the tombolo levels (Bacon et al., 2004).

The flux of sand is primarily redistributed and retained within the breakwater system and a small volume in the region of 10 000 to 12 000 m^3y^{-1} is transported offshore from the breakwater line and enters the regional domain (Bacon et al., 2004).

Bacon et al. (2007) found that stirring by small waves (H_s = 0.5 m, T_p = 5 s) enhanced overall transport rates by a factor of ~3.5 and increased suspended sand transport rates by an order of magnitude when compared to predictions based on tidal currents only.

2.9.3.3 Control of morphological change

Dolphin et al. (2004) show that while waves are responsible for the bigger morphological changes and sediment transport rates than due to tidal current alone (17 000 m^3 lost during storm two compared with 12 000 $m^3\,y^{-1}$ due to tidal currents (Bacon et al., 2004)), the tidal currents, tidal range and tidal tombolos determine sediment transport pathways. Tidal currents alone contribute a small but continual component of the Sea Palling sediment budget (Bacon et al., 2004) but their modulation of wave generated currents is also clearly an important process, influencing morphology behind these breakwaters (Fairley et al., 2009a).

2.10 Summary

The shoreline analysis presented in Section 2.9.1 highlights the volatile nature of sediment volumes on this section of the coastline. It shows the success of retaining sediment on the beach in the local area behind breakwaters but suggests a possible sediment starvation to down-drift beaches. Previous work has identified sediment exchanges in and out of the phase one breakwater system under storm conditions (Dolphin et al., 2004) and under tides and tides plus wave stirring (Bacon, 2005; Bacon et al., 2007; Bacon et al., 2004). This research aims to identify and quantify sediment transport pathways within and around the breakwater system as a whole (phase one and two) and discuss the interactions the breakwaters play in respect to the local sediment budget at Sea Palling.

3 Field methods and data used

This chapter gives an overview of field work data used and collected as part of this thesis. The field data is made up of:

1. Environment Agency data
2. Data collected as part of the LEACOAST2 project
3. Data collected specifically for this thesis.

3.1 Gardline Ltd / Environment Agency AWACS

Gardline Environmental Ltd services instrumentation used in a DEFRA sponsored regional study undertaken by the Environment Agency. Gardline Environmental Ltd holds the contract to deploy, recover, and service instruments, quality check, analyse and distribute the data. The Environment Agency requires concurrent data to match offshore waves to the coastal conditions experienced during major and minor storm events. This study is designed to provide the necessary information to ensure the required coastal defences for the East Coast are adequately and cost effectively engineered in future years.

Figure 3.1 illustrates the location of 20 Nortek AWACS deployed at nearshore sites and five offshore wave buoys.

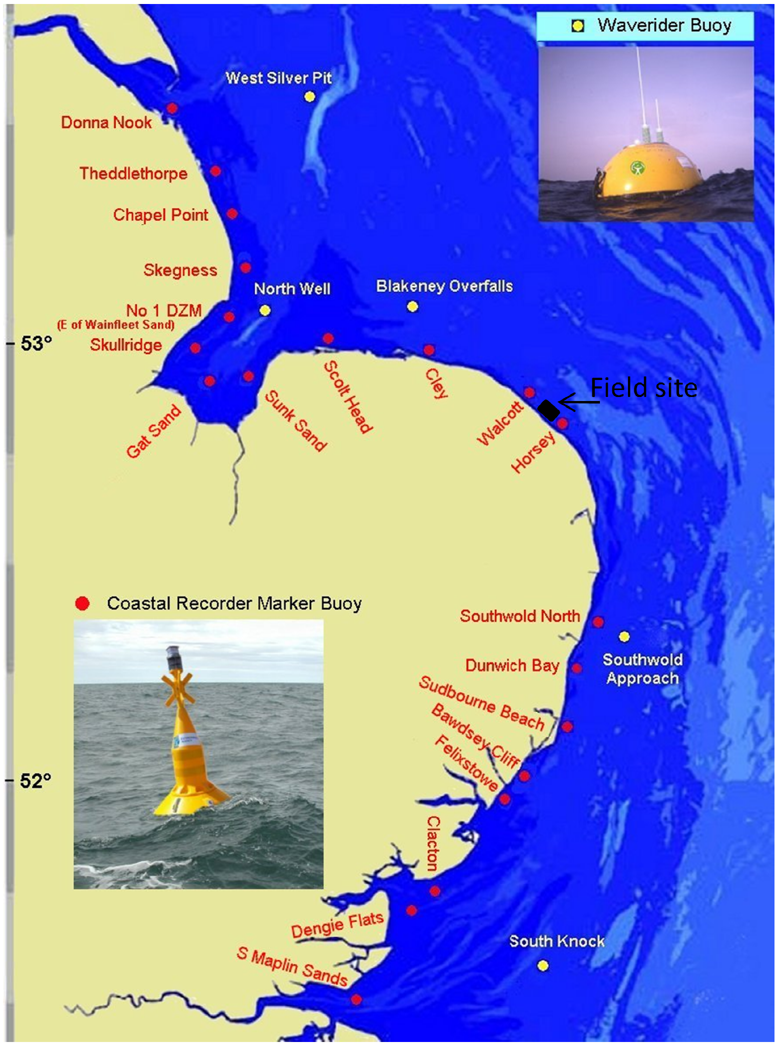


Figure 3.1: Location of Environment Agency instruments: AWAC deployment sites – red. Waverider buoy – yellow. Field site indicated in black (from Gardline Ltd, pers. comm.)

The Nortek AWAC is a combined current profiler and wave directional system in one unit. All Environment agency AWAC's are deployed on the sea bed measuring currents and waves.

3.1.1 Currents

Currents are measured over one minute averages every five minutes in 12 one metre bins. East and north vector current velocities undergo a quality control calibration exercise. Currents are converted to magnitude and direction and compiled into annual datasets before undergoing harmonic analysis, analysis of progressive drift and period residual currents. The vertical vector current velocity is also quality checked. (Gardline Environmental Ltd AWAC raw data processing sheet, pers. comm.)

3.1.1.1 **Depth-average current from current profile**

Throughout this thesis, measurements are compared to depth-average currents simulated by TELEMAC2D (Section 4.3). It is necessary to use measurements at an elevation from the bed representative of the depth-average current.

Five current profiles were averaged over a period of peak current flow around HW at Walcott. The average profile is plotted in Figure 3.2, as normalised water-depth against current speed. The profile was integrated to find the elevation of the depth-average current. Current velocities at 40 % of the water-depth were found to be representative of the depth-average current (Figure 3.2).

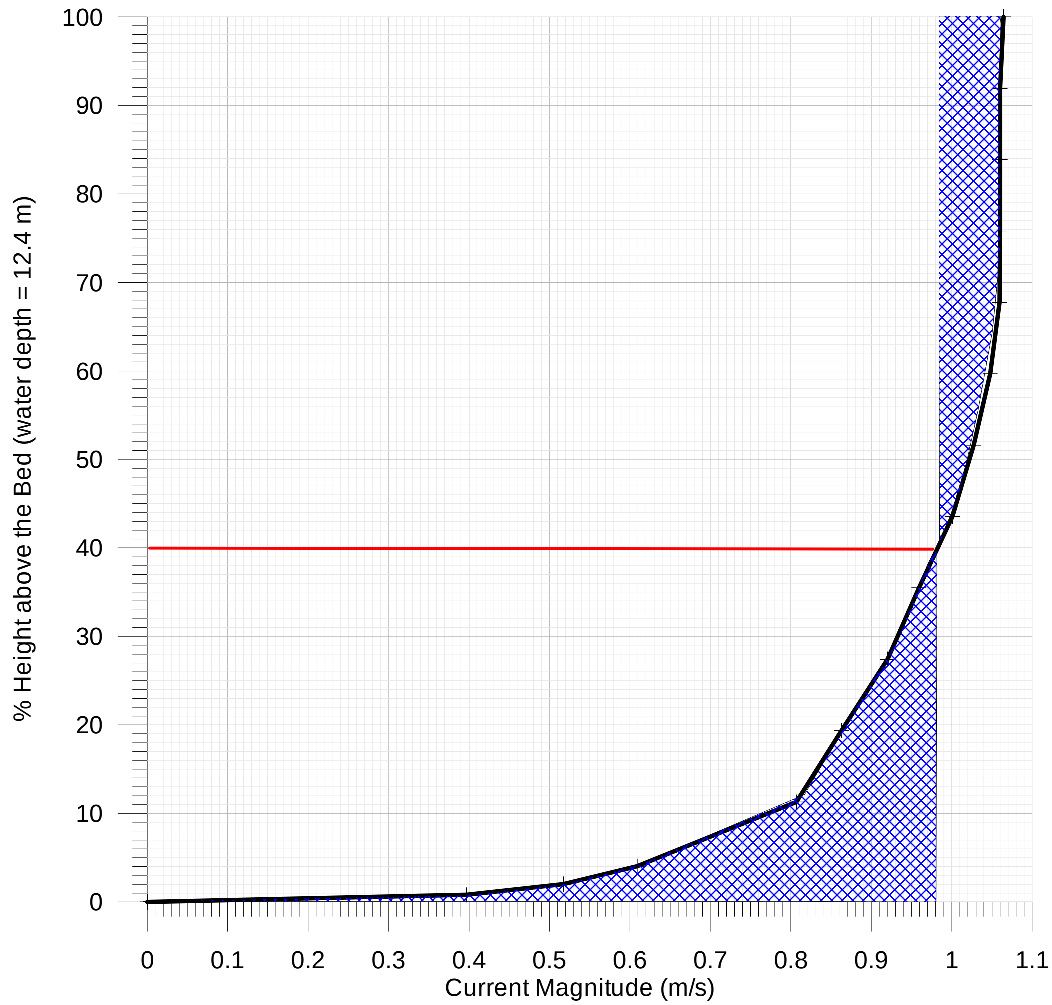


Figure 3.2: Average current profile over peak flow around HW, at Walcott. Velocities at 40 % of water-depth are representative of depth-average current.

3.1.2 Pressure

The pressure (or depth) record is edited during quality assessment. Depths are compensated for atmospheric pressure and water density – temperature is measured but the Nortek software assumes a salinity (35) and standard atmospheric pressure (1013.25mb). Pressure sensor results are checked against surface detection in burst acoustic ranges (Vertical beam during wave sampling).

Settlement is compensated as an iterative process involving comparison with other sites. Calibrated depths are re-levelled to Ordnance Survey Datum Newlyn 1931 (ODN) by period mean level transfer referencing Dataring tide gauges (which are fixed levels to ODN). Residual heights obtained from harmonic analysis are compared to residuals at adjacent Dataring gauges to reduce to ODN datum.

Divergent results at the start of a deployment indicate rate and extent of settling. Analysis is repeated until residuals at adjacent sites have no early deployment anomalies.

Deployment periods are compiled into annual sets where short servicing periods are interpolated. Consecutive years' analyses are compared for consistency (Gardline Environmental Ltd AWAC raw data processing sheet, pers. comm.).

3.1.3 Waves

Waves are measured hourly (2048 burst record at 2Hz). Wave statistics are generated and quality checked in Microsoft Excel with the use of time series graphs and inter-site comparisons (Gardline Environmental Ltd AWAC raw data processing sheet, pers. comm.).

The two AWAC sites used in this study are those at Walcott and Horsey, ~8 km north-west and ~5 km south-east of Sea Palling, respectively (Figure 3.1). Deployment depth at both sites was 5 m plus tide. Currents and water-levels collected at these sites have been used to assess the nature of the tidal wave as it propagates around the coast and to build forcing conditions for the numerical model (Section 4.3.5).

3.2 LEACOAST2 data

Data collected by the LEACOAST2 (Section 1.1) project include intensive process experiments, continuous wave and current measurements, monthly topography surveys and remote sensing using X-band radar and an ARGUS camera installation.

3.2.1 Process experiments

Extensive field measurements of hydrodynamics and sediment transport have been undertaken by the LEACOAST2 project members. Experiments were designed to measure currents and sediment transport in both phase one and phase two of the Sea Palling breakwater system simultaneously, measure the rates of sediment bypassing outside of the breakwaters and measure wave attenuation over a partially submerged breakwater (breakwater 11).

Two experiments were undertaken; experiment 1 from the end of March to the beginning of May 2006 and experiment 2 from the beginning of October 2006 until the middle of January 2007. Instruments were serviced part way through experiment 2 in November 2006 splitting that experiment up into two parts (experiment 2.1 and experiment 2.2). The two deployment periods were designed to capture a range of wave and current conditions; measurements were made in both calm and stormy conditions. Data were captured over one 3 m, several 2 m and longer periods of 1 m wave events (Figure 5.7 in Chapter 5).

3.2.1.1 Instrument frames

Measurements were made using instruments deployed on three sediment transport frames belonging to POL (F1, F2 and F3) and two waves and currents frames (belonging to UEA) (F4 and F5). F1 (

Figure 3.3), F2 and F3 (Figure 3.4) frames are based on similar tripod designs.

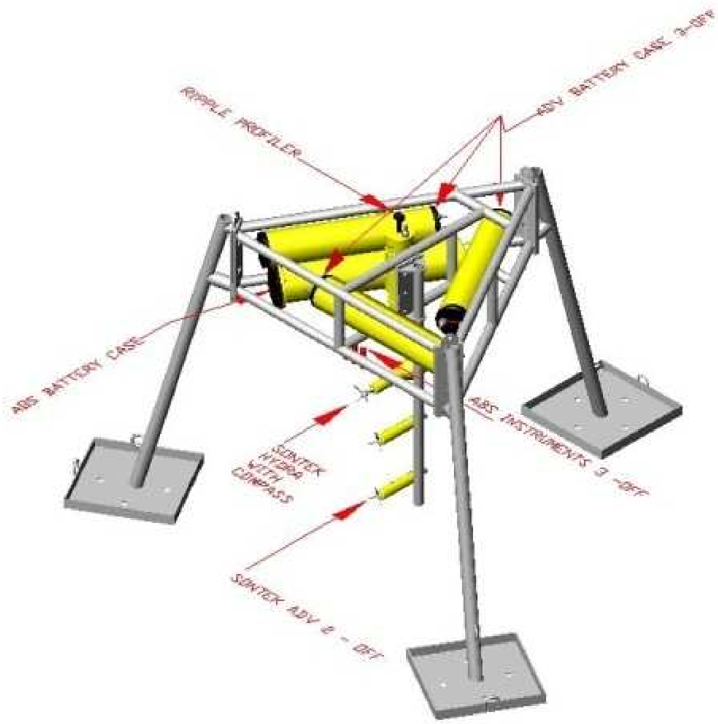


Figure 3.3: F1 tripod 1.53 m high 1.3 m front to back (diagram courtesy of Proudman Oceanographic Laboratory)

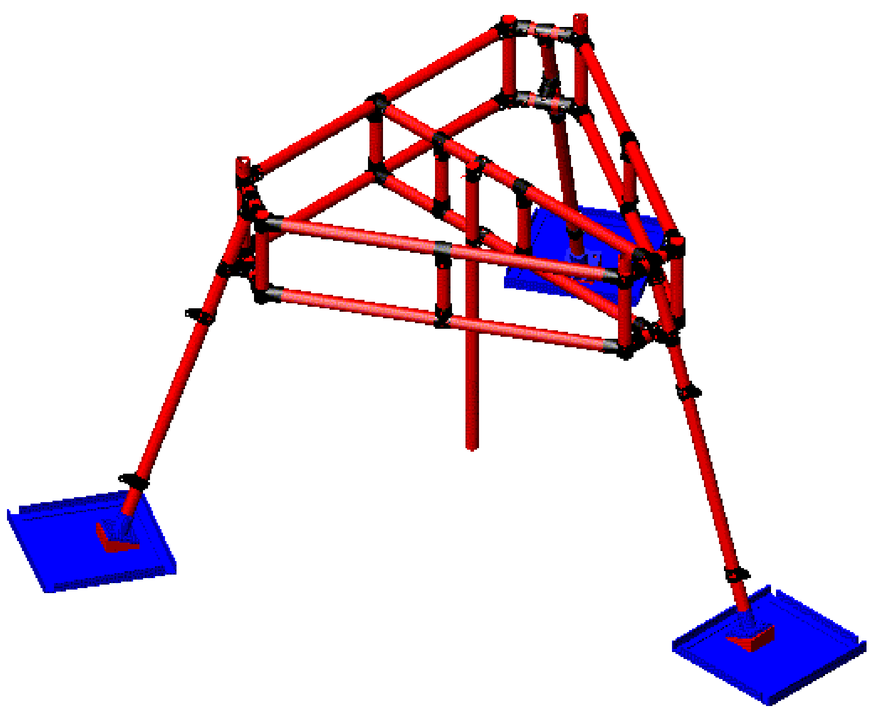


Figure 3.4: F2 and F3 Tripods 1.38 m high 1.44 m front to back (diagram courtesy of Proudman Oceanographic Laboratory)

F4 and F5 are smaller frames (1.2 m x 1.2 m, and 0.7 m tall) with low profile and drag (Figure 3.5). They have a ballast of 40 kg of lead and are deployed with a standard U-mooring (Figure 3.6). Each frame houses a Nortek Aquadopp which measures waves every hour and a current profile every 20 minutes. Currents are measured in 40 0.25 m bins, with a blanking distance of 0.25 m. Wave measurements were made hourly (1024 samples at 2Hz).

Figure 3.5: F4 / F5 frame holding a Nortek Aquadopp

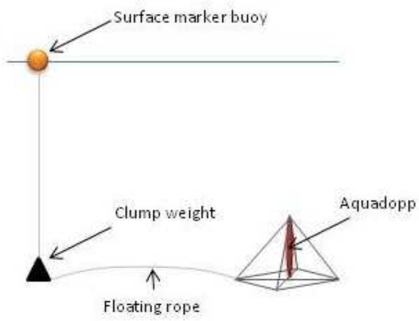


Figure 3.6: U-mooring design

3.2.1.2 Instruments on frames

Table 3.1 shows the sensors used on each frame and whether data recovery was achieved.

	Experiment 1					Experiment 2				
Sensor	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5
ADV	✓	✓	✓			✓	✓	✓		
ADCP	✓					✓				
ABS	✓	✓	✓			✓	✓	✓		
3D Rotary Sonar	✓							✓		
2D Rotary Sonar		✓					✓			
Ripple profiler		✓				✓	✓			
Timed sediment trap	✓	✓	✓			✓	✓			
LISST-100	✓							✓		
Aquadopp				✓	✓				✓	✓

✓ deployed and data recorded

✓ deployed and failed data recording

Table 3.1: Sensors fitted to instrument frames (from Wolf pers. comm.)

3.2.1.3 Timed sediment traps

Timed sediment traps were deployed on F1, F2 and F3. These instruments allow suspended sediment through trap apertures to settle in a column (Figure 3.7). Disks are released at timed intervals to determine date of sample. After deployment the controller unit is removed and the sample is frozen. Figure 3.8 shows an example of the frozen sample removed from its case. Samples were all photographed before being split up and sediment size analyzed.

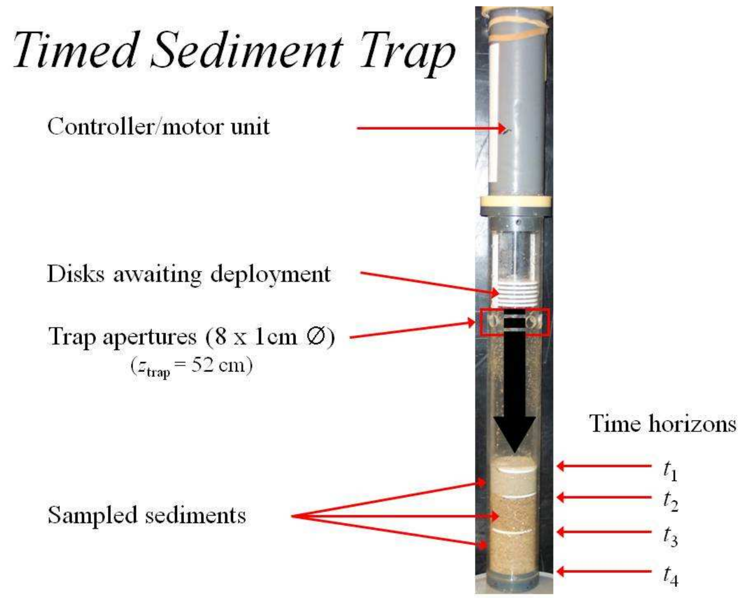


Figure 3.7: Timed sediment trap (diagram courtesy of Tony Dolphin, pers. comm.)

Figure 3.8: Timed sediment trap, frozen sample. Samples separated by disks released at timed intervals.

3.2.1.4 Frame locations (experiment 1 and 2)

Figure 3.9 and Figure 3.10 show the deployment locations for experiment 1 and 2 respectively. As most instruments on F2 failed in the first experiment this frame was replaced in the same location during the second experiment.

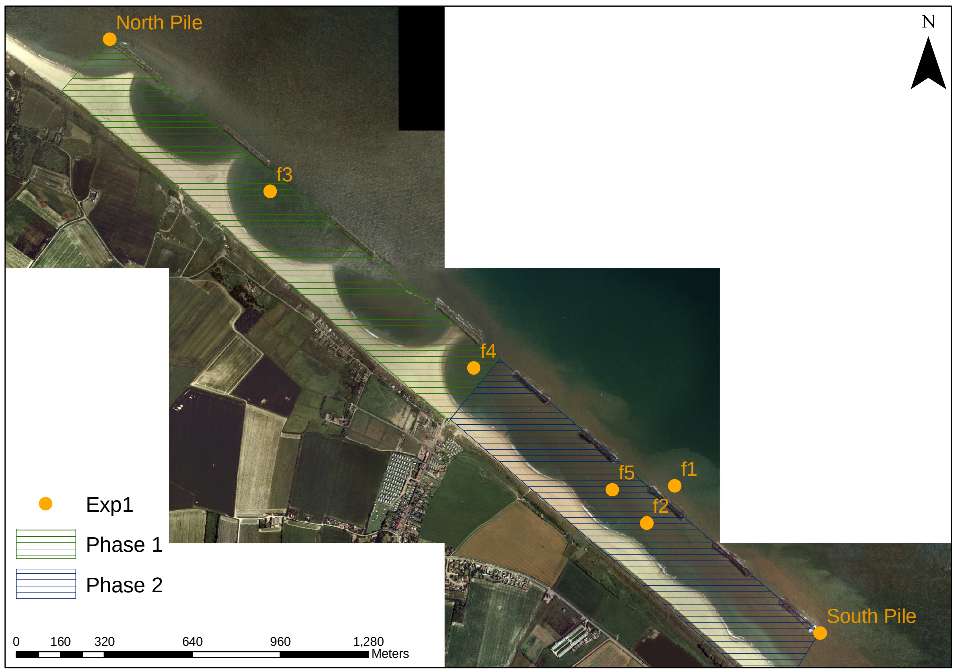


Figure 3.9: Experiment 1 instrument locations (Aerial photo from, Environment Agency, pers. comm.). N.B. American spelling "meters" used by software during diagram generation.

Figure 3.10: Experiment 2 instrument locations. In experiment 2.2 F5 was placed in the position of F3 (F3 was buried and disassembled at the end of experiment 2.1) (Aerial photo from, Environment Agency, pers. comm.). N.B. American spelling "meters" used by software during diagram generation.

3.2.1.5 Frame deployment / retrieval

F1 and F3 were deployed and retrieved using the 23 m survey boat 'Flat Holm' (Figure 3.11). F2 was deployed behind breakwater 11 at spring low water in calm conditions by hand. A JCB was used to carry the frame to the water-line and then approximately six people lifted and walked the frame out over the salient into position (Figure 3.12).

Once in position the lead was attached to each tripod foot to hold the frame securely. F2 was retrieved using the same method in reverse order. F2 was marked using three long yellow flags on each apex of the tripod. It was imperative to adequately mark the position of F2 to allow jet-ski users to keep clear. As much of the frame was dry at LW the use of standard moorings would have led to an unacceptable risk of lines tangling and interfering with instruments.

Figure 3.11: Retrieval of F1 after experiment 1

Figure 3.12: F2 retrieval (photo provided by Richard Cooke, POL)

F4 and F5 were deployed and recovered using a local fishing boat. The frame was lowered into position, a ground line laid attached to a clump-weight which was marked on the surface by a buoy (standard U-mooring).

All but one instrument flooded on F2 during the first experiment resulting in very little data behind breakwater 11 during the calm weather of April 2006. F3 was buried during experiment 2.1, but all instruments were recovered and data was recorded up until burial. It is possible that the F3 position was in a sandwave trough at the start of the deployment. As the sandwave moved, the frame became increasingly buried. Divers were deployed to remove the tripod legs allowing the frame to be recovered. As a result, F3 was not re-deployed in the experiment 2.2.

3.2.2 Pile Aquadopps: Continuous wave and current measurements

Two Nortek Aquadopps were deployed, one at each end of the breakwater system. These were used to measure pressure, as well as U and V components of current (velocity in the east and north direction) (Figure 3.13). Each Nortek Aquadopp has sideways facing transducers which enable the sampling location to be up to 10 m away from the structure. All beams were orientated 45° from the tangent of the pile. Two beams 90° apart in the horizontal plane and one beam 45° off horizontal towards the bed. Instruments are cradled on an acrylonitrile butadiene styrene frame which slides on and off a stainless steel housing permanently strapped to the navigation pile. This enables easy instrument removal for servicing every three to four months.

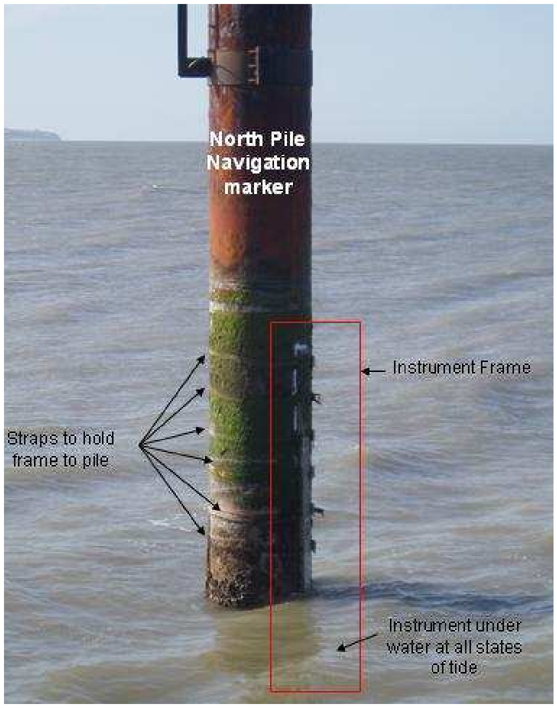


Figure 3.13: Nortek Aquadopp on northern navigation marker

Tidal elevation, referenced to ODN, was calculated from the Aquadopp pressure record, an atmospheric pressure record and the elevation of the sensor. The Aquadopp pressure record is corrected for true atmospheric pressure by removing the nominal value of atmospheric pressure the instrument was programmed with and replacing with true atmospheric pressure recorded at Weybourne, Norfolk. Frame elevation was surveyed using a Total Station; offset to the sensor was measured and applied to give the sensor elevation (accuracy likely to be within 0.02 m). The corrected pressure record was used to calculate water-depths using the relationship of pressure and height (Equation 3.1).

Equation 3.1: relationship between pressure and water-depth

$$P_{total} = \rho g h + P_a ,$$

where ρ = density of water (1025.97 kg m^{-3} was used, no account for temperature and salinity variation made) g = acceleration due to gravity, h = water-depth and

P_a = Atmospheric pressure) and then translated to water-level referenced to ODN using the sensor elevation.

U and V components of velocity were measured along a horizontal profile using acoustic Doppler technology. Three transducers measure the three radial (along-beam) velocities which are converted to easting and northing components of the horizontal water velocity using the internal tilt, roll and compass. Current measurements were made every 20 minutes averaged over 180 s. Twenty 0.5 m bins extended horizontally away from the instrument with a blanking distance of 2 m. Bin 10, which is 7 m from the pile was found to give good quality data.

The pressure sensor samples at 2 Hz (1024 samples, hourly), which enables wave statistics to be calculated.

Each Aquadopp clock is set at the beginning of each deployment. During download at the end of a deployment any time difference is checked. Confidence in the reliability of time stamp is therefore high. No evidence of time drift was noted.

There is a decrease in tidal range from the north pile to the south pile of as much as 13 cm. In Section 4.3.5.1.2 a decreasing amplitude in tidal elevation of 1.37×10^{-5} m^{-1} was calculated between Walcott and Horsey AWACS. Over the distance between the two Aquadopps (3300 m) this would result in a decrease in the tidal range expected of ~5 cm. The difference between this observed decrease in tidal range of 13 cm and the expected 5 cm is likely to be due to differences in the sensitivity / calibration of the pressure sensors in each Aquadopp. As the same Aquadopp was always used on the same pile, this cannot be easily checked.

Figure 3.14 and Figure 3.15 are examples of velocities recorded by the north and south pile Aquadopps respectively. These plots show water-level, speed and direction.

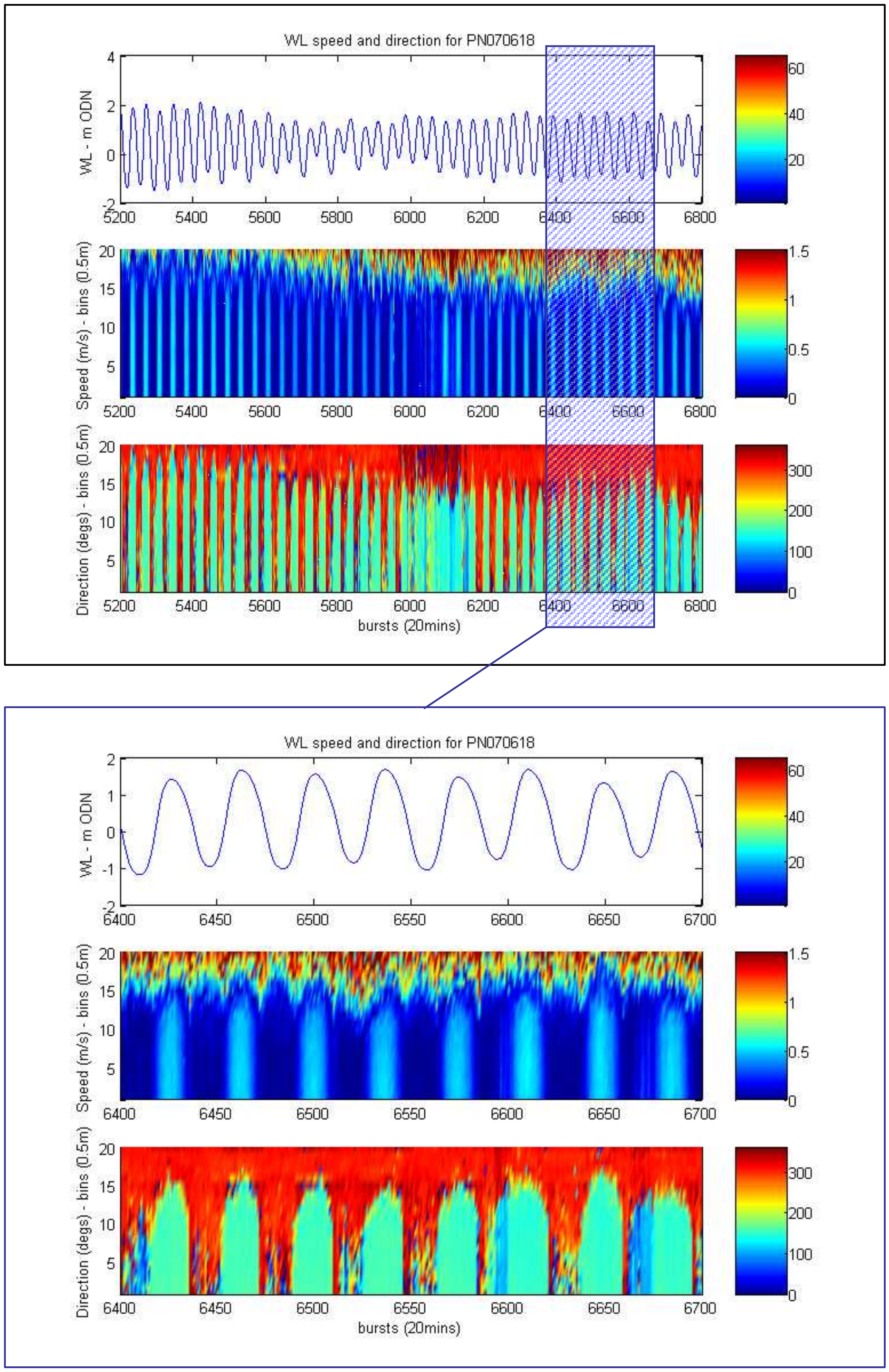


Figure 3.14: Extract of data collected at north pile Aquadopp: Water-level and current speed and direction. Speed and direction are presented as p-color plots. Data from all bins are plotted for each instrument burst and coloured according to the velocity or direction. Instruments are programmed to measure currents every 20 minutes; scale on the x axis is burst not time (time = burst x 20).

Peak flow occurs around high and low water; currents run to the south-east at HW (Figure 3.14) and north-west at LW. The close proximity of the rock breakwater to the instrument location results in only half the tidal flow being measured. The north pile is exposed to the strong south-east flow at high water, but sheltered by the breakwater during the north-west flow in the second half of the tide. In the same way, the instrument on the south pile is exposed to the north-west flow at low water but is sheltered from the south-east flow at high water. Although the south pile is exposed to the north-west flow at LW, the instruments measure flow to the north-east (Figure 3.15) as the flow is deflected around the breakwater. The instrument setup allows a 10 m sampling range to attempt to avoid these sheltering problems. However inspection of the data shows that the bins beyond 12-15 are noisy and show highly variable speeds and directions. Bin 10 (7 m from the instrument) has therefore been selected as the most appropriate sampling position.

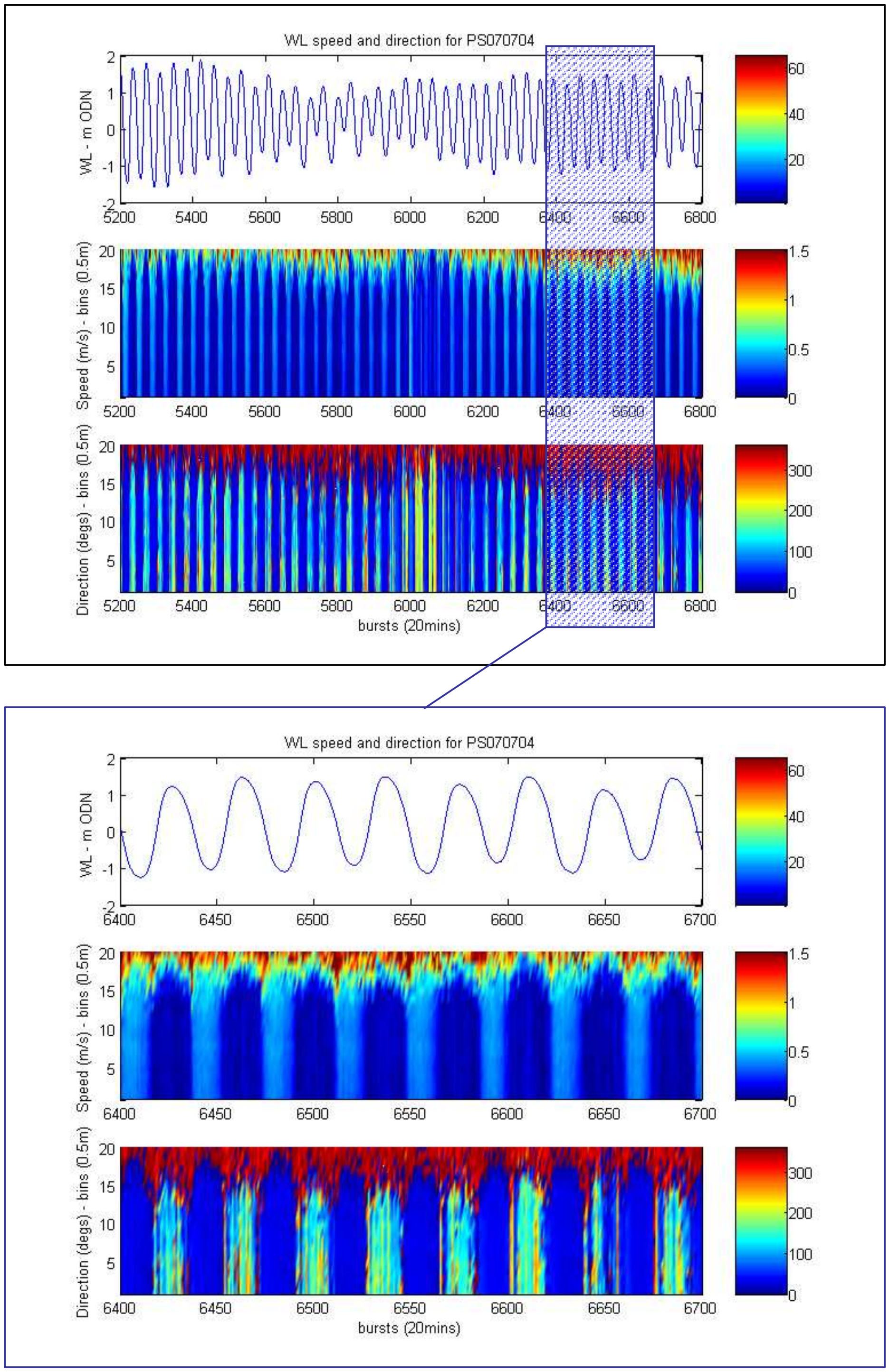


Figure 3.15: Extract of data collected at south pile Aquadopp; Water-level and current, speed and direction. Speed and direction are presented as p-color plots. Data from all bins are plotted for each instrument burst and coloured according to the velocity or direction. Instruments are programmed to measure currents every 20 minutes; scale on the x axis is burst not time (time = burst x 20).

3.2.3 Topography surveys

Monthly beach and bathymetry surveys were undertaken using Real Time Kinematic (RTK) Global Positioning Systems (GPS) and an Echo sounder.

RTK GPS can sample at up to 5 Hz with a precision of ~2 cm in both the horizontal and vertical planes. The capability of sampling at 5 Hz means that the equipment can take measurements at speed.

The RTK GPS system consists of paired GPS units. A base station (Figure 3.16 and Figure 3.17) is located over a known position and transmits real time corrections to one or more roving units (Figure 3.18) using a radio link. This enables the accuracy of GPS measurements made by the roving systems to be improved from metres to centimetres.

Figure 3.16:RTK GPS base station (photograph courtesy of Estelle Dumont)

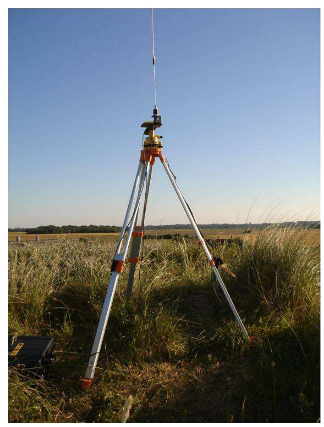


Figure 3.17:RTK GPS base station (photograph courtesy of Estelle Dumont)

Figure 3.18:RTK GPS beach survey setup (diagram courtesy of Estelle Dumont)

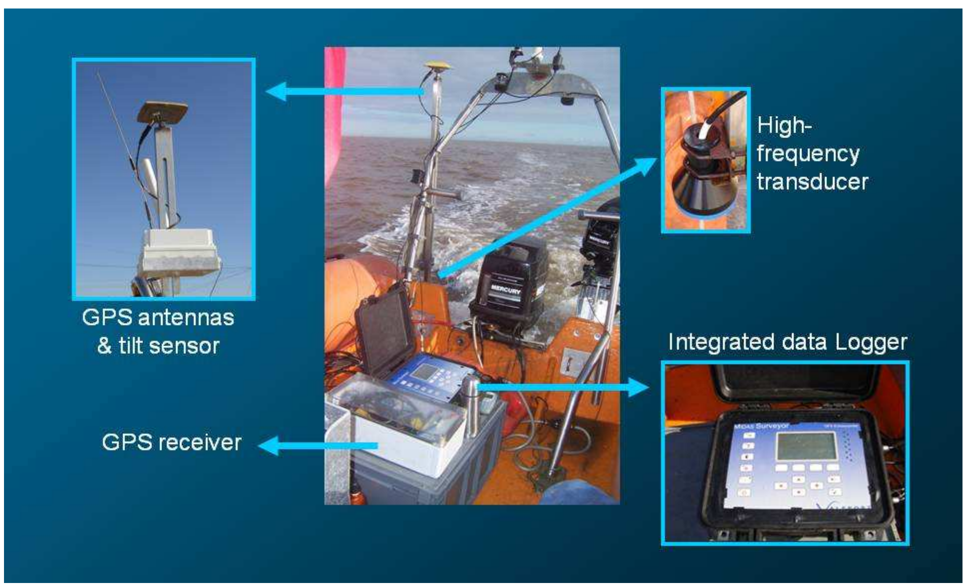


Figure 3.19: Bathymetry survey setup (diagram courtesy of Estelle Dumont)

3.2.3.1 Beach

A Topcon RTK GPS is mounted on a quad bike (Figure 3.18) at a known height. Data (with precision of no less than 2 cm) are logged every 1.5 m. A topographic map of the beach is built up by driving lines (at about 10 – 20 km h^{-1}) along the beach; focussing these lines on 'break of slope' allows an accurate survey to be conducted, while minimising the number of points needed (Figure 3.20). A detailed surface of beach elevation can be realised by creating a TIN (triangulated irregular network) in ArcGIS (Figure 3.21). A length of ~5.5 km of beach was surveyed every month from the level of low water up to the dune or sea wall. This area includes all areas behind and between the nine breakwaters, 1 km north of the breakwater system and 1 km south of the system.

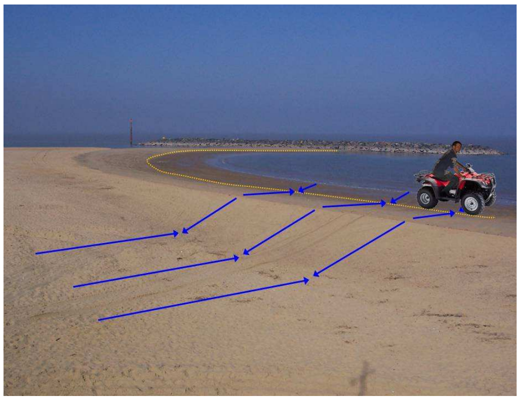


Figure 3.20: Survey Break of Slope. Blue lines indicate slope, yellow line indicates line surveyed (diagram courtesy of Estelle Dumont)

Figure 3.21: TIN creation – orange lines indicate TIN created, yellow line indicates lines surveyed (diagram courtesy of Estelle Dumont)

3.2.3.2 Bathymetry

A small boat equipped with RTK GPS and a high frequency echo sounder (Figure 3.19) is used to measure bathymetry over an area of ~5.5 km along-shore, and ~2 km offshore. Predetermined survey lines are repeated each month in the offshore and inside the phase two breakwaters. Phase one embayment survey tracks were near circular with decreasing radius of ~20 m. Water-depth (>1.5 m) dictated the exact shape and position of the outside survey track. The echo sounder is used to give depth of water. These data are coupled with the GPS record at a known distance from the echo sounder to give water-depths relative to ODN (accuracy ~10 cm vertically ~2 cm horizontally). Shallow water areas (shoreward of breakwaters) were surveyed close to HW to maximise coverage, and ensure no gap between topography surveyed from boat and quad bike. Surveys could not be conducted in waves greater than ~1 m. Although the tilt sensor quality checks the soundings for pitch and roll, larger waves inhibit the safe launch and retrieval of the survey boat from the beach. Beach and bathymetry surveys were conducted within a day of one another.

3.2.4 X-band radar

A standard marine X-band radar (9.8 GHz, 3 cm wavelength) located on top of the lifeguard hut (Figure 3.22) is used to produce images of the sea surface (Figure 3.23). The radar usually records a sequence of 256 images over ~12 minutes every hour. Difference in sea surface roughness typically enables wave patterns to be identified. Paul Bell (POL) is responsible for this system and has successfully used images to make wave, current and bathymetry measurements (Bell, 1999; Wolf and Bell, 2001). Figure 3.23 is a snapshot during a storm at Sea Palling in November 2007. Wave diffraction effects of the breakwaters can be clearly seen in the embayment. The radar was also used to track ‘drifters’ as they moved around the embayments (Section 3.3.1.1).

Figure 3.22: X-band radar installation on life guard hut, Sea Palling (photograph courtesy of Paul Bell, POL)

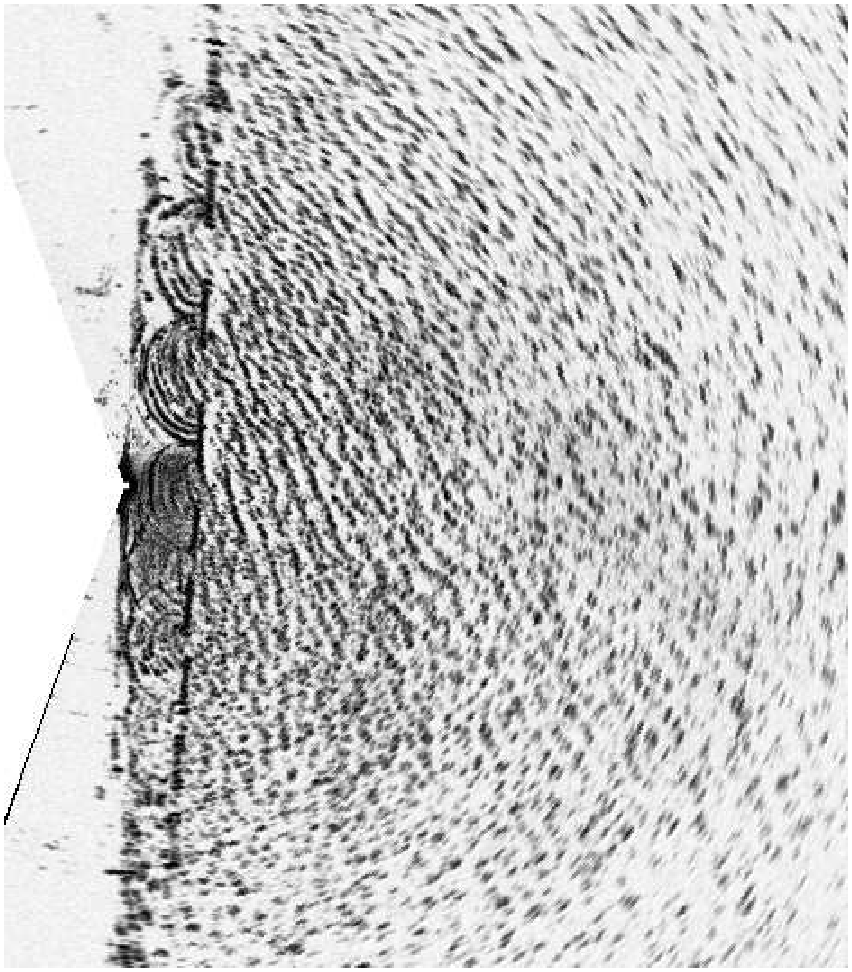


Figure 3.23: X-band radar image (snapshot at 10.00 am 6th November 2007)

3.2.5 ARGUS cameras

The University of Plymouth operate an ARGUS system consisting of six high resolution digital cameras on top of a ~20 m mast (Figure 3.24) giving a view of the complete breakwater system. The cameras are being used to examine short and long-term inter-tidal bathymetry and wave climate changes (Fairley et al., 2009a; Fairley et al., 2009b; Fairley et al., 2009c). Images are available in near-real-time (~20 minutes) via the Argus web site (http://argus-data.wldelft.nl/argus/sites/seapal/2008/index.html) and hence were a useful tool for assessing weather conditions at the site, but have not otherwise been used in this thesis.

Figure 3.24: Argus camera installation

3.3 Thesis field work data

3.3.1 Radar float tracking

The LEACOAST2 X-band radar was used to track floats fitted with radar reflectors as they drifted through the breakwater system.

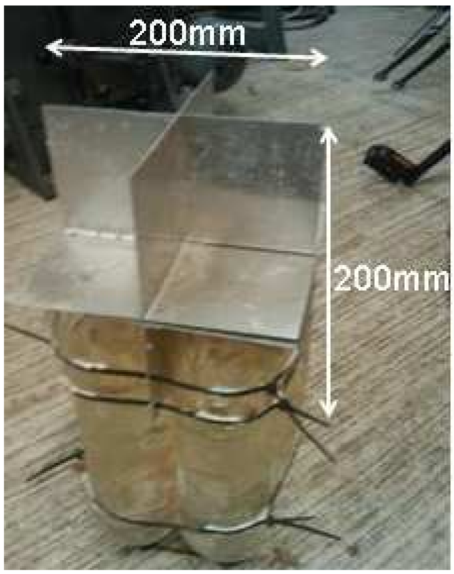


Figure 3.25: Example of a radar float

Figure 3.26: Radar floats deployed

3.3.1.1 Radar floats

As part of the verification of the numerical modelling, floats were deployed to follow the water as it flowed through the breakwater system. Floats, fitted with radar reflectors (radar floats) to be tracked using the X-band radar, were made up of four 2-litre bottles fastened together (Figure 3.25). Each bottle is filled to ~90 % with water to ensure the drifters float with the radar reflector just above the surface (Figure 3.26). This keeps freeboard to a minimum.

Although freeboard was kept to a minimum, these surface piercing floats suffered from effects of even relatively light winds. It was therefore necessary to conduct experiments in the early hours of the morning (during day light) before any sea breeze developed. Calm “no wave” and “no wind” conditions were required to ensure, as far as reasonably possible, that the drifters were following the movement of the water so that only tidal effects were measured.

3.3.1.2 Sampling regime and float deployment

The radar was programmed to record 513 images (~24 minutes) every 30 minutes (the radar system cannot operate continuously but requires a period to transfer data from memory to disk). Radar floats were deployed at the beginning of each recording period. The sampling frequency allowed six minutes to retrieve all floats and get them back into position for re-deployment. Positions could be recorded to an accuracy of 1 pixel (3.75 m).

Radar reflectors used on these floats were relatively small (Figure 3.25) (to keep windage to a minimum) which limits reflected signal strength. Experiments were therefore limited to within ~1 km of the radar (Figure 3.27). Floats were deployed from a small boat on transects perpendicular to current direction. Three main deployment zones were established:

- Orthogonal to the coastline between the shore and north-west end of breakwater 8.
- Between breakwaters 8 and 9.
- Orthogonal to the coastline between the shore and the south-east end of breakwater 10.

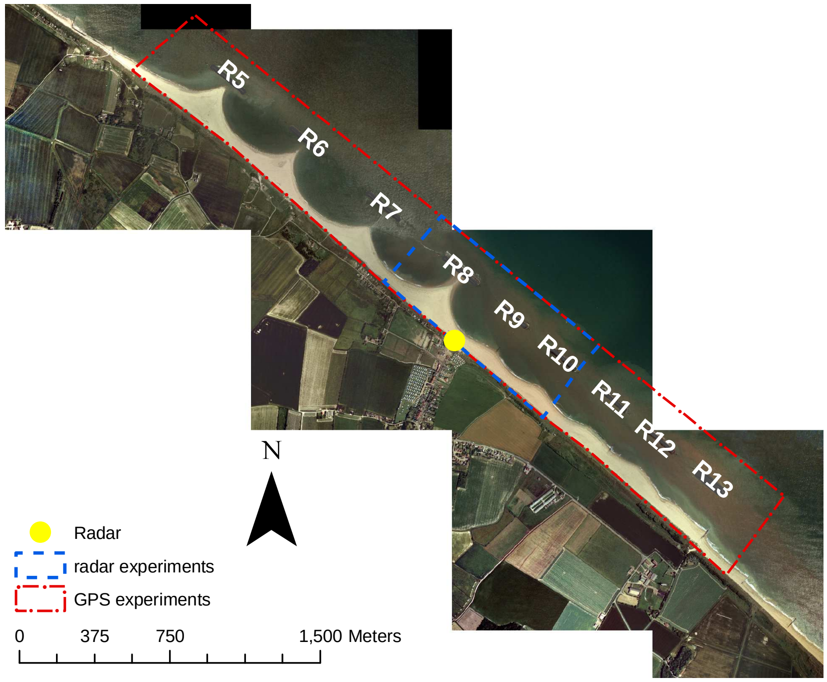


Figure 3.27: Radar and GPS experiment extents (R number denotes breakwater (reef) number). Aerial photo from Environment Agency, pers. comm. N.B. American spelling "meters" used by software during diagram generation.

Code developed by Paul Bell (POL) was used to identify and track float reflections in each image. Time and position of each float was established for comparison with model output (Chapter 6).

3.3.2 GPS float tracking

The radar floats were limited to regions near the centre of the breakwater system, close to the X-band radar (Figure 3.27). To allow the flow further afield to be measured, GPS floats were constructed.

3.3.2.1 GPS floats

GPS floats were made up of three 2-litre bottles fastened to a rod with a dry bag attached on the top and some ballast on the bottom. The dry bag contained a small handheld GPS (Garmin eTrex navigator) to log position. Each bottle was ~90 % filled with water to reduce freeboard (Figure 3.28).

Although surface piercing GPS floats had considerably reduced freeboard when compared to the radar floats they were still subject to some wind effects; experiments were conducted in calm “no wave” conditions to ensure that only tidal effects were measured.

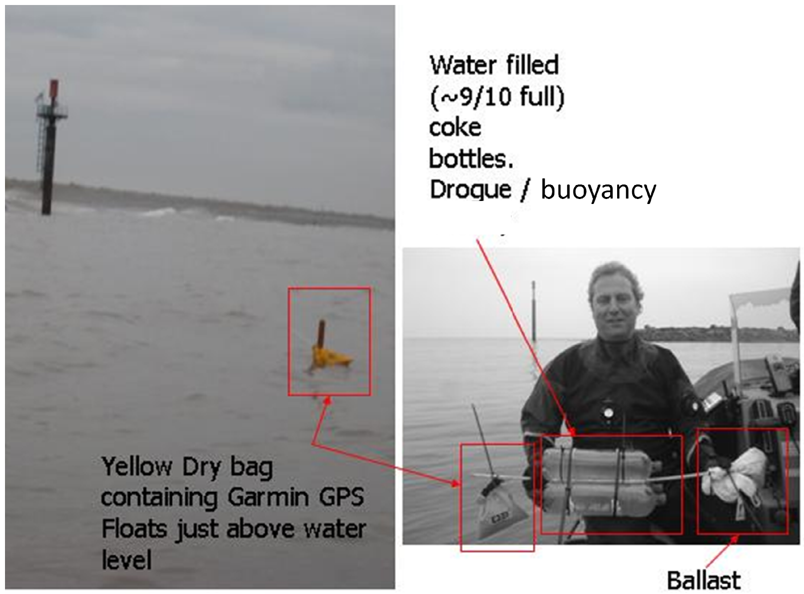


Figure 3.28: GPS drifter floats

GPS floats were deployed on a transect orthogonal to the coastline extending seaward from breakwater 5. Once deployed, floats were allowed to track through the breakwater system logging time and position every 30 seconds. Only one small boat was available for both deployment and retrieval so, to prevent equipment and data loss, floats were retrieved and re-deployed periodically to ensure all floats were within the same working area (~500 m^2).

3.3.2.2 Accuracy and precision of GPS measurements

Garmin quote an accuracy of 15 m for the eTrex personal navigator without the use of DGPS corrections (Garmin, 2003). To assess the precision of the GPS unit a short experiment was conducted leaving a unit un-moved, logging position over a 5.5 hour period. Figure 3.29 shows the distance each measurement was from the average over the deployment. The maximum difference from the mean position was 16 m. A typical float deployment was < 1 hour, this record shows that over this time period (360 s) there is rarely an observed imprecision of > 2 m. The exception being after ~12 800 s, where there is a sharp spike in data.

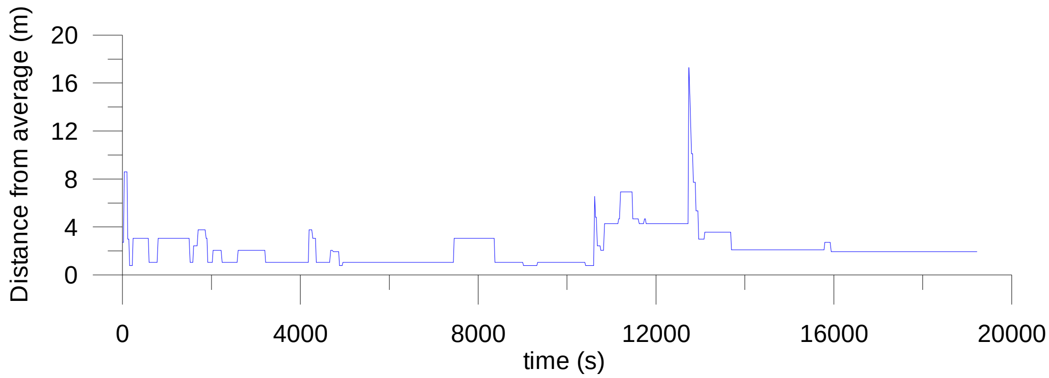


Figure 3.29: Garmin eTrex precision. Difference from the mean over a 5.5 hour record of an un-moved GPS unit (absolute values).

3.3.3 Downward looking Aquadopp transects

Flow separation around the offshore side of breakwater 5 was identified from the model as an important feature of the breakwaters on the tidal flow. A Nortek Aquadopp was mounted on a small boat looking downwards, to measure current velocities over pre-defined transects around breakwater 5 to identify this feature. Transects were repeated over a period leading up to, during and after peak velocity at high water. Transects were designed to measure flow deflection caused by the presence of breakwater 5 and tombolo 5 in the flow stream.

3.3.3.1 Instrument setup

The RTK GPS was used in conjunction with the Aquadopp to provide information about boat position, movement and heading; the RTK GPS and current meter were programmed to sample concurrently. The RTK GPS system logged position and time at a frequency of 1 Hz. The Aquadopp logged currents in five bins of 2 m at a frequency of 0.5 Hz. There was a blanking distance of 1 m and only measurements from bin 1 were used; resulting in a sampling volume between one and three metres below the water surface. Velocity over the ground could then be subtracted from measured velocities, leaving water velocity.

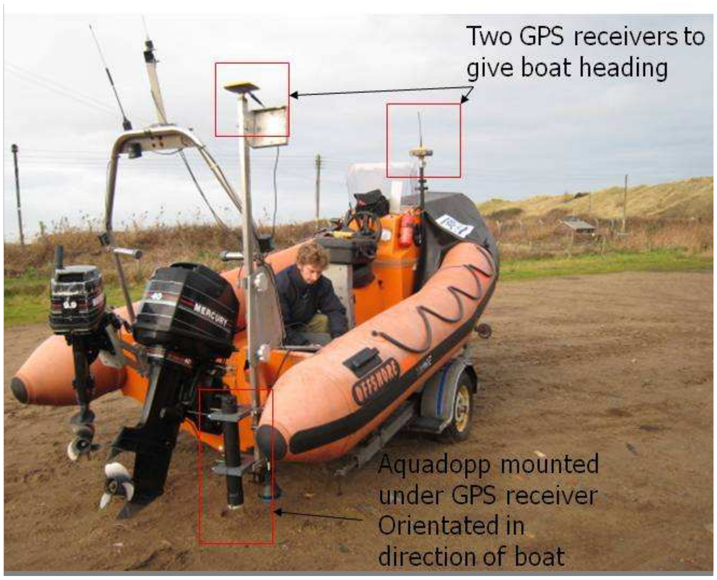


Figure 3.30: Nortek Aquadopp - downward looking

The Aquadopp and GPS were initially installed on the transom of a small rigid inflatable boat (Figure 3.30). The close proximity of the instrument to the engine caused velocity direction uncertainty. Magnetic deviation caused by the engine could not be removed from the Aquadopp internal compass. The instrument setup was transferred to a Dory workboat, where the instrument could be attached near the bow. This allowed the Aquadopp to use its internal compass to make the necessary rotations between coordinate systems.

4 Use of TELEMAC2D to model tidal currents and water-levels at Sea Palling

The study site at Sea Palling has a complex bathymetry of tombolos, salients and the presence of the rubble mound breakwaters themselves. This causes considerable perturbation of the tidal currents. Field measurements can only be made at few points and for limited periods, whereas a numerical model can provide spatial and temporal detail, provided it is properly calibrated and validated. TELEMAC2D is used in this case to help describe and aid understanding of how tidal currents interact with the bathymetry and breakwaters within this complex environment. Depth-average currents generated by the model, using GPS-surveys of the beach morphology and nearshore bathymetry, are used to drive sediment transport formulae to estimate the magnitudes and directions of tidally-driven sediment transport pathways through the system.

4.1 Examples of previous use of TELEMAC

The TELEMAC modelling suite is used extensively within the oceanographic community; examples listed below are just a few of the many studies. Numerous studies in the Southern North Sea have utilised this software (ABP, 1996; Bacon, 2005; Coughlan, 2008; Park, 2007). Studies on the west coast of Britain include investigations utilising TELEMAC within the Dyfi Estuary and neighbouring coastline, mid-Wales (Brown and Davies, 2009) and in the Irish and Celtic seas (Brown and Davies, 2009; Jones and Davies, 2006). Studies using the TELEMAC suite on the channel coasts of England include evaluation of tidal resources at Portland Bill, Dorset (Blunden and Bahaj, 2006) and morphodynamic modelling of the Teign estuary, Devon (Bernardes et al., 2006). Examples in France include the investigation of waves and tides around the Adour river mouth and the adjacent beaches of Anglet (Brière et al., 2007) and the study of a large estuary linear sandbank, the Longe de Boyard, on the French Atlantic coast

(Chaumillon et al., 2008). Examples of the use of TELEMAC further afield include a tide circulation model of the Atlantic coast of the Iberian Peninsula, covering the whole continental shelf, Portugal (Sauvaget et al., 2000) and modelling of the Patos Lagoon coastal plume, Brazil (Marques et al., 2009).

4.1.1 Previous uses in the Southern North Sea

Coughlan et al. (2007) used TELEMAC2D (Section 4.2.1) and TOMOWAC (wave model not including effects of diffraction, Section 4.2.1) to investigate the interaction of waves and currents around Newcombe Sand and the shoreline around Lowestoft and Gt. Yarmouth, Norfolk. Their model domain was ~25 km along-shore and ~10 km across-shore. Coughlan (2008) included the use of SYSYPHE (sediment transport model, Section 4.2.1) to investigate transport rates and morphology change.

Bacon (2005) used TELEMAC2D and ARTEMIS (wave model including effects of diffraction, Section 4.2.1) to investigate the interaction of a section of the Sea Palling shore-parallel breakwaters with tidal currents and their contribution to sand transport. Bacon’s (2005) model domain covered the area of the phase one breakwaters, he calculated a flux through the breakwater system during calm low-wave energy (background) conditions of ~40 000 $m^3 y^{-1}$. Bacon (2005) comments that this may seem a modest quantity compared to the rate before breakwater construction (Section 2.9.3), but this is a continuing contribution to sediment transport along this part of the coastline.

TELEMAC2D was used to simulate the regional flow in the Southern North Sea and English Channel as part of the Southern North Sea Sediment Transport Study (SNSSTS) (HR Wallingford, 2002). The SNSSTS aimed to:

- identify sediment sources, transport pathways and transport volumes for a large range of sediment sizes
- identify offshore features and determine their influence and interaction with wave and tidal current climates

- aid revision of Shore Management Plans (SMPs) and enable a more informed consideration of the effects of dredging off the coast of East Anglia.

TELEMAC2D was used to generate a flow model derived from tidal and wind stress over the region, to input into HR Wallingford's module SANDCALC (HR Wallingford, 1999) and the Admiralty's TIDECALC (Hydrographic Office, 1995). SANDCALC computed bedload and suspended load transport while TIDECALC was used to verify the tidal curves generated by TELEMAC2D. Sand transport was evaluated over a large range of sea surface conditions (calm to 5 m waves, including the effect of storm surges). TELEMAC2D was calibrated using tidal harmonics published for many primary ports along the domain's land boundary. Extensive fieldwork campaigns took place between Happisburgh and Winterton in North East Norfolk, Clacton in Essex and in the Humber estuary. A high degree of confidence was applied to model results in 11 local areas which included North East Norfolk (HR Wallingford 2002).

4.2 Introduction to the TELEMAC system

The Hydrodynamic modelling suite TELEMAC was written and is published by the Department Laboratoire National d'Hydraulique at Electricite de France (EDF-DER, 1998). TELEMAC consists of a comprehensive modular programme system, designed to simulate hydrodynamic processes associated with rivers, estuaries and coastal waters and the physical mechanisms generating sediment transport. HR Wallingford, which markets the system in the UK, has continued development and has provided additional modules to supplement the original package.

One of the key assets of the TELEMAC system is its use of the finite element theory, which comprises a rigorous theoretical framework and flexibility for describing complex geometries (Hervouet, 2000).

4.2.1 TELEMAC suite

The TELEMAC modelling suite is made up of 11 modules (Table 4.1). There are also a number of subroutines; those used in this thesis are included in Table 4.1. Each module runs independently, however the output from one can be used as the input for another. In this way the modules can be “linked” together. The modules are written in the Fortran 90 language and are linked to the user’s operating system using a Perl script language.

Module	Simulation	Details
MATTISSE	Pre-Processor	Interpolation of bathymetry, mesh generation and boundary definitions
STBTEL	Mesh Verification	Coordination of mesh geometry from external mesh generation programs and conversion to TELEMAC format
TELEMAC2D	2D Currents	2D Hydrodynamic solution, on a finite element or orthogonal grid
TELEMAC3D	3D Currents	Full 3D Hydrodynamic solution, on a finite element or orthogonal grid
POSTEL3D	Visualisation	Link for TELEMAC3D to the Post-Processing module RUBENS
SYSYPHE	Non-cohesive sediment	Bedload and suspended load of non-cohesive sediments
SEDI3D	Cohesive sediment	Erosion, transport and deposition of cohesive material in an estuarine environment
ARTEMIS	Waves	Regular and random waves including refraction, diffraction, breaking and reflection from and absorption by structures
COWADIS	Waves	Regular and random waves including refraction and breaking.
TOMAWAC	Waves	Regular and random waves including refraction and breaking.
RUBENS	Post-Processor	Visualisation software to interpret results files from all TELEMAC modules. Calculation of vector quantities, produces surface or isopleth output of plan views and 2D space or time plots. The program can also be used to output TELEMAC results files in binary or ASCII format as time series of individual variables
BORD	FORTRAN subroutine	Allows boundary conditions to vary in time and space. This is included in the FORTRAN file
FLOT	FORTRAN subroutine	Used for particle tracking (Lagrangian drifts) within TELEMAC2D simulation
STRCHE	FORTRAN subroutine	Used to allow the friction coefficient to vary in space.

Table 4.1: TELEMAC system modules and subroutines (adapted from Bacon 2005)

Modules used in this study are:

1. MATTISSE: Used to "set up" the model. Input of bathymetry, determination of domain, mesh generation, setting boundary types.
2. TELEMAC2D: Used to simulate hydrodynamics of tidal flow around the breakwaters. Depth-average currents and water-depths are exported to drive sediment transport formulae. This study looks at calm "no wave" conditions.
3. RUBENS: Used to visually check model output and export results in ASCII format for analysis in Matlab and ArcGIS.

The FORTRAN subroutines BORD, FLOT and STRCHE were used in this study (Table 4.1)

4.3 TELEMAC2D

4.3.1 Equations

TELEMAC2D solves the Saint-Venant equations, the two dimensional depth-integrated shallow water equations derived from the full three dimensional Navier-Stokes equations. The equations solved are the continuity equation (Equation 4.1) and momentum along x and y axes (Equation 4.2 and Equation 4.3)(EDF-DER, 2002a).

Equation 4.1

$$\boldsymbol{\frac{\delta h}{\delta t} + \frac{\delta(uh)}{\delta x} + \frac{\delta(vh)}{\delta y} = 0}$$

Equation 4.2

$$\frac{\delta u}{\delta t} + u\frac{\delta u}{\delta x} + v\frac{\delta u}{\delta y} = -g\frac{\delta \eta}{\delta x} + S_x + \nabla.(\mu_t \nabla u)$$

Equation 4.3

$$\frac{\delta v}{\delta t} + u\frac{\delta v}{\delta x} + v\frac{\delta v}{\delta y} = -g\frac{\delta \eta}{\delta y} + S_y + \nabla.(\mu_t \nabla v)$$

Where,

h = water-depth

u, v = depth-average velocity components

η = free surface elevation

S_x, S_y = horizontal source terms, such as bottom friction

μ_t = coefficient of diffusion of velocity

∇ = gradient (grad) operator

∇. = divergence (div) operator

The model solves the three unknowns h, u, and v at every node in the mesh, by an iterative process known as the fractional steps method (Hervouet, 2007).

4.3.2 Sea Palling domain

The model domain for this study is ~5.5 km along-shore and ~2.2 km offshore (Figure 4.1) and includes all nine breakwaters of both phase one and phase two. Model boundaries need to be far enough from breakwaters to be considered free from their influence. Initial model simulations suggested 1 km north-west and 1 km south-east was sufficient to meet this criterion. The offshore boundary was set at 2.2 km offshore, which extended the domain into ~20 m water-depth; Park (pers. comm.) found model instabilities reduced considerably when the domain extended into water-depths > 20 m.

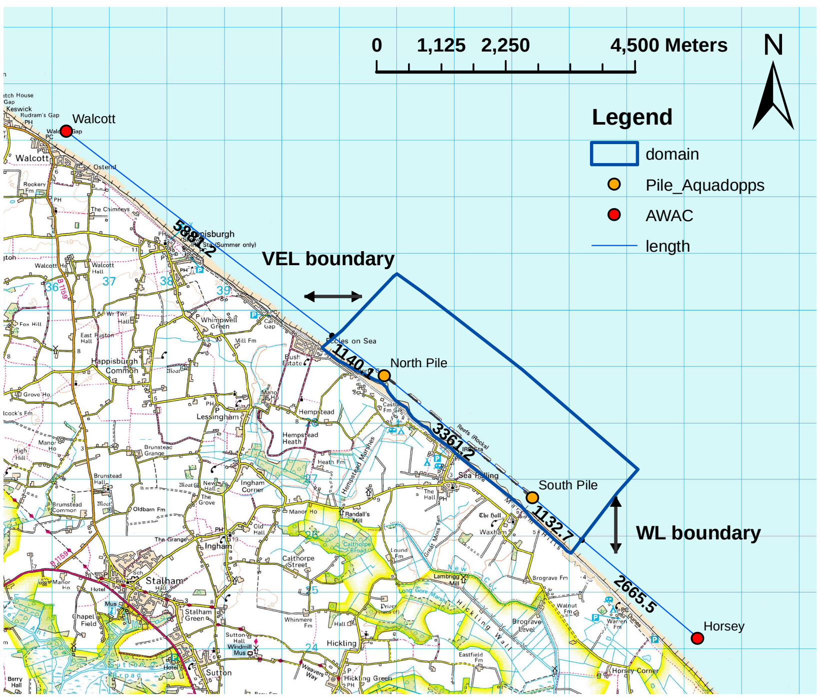


Figure 4.1: Model domain (5.5 km x 2.2 km). (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service). N.B. American spelling "meters" used by software during diagram generation.

4.3.3 Bathymetry and mesh design - MATTISSE

LEACOAST2 bathymetry and beach surveys were used to define the initial beach, nearshore and offshore elevation and morphology. The closest survey date to the time period investigated was utilised.

4.3.3.1 Basic mesh design

MATTISSE generates a finite element mesh using criteria prescribed by the user. A greater density of nodes allows a better representation of the input bathymetry. This also increases the resolution of results, but increasing the number of calculations has a large impact on computation time. It is therefore necessary to find a balance between acceptable computation times and the required node density to realistically represent the bathymetry. Table 4.2 shows the order of criterion applied to the bathymetry data to create the mesh used in this study.

Stage	Input	operator	2nd operator	value
Stage 1	Bathy	constant	-	80
Stage 2	Bathy	Abs (X)	-	-
Stage 3	Stage 2	add	-	0.1
Stage 4	Stage 3	multiply	-	40
Stage 5	Stage 4	Max(x, y)	stage1	-

Table 4.2: Stages of criterion to apply to bathymetry when creating mesh using MATTISSE

The basic mesh design is based on a node separation of 40 multiplied by water-depth with a maximum node separation of 80 m.

4.3.3.2 Breakwater geometry

Bacon (2005) used TELEMAC to investigate the interaction of tidal currents around the phase one breakwaters at Sea Palling. He represented the phase one breakwaters in the model as solid boundaries in the same way as the offshore boundary is defined as a solid wall (Section 4.3.4.1). It would be unrealistic to represent the phase two breakwaters in this way as they are not surface piecing at higher stages of tide; they are exposed by 0.5 m at MHWS. Breakwater 13 has a crest elevation at the same level as MLW so is only exposed on lower than average tides. In this study, breakwater geometry was defined in the model as 'bathymetry' and programmed as being ‘fixed points’ to define them as ‘non erodible’ (EDF-LNHE, 1998). A constant node spacing of 5 m was applied to bathymetry points associated to phase one breakwaters and a node spacing of 3 m was applied to bathymetry points associated to phase two breakwaters. This resulted in the successful representation of the bathymetry whilst maintaining acceptable computation times.

Figure 4.2 shows the nodes over the whole domain and gives an indication of how their density varies spatially. Figure 4.3 shows nodes inshore between breakwaters 8 and 9. Node spacing is ~3 m over breakwaters, ~10 m inside breakwaters and ~80 m in the offshore. There are a total of ~13 000 nodes.

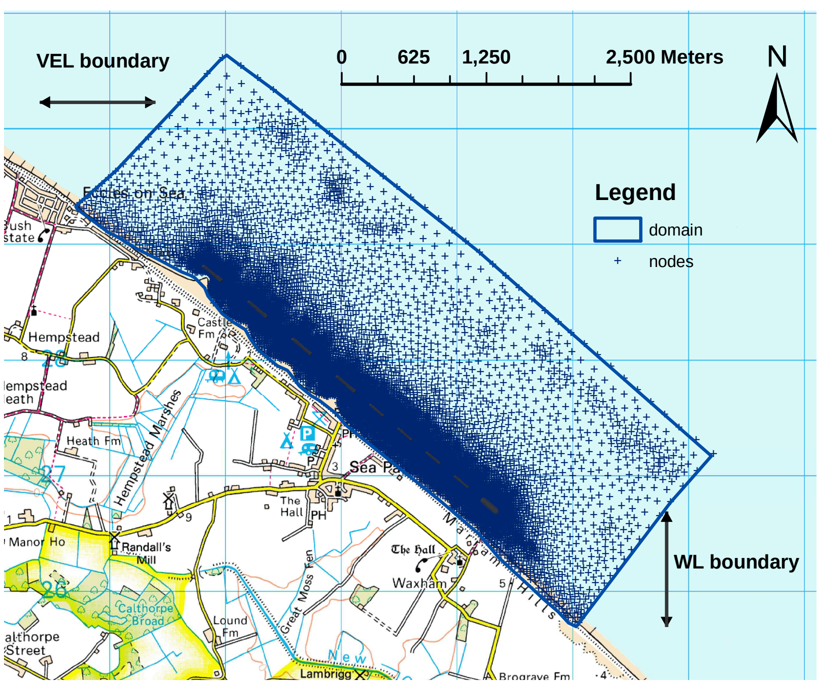


Figure 4.2: Model nodes over the domain (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service).

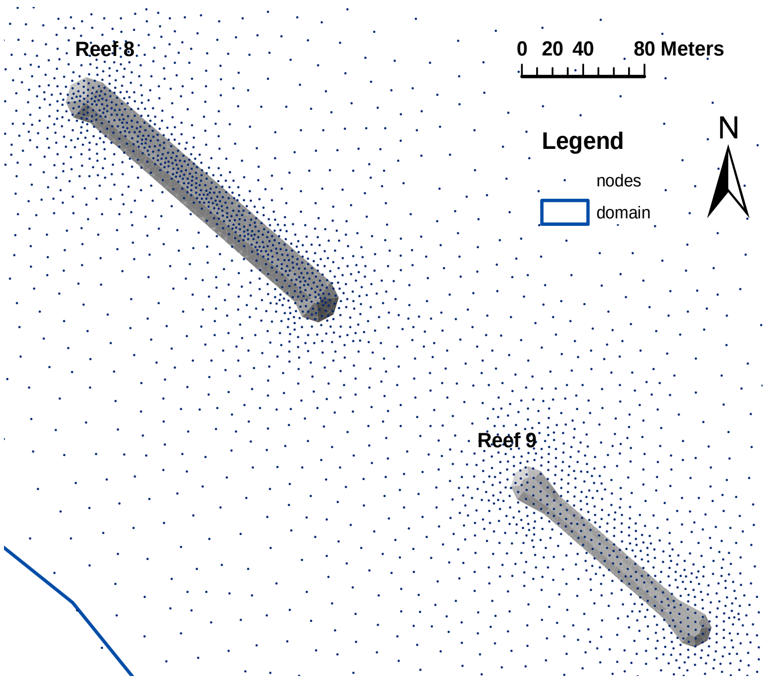


Figure 4.3: Model nodes inshore. N.B. American spelling "meters" used by software during diagram generation.

4.3.4 Boundary conditions

4.3.4.1 Boundary definition

Sea Palling experiences an approximately progressive wave tide; flow is parallel to the coastline and maximum current speeds occur at ~1 hour before high and low water. Flow direction varies locally due to the obstruction caused by the presence of the breakwaters. The offshore boundary is almost 2 km seaward of the breakwater line which minimises dampening of any local across-shore currents caused by the presence of the breakwaters. Bacon's (2005) method for simulating the progressive wave tide experienced at Sea Palling using TELEMAC2D was adopted. The offshore boundary is 'solid' allowing no across-shore flow out, or into the model; the orientation of the offshore boundary has been chosen to be along the direction of the streamlines at maximum flood and ebb to minimise the impact of the boundary being 'solid'. Likewise the inshore boundary is 'solid' and is programmed to a level of 3.5 m AOD. 'Solid' boundaries permit water-level to be free which allows the inter-tidal area to wet and dry. The two remaining boundaries were set to be ‘liquid’; requiring input of time varying information, flow velocity and water-level. By applying velocity to one end and the associated water-level to the other, the characteristics of the progressive wave tide can be successfully simulated (Bacon, 2005). Velocity is prescribed but water-level is allowed to be free along the north-west boundary, while water-level is prescribed allowing velocity to be free along the south-east boundary (Figure 4.2).

4.3.4.2 Coastal boundary friction

The BORD subroutine (Table 4.1) was used within the FORTRAN file to apply coefficients to the forcing conditions across the velocity boundary to include the effect of coastal boundary friction. Bacon (2005) parameterised velocity in accordance with the results from ADCP transects running across-shore just north-west of breakwater 5. The velocity boundary was parameterised into five groups with a coefficient applied to each group (Figure 4.4).

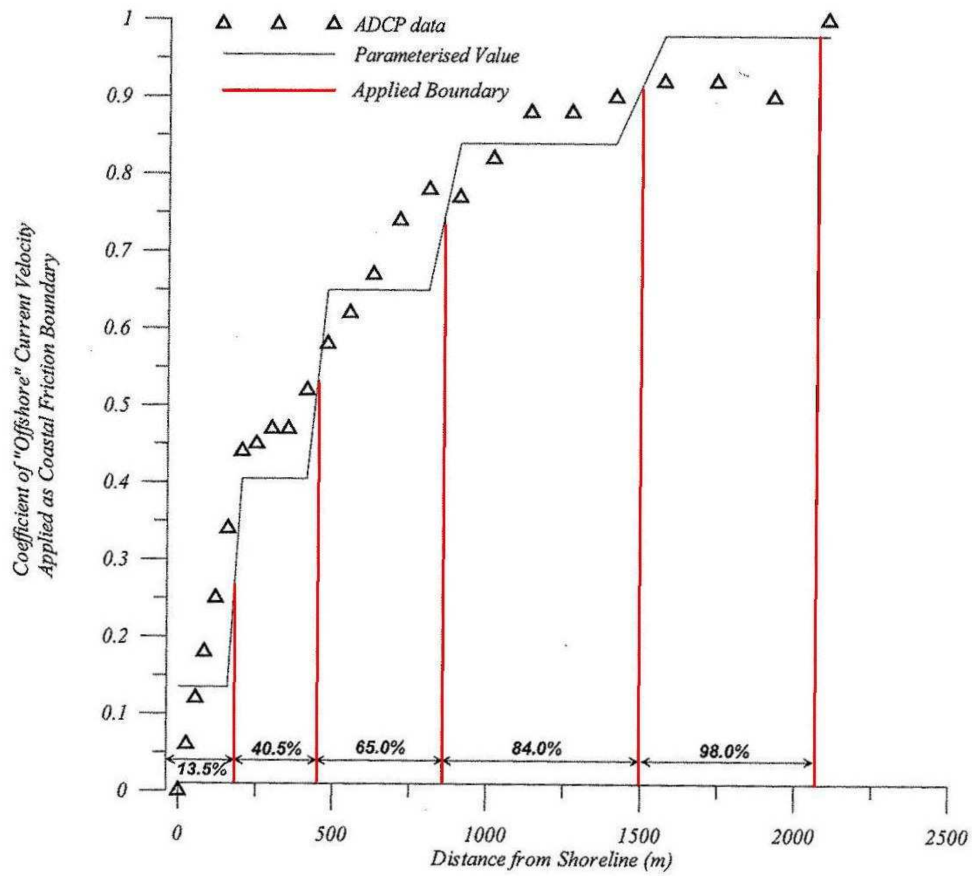


Figure 4.4: Velocity profile applied to the north-west model boundary. Coastal friction boundary developed from ADCP transect data (from Bacon, 2005).

4.3.5 Forcing data

TELEMAC2D is forced with water-levels and flow velocities derived from measurements made by Gardline Ltd at Walcott and Horsey (Section 3.1). Corrections were applied to the forcing conditions to take account of phase and amplitude differences expected between Walcott and each of the boundaries (Section 4.3.5.1). These were based on linear interpolation between measurements at Walcott and Horsey.

Measurements from the Gardline Ltd AWACs are available from October 2006 until September 2009. Coincident forcing data was used for each simulation. Comparison of model output using these data with field measurements at Sea

Palling allowed a more precise assessment of model performance. During model evaluation the model was forced using measurements made at Walcott over the same period that calibration data was available during the LEACOAST2 process experiments. During float tracking model runs, forcing data was used from measurements at Walcott on the day of each experiment.

4.3.5.1 'Corrections' made to Walcott AWAC data

The phase and amplitude of the tidal wave varies as the wave propagates along the coast. As the Walcott AWAC is ~6 km north-west of the velocity boundary and ~11 km north-west of the water-level boundary a correction to both the timing and amplitude was necessary.

Harmonic analysis of Walcott and Horsey AWAC data from December 2006 until May 2007 along with the distance between the sampling locations gave the required information to make the necessary corrections. The Matlab code T_tide (Pawlowicz et al., 2002) was used to conduct the harmonic analysis.

Harmonic analysis is based on the assumption that tidal variations can be represented by a finite number (N) of harmonic terms of the form:
$H_n \cos(\sigma_n t - g_n)$, where H_n is an amplitude, σ_n is an angular speed, and g_n is a phase lag on the Equilibrium tide at Greenwich (Pugh, 1987).

The M_2 constituent of tide was used as it is the most dominant forcing for the tide experienced in this area. The sea surface elevation phase lag on the Equilibrium tide at Greenwich was evaluated as 193.51° at Walcott and 203.55° at Horsey. The same analysis was applied to the along-shore velocity record (positive when flow direction is to the south-east and negative for flow to the north-west) for the same time period. Phase lag associated to velocity was 191.26° at Walcott and 184.98° at Horsey.

4.3.5.1.1 Time differences

To calculate the time difference between Walcott and Horsey the relative time of high water was evaluated. Height of HW will be influenced by H_{M_2} but time will be when $\sigma_{M_2} t - g_{M_2} = 0$ at both Walcott and Horsey. (N.B. subscript M_2 used to denote tidal constituent considered, and H and W whether time or phase lag refers to Horsey or Walcott respectively).

Time difference for sea surface elevation:

$$\sigma_{M_2} t_W - g_{WM_2} = \sigma_{M_2} t_H - g_{HM_2}$$
$$\sigma_{M_2} t_W - \sigma_{M_2} t_H = g_{WM_2} - g_{HM_2}$$
$$t_W - t_H = \frac{g_{WM_2} - g_{HM_2}}{\sigma_{M_2}}$$
$$= \frac{193.51 - 203.55}{28.984} = 0.345 hours$$

This means that it takes 20.7 minutes for the tidal wave to travel from Walcott to Horsey.

For along-shore velocity:

$$\sigma_{M_2} t_W - g_{WM_2} = \sigma_{M_2} t_H - g_{HM_2}$$
$$\sigma_{M_2} t_W - \sigma_{M_2} t_H = g_{WM_2} - g_{HM_2}$$
$$t_W - t_H = \frac{g_{WM_2} - g_{HM_2}}{\sigma_{M_2}}$$
$$= \frac{191.26 - 184.98}{28.984} = 0.217 hours$$

There is a 13 minute offset between velocities at Walcott and Horsey.

Table 4.3 details the time difference to be applied to each model boundary. A time difference of 17 minutes needs to be applied to the water-level data and 5 minutes to the velocity data.

boundary	WL	Vel
time offset (s)	1242.0	780.0
distance (Walcott - Horsey (m))	14180.7	14180.7
time difference per m	0.1	0.1
distance (Walcott - boundary (m))	11515.2	5881.2
time offset to apply (s)	1008.5	323.5
time offset to apply (min)	16.8	5.4

Table 4.3: Time corrections for water-level and velocity boundaries

4.3.5.1.2 Amplitude differences

H_{M_2} gives the amplitude of the M_2 constituent. The difference between H_{M_2} at Walcott and Horsey can be used to correct the water-level and velocity record at the north and south model boundary. Table 4.4 shows the amplitude decrease which needs to be applied to the Walcott data record to reflect the position of each model boundary.

	WL	Vel
Walcott H_{M2}	1.29	0.73
Horsey H_{M2}	1.09	0.68
difference (Walcott - Horsey)	0.19	0.05
distance (Walcott - Horsey (m))	14180.70	14180.70
amplitude decrease per m	0.00	0.00
distance (Walcott - boundary (m))	11515.20	5881.20
amplitude decrease to apply	0.16	0.02

Table 4.4: Amplitude corrections for water-level and velocity boundaries

4.3.5.1.3 Offshore velocity

Bacon's (2005) method for applying coastal friction relies on forcing the model with "offshore" velocity. Coefficients are applied to this to decrease velocity nearer shore.

The Walcott AWAC is ~300 m from the shore so does not measure the offshore velocity. Using Taylor's (pers. comm.) ADCP transects just north-west of the breakwaters, it has been estimated that velocity measured 300 m from the shore represents ~65 % of the offshore velocity. Velocities measured at Walcott were therefore 'scaled up' to represent the offshore flow.

Currents measured at Walcott exhibit a shallow water effect; velocities are greater on the flood where water-levels are higher than on the ebb. This pattern is not present in the offshore current (current at the offshore boundary) (Figure 8.37 in Chapter 8) and a correction was therefore made for this; currents during ebb tides were increased to match those experienced during flood tides.

Figure 4.5 shows the effect these corrections have on the forcing conditions. Measurements at Walcott, adjustments at the boundaries and the values after correction to the 'offshore' are shown.

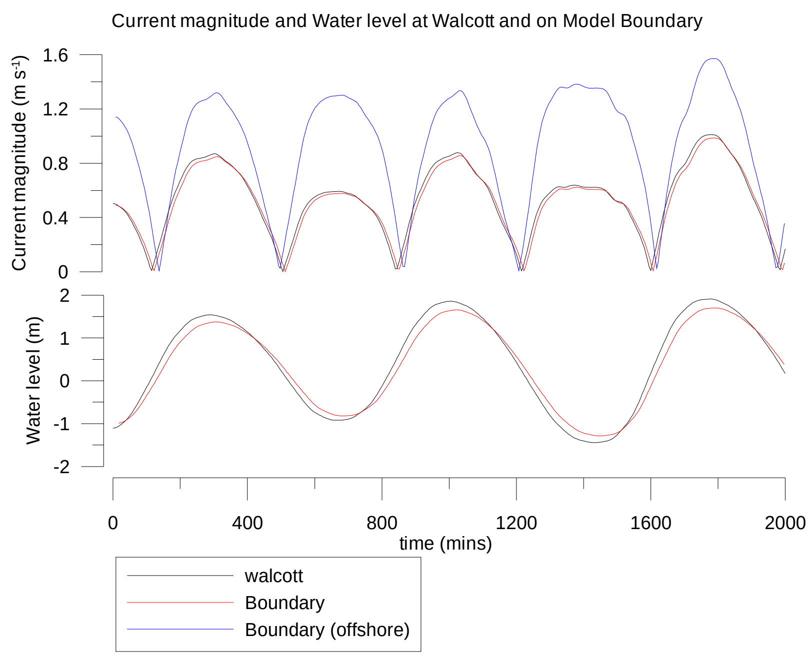


Figure 4.5: Current magnitude and water-level at Walcott and model boundary. Current magnitude at the north-west and water-level at the south-east.

4.3.5.1.4 Application of 'corrections'

Time shifts were applied to the data record in two steps. The time difference associated to the position of the north and south model boundary (16.80-5.39 minutes) was applied first; the timing of the water-levels was delayed by 11.4 minutes. Then the time difference from Walcott to the north boundary (5.4 minutes) was applied overall; all records were delayed by 5 minutes.

Time differences between north and south boundaries were applied by re-sampling the water-level data record via interpolation in order to obtain velocity every 20 seconds. A shift in the data was then applied to the nearest 20 seconds. The new record was then re-sampled with a five minute time interval.

Data with corrected amplitude and time was filtered using a hamming filter (0.25 + 0.5 + 0.25) 15 times to smooth and remove spikes. Figure 4.6 demonstrates that the smoothed velocity data shows little sign of amplitude reduction.

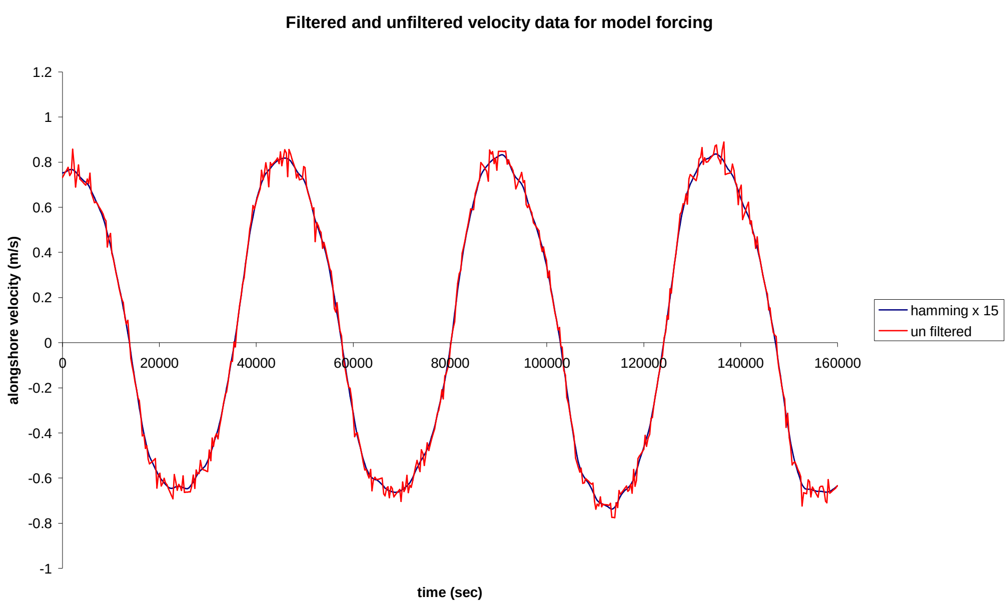


Figure 4.6: Raw and smoothed velocity model forcing data (AWAC).

Time in seconds, water-level and velocity data are saved as a text file with file extension “prn” which forms the liquid boundary file.

4.3.6 Definition of keywords and physical parameters

Keywords and physical parameters are defined in the Steering File. Time-step varied between one and five seconds, five seconds was used unless instabilities required a shortening of time-step. Model output (u, v, and h) was written to the Results File every 10 minutes.

4.3.6.1 Turbulent mixing / viscosity

TELEMAC2D offers four options of different complexity for modelling turbulence.

1. Constant turbulent viscosity.
2. Elder model
3. k-Epsilon model
4. Smagorinski model

These are all investigated during model evaluation (Chapter 5).

4.3.6.2 Bed friction

The friction law used to model friction on the bed is defined using the keyword LAW OF BOTTOM FRICTION. If friction varies in time or space the subroutines CORSTR and STRCHE can be used respectively. The use of STRCHE (Table 4.1) to include the enhanced frictional effects of the breakwaters is investigated in Chapter 6. Frictional effects are likely to vary significantly in the wide range of hydrodynamic conditions simulated over the domain (Davies and Villeret, 2003), although insufficient measurements exist to include temporal or spatial varying friction.

TELEMAC2D offers the following options for defining friction:

1. Nikuradse law
2. Chezy law
3. Mannings law
4. Stricler law

The effects of Chezy's, Stricler's, Manning's and Nikuradse's laws are investigated during model evaluation (Section 5.1.1)

4.3.6.3 Wetting and drying

At LW tombolos and other shallow areas are exposed. In order to prevent spurious solutions, TELEMAC2D offers three options for areas that dry out.

1. Tidal flats detected and free surface gradient corrected. Areas of negative water-level are smoothed.
2. Tidal flat areas removed from the computation. Elements still form part of the mesh but contributions they make to the computation are "masked out".
3. Modification of the porosity in dry elements.

Option one is the default and caused no problems so was utilised in this study.

5 Model evaluation

Calibration and validation is an important process to be completed before a model can be used to carry out hydrodynamic simulations. Calibration is the process where the model predictions can be tuned to best match observed results. Model parameters are varied to match model predictions to a set of measurements made within the model domain to some acceptable criteria. Validation is necessary in order to demonstrate that a model tuned for a particular location and time also represents the physical processes adequately within the wider area of interest, and at other times.

5.1 Model sensitivity

Before TELEMAC2D is calibrated, model sensitivity identifies which of the parameters have significant effect on model output. There are several options for how TELEMAC2D treats both friction and turbulence in the computation. Three friction laws and four turbulence models are investigated; Nikuradse, Chezy and Manning (friction laws), Constant viscosity, Elder model, k-Epsilon model and the Smagorinski model (turbulence models).

The parameters identified for controlling friction and turbulence are investigated to establish which have significant effect on model output. ‘Tuneable’ parameters allow the numerical simulations of the physical processes to be adjusted, thereby altering the currents and water-depths throughout the model. While these parameters have physical meaning, values used are not restricted to physical values that might be measured in the field.

5.1.1 Friction

The following friction law options can be used to define the friction coefficient C_f used by TELEMAC2D during simulations (the values used in this sensitivity test are included).

1. Nikuradse
   - $C_f = \left[\frac{1}{\kappa} ln\left(12\frac{h}{k_s}\right)\right]^{-2}$ where κ is von Karman's constant = 0.40, h is water-depth and k_s is Nikuradse's roughness factor.
   - The following values of k_s were investigated 10, 5, 1, 0.5, 0.4, 0.3, 0.2, 0.1, 0.01, and 0.001.
2. Chezy
   - $C_f = \frac{2g}{C^2}$ where C is the Chezy coefficient.
   - Values of the Chezy coefficient C investigated were 80, 60, 40, 20.
3. Manning
   - $C_f = \frac{2gm^2}{h^{1/3}}$ where m is the manning coefficient.
   - Values of the Manning coefficient m investigated were 0.01, 0.02, and 0.03.

These laws all define friction and as a result they will all have similar sensitivity.

5.1.2 Turbulence

TELEMAC2D offers the user four options for including the physical effects of turbulence in the model (the values used are included below):

1. Constant viscosity:
   - Turbulent viscosity is constant throughout the domain.
   - Using the keyword VELOCITY DIFFUSIVITY the constant viscosity coefficient represents the molecular viscosity, turbulent viscosity and dispersion.

- The value used has an effect on the extent and shape of recirculation. Low values only dissipate small eddies whereas high values will dissipate large circulations (EDF-DER, 2002b).
- Values investigated were: 0.00001, 0.0001, 0.001 and 0.01.

2. Elder model:
   - The Elder model allows different viscosity values to be specified along and across the current (K_l and K_t respectively). $K_l = a_l U^* h$ and $K_t = a_t U^* h$ where U* is the friction velocity (ms^{-1}) and h is the water-depth (m) a_l and a_t are the dimensionless dispersion coefficients equal to 6 and 0.6 respectively (EDF-DER, 2002b).
3. k-Epsilon model:
   - A 2D model that solves the transport equations for turbulent energy (k) and turbulent dissipation (Epsilon)
   - Velocity diffusivity has its real physical value of 0.000001 (molecular diffusion of water)(EDF-DER, 2002b).
4. Smagorinski model:
   - Generally used for maritime domains with large scale eddy phenomena, calculating the mixing coefficient considering the size of the mesh elements and the velocity field (Smagorinski, 1963 cited in Marques et al, 2009).

The range of values of the ‘turbulence parameters’ are used in order to tune the model to realistically synthesise tidal conditions within the domain. During calibration the model was tuned to fit a sub-set of the measured data available from within the domain. During validation the resultant model was compared to a set of independent data.

5.1.3 Sensitivity model run

A boundary conditions file was created using a short period of forcing data during a period of spring tides. A series of steering files were programmed with the relevant constants and keywords in order to test each of the above friction and turbulence options. Each model run included a “spin up” using the first six hours of the forcing conditions in order to stabilise the model with the required programmed options.

Six locations throughout the domain where used to assess the effects of differing the programmable options. The positions of LEACOAST2 F1, F2, F4, F5 and two locations between breakwater 8 and 9 (P1 and P2) were used (Figure 5.1).

Figure 5.1: Frame positions used in model calibration, evaluation and extra positions used for sensitivity analysis (P1 and P2) (Aerial photos from the Environment Agency, pers. comm.). N.B. American spelling “meters” used by software during diagram generation.

The extra positions P1 and P2 where included to investigate the effects of varying turbulence in an area that experiences considerable flow disturbance due to the presence of the breakwaters.

At each sampling location depth (h) and flow velocity (U and V) were recorded at high and low water during one tidal cycle. Figure 5.2 to Figure 5.6 below display these data representing values of h, U and V as difference from the mean of all frames as an indication of spread caused by varying each parameter. Plots are box and whisker diagrams, where the caps at the end of each box indicate the extreme values in, the box is defined by the lower and upper quartiles and the line in the centre of the box represents the median

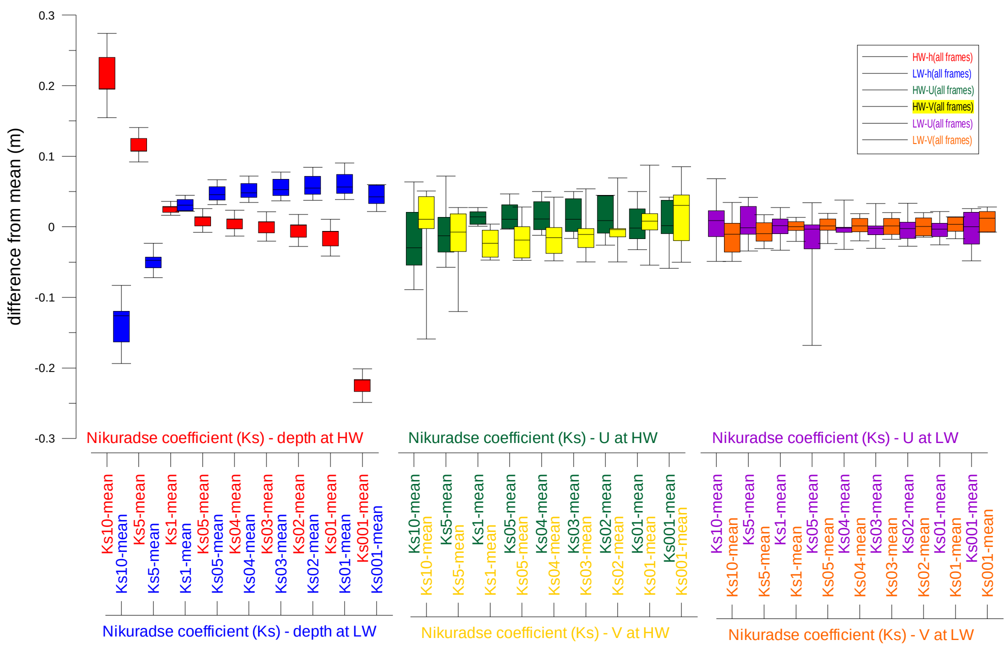


Figure 5.2: Effect of varying k_s when the Nikuradse friction law is used. The left hand section considers difference from the mean water depth (at F1, F2, F4, P1 and P2) at HW and LW. The middle section considers difference from the mean at HW in respect to U and V. The right hand section considers difference from the mean at LW in respect to U and V.

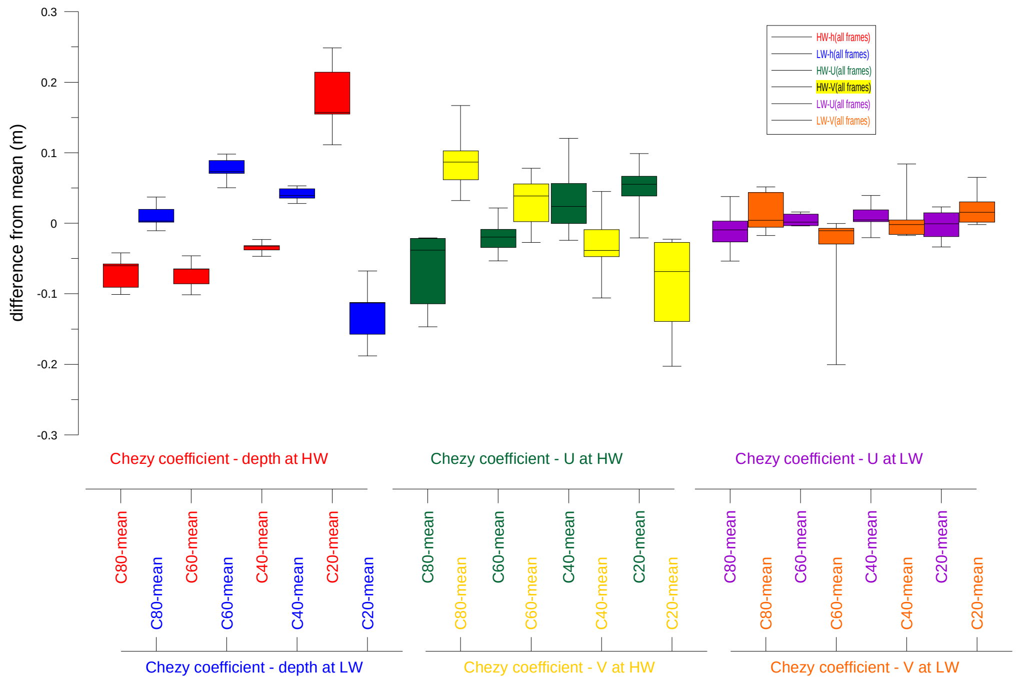


Figure 5.3: Effect of varying the Chezy coefficient C. The left hand section considers difference from the mean water depth (at F1, F2, F4, P1 and P2) at HW and LW. The middle section considers difference from the mean at HW in respect to U and V. The right hand section considers difference from the mean at LW in respect to U and V.

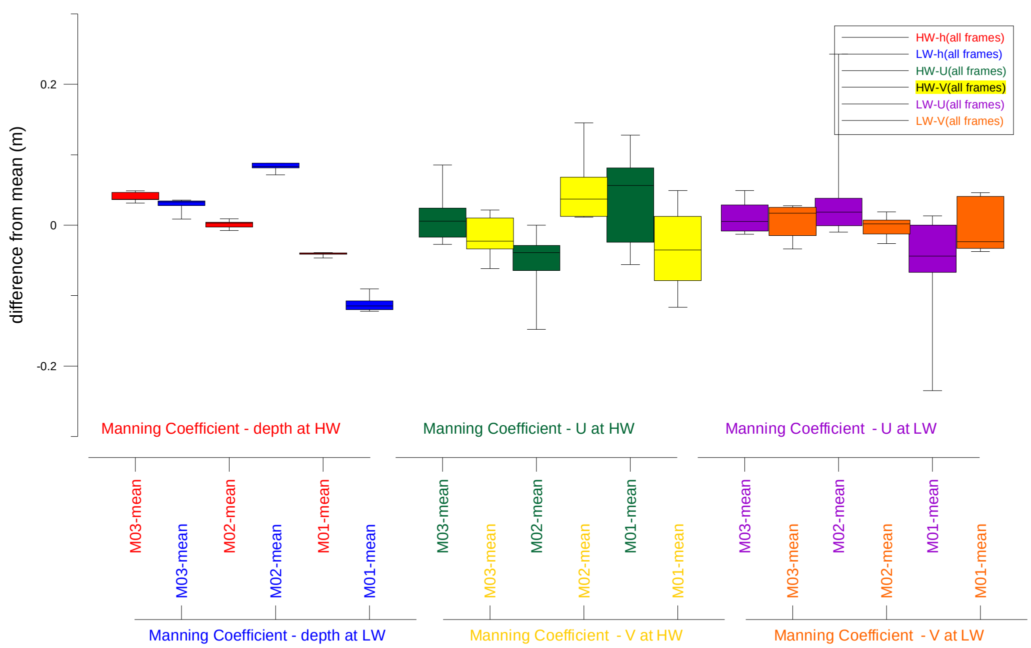


Figure 5.4: Effect of varying the Manning coefficient M. The left hand section considers difference from the mean water depth (at F1, F2, F4, P1 and P2) at HW and LW. The middle section considers difference from the mean at HW in respect to U and V. The right hand section considers difference from the mean at LW in respect to U and V.

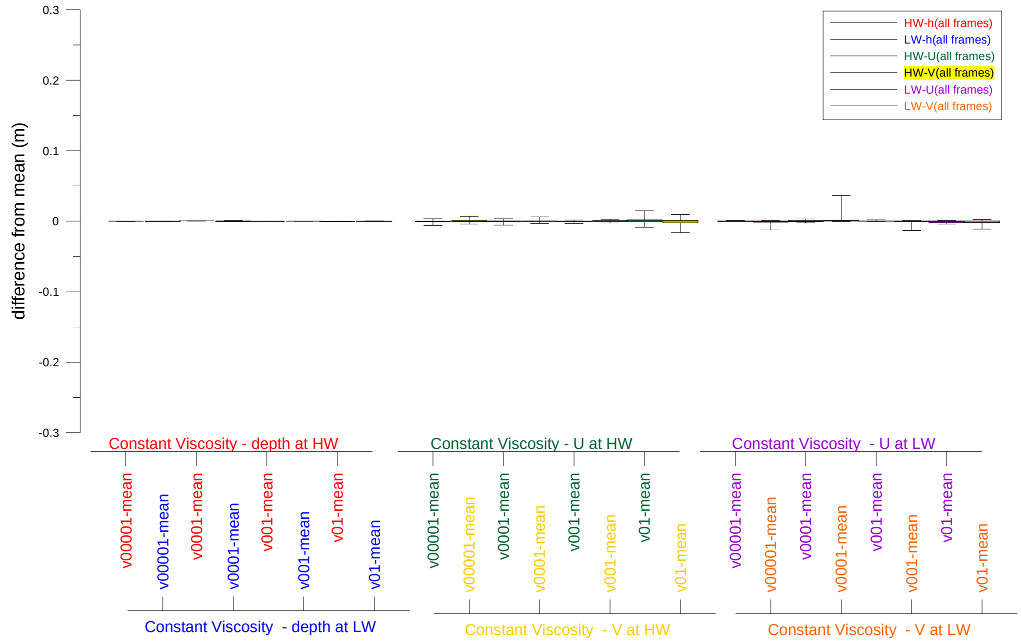


Figure 5.5: Effect of varying the constant viscosity coefficient when constant turbulent viscosity is used. The left hand section considers difference from the mean water depth (at F1, F2, F4, P1 and P2) at HW and LW. The middle section considers difference from the mean at HW in respect to U and V. The right hand section considers difference from the mean at LW in respect to U and V.

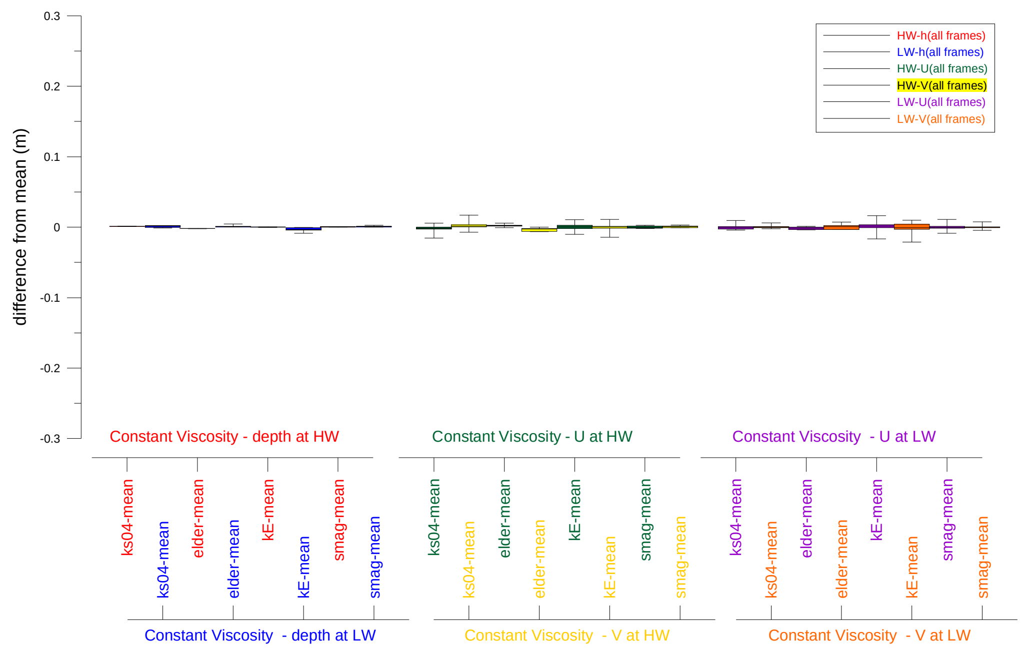


Figure 5.6: Effect of varying the turbulence model. The left hand section considers difference from the mean water depth (at F1, F2, F4, P1 and P2) at HW and LW. The middle section considers difference from the mean at HW in respect to U and V. The right hand section considers difference from the mean at LW in respect to U and V.

5.1.4 Sensitivity results

Figure 5.2 shows that large values of k_s result in the synthesis of larger tidal ranges. Large values of k_s also result in the biggest variations of water-depths across the sampling locations. Smallest variation is observed when k_s = 1. Similarly there is less variation in flow velocity (U and V) when k_s ~1. Difference from the mean varies between -0.2 and almost 0.3 for water-depth, -0.15 to 1 for U and V at HW.

Small values of the Chezy coefficient result in a large tidal range (Figure 5.3). At HW, U increases as the Chezy coefficient decreases and V increases as the Chezy coefficient increases.

Similar differences from the mean are observed for the Nikuradse (Figure 5.2), Chezy (Figure 5.3) and Manning (Figure 5.4) friction laws. It is clear that varying friction results in the generation of significantly different depths and flow velocities whichever law is used. This model setup is therefore sensitive to how friction is defined.

Figure 5.5 and Figure 5.6 show that varying the way in which turbulence is modelled or the value of the constant used, has almost no effect on water-levels or flow velocities simulated. As a result the constant viscosity model with viscosity diffusivity = 0.0001 (default value) was used throughout.

It is therefore necessary to tune the model using friction only. The Nikuradse method is used from this point onwards, although any of the highlighted methods would be equally suitable.

5.2 Model calibration

Model calibration is typically accomplished by qualitatively comparing a time series of modelled and measured water-level and velocities for given locations within the model domain. Sutherland et al. (2004b) recommend the use of model performance statistics as a systematic way of evaluating and tuning a coastal numerical model.

5.2.1 Model performance statistics

The linear correlation coefficient is a widely used method for determining whether two series are related. The use of correlation coefficients can be misleading when assessing the quality of modelling, since they represent the size and not the significance of the correlation between the two series. Sutherland et al. (2004a) suggest that accuracy is best represented by the Mean Absolute Error (MAE) as it does not depend on the distribution of the errors. The MAE is applicable to both vectors (currents) and scalars (water-levels).

5.2.1.1 Mean Absolute Error (MAE)

X is a set of N observed values ($x_1,\ldots, x_N$)
Y is a set of N measured values ($y_1,\ldots, y_N$)
Absolute values of observed and measured are defined in Equation 5.1.

Equation 5.1

$$\langle |X| \rangle = \frac{1}{N}\sum_{n=1}^{N}|x_n|$$

$$\langle |Y| \rangle = \frac{1}{N}\sum_{n=1}^{N}|y_n|$$

An angular bracket denotes an average and $|x|$ is the modulus of x. Mean Absolute Error is given by Equation 5.2.

Equation 5.2

$$MAE = \langle |Y - X| \rangle$$

Sutherland et al. (2004a) note that although using a modulus makes the statistic more analytic than a root-mean-square error (RMSE), MAE is not as heavily influenced by outliers as RMSE.

5.2.1.2 Relative Mean Absolute Error (RMAE)

The quality of the modelling can be judged using the Relative Mean Absolute Error (RMAE). Sutherland et al. (2004b) used this in their evaluation of coastal area modelling systems at an estuary mouth. The RMAE is defined in Equation 5.3.

Equation 5.3

$$RMAE = \frac{\langle |Y - X| \rangle}{\langle |X| \rangle} = \frac{MAE}{\langle |X| \rangle}$$

A RMAE of zero implies a perfect match between modelled and observed data. This will never be achieved as the RMAE includes error from measurement.

Sutherland et al. (2004b) used an Adjusted RMAE (ARMAE) which took into account the observed error calculated by Van Rijn et al. (2000).

Classification	Range of ARMAE
Excellent	<0.2
Good	0.2-0.4
Reasonable	0.4-0.7
Poor	0.7-1.0
Bad	>1.0

Table 5.1: Error classification for ARMAE values (from Sutherland et al., 2004b)

The error classification used is shown in Table 5.1. This classification is designed for the use with the ARMAE rather than RMAE. The ARMAE removes known observed errors and therefore will give lower values. RMAE values calculated in this thesis are used with the ARMAE classification values and therefore quoted classification will be at least as good if not better than quoted.

All measurements include some error. The measurement error has greater influence over results in low flow conditions. Flows in phase one of the breakwater system can typically be low due to the sheltering effects of emergent tombolos. Care must be taken when assessing model results using model performance statistics in these areas.

5.2.2 Calibration and validation data

Data used for the calibration and validation were obtained from LEACOAST2 experiment 2.2 in December 2006 (Section 3.2.1). Frames F1 and F4 were used for calibration purposes and F2 and F5 were used for validation (frame setup and positions can be found in Section 3.2.1). Where velocity was available from an ADCP (F1, F4 and F5) data were selected from bins representative of depth-average current (Section 3.1.1.1). Velocity at F2 was measured using a single ADV, a log profile was assumed to ‘correct’ measurements for depth-average current (Section 3.1.1.1).

5.2.2.1 Period of “calm” conditions

Wave statistics were used to determine a period of “calm” conditions (Figure 5.7). TELEMAC2D was forced with tidal currents only so requires low-wave “tide-only” conditions for calibration. There was a long period of calm weather in the middle of the experiment, however much of this was utilised for instrument servicing. 26 hours from 08:00 07/12/06 was used for calibration and validation during spring tides and 26 hours from 02:00 15/12/06 was used for neap tides.

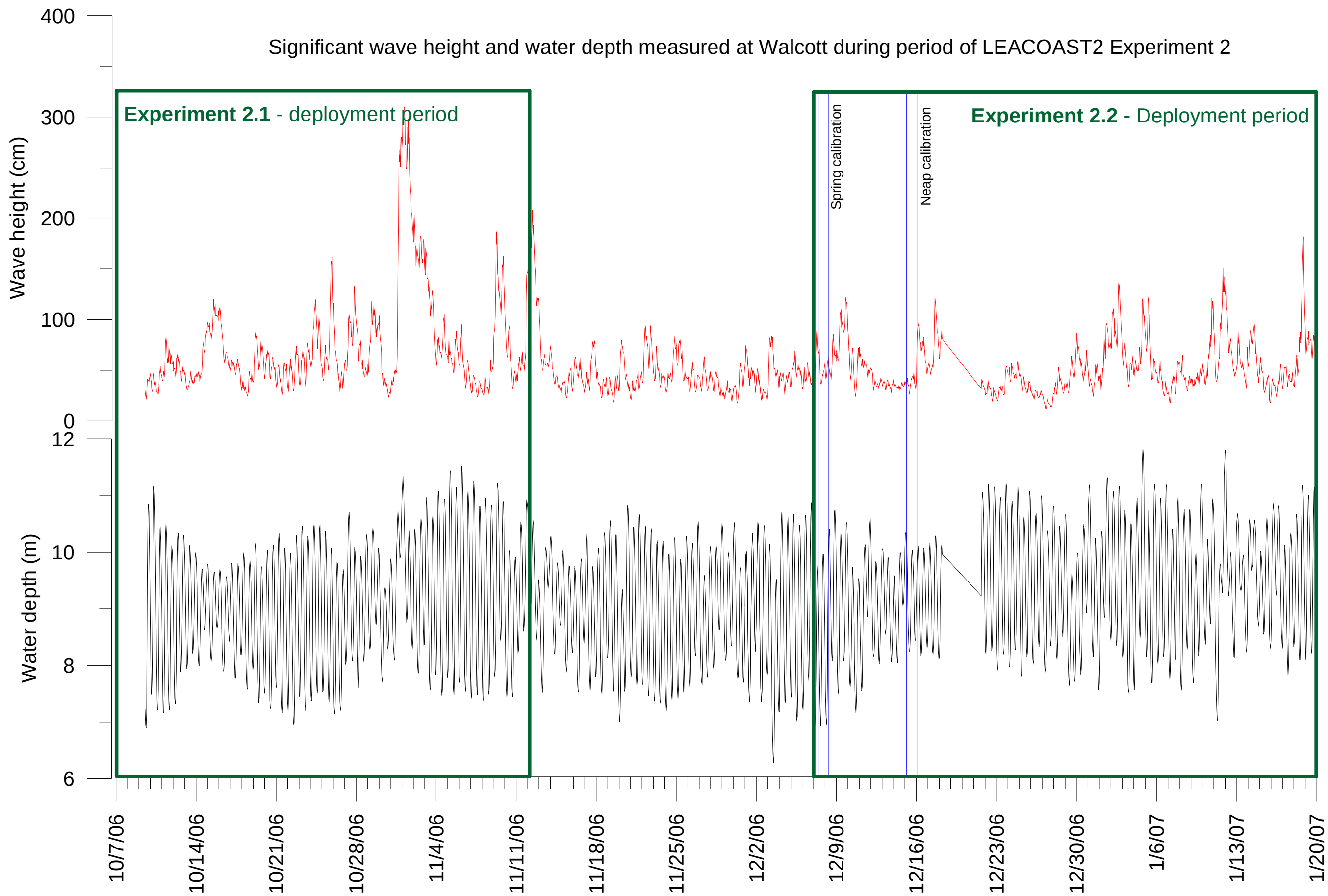


Figure 5.7: Significant wave height (H_s) and water-depth at Walcott during LEACOAST2 experiment 2. This experiment was conducted in two stages; 2.1 and 2.2 with a period of instrument servicing in between. Period where F1, F2, F4 and F5 all deployed indicated by green boxes. Calibration periods indicated by blue boxes.

5.2.2.2 Current vectors

Easting and northing components of current have been rotated anticlockwise by 41.9° to be expressed as along-shore and across-shore flow. Positive and negative values of flow along-shore are to the south-east and north-west respectively. Positive and negative values of flow across-shore are to the north-east and south-west respectively. Tidal currents unobstructed by breakwaters in the offshore are shore-parallel.

Figure 5.8 illustrates the along-shore and across-shore velocity and water-level at the calibration and validation positions. The position of F1 is outside the breakwater line. This flow region could be expected to experience shore-parallel currents, although is still in close proximity to the breakwater line and therefore may show deviations. Figure 5.8 indicates there is an across-shore flow of ~0.3 m s^{-1}; this is a difference of ~20° to along-shore flow. The ADCP on F1 had an external battery pack and was located on a frame in close proximity to other instruments and battery packs (Section 3.2). No compass calibration for the magnetic deviation effects of this was undertaken. This calibration would have required the instrument connected to its battery, a computer and the whole frame including all other instruments and batteries to be rotated through three orientations. This would have been impossible given the dense packing of the instruments (POL pers. comm.). Unfortunately uncertainty in current directions due to problems with instrument calibration means that it is impossible to distinguish between true across-shore velocity and measurement errors.

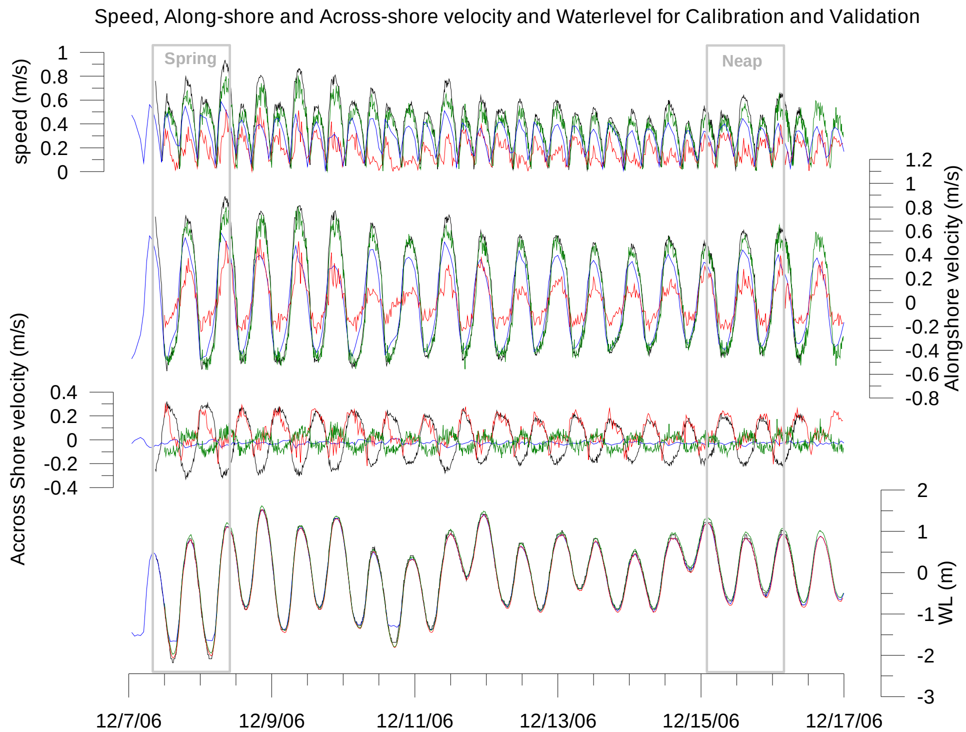
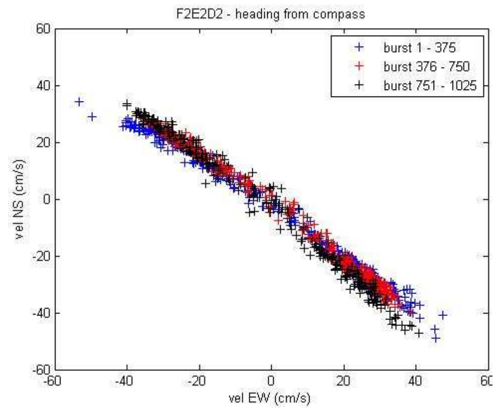


Figure 5.8: Measured along-shore, across-shore and water-levels at four stations, F1 (black), F2 (blue), F4 (red) and F5 (green). Grey boxes indicate calibration / validation periods.

Compass heading on F2 was observed to “drift” by 10° during this deployment. Figure 5.9 demonstrates how the flow direction rotates though the deployment, which suggests a problem with the compass rather than frame movement. Blue crosses indicate data at the beginning of the deployment, black at the middle and red at the end. Figure 5.10 shows how this direction rotation is reduced if an averaged heading is used for each burst. This suggests that there is unlikely to be true frame movement and more likely a problem with the compass; change in magnetic deviation of the battery pack as battery voltage drops is a possible explanation.



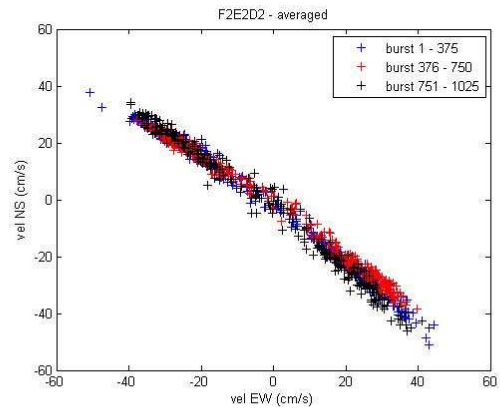


Figure 5.9: F2 velocity data; U plotted against V coloured by burst number. Each burst rotated by compass heading.

Figure 5.10: F2 velocity data; U plotted against V coloured by burst number. Each burst rotated by "averaged heading".

F4 is positioned inside the breakwater line between phase one and phase two breakwaters. Greater across-shore flows are experienced at LW than at HW (Figure 5.8). At LW tombolo 8 is dry and blocks the along-shore north-west ebb flow inside the breakwater line. Water in this location is forced across-shore and out between breakwaters 8 and 9. At HW tombolo 8 is submerged and flow is allowed inside the breakwater line in an along-shore direction.

F5 is positioned just offshore the breakwater line between breakwaters 6 and 7. Figure 5.8 shows small across-shore velocity which suggests the flow is slightly orientated (~10°) towards the shore at LW and offshore at HW. F4 and F5 (Section 3.2.1.1) are smaller frames holding a Nortek Aquadopp with internal batteries. No magnetic deviational effects are expected using this instrument setup.

5.2.3 Calibration exercise

Bed friction was found to be the more sensitive tuneable parameter. The friction coefficient, k_s (Nikuradse formula) was varied to tune the model. The friction coefficient (k_s) was varied between 0.01 and 10. Model performance statistics were calculated for each model perturbation to evaluate simulated water-level, speed, along-shore velocity and across-shore velocity.

The use of a uniform friction coefficient is only valid if the friction is constant in time and space (EDF-DER, 1998). Friction varies spatially throughout the model domain depending on grain size and bed features present. Friction also varies through time as bed features evolve, migrate, build or are wiped out altogether. Insufficient information is available to include temporally and spatially varying friction, so a single uniform friction factor is defined. The friction coefficient is then used as an overall tuning parameter to match the water-level and current velocities to those measured at the calibration positions. The friction coefficient values used in the calibration exercise extend out of the range expected if coefficients where calculated from field data. Varying the value of the fiction coefficient applied to breakwater positions is considered in Chapter 6.

Predicted and observed, speed, along-shore velocity, across-shore velocity and water-level for F1 and F4 (spring and neap) can seen in Figure 5.11 to Figure 5.14.

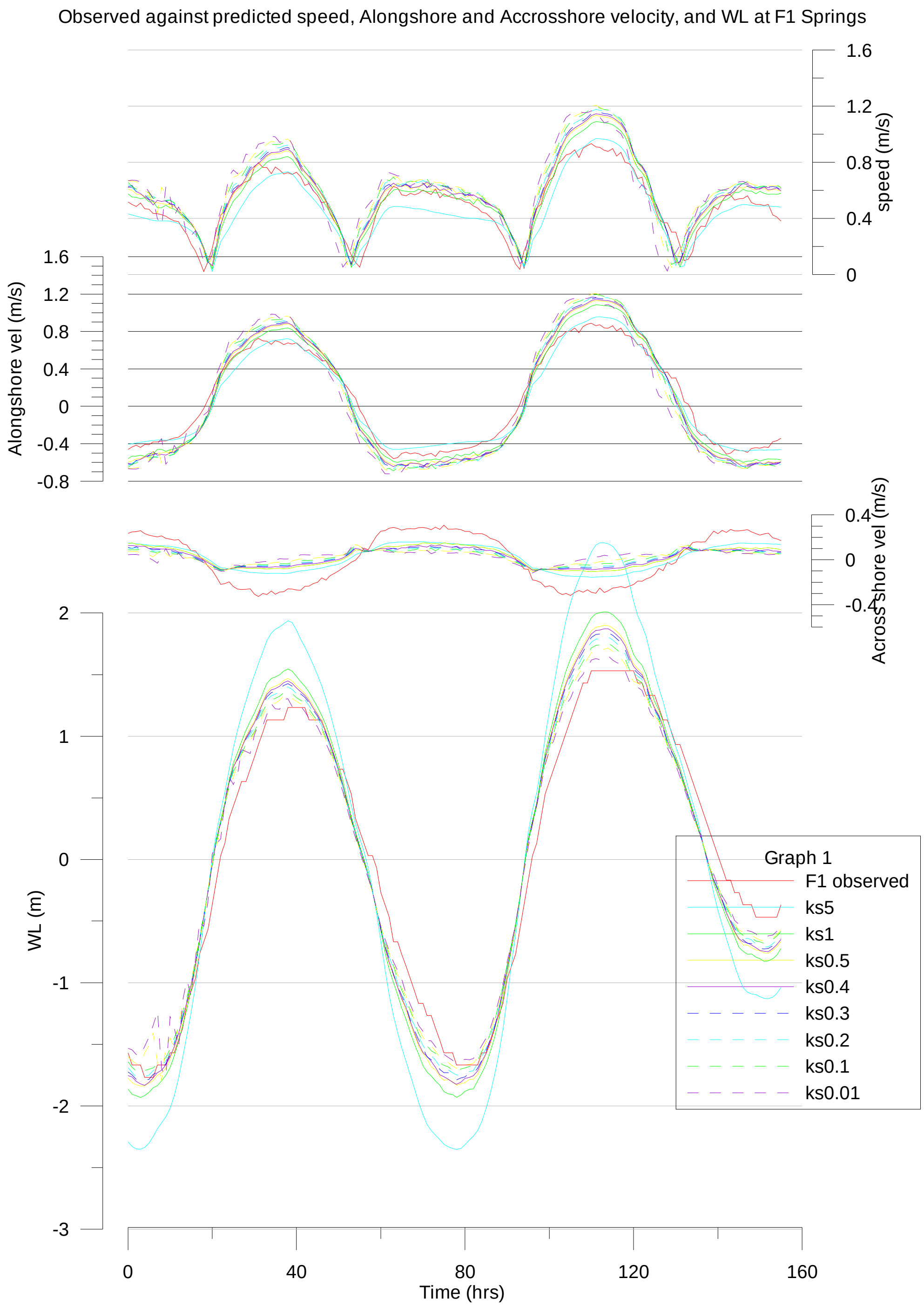


Figure 5.11: Calibration at F1 (spring). ***Observed against predicted speed, along-shore and across-shore velocity and WL at F1 springs***

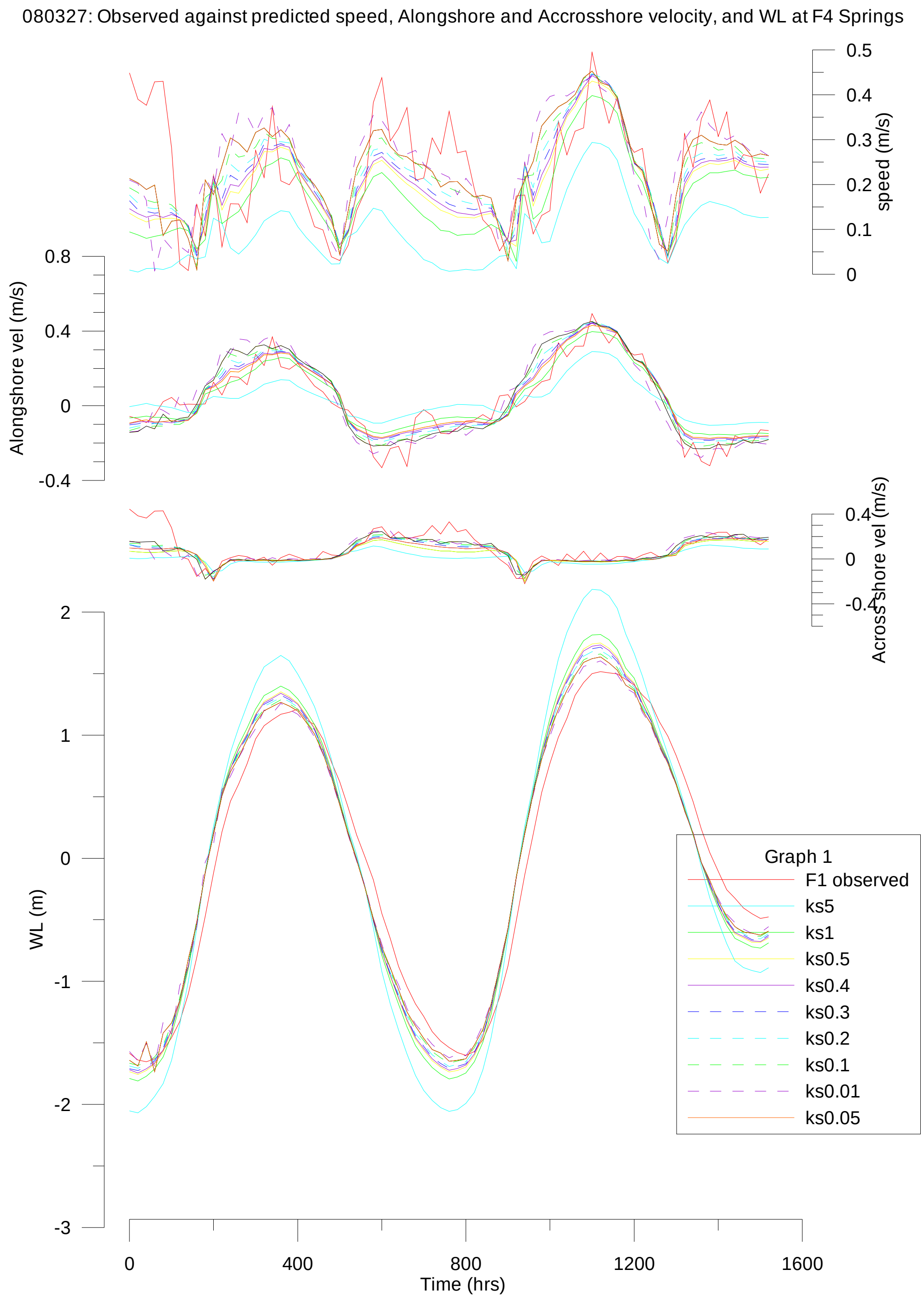


Figure 5.12: Calibration at F4 (spring). ***Observed against predicted speed, along-shore and across-shore velocity and WL at F4 springs***

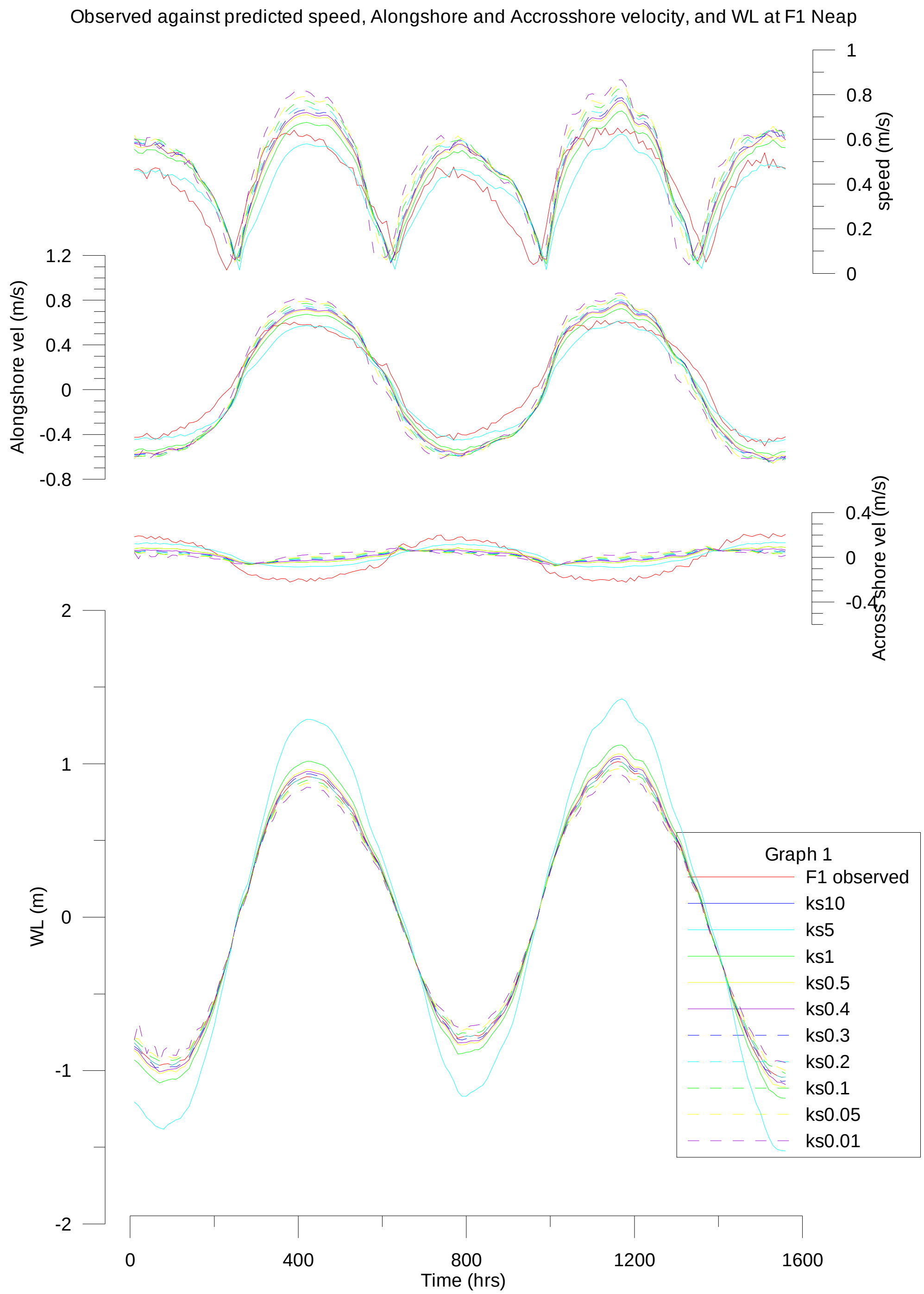


Figure 5.13: Calibration at F1 (neap). ***Observed against predicted speed, along-shore and across-shore velocity and WL at F1 neap***

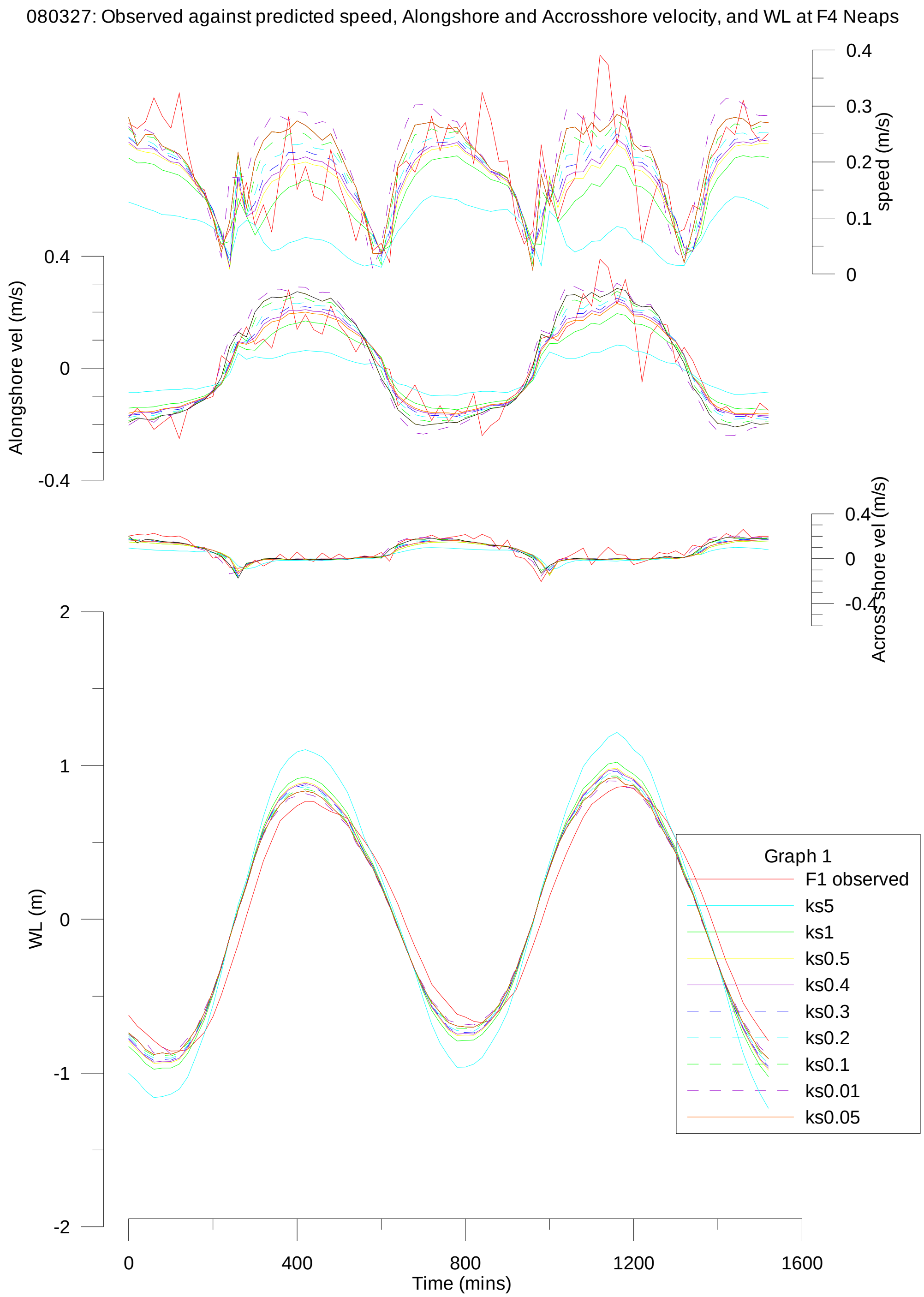


Figure 5.14: Calibration at F4 (neap). ***Observed against predicted speed, along-shore and across-shore velocity and WL at F4 neap***

Modelled water-levels fit observed data well for low values of k_s for all calibration points. Modelled speeds agree with measured data for low values of k_s at F2 (spring and neap). High values of k_s are required for the best fit of modelled to measured data at F1 (spring and neap).

Averaged model performance statistics can be used to find the “best” match. Water-level and speed were chosen as suitable variables to select the “best” friction coefficient to use. Analysis of along-shore and across-shore components of velocity enabled the flow direction to be assessed. Due to the shore-parallel nature of the local tidal climate in this area, across-shore flow is expected to be small at both calibration positions. When small flows are considered, measurement error may dominate and small deviation from the observed will result in a large error value. Table 5.2 shows the model performance statistics for all model perturbations analysed. The “best” friction coefficient was selected choosing the lowest average model performance statistics for water-level and speed at both frames and at both springs and neaps. $k_s = 0.3$ is selected as the “best” fit for these data. All individual water-level and speed RMAE scores are below 0.4. Using Sutherland’s (2004) ARMAE classification index (Table 5.1) these are all “Good” (Figure 5.15). It is also clear that $k_s = 0.3$ has the smallest range of statistics (Figure 5.15).

	k_s	5	1	0.5	0.4	0.3	0.2	0.1	0.05	0.01
spring F4	WL	0.39	0.24	0.22	0.21	0.20	0.20	0.19	0.19	0.18
	along	0.59	0.28	0.26	0.26	0.28	0.29	0.33	0.34	0.42
	across	0.73	0.56	0.55	0.55	0.54	0.54	0.55	0.56	0.53
	speed	0.55	0.26	0.23	0.23	0.23	0.24	0.26	0.28	0.32
spring F1	WL	0.54	0.28	0.23	0.22	0.21	0.20	0.18	0.18	0.17
	along	0.15	0.22	0.28	0.30	0.32	0.34	0.37	0.39	0.40
	across	0.49	0.60	0.66	0.68	0.70	0.73	0.77	0.82	0.88
	speed	0.16	0.14	0.17	0.19	0.20	0.22	0.25	0.26	0.26
neap F1	WL	0.64	0.34	0.29	0.28	0.26	0.25	0.23	0.21	0.19
	along	0.19	0.28	0.32	0.33	0.35	0.37	0.41	0.43	0.46
	across	0.50	0.67	0.74	0.76	0.78	0.81	0.85	0.89	0.95
	speed	0.19	0.21	0.24	0.25	0.27	0.28	0.31	0.33	0.35
neap F4	WL	0.43	0.27	0.24	0.23	0.22	0.22	0.21	0.20	0.19
	along	0.62	0.33	0.30	0.30	0.31	0.33	0.37	0.41	0.49
	across	0.68	0.48	0.43	0.42	0.40	0.38	0.35	0.34	0.33
	speed	0.58	0.30	0.25	0.24	0.24	0.24	0.26	0.28	0.32
mean	all	0.46	0.34	0.34	0.34	0.35	0.35	0.37	0.38	0.40
	WL	0.50	0.28	0.24	0.24	0.23	0.21	0.20	0.19	0.18
	speed	0.37	0.23	0.22	0.23	0.24	0.25	0.27	0.29	0.31
	along & across	0.49	0.43	0.44	0.45	0.46	0.48	0.50	0.52	0.56
	speed & WL	0.43	0.25	0.23	0.23	0.23	0.23	0.23	0.24	0.25

Table 5.2: Model performance statistics for all model perturbations analysed during model calibration.

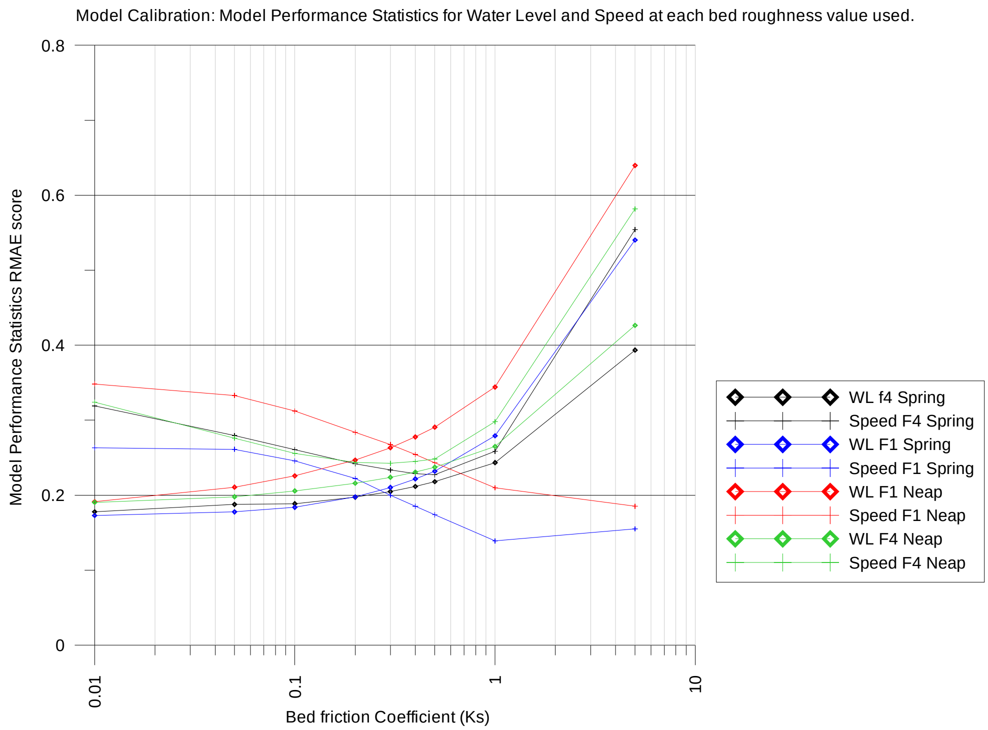


Figure 5.15: RMAE score at calibration stations during spring and neap conditions for water-level and current magnitude. Bed roughness (k_s) values investigated plotted on a log scale. k_s = 0.3 stands out as having the smallest range of statistics.

5.3 Model validation

Model validation was undertaken using data from F2 and F5 to test that the 'tuned' model represents the physical processes adequately at independent sampling locations within the area of interest.

5.3.1 Validation data

The single ADV (Section 8.5.1.2) on F2 gives current measurements at a single point at a distance of 0.62 m from the bed. The ABS (Section 8.5.1.1) was used to detect range to the bed (Figure 5.16) and along with known vertical differences between the ABS and ADV, distance from the sensor and bed could be established.

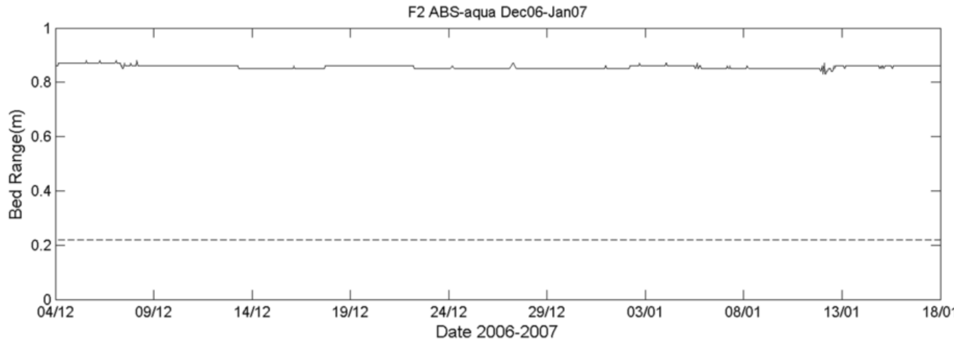


Figure 5.16: Range to bed from ABS on LEACOAST2 F2 during experiment 2.2. Dashed line is location of ADV (below the ABS sensor). The elevation of the ADV is given by the distance between the dashed and solid lines (from Wolf et al., 2008).

By assuming a log profile (Equation 5.4), and using a quadratic friction law (Equation 5.5), velocities at any depth can be corrected for depth-average current. The use of a log profile to estimate velocities at other elevations assumes steady flow, with no acceleration, and constant roughness. Equation 5.8 (derived through Equation 5.4 to Equation 5.7) is used with measurements from the single ADV on F2 to calculate velocities at 40 % of the water-depth, which is shown to be broadly representative of depth-average current (Section 3.1.1.1). Actual bed stresses are difficult to measure and in this case the Sternberg drag coefficient 0.0025 is used. Section 8.5.3 looks at the effect of estimating a drag coefficient and a comparison is made to estimates at F1 where data from more than one ADV exist.

Equation 5.4

$$U(z) = \frac{u_*}{\kappa}\ln\left(\frac{z}{z_0}\right)$$

Equation 5.5

$$\tau_0 = \rho . C_D . u_m{}^2$$

Equation 5.6

$$u_* = \sqrt{\frac{\tau_0}{\rho}}$$

Equation 5.7

$$u_* = u_m\sqrt{C_D}$$

Equation 5.8

$$U(z) = \frac{u_m \sqrt{C_D}}{\kappa} \log_e \left(\frac{z}{z_0} \right)$$ where,

U = velocity, u_* = friction velocity, κ = von Karman constant = 0.4, z = range from bed, z_0 = roughness length = 0.000188, τ_0 = shear stress, ρ = density of the fluid, C_D = drag coefficient = 0.0025.

Figure 5.17 and Figure 5.19 shows modelled and measured water-level, along-shore velocity, across-shore velocity and speed at F2 during spring and neap tides.

The model performs well (speed and water-level) at F2 with a RMAE score of “excellent” (Table 5.3) at spring tides. Model performance statistics are “good” for speeds during neap tides and “excellent” for water-level. Similarly to the calibration exercise, the generally stronger along-shore currents are also well modelled (good), while the weaker cross-shore currents are ‘badly’ modelled.

	WL	along-shore	Across-shore	speed
F2 neap	0.18	0.26	0.84	0.24
F2 spring	0.19	0.20	1.11	0.18
F5 neap	0.24	0.32	0.73	0.30
F5 spring	0.23	0.27	0.90	0.25

Table 5.3: Model Performance Statistics for validation

Validation at F5 during spring and neap tides (Figure 5.18 and Figure 5.20) gave “good” model performance statistical results for speed and water-level (Table 5.3). The model slightly over predicts current magnitudes on the flood and ebb during spring tides.

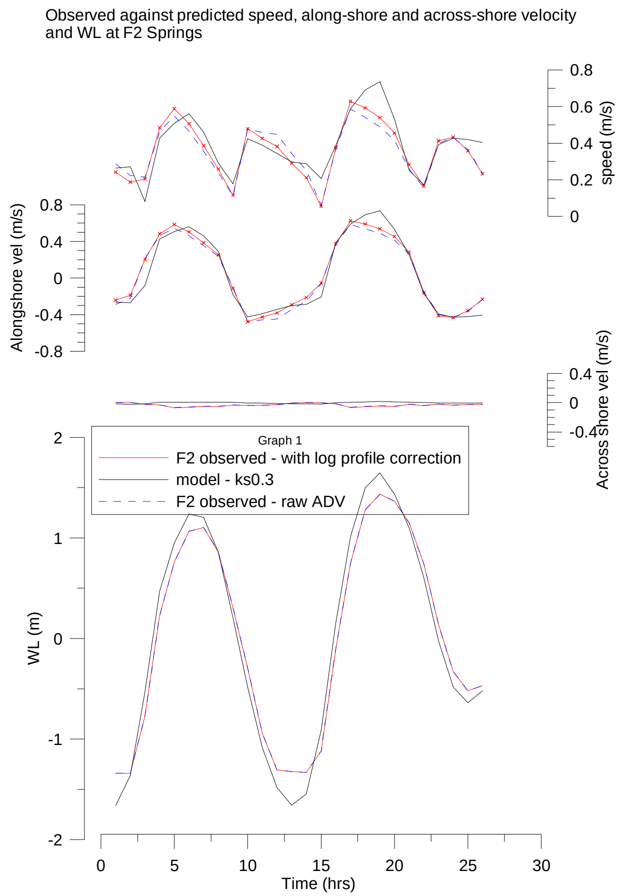


Figure 5.17: Model validation at F2 during spring tides

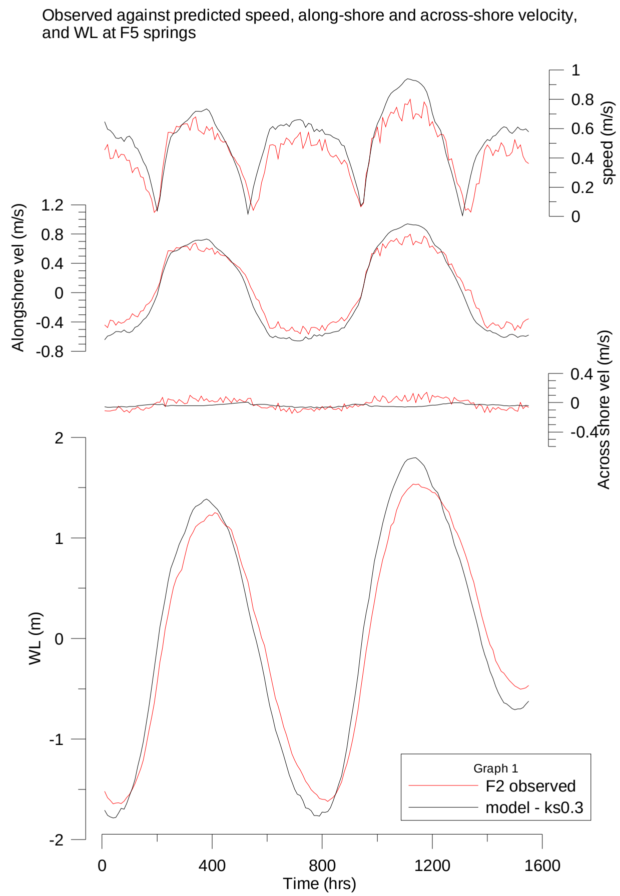


Figure 5.18: Model validation at F5 during spring tides

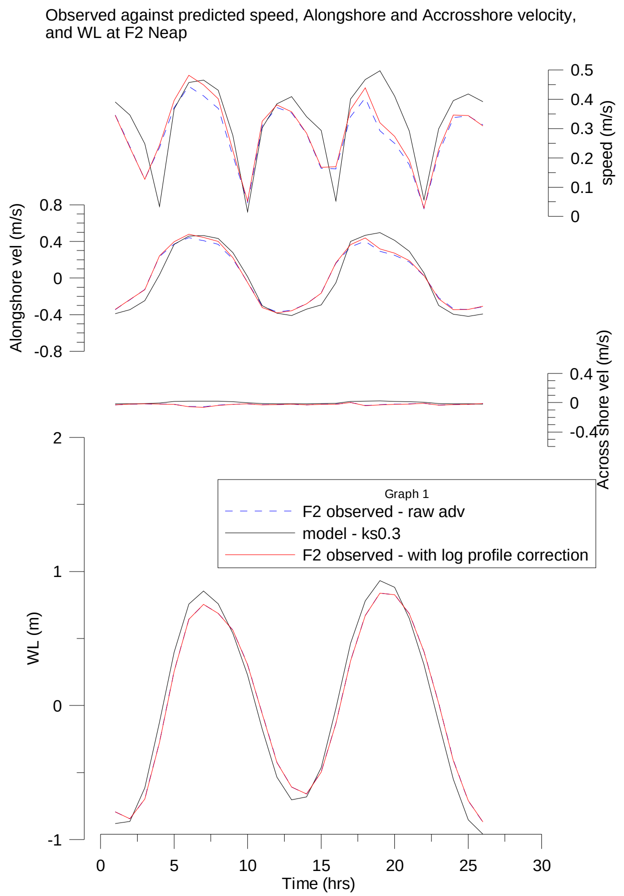


Figure 5.19: Model validation at F2 during neap tides.

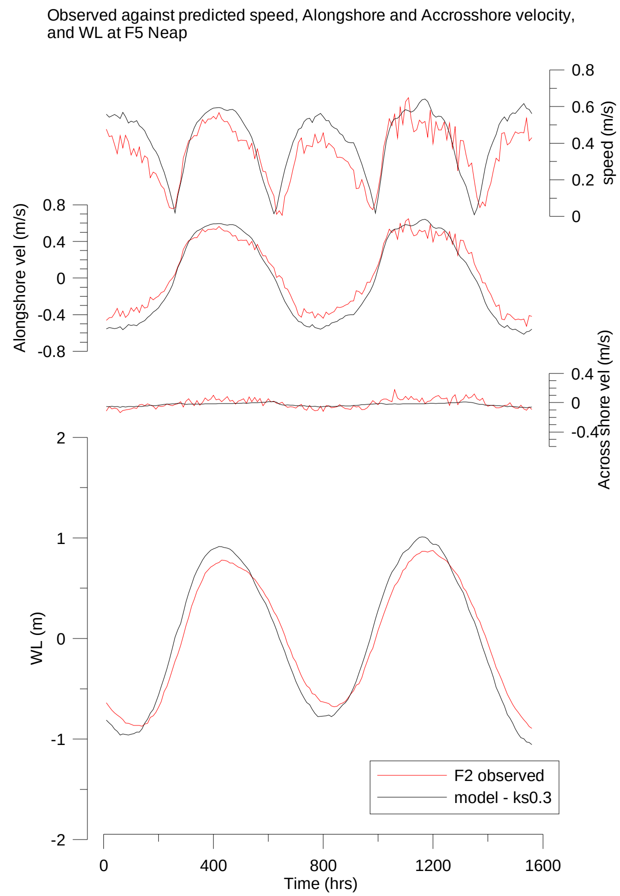


Figure 5.20: Model validation at F5 during neap tides

Observed data have been compared to model results at nodes nearest the position of the frame. Frame positions were recorded using a handheld GPS on board the deployment vessel. This gives a good estimate of the frame location but exact position of the frame could have as far as ~15 m from this GPS position. Figure 5.21 and Figure 5.22 show the variation in current magnitude experienced within a radius of 15 m from the GPS positions of F2 and F5 respectively (spring). It is clear that there is little variation in current speeds around F2 but there is significant variation around F5. This may explain the observed difference between modelled and observed current magnitudes at F5 during spring tides. Figure 5.23 shows the variation observed during neap tides. Lower flow results in a slight reduction of variation.

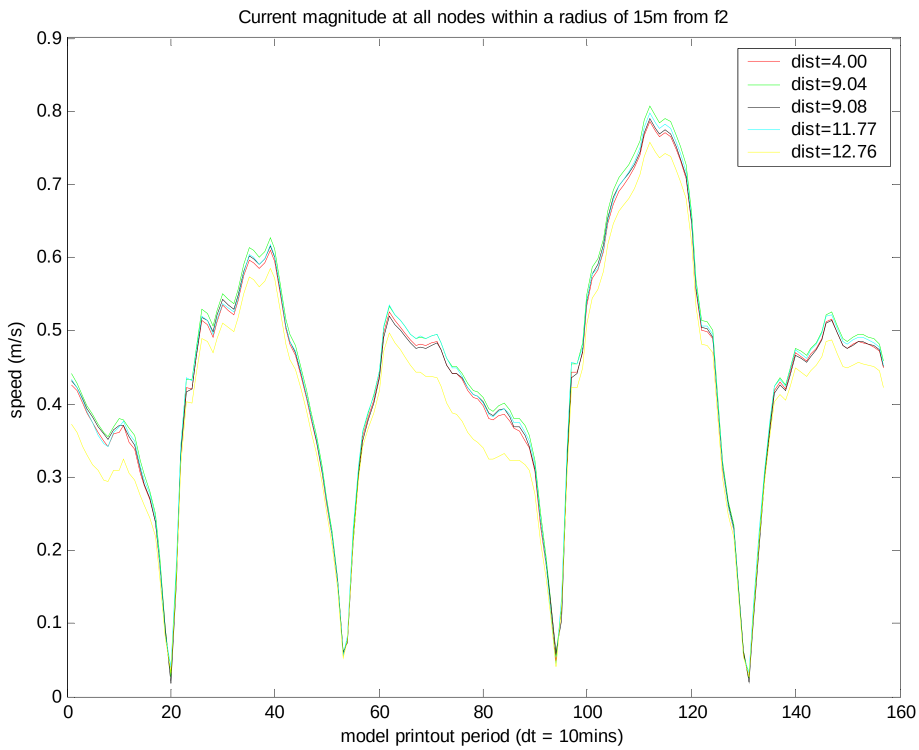


Figure 5.21: Variation of modelled current magnitude around the position of F2 during spring tides. Different lines represent distance in metres from F2.

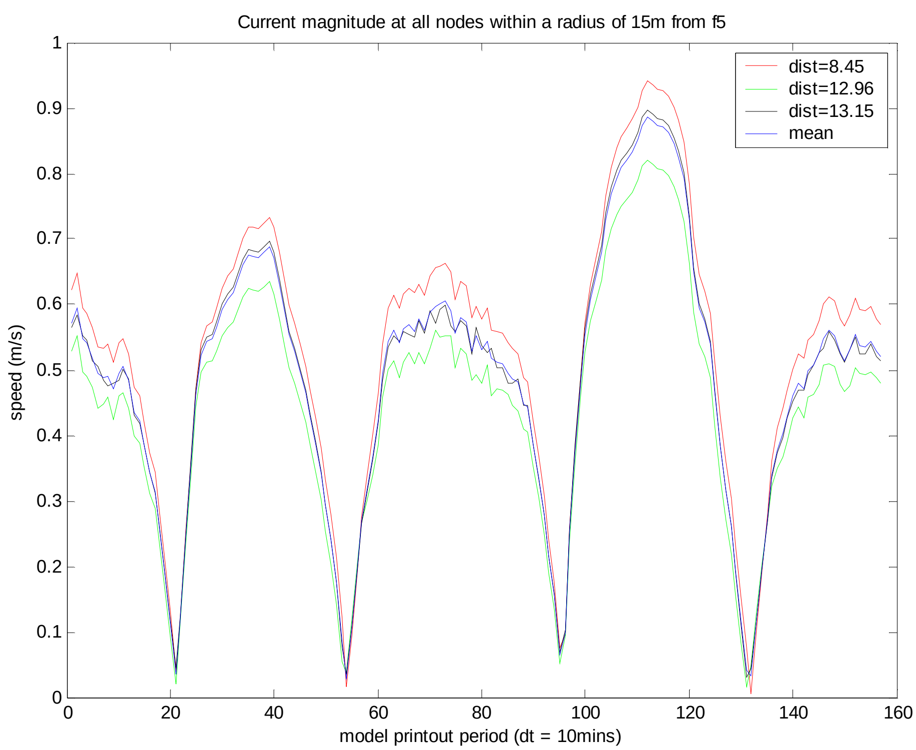


Figure 5.22: Variation of modelled current magnitude around the position of F5 during spring tides. Different lines represent distance in metres from F5.

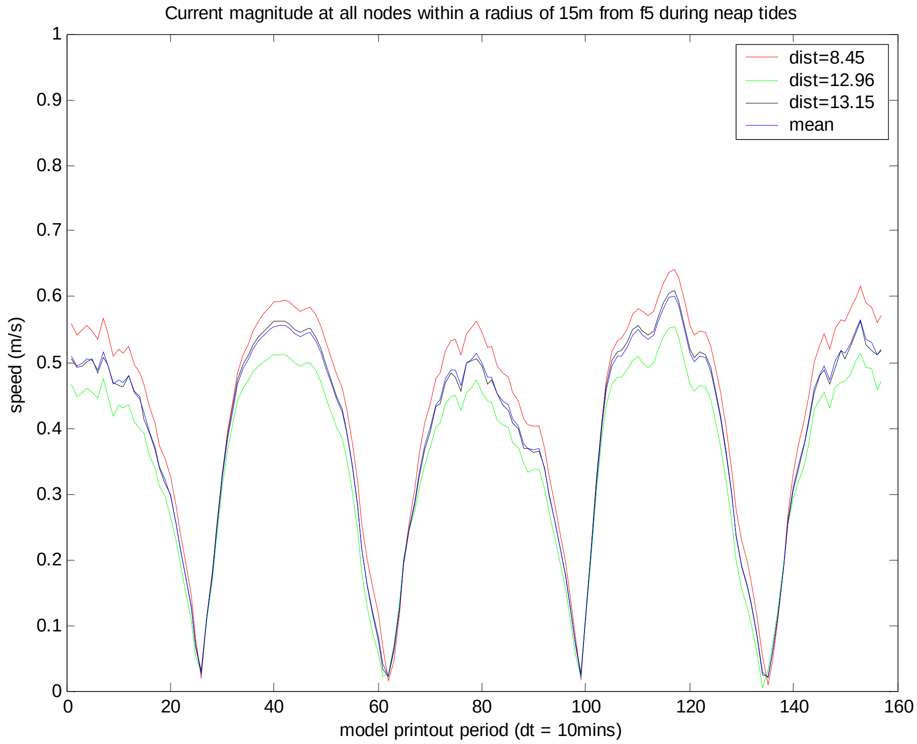


Figure 5.23: Variation of modelled current magnitude around the position of F5 during neap tides. Different lines represent distance in metres from F5.

5.4 Conclusions

TELEMAC2D has been tuned and evaluated at four measurement stations within the model domain. Field measurements during periods of spring and neap tides during "low-waves" were used to evaluate the model simulations. An "excellent" or "good" fit to observed data was found, although, there were still small discrepancies. Current magnitudes were found to be over-estimated by about 10% although this varied between the different measurement stations. Efforts were made to reduce model current magnitudes overall, but problems of current under-prediction were encountered, particularly on the ebb phase of the tide within the breakwater system. Results suggest that modelled currents within the breakwater system are acceptable, as the largest differences between modelled and measured velocities were found only at F1. Comparison of modelled data with float tracking experiments within the area behind breakwaters can be used to confirm this.

Potential problems with simulating the across-shore component of velocity have been identified; model performance statistics highlighted "bad" results. There are several factors which may have influenced this. These include the differences between the recorded and actual frame positions, changes in the bathymetry between the survey and the measurement times and inaccuracies in instrument compasses. It is likely that all of the larger frames experienced some magnetic deviation caused by other instruments or battery packs located nearby on the frame, which has made comparison of across-shore velocities difficult. Although the across-shore component of currents is generally much smaller than the along-shore component, it has implications for sediment exchange in or out of the breakwater system. Chapter 6 considers float tracking as a method to confirm the general patterns of currents within the breakwaters are correct, and assess the degree of confidence that can be applied to model performance overall.

Increased bed roughness associated with the rubble mound breakwaters may also have significant implications for how across-shore currents are modelled. The effect of including increased bed roughness over the breakwaters in the model is investigated in the next chapter (Chapter 6).

6 Breakwater roughness

6.1 Modelled and measured flow disturbance around breakwater 5

6.1.1 Observed differences

6.1.1.1 Transects

A Nortek Aquadopp was mounted to a small boat looking downwards, to measure current velocities over pre-defined transects around breakwater 5 (Section 3.3.3). Transects were designed to measure any flow deflection caused by the presence of breakwater 5 and the tombolo in its lee. Measurements were made over transects that ran alongside (seaward side) breakwater 5 toward the north-west, and returned crossing the expected region of flow difference six times before starting again at the south-east end of breakwater 5 (Figure 6.1). These measurements were repeated over a period leading up to, during, and after peak velocity at high water.

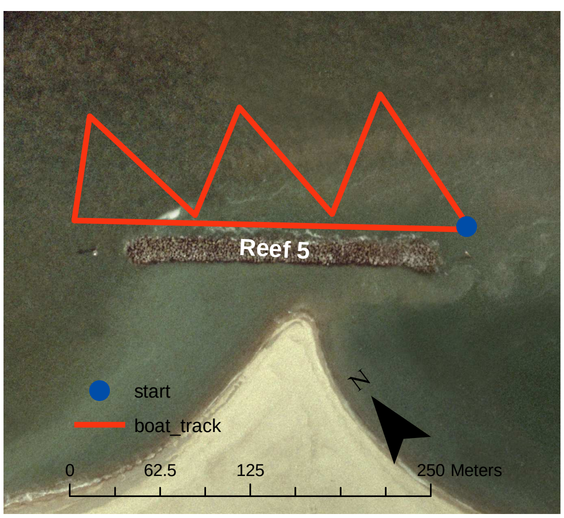


Figure 6.1: Aquadopp transects seaward of breakwater 5 (Aerial photo from Environment Agency, pers. comm.).

6.1.1.2 Aquadopp experiment results

Results from the downward looking Aquadopp experiment (Section 3.3.3) around breakwater 5 show significant flow disturbance caused by its presence (Figure 6.2). Figure 6.3 represents the corresponding modelled velocities for the same time period. These figures show vector arrows representing speed and direction of flow, colours represent velocity magnitude.

It is clear that the flow model does not reproduce the flow deflection associated with the presence of breakwater 5 to the same extent as that measured.

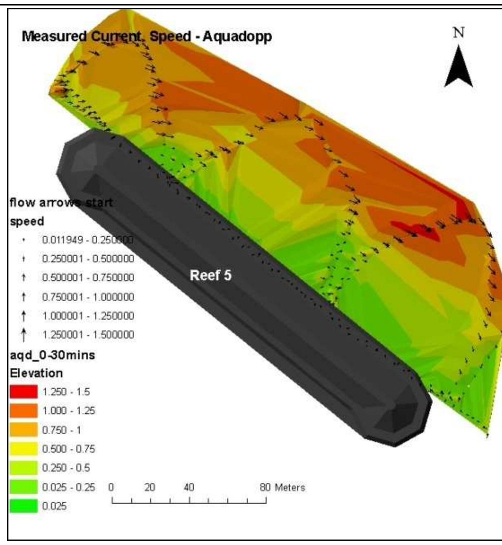


Figure 6.2 - Measured current speed around breakwater 5 (Peak flood tide). Velocity magnitude indicated by colour.

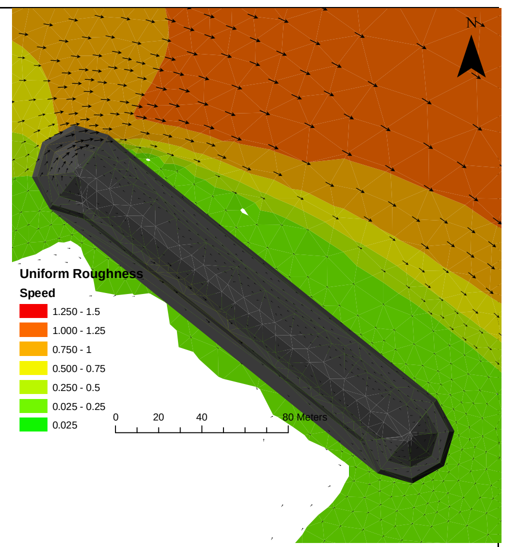


Figure 6.3 - Modelled current speed around breakwater 5 (Peak flood tide). Velocity magnitude indicated by colour.

6.1.2 Uniform bed roughness throughout model domain including breakwaters

Bed roughness has been defined as uniform in time and space throughout the entire domain. Bed features are known to vary between smooth sand, ripples, and sandwaves (Bacon pers. comm.). The domain also includes the nine rubble mound breakwaters which cause significantly enhanced frictional effects. It is clear therefore that bed roughness is not uniform in time or space in reality. The distribution of bed roughness is unknown over the model domain, and will vary as bed-forms change and evolve. It is for this reason that bed roughness has been used as a 'tuning factor' during model calibration rather than calculating a suitable value using sediment grain size and formulae in the literature.

During model calibration and validation a bed roughness of $k_s = 0.3$ was identified as a value that tuned the model to give a good fit to four independent measured Eulerian data sets. It is the overall "best" approximation to enable the model to successfully simulate flow around the breakwaters.

It is clear from Figure 6.3 and Figure 6.2 that model simulations are under representing the flow separation in the vicinity of breakwater 5. The flow regime in these areas is influenced by increased roughness over the large rock mound breakwaters. Roughness over breakwaters does not vary temporally so an increased roughness in these areas could be included in the simulation. The flow regime around breakwater positions is complex and some investigation needs to be undertaken to establish whether the model can compute improved simulations in these regions.

6.1.3 Turbulence and constant viscosity

6.1.3.1 Previous turbulence model

Model sensitivity tests at the six locations investigated revealed little sensitivity to different turbulence models (Section 5.1.2). Constant turbulence viscosity was therefore used with the default value for the constant viscosity coefficient. The way turbulence is simulated in the model could account for the differences highlighted between the Lagrangian measured data and model output. This is investigated to establish whether changing the diffusivity could alter the model's ability to show flow separation. As discussed in Section 5.1.2 the value of the constant viscosity coefficient used has an effect on the extent and shape of recirculation (EDF-DER, 2002b).

6.1.3.2 Effect of varying the constant viscosity coefficient

The value of the constant viscosity coefficient used was varied between 0.000001 and 0.5 (0.000001, 0.0001, 0.01, 0.1 and 0.5). Results were reassessed against the measured Lagrangian data around breakwater 5.

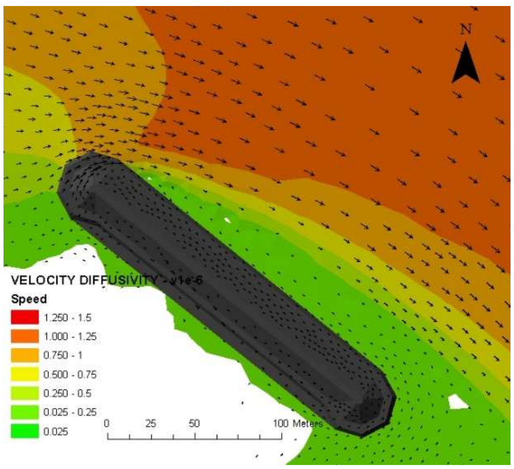


Figure 6.4: Modelled velocity around breakwater 5 during peak flood flow. Viscosity coefficient = 1e-6. (uniform bed roughness)

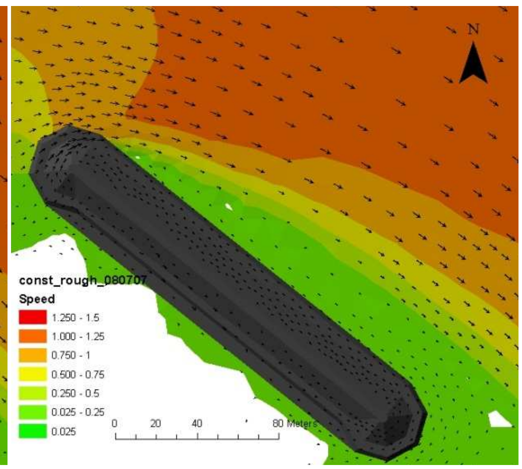


Figure 6.5: Modelled velocity around breakwater 5 during peak flood flow. Viscosity coefficient = 1e-4. (uniform bed roughness)

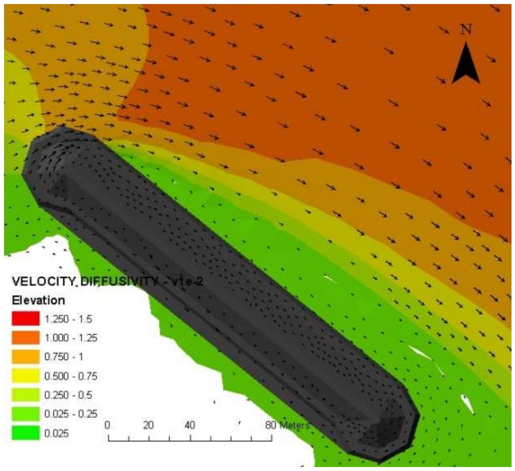


Figure 6.6: Modelled velocity around breakwater 5 during peak flood flow. Viscosity coefficient = 1e-2. (uniform bed roughness)

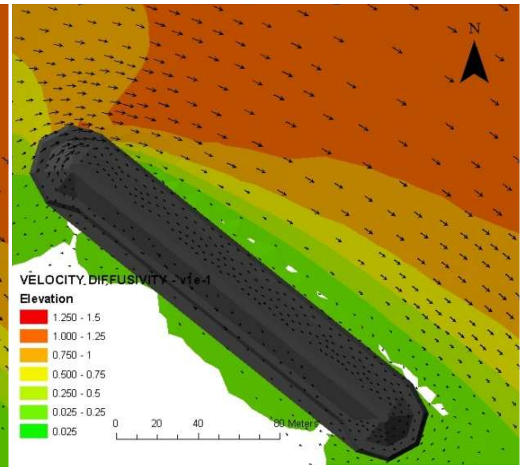


Figure 6.7: Modelled velocity around breakwater 5 during peak flood flow. Viscosity coefficient = 1e-1. (uniform bed roughness)

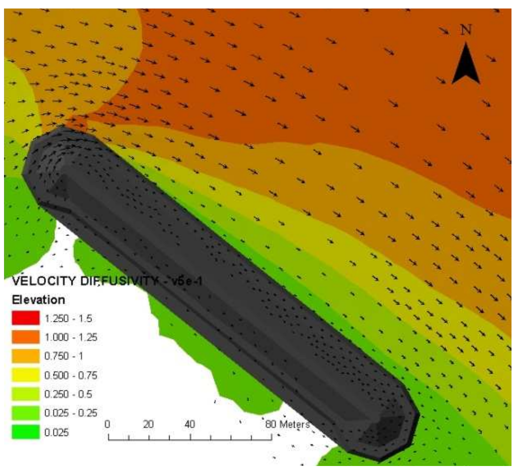


Figure 6.8: Modelled velocity around breakwater 5 during peak flood flow. Viscosity coefficient = 5e-1. (uniform bed roughness)

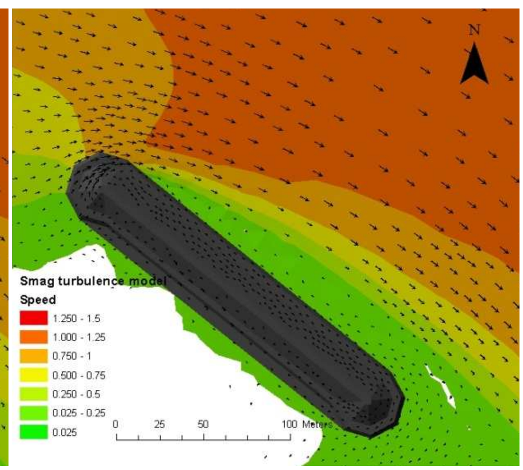


Figure 6.9: Modelled velocity around breakwater 5 during peak flood flow. Smagorinski turbulence model. (uniform bed roughness)

Figure 6.4 to Figure 6.8 show the modelled velocity field around breakwater 5. Little variation can be seen in these figures when the viscosity coefficient is varied. Figure 6.9 displays the velocity field around breakwater 5 when the Smagorinski turbulence model is used. This is included to show that little variation is experienced even if a turbulence model is used. The Smagorinski model was included in this example as it is “generally used in maritime domains with large scale eddy phenomena” (EDF-DER, 1998).

Three profiles approximately normal to the flow have been used to compare modelled data with the relatively sparse and interpolated measured current vector patterns. Using ArcGIS, current magnitude profiles at HW (peak flood flow) were extracted from the modelled and measured (downward looking Aquadopp) data. Figure 6.10 displays the position of the three profiles which originate at the breakwater and extend offshore.

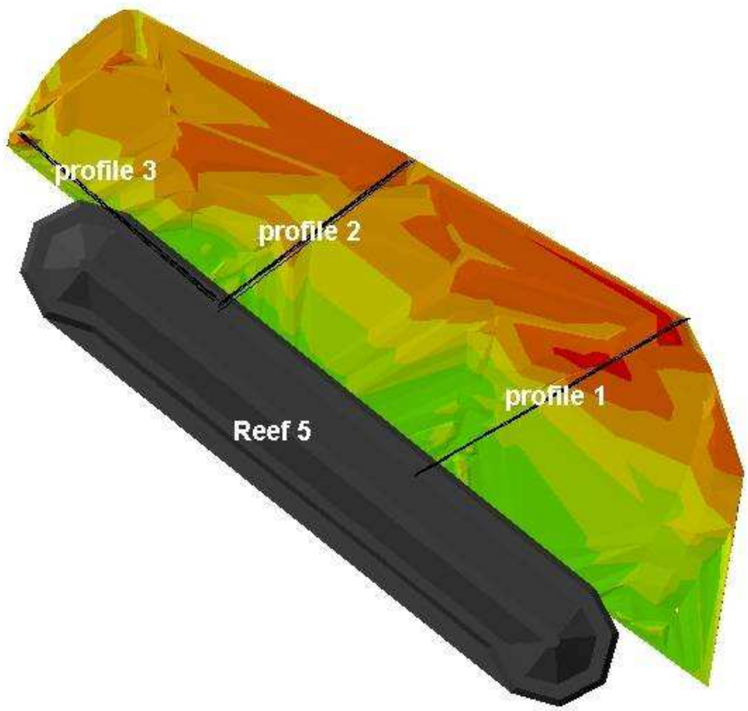


Figure 6.10: Profile positions used when comparing measured and modelled current magnitudes around breakwater 5.

Profiles of current magnitude for all values of the constant viscosity coefficient investigated are plotted in Figure 6.11. This figure demonstrates that changing the value of the viscosity, does not significantly improve the ability of the model to simulate the flow separation in this area.

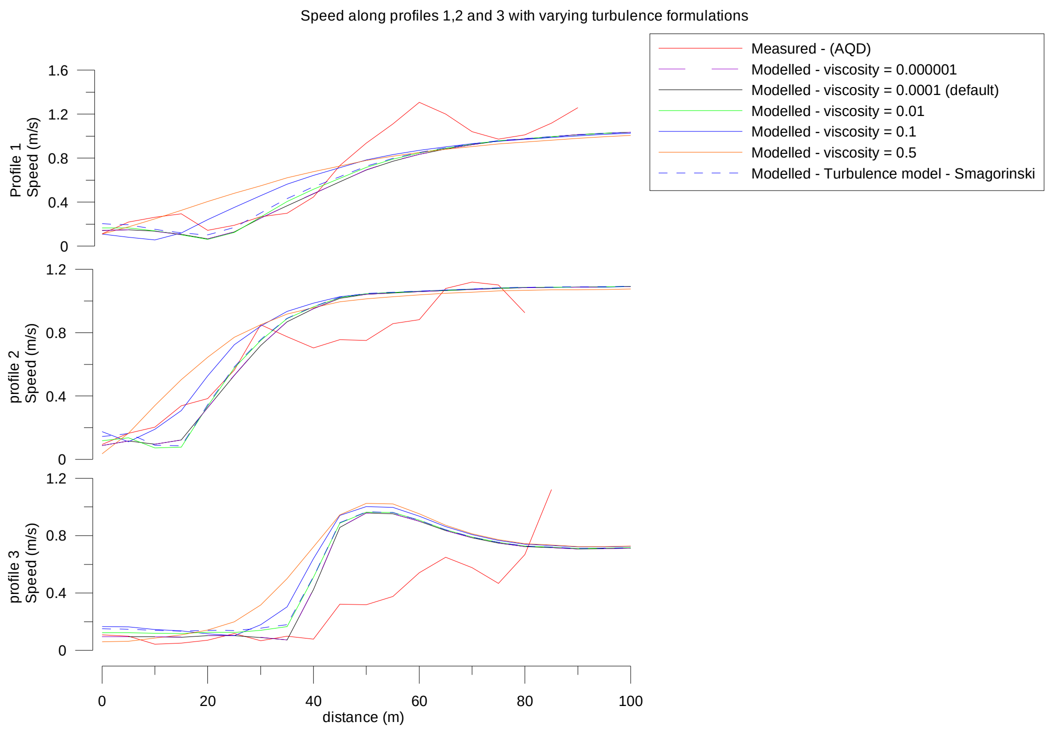


Figure 6.11: Current magnitude profiles extending offshore for measured data and model simulations using different turbulence formulations. Viscosity refers to the constant viscosity coefficient used.

6.1.3.3 Turbulence model discussion and recommendations

Only limited variation in the current speeds across the three profiles occur when the viscosity coefficient is varied between 1 x 10^{-6} and 0.5; higher values tend to smooth out the velocity gradients and increase the current speed close to the breakwater. TELEMAC2D has shown little sensitivity to the method of representing turbulence used both in time and now in space. It is concluded that varying the constant viscosity coefficient is not a suitable parameter to enable the improvement of model results around the breakwaters. The default constant viscosity coefficient (1 x 10^{-4}) is therefore used.

6.2 Effect of increasing bed roughness over breakwaters

The subroutine STRCHE enables the user to define spatially-varying bed roughness over the domain (EDF-DER, 1998). This subroutine was programmed to enable nodes associated to breakwaters to be given an alternative value of bed roughness.

6.2.1 Broad range initially investigated

The model was initially calibrated and verified using a Nikuradse roughness factor of k_s = 0.3 which was uniform over the whole domain including the breakwaters (Section 5.2.3). A broad range of bed roughness was applied to breakwater locations in model simulations (k_s = 3000, 300, 50, 30 and 3). Current magnitude profiles for each simulation are plotted in Figure 6.12.

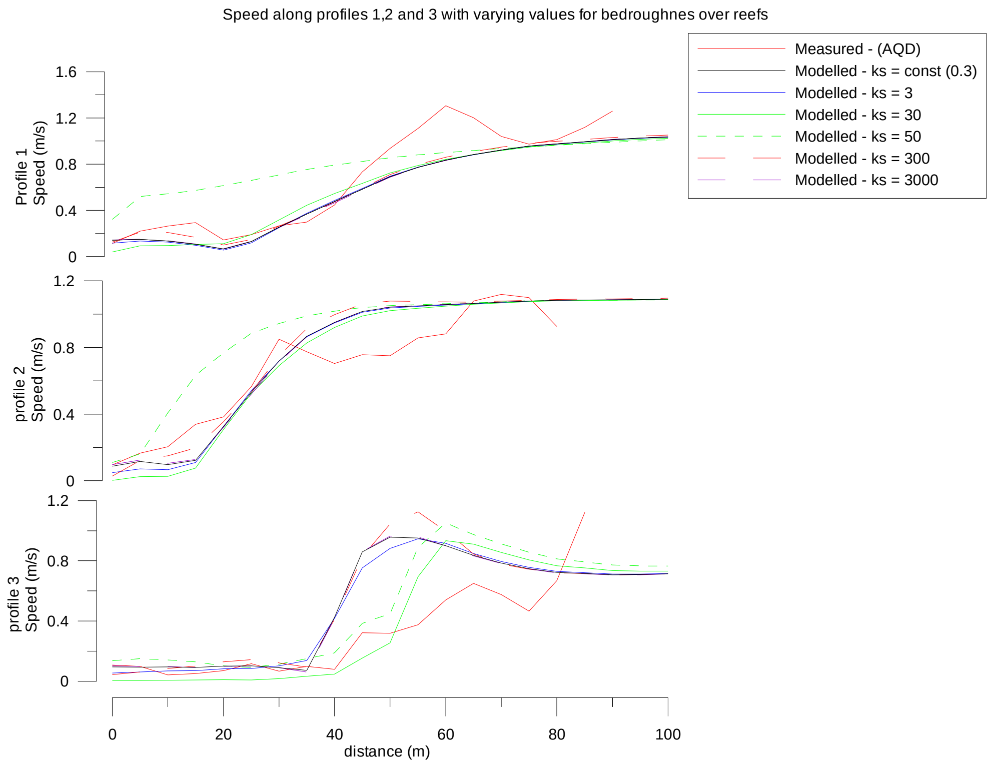


Figure 6.12: Current magnitude profiles extending offshore for measured data and model simulations using different values for bed roughness over breakwaters.

Figure 6.12 highlights a wide variation in current magnitude along all profiles when the roughness of the breakwaters is varied. Speeds are largest in profiles 1 and 2 when bed roughness over the breakwaters is given k_s = 50. Model simulations fit the measured data better when breakwaters are given a bed roughness of k_s = 30.

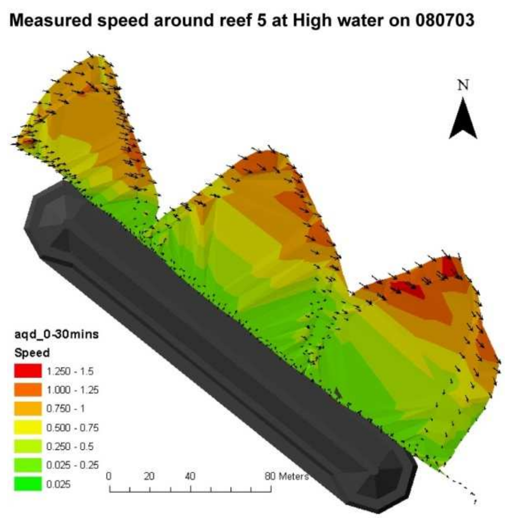


Figure 6.13: Measured velocity around breakwater 5 during peak flood flow

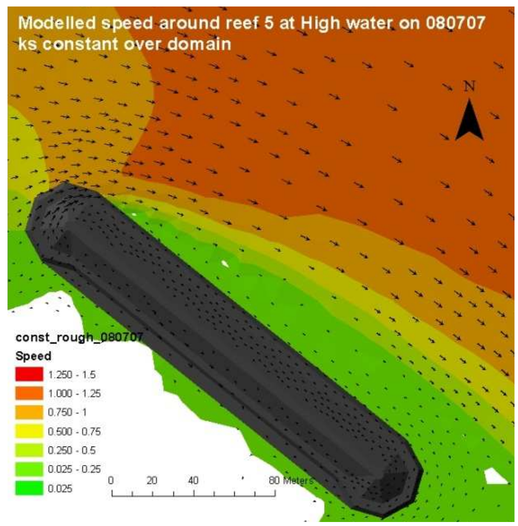


Figure 6.14: Modelled velocity around breakwater 5 during peak flood flow (uniform bed roughness over the domain k_s = 0.3)

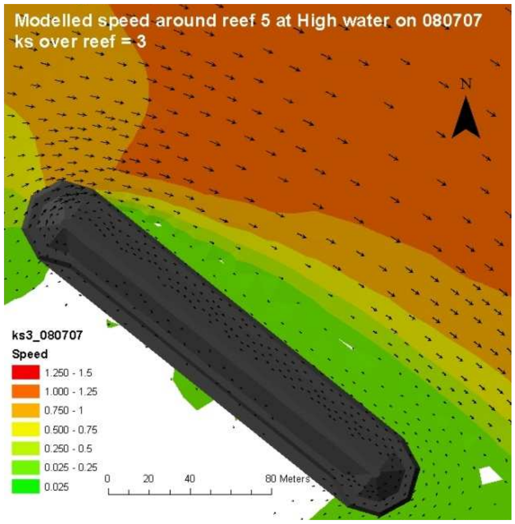


Figure 6.15: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 3)

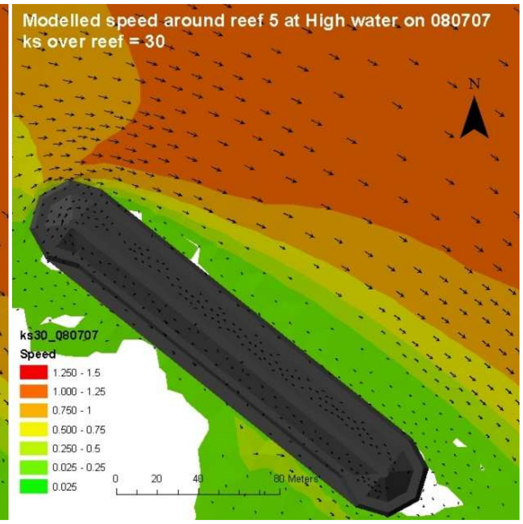


Figure 6.16: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 30)

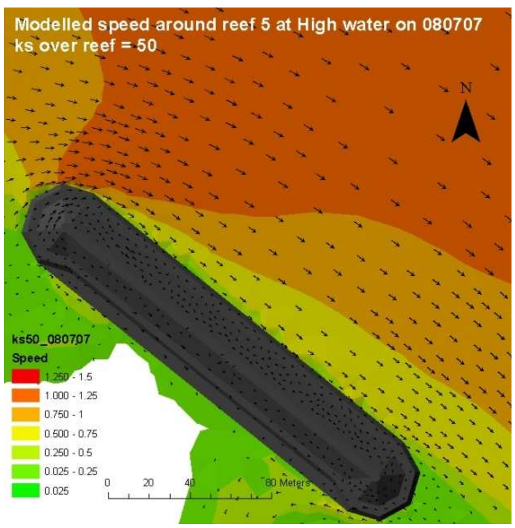


Figure 6.17: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 50)

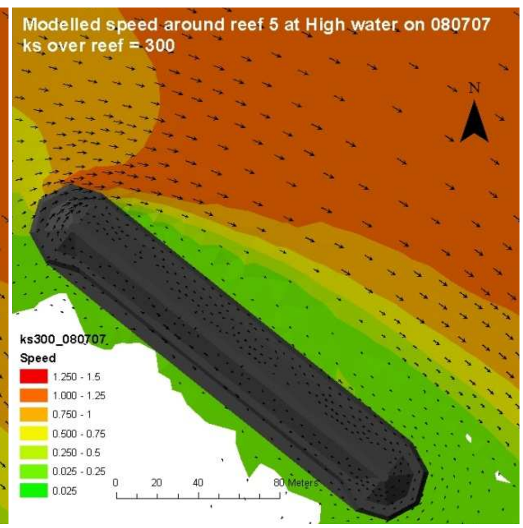


Figure 6.18: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 300)

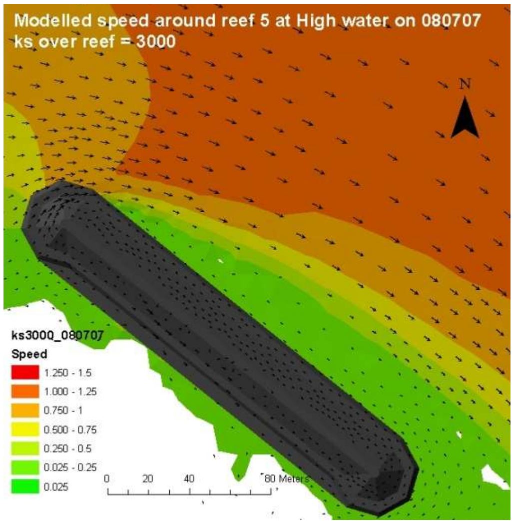


Figure 6.19: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 3000)

Figure 6.13 displays the measured velocity field around breakwater 5 during spring peak flood flow. Figure 6.14 to Figure 6.19 display modelled current magnitude for each of the simulations considered.

6.2.2 Closing in on suitable value

Model simulations were repeated with breakwater roughness defined at values around 30 in an attempt to close in on the most suitable value to use. Figure 6.20 shows the profiles created for each of the simulations considered (k_s = 10, 20, 25, 35, 40 and 50).

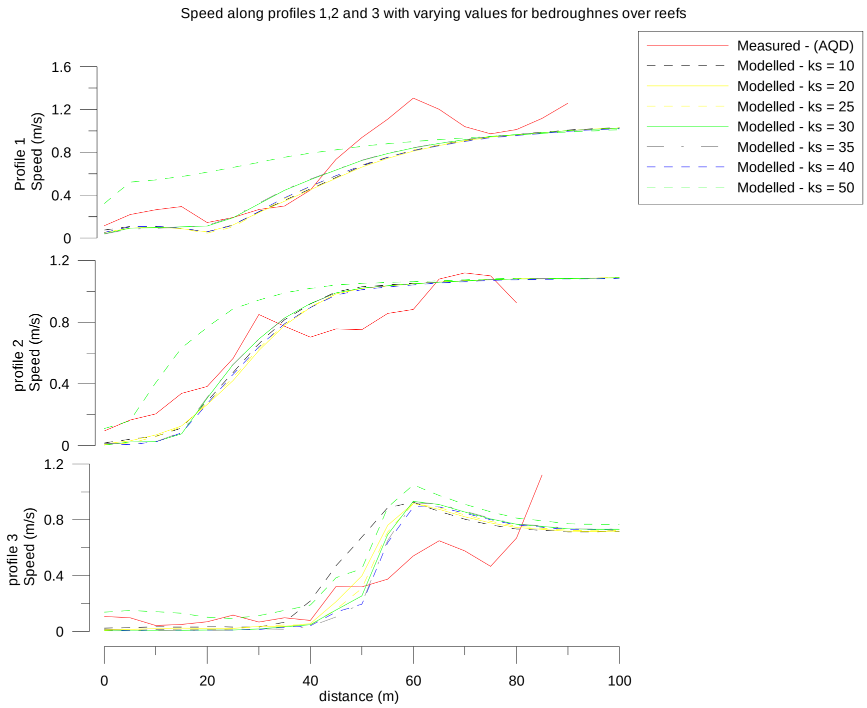


Figure 6.20: Velocity profiles extending offshore for measured data and model simulations using bed roughness over breakwaters of k_s = 10 – 50.

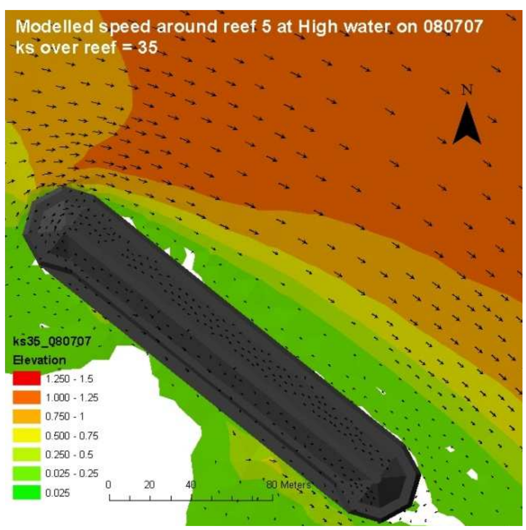


Figure 6.21: Modelled velocity around breakwater 5 during peak flood flow (bed roughness over breakwaters k_s = 35).

A better fit to observed data was found when using k_s = 30 and 35. After visually evaluating the effect of using k_s = 30 (Figure 6.16) and k_s = 35 (Figure 6.21), a bed roughness over the breakwaters of k_s = 30 was accepted as the most appropriate value.

6.3 Validation over model domain

It has been established that using k_s = 30 as an estimate of bed roughness over nodes associated to breakwater positions gives the best results when compared to observed data around breakwater 5. It is important to confirm that model performance is not impaired over the rest of the domain.

6.3.1 Model validation at previous calibration points

The model evaluation was repeated over all previous calibration and validation points (F1, F2, F4 and F5).

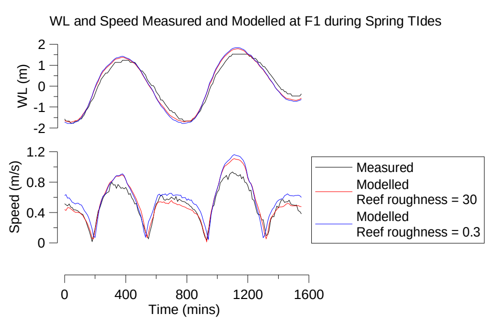


Figure 6.22: Model evaluation at F1 during spring tides.

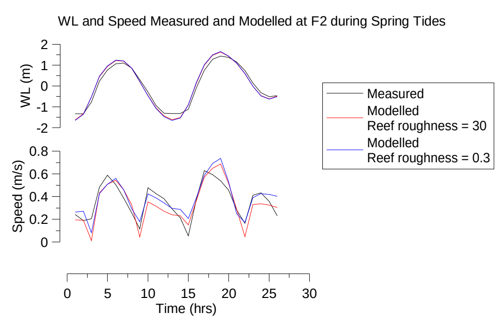


Figure 6.23: Model evaluation at F2 during spring tides.

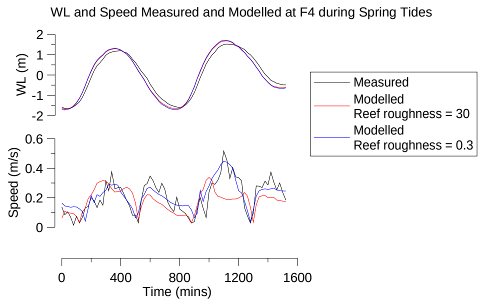


Figure 6.24: Model evaluation at F4 during spring tides.

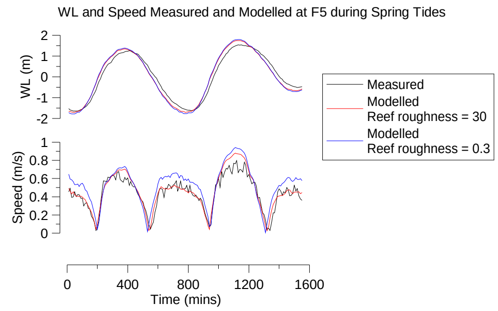


Figure 6.25: Model evaluation at F5 during spring tides.

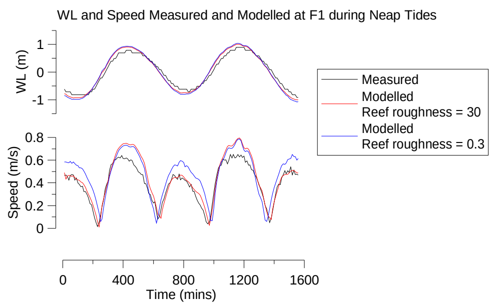


Figure 6.26: Model evaluation at F1 during neap tides.

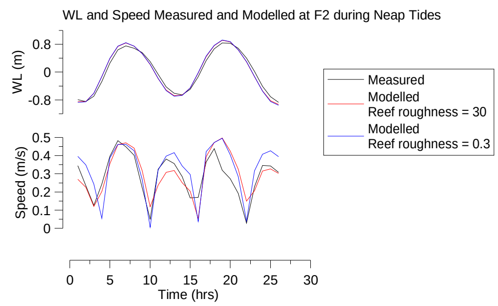


Figure 6.27: Model evaluation at F2 during neap tides.

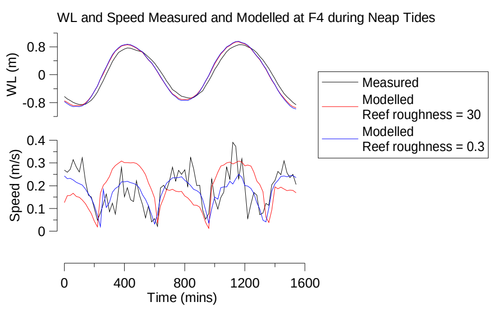


Figure 6.28: Model evaluation at F4 during neap tides.

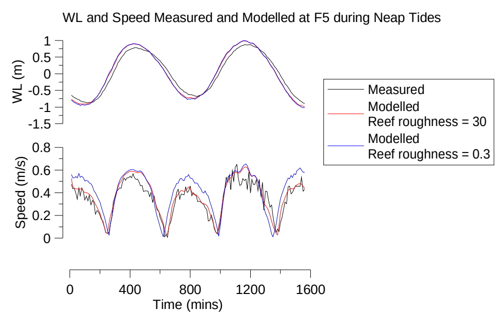


Figure 6.29: Model evaluation at F5 during neap tides.

Applying a bed roughness of k_s = 30 over nodes associated to breakwater positions has little effect on the rest of the model domain evaluated (Figure 6.22 to Figure 6.29). Water-levels and current magnitudes at the four measurement stations are plotted in Figure 6.22 to Figure 6.29. Model results from the original evaluation exercise with a uniform bed roughness of k_s = 0.3 (Chapter 5) are included with measured and the modelled results (k_s = 30). An improvement in modelled velocity is seen at F5 during both spring (Figure 6.25) and neap (Figure 6.29) tides and at F1 during neap tides (Figure 6.26). At F1 spring (Figure 6.22), F2 spring (Figure 6.23) and neap (Figure 6.27) modelled results fit measured data as acceptably as when the bed roughness was uniform. However, modelled velocities are significantly lower than both the measured and the original modelled velocities during peak flood flow at F4 during spring (Figure 6.24) tides.

Model performance statistics were used to assess the overall performance during spring tides (k_s = 30 over the breakwaters) (Table 6.1). Modelled water-levels are shown to have an improved fit to measurements at all four positions. Modelled speeds are improved at F1 and F5, but the converse is true at F2 and F4. Overall there is a slight decrease in performance of modelled speeds and an increase in performance of modelled water-levels.

	uniform roughness k_s = 0.3				roughness over breakwaters k_s = 30			
	Along	Across	Speed	WL	Along	Across	Speed	WL
F1	0.32	0.70	0.20	0.21	0.17	0.69	0.13	0.18
F2	0.20	1.11	0.18	0.19	0.21	1.02	0.21	0.18
F4	0.28	0.54	0.23	0.21	0.48	0.60	0.40	0.19
F5	0.27	0.90	0.23	0.23	0.12	0.99	0.11	0.20
total	1.07	3.25	0.84	0.84	0.98	3.30	0.85	0.75

Table 6.1: Model performance statistics at spring tides for uniform bed roughness (k_s = 0.3) and bed roughness over breakwaters k_s = 30

6.3.2 Recalibration with other domain bed roughness

Underperformance identified during model validation at F4 indicates there may now be a need to recalibrate the model using a different (lower) bed roughness over the rest of the domain. Initial calibration (Section 5.2.3) identified k_s = 0.3 to be the most suitable value to use when applying a uniform bed roughness to the entire domain. This is higher than values used and suggested by other authors in the literature for modelling studies in nearby areas of the Southern North Sea (Bacon, 2005; Coughlan, 2008; HR Wallingford, 2002; Park, 2007). This value for the bed roughness may be higher to compensate for the presence of the nine breakwaters in the model domain. When finding a bed roughness to apply to the breakwaters, it is possible that the breakwaters themselves have resulted in a higher than normal "average" bed roughness. Now that breakwater roughness is being treated independently it is appropriate to assess whether the bed roughness associated with the rest of the domain needs to be so high.

To determine the most appropriate value of bed roughness to apply to the rest of the domain when k_s = 30 is applied to breakwaters, a re-calibration exercise was undertaken. Model performance at each of the calibration and validation points was assessed for each of the following values of bed roughness; k_s = 0.2, 0.1 and 0.05.

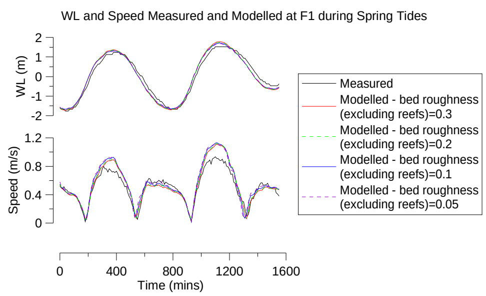


Figure 6.30: Model evaluation at F1 springs - breakwater bed roughness k_s = 30, rest of domain bed roughness between 0.3 and 0.05.

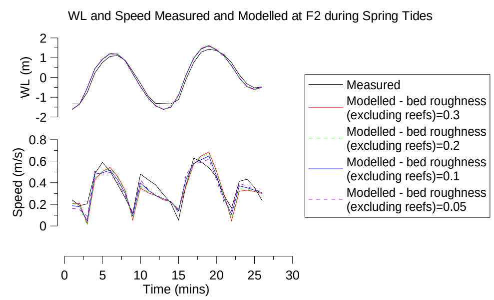


Figure 6.31: Model evaluation at F2 springs - breakwater bed roughness k_s = 30, rest of domain bed roughness between 0.3 and 0.05.

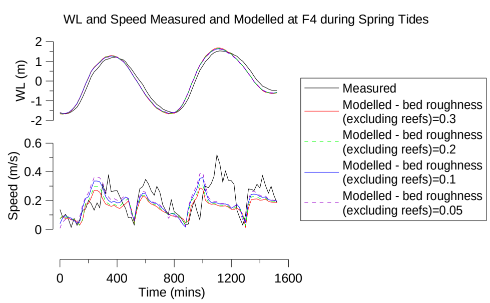


Figure 6.32: Model evaluation at F4 springs - breakwater bed roughness k_s = 30, rest of domain bed roughness between 0.3 and 0.05

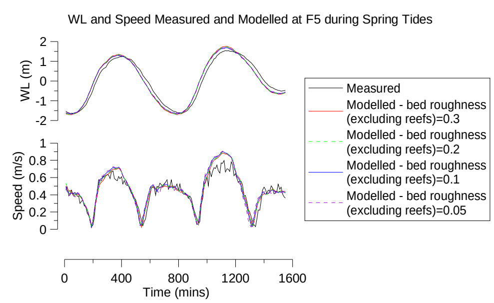


Figure 6.33: Model evaluation at F5 springs - breakwater bed roughness k_s = 30, rest of domain bed roughness between 0.3 and 0.05

Figure 6.30 to Figure 6.33 show the calibration results during spring tide conditions. There is only minor variation between results when bed roughness is reduced. Figure 6.32 highlights the under prediction of velocity at F4 for all values of k_s evaluated.

It is therefore clear that reducing the value of bed roughness applied to the rest of the domain does not solve the inconsistency observed at the position of F4.

6.3.3 Varying breakwater bed roughness to improve performance at F4

In order to improve the model at F4 a different value of bed roughness needed to be applied to breakwaters. Water-levels and velocities were plotted for model simulations where bed roughness over breakwaters is k_s = 10, 25, 30, 35, and 40 (Figure 6.34 to Figure 6.37) which are all considered to give 'acceptable' levels of performance as far as breakwater 5 is concerned.

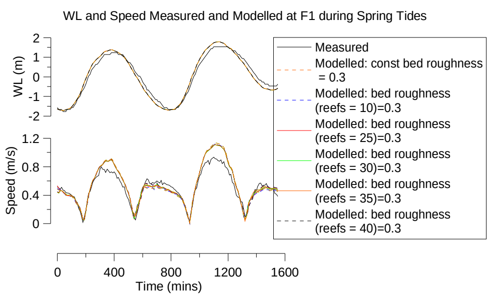


Figure 6.34: Model evaluation at F1 springs - varying breakwater bed roughness

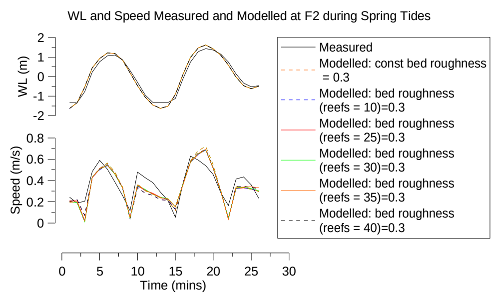


Figure 6.35: Model evaluation at F2 springs - varying breakwater bed roughness

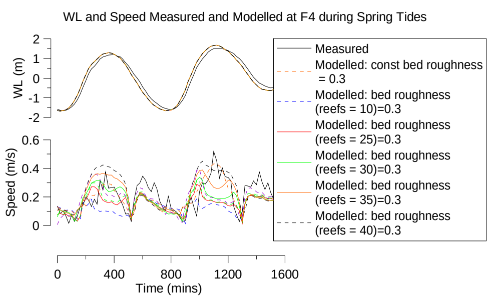


Figure 6.36: Model evaluation at F4 springs - varying breakwater bed roughness

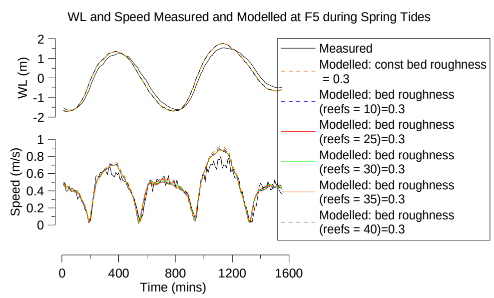


Figure 6.37: Model evaluation at F5 springs - varying breakwater bed roughness

Figure 6.36 represents data at F4, which is the only one of the four locations tested where varying bed roughness associated to breakwater positions has any impact on model performance.

The velocity field around F4 is plotted for each breakwater roughness considered (Figure 6.38 to Figure 6.42). Varying breakwater roughness has significant implications for the position and shape of a gyre which exists in the lee of breakwater 8 relative to F4.

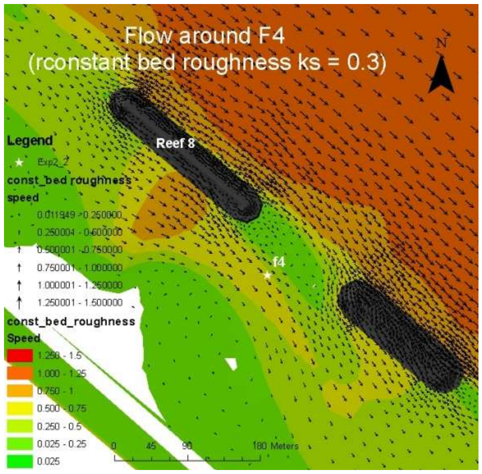


Figure 6.38: Modelled flow around F4 at HW spring. Bed roughness is constant over the domain.

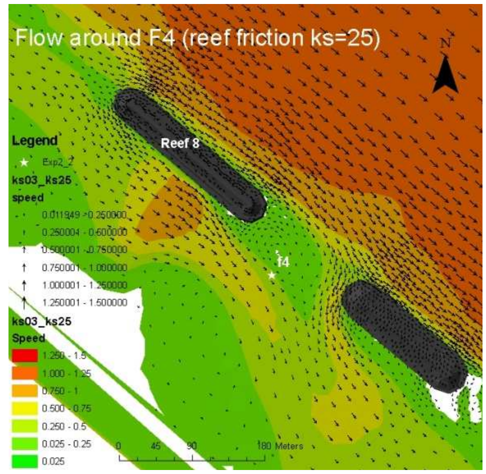


Figure 6.39: Modelled flow around F4 at HW spring. Bed roughness over breakwaters k_s = 25 over rest of domain k_s = 0.3.

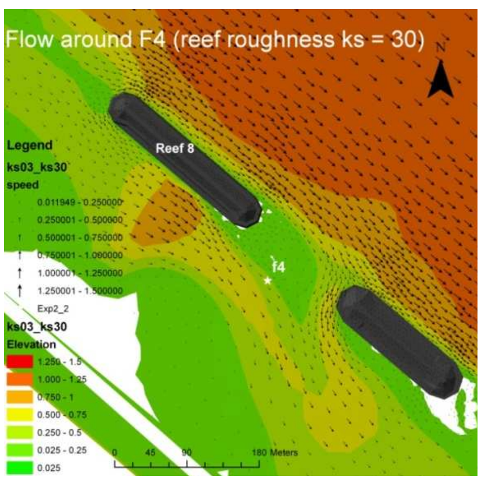


Figure 6.40: Modelled flow around F4 at HW spring. Bed roughness over breakwaters k_s = 30 over rest of domain k_s = 0.3.

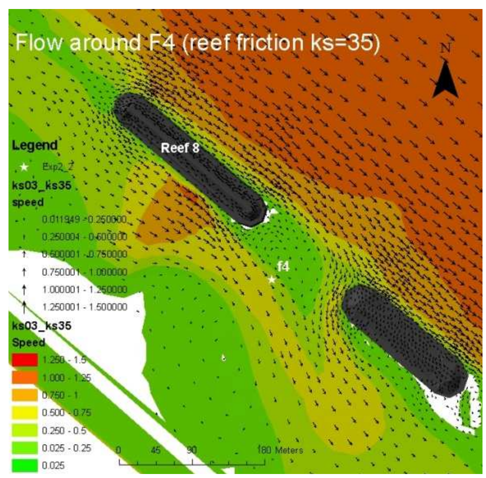


Figure 6.41: Modelled flow around F4 at HW spring. Bed roughness over breakwaters k_s = 35 over rest of domain k_s = 0.3.

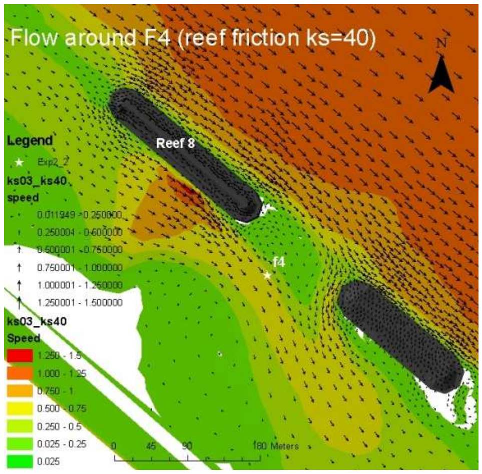


Figure 6.42: Modelled flow around F4 at HW spring. Bed roughness over breakwaters k_s = 40 over rest of domain k = 0.3.

A bed roughness of k_s = 30 was initially selected as the most appropriate value to apply to breakwater positions. It is clear from Figure 6.36 that a bed roughness value of k_s = 40 gives better results at F4. Figure 6.42 highlights that the position of the gyre is not over the F4 instrument location when k_s = 40. This value retains the enhanced flow separation around breakwater 5 whilst maintaining acceptable validation results at the four previously defined model evaluation points.

6.3.4 Limitations

The original model calibration and validation were undertaken using data collected during the winter of 2006 - 2007 and bathymetry measured during winter 2006. The downward looking Aquadopp measurements and the GPS drifter experiments around breakwater 5 were conducted in summer 2008. Summer 2008 bathymetry was used for work around breakwater 5. Extensive bathymetry change can be expected between winter 2006 - 2007 and summer 2008. Varying bed roughness over the breakwaters had significantly more effect around breakwater 5 when using winter 2006 bathymetry, although downward looking

Aquadopp data was not available for this period. Calibration data at the four model evaluation positions were not available during summer 2008. The lack of concurrent data limits the usefulness of this work.

Whilst analysing float tracking experiments (Chapter 6) conducted in 2008 it became apparent that modelled flow patterns at LW were unrealistic. Figure 6.43 displays modelled velocity at LW around breakwaters 8 and 9 when breakwater bed roughness is k_s = 40. Unrealistic flow patterns are modelled offshore of breakwaters 8 and 9. These are very unlikely to exist in reality in this reasonably undisturbed area of the model domain. This can unfortunately not be confirmed by float tracks due to lack of deployments outside of the breakwaters during LW conditions. These gyre-like features are not present when bed roughness over the model domain is constant (Figure 6.44). Figure 6.45 and Figure 6.46 show these differences are consistent when an independent period of forcing conditions and bathymetry are applied (May 2008 forcing conditions and bathymetry rather than May 2007 forcing conditions and bathymetry). These gyres occur during most LW periods.

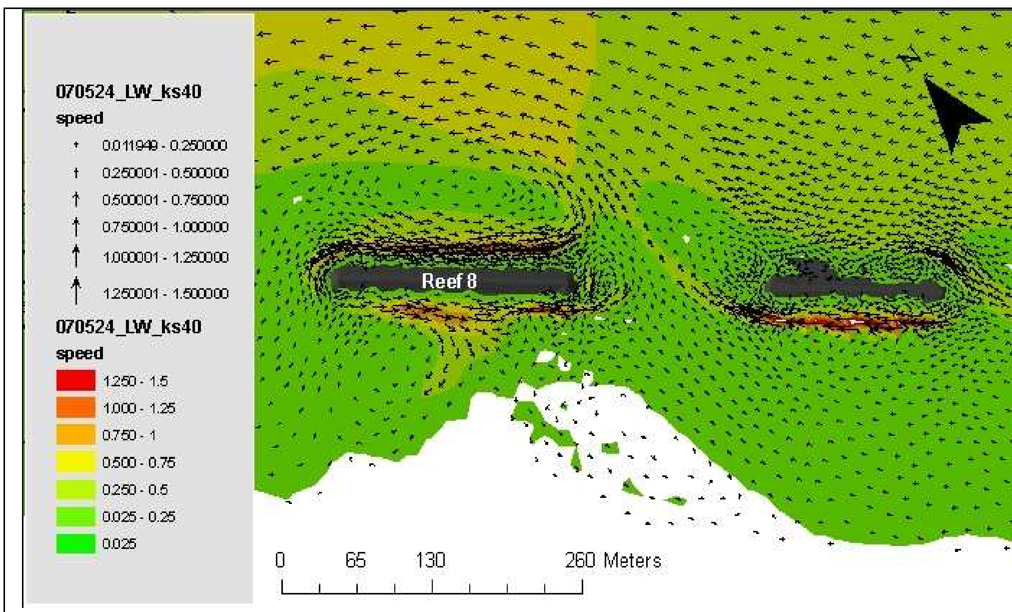


Figure 6.43: Breakwater roughness k_s = 40. Snapshot of velocities around breakwaters 8 and 9 during peak ebb flow. (24/05/07)

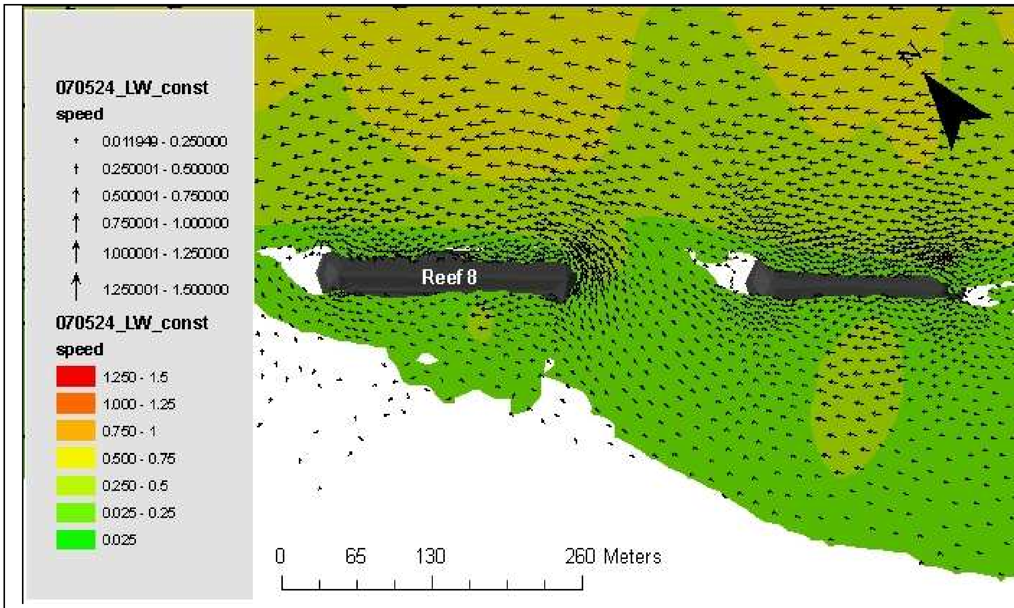


Figure 6.44: Uniform bed roughness. Snapshot of velocities around breakwaters 8 and 9 during peak ebb flow. (24/05/07)

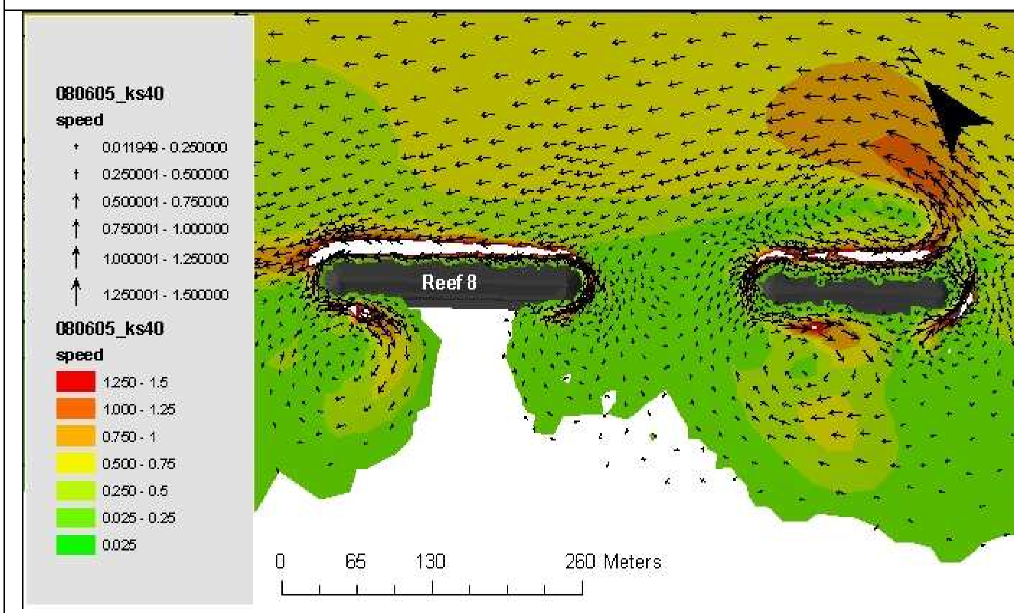


Figure 6.45: Breakwater roughness k_s = 40. Snapshot of velocities around breakwaters 8 and 9 during peak ebb flow. (05/06/08)

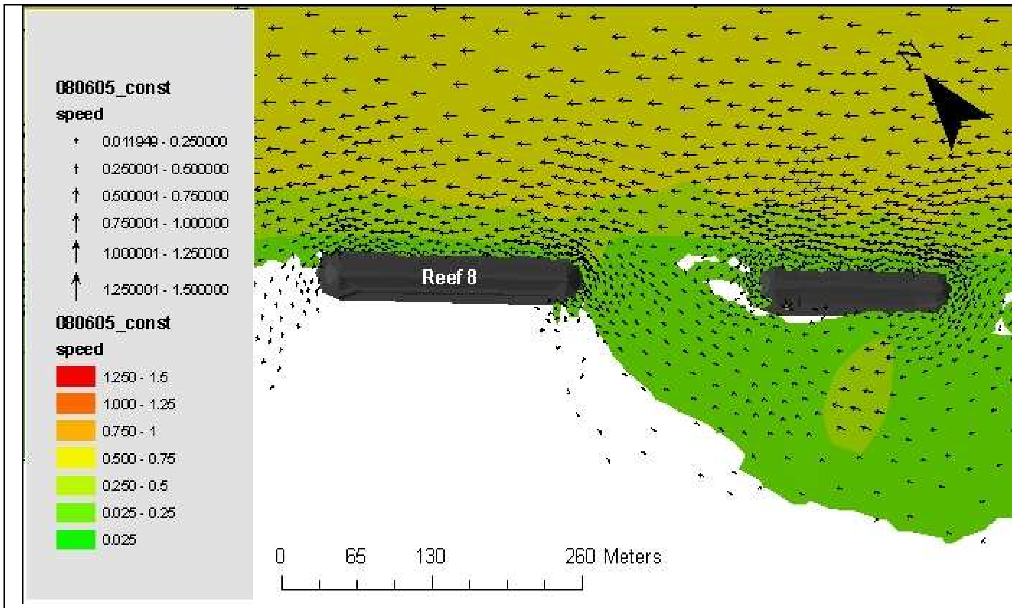


Figure 6.46: Uniform bed roughness. Snapshot of velocities around breakwaters 8 and 9 during peak ebb flow. (05/06/08)

6.4 Conclusions

Increasing bed roughness over nodes associated to breakwater positions has been shown to improve the simulation of the flow-separation around HW observed during the down-looking Aquadopp survey, but also resulted in unrealistic flow structures during ebb flows around breakwaters 8 and 9. Figure 6.34 to Figure 6.37 show that uniform bed roughness also gives the best results for speed at model evaluation positions. This is confirmed by model performance statistics (Table 6.1). It is therefore concluded that it is better to keep bed roughness uniform over the whole domain. Drifters deployed in the area around breakwater 5 will give a measure of confidence that can be applied to model performance in this region (Chapter 6).

7 Confidence in model performance

7.1 Eulerian and Lagrangian data: Model evaluation

7.1.1 Eulerian data: Calibration and validation

TELEMAC2D has been evaluated using Eulerian data collected as part of the LEACOAST2 project. Model results have been shown to be "good" or "excellent" at these sampling locations using Sutherland's (2004b) error classification method. The model domain has an area of approximately 12 km^2 and has over 13 000 nodes. Although calibration and validation using Eulerian data is necessary to assess model performance temporally, it is very difficult to assess overall model performance spatially using only four measurement stations. Spatial model performance is therefore investigated in this chapter using drogues that were tracked either by X-band radar or GPS receivers mounted in the drogues (Section 3.3).

7.1.2 Lagrangian data: Drogue tracking

Model performance is assessed spatially by comparing modelled and measured tracked drifters. GPS and radar were used to track tidal current pathways around the breakwaters. These data were compared with modelled drogue deployments in TELEMAC2D.

7.1.2.1 Measured drogue tracking

Drogues fitted with radar reflectors were used within 1 km of the radar position (Figure 3.27, Chapter 3). These drogues were required to reflect a radar signal for their position to be tracked and therefore needed considerable freeboard (Section 3.3.1.1). Experiments were only undertaken during very calm "no wind" days to minimise the effect of windage.

Drogues fitted with a GPS receiver were used to measure tidal flows in areas outside of the 1 km radius of the radar. Only the GPS receiver needed to be above the water so these drifters had less windage. All experiments were undertaken in calm “no wind” conditions.

Drogue tracking data were filtered and re-sampled to give positions every 30 seconds. Distance between positions gives an indication of the speed of the drogue. In order to compare these estimates of surface current speed with TELEMAC2D output, which is depth-average, an adjustment must be made to correct for the differences between measured surface currents and modelled depth-average currents.

Equation 7.1: for 0 < z < 0.5h (Soulsby, 1997)

$$U(z) = \left(\frac{z}{0.32h}\right)^{\frac{1}{7}} \overline{U}$$

Equation 7.2: for 0.5 h < z < h (Soulsby, 1997)

$$U(z) = 1.07\overline{U}$$

Using Soulsby’s (1997) empirical formula (Equation 7.2: for 0.5 h < z < h (Soulsby, 1997)) for calculating current through the water column depth-average current can be estimated. In order to display measured and modelled drogue tracks, an adjustment to measured time-step must be made to represent the necessary adjustment to velocity.

Equation 7.3: for 0.5h < z < h (Soulsby, 1997)

$$\frac{dist_z}{time_z} = 1.07\frac{dist_{DA}}{time_{DA}}$$

Equation 7.4: for 0.5h < z < h (Soulsby, 1997)

$$time_{DA} = 1.07\, time_z$$

, where DA = depth-average.

Equation 7.2 is expressed in terms of distance and time in Equation 7.3. If distance is kept constant and only time is allowed to vary then Equation 7.4 shows the necessary adjustment to be made to surface measured time-steps. Surface measured positions are then re-sampled to give the required 30 second interval.

7.1.2.2 TELEMAC2D drogue tracking: FLOT subroutine

The TELEMAC2D subroutine FLOT (Table 4.1), allows the user to monitor the tracks followed by particles introduced into the model. The user specifies the release time-step and end of monitoring time-step for each drogue in addition to the coordinates of the deployment position. TELEMAC2D creates a file containing the various positions of the drogue at each time-step. The modified FLOT subroutine must be inserted into the FORTRAN file and the user must include the following information in the steering file:

- Indicate the number of drogues using the key word NUMBER OF DROUGUES.
- The name of the file in which TELEMAC2D is to store the successive positions of the drogues using the key word BINARY RESULTS FILE.
- Configure the printout period using the keyword PRINTOUT PERIOD FOR DROUGUES. This value is expressed as a number of time-steps and is independent of the printout period of TELEMAC2D results.

The TELEMAC2D subroutine FLOT was used to model drifters at concurrent times and positions as those measured. Current velocities and water-levels recorded by the Gardline Ltd AWAC at Walcott were used to force TELEMAC2D with tidal conditions experienced on the day. The FLOT subroutine was programmed with the GPS and radar drogue deployment positions and times. Relevant LEACOAST2 survey data was used to ensure up-to-date bathymetry was utilised during mesh generation.

Five modelled drogues were deployed with a spacing of around 6 m for each measured deployment. This allowed for inaccuracy of measured drogue position and was necessary as small differences in deployment position have been shown to result in different tracked pathways (Figure 7.1). Longer measured GPS drogue tracks of up to one and a half hours were split into several modelled deployments (typically ~20 minutes). In these cases the end of one model deployment was synchronised with the beginning of the next.

Once each drogue was deployed in the model, TELEMAC2D computed its position at every time-step. Drogue positions were exported every 30 seconds to make a direct comparison with measured data.

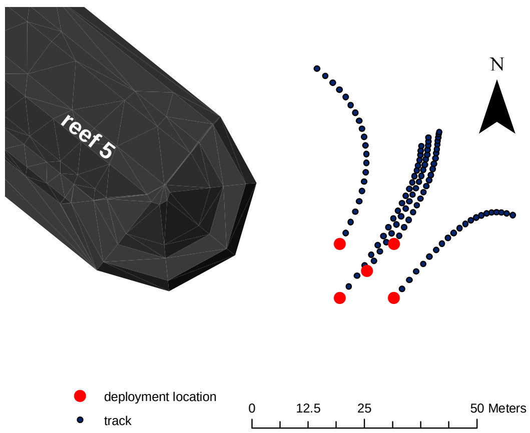


Figure 7.1: Modelled drogues with ~6 m spacing, showing different tracks.

7.2 Drogue tracking data

Measured and modelled drogue tracks are plotted in Figure 7.2 to Figure 7.8. In all these figures, measured tracks are plotted as small filled circles and modelled tracks as small crosses. All diagrams are included to avoid bias in model representation. The model performs well in most cases although there are instances where there is discrepancy. The aim of this work is to assess confidence that can be applied to model performance.

Model performance statistics (Section 5.2.1) were calculated for every modelled drogue speed. Tables comparing modelled and measured speeds with model performance statistics for each deployment are included in Appendix B.

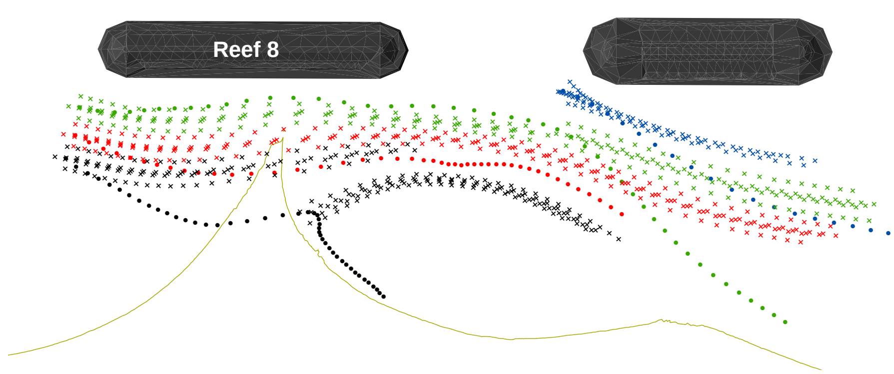
Wind caused significant problems whilst undertaking drogue tracking experiments due to the surface piercing nature of the drogues used. Radar tracked drogues had most freeboard and hence suffered from the effect of windage more than GPS floats. Although experiments were conducted during periods of “no wind”, conditions were rarely absolutely calm.

7.2.1 Radar tracked drogues

Figure 7.2 a displays radar tracked drogues during an experiment on 17/05/06. Three drogues were released between the northern (upstream) end of breakwater 8 and the shoreline during peak flood conditions (HW) and one close to the northern end of breakwater 6. Comparisons were made over periods of 24 minutes; when the observed and modelled tracks diverged significantly, the modelled tracks were ‘reset’ to the actual position of the drogues. Modelled drifter tracks do not match the measured tracks exactly but do give an indication that the model is performing well in this location and time period, in terms of both the speed and direction of the current. Model performance statistics show that most modelled drogue speeds are “good” when compared to those measured (Appendix B). Modelled and measured data match particularly well for the green drogues. The modelled green drogue picks up an almost identical flow pathway and speed as that measured (model performance statistics show an “excellent” match). The black drogue shows the most difference between modelled and measured, although the measured track around the leeward side of salient 8 does seem surprising. Figure 7.2 a ii shows a snapshot of modelled vectors over this area. Modelled currents follow a clockwise pattern, contrary to the measured track. It is necessary to remember that these radar tracked drogues do have a large free board and can be influenced by wind; wind speed was observed to increase during this experiment. Drogues deployed in the following deployment were blown onto the beach ending the days experiment. It is therefore unlikely that the black drogue represents a real tidal effect.

A similar deployment was made on 11/08/06 at HW (Figure 7.5 a) except that all 4 drogues were deployed between breakwater 8 and the shore. Very similar flow streams were observed, with excellent agreement between modelled and measured tracks. Modelled speeds were “excellent” or “good” for the black deployment, “good” for the red and orange deployments and “reasonable” for grey and green deployments. This experiment did not highlight any unanticipated flow in the lee of salient 8.

Figure 7.2 b and Figure 7.2 d show radar tracked drogues during an experiment on 24/05/07 at peak ebb (LW). The drogue deployed in Figure 7.2 b highlights the north-westward ebb flow being forced out between breakwater 8 and 9 by the tombolo blocking flow behind breakwater 8. Modelled drogues pick up measured flow speed and direction very well for the first modelled deployment (RMAE values all < 0.12 representing an "excellent" agreement between modelled and measured results). A second modelled deployment was made where the measured drogue slowed as it neared breakwater 8. Modelled drogue tracks match less well here and speeds were generally "bad" when compared to measured drogues. Drogues are deployed upstream of breakwater 9 in Figure 7.2 d. Modelled and measured drogue tracks generally show good agreement. Drogues closer to shore (black and yellow) are tracked well; modelled and measured speeds are "excellent". Modelled drogues closer to the upstream edge of breakwater 9 match measured poorly, although clearly highlight disturbances in the flow regime in these areas. Figure 7.2 e shows a snapshot of model output for this area at LW. Although tracks do not match well, the model does highlight similar flow disturbances caused by the presence of the breakwater.



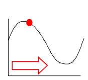
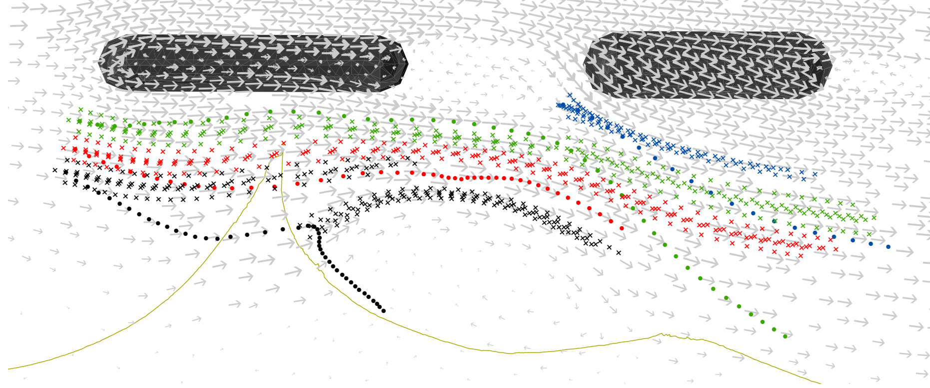
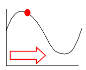
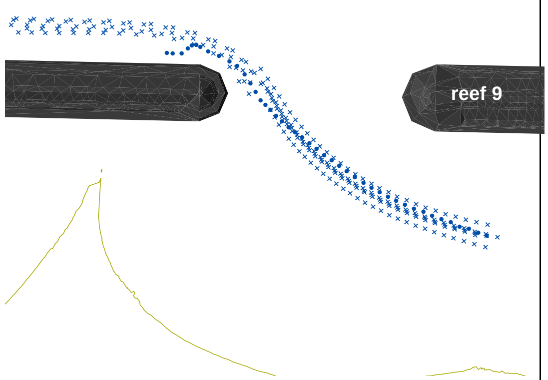


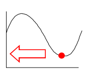
Figure 7.2 a i) Modelled and measured drogues behind breakwaters 8 and 9 (HW+1 (070517))



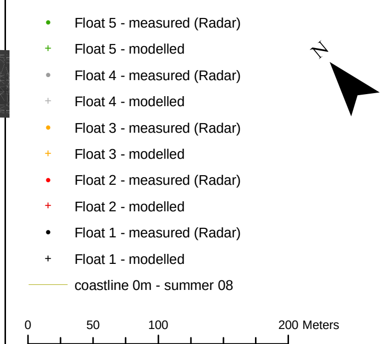


a ii) Modelled and measured radar drogues behind breakwaters 8 and 9 (HW+1 (070517)), with snapshot of model output.

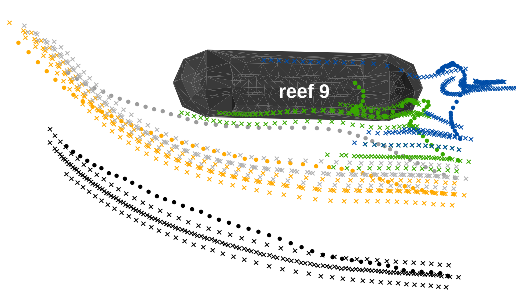


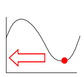


b) Modelled and measured drogues around breakwaters 8 and 9 (LW-1 (070524))

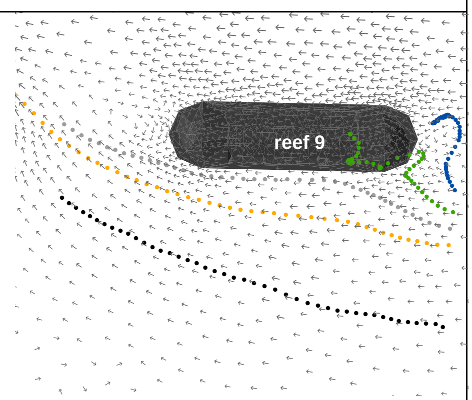


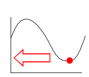
c) legend for diagrams





d) Modelled and measured drogues behind breakwater 9 (LW (070524)).



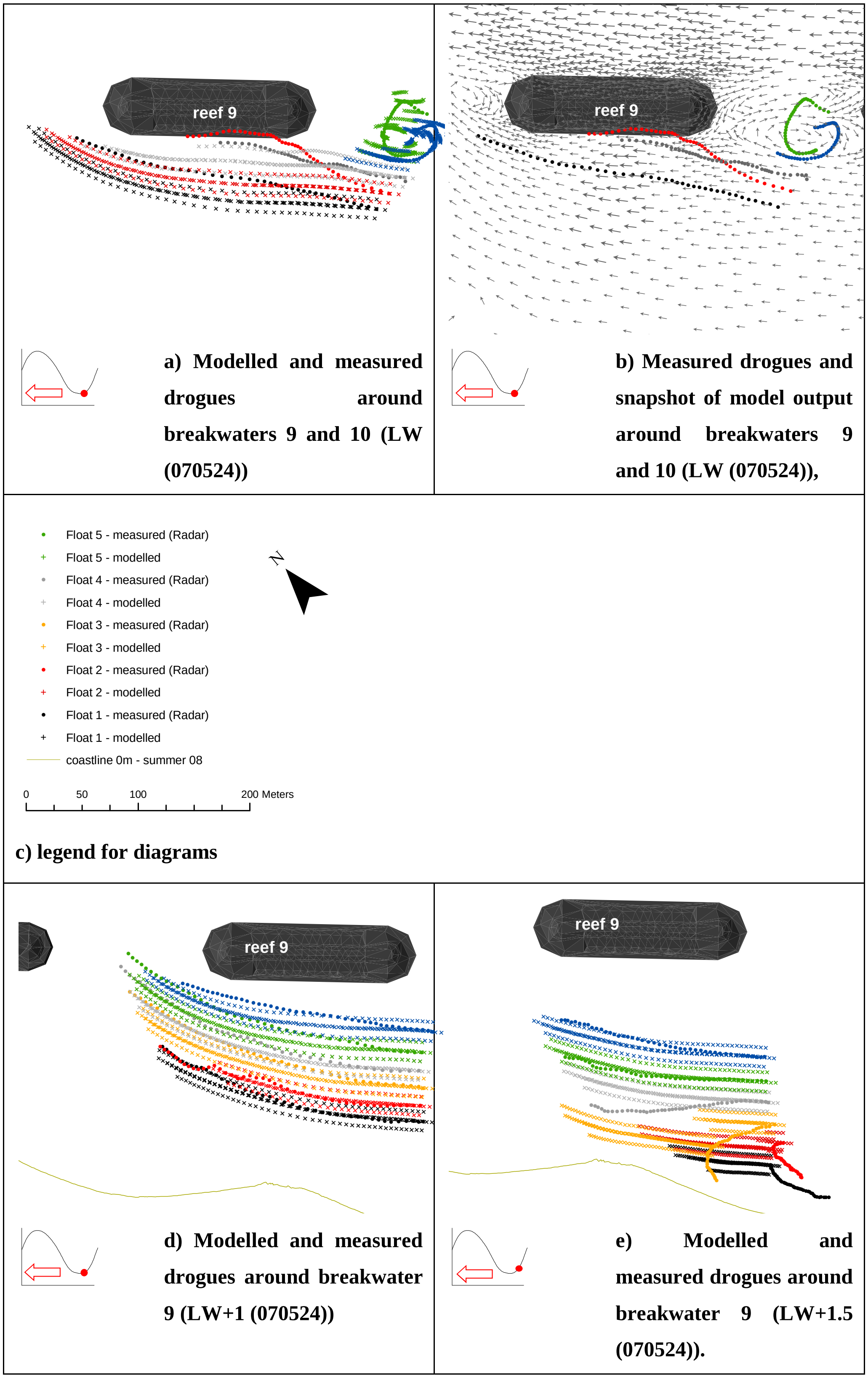


e) Measured drogues and snapshot of model output behind breakwater 9 (LW (070524)).

Figure 7.2: Radar drogue tracks; measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow.

Figure 7.3 displays further radar tracking experiments undertaken on 24/05/07 at LW. Figure 7.3 a and b both illustrate modelled and measured flow for the same measured radar drogue deployments. Figure 7.3 a displays modelled and measured drogue positions and Figure 7.3 b displays measured drogue positions with a snapshot of model output at LW. The green and blue measured drogues clearly highlight a circulation pattern existing in the lee of breakwater 10. This is not clearly identifiable in Figure 7.3 a (modelled drogue positions) however Figure 7.3 b shows that the model does predict a similar flow structure in this region. Modelled and measured tracks for the black deployment show good agreement and speeds are “excellent”. Tracks agree less well for grey and red deployments and modelled speeds are typically 70 % greater than measured. One of the modelled grey deployments follows a similar track to that measured and speeds here are “good” when compared to measured speeds.

Figure 7.3 d shows radar drogue tracking results just after LW. All modelled drogues show a very good fit to measured drogues (speeds are “excellent”). Figure 7.3 e shows drogue positions 30 minutes later and model performance near the beach is poor. Blue, green and grey deployments fit measured data well and speeds are “excellent”.



a) Modelled and measured drogues around breakwaters 9 and 10 (LW (070524))

b) Measured drogues and snapshot of model output around breakwaters 9 and 10 (LW (070524)),

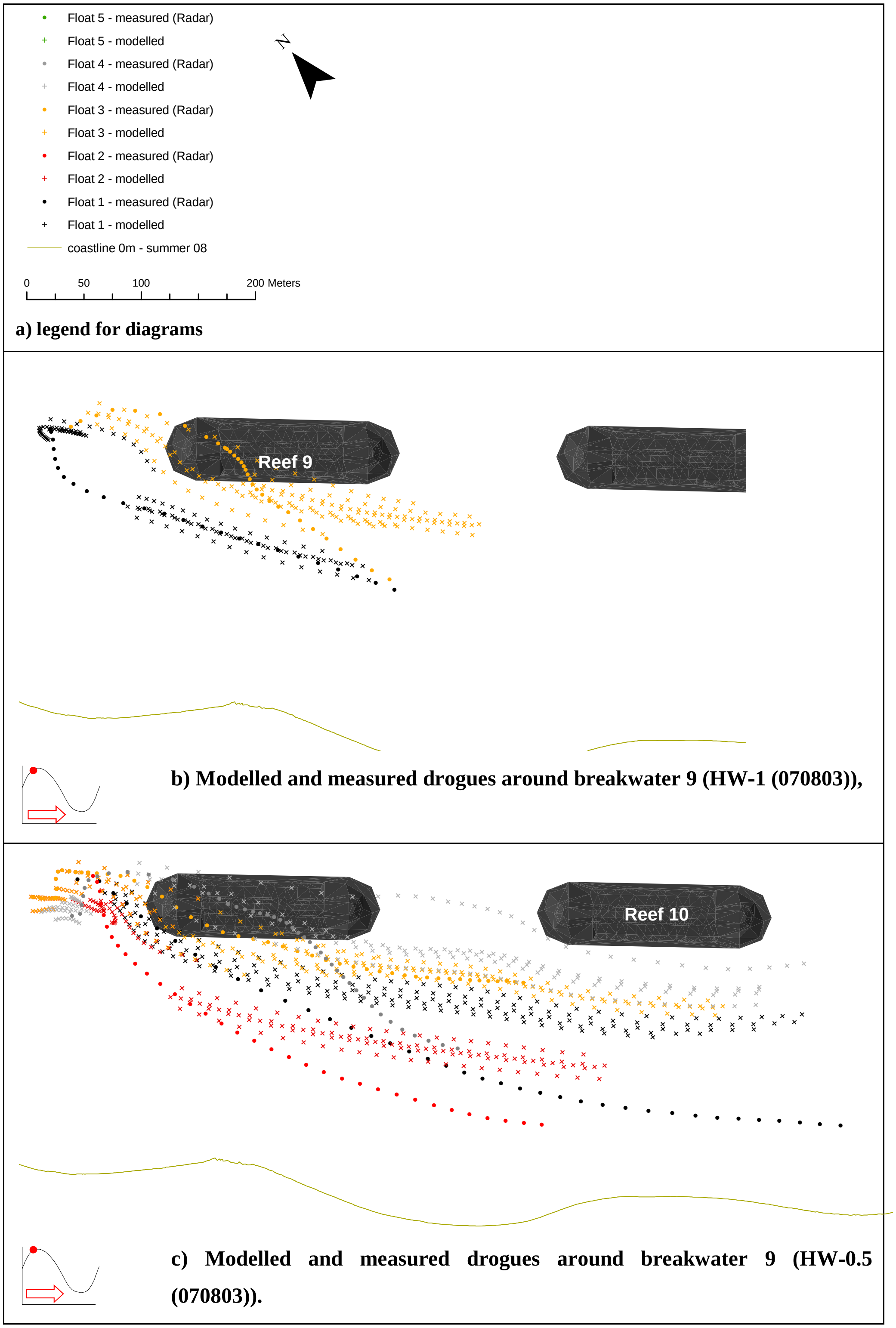
c) legend for diagrams

d) Modelled and measured drogues around breakwater 9 (LW+1 (070524))

e) Modelled and measured drogues around breakwater 9 (LW+1.5 (070524)).

Figure 7.3: Radar drogue tracks; measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow

Figure 7.4 displays radar drogue tracks (modelled and measured) just before HW on 03/08/07. Modelled currents track the measured directions and magnitudes well one hour before HW (Figure 7.4 b). Modelled current speeds are under predicted by all but one of the first black deployments. Although the direction is not as measured, speeds are defined as "good" for this one modelled drogue. All drogues during the second black deployment have an "excellent" fit to the observed data. Modelled current magnitudes are over predicted by ~100 % for the first orange deployment and follow different current paths depending on their original deployment position within a 12 m^2 deployment zone. One of the modelled drogues from this deployment follows the measured track over the top of breakwater 9, although the modelled speed after passing over the top of breakwater does not drop dramatically as measured. The rubble mound breakwater is represented by uniform roughness in the model and has a smooth shape, so the details of flow over the top of the breakwater are not-unexpectedly different from the observations. Modelled current magnitudes match those measured better 30 minutes before HW (Figure 7.4 part c). Both modelled and measured drogues highlight a complex flow pattern near the northern end of breakwater 9. Although flow direction is not identical, when both the observed and modelled drogues move inshore of breakwater 9 the tracks are more coincident. The red and black deployment speeds are mainly "excellent" when compared to the measured. Modelled orange drogues fit measured track directions the best, although speeds are over predicted by ~30 %; model performance statistics confirm this is a "poor" match to measured data. Figure 7.5 e shows an experiment in the same area over a similar tidal stage (one hour after HW). This figure displays the same complex flow patterns between breakwaters 8 and 10 and similar pathways inside breakwater 9.



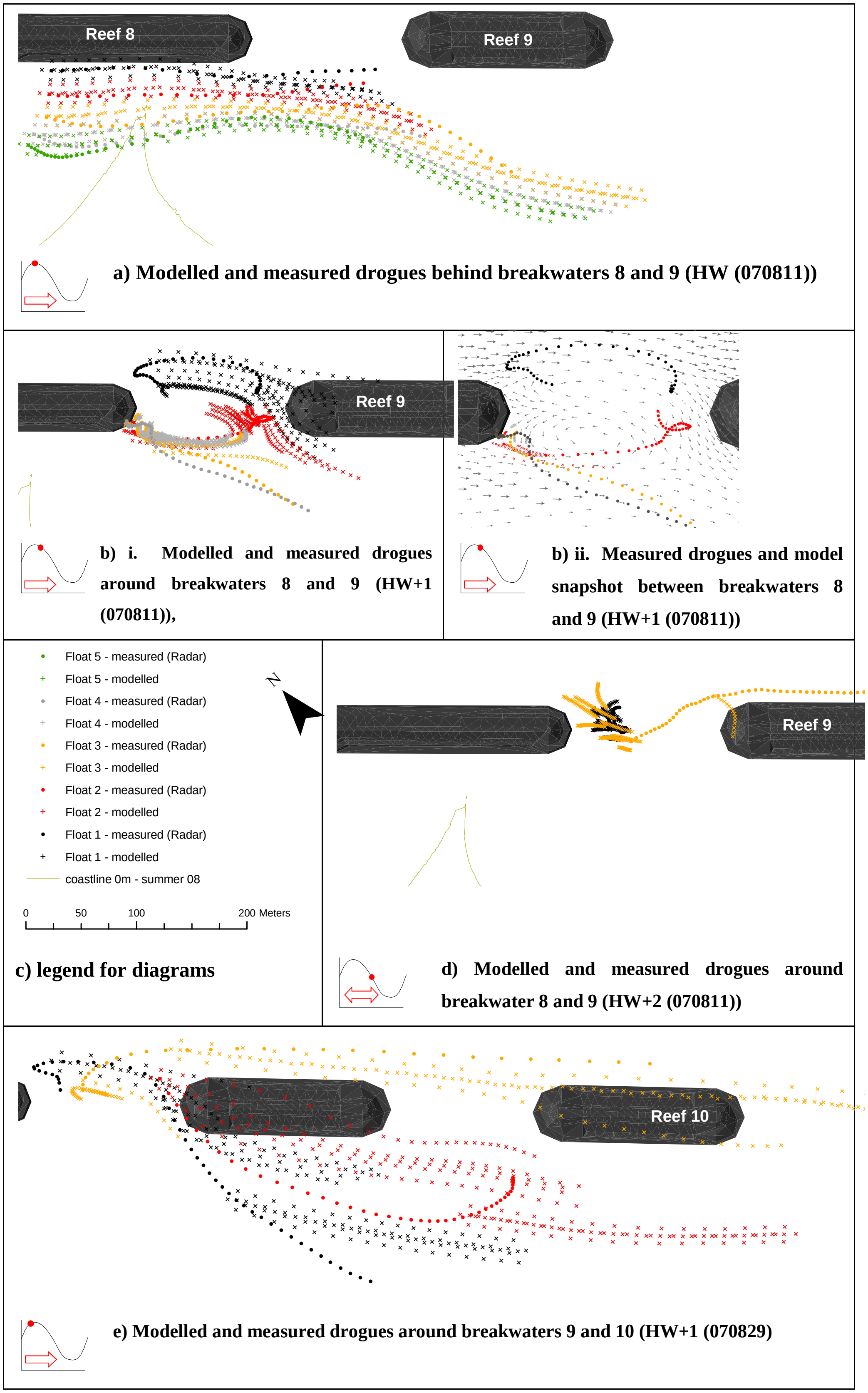
a) legend for diagrams

b) Modelled and measured drogues around breakwater 9 (HW-1 (070803)),

c) Modelled and measured drogues around breakwater 9 (HW-0.5 (070803)).

Figure 7.4: Radar drogue tracks; measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow

Drogues were deployed on 11/08/07 to examine the flow pattern between breakwaters 8 and 9 (Figure 7.5 b(i) and b(ii)). Figure 7.5 b(ii) shows a snapshot of modelled flow in this area at the time of the drogue deployment. It is clear that the model correctly identifies the structure of the flow between these two breakwaters even if modelled drogue tracks (Figure 7.5 b(i)) do not exactly match those measured. These figures give confidence in model performance in these regions. Model simulations seem less effective at mid-tide (Figure 7.5 d). This is the period of flow reversal and maximum rate of change in water-level. Flow direction changes in the model earlier than that observed. The currents in the model have a similar speed to the yellow drogue ~45 minutes earlier.



a) Modelled and measured drogues behind breakwaters 8 and 9 (HW (070811))

b) i. Modelled and measured drogues around breakwaters 8 and 9 (HW+1 (070811)),

b) ii. Measured drogues and model snapshot between breakwaters 8 and 9 (HW+1 (070811))

c) legend for diagrams

d) Modelled and measured drogues around breakwater 8 and 9 (HW+2 (070811))

e) Modelled and measured drogues around breakwaters 9 and 10 (HW+1 (070829)

Figure 7.5: Radar drogue tracks; measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve.

7.2.2 GPS tracked drogues

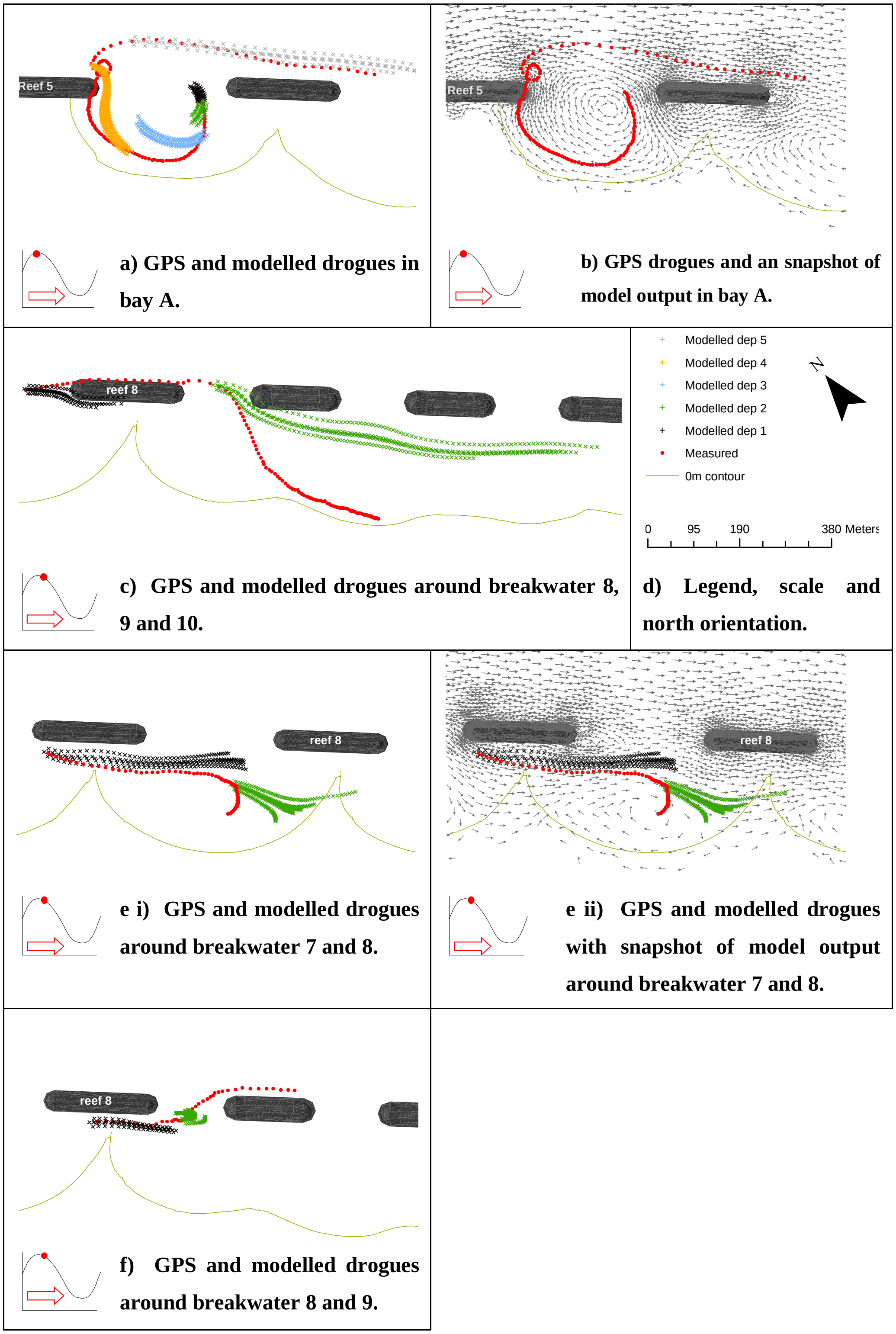
Drogues tracked with GPS receivers on 05/06/08 were used to measure flow patterns around the breakwaters at the northern end of the Sea Palling breakwater system, where the radar could not be used. Figure 7.6 a displays measured (red) and modelled tracks of a drogue released between breakwaters 5 and 6 at HW (close to maximum flood flow). Figure 7.6 b shows the measured drogue track and snapshot of model output (at HW) around breakwaters 5 and 6. The gyre in bay A is well identified in the model simulation with direction and magnitude matching measured very well. Model performance statistics show that there is an “excellent” match between modelled and measured drogue speeds for black and blue deployments and a “good” match for green and orange deployments. When the drogue moves outside the breakwater line the model track is very close to that observed (speeds are slightly higher than observed but are still classed as “good”).

Figure 7.6 c considers flow around breakwaters 8 and 9 on the same day. The observed GPS drifter (red) follows a shore-parallel path outside breakwater 8 before tracking inshore between breakwaters 8 and 9. Modelled drogues released from the original deployment position (black) travel on the ‘wrong’ side of breakwater 8; the small deviation in flow direction in the model is accompanied by current speeds that are also much lower (by ~50 %) than observed. After re-deployment of the modelled drogues (green) outside the breakwater line they follow the observed track, moving inshore between breakwaters 8 and 9. These modelled drogues then continue in a mainly shore-parallel direction inside the breakwater line while the GPS drogue moves close to the shore. Windage may account for this difference. Modelled speeds are ~50 % greater than those measured.

Modelled and measured drogues deployed behind breakwater 7 (black deployment Figure 7.6 e i) show an “excellent” comparison in terms of current magnitude. Drogue track directions also match well. Drogues slow as they enter bay C (between breakwaters 7 and 8) and enter a slow moving gyre. The green deployments in Figure 7.6 e i and model snapshot in Figure 7.6 e ii shows the modelled gyre is not as tight and slow moving as the measured gyre. Modelled drogue speeds are ~30 – 200 % greater than measured. Modelled drogues 200 % greater than measured are clearly not trapped in the gyre (Figure 7.6 e i). Drogues deployed behind breakwater 8 (Figure 7.6 f) show a close agreement between modelled and measured for the first deployment (black). Model performance statistics show modelled speeds have a “good” match to those measured. Modelled drogues are held in a complex flow pattern between breakwater 8 and 9 (Figure 7.5 b(ii)) in the second deployment (green) while the GPS drogue slowed and moved out between the breakwaters. Modelled and measured drogue positions do not match well in this case.

The model shows flow separation occurring during the flood tide offshore breakwater 5 (the most northerly breakwater); GPS drifters were released around breakwater 5 on 05/06/08 to verify this separation. Figure 7.7 a ii shows both measured (red) and modelled (green then black) drogues tracking “upstream” in a back eddy just offshore breakwater 5 (speeds are typically 100 % greater than measured) before entering the main stream and travelling with the expected south-eastward along-shore flood flow. Magnitude is under-simulated by about a half in the black deployment although this is likely to be caused by the modelled drogues not travelling as far offshore. This may be because the modelled region of flow separation is not as wide as that observed. Once re-deployed (orange), just offshore of breakwater 6 (Figure 7.7 a(i)), modelled drogue tracks diverge; four drogues moving inshore of breakwater 7, and one outside. The drogue moving outside breakwater 7 travels at 95 % of the GPS drogue and tracks closer to the breakwater. Model performance statistics suggest there is a “reasonable” fit between modelled and measured drogue speeds. Figure 7.7 b shows modelled drogues following the observed tracks well for the first two (black and green) deployments, although speeds are over predicted for both (~40 % for black and ~20 % for green). The third modelled deployment (blue) follows the measured track less well; modelled drogues travel inshore between breakwater 6 and 7, while the GPS drogue continues along-shore on the seaward side of the breakwater line.

Figure 7.7 c shows two GPS deployments around breakwater 5 and 6. Modelled flow behind breakwater 5 (black) and further offshore (black) matches that measured well. Speeds in the offshore black deployment are “excellent”. Although the exact measured track in the lee of breakwater 5 is not simulated, this area of disturbance is identified in the modelled tracks (green and blue).



a) GPS and modelled drogues in bay A.

b) GPS drogues and an snapshot of model output in bay A.

c) GPS and modelled drogues around breakwater 8, 9 and 10.

d) Legend, scale and north orientation.

e i) GPS and modelled drogues around breakwater 7 and 8.

e ii) GPS and modelled drogues with snapshot of model output around breakwater 7 and 8.

f) GPS and modelled drogues around breakwater 8 and 9.

Figure 7.6: GPS drogue tracks during peak flood time-step = 30 s (080605); measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow.

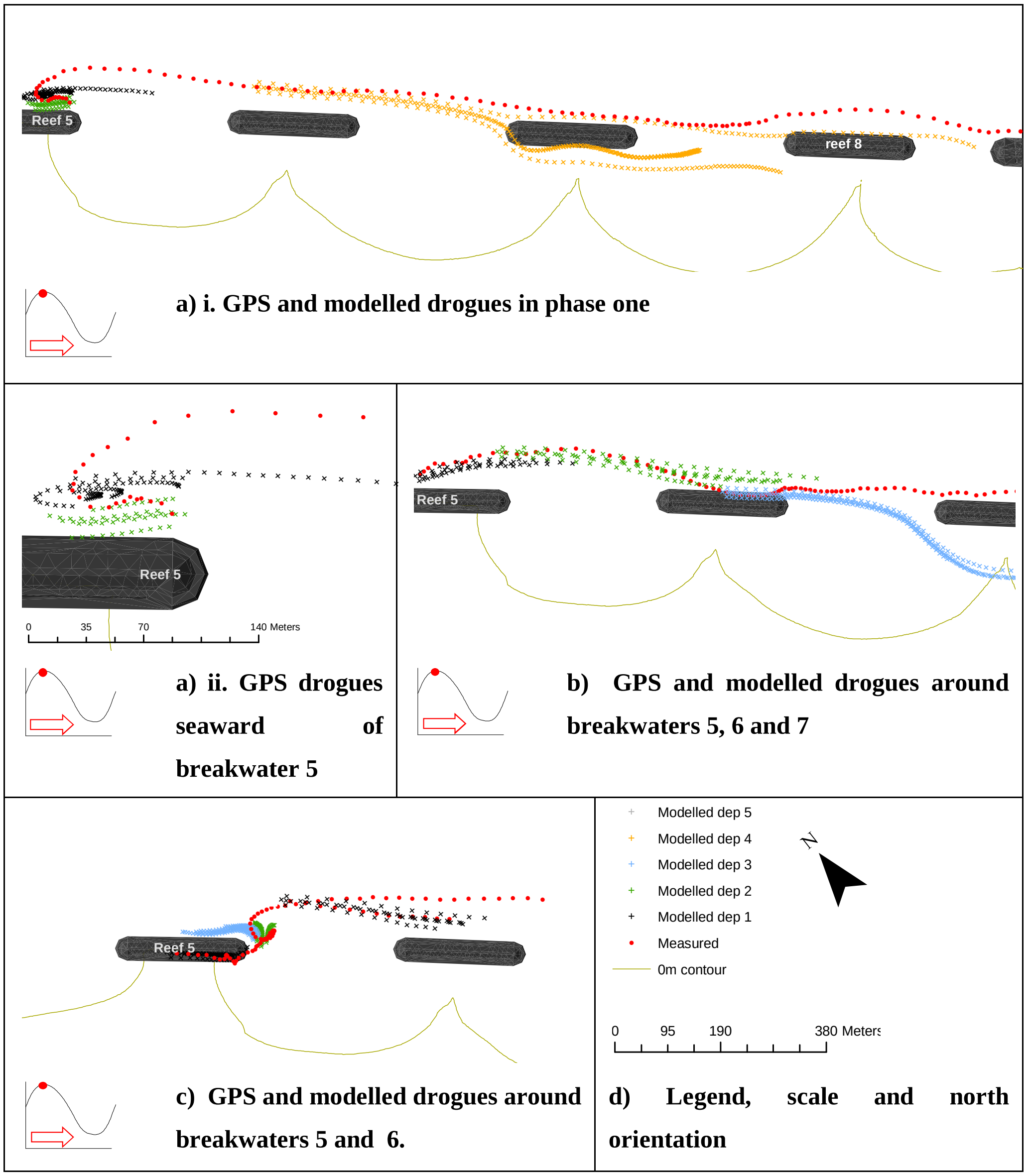


Figure 7.7: GPS drogue tracks during peak flood time-step = 30 s (080605); measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow.

Modelled and measured drifters are displayed in Figure 7.8 for a GPS drifter experiment on 04/06/08 during mid-tide at the end of the flood. This experiment lasts for about an hour. Drogues deployed between breakwaters 5 and 6 are shown in Figure 7.8 b. The black deployment matches observed tracks well (modelled speed is “good” when compared to measured). The flow disturbance observed is not identified in the blue and green modelled deployments. Current speeds in the offshore are over predicted by as much as 100 % (orange).

Although the observed float track pathway is identified by the model in Figure 7.8 c, the model over predicts speed by ~70 %. The flow disturbance observed on the northern end of breakwater 6 (Figure 7.8 d) is identified by modelled drogues; although it is only the green deployment which follows a similar track to that observed (speed is “reasonable” for this deployment).

Observed drogue pathways are identified well in model drogue tracks offshore breakwater 5 (Figure 7.8 c, d, e and f), although modelled speeds are over predicted by as much as 100 % for these deployments. Figure 7.8 f shows three sets of model deployments outside the breakwater line. Deployments made further south-east match measured speeds better. The green deployment overestimates speeds by ~30 % and the blue deployment overestimates speeds by ~20 %.

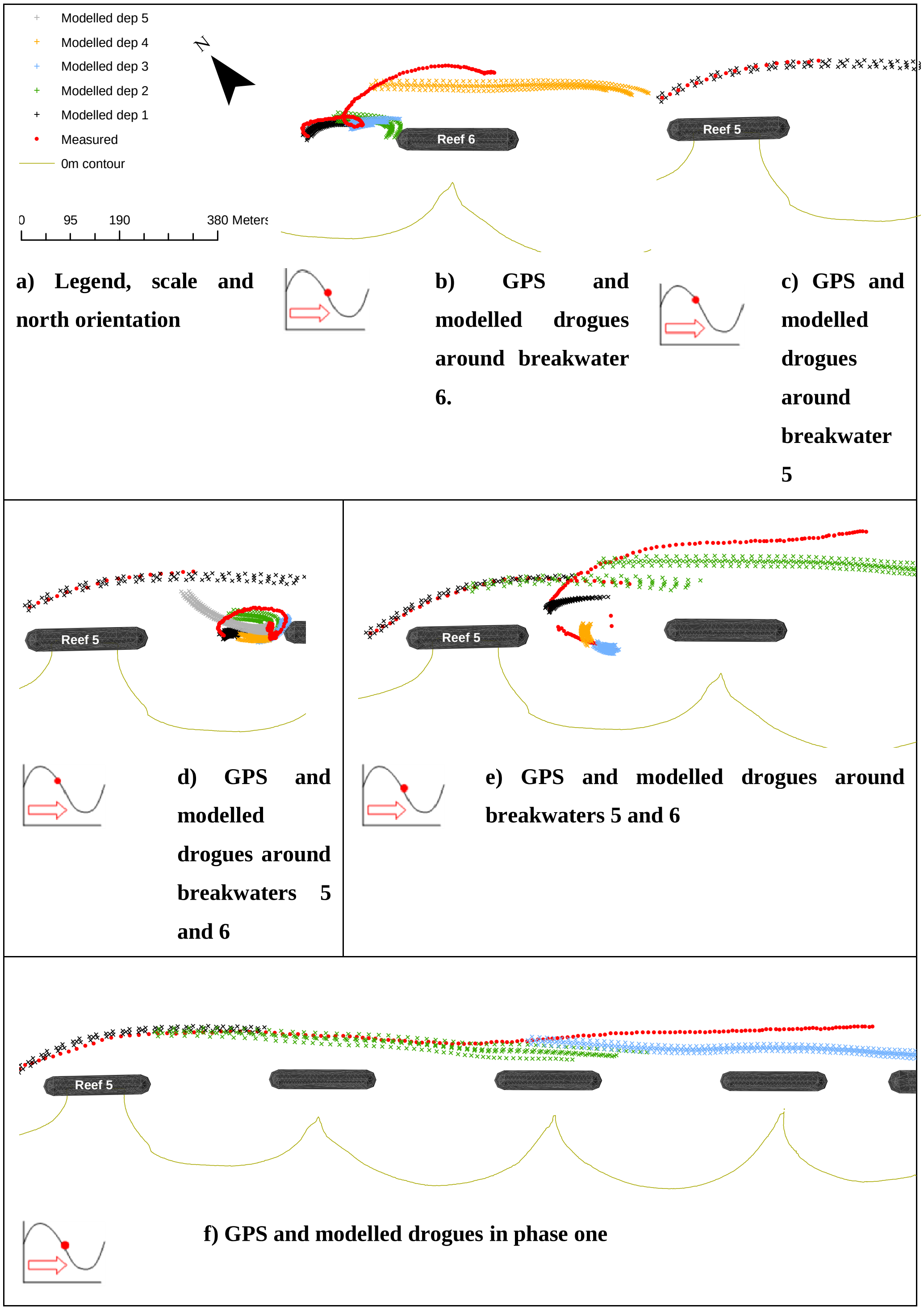


Figure 7.8: GPS drogue tracks during flood / ebb change time-step = 30 s (080604); measured tracks are plotted as small filled circles and modelled tracks as small crosses. Approximate tidal stage represented by red dot on tidal curve. Main direction of flow indicated by red arrow.

7.3 Confidence to be applied to model performance

Model simulations have been matched temporally to the times of the experiments. Model forcing conditions are taken from data collected at Walcott. While corrections made to these data give a good estimation of velocities and water-levels experienced at Sea Palling, they are not exact and times can vary slightly (~5 minutes). Measured and modelled drogue paths which cross demonstrate how fluctuations in flow pathways vary temporally. It is clear therefore that even very minor variation in model start time can influence modelled drogue positions. This may be critical around times of flow reversal but even around times of maximum flood and ebb, there is an impact on timings of transient features between breakwaters.

The objective of the drogue experiments was to get increased verification that the features seen in the model are consistent with those observed around the breakwaters. The fixed measurement stations were few, so of limited value to this exercise. Drogue experiments were restricted to deployments under near-calm conditions, when winds were light; there still remains the possibility of a small amount of wind induced drift.

7.3.1 Evidence of features predicted by the model

The drogue tracking exercises have obtained evidence of a number of features predicted by the model.

a) Flow separation around breakwater 5 at ~HW (peak flood tide): The scale of the separation around breakwater 5 has been shown as very good, although the speeds of the counter-current were over predicted.
b) Single gyres in embayments: The gyres in embayment A (between breakwater 5 and 6) and D (between breakwater 8 and 9) are observed in measured data. These are of the correct size and current magnitudes.
c) Complex flow and transient features between breakwaters: Here the flow is complex and temporally variable which makes correspondence between

the model and ‘reality’ difficult to achieve. Divergent model tracks support this.

d) Current speeds within the breakwaters are generally similar to those observed: Speeds outside the breakwaters are generally higher than observed. This is supported by speeds measured at F1 (Section 5.2.3)

7.4 Conclusions

It can be concluded that a high level of confidence can be applied to model performance during peak flows. TELEMAC2D is shown to identify flow directions less precisely mid-tide; where flow reversal occurs and current speeds are very small. During these mid-tide periods the rate of water-level change is greatest so any errors between observed and modelled data are likely to be exacerbated. This has limited consequence for sediment transport simulation, as poor model confidence is limited to periods of low or no flow, where sediment transport is likely to be negligible

8 Sediment transport rates and pathways (tides only)

8.1 Sediment transport introduction

Sediment transport in the coastal marine environment can be defined as the simultaneous processes of entrainment, movement and deposition of particles by the action of waves and tidal currents.

8.1.1 Threshold of motion

The threshold of motion of sediments on the sea bed is an important factor in the computation of sediment behaviour in response to stresses acting on them due to the motion of water. In this case, mainly sand is considered.

Grains over a sand bed are immobile at very low flow speeds. As flow speed increases, a velocity is reached where grains begin to move. This is the threshold of motion (Soulsby, 1997).

To move a grain of sand on the bed, the forces of flow over it must be capable of overcoming the force of gravity holding the grain down and the friction between the grain and the bed. The Shields parameter (Equation 8.1) can be used to provide a measure of motion in terms of a ratio between the bed shear stress acting to move the grain, and the submerged weight of the grain.

Equation 8.1: Shields parameter

$$\theta_{cr} = \frac{\tau_{cr}}{g(\rho_s - \rho)d}$$

Where θ_{cr} = the critical value of the Shields parameter, τ_{cr} = threshold bed stress, g = acceleration due to gravity, ρ_s = grain density, ρ = fluid density and d= grain diameter.

Van Rijn (1984) gives a formula (Equation 8.2) for predicting the threshold depth-average current $\overline{U}_{cr}$ to move a grain of diameter d (d_{50} refers to the median grain size and d_{90}, the 90 percentile grain size – the grain size that 90 % of grains are smaller than) on a flat horizontal, un-rippled bed in water of depth h.

Equation 8.2

$$\overline{U}_{cr} = 0.19(d_{50})^{0.1}\log_{10}\left(\frac{4h}{d_{90}}\right) \text{ for } 100 \le d_{50} \le 500\ \mu\text{m}$$

$$\overline{U}_{cr} = 8.5(d_{50})^{0.6}\log_{10}\left(\frac{4h}{d_{90}}\right) \text{ for } 500 \le d_{50} \le 2000\ \mu\text{m}$$

8.1.2 Bedload transport

Sand moves by bedload transport when the current exceeds the threshold of motion. This mode of transport involves rolling, sliding and hopping (saltation) of grains along the bed. Bedload is the dominant mode of transport for low flow rates and larger grains (Soulsby, 1997).

8.1.3 Suspended load transport

For current speeds significantly greater than the threshold of motion, sediment is entrained off the bed and into suspension. Sediment then travels at approximately the same speed as the current (Soulsby, 1997). The proportion of sediment travelling in suspension is generally much larger than the simultaneous bedload transport. The suspended load is therefore an important contribution to the total load sediment transport rate (Soulsby, 1997).

For grains to remain in suspension their settling velocity must be less than the upward turbulent component of velocity, which is related to the friction velocity, u_* (Soulsby, 1997). This leads to a threshold of suspension given approximately by Equation 8.3.

Equation 8.3: Threshold of suspension

$$u_{*s} = w_s,$$

where, u_{*s} = skin friction velocity , w_s = settling velocity of grains

8.1.4 Volumetric and Mass transport rates

Transport rates can be expressed in terms of volume or mass of grains moving. Mass transport rates (Q_b) have units, kg m^{-1} s^{-1}, or kg m^{-1} y^{-1}in the case of annual rates and refer to mass transported per unit length per unit time. Volumetric transport rates (q_b) have units m^2 s^{-1} (or annual rate of m^2 y^{-1}) and refer to volume of grains moving per unit time per unit width of bed.

The relationship expressed in Equation 8.4 is used to convert between the two, ρ_s is the density of sediment grains taken as 2650 kg m^{-3} (Soulsby, 1997).

Equation 8.4: Mass transport rate (Soulsby, 1997)

$$Q_b = \rho_s q_b$$

8.2 Sediment grain size: Field measurements

Equation 8.2 and Equation 8.3 show how sediment transport is dependent on grain size. Grain size is a major contribution factor to inaccuracies in sediment transport model formulations (Pinto et al., 2006). Grain size varies spatially within the domain (Figure 8.1). Insufficient information is available to vary grain size programmed in the model spatially so one 'representative' value is used.

8.2.1 Grain size on the bed

Marten and Vincent (pers. comm.) used a grab sampler to sample bed sediment on the offshore side of the Sea Palling breakwaters in 2009, supplementing grab samples made by Bacon (pers. comm.) within the breakwater system in 2005. Figure 8.1 shows the range of grain size (d_{50}) found within and around the system.

Martin (pers. comm.) found 200 µm, 400 µm and 600 µm to be representative of the d_{10}, d_{50} and d_{90} at Sea Palling. These values are used in bedload transport formulations in this thesis, although Section 8.4.1 includes a short sensitivity analysis investigating the effect of varying the grain size applied at F1 and F2.

Figure 8.1: Grain size (µm) found from grab samples made at Sea Palling. Triangles represent a survey undertaken by Bacon (pers. comm.) in 2005, and squares are samples taken in 2009 by Martin and Vincent (pers. comm.) (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service).

8.2.2 Grain size in suspension

Hajek et al. (2010) found the suspended sediment grain size distribution to be smaller and finer than grain size on the bed.

Suspended load transport calculations in this thesis are compared to sediment flux calculations made by Coughlan (pers. comm.) based on ABS and ADV measurements (Section 8.5.2). Coughlan used a median grain size of 200 µm, as a representative value to use for sediment in suspension. Although this is a high value for median grain size of suspended sediment, this value was considered necessary to use in calculations made in this thesis to enable a more direct comparison between modelled and measured data.

Suspended sediment grain size information from sediment retained in timed sediment traps from F1 and F2 during the 25 hours of calm conditions of spring and neap tides highlighted in Section 8.5.1.3 are found in Table 8.1. Apertures in the sediment traps are near the top (Section 3.2.1.3), meaning that the sample elevation may have been as much as 0.70 m from the bed. 0.70 m is the upper limit of integration when sediment fluxes are calculated (Section 8.5.2). This is not ideal, but does give an indication of sediment in suspension and confirms that 200 μm is within the range of suspended sediment grain sizes observed and therefore is not an unrealistic value to use. When the transport model is applied to the whole domain, only one value for sediment size can be used. Information is too sparse to allow grain size to vary in space. 200 μm is therefore presented as an acceptable value to use as median grain size in suspension rather than relying on the values for d_{50} measured in the traps.

Frame	Time period	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)
F1 (SP)	22/12/06 – 25/12/06	24	222	421
F1 (NP)	11/12/06 – 13/12/06	7	102	410
F2 (SP)	22/12/06 – 25/12/06	4	26	168
F2 (NP)	11/12/06 – 13/12/06	5	55	919

Table 8.1: Sediment distribution in suspension at F1 and F2 during 25 hours investigated

8.3 Bedload sediment transport: Field measurements

Bedload transport was not measured during the LEACOAST2 field campaign. Bedload transport can be estimated by tracking bed features migrating along the bed (Hoekstra et al., 2004). F1 and F2 were fitted with bed profilers but these data were not utilised in this study. Migration of sandwaves identified in survey tracks (Section 8.8.3.1) give an indication of bedload transport rates in the offshore. Further work could include estimates of bedload transport from F1 and F2 ripple profiler data. Figure 8.14, Figure 8.15, Table 8.2 and Table 8.3 show that bedload is significantly less than suspended load, so lack of calibration data causes less of an impact on model results.

8.4 Bedload sediment transport: Modelled

It was necessary to include bedload transport to determine total load sediment transport by tides. The Van Rijn (1984) parameterised bedload transport formula (Section 8.6.1) was used to give an indication of bedload in this work. Soulsby (1997) tested a range of bedload transport models and found their results to vary by a factor of 4, predictions using the Van Rijn (1984) equation were found to be mid-range, and therefore, without calibration data was considered an appropriate model to use.

Equation 8.6 to Equation 8.10 give Van Rijn's (1984) parameterised method for calculating total load transport. Equation 8.7 represents the bedload component of total load which is the equation used in this work. Equation 8.9 was used to calculate the threshold current speed as median grain diameter on the bed is taken as 400 μm (Section 8.2.1).

8.4.1 Sensitivity to grain size

Section 8.2.1 highlights 400 μm as a representative value of the median grain size to apply to all nodes within the model domain. Although a representative grain size has been established, Figure 8.1 highlights the spatially variable distribution found around the breakwaters. Inaccurate grain size information can lead to errors in sediment transport formulations (Pinto et al., 2006). Figure 8.2 and Figure 8.3 highlight the effect of varying the median grain size on bedload transport calculations at F1 and F2. There is a ~30 % difference between transport calculated during flood tides and a factor of ~3 at ebb tides at F1 (Figure 8.2), and a ~60 % difference between transport calculated during flood tides and a factor of ~2 at ebb tides at F2 (Figure 8.3).

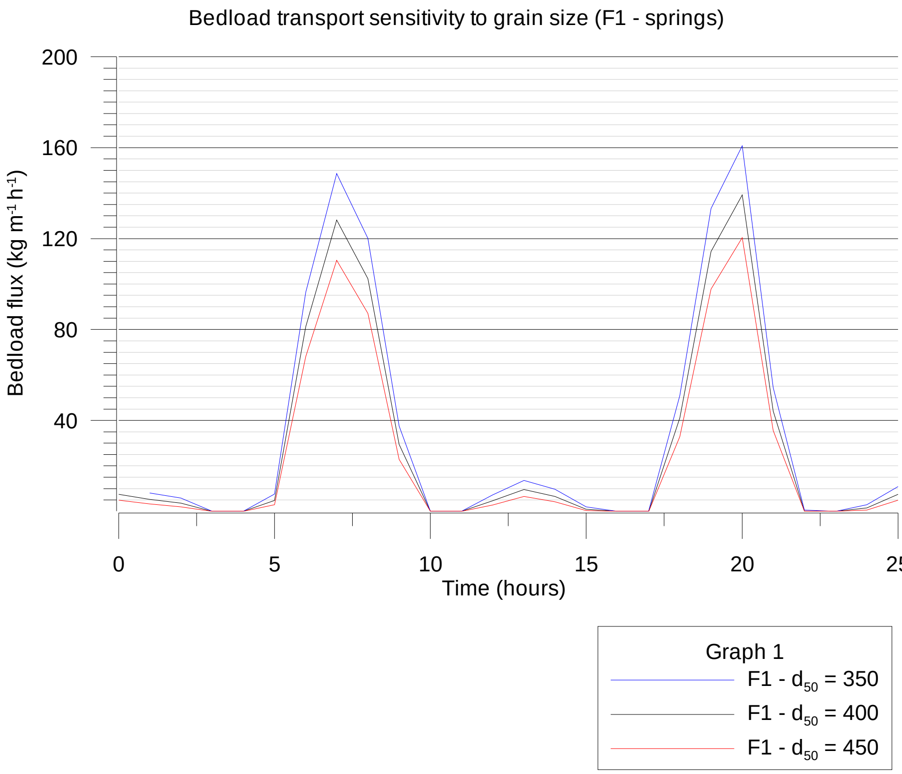


Figure 8.2: Van Rijn bedload transport sensitivity to grain size. Currents from ADV at F1 during spring tides. 350 µm 400 µm and 450 µm investigated.

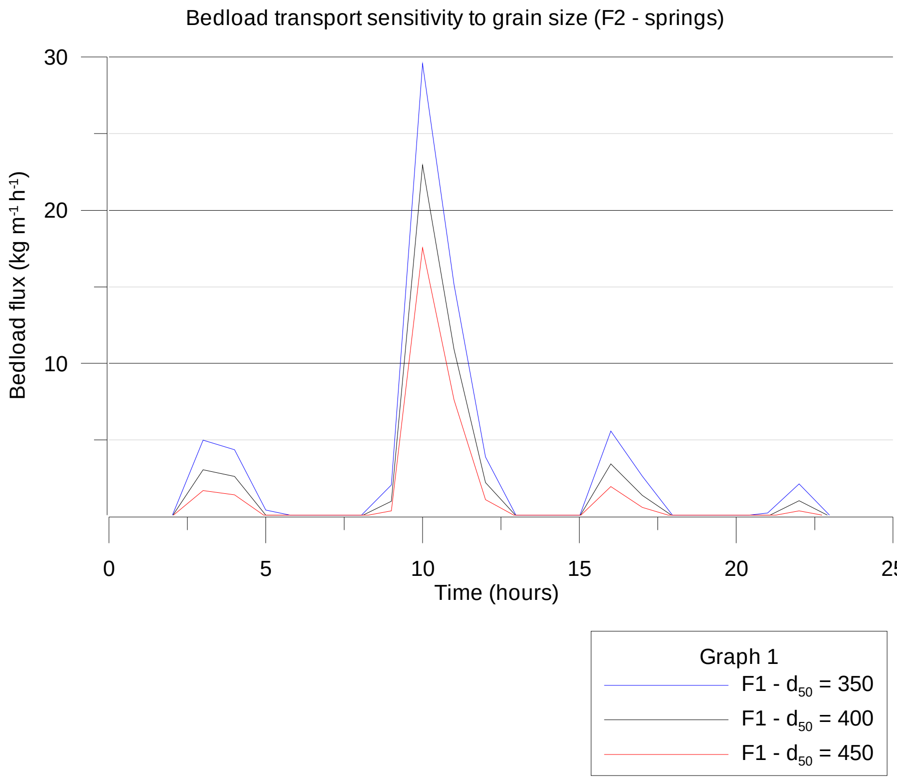


Figure 8.3: Van Rijn bedload transport sensitivity to grain size. Currents from ADV at F2 during spring tides. 350 µm, 400 µm and 450 µm investigated.

Table 8.2 shows the effect on the residual sediment flux over one tide when the grain size is varied. The residual bedload flux predicted varies by ~ 30% of the 400 µm prediction at F1 and ~ 60% at F2.

d_{50}	F1	F2
350	63	9
400	55	7
450	48	5

Table 8.2: Residual bedload flux over one tide at F1 and F2 during spring tides (kg m^{-1} $tide^{-1}$) using different values for median grain size; 350 µm, 400 µm and 450 µm.

These data suggest that programming a spatially varying grain size is likely to improve sediment transport formulations. Although, the largest proportional discrepancies are where current speeds are smaller (ebb flows and within the breakwater system at F2) but are likely to have less impact as sediment transport is also small. During the flood tide and at F1, proportional differences are smaller and suspended sediment transport becomes more important (Table 8.1).

8.4.2 Bedload transport at F1

Predicted bedload transport at F1 is up to ~17 x 10^{-6} m^2 s^{-1} (160 kg m^{-1} h^{-1}) on the flood tide; the residual is ~22 m^2 y^{-1}. Although this cannot be compared to observations at this site, this is within an acceptable range expected for bedload transport. Heathershaw (1981) measured bedload transport rates up to ~9x10^{-6} m^2 s^{-1} using tracer experiments in Swansea Bay. Bacon (2005) estimated transport rates of up to 22 x 10^{-6} m^2 s^{-1} over tombolo 7 by measuring bedform migration rates. These observations cannot be used to validate the bedload transport model, but do give an indication that the results generated are realistic.

8.5 Suspended sediment transport: Observed

8.5.1 Field measurements

Measurements made during the LEACOAST2 field deployments were used to calculate suspended sediment fluxes during spring and neap conditions. Suspended sediment concentrations were measured using an Acoustic Backscatter System (ABS) (Section 8.5.1.1) and currents using Acoustic Doppler Velocimeters (ADV) (Section 8.5.1.2).

8.5.1.1 Acoustic Backscatter System (ABS)

The ABS uses a sonar transducer to emit a short pulse of high frequency sound (0.5 – 5 MHz), typically about one metre above the bed. The backscattered signal is gated into range bins and digitised. As the sound pulse propagates towards the bed, sediment in suspension scatters sound back to the transducer. The bed also returns a strong signal which can give a time history of bed elevation change (Section 5.3.1). The backscattered intensity profile is inverted to give the sediment concentration profile between the instrument and the bed. Mass transport rate is the product of the sediment concentration and velocity profiles (Thorne and Hanes, 2002). Vincent and Hanes (2002) found a variability of +/- 30 % in the suspension observed due to a sequence of similar, regular waves. They suggest that in the natural environment where knowledge of bedforms is rarely good, one cannot expect to predict the suspended concentration to better than a factor of two.

Both F1 and F2 were fitted with ABS (Section 3.2.1.2) which sampled hourly for 20 minutes.

8.5.1.2 Acoustic Doppler Velocimeter (ADV)

Since their introduction in the mid 1990s, ADVs have become the primary instrument for high-frequency, high-resolution three-dimensional flow measurement (MacDonald, 2009). The ADV measures all three components of velocity in a remote (18 cm from the instrument) sampling volume to provide relatively undisturbed measurements of current. The acoustic sensor has one transmit transducer and three receiving transducers.

Three Sontek Hydra 5 MHz ADVs were deployed on the frame F1 measuring velocity at three elevations above the bed (hourly). Only one was deployed on the frame F2 (Section 3.2.1.4).

8.5.1.3 25 hour period of calm weather

In order to compare field measurements to calculations made using a tides only hydrodynamic model it is necessary to identify a period of ‘calm’ weather. A 25 hour period of “no waves” conditions was selected from the LEACOAST2 deployment 2.2 for spring and neap tides. Periods of no waves rarely exist so times where waves were small were identified (Figure 8.4).

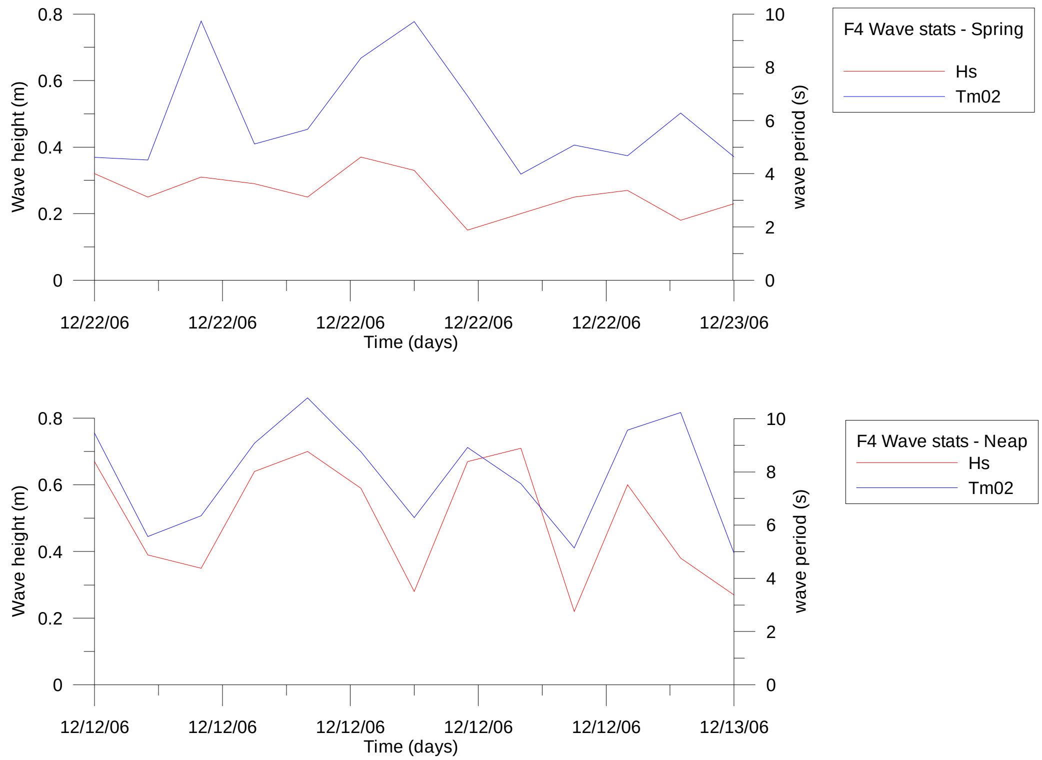


Figure 8.4: Wave statistics at F4 during periods of "no waves" identified at spring and neap. Significant wave height (H_s) and mean zero crossing period (Tm02).

8.5.2 Calculating suspended sediment flux at F1: Two ADVs

Coughlan (pers. comm.) derived burst-averaged (burst duration 20 minutes) concentration profiles C(z) from measurements made by the ABS (assuming a median grain size of 200 µm) and combined these with velocity profiles U(z) derived from top and bottom ADVs to calculate suspended sediment fluxes at F1. Mass transport rate is the integral of the product of C(z) and U(z) between 0 and 0.70 m.

Coughlan (pers. comm.) applied a log profile to current magnitude from the top and bottom ADV to provide a velocity profile through the water column. The shape of the velocity profile is determined by the effect of bed friction or drag. Equation 5.4 was used to calculate velocity (U) at z metres above the bed (Section 5.3.1). Coughlan (pers. comm.) calculated friction, velocity and bed roughness using velocity magnitudes from the two ADVs and a velocity profile was then generated every centimetre to an elevation of 0.70 m above the bed. This was multiplied by the concentration profile to give a profile of suspended sediment flux.

This method neglects any sediment in suspension at heights greater than 0.70 m from the bed. Figure 8.5 gives an example flux profile at peak spring flood flow from ABS and ADV measurements. During these conditions suspended sediment flux at 0.70 m from the bed is 0.015 kg m^{-2} s^{-1}. The black line extrapolates the data up and shows the approximate height above the bed suspended sediment flux is likely to be near zero (1.4 m). In this case a flux of up to 19.5 kg m^{-3} h^{-1} could be missed by neglecting suspended sediment above 0.70 m. This is just over 17 % of the 113.5 kg m^{-3} h^{-1} below 0.70 m.

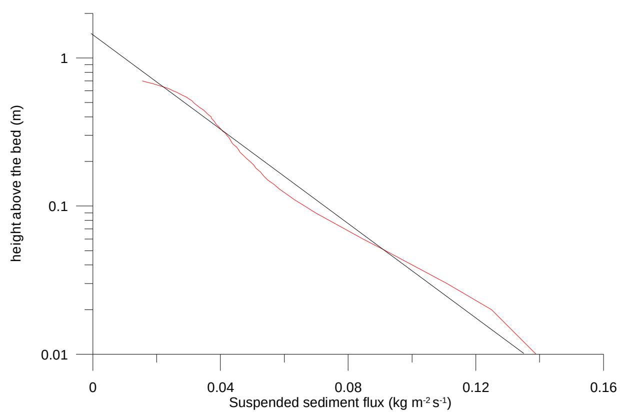


Figure 8.5: Suspended sediment flux profile during peak flood (F1 - spring) calculated from ABS and ADV measurements. Best fit extrapolating flux past 0.70 m.

8.5.3 Calculating suspended sediment flux at F2: One ADV

A concentration profile generated by Coughlan (pers. comm.) from F2 ABS data was combined with a velocity profile to give a profile of suspended sediment. Again, mass transport rate was calculated from the integral of the product of C(z) and U(z) between 0 and 0.70 m.

To calculate a velocity profile at F2 using only one measurement, an assumption about drag caused by the roughness of the sea bed must be made.

The drag coefficient, C_D can be determined using Equation 8.5

Equation 8.5

$$C_D = \left(\frac{u_*}{u}\right)^2 ,$$

Where, u is velocity at elevation measured.

During the tidal cycle C_D will vary as bed features change; steepness and orientation of bedforms, or bedforms wiped-out altogether (flat-bed). By calculating the drag coefficient at F1, an estimate of drag can be applied to the single velocity measurement at F2.

For the 25 hour period of "no wave" conditions investigated during spring tides at F1, the average drag coefficient was 0.00332 with a standard deviation of 0.00069. This is similar to the standard assumed value of 0.0025 (Sternberg, 1966). The drag coefficient used, alters the velocity profile and can significantly alter the sediment transport calculated. Figure 8.6 shows sediment concentration profile measured by the ABS at spring flood and ebb, the velocity profiles using different drag coefficients and the resultant sediment flux. Mean drag coefficient +/- one standard deviation was investigated. Sediment flux is a maximum where velocity is constant through the water column; this has been included as an upper limit to the observed data.

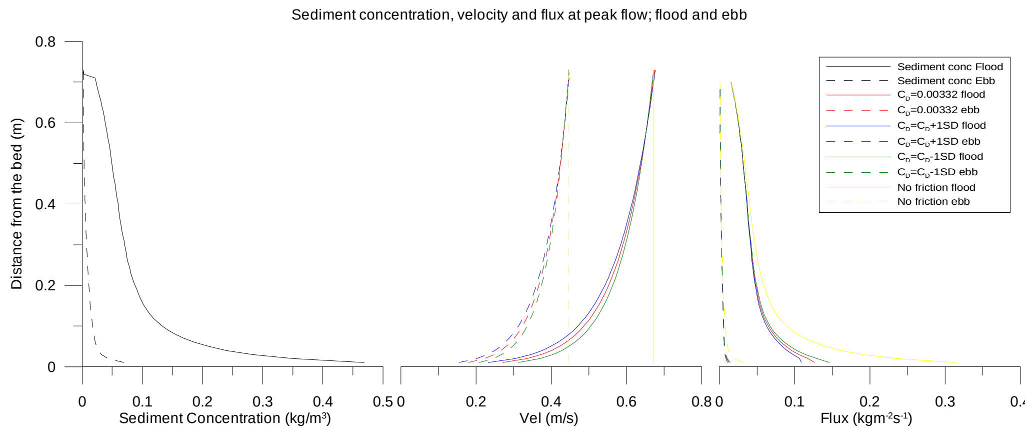


Figure 8.6: Concentration velocity and sediment flux profile from F1 experiment 2.2.

Figure 8.7 shows the effect of estimating the drag coefficient on calculated mass transport rates. This plot shows that there is little difference observed between using an average drag coefficient and using two ADV measurements.

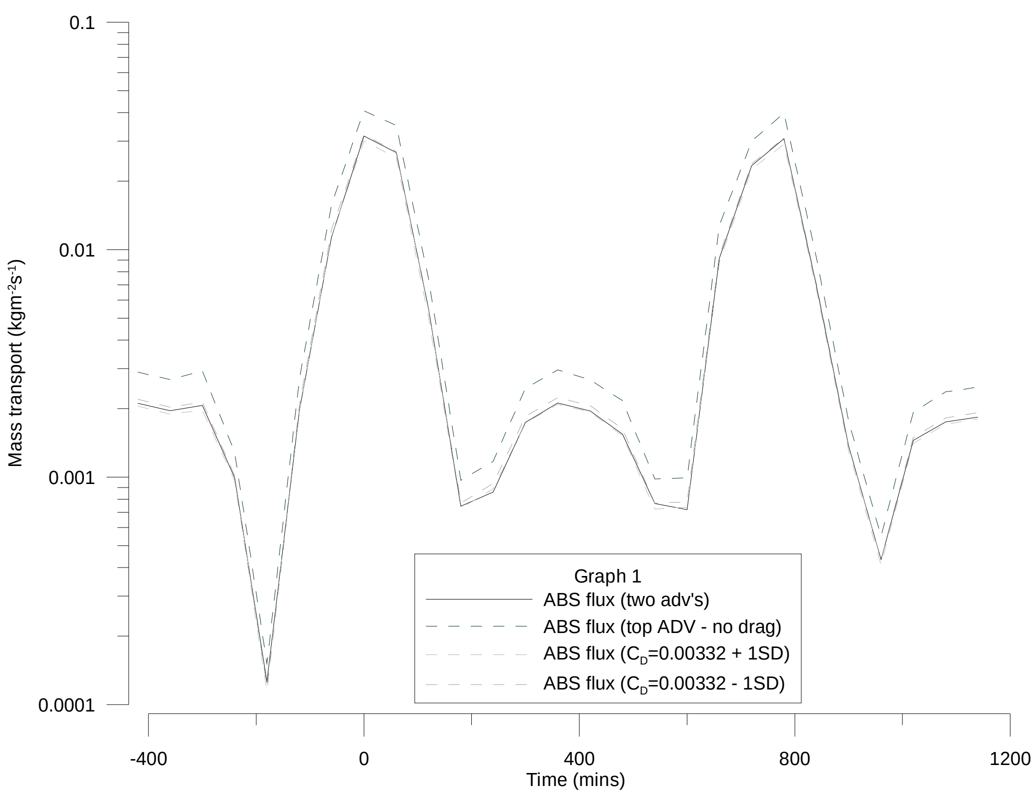


Figure 8.7: Comparison of the magnitude of the mass transport rates at F1 during two tidal cycles (spring) showing the effect of changing the drag coefficient by +/- 1 standard deviation.

The drag coefficient is assumed to be uniform between F1 and F2 and therefore the average at F1 is applied at F2 to calculate the velocity profile at this location.

8.5.4 Residual flux over a tidal cycle

For each suspended sediment flux profile, depths were summed and units converted to kg m^{-1} h^{-1} to give total flux over the hour. Flux magnitudes were split to flux in along-shore and cross-shore directions, and then integrated to give residual flux over 25 hours. Table 8.3 shows residual flux per tide for F1 and F2 for spring and neap tides. Residual flux at F2 has been calculated to be greater during neap tides. These data are taken from the second deployment in LEACOAST2 (winter 2006). Although "no waves" conditions were required it is very difficult to find a time period with no waves, especially during the winter months. It is clear that the neap period had higher wave activity than the spring period (Figure 8.4). Enhanced concentrations of suspended sediment can be expected when wave activity is higher, especially when coupled with shallow water at F2. Flux at F2 is very small at springs and neaps; 8 kg $m^{-1}tide^{-1}$ converted to a volumetric transport rate is just 0.003 m^2 $tide^{-1}$.

	direction	along-shore (+)	along-shore (-)	cross-shore (+)	cross-shore (-)	**residual**
F1 – spring	154	389	190	45	125	**107**
F1 – neap	130	122	77	40	38	**22**
F2 – spring	149	25	15	0	3	**5**
F2 – neap	164	47	33	0	9	**8**

Table 8.3: Sediment flux calculated from ABS and ADV measurements (kg m^{-1} $tide^{-1}$). Flux direction, total along-shore (+), towards the south-east, total along-shore (-), towards the north-west, total cross-shore (+), towards the north-east and total cross-shore (-), towards the south-west.

8.6 Suspended sediment transport: Modelled

A variety of sediment transport formulae were initially applied to the depth-average currents generated by the TELEMAC2D model to determine the most suitable formula to apply to all model nodes. Formulae included Englund and Hansen (1972, as cited in Soulsby, 1997), Ackers and White (1973, as cited in Soulsby, 1997) and Van Rijn (1984) total load equations. The suspended load fluxes calculated from the ABS and ADV data were compared to total load flux using these models; however this is only representative when suspended sediment transport is dominant (e.g. $u_* >> w_s$). It is also important to consider that calculated sediment flux from measurements do not include anything in suspension above 0.70 m from the bed.

Van Rijn's (1984) parameterised method for calculating sediment flux enables the user to calculate bedload and suspended load transport independently. The relative importance of bedload and suspended load can be investigated and a direct comparison between modelled suspended load and measured suspended load fluxes can thus be made.

The power law profile with Smith and McLean's (1977) reference concentration was investigated as an alternative method of modelling suspended sediment transport.

8.6.1 Van Rijn's parameterised method (1984)

Van Rijn (1984) parameterised the results of his full comprehensive theory of sediment transport in rivers in the formulae, Equation 8.6 to Equation 8.10.

Equation 8.6

$$q_t = q_b + q_s$$

Equation 8.7

$$q_b = 0.005\overline{U}h\left(\frac{\overline{U}-\overline{U}_{cr}}{\left[(s-1)gd_{50}\right]^{1/2}}\right)^{2.4}\left(\frac{d_{50}}{h}\right)^{1.2}$$

Equation 8.8

$$q_s = 0.012\overline{U}h\left(\frac{\overline{U}-\overline{U}_{cr}}{\left[(s-1)gd_{50}\right]^{1/2}}\right)^{2.4}\left(\frac{d_{50}}{h}\right)(D_*)^{-0.6}$$

with

Equation 8.9

$$\overline{U}_{cr} = 0.19(d_{50})^{0.1}\log_{10}\left(\frac{4h}{d_{90}}\right) \text{ for } 0.1 \le d_{50} \le 0.5 \text{ mm}$$

Equation 8.10

$$\overline{U}_{cr} = 8.5(d_{50})^{0.6}\log_{10}\left(\frac{4h}{d_{90}}\right) \text{ for } 0.5 \le d_{50} \le 2 \text{ mm}$$

q_t is the volumetric total load transport rate per unit width, q_b = volumetric bedload transport rate per unit width, q_s = volumetric suspended load transport rate per unit width, $\overline{U}$ = depth-average current speed, $\overline{U}_{cr}$ = threshold depth-average current speed, $s = \rho_s / \rho$ ratio of densities of grain and water, g = acceleration due to gravity, d_{50} = median grain diameter, h = water depth.

Figure 8.8 and Figure 8.9 show modelled suspended sediment flux at F1 and F2 (black line). Modelled fluxes using Van Rijn's (1984) parameterised method for calculating suspend sediment transport and depth-average currents from TELEMAC2D (d_{50} = 400μm) are of the order of 10 times those calculated from the product of the ABS concentration profiles and the logarithmic velocity profiles at F1 and 100 times at F2. Currents are known to be over predicted by the model (Section 5.2.3, and 7.4), in order to test the sediment transport model, modelled depth-average currents were replaced with measured currents taken from ADVs on the instrument frames (using the log profile to estimate depth-average current). Fluxes calculated using this method are represented by the blue line in Figure 8.8 and Figure 8.9. This gives improved results although Van Rijn's (1984) transport model shows higher than observed fluxes by a factor of ~4. It is therefore evident that a different model should be considered.

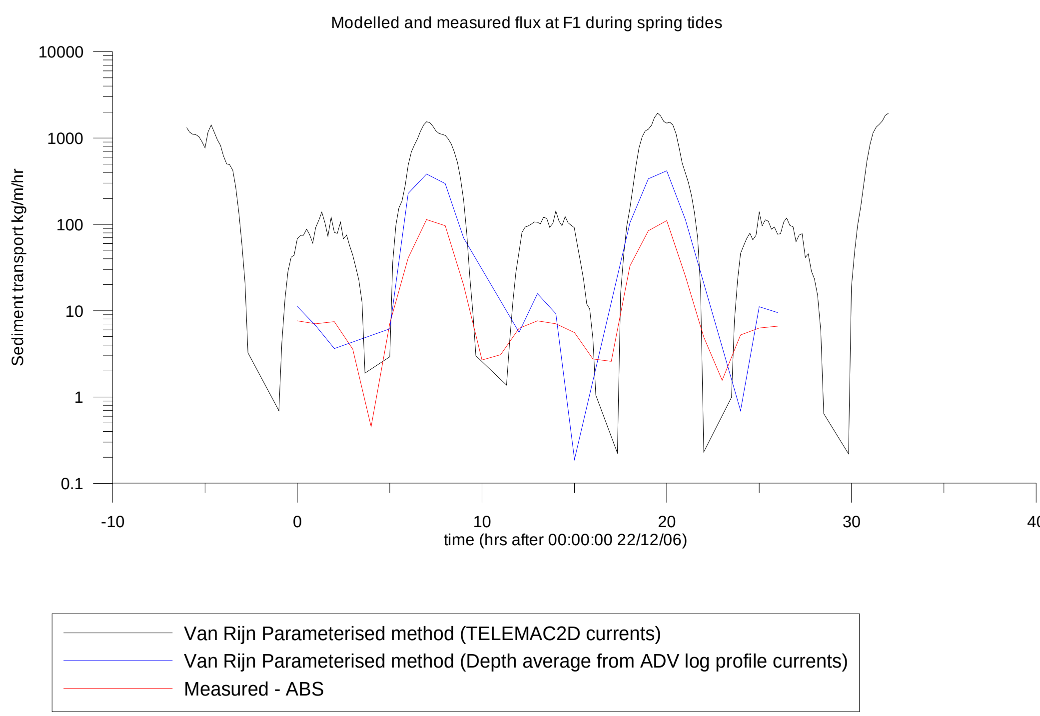


Figure 8.8: Suspended sediment transport at F1. Van Rijn's (1984) parameterised method using modelled currents from TELEMAC2D and measured currents from ADVs. Calculated transport from ABS and ADV measurements. D_{50} = 400µm.

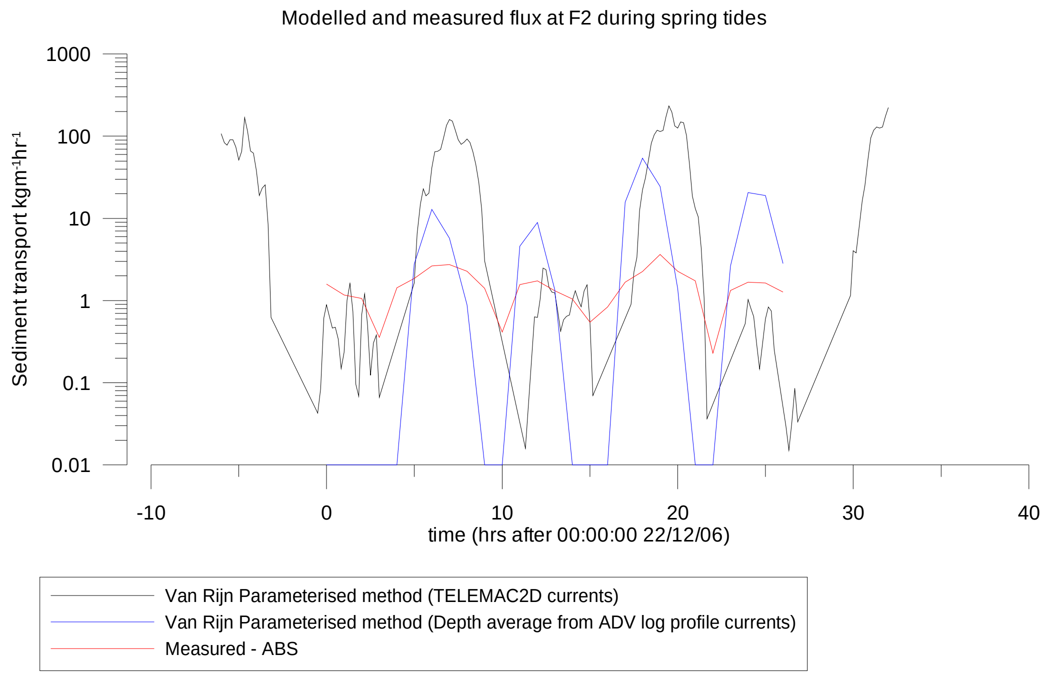


Figure 8.9: Suspended sediment transport at F2. Van Rijn's (1984) parameterised method using modelled currents from TELEMAC2D and measured currents from ADVs. Calculated transport from ABS and ADV measurements. D_{50} = 400μm.

8.6.1.1 Over estimation of current speed

Figure 8.10 shows the difference between modelled and measured depth-average current velocities at F1 which accounts for some of the observed differences in suspended sediment flux results. Measured depth-average currents are calculated by finding the current at 40 % of the water-depth (Section 3.1.1.1). In the case of the ADCP (Chapter 3), the bin at this depth is used. A log profile is applied to ADV data to calculate the velocity at this depth.

Although model performance statistics have shown that TELEMAC2D performance for current generation at F1 during spring tides is "excellent", (Section 5.2.3) modelled current speeds exceed those measures by up to 25% during this time period (confirmed by float tracks, Chapter 6). It is evident therefore that using measured depth-average currents while testing transport formulae will give a more realistic comparison to observed fluxes. Once the transport models have been tested, TELEMAC2D currents can be used to extend the transport model over the whole domain. These currents have been shown to be representative within the breakwater system (Chapter 6).

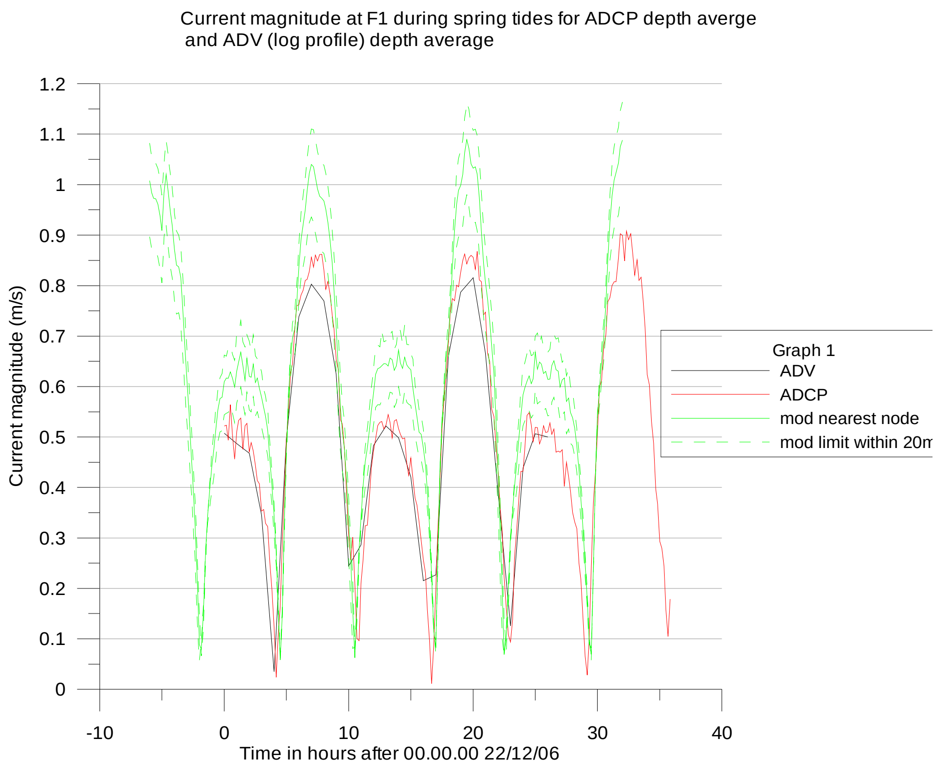


Figure 8.10: Current magnitude at F1 (spring). ADPC and ADV measurements and TELEMAC2D model.

8.6.2 Power law profile using Smith and McLean's (1977) reference concentration

Measured suspended sediment fluxes were generated by combining a concentration profile of suspended sediment from the ABS with a velocity profile created using measured currents from the ADVs (Section 8.5.2). In the same way, a modelled suspended sediment concentration profile can be combined with modelled currents to give suspended sediment flux. Modelled velocity and concentration profiles are integrated over the same limits as those used in the calculations from measured data. Sediment fluxes calculated from measurements and modelled data are therefore directly comparable.

Sand in suspension is a counterbalance between the settling of grains towards the bed and diffusion of sand upwards due to turbulent water motions near the bed (Section 8.1.3). Equation 8.11 governs this balance (Soulsby, 1997).

Equation 8.11

$$w_s C = -K_s \frac{dC}{dz}$$

Where, w_s = settling velocity of sediment grains, C = volume concentration of sediment at height z, K_s = eddy diffusivity of sediment.

Eddy diffusivity depends on the turbulence in the flow and the height above the bed. If eddy diffusivity is assumed to increase linearly with height above the bed, the corresponding concentration profile is the power law profile (Equation 8.12).

Equation 8.12: power law profile

$$C(z) = C_a \left(\frac{z}{z_a} \right)^{-b}$$

Where, C(z) = sediment concentration at height z, C_a = sediment reference concentration at height = z_a, b= Rouse number (Equation 8.13)

Equation 8.13: Rouse number

$$b = \frac{w_s}{\kappa u_*}$$

Where, κ = von Karmans constant = 0.40, u_* = total frictional velocity.

The reference concentration C_a and reference height z_a must be specified to make predictions of concentration (Soulsby, 1997). Garcia and Parker (1991) tested seven expressions for C_a and z_a against a large data set and concluded Smith and McLean's (1977) reference concentration was one of the best two (Equation 8.14).

Equation 8.14: Smith and McLean's (1977) reference concentration and reference height

$$C_a = \frac{0.00156 T_s}{1 + 0.0024 T_s}$$

$$z_a = \frac{26.3 \tau_{cr} T_s}{\rho g (s-1)} + \frac{d_{50}}{12}$$

Where, C_a = concentration at height z_a, z_a = reference height, τ_{cr} = threshold bed shear stress for motion of sediment, $T_s = (\tau_{0s} - \tau_{cr}) / \tau_{cr}$, τ_{0s} = skin friction bed shear-stress, d_{50} = median grain diameter, g = acceleration due to gravity, $s = \rho_s/\rho$, ρ_s = density of sediment material, ρ = density of water.

Equation 8.12 to Equation 8.14 were used to calculate concentration profiles at F1 and F2 every cm to 0.70 m above the bed for a 25 hour period, using a median grain diameter in suspension of 200 µm (Section 8.2.2). These were combined with the velocity profiles from the ADVs to give a profile of sediment flux (measured rather than modelled velocities were used whilst the model was tested). The sediment flux profile was integrated and units converted to kg m^{-1} h^{-1} to give total flux over each hour. The solid orange line in Figure 8.11 and Figure 8.12 shows these calculated fluxes at F1 and F2. These calculated fluxes give a better fit to the observed data (solid red line) than the Van Rijn (1984) method (solid blue line).

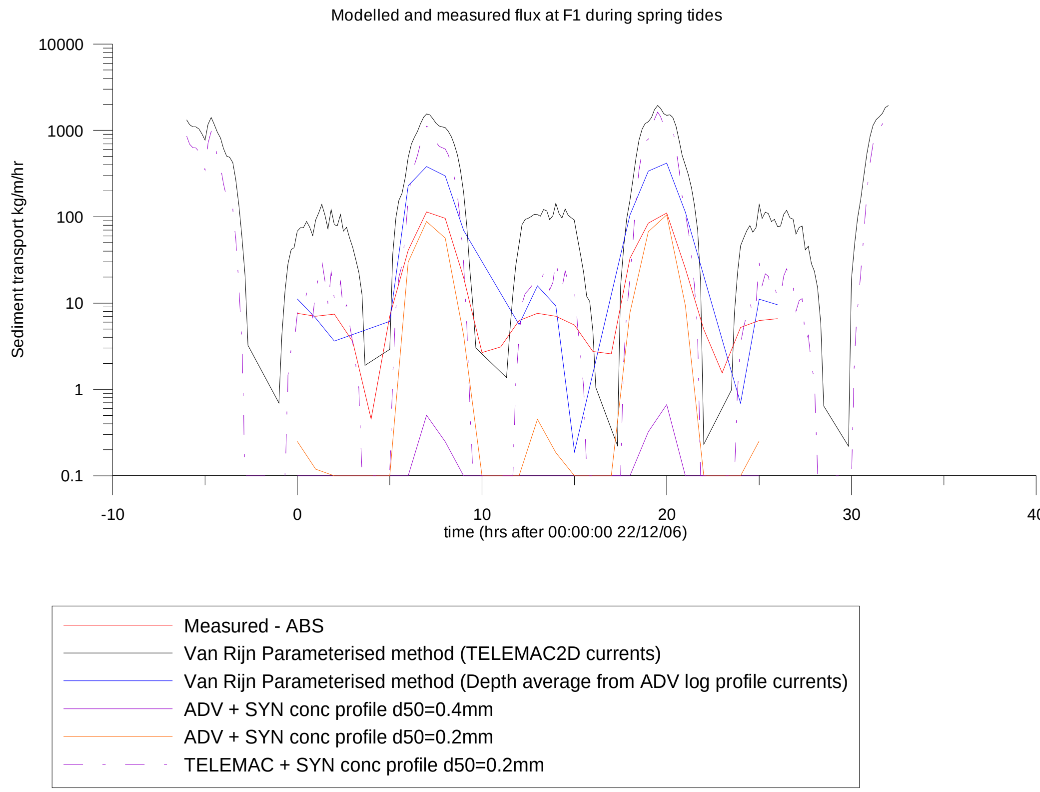


Figure 8.11: Modelled and measured flux at F1 (spring).

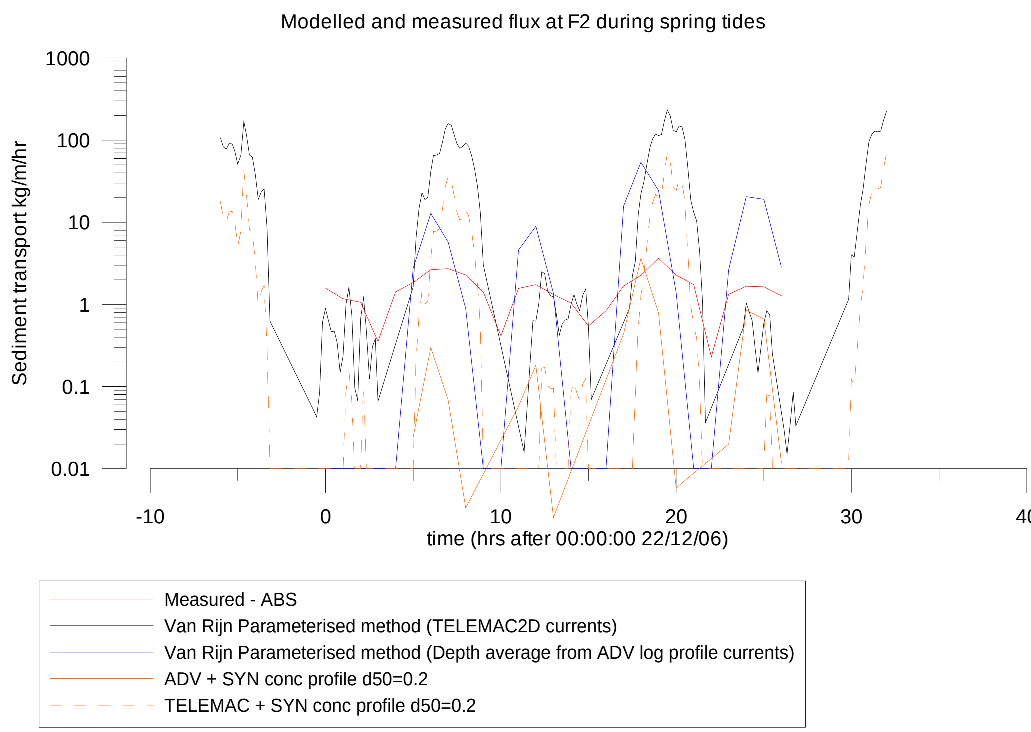


Figure 8.12: Modelled and measured flux at F2 (spring).

The power law method (yellow line) is plotted with the Van Rijn (1984) suspended sediment method (green line), observations (red line) and other total load models referred to in Section 8.6 in Figure 8.13. It is clear that the concentration profile generation method produces results that match the observations the best. The other lines highlight total load equations and are included to give an indication of the range of results prediction equations give. This figure demonstrates a variation by a factor of 4 for both suspended and total load predicted by the different models using these data at F1 springs. Soulsby (1997) found variation in predictions of total load by a factor of 2.

Transport equations assume that suspended sediment is in equilibrium with the flow and bed conditions at that point. This is unlikely to be the case in this environment and is highlighted by the concentration of sediment in suspension not dropping to zero when current speeds do (Figure 8.12). The large differences between suspended sediment in the samples and those modelled could be caused by this lag in time and possibly space.

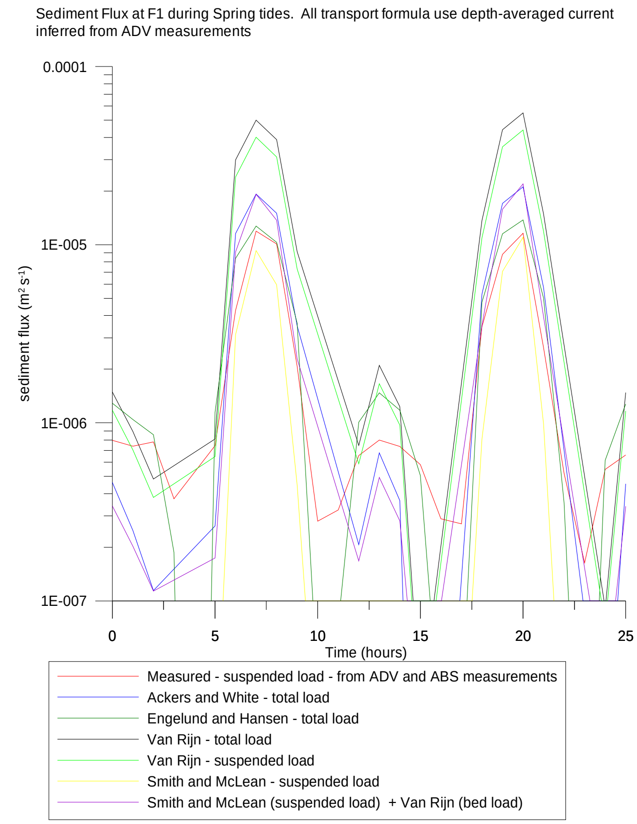


Figure 8.13: Suspended sediment flux calculated at F1 during spring conditions. Values are clipped at 10^{-7} m^2 s^{-1}.

8.6.3 Residual suspended sediment flux over a tidal cycle ($kg\ m^{-1}\ tide^{-1}$)

Modelled suspended sediment flux magnitudes were split to flux in x and y directions, then integrated to give residual flux over 25 hours. Table 8.4 shows residual flux per tide for F1 and F2; springs and neaps.

	F1 - spring	F1 - neap	F2 - spring	F2 - neap
Van Rijn (ADV currents)	347	31	36	31
Van Rijn (TELEMAC2D currents)	3034	297	296	6
Smith and McLeans ref conc (ADV currents)	88	1	4	1
Smith and McLeans using reference concentration from TELEMAC2D currents	2016	51	59	0
Measured - ABS	107	22	5	8

Table 8.4: Modelled and measured suspended sediment flux over one tide (kg m 1 tide 1) (d50 = 400 µm on the bed d50 = 200 µm in suspension).

The method utilising Smith and McLean's (1977) reference concentration to calculate suspended sediment flux was applied to the model domain as it has been shown to give the best results (Table 8.4). The model overestimates current speeds by up to 25 % during this time period, which contributes to an overestimation of sediment flux by an order of magnitude. Model performance statistics have shown the modelled velocities to have an "excellent" fit to measured velocities. Magnitude of flow applied to the model boundaries was experimented with, but reducing the magnitude of the forcing data caused larger discrepancies during ebb flow. This is a problem associated to forcing TELEMAC2D with measurements made nearshore, with a domain which extends >1 km offshore. Further work could investigate more appropriate methods of removing the effect of currents collected in shallow water. This could include a short deployment to collect concurrent measurements at Walcott and a site > 1 km offshore.

8.7 Total sediment flux over the domain

8.7.1 Bedload

Van Rijn's (1984) parameterised method for bedload transport prediction (Section 8.4) was applied over all nodes of the model using depth-average currents and water-depths generated during TELEMAC2D simulations (d_{50} = 400 µm). Residual transport over one tide was determined by summing transport vectors. Figure 8.14 shows residual transport over one spring tide over the model domain.

The LEACOAST2 monthly bathymetry surveys have identified the existence of sandwaves in the offshore (Section 8.8.3.1). Migration of these large bed features identified by analysis of subsequent sequential surveys, gives an indication of bedload transport rates using Equation 8.15. Calculations are corrected for porosity by multiplying by (1 - n) where *n* is porosity amounting to 0.40 (Hoekstra et al., 2004).

Equation 8.15: Volumetric bedload transport rate (Hoekstra et al., 2004).

$$q_b = cfH$$

Where, c = migration rate, H = bedform height and f = 0.5, a dimensionless form or shape factor, assuming a triangular bedform (Hoekstra et al., 2004).

The volumetric bedload transport rate calculated on line 2 (Figure 8.38) on the offshore side of breakwater 6 is 45 $m^2 y^{-1}$. This equates to an average of two sandwaves moving over a period of five months. The predicted residual bedload transport rate for this location using the Van Rijn (1984) method and TELEMAC2D currents is 150 – 190 $m^2 y^{-1}$. The model over predicts bedload transport by a factor of 3.5 at this location. On line 3 the volumetric transport rate calculated from sandwave migration decreased from 75 $m^2 y^{-1}$ through 60 $m^2 y^{-1}$ to 48 $m^2 y^{-1}$ along a 1 km length, toward the south-east. Predicted bedload transport rates for this same location varied from 95 $m^2 y^{-1}$ decreasing to 56 $m^2 y^{-1}$ in a south-eastward direction. At this location the transport model produces predictions very close to calculations from observations.

The over prediction of bedload transport offshore breakwater 6 is likely to be linked to the over prediction of currents outside the breakwater line. The close fit of observed to predicted bedload transport results further offshore on line 3, could suggest that the TELEMAC2D flow model better represents the observed tidal magnitudes further offshore. Unfortunately there is no observed flow data in this area to verify this.

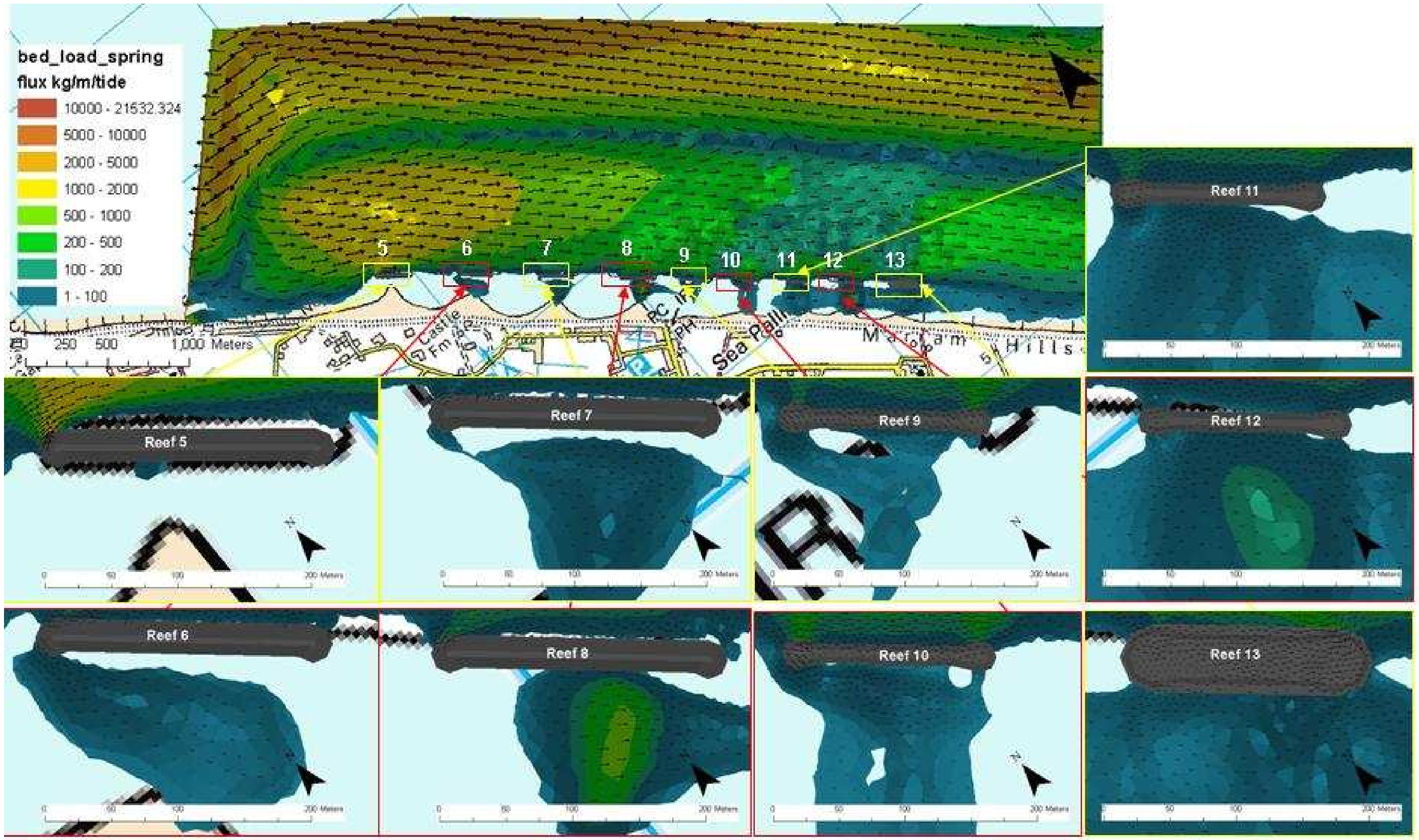


Figure 8.14: Bedload transport over one spring tidal cycle. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service). N.B. base map is present in all images

8.7.2 Suspended load

Smith and McLean's formulation (Section 8.6.2), with 200μm for d_{50} was applied to all nodes in the model domain (Figure 8.15).

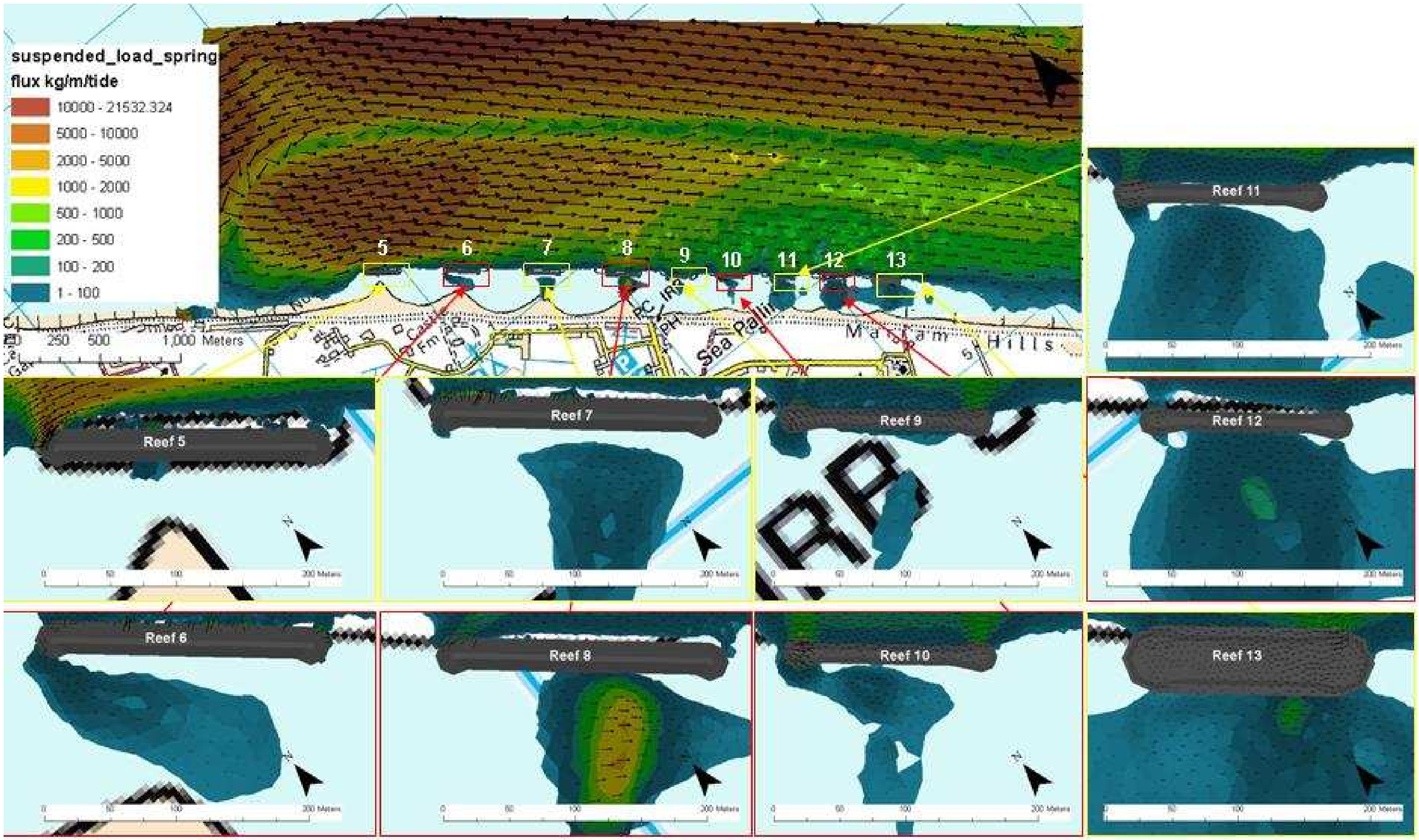


Figure 8.15: Suspended load transport over one spring tidal cycle. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service) **N.B. base map is present in all images**

8.7.3 Total load

Suspended load and bedload have been summed to give total load sediment transport. Figure 8.16 to Figure 8.25 show residual total load transport over one spring tide and Figure 8.26 to Figure 8.35 show residual total load transport over one neap tide.

8.7.3.1 Spring

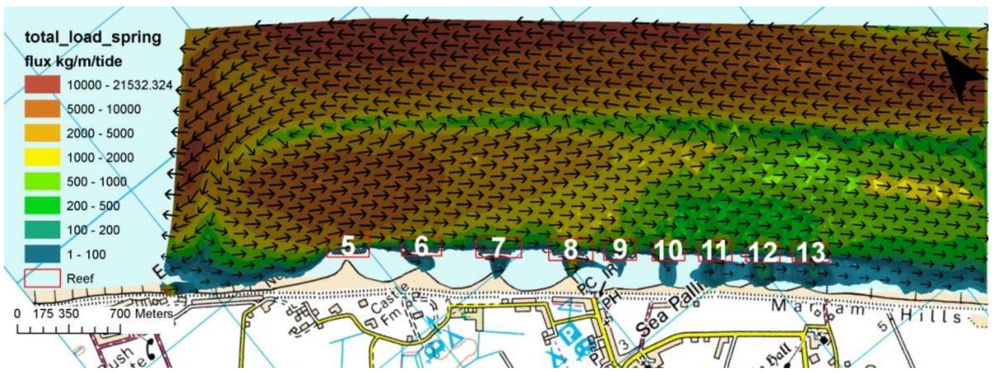


Figure 8.16: Total load sediment transport over one spring tide - summary. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service) N.B. base map is present in all images.

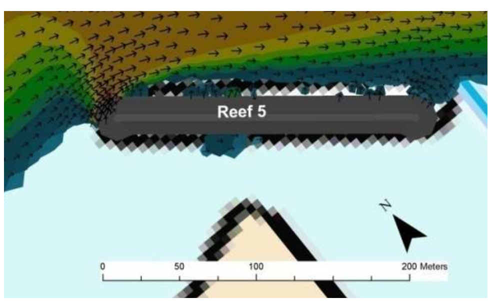


Figure 8.17: Total load sediment transport over one spring tide - breakwater 5.

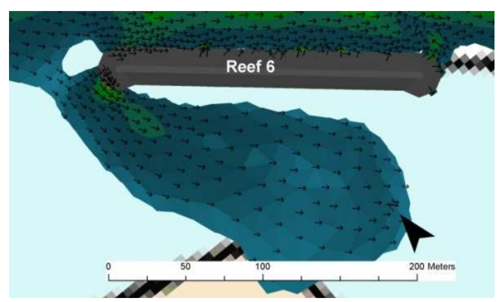


Figure 8.18: Total load sediment transport over one spring tide - breakwater 6.

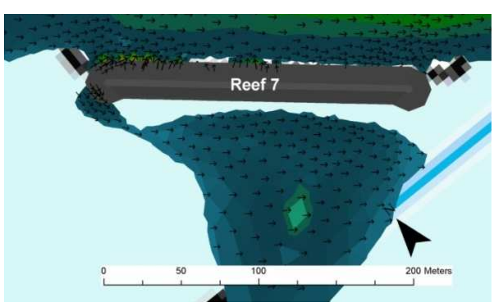


Figure 8.19: Total load sediment transport

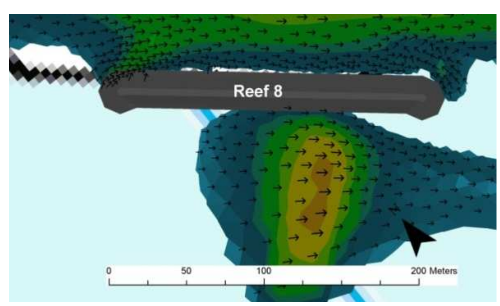


Figure 8.20: Total load sediment transport

over one spring tide - breakwater 7.

over one spring tide - breakwater 8.

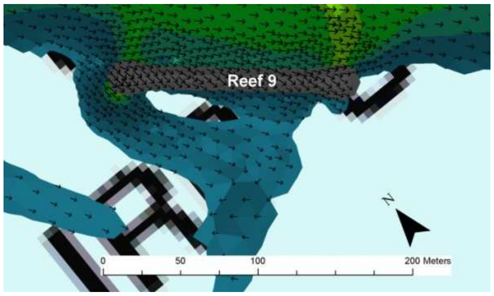


Figure 8.21: Total load sediment transport over one spring tide - breakwater 9.

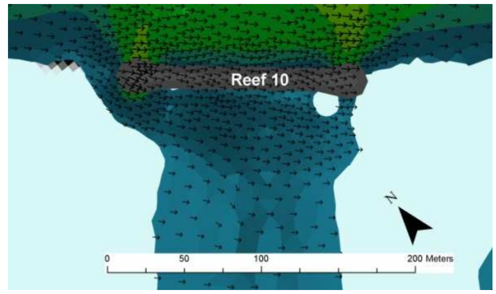


Figure 8.22: Total load sediment transport over one spring tide - breakwater 10.

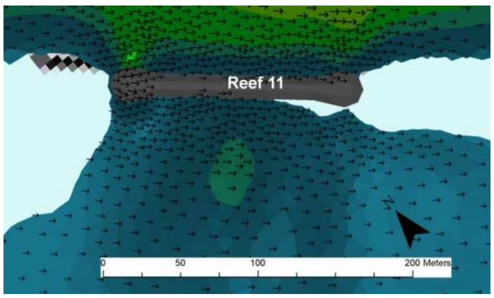


Figure 8.23: Total load sediment transport over one spring tide - breakwater 11.

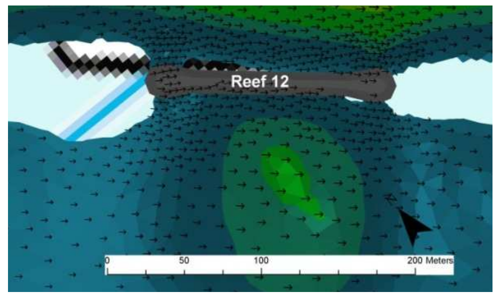


Figure 8.24: Total load sediment transport over one spring tide - breakwater 12.

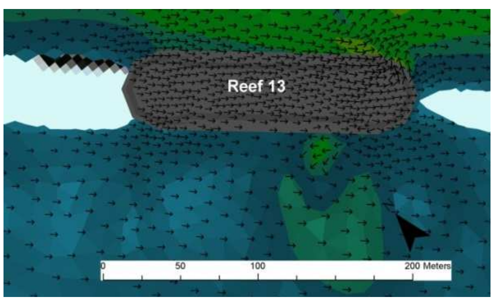


Figure 8.25: Total load sediment transport over one spring tide - breakwater 13.

8.7.3.2 Neap

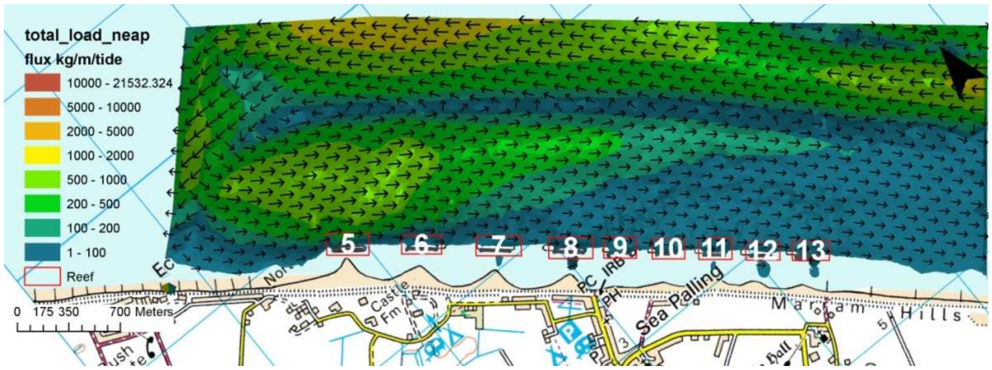


Figure 8.26: Total load sediment transport over one neap tide – summary. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

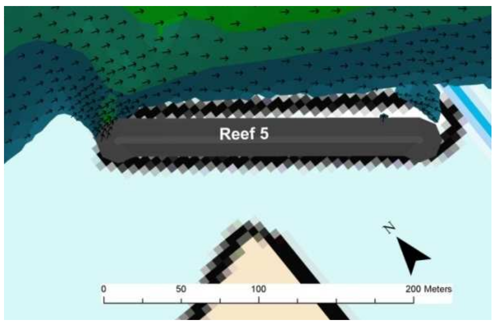


Figure 8.27: Total load sediment transport over one neap tide - breakwater 5.

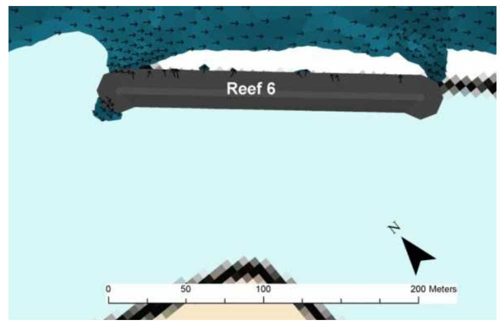


Figure 8.28: Total load sediment transport over one neap tide - breakwater 6.

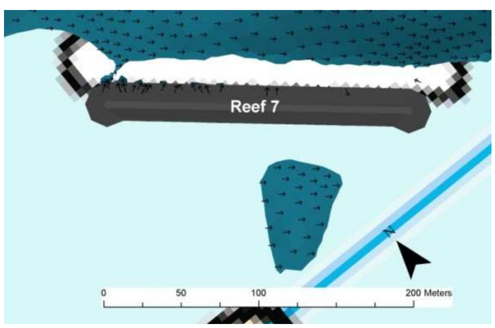


Figure 8.29: Total load sediment transport over one neap tide - breakwater 7.

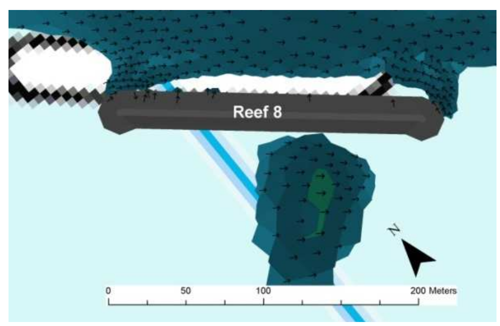


Figure 8.30: Total load sediment transport over one neap tide - breakwater 8.

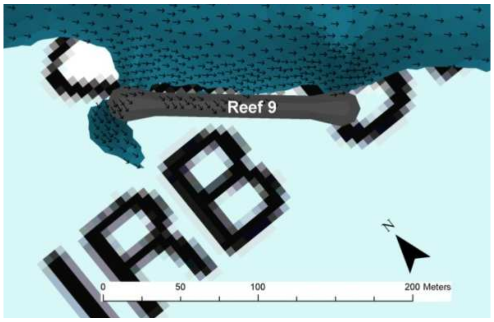


Figure 8.31: Total load sediment transport over one neap tide - breakwater 9.

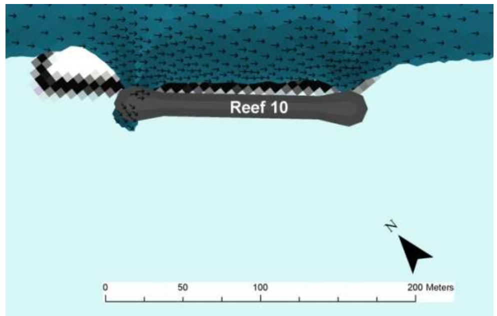


Figure 8.32: Total load sediment transport over one neap tide - breakwater 10.

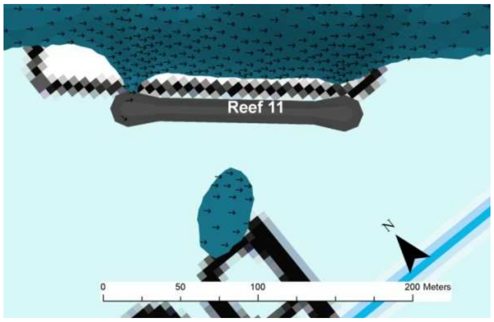


Figure 8.33: Total load sediment transport over one neap tide - breakwater 11.

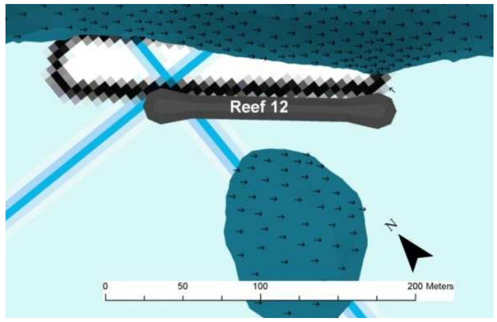


Figure 8.34: Total load sediment transport over one neap tide - breakwater 12.

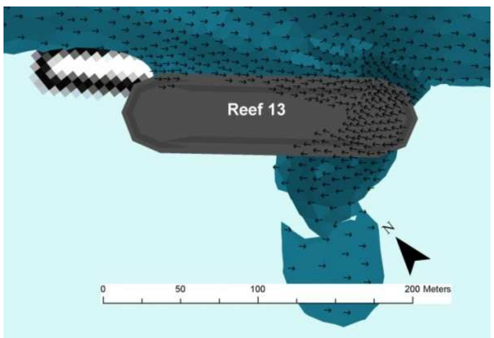


Figure 8.35: Total load sediment transport over one neap tide - breakwater 13.

8.8 Pathways

8.8.1 General pathways

Modelled total load sediment transport pathways can be identified in Figure 8.16 to Figure 8.35. These diagrams show residual sediment transport for spring and neap tides over the model domain. Sediment transport paths are mainly shore-parallel as identified in the summary images for spring (Figure 8.16) and neap (Figure 8.26). These figures highlight residual sediment transport to the south-east in near-coast regions (300 – 1 000 m). Transport direction in offshore regions (1 000 m – 2 000 m) is to the north-west.

Current data collected from all instrument deployments during LEACOAST2 highlight asymmetry in flow magnitude; speed is higher during flood conditions than ebb conditions. Peak tidal flow to the south-east occurs at HW, peak flow to the north-west occurs at LW. Drag caused by bed friction has more effect on current magnitude at LW slowing the north-westward flow. Dominant sediment transport direction was therefore expected to be to the south-east. These model results could suggest that the model domain extends into water-depths where bottom friction has a nearly equal effect on velocity at high and low water. Although this feature is more likely to be a modelled artefact associated with the continuity model. As the offshore boundary is solid, no flow is allowed to cross this edge of the model, constraining water movement. The offshore flow is mainly shore parallel which is why this set up is valid but it is possibly responsible for these inconsistencies. A short investigation into offshore residual current direction and observations from migrating sandwaves identified in survey tracks is described in Section 8.8.3.1.

Transport pathways inside and near the breakwaters are less uniform. Higher high water-levels at spring tides allow limited sediment movement on the shoreward side of breakwater 5 toward the south-east (Figure 8.17). Significant transport rates are observed over tombolos 6, 7 and 8 of up to 2 000 kg m^{-1} $tide^{-1}$ (over tombolo 8) during spring tides (Figure 8.18 to Figure 8.20). Particularly high residual transport rates are experienced in these areas as they dry and are not exposed to the ebb north-eastward flow; sediment is only mobile during the south-eastward flow.

During spring tide conditions there is net sediment transport out of phase one embayments on the south-eastward side of each phase one breakwater (Figure 8.17 to Figure 8.20). No sediment transport is seen in phase one embayments. Sediment is mobile over much of phase two, particularly towards the shallower south-eastern end (breakwater 13). Figure 8.21 shows an input of sediment to the system where phase one and two meet (between breakwater 8 and 9). The transport pathway in phase two is shore-parallel to the south-east.

During neap tides, sediment remains immobile over much of phase one and two. The exceptions are over tombolo 8, and salients 12 and 13 where modest transport is observed. The pattern of net sediment transport out of phase one on the south-eastern side of each phase one breakwater is consistent during neap tides with the exception of breakwater 7 (Figure 8.27 and Figure 8.30). There is a small sediment supply from the offshore at the north-western end of breakwaters 9 and 10 but there is otherwise no transport in this part of phase two (Figure 8.31 and Figure 8.32). There is modest transport over salient 12 and 13, where transport near breakwater 13 is in a north-westward direction (Figure 8.35).

The validity of modelled sediment transport direction in the offshore is examined in the next sections. The offshore model boundary extends to 2.2 km offshore to ensure boundary effects do not influence results in the location of breakwaters and immediate areas either side. Model design was never intended to investigate areas further offshore.

8.8.2 Transport direction indicator: Offshore residual current; LEACOAST1 ADPC deployment

8.8.2.1 Location and nature of deployment

As part of the LEACOAST1 project an ADCP was deployed for a 14 day period over 3 km offshore (Figure 8.36) in 18 m maximum water-depth. The ADCP was deployed on the sea bed in a trawl-resistant stainless steel frame from a small survey boat. The frame was marked with a surface marker tethered with a clump weight away from the frame. Wave statistics and currents were measured every hour (Taylor and Dolphin pers. comm.).

Residual flow from this instrument will give an indication of sediment transport direction in the offshore.

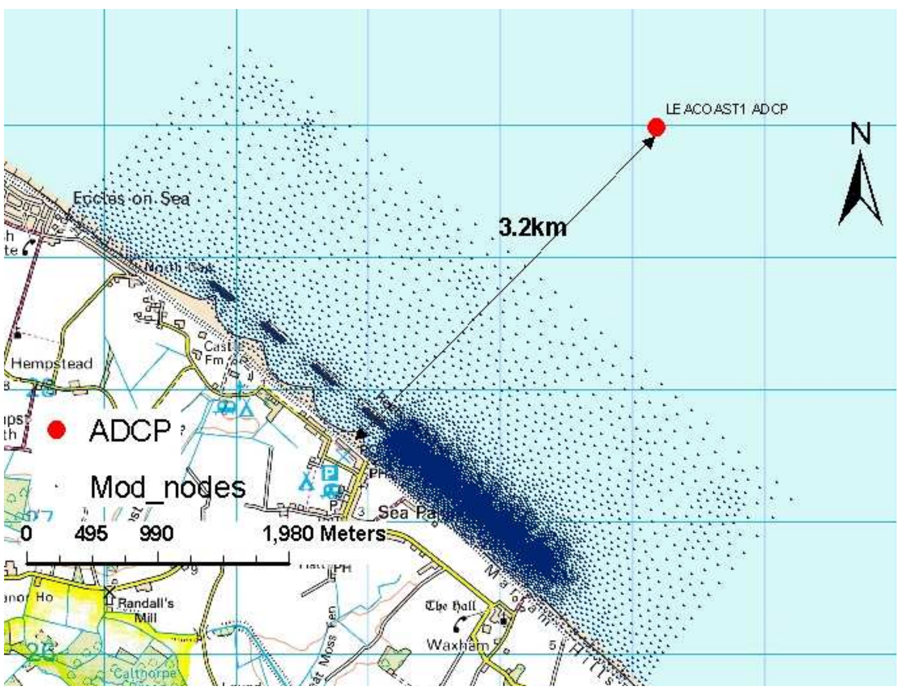


Figure 8.36: Position of LEACOAST1 offshore ADPC deployment. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

8.8.2.2 Currents measured: Residuals

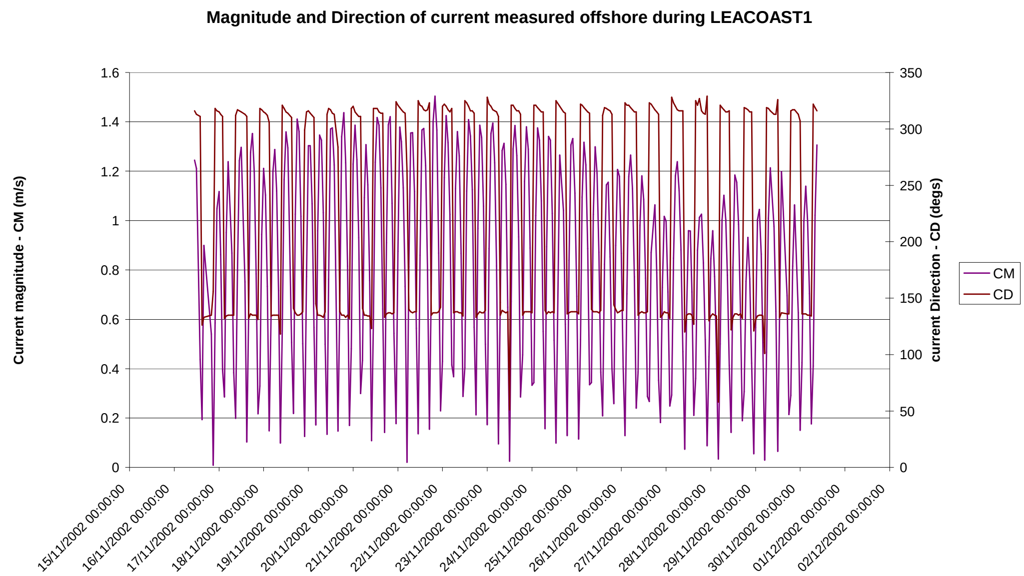


Figure 8.37: Current magnitude (CM) and current direction (CD) from the LEACOAST1 ADCP (figure from Taylor pers. comm.).

Measured currents show peak velocity at high and low water as expected for this section of the coastline. Peak velocity is toward the south-east at HW and north-west at LW. Peak current magnitudes range from 1.4 m s^{-1} at springs to 0.9 m s^{-1} at neaps (Figure 8.37). There is no evidence of a shallow water effect causing higher velocities at HW than at LW, as observed at Walcott and in all LEACOST2 deployments (Section 3.2).

Residual current over the 14 day period shows a residual velocity of 10.73 m/14days toward the north-west. This magnitude is insignificant, although the lack of transport toward the south-east is significant.

8.8.3 Transport direction indicator: Sandwaves

Sandwaves have been observed seaward of the breakwater line in Argus camera images (Section 3.2.5), X-band radar (Section 3.2.4) and survey tracks (Section 3.2.3.2). These bed features are of the order of one metre high and 100 metres long.

8.8.3.1 Sandwaves identifiable in survey tracks

Figure 8.38 to Figure 8.41 show three examples of bottom profiles, from four consecutive surveys between July and December 2006. The bottom profiles from the shore-parallel survey line 250 m seawards of the breakwaters (line 2) show two distinct sandwaves between 600 m and 800 m from the north-west end of the breakwater system (Figure 8.41). These sandwaves are asymmetric with their steep slope on the south-eastern side. Lines coloured by date confirm that these features are migrating toward the south-east at a speed of ~0.15 m per tide. Sandwaves found on line 3 (Figure 8.40), approximately 450 m from the breakwaters are longer, taller, and more symmetric than those found on line 2. Sandwaves also occur more frequently in this area. Although sandwaves here are more symmetric in shape there is migration trend towards the north-west between July and October with a net migration toward the south-east over the full five month period of up to ~0.07 m per tide. Mobile bed features cannot be identified in the extract from line 5 ~850 m offshore (Figure 8.39). Features present in this survey line are consistent in all surveys giving no indication of residual transport.

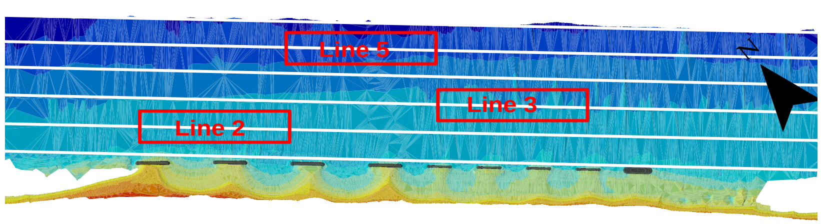


Figure 8.38: Sandwaves: Survey track and bottom profile locations.

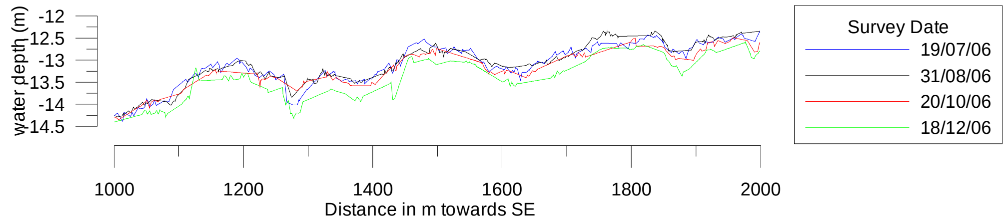


Figure 8.39: Bottom profiles from survey track north-west to south-east: Line 5 (winter 2006).

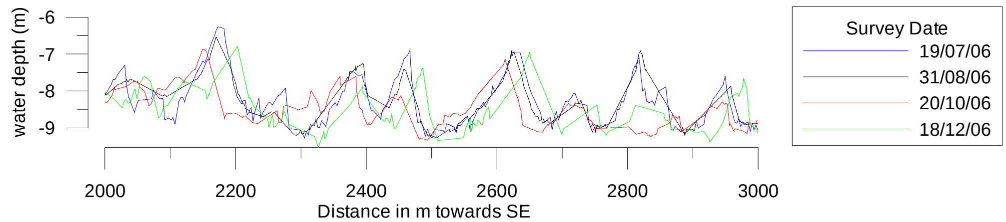


Figure 8.40: Bottom profiles from survey track north-west to south-east: Line 3 (winter 2006).

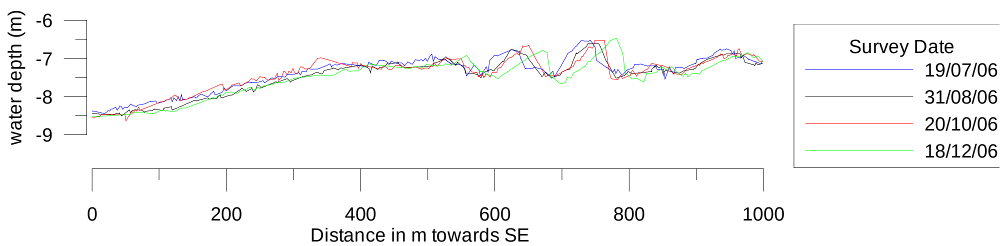


Figure 8.41: Bottom profiles from survey track north-west to south-east: Line 2 (winter 2006).

8.8.4 Summary

Residual current direction measured at the offshore LEACOAST1 ADCP and identified migration of sandwaves give support to the observed model residual transport patterns in the offshore. The offshore area of residual transport to the north-west is close to the offshore boundary. This has been shown to be most likely an artefact, but is outside the area of interest for this study.

8.9 Annual sand fluxes due to tides

The fluxes in Section 8.5.4 are for typical spring and neap tide 'no-wave' conditions. To determine annual transport rates TELEMAC2D was run over a single 14 day spring-neap period and integrated up to a full year.

8.9.1 Spring-neap cycle

A 14 day period of "no waves" conditions was identified between 15th April 2007 and 28th April 2007. Currents were generated for this period using TELEMAC2D. Bedload, suspended load and total load transport rates were calculated. Figure 8.42 shows a summary of residual total load sediment flux over the model domain for the 14 day period.

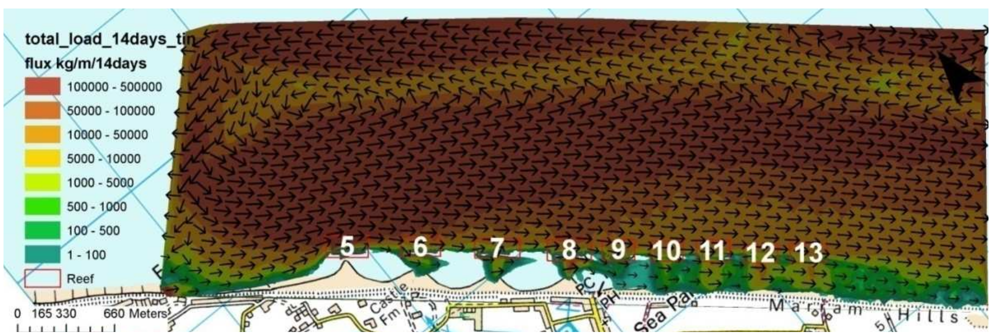


Figure 8.42: Total load sediment flux over a spring-neap cycle (14 day model run). (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

8.9.2 Flux over one year

Total load fluxes over 14 days were integrated up to give an indication of flux over a 12 month period (Figure 8.43 to Figure 8.52). Sediment flux seaward of the breakwaters is toward the south-east and has a magnitude of up to 5 000 000 kg m^{-1} y^{-1} seaward of breakwater 5, this is ~1 886 m^2 y^{-1} expressed as a volumetric transport rate (volume of grains moving per unit time, per unit width of bed) (Soulsby, 1997). For context, Vincent (1979) calculated a littoral transport in the surf and swash zone driven by breaking waves of 150 000 m^3 y^{-1} toward the south-east.

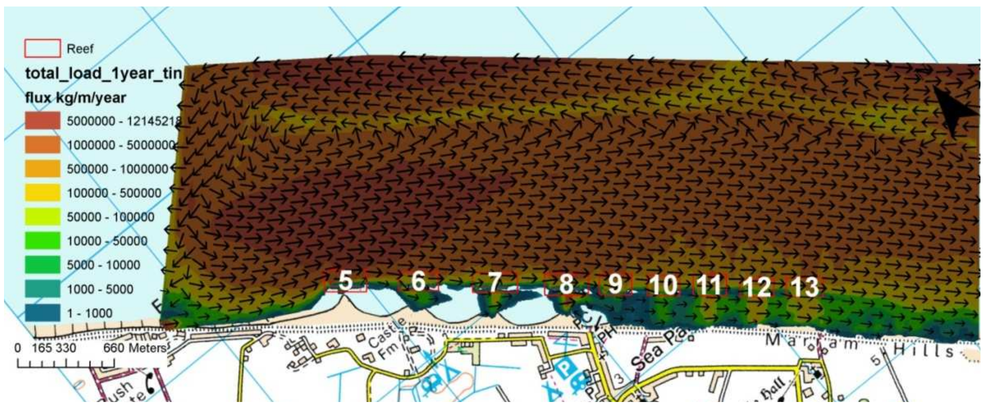


Figure 8.43: Total load sediment flux over 1 year (14 day model run multiplied by 26). Plots are coloured by magnitude of flux. (Base map - © Crown Copyright/database right 2009. An Ordnance Survey/EDINA supplied service)

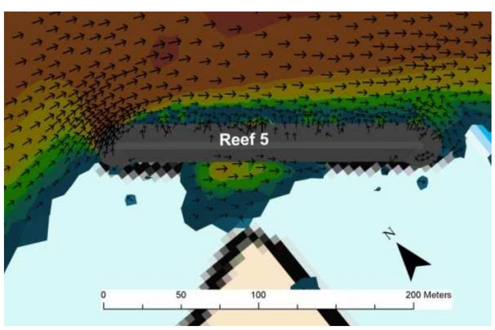


Figure 8.44: Total load sediment flux at breakwater 5

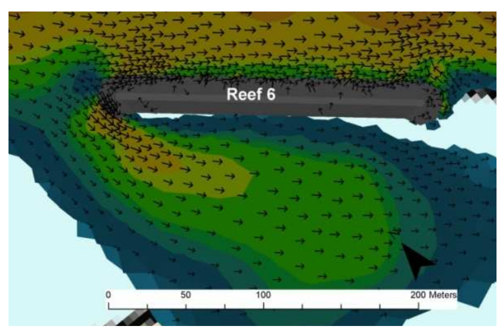


Figure 8.45: Total load sediment flux at breakwater 6

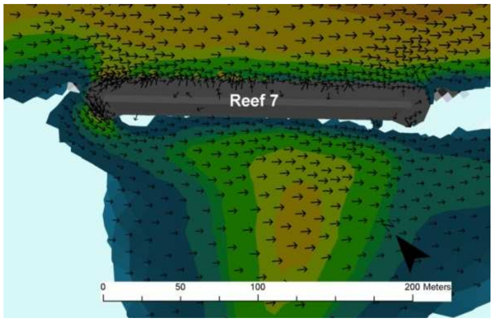


Figure 8.46: Total load sediment flux at breakwater 7.

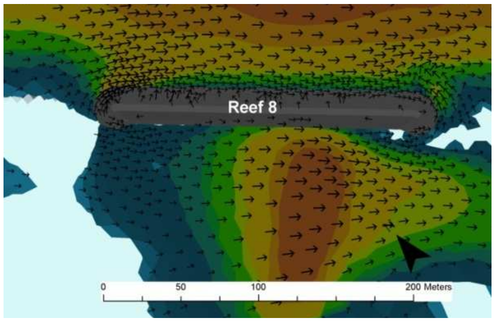


Figure 8.47: Total load sediment flux at breakwater 8.

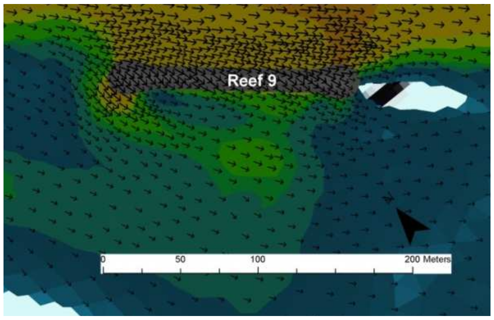


Figure 8.48: Total load sediment flux at breakwater 9.

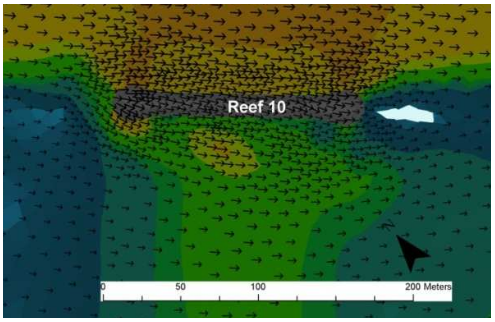


Figure 8.49: Total load sediment flux at breakwater 10.

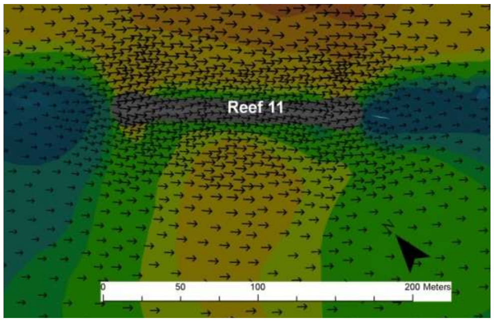


Figure 8.50: Total load sediment flux at breakwater 11.

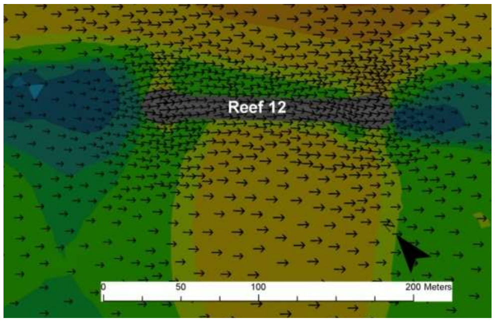


Figure 8.51: Total load sediment flux at breakwater 12.

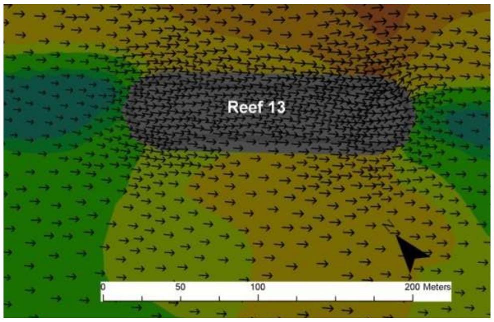


Figure 8.52: Total load sediment flux at breakwater 13.

Figure 8.52 highlights uniform transport to the south-east. Transport towards the north-west near breakwater 13 observed during neap conditions (Figure 8.35) is not a feature of the residual transport direction over a spring-neap cycle.

8.9.3 Inputs and outputs to phase one and phase two

Residual transport in and out of the breakwater system is quantified in order to examine the implications of the complex patterns of residual fluxes around the breakwaters. This enables the implications for the longer-term erosion or accretion of the beaches inshore of the breakwaters for deepening or infilling (continuing in the case of embayment A) to be investigated.

The inshore is divided into two areas; phase one (blue box) and phase two (green box) (Figure 8.53). These are considered independently and then together to look at the whole system. Budgets are examined by looking at inputs and outputs to the system. Inputs and outputs to the system through breakwater gaps are defined as the integral of the cross-shore component of flux between breakwaters. Inputs and outputs perpendicular to main transport direction (i.e. over tombolo 5, 8 and salient 13) are defined as the integral of flux magnitude between breakwater and shoreline. Figure 8.53 gives an overview of these inputs and outputs.

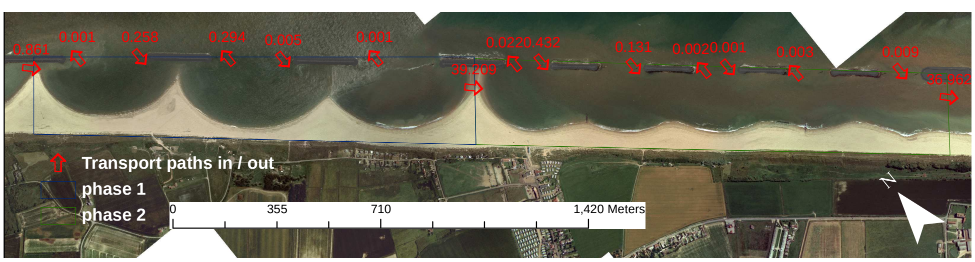


Figure 8.53: Sediment inputs and out puts to phase one and phase two. Annual cross boundary component of flux in M kg y^{-1}(Aerial photo from Environment Agency, pers. comm.)

8.9.3.1 Phase one

Sediment inflows to phase one (breakwaters 5 – 8) of the system are evident over tombolo 5 (Figure 8.44), and the north-west side of breakwaters 6 (Figure 8.45) and 7 (Figure 8.46). Sediment outflows from the system are observed on the south-east side of breakwater 5 (Figure 8.44), 6 (Figure 8.45) and 7 (Figure 8.46) and over tombolo 8 (Figure 8.47).

Sediment input and output to phase one have been quantified in Table 8.5. The largest sediment exchange is found between breakwaters 5 and 6. There is a net loss of sediment from phase one, predominantly over tombolo 8 into phase two.

Bacon et al. (2004) found a similar loss of sediment over tombolos during no, or low-wave conditions. They computed a net flux of ~70 - 100 m^3 per tide over tombolo 7. This includes some wave stirring which they found to increase transport rates by up to a factor of 3.5. Bacon et al. observed a loss of 50 – 100 m^3 per tide from tombolo 7 into the next embayment using survey results and volumetric analysis. Flux over tombolo 7 in this study was found to be ~2 m^3 per tide over tombolo 7 and ~22 m^3 per tide over tombolo 8.

	In (M kg y^{-1})	Out (M kg y^{-1})
	0.861 (over tombolo 5)	0.001 (SE of breakwater 5)
	0.258 (NW of breakwater 6)	0.294 (SE of breakwater 6)
	0.005 (NW of breakwater 7)	0.001 (SE of breakwater 7)
	0.000 (NW of breakwater 8)	39.209 (over tombolo 8)
Total	**1.125**	**39.506**
NET		**38.381**

Table 8.5: Flux in and out of phase one over one year.

The net loss of sediment from phase one implies that sand levels reduce during calm "tide-only" conditions. It is clear that during these conditions sediment is mobile over the tombolos in phase one. Sediment mobile over tombolos in phase one stays within the system, with the exception of tombolo 8 where sediment moves into phase two.

8.9.3.2 Phase two

Sediment inflows to phase two (breakwaters 6 – 13) can be identified over tombolo 8 (Figure 8.47), and on the north-west side of breakwater 9 (Figure 8.48), 10 (Figure 8.49), 11 (Figure 8.50) and 13 (Figure 8.52). Sediment losses occur on the south-east side of breakwater 8 (Figure 8.47), 10 (Figure 8.49) and 11 (Figure 8.50), and over salient 13 (Figure 8.52).

Sediment in and out of phase two has been quantified in Table 8.6. The majority of sediment input to phase two comes over tombolo 8 from phase one. Sediment loss is experienced primarily over salient 13 at the south-eastern end of the breakwater system. The large sediment supply from phase one feeds a net accumulation of sediment in phase two.

	In (M kg y^{-1})		Out (M kg y^{-1})	
	39.209	(over tombolo 8)	0.022	(SE of breakwater 8)
	0.432	(NW of breakwater 9)	0.000	(SE of breakwater 9)
	0.131	(NW of breakwater 10)	0.002	(SE of breakwater 10)
	0.001	(NW of breakwater 11)	0.003	(SE of breakwater 11)
	0.000	(NW of breakwater 12)	36.962	(over salient 13)
	0.009	(NW of breakwater 13)		
Total	39.783		36.990	
NET	2.793			

Table 8.6 Flux in and out of phase two over one year.

8.9.3.3 Phase one and two

Sediment in and out of phase one and two has been quantified in Table 8.7. There is a net loss of > 35 x 10^6 kg y $^{-1}$ (over 6 000 m^3 y^{-1}) from phase one and two.

	In (M kg y^{-1})	Out (M kg y^{-1})
	0.861 (over tombolo 5)	0.001 (SE of breakwater 5)
	0.258 (NW of breakwater 6)*	0.294 (SE of breakwater 6)
	0.005 (NW of breakwater 7)	0.001 (SE of breakwater 7)
	0.000 (NW of breakwater 8)	0.022 (SE of breakwater 8)
	0.432 (NW of breakwater 9)	0.000 (SE of breakwater 9)
	0.131 (NW of breakwater 10)	0.002 (SE of breakwater 10)
	0.001 (NW of breakwater 11)	0.003 (SE of breakwater 11)
	0.000 (NW of breakwater 12)	36.962 (over salient 13)
	0.009 (NW of breakwater 13)	
Total	1.699	37.287
NET		35.588

Table 8.7: Flux in and out of phase one and two over one year.

Unfortunately these patterns cannot be compared to observed morphological change identifiable from differences between surveys. Although it has been possible to identify periods of up to 14 days of "calm" weather, over the two years of LEACOAST2 survey data there are no consecutive surveys either side of "calm weather". "Calm" conditions where significant wave height < 0.5 m were experienced between two surveys in the summer of 2006, but equipment failure caused a loss of data making a comparison impossible.

Periods between January 2006 to March 2006 and April 2007 to May 2007 have been identified as times of low-wave activity where survey data exist to make a comparison. Although wave activity can be considered as "low", both periods include wave events where significant wave heights were up to 1.5 m. Neither period supports modelled indication of a net sediment loss from phase one and two. The presence of small waves is likely to be influencing sediment transport patterns during this period so no conclusion can be made as to the validity of model prediction based on these observations.

9 Discussion and conclusions

The research objectives set out in the introduction (Chapter 1) that this thesis aims to address are:

1. To test the hydrodynamic model TELEMAC2D over a coastal region of complex bathymetry and coastal structures.
2. To make Lagrangian measurements of currents to test the predictions of numerical model output.
3. To identify tidally-driven sediment transport pathways around the breakwaters at Sea Palling.
4. To investigate the tidal contribution to the sediment budgets of the region shoreward of the breakwaters (to evaluate if there is a net increase or decrease of sediment volume).
    a. Within phase one
    b. Within phase two
    c. Within phase one and two combined

Further sub-objectives were defined as a requirement to be able to achieve the main objectives.

8. Set up a modelling methodology using TELEMAC2D which accurately simulates tidal currents over the area of interest.
9. Test the model at locations where data were collected as part of the LEACOAST2 project, to assess the accuracy of simulations.
10. Consider the increased frictional effects of the rubble mound breakwaters.
11. Measure confidence in model performance, particularly where complex flow patterns are predicted by the Lagrangian current dataset.
12. Apply appropriate sediment transport models to currents generated by tides as simulated by TELEMAC2D.
13. Assess sediment transport patterns over spring tides, neap tides and over a longer time period in order to gain an understanding of the long-term contribution of tidally-driven sediment transport.
14. Compare results to those available in the literature.

9.1 Model performance

Great care was taken in developing a methodology and setting up the TELEMAC2D hydrodynamic model to simulate the tidal currents experienced at Sea Palling. Inaccuracies in the magnitude of the tidal currents generated by the model can result in considerable inaccuracies in sediment transport. Pinto et al. (2006) found errors in current velocity to contribute the most inaccuracy to total load transport equations; they found grain size to be the other major contributing factor.

Overestimation of current magnitudes at F1 are responsible for large discrepancies between measured and modelled suspended sediment transport rates during initial comparisons (Section 8.6.1.1). F1 was located outside of the breakwater line and current magnitudes generally matched observations inside the breakwater line better. As instruments on F1 provided useful calibration data for selecting a sediment transport model, it was found to be necessary to use measured currents to force transport equations during transport equation selection. The selected transport equation could then be applied to modelled data to provide sediment transport information over areas where confidence in modelled current speeds was known to be high.

9.1.1 Calibration and validation: Eulerian comparison data

Model evaluation was undertaken by a process of sensitivity analysis, calibration and validation (Chapter 5) using Eulerian data collected as part of the LEACOAST2 field campaign (Chapter 3). Current velocities (magnitude, direction, along-shore and across-shore components) were plotted over the 25 hour investigation period (period of low-waves) during both spring and neap tides for visual analysis, and model performance statistics were calculated to give an objective assessment of model performance over the period investigated. During this calibration process values of bed roughness (k_s) were varied to tune the model to match observations at two stations (F1 and F4). $k_s = 0.3$ was found to give 'good' to 'excellent' results for water-level and speed, and to give the least range in model performance results over the measurement stations and periods (spring / neap tides). 'Good' to 'excellent' results at model validation stations (F2 and F5) suggest that values tuned for optimum model performance at the calibration stations were appropriate, and were found to give acceptable results at the other independent sampling locations.

Although simulated currents match the observed well, there were still small discrepancies. Current magnitudes were found to be overestimated by about 10 %; although this varied between the different measurement stations. Efforts were made to reduce model current magnitudes overall, but problems of current under-prediction were encountered, particularly on the ebb phase of the tide within the breakwater system. Results were considered acceptable, particularly within the breakwaters; float-tracking work was used to confirm the general patterns of currents within the breakwaters and resulted in greater confidence in the model.

The appropriate use of forcing data has been carefully considered throughout this research; however this remains an area where further work could yield improved model results. It could lead to a method where current magnitudes are better simulated over the whole domain and is discussed in Section 9.5.

Model evaluation also highlighted potential problems with simulating the across-shore component of velocity; model performance statistics highlighted “bad” results. There are several factors which may have influenced this. These include the differences between the recorded and actual frame positions, changes in the bathymetry between the survey and the measurement times and inaccuracies in instrument compasses causing potential for incorrect internal current rotation during transformation between different co-ordinate systems. The problems associated with currents measured on the F2 frame were discussed in Section 5.2.2.2, but it is likely that all the larger frames experienced some magnetic deviation caused by other instruments or battery packs located nearby on the frame. No compass calibrations were undertaken to assess the magnitude of these deviations. Although the across-shore component of currents is generally much smaller than the along-shore component it has implications for sediment exchange in or out of the breakwater system. Lagrangian float tracking experiments were undertaken to give confidence that the general patterns of modelled circulations around the breakwaters are correct.

9.1.2 Lagrangian float tracking

Two methods for following the water as it passed through and around the breakwaters were utilised. Radar and GPS trackable floats were used as these followed, as far as possible the surface water. These measurements were used to identify general patterns of circulation around the breakwaters and assess confidence that can be applied to numerical model simulations. X-band radar proved useful for tracking floats within ~1 km of the radar location; at the centre of the breakwater system (Section 3.3.1.2, Figure 3.27). Due to the surface piercing nature of the float required to give a good radar reflection, these experiments were limited to very still days; even light winds influenced float pathways and increased sea surface roughness making the float reflection more difficult to identify. Floats fitted with GPS receivers were not limited by range. Their reduced freeboard allowed their use in a slightly wider range of wind speeds than the radar floats, although on-board data capture made float retrieval crucial for successful data collection. The positional accuracy of both systems was around +/- 5 m.

Currents from the float tracking experiments have shown that modelled current speeds inshore of the breakwater line are generally similar to those observed. Current speeds predicted by the model outside the breakwater line are generally higher than observed (by up to ~100 %). Float tracks in some embayments have confirmed that the model correctly identifies the presence of gyres, and their sizes and current speeds. A flow separation seaward of breakwater 5 was identified, although the model was found to overestimate the magnitude of the counter-current near the breakwater. Complex flow and transient features were identified around the breakwaters, although their temporal variability often made correspondence between model and observations difficult to achieve.

These experiments give considerable confidence to model simulations within the breakwaters, particularly at times of peak flows. TELEMAC2D is shown to identify flow directions less precisely at mid-tide and during periods of low flow or change in flow direction. Around mid-tide the rate of water-level change is greatest so any differences between observed and modelled currents are likely to be exacerbated. This has limited consequence for sediment transport simulation as poor model confidence is limited to periods of low or no flow where sediment transport is negligible.

It was not possible to tune the model to give precise results over the whole domain using the parameters available, bearing in mind the inherent limitations imposed by using the closest (temporal) survey, and the boundary conditions being imposed from measurements at a single depth at Walcott and at Horsey, neither were there detailed data on the bedforms or sediment size variations around the system. Although current magnitudes were overestimated seaward of the breakwaters, these experiments show that currents simulated within the breakwater area are closely representative of those observed by both instrumented frames, and by Lagrangian drifters at times of low or no-waves. By applying sediment transport equations to these results a reasonable representation of tidal only transport rates can be established.

9.1.3 Inclusion of breakwater roughness

Bed roughness, one of the tuneable parameters in the TELEMAC2D model, was initially programmed to be to be uniform in time and space throughout the entire domain. Bed features, and hence bed roughness is known to vary spatially and temporally between smooth sand, ripples, and sandwaves (Bacon, pers. comm.). The distribution of bed roughness is unknown over the model domain, and will vary as bedforms change and evolve in response to varying current velocities. For this reason bed roughness was used as a 'tuning factor' during model calibration, rather than calculating a suitable value using sediment grain size and formulae in the literature. The model domain includes the nine rubble mound breakwaters, which were initially assumed to have the same uniform roughness as the rest of the domain. However, as the roughness associated to the breakwaters does not vary temporally, their spatial extent is known, and the roughness of the breakwaters is clearly greater than other areas of the domain, it seemed appropriate to attempt to represent their enhanced frictional effects within model simulations (Chapter 6).

Increasing bed roughness at model nodes associated to breakwater positions improved the simulation of the flow-separation around breakwater 5 at high water. However the increased roughness also resulted in unrealistic flow structures during ebb flows around breakwaters 8 and 9. The investigation into increased bed roughness associated to breakwater positions (Chapter 6) also included reducing the roughness applied to the rest of the domain when roughness over the breakwaters was increased to maintain the overall system roughness. It was considered that the previously identified appropriate value of uniform roughness (k_s = 0.3) was high as it included the roughness associated to the breakwaters. If breakwaters were to be considered separately it was important not to neglect the possible importance of lowering the roughness associated to all other nodes in the domain. Overall however, uniform bed roughness was found to give the best results for current speed at the model evaluation measurement stations. Model performance statistics confirm the graphical representation as discussed in Section 6.3.1 and it was therefore concluded that although it would seem appropriate to increase the roughness associated to breakwaters, the measured data suggests that it is better to keep bed roughness uniform over the whole domain.

Tuning a model with more than one parameter (two bed roughness parameters in this case) is more complicated than with only one. A full iterative process of varying one parameter after the other was not used and more work developing this tuning methodology may yield a small improvement in model results. A variety of representative combinations have been investigated and considering that the exact starting bathymetry, bedforms or grain size is unknown, the model is performing well and further work is unlikely to add any real value.

9.1.4 Sediment transport model

The Smith and McLean (1977) reference concentration and reference height were used as recommended by Garcia and Parker (1991) with the power law to calculate the concentration profile. This was combined with a velocity profile (generated by assuming a log profile) to give the suspended sediment flux (Section 8.5.2). Comparison of the different models found the concentration profile generation method produces results that match the measurements of the suspended sand concentrations the best (Figure 8.13). There was a difference by a factor of four between suspended and total load transport rate computations at F1 over the spring tide. Soulsby (1997) found a variation in the different models of total load by a factor of 2.

The Van Rijn (1984) parameterised method was used to calculate the bedload component of sediment transport. Bedload is difficult to directly measure in the field although it can be estimated by tracking bedform migration (Hoekstra et al., 2004). Although both frames F1 and F2 were fitted with bedform profilers, time did not permit the investigation of these images. A standard bedload transport formula was therefore selected. Soulsby (1997) found that predicted bedload transport varied by a factor of four depending on the transport model used, predictions using the Van Rijn (1984) equation were found to be mid-range, and it was therefore considered appropriate to use this model. Residual volumetric transport rates estimated from sandwave migration were lower (by a factor of 3.5) than the bedload transport modelled on the offshore side of the breakwater 6, although rates predicted further offshore matched observations well (model over predicts by about 15%). Bedload transport rates predicted near to and within the breakwater system were found to be within an acceptable range based on measurements made by Heathershaw (1981) and calculations based on bedform migration rates made by Bacon (2005) (Chapter 8.3).

9.2 Sediment transport calculations

9.2.1 Sediment transport pathways

This section discusses and highlights the main transport pathways within the model domain. Section 9.2.2 includes quantities and discusses the impact on the breakwater sediment budget.

9.2.1.1 Whole domain scale

Sediment transport calculations have identified an annual net transport toward the south-east for areas up to ~1 km from the shore. Transport calculations suggest that seaward of this limit net transport is toward the north-west. Evidence from the available data was sought to corroborate these modelling observations. The boundaries of the model were located far enough from the primary area of interest, within and around the breakwaters, to ensure calculations made around the breakwaters would not be influenced by the location of the boundaries. It is speculated that the apparent north-west net transport in the offshore is an artefact generated by the offshore boundary of the model.

Asymmetric sandwaves were identified ~600 m (Figure 8.38 line 2) from the shore migrating towards the south-east identified in sequential surveys (Section 8.8.3.1). Larger sandwaves with more symmetric shape were identified in the survey tracks ~1 km from the shore (Figure 8.38 line 3), with residual movement toward the south-east. There is evidence of these sandwaves moving toward the north-west during September and October although as discussed the overall net movement is toward the south-east over the five month period. Mobile bed features were not identified in survey tracks investigated ~1.5 km offshore.

Observations from an offshore (~3.2 km) current meter (Section 8.8.2) indicate a very small residual current toward the north-west. The residual current calculated is ~10 m/14days which would account for negligible net transport and is within the uncertainty of the measurements.

It is concluded that transport toward the north-west in the offshore identified in the numerical modelling is unlikely to be real. Limited observations in the offshore suggest there is negligible net transport. Symmetric sandwaves found ~1 km offshore suggest the tidal regime is responsible for transport in one direction on flood tides and the opposing direction on ebb tides, with little residual movement. The author hypothesises that the net migration toward the south-east over the five months investigated may be a consequence of a large wave event in November 2006, where the usual ebb flow reversal did not occur. Modelling results however, suggest net transport toward the south-east highlighting an over prediction of residual bedload transport even though migration rates fit modelled rates well. Observations nearshore and around breakwaters all highlight an asymmetry in the tidal regime giving residual flow toward the south-east. Magnitudes of transport observed from instrumentation on F1 and F2 are described in Section 8.5.4. A short comparison of bedload transport estimated from sandwave migration and calculated by bedload model evaluations are discussed in Section 9.1.4. Sandwave migration rates suggest that the modelled bedload over predicts transport ~600 m offshore but simulations give very good results around 1 km from the shore.

Sandwave movement is an integration of the effects of tidal currents, plus waves and storms occurring between surveys. More detailed analysis of the LEACOAST2 survey lines provides the potential for further work when waves and storms are included in the modelling. Sandwave size, migration rate and orientation may give considerable insight into the rates, pathways and mechanisms by which sand may be bypassing the breakwater system.

9.2.1.2 Transport pathways around Sea Palling breakwaters

Calculations have been made of sediment transport rates in Chapter 8 of bedload, suspended load and total load, for spring tides, neap tides and a spring-neap period of 14 days, ‘multiplied up’ to approximate annual rates.

Residual sediment transport seaward of the breakwaters is mainly shore-parallel towards the south-east. The all-tide tombolo behind breakwater 5 forces currents offshore and around its seaward side. This creates a tidally-driven sediment transport pathway along the offshore side of the breakwaters (Figure 9.1). During the highest spring tides parts of tombolo 5 are submerged allowing some transport over its top into bay A, providing a modest net transport pathway into the breakwater system. Generally tidal currents are only large enough to mobilise sediment over the top of tombolos 6, 7 and 8, and around the ends of breakwaters within phase one. No net transport is predicted over the majority of phase one bay floors. There is evidence of a small amount of net sediment exchange between breakwaters; out around the south-east end of breakwaters and in around the north-west end (Figure 9.1).

Tidal currents and water-depths in phase two are such that residual sediment mobility extends over the majority of the area. Transport pathways are predominantly toward the south-east (Figure 9.1). Significant sediment exchange is predicted between breakwaters 8 and 9, with sediment moving offshore around the south-east end of breakwater 8 and inshore around the north-west end of 9. Smaller sediment exchanges are observed between breakwaters further south (Figure 8.53).

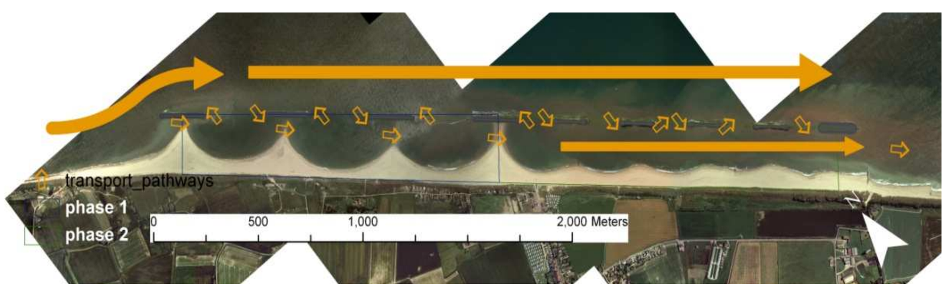


Figure 9.1: Tidally-driven sediment transport pathways around Sea Palling breakwaters. From total load transport residuals over 1 year (Aerial photo from Environment Agency, pers. comm.).

Transport via tides is small in comparison to littoral processes, especially where investigations include shallow water and the nearshore, where waves will have significant implications for sediment transport (van der Molen, 2002). Tidally-driven transport pathways particularly around structures such as the Sea Palling breakwaters are likely to have a significant impact on overall transport paths. Van de Molen (2002) identified tidal action as the predominant factor controlling the net sediment transport for most of the North Sea and especially along the East coast of England and an estimation of tidal currents is essential for an investigation of the net sediment transport over the study area.

Halcrow (2006) estimated an average littoral transport rate of 55 000 $m^3 y^{-1}$ to the north of the breakwaters and an average rate of 15 000 $m^3 y^{-1}$ through the breakwaters (using their Beach Plan Shape Model – BPSM forced with wave conditions 1987 – 1999 assuming breakwaters present). Dolphin et al. (under review) speculate that a significant proportion of the net littoral drift from north to south in this region is directed offshore around breakwater 5. It is likely to follow the pathway identified in this study and presented in Figure 9.1. Dolphin et al. (under review) found evidence for this bypassing in bathymetry surveys, identifying a growing sandbar seaward of breakwater 5.

9.2.2 Sediment budget

Halcrow (2002a) found a net accretion of 343 000 m^3 over the period between January 1992 and January 2000 within the Sea Palling breakwaters. During this period there was a total sediment recharge of 1 550 000 m^3 placed on this frontage, which means the actual change is erosion of 1 207 000 m^3. Over the eight year period this is an annual loss of 151 000 m^3 (Halcrow, 2002a).

Sediment inputs and outputs to the breakwater system were calculated in the sediment transport chapter (Chapter 8). Results suggest a net loss of ~14 400 $m^3 y^{-1}$ (38.4 x 10^6 kg y^{-1}) from phase one, ~1 000 $m^3 y^{--1}$ (2.8 x 10^6 kg y^{-1}) net accumulation in phase two, with a net loss of ~13 500 $m^3 y^{-1}$ (35.6 x 10^6 kg y^{-1}) over the combined area (results based on a year average from a spring-neap tidal simulation). Under tide-only conditions, phase one tombolos are likely to become lower and sediment redistributed within the breakwater system, this is forced by the net balance between terms in transport gradients over the tombolos (Figure 8.16 to Figure 8.35). Sediment from each tombolo is moved into the next embayment to the south-east. Bacon (2005) found a similar redistribution of sediment within the breakwater system. In the case of tombolo 8 this results in the transfer of sediment out from phase one and into phase two and forms the majority of sediment input to the phase two system. This is slightly greater than the estimated output at the south-eastern end and results in a small sediment accumulation in phase two of ~1 000 $m^3\ y^{-1}$. There is minimal sediment input of ~650 $m^3\ y^{-1}$ to phase one and two overall and an output of ~14 100 $m^3\ y^{-1}$ of which ~14 000 $m^3\ y^{-1}$ passes between the shore and breakwater 13 towards the south-east, contributing to the sediment budget of beaches ‘down-drift’. Sediment exchange has been identified in the gaps between breakwaters; a net input to the system of ~200 $m^3\ y^{-1}$ was found (Figure 9.2).

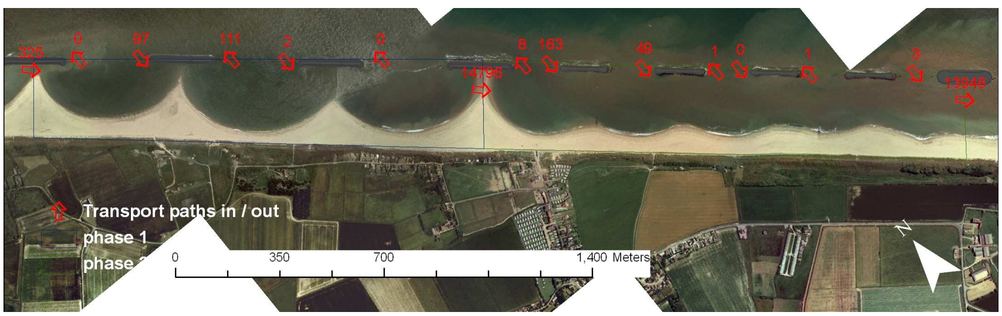


Figure 9.2: Sediment inputs and outputs to phase one and phase two. Annual across boundary component of flux in $m^3\ y^{-1}$ (Aerial photo from Environment Agency, pers. comm.).

Bacon (2005) calculated a net loss of ~40 000 $m^3 y^{-1}$ from phase one. He expected that much of this would enter phase two but that a small proportion may exit the system between breakwaters 8 and 9. Bacon’s estimate is based on tides plus wave stirring (H_s = 0.5 m) which is likely to increase sediment transport by a factor of 3.5 when compared to currents alone (Bacon et al., 2007). This thesis estimates a loss of sediment over tombolo 8 into phase two of ~14 800 $m^3\ y^{-1}$ for tide-only conditions which is comparable with Bacon’s findings. Halcrow (2002a) found an average littoral drift rate through the breakwater system of 15 000 $m^3\ y^{-1}$, this was calculated using Halcrow’s shoreline evolution model BPSM and wave data between 1987 and 1999 but omitted tides. This suggests that considered separately, the sediment transport though the breakwater system due to waves-alone, and to tide-only, have similar magnitudes (~15 000 m^3y^{-1}). This neglects the interaction between the two processes which is likely to produce much greater transport rates through the system during for example, storms with or without surges.

The net loss of sediment from phase one predicted by the modelling will result in a gradual reduction in beach volumes unless other processes resulted in net gain, such as a supply of sediment from another source. The difficulty in modelling diffraction around structures made modelling of wave events impractical as part of this work (Section 9.3.1), however waves are likely to contribute a source of sediment to the budget. Fairly et al. (2009a) using an ARGUS video camera system observed general accretion of the intertidal zone during shore normal storms. Wave stirring by smaller waves will increase transport driven by tidal currents over the pathways highlighted earlier (Bacon, 2005). Waves are likely to be larger in breakwater gaps than in areas sheltered by breakwaters. This is likely to increase the transport in through the gaps more than the transport out behind breakwater 13, resulting in a possible net sediment gain rather than the modelled loss. This conjecture is supported by measurements made by Dolphin et al. (2004), who found that beach volumes behind phase one breakwaters increased during smaller storms where $0.2 < H_s < 1.2$ m. Larger waves can also contribute to sediment losses (Dolphin et al., 2004; Fairley et al., 2009a). Aeolian transport has not been considered at this site; the wind may contribute to sediment transport by blowing sand from the exposed tombolo tops into embayments or on to the back beach.

Dolphin et al. (under review) found that sand volumes (up to 2005) were decreasing within the breakwater system, with the exception of areas around breakwaters 5, 12 and 13. They also found that rates of shoreline recession over tombolos and salients increase closer to the centre of the system. Figure 8.43 to Figure 8.52 (Chapter 8) show that in phase one, transport rates over tombolos also increase toward the south-east which is likely to contribute to the pattern identified by Dolphin et al. (under review). Dolphin et al. (under review) describe how sediment is trapped behind breakwaters at each end of the system as a result of littoral processes associated with northerly and easterly wave events. Wave events transport sediment into the breakwater system, but are less effective in moving sediment out, because of the sheltering effects of the breakwaters. This explains why the ends of the system are experiencing shoreline progradation rather than recession. Dolphin et al's (under review) work shows a net reduction of sediment volume in phase two. This study predicts a small net increase consisting of an increased sediment supply between breakwaters 9 and 10 and a smaller loss between breakwaters 10 and 11. This highlights the importance of waves on the overall sediment budget. Dolphin et al. (under review) show that steady erosion in the centre of the system (bays E, F and salients 9 and 10) is indicative of an insufficient sediment supply to balance losses either seaward through breakwater gaps or along-shore to the south-east as a results of sediment transport by both waves and tidal currents.

9.3 Limitations of the study

9.3.1 Omission of waves from the modelling work

The biggest limitation of this study when considering sediment transport patterns is the omission of waves. Waves are always present to some extent in the natural environment and including their effect is the next logical step in the modelling of sediment transport around the Sea Palling breakwaters. Bacon found that the presence of even small waves (~0.5 m) increased sediment transport by a factor of 3.5.

The difficulty of modelling waves over a coastal domain which includes surface piercing structures is the inclusion of diffraction. Diffraction is an important process when investigating waves in close proximity to breakwaters, as it controls the wave energy reaching the lee of the structure (Zyserman and Johnson, 2002). Diffraction requires elliptic equations to be solved which is a time consuming process (Kuang and Stansby, 2004). Zyserman and Johnson (2002) compared model runs where diffraction was included using the parabolic approximation to the mild-slope equation in one model (MIKE 21 PMS), and another model where diffraction was not included (MIKE 21 NSW). Both models account for directional spreading of the waves; a high degree of directional spreading is sometimes used to 'mimic' diffraction in models that do not otherwise include it (Zyserman and Johnson, 2002). Zyserman and Johnson (2002) found significant differences in sediment transport rates predicted using the different models and concluded that a proper representation of diffracted waves could not be achieved simply by prescribing a high degree of directional spreading. Zyserman and Johnson's (2002) morphological modelling results for the planform shape created behind a breakwater agree qualitatively well with field observations and predictions from empirical rules, however their investigations into the appropriateness of how diffraction is represented (or mimicked) does not seem to be directly compared to any hydrodynamic field measurements.

The TELEMAC module ARTEMIS is an elliptic solver for the mild-slope equation for velocity potential (includes diffraction) (Kuang and Stansby, 2004). ARTEMIS requires a fine grid with at least seven nodes per wavelength (EDF-R&D, 2010). This makes the use of ARTEMIS only suitable for smaller domains and could not be used over this study site due to computational limitations. Bacon (2005) used ARTEMIS over a small area of phase one to investigate transport over one of the tombolos.

The TELEMAC module TOMOWAC is a parabolic solver for the propagation of a wave energy spectrum, without diffraction; this module can solve equations efficiently and can be used over a large domain (Kuang and Stansby, 2004). This model could be applied to the domain in this work and combined with TELEMAC2D to include the effects of tides on the wave climate or the effects of the wave spectrum on the tidal currents (depending on which model result is fed to which model) but not both as this is not an interactive process (Coughlan, 2008).

Although a wave model which includes the effects of diffraction has been highlighted as the most suitable to use by Zyserman and Johnson (2002) for investigating the effect of waves around breakwaters, the effect of directional spreading would be worth investigating at this site, due to the abundance of field measurements during several periods of wave activity (LEACOAST2). F2 was situated directly in the lee of breakwater 10 (Figure 3.10) and could be used to assess the effectiveness of increasing the directional spreading to allow wave energy to reach areas in the lee of this breakwater. The X-band radar (Bell, 1999; Wolf and Bell, 2001) at the site has been used to identify diffraction patterns of waves propagating through breakwater gaps, and perhaps wave statistics inferred from these images could also help assess the patterns predicted by TOMAWAC.

Another method would be to use TOMOWAC for the whole domain and then use ARTEMIS over some areas behind breakwaters. Wave height and direction boundary conditions could be generated from TOMOWAC to apply to ARTEMIS. Model output could then be compared over critical periods, and ‘correction’ factors could be derived to apply to TOMOWAC if needed.

This would enable the effect of wave stirring to be included in sediment budgets proposed and also enable the investigation of the effects of larger storm waves on transport pathways. Unfortunately time did not allow such investigation with TOMAWAC, however this is highlighted as an example of potential future work.

9.3.2 Grain size and bed roughness

Insufficient information about the temporal and spatial distribution of both bedforms and grain size has led to a uniform bed roughness to be applied over the domain. Previous work (Bacon pers. comm.) has shown these to vary both spatially and temporally. Further work could include the use of side-scan sonar to measure the spatial extent of bed features. Repeat passes over a tidal cycle would be required to include the temporal changes; bedforms are likely to get wiped out at high current speeds and also during storms.

Uncertainties in the grain size used in total load transport models have been shown to account for inaccuracies in the transport results of Pinto et al. (2006). The uniform grain size applied to transport models in this study is therefore likely to contribute to inaccuracies in some locations. Transport calculations could be extended over the model domain to include the range of grain size values which are likely to occur at Sea Palling, to give a measure of uncertainty in transport calculations that grain size is responsible for.

9.3.3 Calm conditions survey data

Monthly beach and bathymetry surveys were conducted between November 2005 and September 2007 as part of the LEACOAST2 project field work campaign (Section 3.2.3). Although periods of calm weather (H_s < 0.5 m) existed during this time, there was only one period (during summer 2006) when there were no significant wave events between surveys. Unfortunately equipment failure resulted in the loss of data for one of the surveys. Comparison of these data would have enabled volume calculations to be compared to identify residual sedimentation patterns over phase one, phase two and both phases together to compare to results from model simulations.

9.3.4 Downward looking Aquadopp work

It was considered important to gain some understanding of the extent of the flow deflection caused by the first breakwater and tombolo in its lee. In the absence of a specially designed piece of equipment for measuring currents from the surface whilst a boat moves over pre defined transects (i.e. an instrument such as an AWAC or workhorse with bottom tracking capability) an ADCP and RTK GPS were utilised. Using the RTK GPS to remove boat movements from the ADCP current records proved problematic. Measurements were synchronised and a coarse array of measurements were successfully obtained. These data were useful for determining the region of flow disturbance and identifying the margin of a back eddy close to the breakwater. However measurements could not be made at the required accuracy and consistency for comparing actual speeds within this area.

9.4 Conclusions

The TELEMAC2D model has been implemented to successfully simulate the tidal currents experienced around the breakwaters at Sea Palling. This hydrodynamic model has been shown to perform well at predicting water-levels and currents around the breakwaters. Radar and GPS float tracking experiments have increased the confidence that can be applied to the model results and to its use with sediment transport equations.

Tidally-driven sediment transport pathways have been identified and are presented in Figure 9.1.

- Tidally-driven sediment transport bypassing the system in the north-west is shown to occur.
- Sediment exchange onshore / offshore is observed between all breakwaters.
- Some southward sediment transport takes place over tombolo 5 during the highest tides.
- Sediment is transported from tombolos toward bays to the south-east over each phase one tombolo.
- No transport is observed in phase one embayments.
- Transport over the majority of phase two is towards the south-east, with sediment exiting the system between breakwater 13 and the shore.
- Transport offshore of the breakwaters is toward the south-east.

The tidal contribution to the sediment budgets of the beaches inshore of the breakwaters has been established. Phase one is experiencing a net loss in sediment volume of 14 400 $m^3\,y^{-1}$, predominantly driven by losses over tombolo 8 leaving phase one and entering phase two. Phase two is fairly stable, experiencing a small net increase in sediment volume (1 000 $m^3\,y^{-1}$); sediment input from tombolo 8 is greater than losses between breakwater 13 and the shore. The Sea Palling system as a whole is experiencing a net loss of sediment due to tides-only of 13 500 $m^3\,y^{-1}$.

9.5 Future work

As discussed in Section 9.3.1 the inclusion of waves in the modelling work undertaken in this study is the next logical step. Full implementation of ARTEMIS over the Sea Palling modelling domain is not feasible due to the number of nodes required and the computing time needed to run the model. It is therefore proposed that sensitivity testing of TOMOWAC over the domain using directional spreading as a tuning parameter is undertaken. Results should be compared to those generated by ARTEMIS run over limited areas of the domain for short periods to parameterise any ‘correction’ which may need to be applied to TOMOWAC results behind breakwaters. The model simulations could be tested against field measurements at F2, particularly at low tidal stages (where the breakwater is fully emergent) to assess the effectiveness of wave energy simulated in its lee. Wave statistics inferred from radar images could also be included in model testing. This work would not only enable the inclusion of small waves, which are likely to increase transport over the pathways presented in this work, but also include large wave and storm conditions when very large volumes of sediment are moved over a short period; Halcrow (1991) reported that beach levels adjacent to the sea wall can vary by up to 2 m in a single storm, corresponding to a cross-shore movement of up to 1 000 000 m^3. Wave and current data exist from Horsey and Walcott so the model could be run with a number of real-time scenarios.

The morphodynamic evolution of the bed has not been included in this study. During tide-only conditions bed evolution can be ignored, although when wave events are considered, the bed will change rapidly. A method for updating bed changes may need to be included in the model.

Time did not permit the full iterative process involved in tuning TELEMAC2D with different bed roughness associated to breakwaters and the rest of the domain. Changing bed roughness over one area may have an impact on the other and therefore each must be repeatedly varied in turn, to allow the calibration to converge on the most appropriate results. The alternative may be establishing all possible perturbations of calibration parameters and testing these or a sub set of these. Further work could identify and implement a suitable methodology for dealing with this problem.

As discussed in Section 9.3.2 measurement of the spatial and temporal distribution of grain size and bed roughness could give considerable benefit to the modelling work in this study. Repeat side-scan sonar passes over a tidal cycle could be used to parameterise bed roughness over the tidal cycle. This should include periods of peak flood, peak ebb and mid-tide. If a grain size distribution could be established from these images, this may be used to force a numerical model to estimate the temporal roughness distribution requiring only one side-scan sonar pass. The spatial distribution of grain size could also be used to increase accuracy of total load sediment transport equations (Pinto et al., 2006).

Further work could also include ripple migration tracking from images created by ripple profilers on F1 and F2. This could give observed estimates of bedload transport rates to compare to the bedload transport model used in this study. Time did not permit the inclusion of these data, but calculations made have been shown to be within an acceptable range.

The use of simultaneous measurements for model forcing and test data has enabled a high level of confidence to be applied to model results. The model setup has successfully yielded good results within the breakwater system, although currents seaward of the breakwaters are over predicted by ~10 %. This will result in over prediction of sediment transport rates. Future work could include a short current meter deployment offshore of the Walcott AWAC (Section 3.1) over a spring – neap cycle to better establish the differences between the shallow water data collected and the offshore current applied to the model. This may improve the model performance overall, simulating currents to the observed magnitudes seaward and shoreward of the breakwater line. This deployment may also be useful for highlighting the residual current direction at a distance offshore equal to the offshore model boundary. This can be compared to residual sediment transport results in Section 8.8.1.

Appendices

A. Notation used in the thesis

Symbols

$\vert\ \vert$	modulus
$<$	less than
$< >$	average value
$>$	greater than
∇	gradient (grad) operator
$\nabla .$	divergence (div) operator
μ_t	coefficient of diffusion of velocity
a_l	dimensionless dispersion coefficient along-shore
a_t	dimensionless dispersion coefficient across-shore
b	Rouse number
C	Chezy coefficient
c	bedform migration rate
C(z)	concentration profile
C_a	reference sediment concentration
C_D	drag coefficient
C_f	friction coefficient
d	grain diameter
d_{50}	median grain diameter
d_{90}	90^{th} percentile grain diameter
d_s	average water depth at structure
d_{sa}	annual seaward limit of the littoral zone
E	wave energy at lee of structure
F	instrument frame
f	dimensionless bedform shape factor
g	acceleration due to gravity

g_n	harmonic phase lag
h	distance from centre of breakwater to centre of ellipse
h	water-depth
H	bedform height
H_e	deep water wave height
H_n	harmonic amplitude
H_s	significant wave height
H_z	frequency
I_s	beach response index
k	turbulent energy
K_l	viscosity along current
km	kilometre
k_s	Nikuradse roughness factor
K_S	eddy diffusivity of sediment
K_t	viscosity across current
L_G	gap length
L_S	structure length
L_{SA}	salient length
m	metre
m	Manning coefficient
M	mega (10^6)
M_2	semi diurnal principal lunar component of tide
N	finite number
n	porosity
P	model sensitivity station
P_a	atmospheric pressure
q	volumetric transport rate
Q	mass transport rate
R	reef / breakwater
s	second
S	ratio of sediment to fluid density
S*	structure configuration / planform
S_x	horizontal source term
S_y	horizontal source term
T*	wave transmission characteristics of structure

T_e	wave period corresponding to wave height H_e
Tmo2	mean zero crossing period
T_p	wave period
U	velocity in east direction
u	depth-average current in east direction
U(z)	velocity profile
$\overline{U}$	depth-average current
u_*	friction velocity
u_{*s}	skin friction velocity
u_m	velocity measured
V	velocity in north direction
v	depth-average current in north direction
W*	wave energy at structure
w_s	settling velocity
X	distance offshore
$\bar{X}$	Average distance structure from shore
z	range from bed
z_0	roughness length
z_a	reference concentration height
η	free surface elevation
θ_{cr}	threshold Shields parameter
κ	von Karman’s constant
ρ	density of water
ρ_s	density of sediment
σ_n	harmonic angular speed
τ_0	bed shear stress
τ_{0s}	skin friction bed shear stress
τ_{cr}	threshold bed stress

Abbreviations

ABS	Acoustic backscatter system
ADCP	Acoustic doppler current profiler
ADV	Acoustic doppler velocimeter
AOD	Above ordnance datum
ARMAE	Adjusted relative mean absolute error
BP	Before present
BPSM	Beach plan shape model
CD	Current direction
CM	Current magnitude
DA	Depth average
DGPS	Differential global positioning system
GPS	Global positioning system
HW	High water
LW	Low water
MAE	Mean absolute error
MHWS	Mean high water spring
MLW	Mean low water
MLWS	Mean low water spring
NW	North-west
ODN	Ordnance survey datum
pers. comm.	Personal communication
RMAE	Relative mean absolute error
RMSE	Root mean square error
RTK	Real time kinematic
SE	South-east
SMP	Shoreline management plan
TIN	Triangulated irregular network
WL	Water-level

B. Float tracking experiments: Model performance statistics

Table	deployment	date	Radar / GPS	figure		colour
19	AA	17.05.07	Radar	120	a	black
20	BB	17.05.07	Radar	120	a	black
21	CC	17.05.07	Radar	120	a	red
22	DD	17.05.07	Radar	120	a	green
23	EE	17.05.07	Radar	120	a	green
24	FF	17.05.07	Radar	120	a	blue
25	AA	24.05.07	Radar	121	d	blue
26	BB	24.05.07	Radar	121	d	green
27	CC	24.05.07	Radar	121	d	grey
28	DD	24.05.07	Radar	121	d	orange
29	EE	24.05.07	Radar	121	d	red
30	FF	24.05.07	Radar	121	d	black
31	GG	24.05.07	Radar	121	e	black
32	HH	24.05.07	Radar	121	e	red
33	II	24.05.07	Radar	121	e	red
34	JJ	24.05.07	Radar	121	e	orange
35	KK	24.05.07	Radar	121	e	orange
36	LL	24.05.07	Radar	121	e	grey
37	MM	24.05.07	Radar	121	e	green
38	NN	24.05.07	Radar	121	e	blue
39	OO	24.05.07	Radar	121	a	black
40	PP	24.05.07	Radar	121	a	red
41	QQ	24.05.07	Radar	121	a	grey
42	RR	24.05.07	Radar	121	a	green
43	SS	24.05.07	Radar	121	a	green
44	TT	24.05.07	Radar	121	a	green
45	UU	24.05.07	Radar	121	a	green
46	VV	24.05.07	Radar	121	a	blue
47	WW	24.05.07	Radar	121	a	blue
48	XX	24.05.07	Radar	121	a	blue
49	YY	24.05.07	Radar	120	d	black
50	ZZ2	24.05.07	Radar	120	d	orange
51	ZZ3	24.05.07	Radar	120	d	grey
52	ZZ4	24.05.07	Radar	120	d	green
53	ZZ5	24.05.07	Radar	120	d	green
54	ZZ6	24.05.07	Radar	120	d	blue
55	ZZ7	24.05.07	Radar	120	d	blue
56	ZZ8	24.05.07	Radar	120	b	blue
57	ZZ9	24.05.07	Radar	120	b	blue
58	AA	03.08.07	Radar	122	b	black
59	BB	03.08.07	Radar	122	b	black
60	EE	03.08.07	Radar	122	b	orange
61	FF	03.08.07	Radar	122	b	orange
62	GG	03.08.07	Radar	122	c	black
63	HH	03.08.07	Radar	122	c	red
64	II	03.08.07	Radar	122	c	red
65	JJ	03.08.07	Radar	122	c	red
66	KK	03.08.07	Radar	122	c	red
67	LL	03.08.07	Radar	122	c	orange
68	MM	03.08.07	Radar	122	c	orange
69	NN	03.08.07	Radar	122	c	orange
70	OO	03.08.07	Radar	122	c	grey
71	PP	03.08.07	Radar	122	c	grey
72	AA	11.08.07	Radar	123	a	black
73	BB	11.08.07	Radar	123	a	red
74	CC	11.08.07	Radar	123	a	orange
75	DD	11.08.07	Radar	123	a	grey
76	EE	11.08.07	Radar	123	a	green
77	FF	11.08.07	Radar	123	b	black
78	GG	11.08.07	Radar	123	b	black

79	HH	11.08.07	Radar	123	b	black
80	II	11.08.07	Radar	123	b	red
81	JJ	11.08.07	Radar	123	b	red
82	KK	11.08.07	Radar	123	b	red
83	LL	11.08.07	Radar	123	b	red
84	MM	11.08.07	Radar	123	b	orange
85	NN	11.08.07	Radar	123	b	orange
86	OO	11.08.07	Radar	123	b	grey
87	PP	11.08.07	Radar	123	b	grey
88	QQ	11.08.07	Radar	123	d	black
89	RR	11.08.07	Radar	123	d	black
90	SS	11.08.07	Radar	123	d	black
91	UU	11.08.07	Radar	123	d	orange
92	VV	11.08.07	Radar	123	d	orange
93	AA	29.08.07	Radar	123	e	black
94	BB	29.08.07	Radar	123	e	black
95	CC	29.08.07	Radar	123	e	black
96	DD	29.08.07	Radar	123	e	red
97	EE	29.08.07	Radar	123	e	red
98	FF	29.08.07	Radar	123	e	orange
99	GG	29.08.07	Radar	123	e	orange
100	AA	04.06.08	GPS	126	d	black
101	BB	04.06.08	GPS	126	d	green
102	CC	04.06.08	GPS	126	d	blue
103	DD	04.06.08	GPS	126	d	orange
104	EE	04.06.08	GPS	126	d	grey
105	FF	04.06.08	GPS	126	d	black
106	GG	04.06.08	GPS	126	e	black
107	HH	04.06.08	GPS	126	e	green
108	II	04.06.08	GPS	126	e	black
109	JJ	04.06.08	GPS	126	e	green
110	KK	04.06.08	GPS	126	e	blue
111	LL	04.06.08	GPS	126	e	orange
112	MM	04.06.08	GPS	126	f	black
113	NN	04.06.08	GPS	126	f	green
114	OO	04.06.08	GPS	126	f	blue
115	PP	04.06.08	GPS	126	b	black
116	QQ	04.06.08	GPS	126	b	green
117	RR	04.06.08	GPS	126	b	blue
118	SS	04.06.08	GPS	126	b	orange
119	TT	04.06.08	GPS	126	c	black
120	AA	05.06.08	GPS	124	a	black
121	BB	05.06.08	GPS	124	a	green
122	CC	05.06.08	GPS	124	a	blue
123	DD	05.06.08	GPS	124	a	orange
124	EE	05.06.08	GPS	124	a	grey
125	FF	05.06.08	GPS	124	f	black
126	GG	05.06.08	GPS	124	f	green
127	HH	05.06.08	GPS	125	b	black
128	II	05.06.08	GPS	125	b	green
129	JJ	05.06.08	GPS	125	b	blue
130	KK	05.06.08	GPS	124	c	black
131	LL	05.06.08	GPS	124	c	green
132	MM	05.06.08	GPS	125	a	orange
133	NN	05.06.08	GPS	125	a	blue
134	OO	05.06.08	GPS	125	a	green
135	PP	05.06.08	GPS	125	a	black
136	RR	05.06.08	GPS	125	c	black
137	SS	05.06.08	GPS	125	c	black
138	TT	05.06.08	GPS	125	c	green
139	UU	05.06.08	GPS	125	c	blue
140	VV	05.06.08	GPS	124	e	black
141	WW	05.06.08	GPS	124	e	green

Table 9.1: Index to tables in appendix and figures they refer to

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	Err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.34	0.27	-0.07	-0.20	0.27	-0.07	-0.20	0.26	-0.08	-0.24	0.28	-0.06	-0.19	0.28	-0.06	-0.18
0.34	0.28	-0.07	-0.19	0.27	-0.07	-0.21	0.26	-0.08	-0.23	0.28	-0.06	-0.19	0.28	-0.06	-0.17
0.32	0.28	-0.04	-0.12	0.27	-0.04	-0.13	0.26	-0.06	-0.17	0.28	-0.03	-0.10	0.29	-0.03	-0.09
0.31	0.28	-0.03	-0.08	0.27	-0.04	-0.12	0.27	-0.04	-0.14	0.29	-0.02	-0.05	0.30	-0.01	-0.04

0.30	0.29	-0.01	-0.05	0.28	-0.02	-0.07	0.27	-0.03	-0.11	0.30	0.00	0.00	0.30	0.00	0.01	
0.28	0.29	0.01	0.04	0.28	0.00	0.00	0.27	-0.01	-0.04	0.30	0.02	0.08	0.31	0.03	0.11	
0.29	0.30	0.01	0.04	0.29	0.00	0.00	0.28	-0.01	-0.04	0.32	0.03	0.09	0.33	0.04	0.12	
0.28	0.31	0.04	0.13	0.30	0.02	0.08	0.29	0.01	0.03	0.34	0.06	0.22	0.34	0.06	0.22	
0.26	0.33	0.07	0.27	0.30	0.05	0.18	0.29	0.03	0.13	0.35	0.09	0.35	0.35	0.09	0.37	
0.25	0.34	0.09	0.37	0.32	0.07	0.27	0.31	0.06	0.24	0.38	0.13	0.51	0.37	0.12	0.50	
0.25	0.37	0.12	0.46	0.33	0.08	0.33	0.32	0.07	0.30	0.41	0.16	0.66	0.41	0.16	0.62	
0.25	0.40	0.15	0.61	0.36	0.11	0.43	0.35	0.10	0.41	0.47	0.22	0.88	0.45	0.20	0.81	
0.26	0.45	0.19	0.73	0.39	0.13	0.49	0.39	0.12	0.48	0.55	0.29	1.12	0.52	0.26	0.98	
0.28	0.53	0.25	0.91	0.44	0.16	0.57	0.44	0.16	0.56	0.70	0.43	1.52	0.64	0.36	1.28	
0.30	0.67	0.37	1.25	0.51	0.21	0.71	0.52	0.23	0.77	0.78	0.48	1.64	0.78	0.49	1.64	
0.34	0.78	0.44	1.30	0.63	0.29	0.86	0.66	0.32	0.95	0.64	0.30	0.89	0.73	0.39	1.16	
0.43	0.67	0.24	0.56	0.77	0.33	0.77	0.76	0.33	0.76	0.54	0.11	0.26	0.57	0.14	0.33	
0.47	0.55	0.08	0.17	0.70	0.24	0.51	0.65	0.18	0.39	0.51	0.04	0.09	0.52	0.06	0.13	
0.46	0.51	0.06	0.12	0.56	0.10	0.23	0.52	0.07	0.15	0.49	0.04	0.08	0.51	0.05	0.11	
0.40	0.49	0.09	0.21	0.51	0.11	0.27	0.48	0.08	0.20	0.48	0.08	0.20	0.50	0.09	0.23	
0.32	= <|x|>	*0.12*			*0.11*			*0.10*			*0.13*			*0.14*		*MAE*
		0.38			**0.33**			**0.33**			**0.42**			**0.42**		**RMAE**

Table 9.2: Experiment 17.05.07 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.25	0.46	0.21	0.86	0.55	0.30	1.24	0.42	0.17	0.71	0.38	0.13	0.54	0.50	0.25	1.02	
0.16	0.37	0.21	1.34	0.41	0.25	1.60	0.34	0.18	1.12	0.33	0.18	1.10	0.42	0.26	1.61	
0.10	0.34	0.24	2.30	0.37	0.26	2.54	0.30	0.19	1.86	0.32	0.21	2.05	0.39	0.29	2.75	
0.11	0.33	0.23	2.16	0.35	0.25	2.34	0.29	0.18	1.74	0.31	0.21	1.96	0.38	0.27	2.58	
0.12	0.33	0.21	1.73	0.34	0.22	1.85	0.28	0.16	1.35	0.31	0.19	1.54	0.37	0.25	2.06	
0.10	0.33	0.23	2.26	0.34	0.24	2.42	0.28	0.18	1.84	0.30	0.20	2.02	0.37	0.27	2.66	
0.10	0.32	0.22	2.25	0.34	0.24	2.43	0.27	0.17	1.77	0.30	0.20	2.07	0.36	0.26	2.66	
0.09	0.32	0.22	2.39	0.33	0.24	2.55	0.27	0.18	1.89	0.30	0.21	2.22	0.36	0.27	2.83	
0.12	0.32	0.20	1.68	0.33	0.21	1.78	0.27	0.16	1.33	0.30	0.18	1.54	0.36	0.24	2.03	
0.13	0.32	0.19	1.47	0.33	0.21	1.60	0.27	0.14	1.13	0.30	0.17	1.34	0.36	0.23	1.78	
0.15	0.31	0.16	1.04	0.32	0.17	1.11	0.28	0.12	0.81	0.30	0.15	0.95	0.35	0.20	1.28	
0.15	0.32	0.17	1.12	0.33	0.18	1.20	0.28	0.13	0.84	0.30	0.15	0.98	0.34	0.19	1.28	
0.14	0.31	0.17	1.26	0.33	0.19	1.34	0.28	0.14	1.00	0.30	0.16	1.15	0.34	0.21	1.47	
0.18	0.31	0.13	0.73	0.32	0.14	0.79	0.28	0.10	0.54	0.30	0.12	0.66	0.34	0.16	0.89	
0.14	0.31	0.17	1.28	0.32	0.18	1.33	0.28	0.14	1.02	0.30	0.16	1.17	0.33	0.19	1.42	
0.16	0.30	0.14	0.86	0.31	0.15	0.93	0.28	0.11	0.70	0.29	0.13	0.80	0.33	0.16	1.00	
0.15	0.30	0.15	1.05	0.31	0.16	1.12	0.28	0.13	0.88	0.29	0.14	0.98	0.32	0.18	1.21	
0.13	0.30	0.17	1.33	0.30	0.18	1.39	0.28	0.15	1.18	0.29	0.16	1.25	0.32	0.19	1.52	
0.17	0.30	0.12	0.72	0.30	0.13	0.76	0.27	0.10	0.57	0.29	0.11	0.66	0.32	0.14	0.83	
0.13	0.29	0.15	1.15	0.30	0.16	1.22	0.27	0.14	1.01	0.28	0.14	1.07	0.31	0.17	1.28	
0.15	0.29	0.13	0.87	0.29	0.14	0.91	0.27	0.12	0.76	0.28	0.12	0.81	0.30	0.15	0.98	
0.13	0.28	0.15	1.19	0.29	0.16	1.25	0.27	0.14	1.08	0.27	0.15	1.14	0.29	0.16	1.28	
0.10	0.27	0.17	1.74	0.28	0.18	1.82	0.26	0.16	1.61	0.26	0.16	1.65	0.28	0.18	1.85	
0.14	0.27	0.13	0.90	0.27	0.13	0.92	0.26	0.12	0.82	0.26	0.12	0.84	0.28	0.13	0.95	
0.14	= <|x|>	*0.18*			*0.20*			*0.15*			*0.16*			*0.21*		*MAE*
		1.30			**1.42**			**1.07**			**1.17**			**1.52**		**RMAE**

Table 9.3: : Experiment 17.05.07 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.40	0.29	-0.11	-0.27	0.29	-0.11	-0.28	0.29	-0.11	-0.29	0.30	-0.10	-0.26	0.29	-0.11	-0.27
0.39	0.30	-0.10	-0.24	0.29	-0.11	-0.27	0.29	-0.11	-0.27	0.31	-0.08	-0.21	0.30	-0.10	-0.24
0.36	0.30	-0.06	-0.16	0.29	-0.06	-0.18	0.29	-0.06	-0.18	0.31	-0.05	-0.13	0.31	-0.05	-0.15
0.37	0.31	-0.06	-0.15	0.30	-0.07	-0.19	0.30	-0.07	-0.19	0.33	-0.04	-0.12	0.32	-0.05	-0.14
0.37	0.32	-0.04	-0.12	0.31	-0.06	-0.16	0.31	-0.06	-0.15	0.34	-0.03	-0.07	0.33	-0.03	-0.09
0.34	0.34	0.00	0.01	0.32	-0.01	-0.04	0.32	-0.01	-0.04	0.36	0.02	0.07	0.35	0.02	0.05
0.35	0.36	0.00	0.00	0.34	-0.02	-0.05	0.33	-0.02	-0.06	0.38	0.02	0.07	0.37	0.02	0.04
0.36	0.37	0.01	0.03	0.35	-0.01	-0.03	0.35	-0.01	-0.04	0.41	0.04	0.12	0.39	0.02	0.07
0.36	0.40	0.04	0.12	0.37	0.01	0.04	0.37	0.02	0.04	0.44	0.08	0.22	0.42	0.06	0.17
0.41	0.43	0.02	0.06	0.39	-0.02	-0.04	0.40	-0.01	-0.03	0.49	0.08	0.19	0.45	0.04	0.11
0.46	0.48	0.02	0.04	0.42	-0.04	-0.09	0.44	-0.03	-0.06	0.57	0.11	0.23	0.51	0.04	0.10
0.49	0.56	0.07	0.14	0.47	-0.02	-0.04	0.50	0.01	0.02	0.70	0.21	0.43	0.60	0.10	0.21
0.59	0.69	0.10	0.17	0.54	-0.05	-0.08	0.60	0.00	0.01	0.81	0.22	0.37	0.74	0.15	0.25
0.60	0.81	0.21	0.35	0.68	0.08	0.13	0.76	0.16	0.26	0.68	0.08	0.13	0.81	0.21	0.35
0.60	0.69	0.09	0.15	0.80	0.20	0.34	0.77	0.17	0.29	0.57	-0.03	-0.05	0.65	0.05	0.09
0.58	0.57	-0.01	-0.02	0.70	0.12	0.20	0.61	0.03	0.04	0.53	-0.05	-0.09	0.57	-0.01	-0.02
0.50	0.53	0.03	0.05	0.57	0.07	0.13	0.54	0.03	0.07	0.52	0.01	0.03	0.54	0.04	0.07
0.47	0.52	0.05	0.10	0.53	0.06	0.13	0.51	0.04	0.09	0.52	0.05	0.11	0.53	0.06	0.13
0.42	0.51	0.10	0.23	0.51	0.09	0.22	0.50	0.08	0.20	0.51	0.09	0.23	0.53	0.11	0.25
0.37	0.51	0.14	0.37	0.51	0.14	0.36	0.50	0.13	0.34	0.51	0.14	0.37	0.52	0.14	0.39
0.31	0.51	0.21	0.67	0.51	0.20	0.67	0.50	0.19	0.63	0.51	0.20	0.66	0.52	0.21	0.69
0.25	0.50	0.25	1.03	0.51	0.26	1.06	0.50	0.25	1.01	0.49	0.24	0.96	0.50	0.25	1.02
0.21	0.49	0.28	1.34	0.50	0.29	1.39	0.49	0.28	1.35	0.47	0.26	1.27	0.48	0.27	1.32
0.19	0.48	0.29	1.56	0.49	0.31	1.65	0.47	0.29	1.55	0.45	0.27	1.45	0.47	0.28	1.53
0.17	0.45	0.29	1.75	0.47	0.31	1.86	0.46	0.29	1.78	0.44	0.28	1.70	0.45	0.28	1.70
0.16	0.44	0.28	1.75	0.46	0.29	1.82	0.44	0.28	1.74	0.44	0.28	1.72	0.44	0.28	1.72
0.16	0.44	0.27	1.68	0.44	0.28	1.73	0.44	0.27	1.69	0.43	0.27	1.65	0.43	0.27	1.65

0.17	0.43	0.26	1.49	0.43	0.26	1.50	0.43	0.26	1.48	0.43	0.26	1.48	0.43	0.26	1.48	
0.18	0.43	0.25	1.35	0.43	0.25	1.38	0.43	0.24	1.35	0.42	0.24	1.34	0.43	0.24	1.35	
0.19	0.42	0.24	1.28	0.42	0.24	1.28	0.41	0.23	1.23	0.42	0.24	1.27	0.43	0.24	1.28	
0.19	0.42	0.22	1.16	0.42	0.23	1.19	0.41	0.22	1.14	0.41	0.22	1.14	0.42	0.23	1.18	
0.20	0.41	0.22	1.09	0.42	0.22	1.10	0.41	0.21	1.08	0.42	0.22	1.12	0.42	0.22	1.12	
0.20	0.41	0.21	1.03	0.41	0.21	1.01	0.41	0.20	1.00	0.43	0.23	1.11	0.42	0.22	1.08	
0.22	0.43	0.20	0.91	0.41	0.19	0.86	0.40	0.18	0.80	0.44	0.21	0.96	0.44	0.21	0.95	
0.23	0.43	0.20	0.88	0.42	0.19	0.82	0.41	0.18	0.79	0.45	0.22	0.94	0.45	0.22	0.95	
0.25	0.44	0.19	0.77	0.43	0.18	0.73	0.42	0.17	0.70	0.44	0.19	0.77	0.45	0.21	0.84	
0.26	0.44	0.18	0.70	0.43	0.18	0.69	0.42	0.16	0.64	0.42	0.16	0.63	0.43	0.18	0.70	
0.28	0.42	0.14	0.48	0.44	0.15	0.54	0.42	0.14	0.48	0.39	0.11	0.39	0.41	0.13	0.47	
0.28	0.39	0.11	0.41	0.42	0.14	0.48	0.40	0.12	0.43	0.37	0.09	0.34	0.39	0.11	0.40	
0.30	0.37	0.08	0.26	0.40	0.10	0.34	0.38	0.09	0.29	0.36	0.07	0.22	0.38	0.08	0.27	
0.31	0.36	0.05	0.17	0.38	0.07	0.21	0.36	0.05	0.17	0.35	0.04	0.13	0.36	0.05	0.16	
0.31	0.35	0.04	0.13	0.36	0.05	0.16	0.36	0.04	0.13	0.35	0.03	0.11	0.35	0.04	0.12	
0.33	0.34	0.01	0.03	0.35	0.02	0.06	0.35	0.01	0.04	0.34	0.01	0.02	0.35	0.01	0.04	
0.33	0.34	0.01	0.03	0.34	0.01	0.04	0.34	0.01	0.02	0.33	0.00	0.01	0.34	0.01	0.03	
0.33	= <|x|>	*0.13*			*0.14*			*0.13*			*0.13*			*0.13*		*MAE*
		0.40			**0.41**			**0.38**			**0.41**			**0.41**		**RMAE**

Table 9.4: : Experiment 17.05.07 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.46	0.28	-0.19	-0.40	0.27	-0.20	-0.42	0.29	-0.17	-0.38	0.29	-0.17	-0.37	0.26	-0.20	-0.44	
0.44	0.29	-0.15	-0.34	0.28	-0.16	-0.37	0.30	-0.14	-0.31	0.31	-0.13	-0.30	0.28	-0.16	-0.36	
0.39	0.31	-0.08	-0.20	0.29	-0.10	-0.26	0.31	-0.08	-0.20	0.33	-0.06	-0.15	0.30	-0.08	-0.22	
0.37	0.33	-0.04	-0.11	0.31	-0.06	-0.16	0.32	-0.04	-0.12	0.35	-0.02	-0.04	0.33	-0.04	-0.11	
0.39	0.35	-0.04	-0.10	0.33	-0.06	-0.16	0.34	-0.04	-0.11	0.38	0.00	-0.01	0.35	-0.03	-0.08	
0.39	0.37	-0.02	-0.04	0.35	-0.04	-0.11	0.36	-0.03	-0.07	0.40	0.01	0.01	0.38	-0.01	-0.03	
0.42	0.39	-0.02	-0.06	0.37	-0.05	-0.12	0.38	-0.04	-0.09	0.42	0.00	0.00	0.40	-0.02	-0.05	
0.45	0.41	-0.04	-0.09	0.39	-0.07	-0.15	0.40	-0.05	-0.11	0.44	-0.01	-0.02	0.42	-0.04	-0.08	
0.47	0.44	-0.03	-0.07	0.41	-0.06	-0.13	0.43	-0.03	-0.07	0.49	0.03	0.06	0.44	-0.02	-0.05	
0.51	0.49	-0.02	-0.04	0.44	-0.08	-0.15	0.48	-0.04	-0.07	0.56	0.05	0.09	0.49	-0.02	-0.05	
0.61	0.55	-0.06	-0.10	0.48	-0.14	-0.22	0.54	-0.07	-0.12	0.67	0.06	0.10	0.56	-0.05	-0.09	
0.60	0.66	0.06	0.09	0.54	-0.06	-0.10	0.65	0.04	0.07	0.79	0.19	0.32	0.66	0.05	0.09	
0.65	0.79	0.14	0.21	0.64	0.00	-0.01	0.79	0.14	0.22	0.73	0.09	0.13	0.77	0.12	0.19	
0.65	0.75	0.09	0.14	0.77	0.12	0.18	0.76	0.11	0.16	0.62	-0.04	-0.06	0.74	0.09	0.13	
0.60	0.62	0.02	0.03	0.77	0.16	0.27	0.62	0.01	0.02	0.57	-0.03	-0.05	0.62	0.01	0.02	
0.60	0.57	-0.03	-0.05	0.63	0.02	0.04	0.56	-0.04	-0.07	0.55	-0.06	-0.09	0.57	-0.03	-0.05	
0.54	0.55	0.01	0.02	0.57	0.04	0.07	0.54	0.01	0.01	0.54	0.00	0.00	0.54	0.01	0.01	
0.54	0.54	-0.01	-0.01	0.55	0.00	0.01	0.53	-0.01	-0.02	0.52	-0.02	-0.04	0.53	-0.01	-0.02	
0.52	0.52	0.00	0.01	0.54	0.02	0.04	0.53	0.01	0.02	0.51	-0.01	-0.01	0.50	-0.01	-0.02	
0.53	0.51	-0.02	-0.03	0.52	-0.01	-0.01	0.52	-0.01	-0.02	0.50	-0.03	-0.05	0.50	-0.03	-0.06	
0.51	0.50	-0.01	-0.01	0.51	0.00	0.01	0.51	0.00	0.00	0.48	-0.03	-0.06	0.48	-0.03	-0.05	
0.47	0.48	0.01	0.03	0.50	0.04	0.08	0.49	0.02	0.05	0.46	-0.01	-0.02	0.47	0.00	0.00	
0.43	0.46	0.03	0.08	0.49	0.06	0.14	0.47	0.04	0.10	0.43	0.00	0.01	0.44	0.01	0.03	
0.39	0.44	0.04	0.11	0.46	0.07	0.18	0.45	0.06	0.15	0.42	0.02	0.06	0.42	0.03	0.07	
0.51	= <|x|>	*0.04*			*0.05*			*0.04*			*0.03*			*0.03*		*MAE*
		0.07			**0.11**			**0.08**			**0.07**			**0.06**		**RMAE**

Table 9.5: Experiment 17.05.07 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.39	0.39	0.00	0.01	0.40	0.01	0.02	0.43	0.04	0.09	0.39	0.00	0.00	0.34	-0.05	-0.12	
0.40	0.40	0.00	-0.01	0.40	0.00	0.00	0.43	0.02	0.06	0.40	0.00	-0.01	0.35	-0.05	-0.14	
0.42	0.40	-0.02	-0.04	0.41	-0.02	-0.04	0.43	0.01	0.01	0.40	-0.02	-0.05	0.36	-0.07	-0.16	
0.43	0.41	-0.02	-0.06	0.41	-0.02	-0.04	0.42	-0.01	-0.02	0.41	-0.02	-0.06	0.37	-0.06	-0.14	
0.44	0.41	-0.03	-0.08	0.41	-0.04	-0.08	0.42	-0.03	-0.06	0.41	-0.04	-0.09	0.37	-0.07	-0.16	
0.44	0.41	-0.03	-0.06	0.41	-0.03	-0.06	0.42	-0.01	-0.03	0.42	-0.02	-0.05	0.38	-0.06	-0.14	
0.43	0.42	-0.01	-0.03	0.41	-0.02	-0.05	0.43	0.00	0.00	0.43	0.00	-0.01	0.38	-0.05	-0.12	
0.43	0.44	0.02	0.04	0.43	0.00	0.00	0.45	0.02	0.06	0.45	0.02	0.06	0.40	-0.03	-0.07	
0.41	0.45	0.04	0.11	0.45	0.04	0.09	0.46	0.05	0.13	0.46	0.05	0.13	0.42	0.01	0.01	
0.41	0.46	0.05	0.13	0.46	0.05	0.13	0.46	0.05	0.12	0.45	0.04	0.10	0.44	0.04	0.09	
0.41	0.44	0.03	0.08	0.46	0.05	0.11	0.44	0.02	0.06	0.43	0.02	0.04	0.45	0.04	0.09	
0.42	0.41	0.00	-0.01	0.43	0.02	0.04	0.41	-0.01	-0.03	0.40	-0.02	-0.04	0.43	0.02	0.04	
0.42	0.39	-0.03	-0.08	0.40	-0.02	-0.05	0.38	-0.04	-0.09	0.37	-0.05	-0.12	0.41	-0.02	-0.04	
0.43	0.37	-0.06	-0.15	0.38	-0.05	-0.11	0.37	-0.06	-0.14	0.36	-0.07	-0.17	0.38	-0.05	-0.12	
0.40	0.35	-0.05	-0.11	0.36	-0.04	-0.09	0.36	-0.04	-0.10	0.35	-0.05	-0.13	0.36	-0.04	-0.10	
0.39	0.35	-0.04	-0.11	0.35	-0.04	-0.10	0.35	-0.04	-0.10	0.34	-0.05	-0.13	0.34	-0.05	-0.12	
0.37	0.34	-0.03	-0.08	0.34	-0.02	-0.06	0.34	-0.03	-0.07	0.34	-0.03	-0.08	0.34	-0.03	-0.08	
0.35	0.34	-0.02	-0.05	0.34	-0.02	-0.05	0.34	-0.01	-0.04	0.33	-0.02	-0.06	0.33	-0.02	-0.06	
0.35	0.33	-0.02	-0.06	0.33	-0.02	-0.05	0.33	-0.02	-0.05	0.33	-0.02	-0.06	0.33	-0.02	-0.06	
0.33	0.34	0.01	0.03	0.33	0.00	0.01	0.34	0.01	0.03	0.33	0.01	0.02	0.33	0.00	-0.01	
0.40	= <|x|>	*0.03*			*0.02*			*0.03*			*0.03*			*0.04*		*MAE*
		0.07			**0.06**			**0.07**			**0.07**			**0.10**		**RMAE**

Table 9.6: : Experiment 17.05.07 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.40	0.07	-0.33	-0.82	0.04	-0.36	-0.89	0.19	-0.21	-0.53	0.17	-0.23	-0.57	0.15	-0.24	-0.61
0.42	0.09	-0.33	-0.79	0.05	-0.37	-0.89	0.21	-0.22	-0.51	0.20	-0.23	-0.54	0.16	-0.27	-0.63

0.46	0.12	-0.34	-0.74	0.06	-0.40	-0.87	0.23	-0.22	-0.49	0.24	-0.22	-0.48	0.17	-0.28	-0.62	
0.46	0.16	-0.30	-0.66	0.07	-0.39	-0.84	0.26	-0.20	-0.43	0.27	-0.19	-0.41	0.20	-0.26	-0.57	
0.50	0.19	-0.30	-0.61	0.09	-0.41	-0.82	0.28	-0.21	-0.43	0.30	-0.20	-0.40	0.22	-0.28	-0.55	
0.50	0.23	-0.27	-0.54	0.10	-0.40	-0.79	0.31	-0.19	-0.38	0.32	-0.18	-0.35	0.26	-0.24	-0.49	
0.53	0.26	-0.27	-0.51	0.13	-0.40	-0.76	0.34	-0.19	-0.36	0.35	-0.18	-0.34	0.29	-0.24	-0.45	
0.57	0.30	-0.27	-0.48	0.16	-0.41	-0.72	0.35	-0.22	-0.38	0.37	-0.20	-0.35	0.31	-0.26	-0.45	
0.57	0.32	-0.25	-0.44	0.20	-0.38	-0.66	0.36	-0.21	-0.36	0.38	-0.19	-0.33	0.34	-0.24	-0.41	
0.61	0.34	-0.27	-0.45	0.23	-0.38	-0.62	0.39	-0.22	-0.37	0.41	-0.20	-0.33	0.36	-0.25	-0.41	
0.60	0.36	-0.24	-0.40	0.26	-0.34	-0.57	0.41	-0.19	-0.32	0.44	-0.16	-0.27	0.38	-0.22	-0.37	
0.58	0.37	-0.20	-0.35	0.29	-0.29	-0.50	0.44	-0.14	-0.24	0.46	-0.12	-0.20	0.39	-0.18	-0.32	
0.55	0.39	-0.16	-0.29	0.32	-0.24	-0.43	0.46	-0.09	-0.16	0.47	-0.08	-0.15	0.42	-0.14	-0.24	
0.53	0.42	-0.11	-0.20	0.33	-0.20	-0.37	0.46	-0.07	-0.13	0.44	-0.09	-0.17	0.45	-0.08	-0.15	
0.50	0.45	-0.05	-0.10	0.35	-0.15	-0.30	0.42	-0.07	-0.15	0.40	-0.10	-0.19	0.46	-0.03	-0.07	
0.49	0.46	-0.03	-0.05	0.36	-0.13	-0.26	0.40	-0.09	-0.19	0.38	-0.11	-0.23	0.45	-0.04	-0.08	
0.47	0.44	-0.03	-0.06	0.38	-0.09	-0.19	0.37	-0.10	-0.21	0.36	-0.11	-0.24	0.42	-0.05	-0.12	
0.45	0.41	-0.05	-0.10	0.41	-0.04	-0.09	0.36	-0.09	-0.20	0.34	-0.11	-0.24	0.38	-0.07	-0.16	
0.51	= <|x|>	*0.21*			*0.30*			*0.16*			*0.16*			*0.19*		*MAE*
		0.41			**0.58**			**0.32**			**0.31**			**0.37**		**RMAE**

Table 9.7: Experiment 17.05.07 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.13	0.17	0.05	0.36	0.17	0.04	0.32	0.18	0.05	0.41	0.18	0.05	0.41	0.16	0.03	0.24	
0.17	0.17	0.01	0.04	0.17	0.00	0.01	0.18	0.01	0.08	0.17	0.01	0.05	0.16	-0.01	-0.05	
0.18	0.17	-0.01	-0.05	0.17	-0.01	-0.06	0.17	0.00	-0.01	0.17	0.00	-0.02	0.15	-0.02	-0.13	
0.18	0.17	-0.02	-0.09	0.17	-0.02	-0.09	0.17	-0.01	-0.05	0.17	-0.01	-0.07	0.15	-0.03	-0.16	
0.18	0.17	-0.01	-0.07	0.17	-0.01	-0.04	0.17	0.00	-0.02	0.17	-0.01	-0.06	0.15	-0.03	-0.15	
0.18	0.17	-0.01	-0.08	0.17	-0.01	-0.05	0.17	-0.01	-0.04	0.17	-0.01	-0.08	0.15	-0.03	-0.14	
0.19	0.17	-0.02	-0.12	0.17	-0.02	-0.09	0.17	-0.02	-0.09	0.17	-0.03	-0.14	0.15	-0.04	-0.21	
0.17	0.17	0.00	-0.02	0.18	0.00	0.02	0.18	0.01	0.06	0.17	-0.01	-0.03	0.16	-0.01	-0.09	
0.18	0.18	0.00	0.00	0.19	0.01	0.06	0.18	0.01	0.04	0.17	-0.01	-0.03	0.16	-0.02	-0.10	
0.16	0.18	0.03	0.17	0.20	0.04	0.25	0.19	0.04	0.23	0.17	0.01	0.08	0.16	0.01	0.03	
0.16	0.19	0.03	0.18	0.21	0.05	0.30	0.20	0.04	0.25	0.18	0.02	0.12	0.18	0.02	0.11	
0.17	0.20	0.03	0.19	0.22	0.05	0.31	0.22	0.05	0.27	0.19	0.02	0.10	0.19	0.02	0.10	
0.19	0.21	0.03	0.14	0.25	0.06	0.33	0.23	0.04	0.22	0.20	0.01	0.05	0.19	0.01	0.04	
0.20	0.23	0.03	0.17	0.27	0.07	0.37	0.25	0.05	0.26	0.20	0.00	0.02	0.21	0.01	0.03	
0.22	0.25	0.04	0.18	0.28	0.07	0.31	0.27	0.06	0.26	0.22	0.01	0.03	0.23	0.01	0.06	
0.22	0.28	0.05	0.23	0.28	0.06	0.27	0.28	0.06	0.27	0.24	0.02	0.08	0.25	0.02	0.11	
0.22	0.28	0.07	0.31	0.27	0.05	0.25	0.29	0.07	0.32	0.26	0.05	0.22	0.27	0.05	0.24	
0.21	0.28	0.07	0.35	0.25	0.04	0.21	0.28	0.07	0.35	0.28	0.07	0.34	0.28	0.07	0.32	
0.20	0.26	0.06	0.29	0.24	0.04	0.19	0.26	0.06	0.28	0.28	0.08	0.38	0.27	0.06	0.30	
0.20	0.25	0.04	0.21	0.23	0.02	0.11	0.25	0.04	0.20	0.27	0.07	0.34	0.26	0.05	0.26	
0.21	0.23	0.02	0.10	0.22	0.01	0.04	0.23	0.02	0.09	0.26	0.05	0.22	0.24	0.03	0.15	
0.21	0.23	0.01	0.07	0.21	0.00	0.02	0.23	0.02	0.07	0.24	0.03	0.15	0.23	0.02	0.09	
0.20	0.22	0.02	0.10	0.21	0.01	0.07	0.21	0.02	0.09	0.23	0.03	0.16	0.22	0.02	0.10	
0.19	0.21	0.02	0.13	0.21	0.02	0.12	0.21	0.02	0.13	0.22	0.03	0.18	0.21	0.02	0.13	
0.20	0.21	0.01	0.04	0.20	0.00	0.00	0.21	0.01	0.05	0.21	0.01	0.07	0.21	0.01	0.03	
0.18	0.21	0.03	0.14	0.20	0.02	0.12	0.21	0.03	0.14	0.21	0.03	0.15	0.20	0.02	0.09	
0.18	0.20	0.02	0.11	0.20	0.02	0.10	0.21	0.03	0.14	0.20	0.02	0.12	0.20	0.02	0.09	
0.18	0.20	0.02	0.13	0.20	0.02	0.10	0.20	0.02	0.13	0.21	0.03	0.15	0.20	0.02	0.10	
0.18	0.20	0.02	0.12	0.20	0.02	0.11	0.20	0.03	0.15	0.20	0.03	0.14	0.19	0.02	0.09	
0.19	0.20	0.01	0.04	0.20	0.01	0.03	0.20	0.01	0.05	0.20	0.01	0.03	0.19	0.00	-0.01	
0.17	0.19	0.02	0.10	0.20	0.02	0.12	0.20	0.03	0.15	0.20	0.02	0.13	0.18	0.01	0.06	
0.17	0.20	0.03	0.17	0.19	0.03	0.16	0.20	0.03	0.18	0.20	0.03	0.18	0.19	0.02	0.13	
0.15	0.19	0.04	0.29	0.19	0.04	0.25	0.20	0.05	0.32	0.19	0.04	0.30	0.19	0.04	0.24	
0.13	0.19	0.06	0.44	0.19	0.05	0.41	0.19	0.06	0.44	0.19	0.06	0.44	0.18	0.05	0.40	
0.15	0.18	0.04	0.26	0.18	0.03	0.23	0.19	0.04	0.28	0.19	0.04	0.30	0.18	0.03	0.23	
0.15	0.18	0.03	0.23	0.18	0.03	0.21	0.18	0.04	0.26	0.19	0.04	0.26	0.18	0.03	0.22	
0.14	0.18	0.04	0.27	0.17	0.03	0.22	0.18	0.04	0.28	0.18	0.04	0.30	0.18	0.04	0.25	
0.16	0.18	0.02	0.09	0.17	0.01	0.07	0.18	0.02	0.10	0.18	0.02	0.12	0.17	0.01	0.07	
0.14	0.17	0.03	0.20	0.17	0.03	0.18	0.18	0.03	0.22	0.18	0.03	0.22	0.17	0.03	0.18	
0.16	0.17	0.01	0.07	0.17	0.02	0.10	0.17	0.02	0.10	0.18	0.02	0.12	0.16	0.01	0.04	
0.16	0.17	0.01	0.06	0.17	0.01	0.04	0.17	0.01	0.06	0.17	0.01	0.03	0.16	0.00	0.00	
0.16	0.17	0.00	0.03	0.17	0.00	0.02	0.17	0.01	0.04	0.17	0.01	0.05	0.16	0.00	-0.02	
0.15	0.17	0.02	0.15	0.17	0.02	0.14	0.17	0.02	0.16	0.17	0.02	0.15	0.16	0.02	0.10	
0.18	= <|x|>	0.03			0.03			0.03			0.03			0.02		*MAE*
		0.15			**0.15**			**0.17**			**0.15**			**0.13**		**RMAE**

Table 9.8: Experiment 24.05.07 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.20	0.18	-0.02	-0.12	0.18	-0.02	-0.12	0.18	-0.02	-0.10	0.18	-0.02	-0.10	0.18	-0.03	-0.13
0.21	0.18	-0.02	-0.12	0.18	-0.03	-0.13	0.18	-0.03	-0.13	0.18	-0.02	-0.12	0.17	-0.03	-0.15
0.21	0.18	-0.03	-0.14	0.18	-0.03	-0.13	0.18	-0.02	-0.12	0.18	-0.03	-0.13	0.18	-0.03	-0.14
0.21	0.18	-0.03	-0.16	0.18	-0.03	-0.15	0.18	-0.03	-0.16	0.18	-0.04	-0.17	0.18	-0.04	-0.17
0.21	0.18	-0.04	-0.16	0.19	-0.03	-0.13	0.18	-0.03	-0.14	0.18	-0.04	-0.18	0.17	-0.04	-0.19
0.22	0.18	-0.04	-0.17	0.19	-0.03	-0.12	0.19	-0.03	-0.15	0.18	-0.04	-0.18	0.18	-0.04	-0.18
0.22	0.19	-0.03	-0.14	0.20	-0.02	-0.08	0.19	-0.03	-0.11	0.18	-0.04	-0.17	0.18	-0.04	-0.17
0.22	0.20	-0.02	-0.09	0.21	-0.01	-0.05	0.20	-0.02	-0.09	0.19	-0.03	-0.14	0.19	-0.02	-0.11
0.24	0.20	-0.04	-0.15	0.22	-0.02	-0.09	0.21	-0.04	-0.15	0.19	-0.05	-0.20	0.20	-0.04	-0.16

0.25	0.21	-0.04	-0.15	0.24	-0.01	-0.06	0.22	-0.03	-0.14	0.20	-0.05	-0.21	0.21	-0.04	-0.17	
0.28	0.23	-0.05	-0.19	0.26	-0.02	-0.08	0.23	-0.05	-0.18	0.21	-0.07	-0.25	0.22	-0.05	-0.19	
0.29	0.24	-0.05	-0.18	0.27	-0.02	-0.08	0.24	-0.05	-0.18	0.22	-0.07	-0.26	0.24	-0.05	-0.18	
0.29	0.26	-0.03	-0.10	0.29	-0.01	-0.02	0.26	-0.03	-0.12	0.23	-0.06	-0.20	0.26	-0.03	-0.12	
0.29	0.28	-0.01	-0.03	0.29	0.00	0.01	0.27	-0.01	-0.04	0.25	-0.03	-0.12	0.28	-0.01	-0.03	
0.26	0.29	0.03	0.13	0.28	0.02	0.08	0.28	0.03	0.10	0.27	0.01	0.04	0.29	0.03	0.13	
0.24	0.28	0.04	0.16	0.26	0.02	0.08	0.28	0.04	0.15	0.28	0.04	0.15	0.28	0.04	0.16	
0.24	0.27	0.03	0.13	0.25	0.00	0.02	0.27	0.03	0.12	0.29	0.05	0.20	0.27	0.03	0.14	
0.23	0.26	0.02	0.10	0.23	0.00	0.00	0.26	0.02	0.09	0.28	0.04	0.19	0.26	0.02	0.09	
0.23	0.24	0.01	0.06	0.22	0.00	-0.01	0.24	0.01	0.05	0.26	0.04	0.16	0.24	0.01	0.05	
0.23	0.23	0.00	-0.01	0.22	-0.01	-0.05	0.23	0.00	-0.01	0.25	0.02	0.08	0.23	0.00	-0.01	
0.22	0.22	0.00	-0.01	0.21	-0.01	-0.04	0.22	0.00	-0.01	0.23	0.01	0.05	0.22	0.00	-0.01	
0.23	0.22	-0.02	-0.07	0.21	-0.02	-0.09	0.21	-0.02	-0.08	0.23	-0.01	-0.02	0.22	-0.02	-0.07	
0.24	0.21	-0.03	-0.11	0.21	-0.03	-0.12	0.21	-0.03	-0.11	0.22	-0.02	-0.09	0.21	-0.03	-0.12	
0.23	0.21	-0.02	-0.09	0.21	-0.02	-0.10	0.21	-0.02	-0.09	0.21	-0.02	-0.08	0.21	-0.02	-0.08	
0.24	0.21	-0.03	-0.12	0.21	-0.03	-0.12	0.21	-0.03	-0.12	0.21	-0.02	-0.10	0.21	-0.03	-0.12	
0.23	0.21	-0.02	-0.09	0.21	-0.02	-0.10	0.21	-0.03	-0.12	0.21	-0.03	-0.11	0.21	-0.03	-0.12	
0.22	0.21	-0.02	-0.07	0.20	-0.02	-0.10	0.20	-0.02	-0.08	0.21	-0.01	-0.06	0.21	-0.01	-0.07	
0.22	0.20	-0.02	-0.08	0.20	-0.02	-0.08	0.20	-0.02	-0.08	0.20	-0.02	-0.08	0.20	-0.02	-0.08	
0.21	0.20	-0.01	-0.06	0.20	-0.01	-0.06	0.20	-0.01	-0.06	0.21	-0.01	-0.03	0.20	-0.01	-0.05	
0.21	0.20	-0.01	-0.04	0.20	-0.01	-0.05	0.20	-0.01	-0.05	0.20	-0.01	-0.05	0.20	-0.01	-0.04	
0.20	0.20	0.00	-0.01	0.20	-0.01	-0.03	0.19	-0.01	-0.04	0.20	0.00	0.00	0.20	0.00	-0.02	
0.19	0.19	0.00	0.01	0.19	0.00	-0.02	0.20	0.00	0.02	0.20	0.01	0.04	0.19	0.00	0.01	
0.19	0.19	0.00	-0.01	0.19	-0.01	-0.04	0.19	0.00	-0.02	0.19	0.00	0.00	0.19	0.00	-0.01	
0.19	0.19	0.00	0.02	0.19	0.00	0.00	0.18	0.00	0.00	0.19	0.00	0.02	0.19	0.00	0.01	
0.19	0.18	-0.01	-0.03	0.18	-0.01	-0.05	0.18	0.00	-0.02	0.19	0.00	0.02	0.18	0.00	-0.02	
0.18	0.18	0.01	0.04	0.18	0.00	0.00	0.18	0.00	0.02	0.19	0.01	0.05	0.18	0.00	0.02	
0.18	0.18	0.00	-0.02	0.18	0.00	-0.03	0.18	0.00	-0.01	0.18	0.00	0.01	0.18	0.00	-0.02	
0.19	0.18	-0.01	-0.04	0.18	-0.01	-0.04	0.17	-0.01	-0.06	0.18	-0.01	-0.03	0.18	-0.01	-0.04	
0.18	0.17	0.00	-0.01	0.18	0.00	0.00	0.17	0.00	-0.02	0.18	0.00	0.01	0.17	0.00	-0.02	
0.18	0.17	0.00	-0.02	0.17	-0.01	-0.03	0.17	0.00	-0.02	0.17	-0.01	-0.03	0.17	0.00	-0.02	
0.17	0.17	0.00	0.00	0.17	0.00	-0.01	0.17	0.00	-0.02	0.17	0.00	0.00	0.17	0.00	0.00	
0.17	0.17	0.00	0.03	0.17	0.00	0.01	0.17	0.00	0.01	0.17	0.01	0.04	0.17	0.00	0.03	
0.17	0.17	0.00	-0.01	0.17	0.00	-0.02	0.17	0.00	-0.03	0.17	0.00	0.00	0.17	0.00	-0.01	
0.22	= <|x|>	*0.02*			*0.01*			*0.02*			*0.02*			*0.02*		*MAE*
		0.09			**0.06**			**0.08**			**0.10**			**0.09**		**RMAE**

Table 9.9: Experiment 24.05.07 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.29	0.18	-0.11	-0.38	0.18	-0.11	-0.37	0.18	-0.11	-0.38	0.18	-0.11	-0.37	0.18	-0.11	-0.37
0.28	0.18	-0.10	-0.34	0.18	-0.10	-0.34	0.18	-0.10	-0.34	0.18	-0.10	-0.35	0.18	-0.10	-0.35
0.27	0.18	-0.09	-0.32	0.19	-0.08	-0.30	0.18	-0.08	-0.31	0.18	-0.08	-0.31	0.18	-0.09	-0.32
0.26	0.18	-0.07	-0.29	0.18	-0.07	-0.28	0.18	-0.07	-0.29	0.18	-0.08	-0.30	0.18	-0.08	-0.30
0.25	0.18	-0.06	-0.25	0.20	-0.05	-0.20	0.19	-0.06	-0.23	0.18	-0.06	-0.26	0.18	-0.06	-0.25
0.25	0.19	-0.06	-0.25	0.20	-0.06	-0.23	0.19	-0.06	-0.25	0.18	-0.07	-0.28	0.19	-0.07	-0.26
0.25	0.20	-0.05	-0.22	0.21	-0.04	-0.18	0.19	-0.06	-0.23	0.19	-0.06	-0.26	0.19	-0.06	-0.23
0.26	0.20	-0.06	-0.23	0.21	-0.05	-0.18	0.20	-0.06	-0.23	0.19	-0.07	-0.26	0.20	-0.06	-0.23
0.28	0.21	-0.07	-0.25	0.22	-0.06	-0.20	0.21	-0.07	-0.25	0.20	-0.08	-0.29	0.21	-0.07	-0.25
0.29	0.21	-0.08	-0.26	0.24	-0.05	-0.19	0.21	-0.08	-0.27	0.20	-0.09	-0.31	0.22	-0.08	-0.26
0.31	0.23	-0.08	-0.27	0.25	-0.06	-0.20	0.22	-0.09	-0.29	0.21	-0.10	-0.32	0.23	-0.08	-0.26
0.31	0.24	-0.08	-0.24	0.26	-0.05	-0.15	0.24	-0.07	-0.24	0.22	-0.10	-0.31	0.24	-0.07	-0.23
0.31	0.26	-0.05	-0.16	0.27	-0.04	-0.12	0.25	-0.06	-0.20	0.23	-0.08	-0.25	0.26	-0.05	-0.15
0.28	0.27	-0.02	-0.05	0.28	-0.01	-0.02	0.26	-0.02	-0.07	0.25	-0.04	-0.13	0.27	-0.01	-0.03
0.26	0.28	0.02	0.06	0.27	0.01	0.06	0.27	0.01	0.04	0.26	0.00	0.00	0.28	0.02	0.09
0.24	0.27	0.04	0.15	0.26	0.02	0.10	0.27	0.04	0.15	0.27	0.03	0.13	0.28	0.04	0.18
0.24	0.27	0.03	0.13	0.25	0.01	0.05	0.27	0.03	0.13	0.28	0.04	0.17	0.27	0.03	0.14
0.22	0.26	0.03	0.14	0.23	0.01	0.04	0.26	0.03	0.15	0.27	0.05	0.21	0.26	0.03	0.14
0.22	0.24	0.03	0.12	0.23	0.01	0.04	0.24	0.03	0.13	0.26	0.04	0.20	0.24	0.02	0.10
0.21	0.23	0.02	0.08	0.22	0.01	0.02	0.23	0.02	0.10	0.25	0.04	0.18	0.23	0.02	0.08
0.21	0.22	0.01	0.04	0.21	0.00	0.00	0.22	0.01	0.05	0.24	0.03	0.13	0.22	0.01	0.04
0.21	0.21	0.01	0.04	0.21	0.00	0.01	0.21	0.01	0.04	0.22	0.02	0.08	0.21	0.01	0.03
0.18	0.21	0.03	0.17	0.21	0.03	0.14	0.21	0.03	0.15	0.22	0.04	0.20	0.21	0.03	0.17
0.17	0.21	0.03	0.18	0.21	0.03	0.18	0.21	0.03	0.18	0.21	0.04	0.21	0.21	0.04	0.20
0.18	0.21	0.03	0.16	0.21	0.03	0.17	0.20	0.03	0.15	0.21	0.03	0.17	0.21	0.03	0.17
0.18	0.21	0.02	0.14	0.20	0.02	0.10	0.20	0.02	0.11	0.21	0.02	0.13	0.21	0.02	0.13
0.19	0.20	0.02	0.08	0.20	0.01	0.07	0.20	0.01	0.07	0.20	0.02	0.09	0.20	0.02	0.10
0.20	0.20	0.00	-0.02	0.20	-0.01	-0.03	0.20	-0.01	-0.03	0.20	0.00	-0.02	0.20	0.00	-0.01
0.19	0.20	0.00	0.01	0.20	0.00	0.01	0.19	0.00	-0.01	0.20	0.01	0.05	0.20	0.01	0.03
0.20	0.20	0.00	-0.01	0.19	-0.01	-0.03	0.19	-0.01	-0.04	0.20	0.00	-0.01	0.20	0.00	-0.01
0.20	0.19	0.00	-0.02	0.19	0.00	-0.01	0.19	0.00	-0.02	0.19	0.00	0.00	0.19	0.00	-0.01
0.19	0.19	0.00	-0.03	0.18	-0.01	-0.05	0.18	-0.01	-0.05	0.19	0.00	0.00	0.20	0.00	0.01
0.20	0.19	-0.01	-0.03	0.18	-0.01	-0.06	0.19	-0.01	-0.04	0.19	-0.01	-0.04	0.19	-0.01	-0.03
0.19	0.18	-0.01	-0.03	0.18	-0.01	-0.04	0.18	-0.01	-0.06	0.19	0.00	-0.02	0.18	-0.01	-0.03
0.19	0.18	-0.01	-0.07	0.18	-0.01	-0.07	0.18	-0.01	-0.07	0.19	-0.01	-0.03	0.18	-0.01	-0.05
0.19	0.18	-0.01	-0.05	0.18	-0.01	-0.07	0.18	-0.01	-0.05	0.18	-0.01	-0.04	0.18	-0.01	-0.04
0.20	0.18	-0.02	-0.12	0.17	-0.03	-0.15	0.17	-0.03	-0.13	0.18	-0.02	-0.09	0.18	-0.02	-0.11
0.20	0.17	-0.02	-0.11	0.17	-0.02	-0.12	0.17	-0.02	-0.12	0.18	-0.02	-0.09	0.17	-0.02	-0.11
0.19	0.17	-0.02	-0.11	0.17	-0.02	-0.12	0.17	-0.03	-0.14	0.18	-0.02	-0.10	0.17	-0.02	-0.10
0.18	0.17	-0.01	-0.06	0.17	-0.01	-0.07	0.17	-0.01	-0.06	0.17	-0.01	-0.05	0.17	0.00	-0.03
0.18	0.17	-0.01	-0.06	0.17	-0.01	-0.06	0.16	-0.01	-0.08	0.17	-0.01	-0.05	0.17	-0.01	-0.05

0.19	0.17	-0.02	-0.10	0.16	-0.02	-0.12	0.16	-0.02	-0.13	0.17	-0.02	-0.10	0.17	-0.02	-0.10	
0.19	0.16	-0.02	-0.13	0.17	-0.02	-0.10	0.16	-0.02	-0.13	0.16	-0.02	-0.12	0.17	-0.02	-0.10	
0.22	= <|x|>	*0.03*			*0.03*			*0.04*			*0.04*			*0.03*		*MAE*
		0.15			**0.13**			**0.16**			**0.17**			**0.15**		**RMAE**

Table 9.10: Experiment 24.05.07 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.14	0.18	0.03	0.24	0.18	0.03	0.24	0.18	0.03	0.22	0.18	0.03	0.24	0.18	0.03	0.24	
0.23	0.18	-0.05	-0.22	0.18	-0.05	-0.20	0.18	-0.05	-0.23	0.18	-0.05	-0.21	0.18	-0.04	-0.19	
0.24	0.18	-0.06	-0.25	0.18	-0.05	-0.23	0.18	-0.06	-0.26	0.18	-0.06	-0.26	0.18	-0.06	-0.25	
0.27	0.18	-0.09	-0.33	0.19	-0.08	-0.31	0.18	-0.09	-0.33	0.18	-0.09	-0.34	0.18	-0.09	-0.33	
0.24	0.18	-0.06	-0.25	0.19	-0.06	-0.24	0.18	-0.06	-0.26	0.18	-0.06	-0.26	0.18	-0.06	-0.25	
0.23	0.19	-0.04	-0.17	0.19	-0.03	-0.14	0.18	-0.04	-0.18	0.18	-0.04	-0.19	0.19	-0.04	-0.17	
0.23	0.19	-0.04	-0.18	0.20	-0.03	-0.14	0.19	-0.04	-0.19	0.18	-0.05	-0.20	0.19	-0.04	-0.17	
0.22	0.19	-0.03	-0.13	0.20	-0.02	-0.11	0.19	-0.03	-0.15	0.19	-0.04	-0.16	0.19	-0.03	-0.14	
0.24	0.20	-0.04	-0.16	0.21	-0.03	-0.12	0.20	-0.04	-0.17	0.19	-0.04	-0.19	0.20	-0.04	-0.15	
0.25	0.20	-0.04	-0.17	0.22	-0.03	-0.12	0.20	-0.05	-0.19	0.19	-0.05	-0.21	0.21	-0.04	-0.16	
0.24	0.21	-0.03	-0.13	0.23	-0.01	-0.06	0.21	-0.04	-0.15	0.20	-0.04	-0.18	0.21	-0.03	-0.12	
0.25	0.22	-0.03	-0.13	0.24	-0.02	-0.07	0.22	-0.04	-0.14	0.21	-0.05	-0.18	0.23	-0.03	-0.11	
0.28	0.23	-0.05	-0.17	0.25	-0.03	-0.09	0.22	-0.06	-0.22	0.21	-0.07	-0.23	0.23	-0.05	-0.17	
0.29	0.25	-0.04	-0.15	0.26	-0.03	-0.10	0.23	-0.06	-0.19	0.22	-0.07	-0.23	0.25	-0.04	-0.13	
0.27	0.25	-0.01	-0.05	0.27	0.00	0.01	0.25	-0.02	-0.08	0.23	-0.03	-0.13	0.26	-0.01	-0.02	
0.25	0.26	0.02	0.08	0.27	0.02	0.10	0.25	0.01	0.04	0.25	0.00	0.02	0.27	0.03	0.11	
0.23	0.27	0.04	0.15	0.26	0.03	0.12	0.26	0.03	0.12	0.26	0.02	0.10	0.27	0.04	0.16	
0.22	0.27	0.05	0.22	0.25	0.03	0.15	0.26	0.04	0.19	0.27	0.05	0.22	0.27	0.05	0.21	
0.23	0.26	0.03	0.13	0.24	0.01	0.03	0.26	0.03	0.14	0.27	0.04	0.18	0.26	0.03	0.13	
0.22	0.25	0.03	0.13	0.23	0.01	0.04	0.24	0.03	0.12	0.26	0.04	0.20	0.24	0.02	0.10	
0.21	0.23	0.02	0.10	0.22	0.01	0.05	0.24	0.03	0.13	0.25	0.04	0.21	0.23	0.02	0.11	
0.20	0.22	0.02	0.10	0.21	0.01	0.03	0.22	0.02	0.10	0.24	0.04	0.17	0.22	0.02	0.08	
0.20	0.21	0.01	0.07	0.21	0.01	0.03	0.22	0.02	0.09	0.23	0.03	0.13	0.21	0.01	0.07	
0.20	0.21	0.01	0.06	0.20	0.00	0.02	0.21	0.01	0.06	0.22	0.02	0.13	0.21	0.01	0.07	
0.20	0.20	0.00	-0.01	0.20	0.00	-0.02	0.20	0.00	-0.01	0.21	0.01	0.03	0.20	0.00	-0.01	
0.19	0.20	0.01	0.04	0.20	0.01	0.03	0.20	0.01	0.03	0.21	0.01	0.06	0.20	0.01	0.04	
0.19	0.20	0.01	0.04	0.19	0.00	0.02	0.19	0.00	0.03	0.20	0.01	0.06	0.20	0.01	0.07	
0.20	0.20	-0.01	-0.03	0.19	-0.01	-0.04	0.20	-0.01	-0.03	0.20	0.00	-0.02	0.20	0.00	-0.01	
0.20	0.19	-0.01	-0.05	0.19	-0.01	-0.06	0.19	-0.02	-0.08	0.20	-0.01	-0.04	0.20	-0.01	-0.03	
0.22	0.19	-0.02	-0.11	0.19	-0.03	-0.13	0.19	-0.03	-0.13	0.20	-0.02	-0.10	0.19	-0.02	-0.10	
0.23	0.19	-0.04	-0.18	0.18	-0.04	-0.19	0.18	-0.04	-0.19	0.19	-0.04	-0.16	0.19	-0.04	-0.16	
0.21	0.19	-0.02	-0.11	0.18	-0.03	-0.14	0.18	-0.03	-0.14	0.19	-0.02	-0.11	0.19	-0.02	-0.09	
0.20	0.18	-0.02	-0.09	0.18	-0.02	-0.09	0.18	-0.02	-0.10	0.19	-0.01	-0.06	0.19	-0.01	-0.07	
0.20	0.18	-0.02	-0.08	0.18	-0.02	-0.10	0.18	-0.02	-0.10	0.18	-0.01	-0.07	0.18	-0.01	-0.07	
0.18	0.18	0.00	-0.02	0.17	-0.01	-0.04	0.17	-0.01	-0.06	0.18	0.00	-0.01	0.18	0.00	0.00	
0.19	0.17	-0.02	-0.11	0.17	-0.02	-0.10	0.17	-0.02	-0.11	0.18	-0.02	-0.08	0.18	-0.01	-0.07	
0.20	0.17	-0.02	-0.11	0.17	-0.03	-0.13	0.17	-0.03	-0.14	0.18	-0.02	-0.10	0.18	-0.02	-0.10	
0.20	0.17	-0.03	-0.15	0.17	-0.03	-0.16	0.17	-0.03	-0.15	0.17	-0.03	-0.14	0.17	-0.03	-0.13	
0.20	0.17	-0.03	-0.15	0.17	-0.04	-0.18	0.16	-0.04	-0.19	0.17	-0.03	-0.16	0.17	-0.03	-0.15	
0.19	0.16	-0.03	-0.15	0.16	-0.03	-0.16	0.16	-0.03	-0.15	0.17	-0.02	-0.12	0.17	-0.03	-0.14	
0.19	0.16	-0.03	-0.15	0.16	-0.03	-0.14	0.16	-0.03	-0.16	0.17	-0.02	-0.12	0.17	-0.02	-0.12	
0.18	0.16	-0.02	-0.12	0.16	-0.02	-0.13	0.16	-0.03	-0.16	0.16	-0.02	-0.11	0.17	-0.02	-0.10	
0.18	0.16	-0.02	-0.10	0.16	-0.02	-0.13	0.16	-0.02	-0.12	0.16	-0.02	-0.11	0.16	-0.02	-0.09	
0.22	= <|x|>	*0.03*			*0.02*			*0.03*			*0.03*			*0.03*		*MAE*
		0.13			**0.11**			**0.14**			**0.15**			**0.12**		**RMAE**

Table 9.11: Experiment 24.05.07 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.20	0.17	-0.03	-0.14	0.17	-0.02	-0.12	0.16	-0.03	-0.17	0.17	-0.03	-0.14	0.18	-0.02	-0.10
0.20	0.17	-0.03	-0.14	0.18	-0.03	-0.13	0.17	-0.04	-0.18	0.17	-0.03	-0.16	0.18	-0.03	-0.13
0.20	0.17	-0.03	-0.13	0.18	-0.02	-0.10	0.17	-0.03	-0.16	0.17	-0.03	-0.15	0.18	-0.02	-0.10
0.20	0.17	-0.03	-0.14	0.18	-0.02	-0.11	0.17	-0.03	-0.15	0.17	-0.03	-0.14	0.18	-0.02	-0.09
0.20	0.18	-0.02	-0.08	0.18	-0.01	-0.07	0.17	-0.03	-0.13	0.17	-0.02	-0.11	0.18	-0.01	-0.07
0.20	0.18	-0.02	-0.08	0.18	-0.01	-0.06	0.17	-0.02	-0.12	0.17	-0.02	-0.10	0.18	-0.01	-0.06
0.19	0.18	-0.01	-0.06	0.19	0.00	-0.01	0.18	-0.02	-0.08	0.18	-0.02	-0.08	0.19	0.00	-0.02
0.20	0.19	-0.01	-0.07	0.19	-0.01	-0.04	0.17	-0.02	-0.12	0.18	-0.02	-0.09	0.19	-0.01	-0.05
0.20	0.19	-0.01	-0.06	0.20	-0.01	-0.03	0.18	-0.02	-0.10	0.18	-0.02	-0.11	0.20	-0.01	-0.04
0.21	0.19	-0.01	-0.07	0.20	0.00	-0.02	0.18	-0.02	-0.12	0.19	-0.02	-0.10	0.20	0.00	-0.01
0.22	0.20	-0.02	-0.08	0.21	0.00	-0.01	0.19	-0.02	-0.11	0.19	-0.02	-0.11	0.21	-0.01	-0.05
0.21	0.21	-0.01	-0.03	0.22	0.01	0.03	0.20	-0.02	-0.09	0.19	-0.02	-0.11	0.22	0.00	0.01
0.22	0.21	-0.01	-0.03	0.23	0.01	0.06	0.20	-0.01	-0.07	0.20	-0.01	-0.07	0.23	0.01	0.04
0.22	0.22	0.00	0.01	0.24	0.02	0.08	0.21	-0.01	-0.06	0.21	-0.01	-0.07	0.23	0.01	0.05
0.23	0.23	0.01	0.03	0.25	0.02	0.11	0.22	-0.01	-0.04	0.22	-0.01	-0.04	0.25	0.02	0.10
0.23	0.24	0.02	0.07	0.26	0.03	0.13	0.23	0.00	0.01	0.22	0.00	-0.02	0.26	0.03	0.12
0.24	0.25	0.02	0.06	0.26	0.02	0.08	0.24	0.00	-0.01	0.24	0.00	-0.01	0.26	0.03	0.12
0.24	0.26	0.01	0.05	0.25	0.01	0.03	0.25	0.00	0.01	0.25	0.00	0.01	0.26	0.02	0.08
0.23	0.25	0.02	0.10	0.24	0.01	0.04	0.25	0.02	0.07	0.25	0.02	0.08	0.26	0.03	0.12
0.21	0.25	0.03	0.15	0.23	0.02	0.08	0.25	0.03	0.15	0.26	0.04	0.20	0.24	0.03	0.14
0.20	0.24	0.04	0.19	0.22	0.02	0.09	0.24	0.04	0.19	0.25	0.05	0.26	0.23	0.03	0.17
0.20	0.22	0.03	0.15	0.21	0.02	0.09	0.23	0.04	0.18	0.24	0.05	0.24	0.22	0.03	0.15

0.19	0.22	0.03	0.15	0.20	0.01	0.07	0.21	0.03	0.13	0.24	0.05	0.24	0.22	0.03	0.15	
0.20	0.21	0.00	0.02	0.20	0.00	0.00	0.21	0.01	0.03	0.22	0.02	0.09	0.21	0.00	0.01	
0.20	0.20	0.00	-0.01	0.19	-0.01	-0.05	0.20	0.00	0.01	0.21	0.01	0.06	0.20	0.00	0.01	
0.19	0.20	0.01	0.04	0.19	0.00	0.01	0.20	0.01	0.04	0.20	0.01	0.07	0.20	0.01	0.04	
0.19	0.19	0.01	0.04	0.19	0.00	0.01	0.19	0.00	0.02	0.20	0.01	0.07	0.20	0.01	0.07	
0.19	0.19	-0.01	-0.04	0.19	-0.01	-0.05	0.19	-0.01	-0.03	0.19	0.00	0.00	0.19	0.00	-0.02	
0.19	0.19	0.00	0.00	0.18	0.00	-0.02	0.18	-0.01	-0.03	0.19	0.01	0.03	0.19	0.00	0.02	
0.21	= <|x|>	*0.02*			*0.01*			*0.02*			*0.02*			*0.02*		*MAE*
		0.08			**0.06**			**0.09**			**0.10**			**0.07**		**RMAE**

Table 9.12: Experiment 24.05.07 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.13	0.16	0.02	0.18	0.16	0.03	0.21	0.15	0.01	0.11	0.16	0.03	0.19	0.17	0.03	0.25	
0.16	0.16	0.00	-0.01	0.16	0.00	0.00	0.15	-0.01	-0.04	0.16	0.00	-0.03	0.17	0.01	0.05	
0.21	0.16	-0.05	-0.22	0.17	-0.04	-0.21	0.15	-0.06	-0.28	0.16	-0.05	-0.25	0.17	-0.04	-0.19	
0.23	0.16	-0.07	-0.29	0.17	-0.06	-0.27	0.15	-0.08	-0.34	0.16	-0.07	-0.30	0.17	-0.06	-0.26	
0.23	0.16	-0.07	-0.29	0.17	-0.06	-0.25	0.16	-0.07	-0.32	0.16	-0.07	-0.29	0.17	-0.06	-0.24	
0.19	0.17	-0.02	-0.12	0.17	-0.02	-0.11	0.15	-0.04	-0.20	0.16	-0.03	-0.16	0.17	-0.02	-0.09	
0.18	0.17	-0.01	-0.06	0.17	-0.01	-0.05	0.16	-0.02	-0.13	0.16	-0.02	-0.10	0.18	0.00	-0.02	
0.19	0.17	-0.02	-0.12	0.18	-0.02	-0.08	0.16	-0.03	-0.16	0.17	-0.03	-0.13	0.18	-0.02	-0.08	
0.22	0.17	-0.05	-0.22	0.18	-0.04	-0.20	0.16	-0.06	-0.26	0.17	-0.06	-0.25	0.18	-0.04	-0.17	
0.22	0.18	-0.04	-0.20	0.18	-0.04	-0.16	0.17	-0.05	-0.25	0.17	-0.05	-0.22	0.18	-0.04	-0.17	
0.20	0.18	-0.02	-0.12	0.19	-0.01	-0.06	0.17	-0.04	-0.17	0.17	-0.03	-0.15	0.19	-0.01	-0.07	
0.21	0.18	-0.03	-0.12	0.19	-0.01	-0.06	0.17	-0.03	-0.17	0.18	-0.03	-0.14	0.20	-0.01	-0.04	
0.21	0.19	-0.01	-0.07	0.20	0.00	-0.01	0.18	-0.03	-0.14	0.18	-0.03	-0.13	0.20	0.00	-0.01	
0.22	0.20	-0.02	-0.09	0.21	-0.01	-0.03	0.18	-0.03	-0.16	0.19	-0.03	-0.14	0.21	-0.01	-0.05	
0.22	0.20	-0.02	-0.10	0.22	0.00	-0.01	0.19	-0.04	-0.16	0.19	-0.03	-0.15	0.22	0.00	-0.01	
0.22	0.21	-0.01	-0.06	0.23	0.00	0.02	0.20	-0.03	-0.12	0.19	-0.03	-0.14	0.23	0.00	0.01	
0.24	0.22	-0.02	-0.07	0.24	0.00	0.00	0.20	-0.04	-0.15	0.21	-0.03	-0.13	0.24	0.00	0.01	
0.24	0.23	-0.01	-0.06	0.24	0.00	0.00	0.21	-0.03	-0.13	0.21	-0.03	-0.13	0.24	0.00	0.00	
0.24	0.23	0.00	-0.02	0.25	0.01	0.03	0.22	-0.02	-0.09	0.22	-0.02	-0.08	0.25	0.01	0.05	
0.25	0.24	0.00	-0.02	0.24	-0.01	-0.05	0.23	-0.02	-0.08	0.23	-0.02	-0.07	0.25	0.00	0.00	
0.24	0.24	0.00	0.01	0.23	-0.01	-0.05	0.23	-0.01	-0.04	0.23	-0.01	-0.03	0.24	0.00	0.01	
0.22	0.24	0.01	0.06	0.22	0.00	-0.01	0.23	0.01	0.04	0.24	0.02	0.09	0.24	0.01	0.06	
0.21	0.23	0.01	0.06	0.21	-0.01	-0.03	0.23	0.01	0.06	0.24	0.03	0.14	0.22	0.01	0.04	
0.17	0.21	0.04	0.24	0.20	0.03	0.16	0.22	0.05	0.27	0.23	0.06	0.34	0.21	0.04	0.23	
0.19	0.21	0.02	0.13	0.20	0.01	0.05	0.21	0.02	0.13	0.23	0.04	0.21	0.21	0.02	0.13	
0.19	0.20	0.00	0.02	0.19	0.00	-0.02	0.20	0.01	0.03	0.21	0.02	0.10	0.20	0.00	0.02	
0.20	0.19	0.00	0.00	0.18	-0.01	-0.05	0.19	0.00	0.00	0.20	0.01	0.04	0.19	0.00	0.00	
0.19	0.18	-0.01	-0.04	0.18	-0.01	-0.07	0.18	-0.01	-0.06	0.20	0.00	0.03	0.19	-0.01	-0.03	
0.20	0.18	-0.01	-0.05	0.18	-0.02	-0.10	0.18	-0.01	-0.08	0.19	-0.01	-0.03	0.19	-0.01	-0.04	
0.19	0.18	-0.01	-0.06	0.17	-0.02	-0.09	0.18	-0.01	-0.06	0.18	0.00	-0.02	0.18	-0.01	-0.04	
0.19	0.18	-0.01	-0.07	0.17	-0.02	-0.11	0.17	-0.03	-0.14	0.18	-0.01	-0.06	0.18	-0.01	-0.06	
0.18	0.17	-0.01	-0.04	0.17	-0.01	-0.05	0.17	-0.01	-0.04	0.18	0.00	0.00	0.18	0.00	0.01	
0.17	0.17	0.00	-0.03	0.16	-0.01	-0.04	0.16	-0.01	-0.06	0.17	0.00	0.01	0.17	0.00	0.02	
0.16	0.17	0.01	0.07	0.16	0.01	0.04	0.16	0.00	-0.01	0.17	0.01	0.08	0.17	0.02	0.10	
0.16	0.16	0.00	0.03	0.16	0.00	0.01	0.16	0.00	0.01	0.16	0.01	0.05	0.17	0.01	0.06	
0.16	0.16	0.00	0.01	0.16	0.00	-0.01	0.15	-0.01	-0.04	0.16	0.01	0.04	0.17	0.01	0.06	
0.15	0.16	0.01	0.06	0.15	0.00	0.02	0.15	0.00	0.01	0.16	0.01	0.08	0.16	0.01	0.06	
0.15	0.15	0.01	0.05	0.15	0.00	0.03	0.15	0.00	0.00	0.16	0.01	0.07	0.16	0.01	0.10	
0.14	0.15	0.01	0.04	0.15	0.00	0.03	0.14	0.00	0.01	0.16	0.01	0.08	0.16	0.01	0.10	
0.15	0.15	0.00	0.02	0.15	0.00	-0.02	0.14	-0.01	-0.04	0.16	0.01	0.04	0.16	0.01	0.05	
0.14	0.15	0.01	0.04	0.15	0.00	0.03	0.14	0.00	-0.01	0.15	0.01	0.05	0.16	0.01	0.10	
0.14	0.14	0.00	-0.01	0.14	0.00	0.00	0.14	-0.01	-0.04	0.15	0.00	0.03	0.15	0.01	0.05	
0.15	0.15	-0.01	-0.05	0.14	-0.01	-0.07	0.14	-0.02	-0.11	0.14	-0.01	-0.07	0.15	0.00	-0.02	
0.19	= <|x|>	*0.02*			*0.01*			*0.02*			*0.02*			*0.01*		*MAE*
		0.09			**0.07**			**0.12**			**0.12**			**0.07**		**RMAE**

Table 9.13: Experiment 24.05.07 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	Sd1	err	%err	Sd2	err	%err	Sd3	err	%err	Sd4	err	%err	Sd5	err	%err
0.06	0.06	0.01	0.10	0.06	0.00	0.06	0.05	-0.01	-0.16	0.06	0.01	0.10	0.07	0.02	0.31
0.05	0.06	0.01	0.27	0.06	0.01	0.32	0.05	0.00	0.07	0.06	0.01	0.27	0.07	0.02	0.53
0.07	0.06	-0.01	-0.16	0.06	-0.01	-0.16	0.05	-0.02	-0.33	0.06	-0.01	-0.13	0.07	0.00	0.04
0.05	0.06	0.01	0.17	0.06	0.01	0.13	0.05	0.00	-0.06	0.06	0.01	0.13	0.07	0.02	0.41
0.05	0.06	0.01	0.13	0.06	0.00	0.09	0.04	-0.01	-0.14	0.06	0.01	0.18	0.07	0.02	0.31
0.05	0.05	0.00	0.02	0.06	0.01	0.10	0.05	-0.01	-0.12	0.05	0.00	0.02	0.07	0.02	0.28
0.02	0.06	0.04	1.99	0.05	0.04	1.87	0.04	0.03	1.37	0.06	0.04	2.12	0.07	0.05	2.62
0.02	0.06	0.03	1.56	0.05	0.03	1.45	0.04	0.02	0.92	0.05	0.03	1.45	0.07	0.04	1.99
0.04	0.06	0.02	0.39	0.06	0.02	0.39	0.04	0.00	0.04	0.06	0.02	0.39	0.07	0.03	0.62
0.03	0.05	0.03	1.09	0.05	0.03	1.09	0.04	0.02	0.73	0.06	0.03	1.19	0.07	0.04	1.55
0.04	0.05	0.02	0.39	0.05	0.02	0.39	0.04	0.01	0.15	0.05	0.02	0.39	0.07	0.03	0.69
0.03	0.05	0.03	0.86	0.06	0.03	0.94	0.04	0.02	0.53	0.06	0.03	0.94	0.07	0.04	1.34
0.02	0.05	0.04	2.45	0.06	0.04	2.60	0.04	0.03	1.70	0.05	0.04	2.45	0.07	0.05	3.21
0.05	0.05	0.01	0.10	0.06	0.01	0.15	0.04	-0.01	-0.18	0.05	0.00	0.05	0.07	0.02	0.34
0.03	0.05	0.02	0.68	0.05	0.02	0.60	0.04	0.01	0.38	0.05	0.02	0.68	0.07	0.03	1.04
0.04	0.05	0.01	0.35	0.05	0.02	0.41	0.04	0.00	0.04	0.05	0.02	0.41	0.07	0.03	0.72
0.07	0.05	-0.01	-0.22	0.06	-0.01	-0.14	0.04	-0.02	-0.36	0.05	-0.02	-0.25	0.07	0.00	-0.01

0.03	0.05	0.02	0.71	0.06	0.02	0.78	0.04	0.01	0.26	0.05	0.02	0.71	0.07	0.04	1.15	
0.03	0.05	0.02	0.60	0.05	0.02	0.60	0.04	0.01	0.25	0.05	0.02	0.60	0.07	0.03	0.95	
0.06	0.05	0.00	-0.02	0.05	0.00	-0.02	0.04	-0.01	-0.26	0.05	0.00	-0.06	0.07	0.01	0.24	
0.05	0.05	0.00	0.01	0.06	0.01	0.09	0.04	-0.01	-0.21	0.05	0.00	-0.03	0.07	0.01	0.27	
0.05	0.05	0.00	0.02	0.06	0.00	0.06	0.04	-0.01	-0.24	0.05	0.00	-0.02	0.07	0.01	0.24	
0.07	0.05	-0.02	-0.25	0.06	-0.01	-0.19	0.04	-0.03	-0.45	0.05	-0.02	-0.25	0.07	0.00	-0.03	
0.03	0.05	0.02	0.61	0.06	0.02	0.68	0.04	0.01	0.26	0.05	0.02	0.47	0.07	0.03	1.03	
0.04	0.05	0.01	0.33	0.06	0.02	0.50	0.04	0.00	0.05	0.05	0.01	0.33	0.07	0.03	0.74	
0.06	0.05	0.00	-0.06	0.06	0.00	0.02	0.04	-0.02	-0.30	0.05	0.00	-0.06	0.07	0.01	0.23	
0.03	0.06	0.02	0.63	0.06	0.02	0.70	0.04	0.01	0.16	0.05	0.01	0.43	0.07	0.03	0.97	
0.05	0.05	0.00	0.09	0.06	0.01	0.29	0.04	-0.01	-0.21	0.05	0.01	0.14	0.07	0.02	0.49	
0.05	0.06	0.00	0.07	0.06	0.01	0.16	0.04	-0.01	-0.24	0.05	0.00	-0.07	0.07	0.02	0.33	
0.06	0.06	0.00	-0.02	0.06	0.00	0.07	0.04	-0.01	-0.26	0.05	-0.01	-0.10	0.07	0.02	0.27	
0.08	0.06	-0.03	-0.30	0.06	-0.02	-0.24	0.04	-0.04	-0.52	0.05	-0.03	-0.39	0.08	-0.01	-0.11	
0.07	0.06	-0.01	-0.14	0.06	0.00	-0.03	0.04	-0.02	-0.36	0.06	-0.01	-0.14	0.07	0.01	0.11	
0.05	0.06	0.01	0.30	0.06	0.02	0.41	0.04	-0.01	-0.11	0.05	0.01	0.20	0.08	0.03	0.66	
0.05	0.06	0.01	0.11	0.07	0.01	0.24	0.04	-0.01	-0.20	0.05	0.00	-0.03	0.08	0.02	0.46	
0.04	0.06	0.02	0.36	0.06	0.02	0.47	0.04	0.00	-0.07	0.06	0.01	0.31	0.08	0.03	0.75	
0.07	0.06	0.00	-0.07	0.07	0.00	-0.03	0.04	-0.03	-0.38	0.05	-0.01	-0.20	0.08	0.01	0.14	
0.05	0.06	0.01	0.14	0.06	0.01	0.23	0.04	-0.01	-0.18	0.06	0.00	0.09	0.08	0.02	0.45	
0.06	0.06	0.01	0.10	0.07	0.01	0.18	0.04	-0.01	-0.24	0.05	0.00	-0.03	0.08	0.02	0.39	
0.07	0.06	-0.01	-0.16	0.07	0.00	-0.06	0.04	-0.03	-0.43	0.06	-0.01	-0.19	0.08	0.01	0.11	
0.05	0.06	0.01	0.22	0.06	0.01	0.22	0.04	-0.01	-0.19	0.06	0.00	0.08	0.08	0.03	0.49	
0.09	0.06	-0.03	-0.34	0.07	-0.02	-0.26	0.04	-0.04	-0.50	0.06	-0.03	-0.34	0.08	-0.01	-0.13	
0.06	0.06	0.00	0.00	0.06	0.00	0.00	0.04	-0.02	-0.34	0.05	-0.01	-0.15	0.08	0.02	0.26	
0.08	0.06	-0.02	-0.26	0.07	-0.01	-0.15	0.04	-0.04	-0.50	0.06	-0.02	-0.26	0.08	0.00	0.00	
0.05	= <|x|>	*0.01*			*0.01*			*0.02*			*0.01*			*0.02*		*MAE*
		0.27			**0.28**			**0.30**			**0.28**			**0.44**		**RMAE**

Table 9.14: Experiment 24.05.07 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.10	0.09	-0.01	-0.06	0.09	-0.01	-0.06	0.08	-0.02	-0.18	0.09	-0.01	-0.06	0.10	0.01	0.06	
0.08	0.09	0.01	0.12	0.09	0.01	0.09	0.08	0.00	0.00	0.09	0.01	0.12	0.10	0.02	0.24	
0.08	0.09	0.01	0.15	0.09	0.01	0.19	0.08	0.00	0.00	0.09	0.01	0.16	0.10	0.03	0.34	
0.06	0.09	0.03	0.52	0.08	0.03	0.44	0.08	0.02	0.32	0.09	0.03	0.48	0.10	0.04	0.64	
0.04	0.08	0.04	0.94	0.09	0.04	1.05	0.08	0.03	0.78	0.09	0.04	1.06	0.10	0.05	1.28	
0.07	= <|x|>	*0.02*			*0.02*			*0.01*			*0.02*			*0.03*		*MAE*
		0.28			**0.28**			**0.20**			**0.29**			**0.41**		**RMAE**

Table 9.15: Experiment 24.05.07 Deployment HH

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.06	0.08	0.03	0.48	0.08	0.02	0.44	0.07	0.02	0.27	0.08	0.02	0.44	0.09	0.04	0.69
0.05	0.08	0.03	0.63	0.08	0.03	0.68	0.07	0.02	0.39	0.08	0.03	0.68	0.09	0.04	0.87
0.05	0.08	0.03	0.67	0.08	0.03	0.62	0.07	0.02	0.42	0.08	0.03	0.62	0.09	0.04	0.87
0.04	0.08	0.04	0.95	0.08	0.04	0.89	0.07	0.03	0.66	0.08	0.04	0.95	0.09	0.05	1.17
0.04	0.08	0.04	0.91	0.08	0.03	0.85	0.07	0.03	0.62	0.08	0.04	0.91	0.09	0.05	1.14
0.03	0.08	0.04	1.22	0.08	0.04	1.28	0.07	0.03	0.94	0.08	0.04	1.28	0.08	0.05	1.49
0.03	0.07	0.05	1.85	0.08	0.05	1.95	0.06	0.04	1.48	0.08	0.05	2.04	0.09	0.06	2.41
0.03	0.08	0.05	1.43	0.08	0.04	1.36	0.06	0.03	0.99	0.08	0.04	1.35	0.08	0.05	1.57
0.04	0.08	0.04	0.92	0.08	0.04	0.98	0.06	0.02	0.62	0.08	0.04	0.92	0.09	0.05	1.22
0.04	0.07	0.03	0.75	0.07	0.03	0.75	0.06	0.02	0.52	0.07	0.03	0.75	0.09	0.05	1.09
0.04	0.07	0.03	0.66	0.08	0.03	0.77	0.06	0.02	0.45	0.07	0.03	0.66	0.08	0.04	0.87
0.02	0.08	0.06	3.78	0.08	0.06	3.92	0.06	0.05	3.03	0.08	0.06	3.78	0.09	0.07	4.67
0.01	0.07	0.06	5.58	0.08	0.06	5.80	0.06	0.05	4.53	0.07	0.06	5.58	0.08	0.07	6.43
0.02	0.08	0.06	2.77	0.08	0.06	2.88	0.06	0.04	2.18	0.07	0.05	2.65	0.08	0.06	3.24
0.03	0.08	0.04	1.17	0.08	0.04	1.23	0.06	0.03	0.83	0.07	0.04	1.03	0.09	0.05	1.51
0.03	0.07	0.04	1.27	0.08	0.04	1.34	0.06	0.03	0.90	0.07	0.04	1.27	0.08	0.05	1.63
0.03	0.07	0.04	1.27	0.08	0.05	1.42	0.06	0.03	0.98	0.07	0.04	1.27	0.08	0.05	1.64
0.03	0.08	0.04	1.30	0.08	0.05	1.44	0.06	0.03	0.94	0.07	0.04	1.15	0.09	0.05	1.65
0.03	0.08	0.04	1.19	0.08	0.04	1.26	0.06	0.03	0.85	0.07	0.04	1.05	0.09	0.05	1.53
0.04	0.08	0.03	0.78	0.08	0.04	0.83	0.06	0.02	0.45	0.08	0.03	0.73	0.09	0.05	1.05
0.04	0.08	0.03	0.74	0.08	0.04	0.85	0.06	0.02	0.47	0.07	0.03	0.68	0.09	0.05	1.06
0.01	0.08	0.06	4.22	0.08	0.07	4.54	0.07	0.05	3.43	0.08	0.06	4.06	0.09	0.07	5.01
0.03	0.08	0.05	2.10	0.08	0.06	2.28	0.06	0.04	1.53	0.07	0.05	1.91	0.09	0.06	2.57
0.04	0.08	0.04	0.90	0.08	0.04	0.95	0.07	0.02	0.56	0.08	0.03	0.79	0.09	0.05	1.23
0.02	0.08	0.06	3.18	0.08	0.07	3.55	0.07	0.05	2.67	0.08	0.06	3.05	0.09	0.07	3.93
0.05	0.08	0.02	0.43	0.09	0.03	0.60	0.07	0.01	0.21	0.08	0.02	0.38	0.09	0.04	0.69
0.03	0.08	0.05	1.47	0.09	0.05	1.69	0.07	0.03	1.03	0.07	0.04	1.25	0.09	0.06	1.83
0.02	0.08	0.06	3.70	0.08	0.07	3.83	0.07	0.05	2.76	0.08	0.06	3.43	0.10	0.08	4.50
0.05	0.08	0.03	0.70	0.09	0.04	0.90	0.07	0.02	0.40	0.08	0.03	0.60	0.09	0.05	1.00
0.04	0.08	0.04	0.94	0.09	0.04	0.99	0.07	0.02	0.56	0.08	0.03	0.78	0.09	0.05	1.15
0.07	0.08	0.01	0.21	0.09	0.03	0.38	0.07	0.00	0.00	0.08	0.01	0.14	0.10	0.03	0.42
0.06	0.09	0.03	0.50	0.09	0.03	0.50	0.07	0.01	0.18	0.08	0.02	0.30	0.10	0.04	0.65
0.04	0.09	0.04	0.96	0.09	0.05	1.06	0.07	0.03	0.59	0.08	0.04	0.85	0.10	0.06	1.27
0.04	0.08	0.05	1.31	0.09	0.06	1.57	0.07	0.04	0.99	0.08	0.04	1.18	0.10	0.06	1.64
0.05	0.09	0.04	0.77	0.09	0.05	0.91	0.07	0.02	0.48	0.08	0.03	0.67	0.10	0.05	1.06
0.03	0.09	0.06	2.41	0.09	0.07	2.58	0.07	0.04	1.68	0.08	0.06	2.22	0.11	0.08	3.03
0.02	0.09	0.06	2.67	0.10	0.07	3.07	0.07	0.05	2.07	0.08	0.06	2.57	0.10	0.08	3.37

0.03	0.09	0.06	1.77	0.10	0.06	2.00	0.07	0.04	1.26	0.08	0.05	1.48	0.11	0.07	2.29	
0.00	0.09	0.09		0.10	0.10		0.07	0.07		0.08	0.08		0.11	0.11		
0.00	0.09	0.09		0.10	0.10		0.07	0.07		0.08	0.08		0.11	0.11		
0.00	0.09	0.09		0.10	0.10		0.07	0.07		0.09	0.09		0.11	0.11		
0.00	0.09	0.09		0.10	0.10		0.07	0.07		0.08	0.08		0.11	0.11		
0.00	0.09	0.09		0.10	0.10		0.07	0.07		0.09	0.09		0.11	0.11		
0.03	= <|x|>	*0.05*			*0.05*			*0.03*			*0.05*			*0.06*		*MAE*
		1.50			**1.63**			**1.08**			**1.40**			**1.90**		**RMAE**

Table 9.16: Experiment 24.05.07 Deployment II

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.15	0.11	-0.04	-0.26	0.11	-0.04	-0.26	0.10	-0.05	-0.32	0.11	-0.04	-0.24	0.12	-0.03	-0.20	
0.11	0.11	-0.01	-0.06	0.10	-0.01	-0.08	0.10	-0.02	-0.14	0.11	0.00	-0.04	0.12	0.01	0.04	
0.12	0.11	-0.01	-0.10	0.11	-0.01	-0.10	0.10	-0.02	-0.18	0.11	-0.01	-0.08	0.11	0.00	-0.04	
0.09	0.10	0.01	0.11	0.10	0.01	0.11	0.10	0.00	0.04	0.10	0.01	0.11	0.11	0.02	0.22	
0.09	0.10	0.02	0.18	0.10	0.02	0.18	0.09	0.01	0.07	0.11	0.02	0.21	0.11	0.03	0.29	
0.10	0.10	0.00	0.01	0.10	0.00	0.01	0.09	-0.01	-0.10	0.10	0.00	0.01	0.11	0.01	0.08	
0.13	0.10	-0.03	-0.24	0.10	-0.03	-0.21	0.09	-0.04	-0.30	0.10	-0.03	-0.22	0.11	-0.02	-0.15	
0.11	0.10	-0.01	-0.05	0.10	-0.01	-0.07	0.09	-0.02	-0.18	0.10	-0.01	-0.07	0.11	0.00	0.01	
0.13	0.10	-0.03	-0.22	0.10	-0.02	-0.18	0.09	-0.03	-0.25	0.10	-0.03	-0.22	0.11	-0.02	-0.12	
0.10	0.10	0.00	0.01	0.10	0.00	0.01	0.09	-0.01	-0.12	0.10	0.00	-0.01	0.11	0.01	0.08	
0.10	0.10	0.00	0.04	0.10	0.01	0.09	0.09	0.00	-0.01	0.10	0.00	0.02	0.11	0.02	0.19	
0.07	0.11	0.03	0.46	0.11	0.03	0.46	0.09	0.02	0.30	0.10	0.03	0.43	0.11	0.04	0.53	
0.08	0.10	0.03	0.35	0.10	0.03	0.38	0.09	0.01	0.20	0.10	0.02	0.32	0.11	0.04	0.51	
0.07	0.10	0.04	0.56	0.11	0.04	0.63	0.09	0.03	0.45	0.10	0.03	0.52	0.11	0.05	0.74	
0.06	0.10	0.04	0.71	0.11	0.05	0.75	0.09	0.03	0.48	0.10	0.04	0.68	0.11	0.05	0.87	
0.09	0.10	0.01	0.12	0.11	0.02	0.20	0.09	0.00	0.04	0.10	0.01	0.09	0.11	0.02	0.22	
0.07	0.11	0.04	0.50	0.11	0.04	0.50	0.09	0.02	0.33	0.10	0.03	0.43	0.11	0.04	0.60	
0.09	0.10	0.01	0.15	0.11	0.02	0.21	0.09	0.00	0.05	0.10	0.01	0.13	0.12	0.03	0.29	
0.07	0.10	0.03	0.48	0.11	0.04	0.55	0.09	0.02	0.31	0.10	0.03	0.45	0.12	0.05	0.65	
0.07	0.11	0.04	0.66	0.11	0.05	0.69	0.10	0.03	0.47	0.11	0.04	0.62	0.12	0.05	0.80	
0.09	= <|x|>	*0.02*			*0.02*			*0.02*			*0.02*			*0.03*		*MAE*
		0.23			**0.24**			**0.21**			**0.21**			**0.27**		**RMAE**

Table 9.17: Experiment 24.05.07 Deployment JJ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.08	0.01	0.15	0.09	0.02	0.24	0.08	0.00	0.05	0.08	0.01	0.15	0.10	0.03	0.34	
0.05	0.09	0.04	0.76	0.09	0.04	0.85	0.07	0.02	0.47	0.08	0.03	0.66	0.10	0.05	0.95	
0.05	0.09	0.03	0.59	0.09	0.04	0.68	0.08	0.02	0.38	0.08	0.03	0.50	0.10	0.04	0.80	
0.03	0.09	0.06	1.77	0.10	0.06	1.99	0.08	0.04	1.34	0.08	0.05	1.63	0.10	0.07	2.06	
0.05	0.09	0.04	0.70	0.10	0.04	0.79	0.08	0.02	0.44	0.08	0.03	0.53	0.10	0.05	0.92	
0.05	0.09	0.04	0.74	0.10	0.05	0.88	0.08	0.03	0.56	0.08	0.03	0.65	0.10	0.05	0.97	
0.03	0.09	0.06	1.86	0.09	0.06	2.01	0.08	0.05	1.48	0.08	0.05	1.71	0.10	0.07	2.23	
0.03	0.09	0.07	2.51	0.10	0.07	2.60	0.08	0.05	1.98	0.08	0.06	2.15	0.10	0.08	2.86	
0.04	0.09	0.06	1.61	0.10	0.06	1.81	0.08	0.04	1.20	0.09	0.05	1.54	0.11	0.07	2.01	
0.04	0.09	0.05	1.18	0.10	0.06	1.29	0.08	0.04	0.85	0.09	0.05	1.07	0.10	0.06	1.39	
0.07	0.10	0.03	0.46	0.10	0.04	0.57	0.08	0.02	0.29	0.09	0.02	0.36	0.11	0.04	0.64	
0.09	0.10	0.01	0.11	0.11	0.02	0.19	0.08	-0.01	-0.08	0.09	0.00	0.03	0.11	0.02	0.21	
0.07	0.10	0.03	0.38	0.10	0.03	0.44	0.08	0.01	0.15	0.09	0.02	0.31	0.11	0.04	0.54	
0.07	0.10	0.03	0.39	0.11	0.04	0.56	0.08	0.01	0.20	0.09	0.02	0.33	0.11	0.04	0.59	
0.04	0.10	0.06	1.68	0.11	0.07	2.01	0.09	0.05	1.37	0.09	0.06	1.50	0.12	0.08	2.13	
0.04	0.11	0.06	1.38	0.11	0.07	1.54	0.08	0.04	0.90	0.10	0.05	1.17	0.12	0.07	1.59	
0.05	0.10	0.05	1.10	0.11	0.06	1.24	0.09	0.04	0.81	0.09	0.04	0.91	0.12	0.07	1.43	
0.07	0.11	0.04	0.52	0.12	0.04	0.62	0.09	0.02	0.29	0.10	0.03	0.36	0.12	0.05	0.69	
0.07	0.11	0.04	0.60	0.12	0.05	0.71	0.09	0.02	0.36	0.10	0.03	0.49	0.13	0.06	0.88	
0.07	0.11	0.04	0.52	0.12	0.04	0.61	0.10	0.02	0.32	0.10	0.03	0.42	0.13	0.05	0.71	
0.05	0.11	0.06	1.14	0.12	0.07	1.27	0.10	0.04	0.82	0.10	0.05	0.96	0.13	0.08	1.45	
0.05	0.11	0.06	1.32	0.12	0.07	1.46	0.10	0.05	1.03	0.11	0.06	1.18	0.13	0.08	1.70	
0.07	0.12	0.05	0.73	0.12	0.05	0.77	0.10	0.03	0.46	0.11	0.04	0.56	0.13	0.06	0.91	
0.05	= <|x|>	*0.04*			*0.05*			*0.03*			*0.04*			*0.06*		*MAE*
		0.80			**0.92**			**0.55**			**0.68**			**1.03**		**RMAE**

Table 9.18: Experiment 24.05.07 Deployment KK

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.09	0.13	0.04	0.38	0.13	0.04	0.38	0.12	0.03	0.28	0.13	0.04	0.41	0.13	0.04	0.43
0.12	0.13	0.01	0.06	0.13	0.01	0.06	0.12	0.00	0.00	0.13	0.01	0.08	0.13	0.02	0.14
0.16	0.13	-0.03	-0.20	0.13	-0.03	-0.21	0.12	-0.04	-0.27	0.12	-0.03	-0.21	0.13	-0.03	-0.18
0.17	0.12	-0.04	-0.26	0.12	-0.04	-0.26	0.12	-0.05	-0.29	0.13	-0.04	-0.24	0.13	-0.03	-0.20
0.14	0.12	-0.02	-0.17	0.13	-0.02	-0.13	0.12	-0.03	-0.20	0.12	-0.02	-0.15	0.13	-0.01	-0.10
0.15	0.13	-0.02	-0.14	0.13	-0.02	-0.12	0.11	-0.03	-0.22	0.12	-0.02	-0.17	0.13	-0.02	-0.12
0.14	0.12	-0.02	-0.15	0.12	-0.02	-0.14	0.12	-0.02	-0.17	0.12	-0.02	-0.14	0.13	-0.01	-0.08
0.13	0.12	0.00	-0.02	0.13	0.00	0.00	0.11	-0.01	-0.10	0.12	-0.01	-0.06	0.13	0.00	0.02
0.15	0.12	-0.03	-0.17	0.13	-0.02	-0.14	0.11	-0.04	-0.24	0.12	-0.03	-0.19	0.13	-0.01	-0.09

0.16	0.12	-0.03	-0.21	0.13	-0.03	-0.18	0.12	-0.04	-0.26	0.12	-0.04	-0.23	0.13	-0.03	-0.17	
0.12	0.13	0.01	0.07	0.13	0.01	0.07	0.12	0.00	-0.01	0.13	0.01	0.07	0.13	0.02	0.13	
0.14	0.13	-0.02	-0.11	0.13	-0.01	-0.06	0.12	-0.02	-0.14	0.12	-0.02	-0.15	0.13	-0.01	-0.06	
0.13	0.13	0.00	0.00	0.13	0.00	0.00	0.12	-0.01	-0.09	0.12	0.00	-0.03	0.13	0.01	0.04	
0.15	0.13	-0.02	-0.13	0.13	-0.02	-0.13	0.12	-0.03	-0.17	0.12	-0.02	-0.16	0.13	-0.01	-0.08	
0.15	0.13	-0.02	-0.16	0.13	-0.02	-0.11	0.12	-0.03	-0.23	0.12	-0.03	-0.18	0.13	-0.01	-0.10	
0.14	0.13	-0.01	-0.09	0.13	-0.01	-0.06	0.12	-0.02	-0.16	0.13	-0.01	-0.09	0.13	-0.01	-0.06	
0.13	0.13	-0.01	-0.05	0.13	0.00	-0.02	0.12	-0.01	-0.09	0.12	-0.01	-0.09	0.14	0.00	0.02	
0.12	0.13	0.01	0.08	0.13	0.01	0.09	0.12	0.00	-0.02	0.13	0.00	0.02	0.14	0.02	0.13	
0.11	0.13	0.02	0.16	0.14	0.03	0.25	0.12	0.01	0.10	0.13	0.02	0.14	0.14	0.03	0.25	
0.10	0.13	0.04	0.38	0.14	0.05	0.47	0.12	0.03	0.28	0.13	0.03	0.33	0.14	0.05	0.50	
0.11	0.14	0.02	0.22	0.14	0.03	0.26	0.12	0.01	0.11	0.13	0.02	0.16	0.14	0.03	0.28	
0.10	0.14	0.04	0.36	0.15	0.05	0.47	0.13	0.03	0.26	0.13	0.03	0.31	0.15	0.05	0.47	
0.10	0.14	0.04	0.42	0.15	0.05	0.50	0.13	0.03	0.31	0.13	0.03	0.33	0.15	0.05	0.54	
0.13	0.14	0.02	0.13	0.15	0.02	0.19	0.13	0.01	0.04	0.14	0.01	0.08	0.15	0.03	0.21	
0.09	0.15	0.05	0.59	0.16	0.07	0.72	0.13	0.04	0.44	0.14	0.04	0.49	0.16	0.07	0.72	
0.12	0.15	0.02	0.19	0.16	0.03	0.28	0.13	0.01	0.09	0.14	0.02	0.13	0.16	0.04	0.30	
0.12	0.15	0.03	0.25	0.16	0.04	0.35	0.14	0.02	0.15	0.14	0.02	0.17	0.17	0.05	0.39	
0.09	0.15	0.06	0.63	0.16	0.07	0.71	0.14	0.05	0.48	0.14	0.05	0.53	0.17	0.07	0.76	
0.12	0.16	0.04	0.37	0.17	0.05	0.43	0.14	0.03	0.22	0.15	0.03	0.29	0.17	0.05	0.43	
0.09	0.16	0.07	0.74	0.16	0.07	0.75	0.15	0.05	0.59	0.15	0.06	0.64	0.17	0.08	0.87	
0.11	0.16	0.05	0.52	0.16	0.06	0.52	0.15	0.04	0.40	0.15	0.05	0.42	0.17	0.06	0.57	
0.12	0.16	0.04	0.36	0.16	0.04	0.32	0.15	0.03	0.27	0.16	0.04	0.33	0.17	0.05	0.40	
0.14	0.16	0.03	0.20	0.15	0.02	0.12	0.15	0.02	0.11	0.16	0.02	0.16	0.16	0.02	0.17	
0.12	0.15	0.03	0.26	0.15	0.02	0.20	0.15	0.03	0.21	0.16	0.04	0.31	0.16	0.03	0.27	
0.16	0.15	-0.01	-0.05	0.14	-0.02	-0.12	0.15	-0.01	-0.07	0.16	-0.01	-0.04	0.15	-0.01	-0.08	
0.15	0.15	-0.01	-0.04	0.13	-0.02	-0.12	0.15	0.00	-0.02	0.16	0.01	0.04	0.15	0.00	-0.03	
0.14	0.14	0.00	0.02	0.14	0.00	-0.03	0.14	0.00	0.01	0.15	0.01	0.08	0.14	0.00	0.00	
0.14	0.14	0.00	0.02	0.13	-0.01	-0.06	0.14	0.00	0.00	0.15	0.01	0.07	0.14	0.00	-0.01	
0.10	0.13	0.03	0.30	0.13	0.03	0.28	0.14	0.03	0.34	0.15	0.04	0.44	0.14	0.03	0.34	
0.11	0.13	0.03	0.23	0.12	0.02	0.16	0.13	0.02	0.23	0.14	0.03	0.27	0.13	0.03	0.25	
0.12	0.13	0.01	0.08	0.12	0.01	0.05	0.13	0.01	0.08	0.13	0.02	0.14	0.13	0.01	0.10	
0.09	0.12	0.03	0.32	0.12	0.02	0.27	0.12	0.03	0.32	0.13	0.04	0.41	0.13	0.03	0.37	
0.12	0.12	0.01	0.08	0.12	0.01	0.04	0.12	0.01	0.04	0.12	0.01	0.08	0.12	0.01	0.07	
0.12	=<|x|>	*0.02*			*0.03*			*0.02*			*0.02*			*0.03*		*MAE*
		0.20			**0.21**			**0.18**			**0.19**			**0.22**		**RMAE**

Table 9.19: Experiment 24.05.07 Deployment LL

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.14	0.14	0.00	-0.03	0.14	0.00	-0.03	0.13	-0.01	-0.08	0.14	0.00	-0.02	0.14	0.00	0.00
0.12	0.14	0.02	0.14	0.14	0.02	0.14	0.13	0.02	0.13	0.14	0.02	0.17	0.14	0.02	0.20
0.15	0.14	-0.02	-0.11	0.14	-0.02	-0.11	0.13	-0.02	-0.14	0.14	-0.02	-0.11	0.14	-0.01	-0.08
0.14	0.14	0.00	0.00	0.14	0.00	0.02	0.13	0.00	-0.04	0.14	0.00	0.00	0.14	0.00	0.02
0.15	0.13	-0.02	-0.11	0.14	-0.01	-0.08	0.13	-0.02	-0.14	0.13	-0.02	-0.11	0.14	-0.01	-0.06
0.13	0.13	0.00	0.01	0.14	0.00	0.03	0.13	0.00	-0.02	0.13	0.00	-0.01	0.14	0.01	0.05
0.12	0.14	0.01	0.12	0.14	0.02	0.14	0.13	0.01	0.08	0.13	0.01	0.10	0.14	0.02	0.14
0.14	0.14	0.00	-0.01	0.14	0.00	-0.01	0.13	-0.01	-0.05	0.13	0.00	-0.03	0.14	0.01	0.04
0.15	0.14	-0.01	-0.05	0.14	-0.01	-0.05	0.13	-0.02	-0.12	0.13	-0.01	-0.09	0.14	-0.01	-0.05
0.17	0.13	-0.03	-0.19	0.14	-0.02	-0.13	0.13	-0.03	-0.19	0.13	-0.03	-0.19	0.14	-0.02	-0.14
0.15	0.14	-0.01	-0.05	0.14	0.00	-0.02	0.13	-0.01	-0.08	0.13	-0.01	-0.08	0.14	0.00	-0.02
0.15	0.14	-0.02	-0.10	0.14	-0.01	-0.07	0.13	-0.02	-0.14	0.14	-0.02	-0.11	0.14	-0.01	-0.08
0.14	0.14	0.00	0.00	0.14	0.00	0.02	0.13	-0.01	-0.05	0.14	0.00	-0.02	0.15	0.00	0.04
0.15	0.14	-0.01	-0.06	0.15	0.00	-0.03	0.13	-0.02	-0.11	0.14	-0.01	-0.09	0.14	-0.01	-0.05
0.14	0.14	0.00	0.00	0.15	0.00	0.03	0.14	-0.01	-0.05	0.14	-0.01	-0.05	0.15	0.00	0.03
0.15	0.14	0.00	-0.03	0.15	0.01	0.04	0.14	-0.01	-0.06	0.14	-0.01	-0.04	0.15	0.00	0.01
0.15	0.14	-0.01	-0.05	0.15	0.00	-0.01	0.14	-0.02	-0.10	0.14	-0.01	-0.07	0.15	0.00	0.01
0.12	0.15	0.03	0.26	0.16	0.04	0.34	0.14	0.02	0.19	0.14	0.02	0.19	0.16	0.04	0.30
0.15	0.15	0.00	0.03	0.16	0.01	0.10	0.14	0.00	-0.02	0.14	0.00	-0.01	0.16	0.02	0.11
0.16	0.16	0.00	-0.02	0.17	0.01	0.04	0.15	-0.01	-0.09	0.15	-0.01	-0.09	0.16	0.00	0.01
0.13	0.16	0.02	0.18	0.17	0.04	0.26	0.15	0.02	0.12	0.15	0.02	0.12	0.17	0.03	0.25
0.14	0.16	0.02	0.13	0.18	0.03	0.23	0.15	0.01	0.05	0.15	0.01	0.06	0.17	0.03	0.20
0.14	0.17	0.03	0.22	0.18	0.04	0.30	0.16	0.02	0.15	0.16	0.02	0.15	0.18	0.04	0.31
0.14	0.17	0.03	0.20	0.18	0.04	0.25	0.16	0.02	0.12	0.16	0.02	0.12	0.18	0.04	0.28
0.17	0.17	0.01	0.04	0.18	0.01	0.09	0.16	0.00	-0.03	0.17	0.00	-0.01	0.18	0.02	0.10
0.15	0.18	0.02	0.15	0.18	0.02	0.16	0.17	0.01	0.09	0.17	0.01	0.07	0.18	0.03	0.19
0.15	0.18	0.03	0.19	0.17	0.02	0.15	0.17	0.02	0.12	0.17	0.02	0.15	0.18	0.03	0.22
0.15	0.18	0.03	0.20	0.17	0.02	0.16	0.17	0.02	0.15	0.17	0.02	0.17	0.18	0.03	0.22
0.15	0.17	0.02	0.14	0.17	0.01	0.09	0.17	0.02	0.12	0.18	0.03	0.17	0.17	0.02	0.14
0.16	0.17	0.01	0.08	0.16	0.00	-0.01	0.17	0.01	0.06	0.17	0.02	0.10	0.17	0.01	0.06
0.16	0.16	0.01	0.05	0.15	0.00	-0.01	0.16	0.01	0.05	0.17	0.01	0.09	0.17	0.01	0.08
0.17	0.16	-0.01	-0.07	0.15	-0.02	-0.12	0.16	-0.01	-0.06	0.17	0.00	0.00	0.16	-0.01	-0.08
0.16	0.15	0.00	-0.01	0.15	-0.01	-0.07	0.16	0.00	0.02	0.17	0.01	0.08	0.15	0.00	-0.01
0.14	0.15	0.01	0.08	0.14	0.00	0.01	0.15	0.01	0.05	0.16	0.02	0.13	0.15	0.01	0.06
0.13	0.15	0.02	0.16	0.14	0.02	0.15	0.15	0.02	0.20	0.15	0.03	0.22	0.15	0.02	0.16
0.13	0.14	0.01	0.11	0.14	0.01	0.08	0.14	0.01	0.11	0.15	0.02	0.16	0.14	0.01	0.11
0.13	0.14	0.00	0.03	0.13	0.00	-0.01	0.14	0.00	0.01	0.15	0.01	0.08	0.14	0.00	0.03
0.13	0.14	0.01	0.07	0.13	0.00	0.03	0.14	0.01	0.06	0.14	0.02	0.12	0.14	0.01	0.10
0.12	0.13	0.01	0.08	0.13	0.01	0.07	0.13	0.01	0.08	0.14	0.01	0.10	0.13	0.01	0.08
0.11	0.13	0.02	0.19	0.13	0.02	0.17	0.13	0.02	0.17	0.14	0.02	0.22	0.13	0.02	0.19
0.14	0.13	-0.01	-0.09	0.13	-0.02	-0.11	0.13	-0.02	-0.11	0.13	-0.01	-0.06	0.13	-0.01	-0.08

0.12	0.13	0.01	0.08	0.13	0.01	0.07	0.12	0.01	0.05	0.13	0.01	0.08	0.13	0.01	0.11	
0.12	0.13	0.00	0.04	0.13	0.01	0.06	0.12	0.00	0.03	0.13	0.01	0.07	0.13	0.01	0.09	
0.14	= <|x|>	*0.01*			*0.01*			*0.01*			*0.01*			*0.01*		*MAE*
		0.09			**0.09**			**0.09**			**0.09**			**0.10**		**RMAE**

Table 9.20: Experiment 24.05.07 Deployment MM

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.11	0.15	0.04	0.39	0.15	0.04	0.39	0.14	0.04	0.37	0.15	0.05	0.43	0.15	0.04	0.41	
0.13	0.15	0.02	0.17	0.14	0.02	0.15	0.14	0.02	0.15	0.15	0.02	0.17	0.15	0.02	0.19	
0.12	0.15	0.02	0.19	0.14	0.02	0.17	0.15	0.02	0.19	0.15	0.03	0.21	0.14	0.02	0.17	
0.15	0.14	-0.01	-0.04	0.14	-0.01	-0.04	0.14	-0.01	-0.07	0.14	-0.01	-0.04	0.14	-0.01	-0.04	
0.16	0.14	-0.02	-0.11	0.14	-0.01	-0.08	0.14	-0.01	-0.09	0.14	-0.01	-0.09	0.14	-0.01	-0.09	
0.17	0.14	-0.02	-0.15	0.14	-0.02	-0.13	0.14	-0.03	-0.16	0.14	-0.03	-0.16	0.14	-0.03	-0.16	
0.19	0.14	-0.05	-0.25	0.14	-0.04	-0.24	0.14	-0.04	-0.23	0.14	-0.04	-0.24	0.14	-0.04	-0.24	
0.15	0.14	-0.01	-0.05	0.15	0.00	-0.01	0.14	-0.01	-0.08	0.14	-0.01	-0.08	0.14	-0.01	-0.06	
0.17	0.14	-0.03	-0.16	0.15	-0.03	-0.15	0.14	-0.03	-0.16	0.14	-0.03	-0.19	0.14	-0.03	-0.18	
0.14	0.14	0.00	0.00	0.15	0.00	0.02	0.14	0.00	0.00	0.14	0.00	-0.02	0.14	0.00	-0.02	
0.15	0.14	0.00	-0.02	0.15	0.00	0.03	0.15	0.00	0.00	0.14	-0.01	-0.04	0.15	0.00	0.00	
0.15	0.15	0.00	0.02	0.16	0.01	0.07	0.15	0.00	0.01	0.14	0.00	-0.01	0.15	0.00	0.02	
0.14	0.15	0.01	0.05	0.16	0.01	0.08	0.15	0.00	0.02	0.14	0.00	0.00	0.15	0.01	0.03	
0.16	0.15	-0.01	-0.05	0.16	0.00	0.01	0.15	-0.01	-0.05	0.15	-0.01	-0.08	0.16	0.00	-0.02	
0.16	0.16	0.00	-0.01	0.16	0.01	0.04	0.15	-0.01	-0.04	0.15	-0.01	-0.07	0.15	0.00	-0.02	
0.16	0.16	0.00	-0.03	0.17	0.01	0.06	0.16	0.00	-0.03	0.15	-0.01	-0.06	0.16	0.00	-0.02	
0.14	0.16	0.03	0.19	0.17	0.04	0.28	0.16	0.02	0.16	0.15	0.01	0.11	0.17	0.03	0.21	
0.15	0.17	0.01	0.10	0.18	0.03	0.19	0.16	0.01	0.08	0.16	0.01	0.05	0.17	0.02	0.11	
0.15	0.17	0.02	0.15	0.18	0.03	0.21	0.16	0.01	0.09	0.16	0.01	0.04	0.18	0.03	0.16	
0.15	0.17	0.02	0.14	0.19	0.04	0.27	0.17	0.02	0.14	0.17	0.01	0.10	0.18	0.03	0.19	
0.18	0.19	0.00	0.02	0.19	0.01	0.06	0.18	-0.01	-0.03	0.17	-0.01	-0.07	0.19	0.01	0.04	
0.17	0.19	0.02	0.12	0.20	0.03	0.17	0.18	0.02	0.10	0.18	0.01	0.06	0.19	0.03	0.16	
0.17	0.19	0.02	0.11	0.19	0.02	0.09	0.19	0.01	0.08	0.18	0.01	0.05	0.19	0.02	0.12	
0.19	0.20	0.00	0.02	0.19	0.00	0.00	0.19	0.00	-0.01	0.19	-0.01	-0.03	0.20	0.00	0.02	
0.15	0.19	0.04	0.26	0.18	0.03	0.22	0.19	0.04	0.26	0.19	0.04	0.26	0.19	0.04	0.28	
0.15	0.19	0.04	0.27	0.18	0.03	0.18	0.19	0.04	0.25	0.19	0.04	0.28	0.19	0.04	0.25	
0.14	0.18	0.04	0.29	0.17	0.03	0.21	0.18	0.04	0.29	0.19	0.05	0.34	0.18	0.04	0.31	
0.14	0.18	0.04	0.26	0.16	0.02	0.16	0.18	0.04	0.28	0.18	0.05	0.33	0.17	0.03	0.24	
0.15	0.17	0.02	0.11	0.16	0.01	0.06	0.17	0.02	0.14	0.18	0.03	0.20	0.17	0.02	0.10	
0.14	0.16	0.02	0.18	0.15	0.02	0.13	0.16	0.02	0.18	0.18	0.04	0.28	0.16	0.02	0.16	
0.13	0.16	0.03	0.26	0.15	0.02	0.17	0.16	0.03	0.26	0.17	0.04	0.33	0.16	0.03	0.26	
0.13	0.15	0.02	0.16	0.15	0.02	0.12	0.15	0.02	0.16	0.16	0.03	0.21	0.15	0.02	0.12	
0.15	0.15	0.00	-0.01	0.14	0.00	-0.03	0.15	0.00	0.01	0.16	0.01	0.05	0.15	0.00	0.02	
0.15	0.15	0.00	0.00	0.15	0.00	-0.01	0.15	0.00	-0.01	0.15	0.01	0.05	0.15	0.00	0.00	
0.14	0.15	0.01	0.07	0.14	0.01	0.04	0.15	0.01	0.05	0.15	0.01	0.08	0.15	0.01	0.05	
0.14	0.14	0.00	0.00	0.14	0.00	0.00	0.14	0.00	0.00	0.15	0.00	0.03	0.14	0.00	0.03	
0.11	0.14	0.03	0.23	0.14	0.03	0.24	0.14	0.02	0.22	0.14	0.03	0.25	0.14	0.03	0.23	
0.14	0.14	0.00	-0.02	0.14	-0.01	-0.04	0.14	0.00	-0.02	0.14	-0.01	-0.04	0.14	0.00	-0.02	
0.13	0.14	0.01	0.04	0.14	0.01	0.04	0.13	0.00	0.02	0.14	0.01	0.07	0.14	0.01	0.07	
0.12	0.14	0.02	0.18	0.14	0.02	0.17	0.13	0.02	0.14	0.14	0.02	0.16	0.14	0.02	0.18	
0.12	0.13	0.01	0.12	0.13	0.02	0.13	0.13	0.02	0.13	0.14	0.02	0.13	0.14	0.02	0.18	
0.09	0.14	0.05	0.60	0.13	0.05	0.58	0.13	0.05	0.54	0.14	0.05	0.60	0.14	0.05	0.60	
0.11	0.13	0.02	0.23	0.13	0.02	0.19	0.13	0.02	0.21	0.14	0.03	0.26	0.13	0.03	0.25	
0.14	= <|x|>	*0.02*			*0.02*			*0.02*			*0.02*			*0.02*		*MAE*
		0.13			**0.12**			**0.12**			**0.14**			**0.13**		**RMAE**

Table 9.21: Experiment 24.05.07 Deployment NN

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.24	0.26	0.01	0.06	0.25	0.01	0.03	0.25	0.01	0.05	0.26	0.02	0.07	0.25	0.01	0.04
0.23	0.25	0.02	0.08	0.24	0.01	0.06	0.25	0.02	0.10	0.25	0.03	0.12	0.25	0.02	0.08
0.22	0.25	0.02	0.10	0.24	0.02	0.09	0.24	0.02	0.09	0.25	0.03	0.13	0.24	0.02	0.09
0.21	0.24	0.03	0.13	0.23	0.02	0.08	0.24	0.03	0.12	0.24	0.03	0.14	0.23	0.02	0.10
0.20	0.23	0.03	0.15	0.23	0.03	0.13	0.23	0.03	0.15	0.24	0.04	0.18	0.23	0.03	0.15
0.20	0.23	0.03	0.16	0.22	0.03	0.14	0.23	0.03	0.17	0.23	0.04	0.18	0.22	0.03	0.15
0.19	0.22	0.03	0.15	0.22	0.02	0.12	0.22	0.03	0.16	0.23	0.03	0.17	0.22	0.03	0.13
0.19	0.22	0.03	0.14	0.22	0.03	0.15	0.22	0.03	0.17	0.22	0.03	0.17	0.21	0.02	0.12
0.19	0.22	0.03	0.15	0.22	0.03	0.15	0.22	0.03	0.17	0.22	0.03	0.15	0.21	0.02	0.12
0.19	0.22	0.03	0.17	0.22	0.03	0.19	0.22	0.03	0.17	0.22	0.03	0.17	0.21	0.02	0.13
0.18	0.21	0.04	0.21	0.22	0.05	0.27	0.22	0.04	0.25	0.21	0.04	0.21	0.21	0.04	0.20
0.17	0.23	0.05	0.30	0.23	0.06	0.34	0.23	0.05	0.31	0.21	0.04	0.23	0.22	0.04	0.25
0.17	0.23	0.06	0.33	0.25	0.07	0.43	0.24	0.06	0.37	0.22	0.05	0.28	0.22	0.05	0.28
0.17	0.24	0.07	0.39	0.26	0.09	0.51	0.25	0.07	0.43	0.23	0.06	0.33	0.23	0.06	0.36
0.17	0.26	0.09	0.55	0.28	0.11	0.67	0.26	0.09	0.56	0.24	0.07	0.44	0.24	0.08	0.46
0.17	0.27	0.10	0.59	0.30	0.13	0.77	0.27	0.10	0.59	0.25	0.08	0.45	0.26	0.09	0.52
0.16	0.30	0.14	0.84	0.33	0.17	1.07	0.30	0.14	0.84	0.27	0.11	0.66	0.29	0.13	0.80
0.18	0.33	0.14	0.78	0.35	0.16	0.90	0.32	0.14	0.76	0.29	0.11	0.58	0.32	0.13	0.73
0.21	0.34	0.13	0.61	0.34	0.13	0.60	0.34	0.12	0.58	0.32	0.11	0.52	0.34	0.13	0.61
0.24	0.34	0.10	0.43	0.32	0.08	0.34	0.34	0.10	0.42	0.34	0.10	0.41	0.35	0.11	0.44
0.27	0.33	0.06	0.22	0.30	0.03	0.12	0.33	0.06	0.23	0.34	0.08	0.29	0.33	0.07	0.25
0.28	0.30	0.02	0.07	0.28	0.00	-0.01	0.30	0.02	0.06	0.33	0.04	0.16	0.30	0.02	0.07

0.28	0.28	0.00	-0.01	0.26	-0.02	-0.06	0.28	0.00	-0.01	0.30	0.02	0.08	0.28	0.00	-0.01	
0.27	0.26	-0.01	-0.03	0.26	-0.02	-0.06	0.26	-0.01	-0.03	0.28	0.01	0.04	0.27	-0.01	-0.02	
0.26	0.26	-0.01	-0.02	0.25	-0.01	-0.04	0.26	-0.01	-0.03	0.27	0.00	0.02	0.26	-0.01	-0.03	
0.25	0.25	0.00	0.02	0.25	0.00	0.01	0.25	0.00	0.02	0.26	0.01	0.04	0.25	0.00	0.01	
0.24	0.24	0.01	0.04	0.25	0.01	0.04	0.24	0.01	0.03	0.25	0.01	0.05	0.25	0.01	0.05	
0.24	0.25	0.00	0.02	0.24	0.00	0.00	0.25	0.00	0.02	0.25	0.01	0.02	0.24	0.00	0.00	
0.24	0.24	0.01	0.04	0.24	0.01	0.03	0.24	0.01	0.03	0.24	0.01	0.03	0.25	0.01	0.04	
0.23	0.24	0.02	0.07	0.24	0.01	0.06	0.24	0.01	0.06	0.25	0.02	0.09	0.24	0.01	0.06	
0.22	0.24	0.02	0.10	0.24	0.02	0.09	0.24	0.02	0.09	0.24	0.02	0.10	0.24	0.02	0.09	
0.21	0.24	0.02	0.11	0.24	0.02	0.10	0.24	0.02	0.10	0.24	0.03	0.12	0.24	0.02	0.11	
0.22	0.23	0.01	0.07	0.23	0.01	0.05	0.24	0.02	0.07	0.24	0.02	0.08	0.24	0.02	0.07	
0.23	0.23	0.00	0.01	0.23	0.00	-0.01	0.23	0.00	-0.01	0.23	0.00	0.02	0.23	0.00	0.00	
0.23	0.23	0.00	0.00	0.22	-0.01	-0.03	0.23	0.00	-0.01	0.23	0.00	0.01	0.23	0.00	0.00	
0.22	0.22	0.00	-0.01	0.22	0.00	-0.01	0.22	0.00	0.01	0.23	0.01	0.03	0.22	0.00	0.00	
0.21	0.22	0.01	0.04	0.21	0.00	0.01	0.22	0.00	0.02	0.22	0.01	0.04	0.22	0.01	0.03	
0.21	0.21	0.01	0.03	0.21	0.01	0.03	0.21	0.01	0.03	0.22	0.01	0.05	0.21	0.00	0.02	
0.21	0.21	0.00	0.01	0.21	0.00	0.00	0.21	0.00	-0.01	0.21	0.00	0.02	0.21	0.00	0.00	
0.21	0.21	0.00	0.01	0.21	0.00	0.01	0.21	0.00	-0.01	0.21	0.00	0.02	0.21	0.00	0.01	
0.21	0.21	0.00	0.01	0.21	0.00	0.00	0.21	0.00	0.00	0.21	0.00	0.00	0.21	0.00	0.00	
0.20	0.21	0.00	0.01	0.20	0.00	0.00	0.20	0.00	-0.01	0.21	0.00	0.02	0.21	0.00	0.02	
0.20	0.21	0.01	0.05	0.21	0.01	0.04	0.20	0.01	0.04	0.21	0.01	0.04	0.21	0.01	0.05	
0.21	$= \langle \lvert x \rvert \rangle$	*0.03*			*0.03*			*0.03*			*0.03*			*0.03*		*MAE*
		0.15			**0.16**			**0.15**			**0.15**			**0.14**		**RMAE**

Table 9.22: Experiment 24.05.07 Deployment OO

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.26	0.25	-0.01	-0.03	0.25	-0.02	-0.06	0.26	0.00	-0.02	0.26	0.00	-0.02	0.24	-0.02	-0.08	
0.27	0.25	-0.02	-0.08	0.25	-0.03	-0.11	0.26	-0.02	-0.06	0.25	-0.02	-0.07	0.24	-0.04	-0.14	
0.27	0.24	-0.03	-0.11	0.24	-0.03	-0.11	0.25	-0.02	-0.09	0.25	-0.02	-0.06	0.23	-0.04	-0.15	
0.24	0.24	0.00	0.01	0.23	-0.01	-0.03	0.25	0.01	0.03	0.24	0.00	0.01	0.23	-0.01	-0.05	
0.20	0.23	0.02	0.11	0.23	0.02	0.11	0.24	0.03	0.15	0.24	0.03	0.15	0.22	0.01	0.07	
0.19	0.23	0.03	0.17	0.22	0.02	0.13	0.23	0.04	0.20	0.23	0.04	0.19	0.21	0.01	0.06	
0.18	0.22	0.03	0.19	0.21	0.03	0.17	0.22	0.04	0.23	0.22	0.04	0.23	0.20	0.02	0.11	
0.17	0.21	0.04	0.22	0.21	0.03	0.18	0.22	0.05	0.28	0.22	0.05	0.26	0.20	0.02	0.13	
0.16	0.21	0.05	0.32	0.21	0.05	0.30	0.21	0.06	0.36	0.21	0.05	0.35	0.19	0.03	0.21	
0.14	0.20	0.06	0.41	0.20	0.06	0.40	0.21	0.07	0.48	0.21	0.06	0.43	0.19	0.05	0.31	
0.13	0.20	0.07	0.56	0.21	0.08	0.61	0.21	0.08	0.63	0.21	0.08	0.59	0.18	0.06	0.43	
0.13	0.21	0.07	0.57	0.21	0.07	0.57	0.21	0.08	0.63	0.20	0.07	0.54	0.18	0.05	0.39	
0.13	0.20	0.07	0.51	0.21	0.08	0.57	0.22	0.08	0.60	0.20	0.07	0.50	0.18	0.05	0.35	
0.13	0.21	0.07	0.55	0.22	0.08	0.62	0.22	0.09	0.63	0.20	0.07	0.51	0.19	0.05	0.39	
0.13	0.21	0.08	0.60	0.23	0.10	0.72	0.23	0.10	0.72	0.21	0.07	0.54	0.19	0.06	0.42	
0.13	0.23	0.10	0.79	0.24	0.11	0.88	0.24	0.12	0.92	0.21	0.08	0.66	0.20	0.07	0.56	
0.11	0.24	0.13	1.19	0.26	0.15	1.41	0.26	0.15	1.36	0.22	0.11	1.03	0.21	0.10	0.92	
0.10	0.25	0.16	1.59	0.29	0.19	1.97	0.28	0.18	1.86	0.24	0.14	1.42	0.22	0.12	1.27	
0.09	0.28	0.19	2.05	0.32	0.23	2.52	0.31	0.22	2.36	0.25	0.15	1.69	0.23	0.14	1.56	
0.09	0.32	0.22	2.45	0.34	0.25	2.73	0.33	0.24	2.66	0.28	0.19	2.02	0.26	0.17	1.81	
0.10	0.34	0.24	2.34	0.34	0.24	2.36	0.35	0.24	2.41	0.30	0.20	1.99	0.29	0.19	1.85	
0.10	0.34	0.24	2.36	0.32	0.21	2.13	0.34	0.24	2.36	0.33	0.23	2.31	0.32	0.22	2.15	
0.10	0.32	0.21	2.07	0.29	0.19	1.84	0.31	0.21	2.02	0.34	0.24	2.27	0.33	0.23	2.18	
0.11	0.30	0.19	1.82	0.27	0.16	1.55	0.29	0.18	1.73	0.32	0.22	2.06	0.32	0.21	2.00	
0.10	0.28	0.17	1.73	0.26	0.16	1.62	0.27	0.17	1.66	0.30	0.20	1.94	0.30	0.19	1.92	
0.10	0.26	0.16	1.59	0.25	0.15	1.48	0.25	0.15	1.53	0.28	0.17	1.73	0.27	0.17	1.71	
0.09	0.25	0.16	1.66	0.25	0.15	1.64	0.26	0.16	1.72	0.26	0.17	1.79	0.26	0.16	1.74	
0.10	0.25	0.14	1.37	0.24	0.14	1.33	0.24	0.14	1.35	0.25	0.15	1.45	0.25	0.14	1.39	
0.12	0.24	0.12	1.03	0.24	0.12	0.98	0.25	0.13	1.06	0.24	0.12	1.03	0.24	0.12	0.99	
0.13	0.24	0.11	0.89	0.24	0.11	0.90	0.25	0.12	0.94	0.24	0.12	0.92	0.24	0.11	0.86	
0.13	0.24	0.11	0.81	0.24	0.10	0.80	0.24	0.11	0.84	0.24	0.11	0.82	0.23	0.10	0.76	
0.14	0.24	0.10	0.70	0.23	0.09	0.67	0.24	0.10	0.73	0.24	0.10	0.71	0.23	0.09	0.63	
0.15	0.23	0.09	0.59	0.23	0.09	0.60	0.24	0.09	0.62	0.24	0.09	0.61	0.22	0.08	0.52	
0.16	0.23	0.08	0.49	0.23	0.07	0.48	0.23	0.08	0.50	0.23	0.08	0.49	0.22	0.07	0.44	
0.17	0.23	0.07	0.40	0.23	0.06	0.36	0.23	0.07	0.40	0.23	0.06	0.39	0.21	0.05	0.29	
0.16	0.23	0.06	0.37	0.22	0.06	0.35	0.23	0.06	0.38	0.23	0.06	0.38	0.22	0.06	0.35	
0.17	0.22	0.05	0.29	0.22	0.04	0.25	0.22	0.05	0.29	0.23	0.05	0.32	0.22	0.04	0.26	
0.19	0.21	0.03	0.14	0.21	0.02	0.11	0.22	0.03	0.16	0.22	0.03	0.18	0.22	0.03	0.15	
0.19	0.21	0.02	0.12	0.21	0.02	0.13	0.21	0.03	0.14	0.21	0.03	0.15	0.21	0.02	0.12	
0.17	0.21	0.03	0.20	0.21	0.03	0.18	0.21	0.04	0.20	0.21	0.04	0.22	0.20	0.03	0.16	
0.18	0.21	0.03	0.14	0.21	0.03	0.14	0.21	0.03	0.14	0.21	0.03	0.15	0.20	0.02	0.11	
0.17	0.20	0.03	0.18	0.20	0.03	0.18	0.21	0.04	0.22	0.20	0.03	0.18	0.20	0.02	0.14	
0.17	0.21	0.03	0.18	0.20	0.03	0.16	0.21	0.04	0.20	0.20	0.03	0.18	0.19	0.02	0.12	
0.15	$= \langle \lvert x \rvert \rangle$	*0.09*			*0.09*			*0.10*			*0.09*			*0.08*		*MAE*
		0.61			**0.61**			**0.64**			**0.60**			**0.54**		**RMAE**

Table 9.23: Experiment 24.05.07 Deployment PP

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.12	0.23	0.11	0.98	0.22	0.11	0.93	0.25	0.13	1.14	0.23	0.12	1.02	0.19	0.07	0.63
0.13	0.22	0.09	0.74	0.21	0.09	0.69	0.25	0.12	0.92	0.23	0.10	0.78	0.18	0.06	0.44
0.13	0.22	0.09	0.71	0.21	0.09	0.68	0.24	0.11	0.90	0.22	0.09	0.75	0.18	0.05	0.42
0.22	0.21	-0.01	-0.03	0.20	-0.01	-0.06	0.23	0.02	0.07	0.21	0.00	0.00	0.17	-0.04	-0.19

0.18	0.21	0.03	0.17	0.20	0.02	0.13	0.23	0.05	0.30	0.21	0.03	0.19	0.17	-0.01	-0.05	
0.20	0.20	0.00	-0.02	0.19	-0.01	-0.06	0.22	0.02	0.09	0.21	0.00	0.01	0.16	-0.04	-0.21	
0.19	0.19	0.00	0.01	0.18	0.00	-0.01	0.21	0.03	0.15	0.20	0.01	0.05	0.16	-0.03	-0.16	
0.08	0.19	0.11	1.39	0.17	0.10	1.24	0.21	0.13	1.66	0.19	0.11	1.45	0.15	0.07	0.92	
0.07	0.17	0.11	1.57	0.17	0.10	1.50	0.20	0.13	1.92	0.19	0.12	1.75	0.14	0.07	1.10	
0.06	0.17	0.11	1.79	0.16	0.10	1.72	0.20	0.14	2.26	0.18	0.12	1.95	0.13	0.07	1.19	
0.10	0.17	0.06	0.61	0.16	0.06	0.56	0.19	0.09	0.84	0.17	0.06	0.63	0.13	0.03	0.25	
0.15	0.16	0.01	0.04	0.16	0.00	0.02	0.19	0.03	0.21	0.17	0.01	0.07	0.12	-0.04	-0.23	
0.13	0.16	0.02	0.16	0.16	0.02	0.16	0.18	0.05	0.37	0.16	0.03	0.19	0.11	-0.02	-0.15	
0.14	0.15	0.02	0.12	0.15	0.02	0.12	0.18	0.04	0.32	0.15	0.02	0.11	0.10	-0.03	-0.24	
0.10	0.15	0.05	0.48	0.16	0.05	0.53	0.18	0.08	0.81	0.15	0.05	0.51	0.10	0.00	-0.04	
0.09	0.15	0.06	0.71	0.16	0.07	0.76	0.19	0.10	1.10	0.15	0.06	0.68	0.09	0.00	0.05	
0.10	0.15	0.05	0.49	0.16	0.06	0.58	0.19	0.09	0.86	0.15	0.05	0.46	0.09	-0.01	-0.11	
0.12	0.16	0.04	0.38	0.17	0.05	0.42	0.20	0.09	0.74	0.15	0.03	0.30	0.08	-0.03	-0.27	
0.12	0.16	0.04	0.32	0.18	0.06	0.47	0.22	0.09	0.76	0.16	0.03	0.28	0.09	-0.03	-0.28	
0.15	0.17	0.03	0.19	0.19	0.05	0.31	0.23	0.08	0.56	0.16	0.02	0.10	0.08	-0.06	-0.42	
0.14	0.18	0.05	0.35	0.20	0.07	0.48	0.24	0.11	0.78	0.17	0.03	0.21	0.08	-0.05	-0.38	
0.13	0.20	0.07	0.50	0.22	0.09	0.68	0.27	0.14	1.08	0.18	0.05	0.36	0.08	-0.05	-0.35	
0.13	0.21	0.07	0.54	0.24	0.10	0.75	0.30	0.17	1.26	0.19	0.05	0.40	0.09	-0.05	-0.35	
0.12	0.22	0.10	0.77	0.26	0.14	1.10	0.32	0.20	1.61	0.20	0.08	0.62	0.09	-0.04	-0.29	
0.12	0.25	0.12	1.00	0.29	0.16	1.34	0.32	0.20	1.63	0.21	0.09	0.71	0.09	-0.03	-0.24	
0.11	0.27	0.16	1.51	0.30	0.20	1.82	0.30	0.20	1.82	0.23	0.13	1.18	0.09	-0.01	-0.13	
0.09	0.29	0.20	2.11	0.30	0.21	2.22	0.28	0.19	1.99	0.25	0.16	1.69	0.10	0.01	0.06	
0.09	0.30	0.22	2.43	0.29	0.20	2.22	0.26	0.18	1.97	0.28	0.19	2.16	0.11	0.03	0.29	
0.09	0.29	0.20	2.29	0.27	0.18	2.00	0.25	0.16	1.83	0.30	0.21	2.37	0.13	0.04	0.42	
0.09	0.28	0.18	1.94	0.25	0.16	1.66	0.24	0.15	1.57	0.30	0.21	2.21	0.14	0.04	0.46	
0.10	0.26	0.16	1.59	0.24	0.14	1.38	0.24	0.14	1.35	0.28	0.18	1.82	0.15	0.05	0.53	
0.10	0.24	0.14	1.39	0.23	0.13	1.27	0.23	0.13	1.32	0.26	0.16	1.61	0.17	0.06	0.64	
0.11	0.23	0.12	1.04	0.22	0.11	0.95	0.23	0.11	1.00	0.25	0.13	1.19	0.18	0.07	0.58	
0.12	0.22	0.10	0.85	0.21	0.09	0.79	0.23	0.11	0.90	0.23	0.11	0.95	0.19	0.07	0.55	
0.13	0.22	0.09	0.68	0.21	0.08	0.62	0.22	0.09	0.69	0.22	0.10	0.74	0.20	0.07	0.55	
0.14	0.21	0.07	0.46	0.21	0.06	0.43	0.22	0.07	0.50	0.22	0.07	0.51	0.21	0.07	0.49	
0.15	0.21	0.05	0.36	0.20	0.05	0.32	0.22	0.06	0.42	0.21	0.06	0.39	0.23	0.08	0.53	
0.17	0.20	0.03	0.16	0.19	0.02	0.13	0.22	0.05	0.28	0.21	0.03	0.20	0.25	0.08	0.45	
0.19	0.20	0.01	0.06	0.20	0.01	0.08	0.22	0.03	0.17	0.20	0.02	0.10	0.26	0.07	0.39	
0.20	0.20	-0.01	-0.04	0.20	-0.01	-0.04	0.21	0.01	0.04	0.20	-0.01	-0.04	0.25	0.04	0.22	
0.21	0.19	-0.02	-0.09	0.20	-0.01	-0.05	0.21	0.00	-0.02	0.19	-0.02	-0.08	0.24	0.03	0.12	
0.21	0.20	-0.02	-0.07	0.20	-0.01	-0.06	0.20	-0.01	-0.06	0.19	-0.02	-0.10	0.23	0.01	0.06	
0.13	= <|x|>	*0.08*			*0.08*			*0.10*			*0.08*			*0.04*		*MAE*
		0.58			**0.59**			**0.74**			**0.57**			**0.33**		**RMAE**

Table 9.24: Experiment 24.05.07 Deployment QQ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.02	0.07	0.05	2.35	0.07	0.05	2.57	0.14	0.12	5.67	0.06	0.04	2.16	0.02	0.00	-0.02	
0.02	0.07	0.04	1.79	0.08	0.05	2.06	0.14	0.12	4.73	0.06	0.04	1.51	0.02	0.00	-0.19	
0.03	0.07	0.04	1.13	0.08	0.05	1.40	0.14	0.11	3.24	0.07	0.04	1.06	0.02	-0.01	-0.39	
0.04	0.07	0.04	0.93	0.08	0.04	1.05	0.14	0.10	2.60	0.07	0.03	0.83	0.02	-0.01	-0.38	
0.05	0.08	0.03	0.65	0.08	0.03	0.70	0.13	0.09	1.94	0.07	0.03	0.61	0.02	-0.02	-0.48	
0.07	0.08	0.01	0.08	0.08	0.01	0.08	0.13	0.06	0.87	0.07	0.00	-0.02	0.03	-0.05	-0.65	
0.09	0.08	-0.01	-0.14	0.08	-0.01	-0.16	0.13	0.04	0.44	0.08	-0.01	-0.16	0.03	-0.06	-0.70	
0.10	0.08	-0.02	-0.16	0.08	-0.02	-0.19	0.13	0.03	0.31	0.08	-0.02	-0.19	0.03	-0.07	-0.70	
0.10	0.08	-0.02	-0.19	0.07	-0.02	-0.23	0.13	0.03	0.31	0.08	-0.02	-0.17	0.03	-0.06	-0.66	
0.09	0.08	-0.01	-0.11	0.07	-0.02	-0.18	0.12	0.03	0.32	0.08	-0.01	-0.09	0.03	-0.06	-0.65	
0.08	0.08	0.00	-0.05	0.07	-0.01	-0.15	0.11	0.03	0.40	0.08	0.00	0.01	0.04	-0.04	-0.53	
0.08	0.08	0.00	-0.05	0.07	-0.01	-0.17	0.11	0.03	0.31	0.08	0.00	0.03	0.04	-0.04	-0.54	
0.08	0.08	0.00	0.02	0.07	-0.01	-0.17	0.10	0.02	0.29	0.08	0.00	0.02	0.04	-0.04	-0.48	
0.07	= <|x|>	0.02			0.03			0.06			0.02			0.04		*MAE*
		0.31			**0.40**			**0.94**			**0.28**			**0.56**		**RMAE**

Table 9.25: Experiment 24.05.07 Deployment RR

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.08	0.07	-0.01	-0.18	0.07	-0.01	-0.16	0.12	0.04	0.44	0.06	-0.02	-0.24	0.01	-0.07	-0.82	
0.08	0.06	-0.02	-0.21	0.07	-0.01	-0.18	0.12	0.04	0.53	0.06	-0.02	-0.21	0.02	-0.06	-0.79	
0.07	0.06	-0.01	-0.12	0.06	-0.01	-0.13	0.11	0.04	0.52	0.06	-0.01	-0.14	0.02	-0.06	-0.76	
0.08	0.06	-0.02	-0.21	0.06	-0.02	-0.29	0.11	0.03	0.37	0.06	-0.02	-0.25	0.01	-0.07	-0.82	
0.09	0.06	-0.03	-0.36	0.05	-0.04	-0.41	0.11	0.01	0.16	0.07	-0.02	-0.27	0.01	-0.08	-0.88	
0.09	0.06	-0.03	-0.35	0.05	-0.04	-0.42	0.10	0.01	0.13	0.06	-0.03	-0.31	0.01	-0.08	-0.85	
0.09	0.06	-0.04	-0.39	0.05	-0.05	-0.50	0.09	0.00	0.03	0.06	-0.03	-0.34	0.01	-0.08	-0.85	
0.08	= <|x|>	0.02			0.03			0.03			0.02			0.07		*MAE*
		0.27			**0.31**			**0.30**			**0.26**			**0.83**		**RMAE**

Table 9.26: Experiment 24.05.07 Deployment SS

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.08	0.04	-0.05	-0.55	0.05	-0.04	-0.45	0.01	-0.07	-0.84	0.03	-0.05	-0.64	0.07	-0.01	-0.12
0.08	0.04	-0.04	-0.51	0.05	-0.03	-0.42	0.02	-0.07	-0.79	0.03	-0.05	-0.60	0.07	-0.01	-0.14
0.08	0.04	-0.05	-0.55	0.05	-0.04	-0.43	0.01	-0.07	-0.84	0.03	-0.06	-0.66	0.07	-0.01	-0.13

0.09	0.04	-0.05	-0.59	0.05	-0.04	-0.44	0.01	-0.08	-0.86	0.03	-0.06	-0.67	0.07	-0.02	-0.21	
0.09	0.04	-0.05	-0.60	0.05	-0.04	-0.40	0.01	-0.07	-0.84	0.03	-0.06	-0.70	0.07	-0.02	-0.17	
0.08	0.04	-0.04	-0.55	0.05	-0.03	-0.39	0.01	-0.07	-0.87	0.03	-0.05	-0.64	0.07	-0.01	-0.11	
0.08	0.04	-0.04	-0.52	0.05	-0.03	-0.36	0.01	-0.07	-0.85	0.03	-0.05	-0.64	0.07	-0.01	-0.13	
0.07	0.03	-0.04	-0.56	0.05	-0.02	-0.33	0.01	-0.06	-0.87	0.02	-0.05	-0.70	0.06	-0.01	-0.14	
0.07	0.03	-0.04	-0.54	0.05	-0.03	-0.35	0.01	-0.06	-0.85	0.03	-0.05	-0.65	0.06	-0.01	-0.12	
0.07	0.03	-0.04	-0.58	0.05	-0.03	-0.35	0.01	-0.06	-0.84	0.02	-0.05	-0.67	0.06	-0.01	-0.19	
0.06	0.03	-0.03	-0.51	0.04	-0.02	-0.27	0.01	-0.05	-0.84	0.02	-0.04	-0.67	0.06	0.00	-0.02	
0.06	0.03	-0.03	-0.53	0.04	-0.02	-0.26	0.01	-0.05	-0.75	0.02	-0.04	-0.65	0.06	0.00	-0.06	
0.06	0.03	-0.03	-0.50	0.04	-0.02	-0.30	0.01	-0.05	-0.82	0.02	-0.04	-0.70	0.05	0.00	-0.04	
0.06	0.02	-0.03	-0.59	0.04	-0.02	-0.28	0.01	-0.05	-0.82	0.02	-0.04	-0.70	0.05	-0.01	-0.15	
0.07	= <|x|>	0.04			0.03			0.06			0.05			0.01		*MAE*
		0.55			**0.37**			**0.84**			**0.66**			**0.13**		**RMAE**

Table 9.27: Experiment 24.05.07 Deployment TT

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.05	0.04	-0.02	-0.34	0.03	-0.03	-0.47	0.06	0.01	0.19	0.04	-0.02	-0.32	0.05	0.00	-0.06	
0.05	0.03	-0.02	-0.33	0.03	-0.02	-0.43	0.06	0.01	0.29	0.03	-0.02	-0.30	0.05	0.00	0.07	
0.06	0.04	-0.03	-0.42	0.03	-0.03	-0.54	0.06	0.00	-0.03	0.03	-0.03	-0.48	0.05	-0.01	-0.21	
0.08	0.04	-0.04	-0.51	0.03	-0.05	-0.63	0.06	-0.02	-0.23	0.03	-0.04	-0.55	0.04	-0.03	-0.43	
0.10	0.04	-0.06	-0.58	0.03	-0.07	-0.68	0.05	-0.04	-0.43	0.03	-0.06	-0.66	0.04	-0.05	-0.56	
0.12	0.04	-0.08	-0.67	0.03	-0.09	-0.77	0.05	-0.07	-0.55	0.03	-0.09	-0.77	0.04	-0.08	-0.68	
0.14	0.04	-0.11	-0.75	0.03	-0.11	-0.76	0.05	-0.09	-0.63	0.03	-0.11	-0.78	0.04	-0.10	-0.73	
0.14	0.04	-0.11	-0.75	0.03	-0.11	-0.80	0.05	-0.09	-0.65	0.03	-0.12	-0.81	0.03	-0.11	-0.76	
0.14	0.03	-0.10	-0.77	0.03	-0.10	-0.76	0.05	-0.09	-0.65	0.03	-0.11	-0.80	0.04	-0.10	-0.73	
0.10	= <|x|>	0.06			0.07			0.05			0.07			0.06		*MAE*
		0.63			**0.70**			**0.48**			**0.68**			**0.57**		**RMAE**

Table 9.28: Experiment 24.05.07 Deployment UU

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.08	0.03	-0.05	-0.57	0.04	-0.04	-0.51	0.01	-0.07	-0.88	0.03	-0.05	-0.59	0.06	-0.02	-0.29	
0.08	0.03	-0.05	-0.60	0.04	-0.04	-0.54	0.02	-0.07	-0.80	0.03	-0.05	-0.63	0.05	-0.03	-0.34	
0.08	0.03	-0.05	-0.58	0.04	-0.04	-0.52	0.01	-0.07	-0.85	0.03	-0.05	-0.59	0.05	-0.03	-0.33	
0.07	0.03	-0.04	-0.55	0.03	-0.04	-0.51	0.01	-0.06	-0.85	0.03	-0.04	-0.57	0.05	-0.02	-0.30	
0.07	0.03	-0.04	-0.56	0.03	-0.03	-0.47	0.02	-0.05	-0.73	0.03	-0.04	-0.58	0.05	-0.02	-0.28	
0.06	0.03	-0.03	-0.46	0.03	-0.02	-0.41	0.01	-0.04	-0.75	0.03	-0.03	-0.52	0.04	-0.01	-0.23	
0.06	0.02	-0.03	-0.56	0.03	-0.03	-0.46	0.01	-0.04	-0.76	0.03	-0.03	-0.51	0.04	-0.01	-0.19	
0.05	0.03	-0.02	-0.46	0.03	-0.02	-0.44	0.02	-0.03	-0.67	0.02	-0.03	-0.54	0.04	-0.01	-0.12	
0.04	0.02	-0.02	-0.50	0.03	-0.01	-0.32	0.01	-0.03	-0.67	0.02	-0.02	-0.44	0.04	0.00	-0.10	
0.03	0.02	-0.01	-0.31	0.02	-0.01	-0.28	0.02	-0.01	-0.41	0.02	-0.01	-0.31	0.04	0.00	0.04	
0.03	0.02	-0.01	-0.42	0.03	-0.01	-0.27	0.02	-0.02	-0.51	0.02	-0.01	-0.40	0.04	0.00	0.08	
0.04	0.02	-0.02	-0.44	0.02	-0.01	-0.32	0.02	-0.01	-0.41	0.02	-0.02	-0.43	0.03	0.00	-0.07	
0.04	0.02	-0.02	-0.53	0.02	-0.02	-0.53	0.02	-0.02	-0.53	0.02	-0.02	-0.58	0.04	-0.01	-0.17	
0.04	0.02	-0.02	-0.50	0.02	-0.02	-0.49	0.02	-0.02	-0.39	0.02	-0.02	-0.47	0.03	-0.01	-0.28	
0.04	0.02	-0.02	-0.48	0.02	-0.02	-0.48	0.03	-0.01	-0.35	0.02	-0.02	-0.42	0.03	-0.01	-0.14	
0.04	0.02	-0.02	-0.52	0.02	-0.02	-0.59	0.02	-0.02	-0.47	0.02	-0.02	-0.57	0.03	-0.01	-0.33	
0.05	= <|x|>	0.03			0.02			0.04			0.03			0.01		*MAE*
		0.52			**0.47**			**0.68**			**0.53**			**0.23**		**RMAE**

Table 9.29: Experiment 24.05.07 Deployment VV

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.04	0.03	-0.02	-0.41	0.03	-0.02	-0.40	0.02	-0.03	-0.58	0.02	-0.02	-0.56	0.03	-0.02	-0.40	
0.05	0.03	-0.03	-0.49	0.03	-0.02	-0.42	0.02	-0.03	-0.63	0.02	-0.03	-0.62	0.03	-0.02	-0.46	
0.06	0.03	-0.03	-0.55	0.02	-0.04	-0.61	0.02	-0.04	-0.68	0.02	-0.04	-0.72	0.02	-0.04	-0.60	
0.07	0.02	-0.04	-0.66	0.02	-0.04	-0.66	0.02	-0.05	-0.73	0.02	-0.05	-0.75	0.03	-0.04	-0.60	
0.08	0.02	-0.05	-0.69	0.02	-0.05	-0.69	0.02	-0.05	-0.70	0.02	-0.06	-0.77	0.02	-0.05	-0.68	
0.08	0.02	-0.06	-0.70	0.02	-0.06	-0.71	0.02	-0.06	-0.78	0.02	-0.06	-0.80	0.02	-0.06	-0.73	
0.08	0.02	-0.06	-0.75	0.02	-0.06	-0.75	0.02	-0.06	-0.76	0.02	-0.07	-0.78	0.02	-0.06	-0.71	
0.09	0.02	-0.07	-0.76	0.02	-0.07	-0.76	0.02	-0.07	-0.76	0.01	-0.07	-0.84	0.02	-0.06	-0.74	
0.08	0.02	-0.06	-0.77	0.02	-0.06	-0.73	0.02	-0.06	-0.75	0.02	-0.07	-0.79	0.02	-0.06	-0.73	
0.08	0.02	-0.07	-0.79	0.02	-0.06	-0.75	0.02	-0.06	-0.72	0.02	-0.07	-0.80	0.02	-0.07	-0.79	
0.09	0.02	-0.07	-0.79	0.02	-0.07	-0.76	0.02	-0.07	-0.75	0.01	-0.08	-0.84	0.02	-0.07	-0.76	
0.09	0.02	-0.07	-0.79	0.02	-0.07	-0.79	0.03	-0.07	-0.71	0.02	-0.07	-0.81	0.02	-0.07	-0.77	
0.08	0.02	-0.06	-0.74	0.02	-0.06	-0.74	0.03	-0.06	-0.67	0.01	-0.07	-0.82	0.02	-0.06	-0.73	
0.09	0.02	-0.07	-0.82	0.02	-0.07	-0.79	0.03	-0.06	-0.66	0.01	-0.08	-0.87	0.02	-0.07	-0.80	
0.08	= <|x|>	0.06			0.05			0.05			0.06			0.05		*MAE*
		0.71			**0.70**			**0.71**			**0.78**			**0.70**		**RMAE**

Table 9.30: Experiment 24.05.07 Deployment WW

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.09	0.11	0.02	0.17	0.11	0.02	0.19	0.17	0.07	0.76	0.11	0.01	0.14	0.06	-0.04	-0.40
0.11	0.11	0.00	0.00	0.11	0.00	-0.02	0.17	0.05	0.45	0.11	0.00	-0.04	0.06	-0.06	-0.50
0.12	0.11	0.00	-0.04	0.11	-0.01	-0.06	0.17	0.05	0.40	0.11	0.00	-0.04	0.06	-0.06	-0.50

0.11	0.11	0.00	-0.02	0.11	0.00	-0.02	0.16	0.05	0.47	0.11	0.00	0.02	0.06	-0.05	-0.45	
0.10	0.11	0.00	0.03	0.11	0.01	0.06	0.15	0.05	0.46	0.11	0.01	0.06	0.06	-0.04	-0.39	
0.09	0.11	0.02	0.27	0.10	0.02	0.20	0.15	0.07	0.76	0.11	0.02	0.27	0.06	-0.03	-0.30	
0.08	0.11	0.02	0.26	0.10	0.02	0.23	0.15	0.06	0.73	0.11	0.03	0.31	0.07	-0.02	-0.22	
0.08	0.11	0.03	0.36	0.10	0.02	0.19	0.14	0.06	0.77	0.11	0.03	0.38	0.06	-0.02	-0.24	
0.08	0.10	0.02	0.20	0.10	0.01	0.15	0.14	0.05	0.62	0.11	0.02	0.28	0.06	-0.02	-0.25	
0.09	0.10	0.01	0.18	0.09	0.01	0.11	0.13	0.05	0.56	0.11	0.02	0.28	0.07	-0.02	-0.22	
0.09	0.10	0.01	0.09	0.09	0.00	-0.02	0.13	0.04	0.42	0.11	0.02	0.18	0.07	-0.02	-0.24	
0.10	0.09	0.00	-0.04	0.08	-0.02	-0.17	0.12	0.02	0.23	0.10	0.00	0.03	0.06	-0.03	-0.34	
0.09	0.09	0.00	-0.02	0.08	-0.01	-0.15	0.12	0.02	0.25	0.10	0.01	0.12	0.07	-0.03	-0.29	
0.10	= <|x|>	0.01			0.01			0.05			0.01			0.03		*MAE*
		0.12			**0.11**			**0.52**			**0.15**			**0.35**		**RMAE**

Table 9.31: Experiment 24.05.07 Deployment XX

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	Sd1	err	%err	Sd2	err	%err	Sd3	err	%err	Sd4	err	%err	Sd5	err	%err	
0.20	0.21	0.01	0.07	0.21	0.01	0.07	0.20	0.00	0.02	0.22	0.02	0.09	0.22	0.03	0.13	
0.24	0.21	-0.03	-0.12	0.21	-0.03	-0.11	0.20	-0.04	-0.18	0.21	-0.03	-0.11	0.22	-0.02	-0.09	
0.24	0.21	-0.03	-0.11	0.22	-0.02	-0.09	0.21	-0.03	-0.14	0.21	-0.03	-0.11	0.22	-0.02	-0.07	
0.23	0.22	-0.01	-0.04	0.22	0.00	-0.02	0.21	-0.02	-0.09	0.21	-0.02	-0.07	0.22	0.00	-0.02	
0.23	0.22	-0.01	-0.05	0.23	-0.01	-0.03	0.21	-0.03	-0.12	0.21	-0.02	-0.08	0.23	-0.01	-0.03	
0.20	0.22	0.02	0.10	0.23	0.03	0.15	0.21	0.01	0.05	0.22	0.02	0.08	0.23	0.03	0.15	
0.22	0.23	0.02	0.07	0.23	0.02	0.08	0.22	0.00	0.01	0.22	0.01	0.04	0.24	0.02	0.11	
0.23	0.24	0.01	0.03	0.25	0.02	0.09	0.23	0.00	-0.01	0.23	0.00	0.01	0.25	0.02	0.08	
0.23	0.24	0.02	0.07	0.25	0.03	0.12	0.23	0.00	0.01	0.23	0.01	0.03	0.25	0.03	0.12	
0.24	0.25	0.01	0.05	0.27	0.03	0.12	0.24	0.00	0.01	0.24	0.01	0.03	0.26	0.03	0.12	
0.24	0.27	0.02	0.10	0.29	0.04	0.18	0.25	0.01	0.03	0.25	0.01	0.03	0.28	0.04	0.15	
0.24	0.28	0.03	0.14	0.30	0.05	0.22	0.26	0.01	0.06	0.26	0.01	0.06	0.29	0.05	0.20	
0.25	0.29	0.04	0.17	0.32	0.07	0.28	0.27	0.02	0.08	0.28	0.02	0.09	0.31	0.06	0.24	
0.25	0.32	0.06	0.24	0.35	0.10	0.38	0.29	0.04	0.15	0.29	0.04	0.14	0.34	0.09	0.35	
0.28	0.34	0.06	0.22	0.36	0.08	0.30	0.31	0.03	0.11	0.31	0.03	0.10	0.36	0.08	0.29	
0.30	0.36	0.06	0.21	0.36	0.06	0.21	0.34	0.04	0.13	0.33	0.04	0.12	0.37	0.08	0.26	
0.30	0.36	0.06	0.22	0.34	0.04	0.15	0.35	0.05	0.18	0.36	0.06	0.21	0.37	0.07	0.23	
0.30	0.35	0.05	0.15	0.32	0.02	0.06	0.35	0.05	0.16	0.36	0.06	0.20	0.34	0.04	0.13	
0.29	0.33	0.04	0.13	0.30	0.01	0.05	0.34	0.05	0.16	0.35	0.06	0.22	0.32	0.03	0.11	
0.28	0.31	0.03	0.09	0.29	0.01	0.02	0.31	0.03	0.11	0.34	0.06	0.20	0.30	0.02	0.08	
0.27	0.30	0.03	0.12	0.28	0.01	0.05	0.29	0.03	0.11	0.31	0.05	0.18	0.29	0.03	0.10	
0.27	0.28	0.01	0.04	0.27	0.00	0.01	0.28	0.01	0.03	0.30	0.03	0.11	0.28	0.01	0.06	
0.26	0.27	0.01	0.04	0.27	0.00	0.01	0.27	0.01	0.03	0.28	0.02	0.08	0.27	0.01	0.04	
0.26	0.27	0.01	0.03	0.26	0.00	0.00	0.26	0.00	0.00	0.28	0.02	0.07	0.27	0.01	0.06	
0.26	0.26	0.00	0.01	0.25	0.00	-0.02	0.25	-0.01	-0.02	0.26	0.01	0.03	0.27	0.01	0.04	
0.24	0.26	0.01	0.06	0.24	0.00	0.00	0.25	0.00	0.01	0.26	0.02	0.07	0.26	0.01	0.05	
0.24	0.25	0.00	0.02	0.24	0.00	-0.01	0.24	0.00	-0.02	0.26	0.01	0.06	0.26	0.01	0.05	
0.25	0.24	-0.01	-0.03	0.23	-0.01	-0.05	0.23	-0.01	-0.05	0.25	0.00	0.00	0.25	0.00	0.01	
0.25	0.24	-0.01	-0.05	0.23	-0.02	-0.07	0.23	-0.02	-0.07	0.24	0.00	-0.02	0.24	0.00	-0.02	
0.24	0.23	-0.01	-0.03	0.23	-0.01	-0.05	0.22	-0.02	-0.08	0.24	0.00	-0.01	0.24	0.00	0.00	
0.23	0.23	0.00	-0.01	0.22	-0.01	-0.05	0.22	-0.01	-0.06	0.23	0.00	0.01	0.24	0.00	0.02	
0.24	0.22	-0.02	-0.07	0.22	-0.02	-0.08	0.21	-0.02	-0.10	0.23	-0.01	-0.04	0.23	-0.01	-0.04	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.10	0.21	-0.03	-0.12	0.22	-0.02	-0.06	0.22	-0.02	-0.06	
0.23	0.22	-0.02	-0.07	0.21	-0.02	-0.08	0.21	-0.03	-0.11	0.22	-0.01	-0.06	0.22	-0.01	-0.03	
0.22	0.21	-0.01	-0.04	0.21	-0.01	-0.06	0.20	-0.02	-0.07	0.22	0.00	-0.02	0.22	0.00	-0.01	
0.22	0.21	-0.01	-0.05	0.21	-0.01	-0.06	0.20	-0.02	-0.08	0.21	-0.01	-0.03	0.22	0.00	-0.01	
0.21	0.21	0.00	-0.02	0.20	-0.01	-0.04	0.20	-0.01	-0.06	0.21	0.00	-0.01	0.21	0.00	0.02	
0.22	0.20	-0.02	-0.08	0.20	-0.02	-0.08	0.20	-0.03	-0.12	0.20	-0.02	-0.07	0.21	-0.01	-0.03	
0.20	0.20	0.00	-0.01	0.20	-0.01	-0.03	0.19	-0.01	-0.06	0.20	0.00	0.00	0.21	0.01	0.03	
0.21	0.20	-0.01	-0.06	0.20	-0.01	-0.07	0.19	-0.02	-0.12	0.20	-0.01	-0.04	0.21	0.00	-0.01	
0.22	0.20	-0.02	-0.09	0.19	-0.02	-0.11	0.19	-0.03	-0.15	0.20	-0.02	-0.08	0.21	-0.01	-0.05	
0.21	0.19	-0.02	-0.10	0.19	-0.02	-0.10	0.18	-0.03	-0.13	0.20	-0.01	-0.07	0.21	0.00	-0.02	
0.22	0.19	-0.03	-0.13	0.19	-0.03	-0.12	0.18	-0.04	-0.18	0.19	-0.03	-0.13	0.20	-0.02	-0.08	
0.24	= <|x|>	0.02			0.02			0.02			0.02			0.02		*MAE*
		0.09			**0.09**			**0.09**			**0.08**			**0.09**		**RMAE**

Table 9.32: Experiment 24.05.07 Deployment YY

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.29	0.24	-0.05	-0.18	0.23	-0.06	-0.20	0.24	-0.05	-0.18	0.25	-0.05	-0.16	0.24	-0.06	-0.20
0.27	0.24	-0.04	-0.13	0.23	-0.04	-0.15	0.24	-0.04	-0.13	0.24	-0.03	-0.11	0.23	-0.04	-0.14
0.25	0.23	-0.02	-0.07	0.23	-0.02	-0.08	0.24	-0.01	-0.05	0.23	-0.02	-0.06	0.23	-0.02	-0.09
0.23	0.23	0.00	-0.01	0.23	0.00	-0.01	0.23	0.00	-0.01	0.24	0.00	0.01	0.22	-0.01	-0.04
0.22	0.23	0.01	0.04	0.23	0.01	0.05	0.23	0.01	0.07	0.23	0.01	0.03	0.22	0.01	0.03
0.22	0.23	0.01	0.05	0.24	0.02	0.07	0.23	0.01	0.06	0.23	0.01	0.04	0.22	0.00	0.01
0.23	0.24	0.01	0.04	0.25	0.02	0.09	0.24	0.01	0.05	0.23	0.00	0.01	0.23	0.00	0.01
0.23	0.25	0.02	0.09	0.27	0.04	0.18	0.25	0.03	0.12	0.24	0.01	0.05	0.24	0.01	0.05
0.23	0.27	0.04	0.18	0.29	0.06	0.28	0.27	0.04	0.20	0.25	0.02	0.09	0.25	0.03	0.13
0.23	0.28	0.05	0.23	0.31	0.08	0.35	0.28	0.05	0.22	0.27	0.03	0.15	0.27	0.04	0.18
0.26	0.31	0.05	0.19	0.36	0.10	0.37	0.31	0.05	0.21	0.28	0.02	0.07	0.30	0.04	0.14
0.29	0.35	0.06	0.22	0.40	0.11	0.39	0.35	0.06	0.21	0.31	0.02	0.07	0.33	0.05	0.16
0.33	0.39	0.06	0.19	0.41	0.08	0.25	0.39	0.06	0.18	0.34	0.01	0.04	0.38	0.06	0.17
0.33	0.41	0.08	0.25	0.40	0.06	0.19	0.41	0.08	0.24	0.39	0.06	0.17	0.41	0.08	0.25
0.33	0.40	0.07	0.20	0.37	0.03	0.10	0.40	0.07	0.20	0.41	0.08	0.25	0.40	0.07	0.21
0.33	0.37	0.04	0.12	0.33	0.00	0.01	0.37	0.04	0.12	0.41	0.08	0.24	0.37	0.04	0.13

0.30	0.34	0.04	0.13	0.32	0.02	0.06	0.34	0.04	0.13	0.37	0.07	0.24	0.34	0.04	0.13	
0.29	0.32	0.03	0.09	0.31	0.02	0.06	0.32	0.03	0.09	0.34	0.05	0.16	0.32	0.03	0.10	
0.29	0.31	0.02	0.09	0.31	0.02	0.07	0.31	0.02	0.07	0.32	0.04	0.13	0.31	0.02	0.08	
0.29	0.31	0.02	0.08	0.30	0.02	0.06	0.30	0.02	0.07	0.31	0.03	0.10	0.31	0.02	0.07	
0.27	0.31	0.04	0.14	0.30	0.03	0.12	0.30	0.04	0.13	0.31	0.04	0.14	0.30	0.03	0.12	
0.27	0.30	0.03	0.11	0.30	0.03	0.10	0.30	0.03	0.12	0.30	0.03	0.13	0.30	0.03	0.11	
0.27	0.30	0.02	0.08	0.29	0.02	0.07	0.30	0.02	0.09	0.30	0.03	0.11	0.29	0.02	0.08	
0.28	0.29	0.02	0.06	0.29	0.01	0.04	0.29	0.01	0.04	0.30	0.02	0.07	0.29	0.01	0.05	
0.28	0.29	0.01	0.03	0.28	0.00	-0.01	0.29	0.01	0.02	0.29	0.01	0.02	0.29	0.01	0.02	
0.28	0.28	0.00	0.01	0.28	0.00	-0.01	0.28	0.00	0.01	0.29	0.01	0.04	0.28	0.00	0.01	
0.28	0.28	0.00	-0.02	0.27	-0.01	-0.05	0.28	0.00	-0.02	0.28	0.00	0.01	0.28	0.00	-0.01	
0.28	0.27	-0.01	-0.03	0.26	-0.01	-0.05	0.27	-0.01	-0.03	0.28	0.00	0.00	0.27	-0.01	-0.04	
0.27	0.26	-0.01	-0.04	0.26	-0.02	-0.06	0.26	-0.01	-0.04	0.27	-0.01	-0.02	0.26	-0.01	-0.04	
0.27	0.26	-0.01	-0.04	0.26	-0.01	-0.05	0.26	-0.01	-0.04	0.26	-0.01	-0.03	0.26	-0.01	-0.04	
0.27	0.26	-0.01	-0.03	0.26	-0.01	-0.04	0.26	-0.01	-0.05	0.26	-0.01	-0.03	0.26	-0.01	-0.05	
0.27	0.26	-0.02	-0.06	0.26	-0.02	-0.06	0.26	-0.02	-0.06	0.26	-0.02	-0.06	0.26	-0.02	-0.07	
0.28	0.26	-0.02	-0.06	0.26	-0.02	-0.08	0.25	-0.02	-0.09	0.26	-0.02	-0.06	0.26	-0.02	-0.07	
0.28	0.25	-0.03	-0.10	0.25	-0.03	-0.09	0.26	-0.02	-0.09	0.26	-0.02	-0.08	0.25	-0.03	-0.10	
0.27	0.25	-0.02	-0.06	0.25	-0.02	-0.08	0.25	-0.02	-0.06	0.26	-0.02	-0.06	0.25	-0.02	-0.09	
0.28	0.25	-0.03	-0.12	0.25	-0.03	-0.11	0.25	-0.03	-0.11	0.25	-0.03	-0.11	0.25	-0.04	-0.13	
0.30	0.25	-0.04	-0.15	0.25	-0.05	-0.16	0.25	-0.04	-0.15	0.25	-0.05	-0.16	0.24	-0.05	-0.18	
0.29	0.25	-0.03	-0.12	0.26	-0.03	-0.09	0.26	-0.03	-0.11	0.25	-0.03	-0.12	0.24	-0.04	-0.15	
0.30	0.26	-0.04	-0.14	0.27	-0.03	-0.10	0.26	-0.04	-0.13	0.25	-0.05	-0.16	0.25	-0.05	-0.17	
0.32	0.27	-0.05	-0.16	0.29	-0.03	-0.10	0.27	-0.04	-0.14	0.26	-0.06	-0.18	0.25	-0.07	-0.21	
0.33	0.28	-0.05	-0.14	0.31	-0.02	-0.05	0.29	-0.04	-0.11	0.26	-0.06	-0.19	0.26	-0.06	-0.20	
0.34	0.31	-0.03	-0.10	0.36	0.02	0.05	0.31	-0.03	-0.09	0.28	-0.06	-0.19	0.28	-0.06	-0.18	
0.36	0.35	-0.01	-0.03	0.42	0.06	0.17	0.35	-0.01	-0.03	0.30	-0.06	-0.16	0.32	-0.04	-0.12	
0.28	= <|x|>	0.03			0.03			0.03			0.03			0.03		*MAE*
		0.10			**0.11**			**0.10**			**0.11**			**0.11**		**RMAE**

Table 9.33: Experiment 24.05.07 Deployment ZZ2

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.29	0.23	-0.06	-0.20	0.23	-0.07	-0.22	0.24	-0.05	-0.18	0.24	-0.05	-0.18	0.22	-0.07	-0.24	
0.26	0.23	-0.03	-0.11	0.22	-0.04	-0.14	0.23	-0.02	-0.09	0.23	-0.03	-0.10	0.21	-0.04	-0.17	
0.24	0.22	-0.02	-0.09	0.22	-0.02	-0.10	0.23	-0.02	-0.06	0.23	-0.01	-0.05	0.21	-0.03	-0.14	
0.23	0.22	0.00	-0.02	0.22	-0.01	-0.04	0.23	0.00	0.00	0.23	0.00	0.00	0.21	-0.02	-0.08	
0.22	0.22	0.00	-0.01	0.22	0.00	0.02	0.23	0.01	0.05	0.22	0.00	0.00	0.20	-0.02	-0.07	
0.21	0.22	0.01	0.06	0.22	0.02	0.08	0.22	0.02	0.08	0.22	0.01	0.05	0.21	0.00	0.01	
0.19	0.22	0.03	0.17	0.23	0.04	0.22	0.23	0.04	0.22	0.22	0.03	0.14	0.21	0.02	0.08	
0.17	0.23	0.06	0.34	0.25	0.08	0.43	0.24	0.07	0.40	0.22	0.05	0.30	0.22	0.04	0.24	
0.16	0.25	0.09	0.53	0.26	0.10	0.64	0.26	0.10	0.61	0.23	0.07	0.44	0.23	0.07	0.43	
0.17	0.26	0.10	0.59	0.29	0.13	0.76	0.28	0.11	0.69	0.25	0.08	0.49	0.24	0.08	0.47	
0.17	0.29	0.11	0.65	0.33	0.16	0.92	0.30	0.13	0.75	0.26	0.09	0.50	0.27	0.09	0.54	
0.19	0.32	0.14	0.72	0.38	0.19	1.02	0.34	0.15	0.81	0.28	0.09	0.49	0.29	0.10	0.55	
0.21	0.37	0.17	0.79	0.41	0.20	0.97	0.39	0.18	0.88	0.32	0.11	0.53	0.34	0.13	0.64	
0.22	0.41	0.19	0.86	0.40	0.18	0.82	0.41	0.19	0.87	0.37	0.15	0.66	0.39	0.17	0.74	
0.26	0.41	0.15	0.56	0.37	0.11	0.42	0.40	0.14	0.55	0.41	0.15	0.57	0.41	0.15	0.57	
0.29	0.37	0.08	0.28	0.33	0.04	0.15	0.37	0.08	0.27	0.41	0.12	0.40	0.39	0.09	0.32	
0.30	0.34	0.05	0.16	0.32	0.02	0.07	0.34	0.04	0.13	0.38	0.08	0.29	0.35	0.05	0.18	
0.32	0.32	0.00	-0.01	0.31	-0.01	-0.04	0.32	0.00	-0.01	0.35	0.03	0.08	0.33	0.00	0.01	
0.31	0.31	0.00	0.00	0.30	-0.01	-0.03	0.31	0.00	0.00	0.33	0.01	0.04	0.31	0.00	-0.01	
0.30	0.31	0.00	0.01	0.30	0.00	0.00	0.31	0.00	0.02	0.31	0.01	0.03	0.30	0.00	-0.01	
0.28	0.30	0.02	0.07	0.29	0.02	0.06	0.30	0.02	0.09	0.31	0.03	0.10	0.30	0.02	0.06	
0.27	0.30	0.03	0.10	0.29	0.02	0.08	0.30	0.03	0.11	0.30	0.03	0.11	0.29	0.02	0.07	
0.28	0.29	0.01	0.05	0.29	0.01	0.04	0.30	0.02	0.07	0.30	0.02	0.06	0.28	0.00	0.01	
0.28	0.29	0.01	0.04	0.29	0.01	0.04	0.29	0.02	0.05	0.29	0.02	0.06	0.28	0.00	0.00	
0.28	0.29	0.01	0.03	0.28	0.00	0.00	0.29	0.01	0.05	0.29	0.01	0.04	0.28	0.00	0.01	
0.27	0.28	0.02	0.07	0.28	0.01	0.04	0.28	0.02	0.06	0.29	0.02	0.08	0.28	0.01	0.05	
0.26	0.28	0.02	0.07	0.27	0.01	0.04	0.28	0.02	0.08	0.28	0.03	0.10	0.27	0.02	0.06	
0.25	0.27	0.02	0.08	0.26	0.01	0.05	0.27	0.02	0.10	0.28	0.03	0.13	0.26	0.02	0.07	
0.23	0.26	0.02	0.10	0.26	0.02	0.09	0.26	0.03	0.12	0.27	0.03	0.14	0.25	0.02	0.08	
0.23	0.26	0.03	0.14	0.26	0.03	0.14	0.26	0.03	0.15	0.26	0.03	0.15	0.25	0.02	0.11	
0.22	0.26	0.04	0.17	0.26	0.04	0.17	0.26	0.04	0.18	0.26	0.04	0.17	0.25	0.03	0.13	
0.22	0.26	0.04	0.16	0.25	0.03	0.14	0.26	0.04	0.17	0.26	0.04	0.16	0.24	0.02	0.10	
0.23	0.25	0.02	0.11	0.25	0.03	0.11	0.26	0.03	0.15	0.26	0.03	0.14	0.25	0.02	0.09	
0.23	0.25	0.02	0.10	0.24	0.01	0.06	0.25	0.02	0.10	0.25	0.02	0.10	0.24	0.01	0.05	
0.22	0.25	0.02	0.10	0.24	0.02	0.07	0.25	0.03	0.12	0.25	0.02	0.11	0.24	0.01	0.05	
0.23	0.24	0.01	0.03	0.24	0.00	0.01	0.25	0.02	0.07	0.25	0.01	0.06	0.23	0.00	-0.01	
0.23	0.24	0.00	0.01	0.24	0.00	0.01	0.25	0.01	0.05	0.24	0.01	0.04	0.23	-0.01	-0.03	
0.23	0.24	0.01	0.05	0.23	0.01	0.03	0.25	0.02	0.10	0.24	0.01	0.05	0.22	-0.01	-0.03	
0.23	0.23	0.00	0.01	0.24	0.01	0.04	0.25	0.02	0.10	0.23	0.00	0.01	0.22	-0.01	-0.04	
0.24	0.24	0.00	-0.02	0.25	0.01	0.03	0.26	0.01	0.05	0.24	-0.01	-0.03	0.21	-0.03	-0.14	
0.25	0.25	0.00	0.00	0.27	0.02	0.08	0.27	0.02	0.09	0.24	-0.01	-0.04	0.21	-0.04	-0.16	
0.26	0.26	0.00	0.00	0.30	0.04	0.14	0.30	0.03	0.12	0.24	-0.02	-0.07	0.22	-0.05	-0.17	
0.26	0.29	0.03	0.13	0.34	0.08	0.31	0.33	0.07	0.28	0.26	0.00	0.01	0.23	-0.03	-0.13	
0.24	= <|x|>	0.04			0.04			0.05			0.04			0.04		*MAE*
		0.16			**0.18**			**0.19**			**0.16**			**0.15**		**RMAE**

Table 9.34: Experiment 24.05.07 Deployment ZZ3

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.22	0.21	-0.01	-0.03	0.20	-0.02	-0.08	0.23	0.01	0.04	0.22	0.00	0.00	0.18	-0.04	-0.17	
0.20	0.20	0.00	0.01	0.20	0.00	0.00	0.22	0.02	0.12	0.21	0.01	0.06	0.17	-0.03	-0.13	
0.19	0.20	0.01	0.03	0.20	0.00	0.02	0.21	0.02	0.12	0.20	0.01	0.06	0.17	-0.02	-0.10	
0.18	0.20	0.02	0.12	0.20	0.02	0.11	0.21	0.04	0.21	0.20	0.03	0.14	0.17	-0.01	-0.06	
0.17	0.20	0.03	0.19	0.20	0.03	0.18	0.21	0.05	0.28	0.20	0.03	0.18	0.17	0.00	0.02	
0.15	0.20	0.05	0.32	0.20	0.05	0.35	0.21	0.06	0.41	0.20	0.05	0.31	0.17	0.02	0.14	
0.14	0.20	0.06	0.42	0.20	0.07	0.47	0.22	0.08	0.55	0.19	0.06	0.40	0.17	0.03	0.21	
0.11	0.20	0.09	0.79	0.22	0.10	0.89	0.22	0.11	0.96	0.20	0.08	0.73	0.17	0.06	0.52	
0.10	0.21	0.11	1.16	0.23	0.14	1.40	0.24	0.14	1.42	0.20	0.11	1.08	0.18	0.08	0.84	
0.07	0.23	0.15	2.07	0.25	0.18	2.35	0.25	0.18	2.35	0.21	0.13	1.78	0.19	0.11	1.50	
0.05	0.25	0.20	4.02	0.28	0.23	4.64	0.27	0.23	4.61	0.22	0.17	3.55	0.20	0.15	3.11	
0.07	0.27	0.20	3.01	0.32	0.25	3.71	0.30	0.24	3.51	0.24	0.17	2.59	0.22	0.15	2.31	
0.12	0.30	0.18	1.49	0.37	0.25	2.04	0.35	0.23	1.91	0.26	0.14	1.18	0.24	0.12	1.02	
0.14	= <|x|>	0.09			0.10			0.11			0.08			0.06		*MAE*
		0.63			**0.75**			**0.79**			**0.56**			**0.47**		**RMAE**

Table 9.35: Experiment 24.05.07 Deployment ZZ4

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.14	0.06	-0.07	-0.53	0.07	-0.06	-0.47	0.11	-0.03	-0.22	0.06	-0.07	-0.53	0.03	-0.10	-0.74	
0.17	0.07	-0.10	-0.61	0.09	-0.08	-0.49	0.11	-0.06	-0.35	0.06	-0.11	-0.64	0.03	-0.14	-0.82	
0.11	0.07	-0.04	-0.39	0.10	-0.01	-0.10	0.11	0.00	0.01	0.06	-0.05	-0.45	0.03	-0.08	-0.72	
0.08	0.07	-0.01	-0.14	0.12	0.04	0.52	0.12	0.04	0.56	0.06	-0.02	-0.25	0.03	-0.05	-0.68	
0.08	0.07	-0.01	-0.13	0.15	0.07	0.85	0.14	0.05	0.67	0.05	-0.03	-0.33	0.03	-0.05	-0.65	
0.12	0.09	-0.03	-0.26	0.19	0.07	0.60	0.17	0.05	0.45	0.06	-0.06	-0.51	0.03	-0.09	-0.78	
0.24	0.10	-0.15	-0.60	0.20	-0.05	-0.19	0.19	-0.05	-0.20	0.06	-0.19	-0.77	0.03	-0.22	-0.89	
0.33	0.12	-0.21	-0.64	0.20	-0.14	-0.41	0.22	-0.11	-0.32	0.06	-0.27	-0.82	0.03	-0.30	-0.92	
0.27	0.15	-0.12	-0.45	0.19	-0.08	-0.31	0.23	-0.04	-0.15	0.06	-0.21	-0.78	0.03	-0.25	-0.90	
0.22	0.18	-0.03	-0.16	0.19	-0.02	-0.10	0.24	0.03	0.12	0.06	-0.15	-0.70	0.02	-0.19	-0.89	
0.04	0.20	0.16	3.92	0.21	0.17	4.22	0.25	0.21	5.33	0.07	0.03	0.78	0.02	-0.02	-0.44	
0.00	0.20	0.19	58.40	0.22	0.22	65.47	0.29	0.28	85.27	0.08	0.08	23.60	0.03	0.03	7.54	
0.01	0.19	0.18	15.59	0.24	0.22	19.24	0.31	0.30	25.50	0.10	0.09	7.94	0.03	0.02	1.30	
0.03	0.19	0.16	5.45	0.25	0.22	7.21	0.32	0.29	9.59	0.13	0.10	3.17	0.03	0.00	0.13	
0.18	0.21	0.03	0.15	0.24	0.06	0.35	0.30	0.12	0.66	0.16	-0.02	-0.12	0.04	-0.14	-0.76	
0.18	0.23	0.05	0.29	0.23	0.05	0.30	0.28	0.10	0.57	0.19	0.01	0.08	0.05	-0.12	-0.71	
0.19	0.24	0.05	0.27	0.21	0.02	0.08	0.25	0.06	0.34	0.20	0.01	0.04	0.05	-0.14	-0.71	
0.17	0.25	0.08	0.50	0.19	0.02	0.12	0.24	0.07	0.41	0.19	0.02	0.13	0.08	-0.09	-0.55	
0.08	0.25	0.16	1.98	0.17	0.09	1.11	0.22	0.14	1.64	0.19	0.11	1.28	0.10	0.02	0.22	
0.06	0.23	0.17	2.64	0.16	0.10	1.54	0.20	0.14	2.21	0.19	0.13	2.02	0.12	0.05	0.86	
0.03	0.21	0.17	5.25	0.15	0.12	3.49	0.20	0.17	4.99	0.21	0.17	5.26	0.13	0.10	2.97	
0.02	0.19	0.17	7.17	0.14	0.12	5.06	0.20	0.17	7.44	0.22	0.20	8.55	0.14	0.12	5.15	
0.08	0.17	0.10	1.28	0.13	0.05	0.72	0.18	0.11	1.43	0.23	0.15	2.02	0.14	0.07	0.87	
0.13	0.17	0.04	0.32	0.13	0.00	0.04	0.17	0.05	0.39	0.24	0.12	0.93	0.13	0.01	0.05	
0.11	0.15	0.04	0.41	0.13	0.02	0.15	0.17	0.06	0.54	0.24	0.13	1.18	0.12	0.01	0.08	
0.13	0.14	0.01	0.07	0.12	-0.01	-0.10	0.17	0.04	0.27	0.22	0.08	0.63	0.12	-0.02	-0.14	
0.13	0.14	0.01	0.12	0.12	-0.01	-0.06	0.17	0.04	0.35	0.20	0.08	0.63	0.11	-0.02	-0.13	
0.16	0.13	-0.03	-0.18	0.11	-0.05	-0.30	0.17	0.01	0.05	0.19	0.03	0.18	0.12	-0.04	-0.27	
0.14	0.13	-0.01	-0.08	0.10	-0.04	-0.28	0.17	0.03	0.20	0.17	0.03	0.19	0.13	-0.02	-0.11	
0.01	0.12	0.12	15.49	0.10	0.10	12.91	0.17	0.16	21.36	0.16	0.15	20.58	0.14	0.13	17.66	
0.12	= <|x|>	0.09			0.08			0.10			0.10			0.09		*MAE*
		0.75			**0.64**			**0.83**			**0.80**			**0.72**		**RMAE**

Table 9.36: Experiment 24.05.07 Deployment ZZ5

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.14	0.14	0.00	0.02	0.13	0.00	-0.02	0.18	0.04	0.31	0.14	0.01	0.06	0.09	-0.05	-0.33	
0.11	0.13	0.02	0.21	0.13	0.01	0.12	0.17	0.06	0.57	0.14	0.03	0.28	0.09	-0.02	-0.19	
0.10	0.13	0.02	0.24	0.13	0.02	0.24	0.17	0.07	0.68	0.13	0.03	0.29	0.08	-0.02	-0.20	
0.08	0.13	0.05	0.57	0.13	0.05	0.59	0.17	0.09	1.10	0.13	0.05	0.64	0.08	0.00	0.01	
0.08	0.12	0.05	0.63	0.12	0.05	0.66	0.17	0.09	1.25	0.13	0.05	0.67	0.07	0.00	-0.03	
0.08	0.12	0.05	0.60	0.13	0.05	0.72	0.17	0.09	1.26	0.12	0.04	0.54	0.07	0.00	-0.05	
0.07	0.12	0.05	0.76	0.13	0.06	0.80	0.17	0.10	1.41	0.12	0.05	0.70	0.07	0.00	0.01	
0.07	0.12	0.05	0.63	0.13	0.05	0.73	0.17	0.10	1.35	0.11	0.04	0.54	0.07	-0.01	-0.09	
0.14	0.13	-0.02	-0.11	0.13	-0.01	-0.05	0.18	0.04	0.29	0.12	-0.02	-0.17	0.06	-0.08	-0.55	
0.18	0.12	-0.06	-0.32	0.14	-0.04	-0.23	0.19	0.01	0.05	0.12	-0.06	-0.33	0.06	-0.12	-0.65	
0.19	0.13	-0.06	-0.31	0.16	-0.03	-0.14	0.20	0.02	0.08	0.12	-0.07	-0.38	0.06	-0.13	-0.68	
0.18	0.13	-0.05	-0.28	0.18	-0.01	-0.03	0.22	0.04	0.22	0.12	-0.06	-0.34	0.06	-0.12	-0.66	
0.09	0.15	0.05	0.54	0.20	0.11	1.15	0.24	0.15	1.57	0.12	0.02	0.23	0.05	-0.04	-0.45	
0.07	0.16	0.09	1.33	0.23	0.16	2.23	0.27	0.20	2.80	0.12	0.05	0.74	0.06	-0.01	-0.20	
0.11	= <|x|>	0.04			0.05			0.08			0.04			0.04		*MAE*
		0.39			**0.41**			**0.70**			**0.37**			**0.38**		**RMAE**

Table 9.37: Experiment 24.05.07 Deployment ZZ6

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.09	0.03	-0.06	-0.66	0.05	-0.03	-0.37	0.05	-0.04	-0.46	0.01	-0.08	-0.91	0.13	0.04	0.46	
0.10	0.02	-0.07	-0.76	0.05	-0.05	-0.48	0.05	-0.05	-0.47	0.01	-0.09	-0.90	0.12	0.03	0.26	
0.10	0.02	-0.08	-0.78	0.04	-0.06	-0.58	0.05	-0.05	-0.49	0.01	-0.10	-0.94	0.12	0.02	0.15	
0.10	0.02	-0.08	-0.80	0.04	-0.06	-0.58	0.05	-0.05	-0.49	0.01	-0.09	-0.87	0.11	0.01	0.10	
0.09	0.02	-0.07	-0.78	0.04	-0.06	-0.61	0.06	-0.04	-0.40	0.01	-0.08	-0.87	0.11	0.02	0.16	
0.08	0.01	-0.06	-0.81	0.03	-0.05	-0.58	0.06	-0.02	-0.24	0.02	-0.06	-0.79	0.10	0.02	0.30	
0.04	0.01	-0.02	-0.64	0.03	-0.01	-0.21	0.06	0.02	0.47	0.02	-0.02	-0.45	0.10	0.07	1.68	
0.02	0.01	0.00	-0.20	0.03	0.01	0.65	0.06	0.04	2.22	0.02	0.00	0.15	0.10	0.08	4.36	
0.02	0.02	-0.01	-0.28	0.02	0.00	-0.03	0.06	0.04	1.68	0.03	0.00	0.13	0.10	0.08	3.33	
0.05	0.02	-0.03	-0.63	0.02	-0.02	-0.47	0.06	0.01	0.32	0.03	-0.02	-0.38	0.10	0.05	1.13	
0.06	0.02	-0.04	-0.67	0.02	-0.04	-0.63	0.06	0.00	0.03	0.03	-0.04	-0.59	0.11	0.04	0.69	
0.06	0.03	-0.04	-0.58	0.02	-0.04	-0.69	0.06	0.00	-0.02	0.03	-0.03	-0.51	0.12	0.05	0.86	
0.05	0.03	-0.03	-0.53	0.02	-0.03	-0.62	0.06	0.01	0.18	0.03	-0.03	-0.48	0.15	0.09	1.69	
0.07	0.03	-0.04	-0.56	0.02	-0.05	-0.66	0.07	0.00	-0.04	0.03	-0.04	-0.55	0.24	0.17	2.39	
0.09	0.03	-0.06	-0.67	0.02	-0.06	-0.73	0.07	-0.02	-0.23	0.03	-0.06	-0.67	0.37	0.29	3.32	
0.06	0.03	-0.02	-0.42	0.03	-0.03	-0.51	0.07	0.01	0.21	0.03	-0.03	-0.45	0.36	0.30	5.28	
0.06	0.03	-0.03	-0.44	0.02	-0.04	-0.59	0.07	0.01	0.12	0.03	-0.03	-0.52	0.28	0.22	3.62	
0.09	0.04	-0.06	-0.62	0.03	-0.06	-0.65	0.07	-0.02	-0.23	0.03	-0.06	-0.64	0.24	0.15	1.61	
0.14	0.04	-0.10	-0.71	0.04	-0.10	-0.74	0.07	-0.07	-0.52	0.03	-0.11	-0.76	0.23	0.09	0.66	
0.09	0.04	-0.05	-0.56	0.04	-0.05	-0.58	0.06	-0.03	-0.30	0.03	-0.06	-0.64	0.22	0.13	1.40	
0.01	0.04	0.03	1.88	0.04	0.03	1.88	0.06	0.05	3.18	0.03	0.02	1.07	0.22	0.20	13.68	
0.02	0.04	0.02	0.96	0.04	0.02	1.03	0.06	0.04	1.78	0.03	0.01	0.51	0.21	0.19	8.62	
0.00	0.05	0.04	13.42	0.05	0.04	13.21	0.06	0.06	18.21	0.03	0.03	7.60	0.21	0.20	61.37	
0.01	0.05	0.04	5.45	0.05	0.04	5.71	0.06	0.05	7.32	0.03	0.03	3.47	0.20	0.19	25.97	
0.01	0.05	0.04	5.08	0.05	0.04	5.83	0.07	0.06	8.31	0.03	0.02	3.12	0.21	0.20	26.60	
0.03	0.05	0.02	0.94	0.06	0.03	1.23	0.06	0.04	1.55	0.03	0.00	0.13	0.20	0.18	7.00	
0.03	0.05	0.02	0.48	0.06	0.03	0.78	0.06	0.03	0.88	0.03	0.00	-0.11	0.20	0.17	4.83	
0.02	0.05	0.03	1.21	0.06	0.04	1.82	0.06	0.04	1.91	0.04	0.01	0.62	0.19	0.17	7.72	
0.01	0.05	0.04	4.02	0.07	0.06	5.62	0.06	0.05	4.75	0.03	0.02	2.29	0.19	0.18	18.09	
0.06	$= \langle \lvert x \rvert \rangle$	0.04			0.04			0.03			0.04			0.13		*MAE*
		0.77			**0.74**			**0.59**			**0.72**			**2.24**		**RMAE**

Table 9.38: Experiment 24.05.07 Deployment ZZ7

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.24	0.29	0.06	0.24	0.28	0.04	0.18	0.30	0.06	0.25	0.31	0.08	0.32	0.29	0.06	0.24	
0.25	0.28	0.03	0.12	0.27	0.02	0.07	0.28	0.03	0.11	0.29	0.04	0.17	0.28	0.03	0.12	
0.25	0.27	0.03	0.10	0.27	0.02	0.08	0.27	0.02	0.09	0.28	0.04	0.14	0.27	0.03	0.10	
0.25	0.27	0.02	0.06	0.26	0.01	0.06	0.26	0.01	0.04	0.27	0.02	0.08	0.27	0.02	0.08	
0.25	0.26	0.01	0.04	0.26	0.00	0.01	0.26	0.01	0.02	0.27	0.01	0.05	0.27	0.01	0.06	
0.25	0.26	0.01	0.03	0.26	0.01	0.03	0.25	0.00	0.01	0.26	0.01	0.05	0.27	0.02	0.06	
0.25	0.26	0.01	0.02	0.25	0.00	0.00	0.25	0.00	-0.01	0.26	0.01	0.03	0.26	0.01	0.04	
0.25	0.25	0.00	0.01	0.25	0.00	-0.01	0.25	0.00	-0.01	0.26	0.00	0.02	0.26	0.01	0.04	
0.25	0.25	0.00	0.01	0.25	0.00	-0.01	0.24	0.00	-0.02	0.26	0.01	0.03	0.26	0.01	0.04	
0.25	0.25	0.00	-0.01	0.24	-0.01	-0.03	0.24	-0.01	-0.04	0.25	0.00	0.02	0.25	0.00	0.01	
0.24	0.24	0.01	0.03	0.24	0.00	0.01	0.24	0.00	0.00	0.25	0.01	0.04	0.25	0.02	0.07	
0.24	0.24	0.00	0.02	0.24	0.00	-0.01	0.23	-0.01	-0.02	0.24	0.01	0.03	0.25	0.01	0.03	
0.24	0.24	-0.01	-0.03	0.23	-0.01	-0.04	0.23	-0.01	-0.05	0.24	0.00	-0.02	0.24	0.00	0.00	
0.24	0.23	-0.01	-0.06	0.23	-0.02	-0.07	0.22	-0.02	-0.08	0.24	-0.01	-0.03	0.24	-0.01	-0.04	
0.26	0.23	-0.03	-0.10	0.22	-0.03	-0.13	0.22	-0.04	-0.14	0.23	-0.02	-0.09	0.23	-0.02	-0.09	
0.26	0.23	-0.04	-0.14	0.22	-0.04	-0.15	0.22	-0.04	-0.16	0.23	-0.03	-0.13	0.23	-0.03	-0.12	
0.24	0.22	-0.02	-0.07	0.22	-0.02	-0.08	0.22	-0.02	-0.10	0.22	-0.01	-0.06	0.23	-0.01	-0.04	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.08	0.21	-0.03	-0.11	0.22	-0.02	-0.07	0.23	-0.01	-0.04	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.10	0.21	-0.03	-0.12	0.23	-0.01	-0.06	0.23	-0.01	-0.04	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.08	0.21	-0.03	-0.13	0.22	-0.02	-0.09	0.23	-0.01	-0.05	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.08	0.21	-0.02	-0.10	0.22	-0.01	-0.06	0.23	-0.01	-0.03	
0.24	0.22	-0.02	-0.08	0.22	-0.02	-0.09	0.21	-0.03	-0.14	0.22	-0.02	-0.07	0.23	-0.01	-0.05	
0.22	0.22	0.00	0.01	0.22	0.00	0.01	0.21	-0.01	-0.03	0.22	0.00	0.02	0.23	0.01	0.06	
0.22	0.22	0.01	0.03	0.22	0.01	0.03	0.21	-0.01	-0.03	0.22	0.01	0.03	0.24	0.02	0.09	
0.23	0.23	0.00	0.01	0.23	0.00	0.01	0.21	-0.02	-0.07	0.23	0.00	0.01	0.24	0.02	0.07	
0.21	0.23	0.02	0.09	0.23	0.02	0.11	0.21	0.00	0.02	0.23	0.02	0.09	0.25	0.04	0.19	
0.20	0.24	0.03	0.15	0.24	0.04	0.18	0.21	0.01	0.05	0.23	0.03	0.15	0.26	0.06	0.28	
0.18	0.25	0.06	0.34	0.25	0.07	0.38	0.22	0.04	0.19	0.24	0.06	0.30	0.28	0.10	0.53	
0.17	0.26	0.09	0.52	0.28	0.11	0.62	0.22	0.05	0.30	0.25	0.08	0.46	0.31	0.14	0.81	
0.24	$= \langle \lvert x \rvert \rangle$	0.02			0.02			0.02			0.02			0.02		*MAE*
		0.08			**0.09**			**0.08**			**0.09**			**0.11**		**RMAE**

Table 9.39: Experiment 24.05.07 Deployment ZZ8

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.25	0.37	0.12	0.50	0.44	0.20	0.81	0.33	0.08	0.33	0.32	0.07	0.31	0.39	0.14	0.59
0.25	0.45	0.20	0.77	0.54	0.29	1.13	0.40	0.15	0.58	0.37	0.12	0.45	0.47	0.22	0.85
0.28	0.52	0.24	0.88	0.55	0.27	0.96	0.50	0.22	0.80	0.44	0.17	0.59	0.53	0.25	0.90
0.28	0.56	0.28	0.98	0.54	0.25	0.90	0.55	0.27	0.94	0.51	0.23	0.81	0.57	0.29	1.02
0.24	0.56	0.32	1.35	0.51	0.27	1.11	0.56	0.32	1.33	0.56	0.32	1.33	0.57	0.33	1.37

0.30	0.55	0.25	0.83	0.47	0.17	0.56	0.54	0.24	0.80	0.58	0.28	0.92	0.56	0.26	0.87	
0.30	0.52	0.22	0.73	0.43	0.14	0.45	0.51	0.21	0.71	0.57	0.27	0.90	0.53	0.23	0.77	
0.23	0.49	0.25	1.09	0.41	0.18	0.77	0.48	0.25	1.06	0.55	0.32	1.36	0.51	0.28	1.19	
0.11	0.46	0.35	3.23	0.39	0.28	2.54	0.45	0.34	3.10	0.52	0.41	3.80	0.49	0.38	3.47	
0.12	0.45	0.34	2.90	0.38	0.26	2.25	0.43	0.31	2.72	0.50	0.39	3.33	0.48	0.36	3.13	
0.14	0.44	0.30	2.20	0.36	0.23	1.67	0.41	0.28	2.01	0.49	0.35	2.56	0.46	0.33	2.39	
0.20	0.42	0.22	1.13	0.36	0.16	0.82	0.40	0.21	1.06	0.48	0.28	1.43	0.45	0.25	1.27	
0.23	0.41	0.18	0.78	0.35	0.12	0.53	0.39	0.16	0.71	0.46	0.24	1.03	0.43	0.21	0.91	
0.15	0.40	0.25	1.64	0.34	0.19	1.23	0.38	0.23	1.49	0.45	0.30	1.97	0.43	0.28	1.82	
0.22	= <|x|>	0.25			0.21			0.23			0.27			0.27		*MAE*
		1.15			**0.97**			**1.06**			**1.22**			**1.24**		**RMAE**

Table 9.40: Experiment 24.05.07 Deployment ZZ9

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.08	0.06	-0.02	-0.23	0.04	-0.04	-0.51	0.04	-0.04	-0.51	0.08	0.00	0.03	0.08	0.00	0.03	
0.22	0.07	-0.15	-0.68	0.06	-0.16	-0.72	0.03	-0.19	-0.85	0.08	-0.15	-0.66	0.29	0.07	0.32	
0.25	0.08	-0.17	-0.67	0.08	-0.17	-0.68	0.04	-0.22	-0.86	0.07	-0.18	-0.71	0.28	0.02	0.10	
0.28	0.09	-0.18	-0.67	0.10	-0.18	-0.65	0.03	-0.24	-0.88	0.08	-0.20	-0.73	0.28	0.00	0.02	
0.27	0.09	-0.18	-0.65	0.12	-0.15	-0.56	0.03	-0.24	-0.89	0.07	-0.20	-0.74	0.28	0.01	0.03	
0.28	0.09	-0.19	-0.67	0.12	-0.16	-0.56	0.03	-0.25	-0.88	0.07	-0.21	-0.74	0.27	-0.02	-0.06	
0.33	0.09	-0.23	-0.72	0.13	-0.19	-0.60	0.03	-0.30	-0.92	0.08	-0.25	-0.77	0.26	-0.07	-0.21	
0.41	0.09	-0.31	-0.77	0.13	-0.28	-0.69	0.02	-0.38	-0.94	0.07	-0.33	-0.82	0.25	-0.16	-0.39	
0.49	0.09	-0.40	-0.82	0.12	-0.37	-0.75	0.02	-0.47	-0.96	0.07	-0.42	-0.85	0.24	-0.26	-0.52	
0.56	0.09	-0.47	-0.84	0.12	-0.44	-0.78	0.02	-0.54	-0.96	0.07	-0.49	-0.88	0.23	-0.33	-0.59	
0.32	= <|x|>	*0.23*			*0.21*			*0.29*			*0.24*			*0.09*		*MAE*
		0.73			**0.68**			**0.91**			**0.77**			**0.30**		**RMAE**

Table 9.41: Experiment 03.08.07 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.59	0.33	-0.26	-0.44	0.34	-0.25	-0.43	0.42	-0.17	-0.29	0.33	-0.26	-0.44	0.21	-0.38	-0.65	
0.56	0.35	-0.21	-0.38	0.34	-0.22	-0.39	0.43	-0.13	-0.23	0.35	-0.21	-0.38	0.22	-0.34	-0.61	
0.55	0.36	-0.19	-0.35	0.35	-0.20	-0.36	0.44	-0.11	-0.20	0.37	-0.18	-0.33	0.24	-0.31	-0.56	
0.55	0.38	-0.16	-0.30	0.37	-0.17	-0.32	0.45	-0.10	-0.18	0.39	-0.16	-0.29	0.28	-0.27	-0.49	
0.53	0.40	-0.13	-0.25	0.39	-0.14	-0.26	0.45	-0.08	-0.15	0.40	-0.13	-0.25	0.31	-0.23	-0.42	
0.53	0.41	-0.12	-0.22	0.40	-0.12	-0.23	0.46	-0.07	-0.13	0.42	-0.11	-0.21	0.33	-0.19	-0.37	
0.54	0.43	-0.11	-0.21	0.42	-0.12	-0.23	0.47	-0.07	-0.12	0.44	-0.10	-0.19	0.37	-0.17	-0.32	
0.56	0.44	-0.12	-0.21	0.43	-0.13	-0.23	0.50	-0.06	-0.12	0.46	-0.10	-0.18	0.39	-0.17	-0.30	
0.58	0.47	-0.11	-0.19	0.45	-0.13	-0.22	0.53	-0.05	-0.09	0.49	-0.09	-0.15	0.41	-0.17	-0.29	
0.57	0.51	-0.06	-0.10	0.48	-0.09	-0.15	0.54	-0.03	-0.05	0.53	-0.04	-0.07	0.43	-0.14	-0.24	
0.57	0.53	-0.04	-0.07	0.52	-0.05	-0.10	0.51	-0.06	-0.10	0.52	-0.05	-0.09	0.46	-0.11	-0.19	
0.55	0.51	-0.03	-0.06	0.53	-0.02	-0.03	0.48	-0.07	-0.13	0.49	-0.06	-0.11	0.51	-0.04	-0.08	
0.54	0.48	-0.06	-0.11	0.51	-0.03	-0.05	0.45	-0.09	-0.17	0.45	-0.08	-0.16	0.53	-0.01	-0.01	
0.54	0.45	-0.09	-0.17	0.47	-0.07	-0.14	0.43	-0.11	-0.20	0.43	-0.11	-0.20	0.52	-0.02	-0.04	
0.55	= <|x|>	*0.12*			*0.12*			*0.09*			*0.12*			*0.18*		*MAE*
		0.22			**0.22**			**0.16**			**0.22**			**0.33**		**RMAE**

Table 9.42: Experiment 03.08.07 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.31	0.58	0.28	0.89	0.58	0.27	0.88	0.41	0.10	0.34	0.58	0.27	0.88	0.70	0.39	1.27	
0.46	0.54	0.08	0.18	0.55	0.09	0.20	0.40	-0.06	-0.13	0.52	0.06	0.14	0.65	0.19	0.41	
0.46	0.47	0.01	0.03	0.49	0.03	0.07	0.37	-0.09	-0.19	0.46	0.00	0.00	0.57	0.11	0.25	
0.62	0.47	-0.15	-0.24	0.44	-0.18	-0.28	0.35	-0.27	-0.43	0.54	-0.08	-0.13	0.61	-0.01	-0.01	
0.68	0.59	-0.09	-0.14	0.52	-0.16	-0.24	0.37	-0.31	-0.45	0.67	-0.01	-0.02	0.74	0.06	0.08	
0.75	0.64	-0.11	-0.15	0.61	-0.14	-0.18	0.39	-0.36	-0.48	0.61	-0.14	-0.19	0.69	-0.06	-0.08	
0.65	0.56	-0.08	-0.13	0.59	-0.06	-0.09	0.42	-0.23	-0.36	0.55	-0.10	-0.15	0.64	-0.01	-0.01	
0.37	0.55	0.18	0.49	0.54	0.18	0.48	0.43	0.06	0.16	0.54	0.17	0.48	0.55	0.18	0.49	
0.22	0.54	0.32	1.43	0.53	0.31	1.41	0.42	0.20	0.90	0.54	0.32	1.44	0.54	0.32	1.44	
0.07	0.55	0.48	6.89	0.54	0.47	6.66	0.43	0.36	5.15	0.56	0.49	7.00	0.54	0.47	6.75	
0.11	0.57	0.46	4.13	0.55	0.44	3.98	0.45	0.34	3.05	0.58	0.47	4.25	0.53	0.42	3.81	
0.15	0.59	0.44	2.93	0.58	0.43	2.88	0.46	0.31	2.09	0.56	0.41	2.74	0.52	0.37	2.46	
0.14	0.54	0.40	2.81	0.57	0.43	3.03	0.48	0.34	2.39	0.50	0.36	2.52	0.48	0.34	2.39	
0.13	0.48	0.35	2.71	0.52	0.39	3.02	0.52	0.39	2.96	0.46	0.33	2.50	0.43	0.30	2.27	
0.12	0.44	0.32	2.64	0.47	0.35	2.85	0.55	0.43	3.48	0.42	0.30	2.46	0.40	0.28	2.30	
0.11	0.42	0.30	2.65	0.43	0.32	2.80	0.54	0.43	3.72	0.41	0.30	2.59	0.41	0.30	2.59	
0.34	= <|x|>	*0.25*			*0.27*			*0.27*			*0.24*			*0.24*		*MAE*
		0.76			**0.79**			**0.80**			**0.71**			**0.71**		**RMAE**

Table 9.43: Experiment 03.08.07 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.13	0.53	0.41	3.14	0.53	0.40	3.11	0.54	0.42	3.21	0.54	0.41	3.17	0.51	0.38	2.93

0.14	0.55	0.41	2.88	0.55	0.41	2.85	0.57	0.43	3.00	0.56	0.41	2.91	0.52	0.38	2.67	
0.17	0.57	0.40	2.44	0.57	0.40	2.42	0.59	0.42	2.55	0.56	0.40	2.40	0.55	0.38	2.30	
0.18	0.55	0.38	2.17	0.57	0.40	2.28	0.56	0.38	2.17	0.53	0.36	2.04	0.54	0.37	2.11	
0.21	0.51	0.29	1.37	0.53	0.32	1.50	0.50	0.28	1.32	0.48	0.27	1.27	0.51	0.30	1.41	
0.25	0.46	0.21	0.82	0.48	0.23	0.89	0.45	0.20	0.79	0.44	0.19	0.73	0.48	0.22	0.88	
0.28	0.42	0.14	0.49	0.44	0.15	0.54	0.42	0.14	0.49	0.41	0.13	0.45	0.43	0.14	0.51	
0.32	0.41	0.09	0.27	0.42	0.10	0.30	0.41	0.09	0.28	0.41	0.09	0.27	0.41	0.09	0.28	
0.38	0.41	0.03	0.09	0.41	0.03	0.07	0.41	0.03	0.09	0.41	0.03	0.09	0.41	0.03	0.08	
0.43	0.41	-0.02	-0.04	0.41	-0.02	-0.04	0.41	-0.02	-0.04	0.41	-0.02	-0.05	0.41	-0.02	-0.05	
0.45	0.41	-0.04	-0.09	0.41	-0.04	-0.09	0.41	-0.04	-0.09	0.41	-0.04	-0.09	0.41	-0.04	-0.09	
0.48	0.41	-0.07	-0.14	0.41	-0.07	-0.14	0.41	-0.07	-0.14	0.40	-0.08	-0.16	0.40	-0.08	-0.16	
0.49	0.40	-0.09	-0.18	0.41	-0.09	-0.18	0.41	-0.08	-0.17	0.40	-0.10	-0.19	0.40	-0.10	-0.19	
0.30	= <|x|>	*0.20*			*0.20*			*0.20*			*0.19*			*0.19*		*MAE*
		0.66			**0.67**			**0.66**			**0.64**			**0.65**		**RMAE**

Table 9.44: Experiment 03.08.07 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.59	0.37	-0.22	-0.38	0.33	-0.26	-0.44	0.24	-0.35	-0.60	0.42	-0.17	-0.29	0.48	-0.11	-0.19	
0.50	0.38	-0.12	-0.24	0.31	-0.19	-0.37	0.23	-0.27	-0.55	0.49	-0.01	-0.02	0.48	-0.02	-0.04	
0.46	0.42	-0.04	-0.09	0.32	-0.14	-0.31	0.22	-0.24	-0.52	0.54	0.08	0.17	0.59	0.13	0.28	
0.52	0.44	-0.08	-0.16	0.33	-0.19	-0.37	0.21	-0.31	-0.60	0.53	0.01	0.01	0.64	0.12	0.22	
0.55	0.45	-0.10	-0.18	0.33	-0.22	-0.40	0.21	-0.35	-0.63	0.51	-0.05	-0.09	0.57	0.02	0.03	
0.60	0.45	-0.15	-0.25	0.36	-0.24	-0.40	0.22	-0.38	-0.63	0.52	-0.08	-0.13	0.56	-0.03	-0.06	
0.66	0.46	-0.20	-0.30	0.38	-0.28	-0.43	0.26	-0.40	-0.61	0.53	-0.13	-0.20	0.56	-0.10	-0.15	
0.66	0.48	-0.17	-0.26	0.39	-0.26	-0.40	0.29	-0.37	-0.56	0.55	-0.11	-0.16	0.58	-0.08	-0.12	
0.68	0.50	-0.18	-0.26	0.42	-0.26	-0.38	0.33	-0.35	-0.52	0.58	-0.10	-0.14	0.61	-0.07	-0.11	
0.71	0.54	-0.17	-0.24	0.45	-0.26	-0.37	0.36	-0.35	-0.49	0.61	-0.10	-0.14	0.62	-0.09	-0.13	
0.71	0.57	-0.13	-0.19	0.47	-0.24	-0.33	0.40	-0.31	-0.43	0.57	-0.14	-0.20	0.57	-0.14	-0.20	
0.69	0.59	-0.10	-0.14	0.51	-0.18	-0.27	0.43	-0.26	-0.37	0.51	-0.18	-0.26	0.51	-0.18	-0.26	
0.63	0.55	-0.08	-0.13	0.55	-0.09	-0.13	0.47	-0.17	-0.26	0.47	-0.17	-0.26	0.47	-0.17	-0.26	
0.62	0.49	-0.13	-0.21	0.58	-0.04	-0.07	0.50	-0.13	-0.20	0.44	-0.18	-0.29	0.45	-0.18	-0.28	
0.59	0.46	-0.13	-0.22	0.57	-0.02	-0.03	0.54	-0.05	-0.08	0.44	-0.15	-0.26	0.44	-0.15	-0.25	
0.55	0.44	-0.11	-0.21	0.51	-0.04	-0.08	0.58	0.03	0.06	0.44	-0.11	-0.20	0.45	-0.11	-0.19	
0.56	0.44	-0.13	-0.22	0.47	-0.09	-0.16	0.56	0.00	-0.01	0.44	-0.12	-0.22	0.45	-0.12	-0.21	
0.54	0.44	-0.10	-0.19	0.45	-0.09	-0.17	0.51	-0.03	-0.06	0.44	-0.10	-0.18	0.44	-0.10	-0.18	
0.54	0.44	-0.10	-0.18	0.44	-0.10	-0.19	0.47	-0.07	-0.13	0.44	-0.10	-0.19	0.44	-0.10	-0.19	
0.52	0.44	-0.08	-0.16	0.44	-0.09	-0.17	0.44	-0.08	-0.15	0.44	-0.09	-0.16	0.44	-0.09	-0.17	
0.52	0.44	-0.08	-0.15	0.44	-0.08	-0.15	0.44	-0.08	-0.16	0.44	-0.08	-0.15	0.44	-0.08	-0.15	
0.53	0.44	-0.08	-0.16	0.44	-0.08	-0.16	0.44	-0.09	-0.17	0.45	-0.08	-0.15	0.44	-0.08	-0.16	
0.54	0.44	-0.10	-0.18	0.44	-0.10	-0.18	0.44	-0.10	-0.18	0.46	-0.08	-0.15	0.46	-0.08	-0.15	
0.56	0.45	-0.11	-0.19	0.45	-0.11	-0.20	0.45	-0.11	-0.20	0.47	-0.09	-0.16	0.48	-0.08	-0.14	
0.56	0.46	-0.10	-0.18	0.45	-0.11	-0.20	0.44	-0.12	-0.21	0.51	-0.05	-0.09	0.52	-0.04	-0.06	
0.57	0.48	-0.10	-0.17	0.45	-0.13	-0.22	0.45	-0.13	-0.22	0.55	-0.02	-0.04	0.57	0.00	-0.01	
0.60	0.51	-0.10	-0.16	0.46	-0.14	-0.24	0.45	-0.15	-0.26	0.59	-0.01	-0.02	0.60	0.00	0.00	
0.63	0.55	-0.07	-0.12	0.47	-0.16	-0.25	0.46	-0.17	-0.27	0.62	-0.01	-0.01	0.64	0.01	0.02	
0.62	0.58	-0.04	-0.06	0.49	-0.13	-0.21	0.46	-0.16	-0.26	0.66	0.04	0.06	0.68	0.05	0.08	
0.66	0.62	-0.04	-0.06	0.53	-0.13	-0.20	0.47	-0.19	-0.29	0.69	0.03	0.04	0.69	0.03	0.05	
0.63	0.66	0.03	0.05	0.57	-0.06	-0.09	0.50	-0.13	-0.21	0.68	0.05	0.07	0.66	0.03	0.06	
0.60	0.69	0.09	0.15	0.60	0.00	0.01	0.54	-0.06	-0.10	0.63	0.04	0.06	0.62	0.02	0.03	
0.58	0.68	0.10	0.17	0.64	0.06	0.11	0.57	-0.01	-0.01	0.59	0.01	0.02	0.58	0.00	0.01	
0.56	0.63	0.07	0.12	0.68	0.12	0.21	0.60	0.04	0.07	0.58	0.02	0.03	0.58	0.02	0.03	
0.55	0.59	0.04	0.07	0.68	0.13	0.24	0.64	0.09	0.17	0.57	0.02	0.04	0.56	0.01	0.02	
0.56	0.58	0.01	0.03	0.65	0.09	0.16	0.68	0.12	0.21	0.55	-0.02	-0.03	0.53	-0.03	-0.06	
0.59	= <|x|>	*0.10*			*0.14*			*0.17*			*0.08*			*0.07*		*MAE*
		0.17			**0.23**			**0.30**			**0.13**			**0.13**		**RMAE**

Table 9.45: Experiment 03.08.07 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.27	0.07	-0.20	-0.75	0.06	-0.21	-0.79	0.10	-0.16	-0.61	0.07	-0.19	-0.73	0.10	-0.16	-0.62	
0.27	0.07	-0.20	-0.75	0.06	-0.20	-0.77	0.10	-0.17	-0.63	0.07	-0.20	-0.74	0.10	-0.16	-0.61	
0.20	0.06	-0.14	-0.69	0.07	-0.14	-0.67	0.10	-0.11	-0.52	0.06	-0.14	-0.70	0.11	-0.09	-0.46	
0.12	0.06	-0.06	-0.50	0.07	-0.05	-0.44	0.10	-0.03	-0.21	0.06	-0.06	-0.49	0.12	0.00	-0.02	
0.19	0.07	-0.12	-0.64	0.06	-0.13	-0.68	0.09	-0.10	-0.53	0.07	-0.12	-0.65	0.13	-0.06	-0.30	
0.17	0.08	-0.10	-0.56	0.05	-0.12	-0.69	0.09	-0.09	-0.50	0.06	-0.11	-0.64	0.15	-0.02	-0.14	
0.20	= <|x|>	*0.14*			*0.14*			*0.11*			*0.14*			*0.08*		*MAE*
		0.67			**0.70**			**0.53**			**0.68**			**0.41**		**RMAE**

Table 9.46: Experiment 03.08.07 Deployment HH

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.17	0.58	0.41	2.47	0.57	0.41	2.44	0.38	0.21	1.26	0.58	0.42	2.49	0.72	0.55	3.33
0.18	0.54	0.36	2.03	0.54	0.37	2.07	0.36	0.19	1.05	0.52	0.35	1.96	0.66	0.49	2.76
0.16	0.47	0.31	1.89	0.49	0.33	2.02	0.34	0.18	1.11	0.47	0.30	1.86	0.59	0.43	2.62
0.20	0.48	0.29	1.45	0.44	0.25	1.25	0.32	0.13	0.63	0.55	0.35	1.77	0.65	0.45	2.30

0.26	0.58	0.32	1.21	0.52	0.25	0.95	0.32	0.06	0.21	0.65	0.39	1.48	0.78	0.52	1.96	
0.19	=<|x|>	*0.34*			*0.32*			*0.15*			*0.36*			*0.49*		*MAE*
		1.74			**1.66**			**0.78**			**1.87**			**2.52**		**RMAE**

Table 9.47: Experiment 03.08.07 Deployment II

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.34	0.17	-0.17	-0.51	0.09	-0.25	-0.75	0.06	-0.27	-0.81	0.24	-0.10	-0.31	0.35	0.01	0.04	
0.32	0.15	-0.17	-0.54	0.08	-0.24	-0.74	0.08	-0.24	-0.75	0.22	-0.10	-0.30	0.33	0.01	0.03	
0.33	0.12	-0.21	-0.63	0.07	-0.25	-0.78	0.09	-0.24	-0.73	0.21	-0.11	-0.35	0.33	0.00	0.00	
0.31	0.11	-0.21	-0.66	0.06	-0.25	-0.79	0.10	-0.21	-0.69	0.20	-0.12	-0.37	0.34	0.03	0.10	
0.29	0.09	-0.20	-0.70	0.06	-0.23	-0.80	0.10	-0.19	-0.67	0.18	-0.11	-0.37	0.34	0.05	0.19	
0.31	0.07	-0.25	-0.78	0.05	-0.27	-0.85	0.10	-0.21	-0.68	0.18	-0.13	-0.41	0.36	0.05	0.16	
0.37	0.04	-0.32	-0.88	0.04	-0.33	-0.89	0.09	-0.27	-0.75	0.20	-0.17	-0.45	0.38	0.02	0.04	
0.42	0.04	-0.38	-0.91	0.03	-0.39	-0.93	0.09	-0.32	-0.78	0.24	-0.18	-0.43	0.40	-0.02	-0.05	
0.46	0.05	-0.40	-0.89	0.02	-0.44	-0.96	0.08	-0.37	-0.81	0.27	-0.19	-0.41	0.42	-0.04	-0.08	
0.35	=<|x|>	*0.26*			*0.29*			*0.26*			*0.13*			*0.03*	*0.08*	*MAE*
		0.74			**0.84**			**0.75**			**0.38**			**0.07**	**0.22**	**RMAE**

Table 9.48: Experiment 03.08.07 Deployment JJ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.49	0.53	0.04	0.09	0.54	0.05	0.10	0.55	0.06	0.13	0.53	0.04	0.08	0.49	0.01	0.01	
0.50	0.54	0.05	0.09	0.54	0.05	0.10	0.56	0.06	0.12	0.54	0.05	0.09	0.50	0.01	0.01	
0.50	0.56	0.07	0.14	0.56	0.06	0.12	0.58	0.08	0.17	0.58	0.08	0.16	0.52	0.03	0.06	
0.50	0.60	0.10	0.20	0.59	0.09	0.18	0.61	0.11	0.23	0.61	0.11	0.22	0.57	0.07	0.13	
0.50	0.62	0.11	0.22	0.62	0.11	0.23	0.62	0.11	0.22	0.60	0.10	0.20	0.60	0.10	0.19	
0.51	0.58	0.07	0.14	0.60	0.09	0.17	0.58	0.07	0.13	0.56	0.04	0.08	0.59	0.07	0.14	
0.53	0.54	0.01	0.02	0.56	0.03	0.06	0.53	0.01	0.01	0.51	-0.01	-0.02	0.54	0.01	0.03	
0.52	0.50	-0.02	-0.04	0.52	0.00	-0.01	0.51	-0.01	-0.02	0.49	-0.03	-0.06	0.50	-0.02	-0.04	
0.51	0.48	-0.03	-0.06	0.50	-0.01	-0.03	0.49	-0.02	-0.04	0.47	-0.04	-0.07	0.47	-0.03	-0.07	
0.52	0.47	-0.05	-0.09	0.48	-0.04	-0.08	0.47	-0.04	-0.09	0.46	-0.06	-0.11	0.46	-0.06	-0.11	
0.52	0.46	-0.06	-0.11	0.47	-0.05	-0.10	0.47	-0.05	-0.09	0.46	-0.06	-0.11	0.45	-0.07	-0.13	
0.51	0.46	-0.05	-0.10	0.46	-0.05	-0.09	0.47	-0.04	-0.08	0.46	-0.05	-0.10	0.46	-0.05	-0.11	
0.52	0.47	-0.05	-0.10	0.47	-0.05	-0.10	0.48	-0.04	-0.08	0.47	-0.05	-0.09	0.46	-0.06	-0.12	
0.52	0.47	-0.05	-0.10	0.47	-0.05	-0.10	0.48	-0.04	-0.08	0.48	-0.05	-0.09	0.46	-0.06	-0.12	
0.53	0.48	-0.05	-0.09	0.48	-0.05	-0.09	0.49	-0.04	-0.08	0.48	-0.05	-0.10	0.47	-0.06	-0.12	
0.52	0.48	-0.04	-0.08	0.49	-0.04	-0.08	0.49	-0.03	-0.06	0.48	-0.04	-0.08	0.47	-0.05	-0.10	
0.50	0.49	-0.01	-0.02	0.49	-0.01	-0.03	0.49	0.00	-0.01	0.49	-0.01	-0.02	0.47	-0.02	-0.05	
0.50	0.50	0.00	-0.01	0.49	-0.01	-0.01	0.50	0.00	0.00	0.50	0.00	0.00	0.48	-0.02	-0.03	
0.51	0.51	0.01	0.01	0.50	0.00	0.00	0.52	0.02	0.03	0.52	0.02	0.03	0.49	-0.01	-0.03	
0.50	0.54	0.03	0.07	0.53	0.02	0.05	0.54	0.04	0.08	0.55	0.05	0.09	0.52	0.02	0.03	
0.50	0.56	0.06	0.12	0.55	0.05	0.10	0.57	0.07	0.13	0.57	0.07	0.13	0.54	0.04	0.08	
0.48	0.58	0.10	0.21	0.57	0.09	0.19	0.59	0.11	0.22	0.60	0.12	0.25	0.57	0.09	0.19	
0.51	=<|x|>	*0.05*			*0.05*			*0.05*			*0.05*			*0.04*		*MAE*
		0.09			**0.09**			**0.09**			**0.10**			**0.09**		**RMAE**

Table 9.49: Experiment 03.08.07 Deployment KK

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.27	0.07	-0.20	-0.75	0.06	-0.21	-0.79	0.10	-0.16	-0.61	0.07	-0.19	-0.73	0.10	-0.16	-0.62	
0.27	0.07	-0.20	-0.75	0.06	-0.20	-0.77	0.10	-0.17	-0.63	0.07	-0.20	-0.74	0.10	-0.16	-0.61	
0.20	0.06	-0.14	-0.69	0.07	-0.14	-0.67	0.10	-0.11	-0.52	0.06	-0.14	-0.70	0.11	-0.09	-0.46	
0.12	0.06	-0.06	-0.50	0.07	-0.05	-0.44	0.10	-0.03	-0.21	0.06	-0.06	-0.49	0.12	0.00	-0.02	
0.19	0.07	-0.12	-0.64	0.06	-0.13	-0.68	0.09	-0.10	-0.53	0.07	-0.12	-0.65	0.13	-0.06	-0.30	
0.17	0.08	-0.10	-0.56	0.05	-0.12	-0.69	0.09	-0.09	-0.50	0.06	-0.11	-0.64	0.15	-0.02	-0.14	
0.20	=<|x|>	*0.14*			*0.14*			*0.11*			*0.14*			*0.08*		*MAE*
		0.67			**0.70**			**0.53**			**0.68**			**0.41**		**RMAE**

Table 9.50: Experiment 03.08.07 Deployment LL

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.17	0.58	0.41	2.47	0.57	0.41	2.44	0.38	0.21	1.26	0.58	0.42	2.49	0.72	0.55	3.33
0.18	0.54	0.36	2.02	0.54	0.37	2.07	0.36	0.19	1.05	0.52	0.35	1.96	0.66	0.49	2.75
0.24	0.47	0.23	0.97	0.49	0.25	1.06	0.34	0.10	0.44	0.47	0.23	0.95	0.59	0.35	1.46
0.29	0.48	0.19	0.64	0.44	0.15	0.51	0.32	0.03	0.09	0.55	0.25	0.86	0.65	0.36	1.21
0.35	0.58	0.23	0.65	0.52	0.16	0.46	0.32	-0.03	-0.09	0.65	0.30	0.86	0.78	0.43	1.22
0.40	0.63	0.22	0.55	0.59	0.19	0.47	0.33	-0.07	-0.17	0.61	0.20	0.51	0.71	0.31	0.76
0.40	0.57	0.17	0.43	0.58	0.19	0.48	0.34	-0.06	-0.14	0.57	0.18	0.44	0.60	0.20	0.51
0.47	0.56	0.09	0.20	0.55	0.08	0.17	0.35	-0.12	-0.25	0.56	0.10	0.20	0.58	0.11	0.24
0.49	0.56	0.07	0.13	0.55	0.05	0.11	0.38	-0.12	-0.24	0.58	0.08	0.17	0.59	0.10	0.20
0.48	0.58	0.10	0.21	0.55	0.08	0.16	0.39	-0.09	-0.19	0.60	0.12	0.26	0.60	0.12	0.26
0.50	0.61	0.11	0.23	0.58	0.09	0.17	0.42	-0.08	-0.16	0.62	0.13	0.26	0.58	0.09	0.18

0.47	0.62	0.15	0.32	0.61	0.14	0.31	0.44	-0.02	-0.05	0.59	0.12	0.26	0.57	0.10	0.21	
0.44	0.57	0.13	0.30	0.61	0.17	0.39	0.47	0.03	0.06	0.53	0.09	0.20	0.50	0.06	0.14	
0.41	0.51	0.10	0.23	0.55	0.14	0.33	0.50	0.09	0.22	0.48	0.06	0.16	0.46	0.05	0.12	
0.38	= <|x|>	*0.18*			*0.18*			*0.09*			*0.19*			*0.24*		*MAE*
		0.48			**0.47**			**0.23**			**0.50**			**0.63**		**RMAE**

Table 9.51: Experiment 03.08.07 Deployment MM

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.41	0.61	0.21	0.51	0.61	0.20	0.49	0.62	0.22	0.53	0.61	0.20	0.50	0.60	0.20	0.48	
0.42	0.60	0.18	0.43	0.61	0.20	0.47	0.60	0.18	0.44	0.57	0.16	0.38	0.60	0.18	0.43	
0.42	0.55	0.13	0.32	0.57	0.15	0.37	0.54	0.12	0.28	0.53	0.11	0.27	0.57	0.15	0.36	
0.42	0.50	0.08	0.20	0.53	0.11	0.25	0.49	0.07	0.16	0.48	0.06	0.14	0.52	0.10	0.23	
0.40	0.46	0.06	0.15	0.47	0.07	0.18	0.46	0.06	0.14	0.46	0.06	0.15	0.47	0.07	0.17	
0.39	0.45	0.07	0.17	0.46	0.07	0.18	0.45	0.06	0.17	0.46	0.07	0.18	0.46	0.08	0.20	
0.38	0.46	0.08	0.20	0.45	0.07	0.19	0.45	0.07	0.18	0.45	0.07	0.18	0.46	0.08	0.20	
0.37	0.45	0.08	0.22	0.46	0.09	0.24	0.45	0.08	0.22	0.45	0.08	0.22	0.45	0.08	0.22	
0.35	0.45	0.10	0.27	0.45	0.10	0.28	0.45	0.10	0.28	0.44	0.09	0.26	0.44	0.09	0.27	
0.35	0.43	0.08	0.23	0.44	0.09	0.25	0.44	0.09	0.25	0.43	0.08	0.21	0.43	0.07	0.21	
0.34	0.43	0.09	0.28	0.43	0.10	0.29	0.43	0.10	0.28	0.43	0.09	0.27	0.41	0.07	0.22	
0.32	0.42	0.11	0.33	0.43	0.11	0.34	0.44	0.12	0.38	0.42	0.10	0.32	0.41	0.09	0.28	
0.30	0.43	0.12	0.40	0.42	0.12	0.40	0.44	0.14	0.46	0.43	0.12	0.41	0.40	0.10	0.33	
0.30	0.44	0.14	0.45	0.44	0.13	0.44	0.45	0.15	0.49	0.45	0.14	0.48	0.42	0.11	0.37	
0.30	0.46	0.16	0.54	0.45	0.15	0.50	0.48	0.18	0.58	0.48	0.17	0.58	0.44	0.14	0.46	
0.30	0.50	0.21	0.70	0.48	0.19	0.63	0.51	0.22	0.73	0.52	0.23	0.77	0.48	0.18	0.62	
0.27	0.56	0.28	1.04	0.53	0.26	0.95	0.57	0.29	1.08	0.58	0.30	1.12	0.54	0.26	0.97	
0.25	0.59	0.34	1.35	0.58	0.33	1.30	0.60	0.35	1.37	0.61	0.35	1.40	0.59	0.33	1.31	
0.25	0.62	0.38	1.52	0.61	0.36	1.46	0.63	0.38	1.54	0.64	0.39	1.58	0.61	0.36	1.46	
0.25	0.66	0.42	1.70	0.65	0.40	1.64	0.67	0.42	1.72	0.68	0.44	1.77	0.65	0.40	1.64	
0.25	0.69	0.44	1.78	0.68	0.43	1.75	0.70	0.45	1.80	0.69	0.44	1.78	0.68	0.43	1.75	
0.22	0.68	0.46	2.04	0.69	0.47	2.08	0.68	0.45	2.02	0.66	0.44	1.96	0.68	0.46	2.04	
0.23	0.63	0.40	1.72	0.66	0.42	1.81	0.62	0.39	1.68	0.61	0.38	1.62	0.64	0.41	1.75	
0.33	= <|x|>	*0.20*			*0.20*			*0.20*			*0.20*			*0.19*		*MAE*
		0.62			**0.62**			**0.62**			**0.61**			**0.59**		**RMAE**

Table 9.52: Experiment 03.08.07 Deployment NN

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.23	0.14	-0.08	-0.37	0.13	-0.10	-0.44	0.09	-0.14	-0.60	0.14	-0.09	-0.40	0.07	-0.16	-0.70	
0.24	0.13	-0.11	-0.47	0.12	-0.12	-0.49	0.09	-0.14	-0.61	0.14	-0.10	-0.41	0.06	-0.18	-0.74	
0.25	0.12	-0.13	-0.51	0.12	-0.13	-0.53	0.09	-0.16	-0.63	0.14	-0.11	-0.46	0.05	-0.20	-0.79	
0.23	0.12	-0.11	-0.46	0.11	-0.12	-0.53	0.10	-0.13	-0.55	0.12	-0.11	-0.48	0.04	-0.18	-0.81	
0.23	0.13	-0.11	-0.46	0.11	-0.12	-0.54	0.10	-0.13	-0.56	0.11	-0.12	-0.51	0.04	-0.19	-0.83	
0.26	0.11	-0.15	-0.57	0.10	-0.16	-0.61	0.10	-0.16	-0.61	0.11	-0.16	-0.59	0.03	-0.23	-0.89	
0.32	0.11	-0.21	-0.66	0.10	-0.23	-0.71	0.09	-0.23	-0.71	0.09	-0.23	-0.71	0.03	-0.30	-0.92	
0.25	= <|x|>	*0.13*			*0.14*			*0.16*			*0.13*			*0.21*		*MAE*
		0.51			**0.56**			**0.62**			**0.52**			**0.82**		**RMAE**

Table 9.53: Experiment 03.08.07 Deployment OO

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	Sd1	err	%err	Sd2	err	%err	Sd3	err	%err	Sd4	err	%err	Sd5	err	%err
0.52	0.65	0.13	0.26	0.62	0.10	0.20	0.55	0.03	0.06	0.72	0.20	0.39	0.76	0.25	0.48
0.58	0.79	0.21	0.37	0.69	0.11	0.19	0.66	0.08	0.14	0.82	0.24	0.42	0.86	0.28	0.49
0.67	0.78	0.11	0.17	0.80	0.13	0.20	0.70	0.03	0.05	0.77	0.11	0.16	0.86	0.20	0.30
0.62	0.76	0.14	0.23	0.74	0.12	0.20	0.54	-0.08	-0.12	0.77	0.15	0.24	0.86	0.24	0.39
0.43	0.73	0.30	0.69	0.70	0.27	0.63	0.56	0.13	0.30	0.73	0.30	0.69	0.85	0.42	0.97
0.33	0.66	0.33	1.00	0.63	0.30	0.91	0.57	0.24	0.73	0.65	0.33	1.00	0.83	0.50	1.53
0.27	0.62	0.36	1.34	0.62	0.36	1.33	0.59	0.32	1.20	0.62	0.35	1.31	0.86	0.59	2.21
0.25	0.61	0.36	1.45	0.61	0.36	1.46	0.61	0.36	1.47	0.61	0.36	1.46	0.69	0.44	1.80
0.24	0.58	0.33	1.36	0.59	0.34	1.41	0.59	0.34	1.41	0.52	0.27	1.12	0.55	0.30	1.23
0.23	0.48	0.25	1.09	0.55	0.32	1.38	0.55	0.32	1.39	0.48	0.25	1.07	0.48	0.25	1.09
0.20	0.47	0.28	1.41	0.47	0.27	1.38	0.49	0.30	1.51	0.46	0.26	1.34	0.46	0.27	1.35
0.20	0.45	0.25	1.25	0.47	0.27	1.31	0.46	0.26	1.30	0.43	0.23	1.14	0.43	0.23	1.12
0.19	0.43	0.24	1.28	0.45	0.27	1.40	0.46	0.27	1.41	0.42	0.23	1.19	0.38	0.19	1.01
0.19	0.42	0.23	1.25	0.45	0.26	1.39	0.45	0.26	1.41	0.38	0.19	1.03	0.36	0.18	0.94
0.19	0.39	0.20	1.03	0.43	0.24	1.22	0.45	0.25	1.32	0.36	0.16	0.84	0.36	0.16	0.85
0.21	0.36	0.16	0.76	0.41	0.20	0.96	0.45	0.24	1.15	0.34	0.13	0.63	0.34	0.14	0.66
0.21	0.35	0.14	0.67	0.39	0.18	0.84	0.43	0.22	1.05	0.32	0.11	0.51	0.33	0.12	0.58
0.21	0.34	0.14	0.68	0.38	0.18	0.86	0.43	0.22	1.09	0.32	0.11	0.54	0.34	0.14	0.68
0.21	0.34	0.13	0.64	0.38	0.17	0.82	0.42	0.22	1.04	0.32	0.11	0.53	0.39	0.18	0.86
0.21	0.35	0.14	0.70	0.38	0.17	0.85	0.43	0.22	1.07	0.32	0.12	0.58	0.44	0.24	1.17
0.20	0.38	0.17	0.83	0.39	0.19	0.92	0.44	0.23	1.13	0.36	0.16	0.77	0.54	0.33	1.63
0.21	0.41	0.20	0.95	0.42	0.21	1.01	0.46	0.25	1.18	0.40	0.19	0.88	0.62	0.41	1.93
0.22	0.47	0.24	1.09	0.47	0.25	1.12	0.50	0.28	1.24	0.46	0.23	1.04	0.62	0.40	1.78
0.23	0.54	0.31	1.36	0.54	0.31	1.33	0.55	0.32	1.40	0.54	0.31	1.34	0.63	0.40	1.75
0.24	0.59	0.35	1.46	0.59	0.35	1.47	0.60	0.36	1.50	0.58	0.34	1.44	0.66	0.43	1.78

0.24	0.61	0.37	1.58	0.61	0.38	1.59	0.62	0.39	1.63	0.61	0.37	1.58	0.67	0.43	1.82	
0.27	0.65	0.38	1.41	0.65	0.38	1.41	0.66	0.40	1.47	0.65	0.38	1.40	0.64	0.37	1.38	
0.29	0.68	0.39	1.34	0.68	0.39	1.35	0.69	0.40	1.38	0.68	0.39	1.33	0.61	0.32	1.11	
0.31	0.66	0.35	1.12	0.67	0.36	1.15	0.68	0.37	1.19	0.66	0.34	1.11	0.59	0.28	0.90	
0.34	0.62	0.29	0.85	0.63	0.30	0.88	0.63	0.30	0.89	0.62	0.29	0.86	0.53	0.20	0.59	
0.34	0.59	0.25	0.75	0.59	0.25	0.75	0.59	0.26	0.76	0.59	0.25	0.75	0.48	0.15	0.44	
0.37	0.57	0.20	0.53	0.57	0.20	0.54	0.58	0.21	0.56	0.57	0.20	0.53	0.46	0.09	0.24	
0.29	= <|x|>	*0.25*			*0.26*			*0.25*			*0.24*			*0.29*		*MAE*
		0.85			**0.87**			**0.87**			**0.82**			**0.97**		**RMAE**

Table 9.54: Experiment 03.08.07 Deployment PP

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.33	0.38	0.05	0.16	0.37	0.04	0.13	0.39	0.06	0.18	0.40	0.07	0.22	0.35	0.02	0.06	
0.35	0.41	0.06	0.18	0.39	0.04	0.12	0.42	0.07	0.19	0.44	0.09	0.27	0.36	0.02	0.04	
0.36	0.45	0.09	0.26	0.41	0.05	0.14	0.47	0.11	0.29	0.50	0.13	0.37	0.41	0.04	0.12	
0.39	0.51	0.11	0.29	0.46	0.07	0.18	0.53	0.13	0.34	0.56	0.17	0.43	0.45	0.06	0.14	
0.43	0.58	0.15	0.34	0.52	0.09	0.20	0.60	0.17	0.40	0.65	0.22	0.52	0.49	0.06	0.15	
0.47	0.67	0.20	0.44	0.60	0.13	0.28	0.72	0.25	0.54	0.71	0.24	0.52	0.57	0.10	0.22	
0.50	0.70	0.19	0.38	0.69	0.18	0.36	0.73	0.23	0.45	0.62	0.12	0.23	0.62	0.12	0.23	
0.51	0.59	0.08	0.15	0.67	0.16	0.31	0.61	0.09	0.19	0.54	0.03	0.05	0.56	0.05	0.10	
0.52	0.52	-0.01	-0.01	0.56	0.04	0.07	0.55	0.02	0.05	0.48	-0.04	-0.07	0.47	-0.06	-0.11	
0.53	0.47	-0.06	-0.10	0.50	-0.03	-0.05	0.51	-0.01	-0.03	0.46	-0.07	-0.12	0.42	-0.11	-0.21	
0.51	0.47	-0.05	-0.09	0.47	-0.04	-0.08	0.50	-0.01	-0.02	0.46	-0.06	-0.11	0.38	-0.13	-0.25	
0.53	0.43	-0.09	-0.17	0.45	-0.07	-0.14	0.47	-0.05	-0.10	0.42	-0.11	-0.21	0.36	-0.17	-0.32	
0.52	0.41	-0.11	-0.21	0.42	-0.10	-0.19	0.45	-0.07	-0.14	0.41	-0.11	-0.21	0.35	-0.17	-0.33	
0.53	0.41	-0.12	-0.22	0.41	-0.12	-0.22	0.45	-0.08	-0.15	0.40	-0.13	-0.24	0.33	-0.19	-0.37	
0.49	0.39	-0.11	-0.21	0.40	-0.09	-0.19	0.44	-0.06	-0.12	0.38	-0.11	-0.22	0.31	-0.18	-0.36	
0.45	0.37	-0.08	-0.18	0.38	-0.08	-0.17	0.41	-0.04	-0.09	0.37	-0.08	-0.18	0.31	-0.15	-0.32	
0.43	0.37	-0.06	-0.14	0.37	-0.06	-0.13	0.39	-0.04	-0.09	0.37	-0.06	-0.15	0.30	-0.13	-0.31	
0.40	0.35	-0.05	-0.12	0.36	-0.04	-0.10	0.37	-0.03	-0.07	0.33	-0.07	-0.18	0.30	-0.10	-0.24	
0.40	0.33	-0.07	-0.18	0.34	-0.05	-0.13	0.34	-0.05	-0.13	0.30	-0.09	-0.23	0.30	-0.10	-0.24	
0.38	0.30	-0.09	-0.22	0.32	-0.06	-0.17	0.33	-0.05	-0.14	0.29	-0.10	-0.25	0.30	-0.09	-0.22	
0.37	0.28	-0.09	-0.25	0.29	-0.08	-0.21	0.33	-0.04	-0.12	0.27	-0.10	-0.27	0.29	-0.08	-0.22	
0.34	0.26	-0.08	-0.23	0.27	-0.07	-0.21	0.33	-0.01	-0.03	0.26	-0.08	-0.23	0.27	-0.07	-0.20	
0.44	= <|x|>	*0.09*			*0.08*			*0.08*			*0.10*			*0.10*		*MAE*
		0.20			**0.17**			**0.17**			**0.23**			**0.22**		**RMAE**

Table 9.55: Experiment 11.08.07 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.27	0.39	0.12	0.45	0.38	0.11	0.41	0.38	0.12	0.43	0.41	0.14	0.52	0.39	0.12	0.46	
0.28	0.42	0.14	0.51	0.39	0.12	0.43	0.41	0.13	0.48	0.44	0.17	0.61	0.42	0.14	0.51	
0.30	0.46	0.16	0.55	0.42	0.13	0.43	0.46	0.16	0.53	0.50	0.20	0.69	0.47	0.17	0.57	
0.32	0.52	0.20	0.61	0.47	0.15	0.47	0.51	0.18	0.57	0.58	0.26	0.80	0.52	0.20	0.62	
0.36	0.61	0.24	0.67	0.54	0.17	0.48	0.60	0.24	0.65	0.70	0.34	0.92	0.61	0.25	0.69	
0.40	0.73	0.33	0.82	0.64	0.24	0.59	0.74	0.33	0.83	0.77	0.37	0.92	0.72	0.32	0.80	
0.46	0.75	0.29	0.64	0.76	0.30	0.65	0.77	0.31	0.68	0.66	0.20	0.42	0.74	0.28	0.60	
0.48	0.62	0.15	0.31	0.72	0.24	0.51	0.63	0.15	0.32	0.58	0.10	0.21	0.62	0.14	0.29	
0.49	0.56	0.07	0.14	0.60	0.10	0.21	0.56	0.06	0.12	0.54	0.04	0.09	0.55	0.06	0.12	
0.48	0.53	0.05	0.10	0.56	0.07	0.15	0.53	0.05	0.10	0.53	0.04	0.09	0.52	0.04	0.09	
0.44	0.52	0.08	0.19	0.53	0.09	0.21	0.53	0.09	0.20	0.51	0.07	0.16	0.51	0.08	0.17	
0.42	0.50	0.08	0.19	0.52	0.10	0.23	0.51	0.09	0.21	0.49	0.07	0.17	0.49	0.06	0.15	
0.41	0.49	0.08	0.19	0.49	0.08	0.20	0.50	0.09	0.22	0.48	0.07	0.17	0.47	0.06	0.14	
0.42	0.48	0.06	0.13	0.49	0.07	0.15	0.49	0.07	0.17	0.47	0.05	0.12	0.46	0.03	0.08	
0.43	0.46	0.03	0.07	0.47	0.04	0.09	0.48	0.05	0.11	0.46	0.02	0.06	0.45	0.01	0.03	
0.44	0.45	0.01	0.02	0.46	0.02	0.04	0.46	0.01	0.03	0.43	-0.01	-0.03	0.42	-0.02	-0.04	
0.45	0.42	-0.02	-0.05	0.44	0.00	-0.01	0.44	0.00	-0.01	0.42	-0.03	-0.07	0.41	-0.04	-0.09	
0.45	0.41	-0.04	-0.10	0.42	-0.03	-0.07	0.42	-0.03	-0.06	0.39	-0.06	-0.12	0.38	-0.07	-0.16	
0.45	0.39	-0.07	-0.14	0.39	-0.06	-0.13	0.41	-0.04	-0.09	0.39	-0.06	-0.14	0.36	-0.09	-0.19	
0.45	0.39	-0.06	-0.13	0.39	-0.06	-0.14	0.41	-0.04	-0.08	0.39	-0.06	-0.13	0.35	-0.10	-0.22	
0.43	0.39	-0.04	-0.10	0.39	-0.05	-0.11	0.41	-0.02	-0.05	0.40	-0.03	-0.08	0.35	-0.08	-0.18	
0.42	0.39	-0.02	-0.05	0.39	-0.03	-0.06	0.41	0.00	-0.01	0.40	-0.02	-0.04	0.36	-0.06	-0.14	
0.40	0.40	0.00	0.00	0.39	-0.01	-0.01	0.41	0.01	0.03	0.40	0.01	0.01	0.37	-0.03	-0.08	
0.41	= <|x|>	*0.10*			*0.10*			*0.10*			*0.11*			*0.11*		*MAE*
		0.25			**0.24**			**0.24**			**0.26**			**0.26**		**RMAE**

Table 9.56: Experiment 11.08.07 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.27	0.37	0.10	0.38	0.35	0.09	0.32	0.35	0.08	0.31	0.38	0.12	0.44	0.38	0.11	0.41
0.27	0.39	0.12	0.46	0.37	0.10	0.38	0.38	0.11	0.41	0.42	0.15	0.57	0.40	0.14	0.51
0.27	0.43	0.17	0.62	0.40	0.14	0.51	0.41	0.14	0.54	0.47	0.20	0.76	0.45	0.18	0.66
0.27	0.48	0.21	0.78	0.44	0.16	0.61	0.46	0.19	0.69	0.55	0.27	1.01	0.50	0.23	0.84
0.28	0.57	0.28	1.00	0.49	0.21	0.75	0.54	0.25	0.90	0.66	0.38	1.34	0.59	0.30	1.07
0.30	0.70	0.40	1.31	0.59	0.29	0.94	0.67	0.36	1.20	0.79	0.49	1.61	0.72	0.41	1.36

0.36	0.79	0.43	1.21	0.73	0.38	1.06	0.79	0.43	1.21	0.68	0.33	0.92	0.79	0.43	1.21	
0.42	0.65	0.23	0.55	0.78	0.36	0.86	0.67	0.25	0.60	0.56	0.15	0.35	0.63	0.22	0.52	
0.47	0.55	0.08	0.17	0.61	0.14	0.30	0.55	0.08	0.17	0.52	0.05	0.11	0.56	0.09	0.19	
0.49	0.52	0.03	0.07	0.54	0.05	0.11	0.51	0.02	0.04	0.51	0.02	0.04	0.53	0.04	0.08	
0.45	0.51	0.06	0.12	0.52	0.07	0.14	0.50	0.05	0.10	0.50	0.05	0.11	0.52	0.07	0.15	
0.41	0.50	0.09	0.22	0.51	0.10	0.23	0.49	0.08	0.19	0.50	0.09	0.22	0.51	0.10	0.24	
0.40	0.50	0.10	0.25	0.50	0.10	0.26	0.49	0.09	0.23	0.49	0.10	0.24	0.50	0.11	0.27	
0.40	0.50	0.10	0.24	0.50	0.10	0.25	0.50	0.09	0.22	0.49	0.09	0.22	0.50	0.09	0.23	
0.42	0.49	0.07	0.18	0.49	0.08	0.19	0.49	0.07	0.17	0.48	0.06	0.15	0.48	0.07	0.16	
0.42	0.47	0.05	0.12	0.49	0.06	0.15	0.47	0.05	0.12	0.46	0.04	0.09	0.47	0.04	0.10	
0.42	0.46	0.04	0.10	0.47	0.06	0.13	0.46	0.04	0.10	0.45	0.03	0.06	0.45	0.03	0.07	
0.42	0.44	0.02	0.06	0.45	0.04	0.09	0.44	0.03	0.06	0.43	0.02	0.04	0.43	0.01	0.03	
0.41	0.43	0.01	0.03	0.44	0.02	0.06	0.43	0.02	0.05	0.42	0.01	0.02	0.42	0.00	0.01	
0.40	0.42	0.02	0.05	0.43	0.02	0.06	0.42	0.02	0.05	0.42	0.02	0.05	0.42	0.01	0.03	
0.39	0.42	0.03	0.07	0.42	0.03	0.08	0.42	0.03	0.08	0.42	0.03	0.07	0.41	0.02	0.06	
0.38	0.42	0.03	0.09	0.42	0.03	0.09	0.42	0.03	0.09	0.42	0.03	0.09	0.41	0.03	0.08	
0.37	0.42	0.05	0.13	0.42	0.05	0.13	0.41	0.05	0.12	0.42	0.05	0.13	0.42	0.05	0.13	
0.36	0.42	0.05	0.15	0.42	0.06	0.15	0.41	0.05	0.13	0.41	0.05	0.14	0.42	0.05	0.15	
0.34	0.41	0.07	0.21	0.41	0.07	0.22	0.41	0.07	0.20	0.41	0.07	0.21	0.41	0.07	0.21	
0.32	0.41	0.09	0.29	0.41	0.09	0.29	0.41	0.09	0.28	0.42	0.10	0.31	0.42	0.10	0.30	
0.31	0.42	0.11	0.35	0.41	0.10	0.32	0.41	0.10	0.31	0.43	0.12	0.39	0.42	0.11	0.36	
0.31	0.43	0.13	0.41	0.43	0.12	0.38	0.41	0.11	0.35	0.44	0.14	0.44	0.44	0.13	0.43	
0.32	0.45	0.12	0.38	0.44	0.11	0.35	0.43	0.11	0.33	0.45	0.12	0.37	0.46	0.13	0.40	
0.32	0.45	0.13	0.39	0.44	0.12	0.38	0.44	0.11	0.36	0.44	0.12	0.36	0.45	0.13	0.41	
0.33	0.43	0.10	0.32	0.45	0.12	0.37	0.43	0.10	0.32	0.41	0.09	0.27	0.44	0.11	0.34	
0.34	0.41	0.07	0.20	0.43	0.09	0.26	0.41	0.07	0.20	0.40	0.06	0.17	0.41	0.07	0.21	
0.34	0.39	0.05	0.14	0.41	0.06	0.19	0.39	0.05	0.15	0.38	0.04	0.11	0.39	0.05	0.15	
0.36	0.38	0.02	0.05	0.39	0.03	0.08	0.38	0.02	0.06	0.37	0.01	0.03	0.38	0.02	0.06	
0.35	0.37	0.02	0.05	0.38	0.02	0.07	0.37	0.01	0.04	0.36	0.01	0.02	0.37	0.01	0.03	
0.36	0.36	0.00	0.00	0.36	0.00	0.01	0.35	0.00	-0.01	0.35	-0.01	-0.02	0.35	0.00	-0.01	
0.37	0.35	-0.02	-0.06	0.36	-0.01	-0.03	0.35	-0.02	-0.06	0.35	-0.02	-0.06	0.35	-0.02	-0.05	
0.37	0.35	-0.02	-0.06	0.35	-0.02	-0.06	0.35	-0.03	-0.08	0.34	-0.03	-0.08	0.35	-0.02	-0.06	
0.38	0.34	-0.04	-0.12	0.34	-0.04	-0.10	0.34	-0.05	-0.12	0.33	-0.05	-0.12	0.34	-0.04	-0.11	
0.35	0.34	-0.01	-0.04	0.34	-0.01	-0.04	0.33	-0.02	-0.06	0.34	-0.01	-0.04	0.34	-0.01	-0.03	
0.36	= <|x|>	*0.09*			*0.09*			*0.09*			*0.09*			*0.10*		*MAE*
		0.26			**0.26**			**0.25**			**0.26**			**0.27**		**RMAE**

Table 9.57: Experiment 11.08.07 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.18	0.32	0.14	0.75	0.30	0.12	0.69	0.30	0.12	0.65	0.33	0.15	0.83	0.33	0.15	0.86	
0.17	0.33	0.16	0.96	0.32	0.15	0.85	0.31	0.14	0.82	0.35	0.18	1.06	0.35	0.18	1.05	
0.17	0.36	0.19	1.15	0.34	0.17	1.03	0.34	0.17	1.04	0.38	0.22	1.32	0.38	0.21	1.30	
0.17	0.39	0.22	1.34	0.36	0.19	1.17	0.36	0.20	1.18	0.42	0.26	1.55	0.41	0.25	1.48	
0.17	0.43	0.26	1.59	0.38	0.22	1.33	0.39	0.23	1.39	0.48	0.32	1.93	0.46	0.29	1.78	
0.16	0.50	0.33	2.05	0.43	0.27	1.67	0.46	0.30	1.82	0.59	0.43	2.64	0.54	0.38	2.34	
0.17	0.61	0.44	2.49	0.50	0.33	1.87	0.55	0.37	2.14	0.74	0.57	3.25	0.67	0.50	2.86	
0.17	0.75	0.59	3.56	0.62	0.46	2.76	0.69	0.53	3.19	0.73	0.57	3.43	0.78	0.62	3.73	
0.18	0.71	0.54	3.03	0.76	0.58	3.26	0.75	0.57	3.23	0.58	0.40	2.27	0.66	0.48	2.73	
0.20	0.57	0.37	1.84	0.71	0.51	2.54	0.61	0.41	2.06	0.51	0.31	1.57	0.55	0.35	1.75	
0.21	0.51	0.30	1.41	0.56	0.35	1.64	0.52	0.31	1.46	0.50	0.28	1.33	0.51	0.30	1.40	
0.27	0.49	0.22	0.83	0.51	0.24	0.90	0.49	0.22	0.82	0.48	0.21	0.80	0.50	0.23	0.85	
0.34	0.49	0.15	0.45	0.49	0.16	0.47	0.48	0.14	0.42	0.48	0.14	0.43	0.49	0.16	0.47	
0.42	0.48	0.07	0.16	0.49	0.07	0.16	0.47	0.06	0.13	0.49	0.07	0.16	0.50	0.08	0.18	
0.46	0.48	0.02	0.05	0.48	0.03	0.06	0.47	0.01	0.02	0.48	0.02	0.04	0.49	0.04	0.08	
0.46	0.48	0.01	0.02	0.48	0.01	0.02	0.46	0.00	-0.01	0.47	0.00	0.01	0.49	0.02	0.04	
0.45	0.47	0.02	0.04	0.48	0.03	0.06	0.46	0.01	0.02	0.46	0.01	0.02	0.47	0.02	0.05	
0.42	0.46	0.03	0.08	0.47	0.05	0.11	0.45	0.03	0.07	0.45	0.02	0.05	0.46	0.04	0.09	
0.43	0.44	0.01	0.03	0.45	0.03	0.06	0.43	0.01	0.01	0.43	0.00	0.00	0.44	0.01	0.03	
0.42	0.43	0.01	0.03	0.44	0.02	0.06	0.43	0.01	0.03	0.42	0.01	0.02	0.43	0.02	0.04	
0.40	0.42	0.02	0.06	0.43	0.03	0.07	0.42	0.01	0.04	0.42	0.02	0.04	0.43	0.03	0.06	
0.39	0.42	0.03	0.08	0.42	0.04	0.09	0.41	0.02	0.06	0.41	0.02	0.06	0.42	0.04	0.09	
0.37	0.41	0.04	0.11	0.42	0.05	0.13	0.41	0.04	0.11	0.41	0.04	0.12	0.41	0.05	0.13	
0.35	0.41	0.06	0.16	0.41	0.06	0.17	0.40	0.05	0.13	0.41	0.05	0.15	0.42	0.06	0.18	
0.33	0.40	0.08	0.23	0.41	0.08	0.24	0.39	0.06	0.20	0.40	0.07	0.22	0.41	0.08	0.26	
0.30	0.40	0.10	0.33	0.41	0.10	0.35	0.39	0.09	0.30	0.40	0.10	0.32	0.41	0.11	0.35	
0.29	0.40	0.11	0.37	0.40	0.11	0.37	0.38	0.09	0.32	0.40	0.10	0.36	0.41	0.12	0.40	
0.29	0.39	0.10	0.34	0.39	0.10	0.34	0.38	0.08	0.29	0.40	0.10	0.35	0.41	0.12	0.39	
0.31	0.40	0.09	0.28	0.40	0.08	0.27	0.38	0.07	0.23	0.41	0.10	0.30	0.42	0.11	0.34	
0.30	0.41	0.10	0.34	0.40	0.10	0.31	0.38	0.08	0.26	0.41	0.11	0.36	0.43	0.12	0.40	
0.31	0.42	0.11	0.37	0.41	0.11	0.34	0.39	0.09	0.28	0.42	0.12	0.38	0.44	0.13	0.44	
0.30	0.42	0.13	0.42	0.42	0.12	0.40	0.39	0.10	0.33	0.41	0.12	0.39	0.43	0.13	0.44	
0.30	0.41	0.11	0.39	0.42	0.13	0.43	0.40	0.11	0.36	0.40	0.10	0.34	0.41	0.12	0.39	
0.31	0.39	0.09	0.28	0.41	0.10	0.34	0.40	0.09	0.28	0.38	0.07	0.24	0.39	0.08	0.27	
0.29	0.38	0.09	0.32	0.39	0.11	0.37	0.38	0.09	0.31	0.37	0.08	0.27	0.38	0.09	0.32	
0.28	0.36	0.09	0.31	0.37	0.10	0.34	0.37	0.09	0.32	0.36	0.08	0.28	0.36	0.08	0.30	
0.26	0.36	0.10	0.38	0.36	0.11	0.42	0.35	0.09	0.37	0.35	0.09	0.34	0.35	0.10	0.38	
0.25	0.35	0.10	0.40	0.35	0.10	0.42	0.34	0.09	0.38	0.35	0.10	0.39	0.35	0.10	0.40	
0.26	0.34	0.08	0.31	0.35	0.09	0.33	0.33	0.08	0.29	0.34	0.08	0.30	0.34	0.08	0.32	
0.26	0.33	0.07	0.28	0.34	0.08	0.30	0.33	0.07	0.27	0.33	0.07	0.26	0.34	0.08	0.30	
0.29	= <|x|>	*0.14*			*0.14*			*0.13*			*0.14*			*0.15*		*MAE*

		0.49			**0.49**			**0.45**			**0.49**			**0.52**		**RMAE**

Table 9.58: Experiment 11.08.07 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.11	0.29	0.18	1.61	0.28	0.17	1.52	0.27	0.16	1.42	0.30	0.19	1.72	0.31	0.20	1.78	
0.11	0.30	0.19	1.75	0.29	0.18	1.62	0.28	0.17	1.56	0.32	0.21	1.92	0.32	0.21	1.95	
0.11	0.32	0.21	1.93	0.30	0.19	1.77	0.30	0.19	1.71	0.34	0.23	2.09	0.34	0.23	2.12	
0.11	0.34	0.23	2.16	0.32	0.21	1.94	0.31	0.21	1.91	0.38	0.27	2.49	0.37	0.26	2.40	
0.10	0.37	0.27	2.55	0.34	0.23	2.22	0.34	0.24	2.26	0.41	0.31	2.97	0.40	0.29	2.81	
0.11	0.42	0.31	2.90	0.38	0.27	2.46	0.38	0.27	2.50	0.49	0.38	3.50	0.46	0.35	3.23	
0.11	0.49	0.38	3.43	0.42	0.31	2.81	0.44	0.33	2.99	0.61	0.50	4.50	0.54	0.43	3.89	
0.12	0.60	0.49	4.16	0.48	0.36	3.11	0.53	0.42	3.55	0.74	0.62	5.30	0.68	0.56	4.79	
0.12	0.74	0.62	5.40	0.60	0.49	4.21	0.67	0.55	4.78	0.70	0.58	5.05	0.77	0.65	5.63	
0.12	0.70	0.58	4.80	0.74	0.62	5.12	0.73	0.61	5.07	0.56	0.44	3.60	0.64	0.52	4.30	
0.12	0.56	0.43	3.47	0.70	0.58	4.66	0.60	0.47	3.82	0.51	0.38	3.09	0.54	0.41	3.32	
0.13	0.50	0.37	2.77	0.56	0.42	3.18	0.50	0.37	2.75	0.48	0.35	2.61	0.50	0.37	2.74	
0.16	0.48	0.32	1.97	0.50	0.34	2.10	0.47	0.31	1.89	0.47	0.30	1.88	0.48	0.32	1.99	
0.18	0.47	0.30	1.69	0.49	0.31	1.77	0.46	0.28	1.60	0.47	0.29	1.67	0.48	0.31	1.75	
0.21	0.46	0.26	1.26	0.47	0.26	1.28	0.45	0.24	1.17	0.46	0.25	1.24	0.48	0.27	1.33	
0.24	0.46	0.22	0.91	0.46	0.22	0.90	0.44	0.20	0.83	0.46	0.22	0.91	0.47	0.23	0.95	
0.28	0.46	0.19	0.66	0.46	0.18	0.66	0.45	0.17	0.60	0.45	0.17	0.62	0.48	0.20	0.71	
0.36	0.45	0.10	0.28	0.46	0.11	0.31	0.44	0.09	0.24	0.45	0.09	0.26	0.46	0.11	0.31	
0.44	0.44	0.00	0.00	0.45	0.01	0.02	0.43	-0.01	-0.03	0.43	-0.02	-0.04	0.44	0.00	0.00	
0.48	0.43	-0.04	-0.09	0.44	-0.03	-0.07	0.43	-0.05	-0.10	0.42	-0.05	-0.11	0.44	-0.04	-0.08	
0.49	0.42	-0.07	-0.14	0.43	-0.05	-0.11	0.41	-0.07	-0.15	0.41	-0.07	-0.15	0.42	-0.06	-0.13	
0.45	0.41	-0.04	-0.09	0.42	-0.03	-0.08	0.41	-0.05	-0.10	0.40	-0.05	-0.10	0.42	-0.03	-0.07	
0.40	0.41	0.00	0.01	0.41	0.01	0.03	0.40	-0.01	-0.02	0.40	0.00	0.00	0.41	0.01	0.03	
0.38	0.40	0.02	0.06	0.41	0.03	0.07	0.39	0.01	0.03	0.40	0.02	0.04	0.41	0.03	0.07	
0.37	0.39	0.02	0.06	0.40	0.03	0.08	0.38	0.01	0.04	0.39	0.02	0.06	0.41	0.04	0.10	
0.36	0.39	0.03	0.08	0.39	0.03	0.08	0.38	0.02	0.04	0.38	0.02	0.06	0.40	0.04	0.10	
0.37	0.38	0.01	0.04	0.39	0.02	0.05	0.37	0.00	0.00	0.38	0.01	0.03	0.40	0.02	0.06	
0.38	0.38	0.00	0.00	0.38	0.00	0.01	0.37	-0.02	-0.04	0.38	0.00	-0.01	0.39	0.01	0.03	
0.40	0.38	-0.02	-0.05	0.38	-0.02	-0.04	0.36	-0.03	-0.09	0.38	-0.02	-0.05	0.39	0.00	-0.01	
0.38	0.38	0.00	0.01	0.38	0.00	-0.01	0.36	-0.02	-0.05	0.38	0.01	0.01	0.40	0.02	0.07	
0.36	0.38	0.02	0.05	0.38	0.02	0.05	0.36	-0.01	-0.02	0.39	0.02	0.07	0.41	0.05	0.13	
0.34	0.39	0.05	0.15	0.38	0.04	0.12	0.35	0.01	0.04	0.40	0.06	0.17	0.42	0.08	0.22	
0.32	0.40	0.08	0.23	0.39	0.07	0.21	0.36	0.04	0.12	0.40	0.08	0.24	0.42	0.10	0.30	
0.31	0.40	0.08	0.27	0.39	0.08	0.26	0.37	0.06	0.18	0.39	0.07	0.24	0.40	0.09	0.30	
0.29	0.39	0.09	0.33	0.39	0.10	0.35	0.37	0.08	0.26	0.37	0.08	0.28	0.39	0.09	0.32	
0.27	0.37	0.10	0.35	0.39	0.11	0.41	0.36	0.09	0.32	0.36	0.08	0.30	0.37	0.09	0.34	
0.26	0.36	0.10	0.36	0.37	0.11	0.41	0.36	0.10	0.37	0.35	0.08	0.32	0.36	0.09	0.36	
0.25	0.35	0.09	0.37	0.36	0.10	0.41	0.35	0.09	0.37	0.34	0.09	0.35	0.35	0.10	0.38	
0.25	0.34	0.09	0.37	0.35	0.10	0.40	0.34	0.09	0.36	0.33	0.08	0.34	0.34	0.09	0.38	
0.23	0.33	0.10	0.44	0.34	0.11	0.48	0.33	0.10	0.44	0.32	0.10	0.42	0.34	0.11	0.47	
0.26	$=\langle \lvert x \rvert \rangle$	*0.17*			*0.16*			*0.16*			*0.17*			*0.18*		*MAE*
		0.63			**0.62**			**0.59**			**0.65**			**0.67**		**RMAE**

Table 9.59: Experiment 11.08.07 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.14	0.10	-0.04	-0.29	0.07	-0.06	-0.45	0.04	-0.09	-0.67	0.09	-0.05	-0.34	0.32	0.18	1.32	
0.11	0.11	-0.01	-0.06	0.10	-0.02	-0.16	0.04	-0.07	-0.65	0.10	-0.02	-0.13	0.32	0.20	1.76	
0.11	0.11	0.01	0.05	0.14	0.03	0.27	0.04	-0.06	-0.60	0.10	0.00	-0.04	0.30	0.19	1.79	
0.09	0.12	0.03	0.27	0.15	0.06	0.66	0.04	-0.05	-0.57	0.11	0.02	0.17	0.30	0.21	2.23	
0.10	0.13	0.03	0.35	0.16	0.06	0.62	0.04	-0.06	-0.62	0.11	0.01	0.16	0.30	0.20	2.11	
0.09	0.13	0.04	0.40	0.16	0.07	0.73	0.04	-0.06	-0.61	0.11	0.02	0.17	0.29	0.19	2.11	
0.11	0.13	0.03	0.25	0.17	0.06	0.55	0.03	-0.08	-0.76	0.11	0.01	0.05	0.28	0.17	1.58	
0.10	0.13	0.03	0.27	0.17	0.06	0.61	0.03	-0.08	-0.76	0.12	0.01	0.13	0.27	0.17	1.59	
0.10	0.13	0.04	0.36	0.17	0.07	0.70	0.04	-0.06	-0.63	0.12	0.03	0.27	0.26	0.16	1.67	
0.08	0.14	0.06	0.68	0.17	0.08	1.00	0.04	-0.04	-0.47	0.12	0.04	0.49	0.24	0.15	1.87	
0.04	0.14	0.10	2.85	0.17	0.13	3.71	0.07	0.04	1.05	0.13	0.09	2.53	0.23	0.19	5.37	
0.03	0.14	0.11	3.15	0.16	0.13	3.78	0.10	0.07	1.92	0.12	0.09	2.60	0.23	0.19	5.66	
0.04	0.14	0.10	2.86	0.16	0.13	3.67	0.11	0.07	2.00	0.13	0.09	2.59	0.24	0.21	5.97	
0.05	0.14	0.08	1.62	0.16	0.10	1.99	0.11	0.06	1.13	0.13	0.08	1.46	0.25	0.20	3.82	
0.08	0.13	0.06	0.75	0.16	0.08	1.03	0.11	0.04	0.47	0.13	0.05	0.66	0.25	0.17	2.22	
0.10	0.13	0.04	0.41	0.15	0.05	0.56	0.12	0.02	0.26	0.12	0.02	0.25	0.25	0.15	1.61	
0.09	0.13	0.04	0.40	0.15	0.06	0.60	0.13	0.03	0.38	0.12	0.03	0.29	0.25	0.16	1.76	
0.09	0.13	0.04	0.46	0.15	0.06	0.68	0.13	0.04	0.47	0.12	0.03	0.35	0.26	0.17	2.00	
0.09	0.12	0.03	0.33	0.14	0.05	0.51	0.13	0.04	0.39	0.11	0.02	0.23	0.26	0.16	1.74	
0.13	0.12	-0.01	-0.07	0.13	0.01	0.04	0.13	0.00	-0.01	0.11	-0.02	-0.16	0.26	0.13	1.02	
0.09	$=\langle \lvert x \rvert \rangle$	*0.05*			*0.07*			*0.05*			*0.04*			*0.18*		*MAE*
		0.51			**0.78**			**0.60**			**0.41**			**2.03**		**RMAE**

Table 9.60: Experiment 11.08.07 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.18	0.49	0.31	1.76	0.51	0.33	1.86	0.41	0.23	1.29	0.48	0.31	1.72	0.55	0.37	2.11	
0.24	0.49	0.25	1.07	0.49	0.26	1.09	0.38	0.15	0.64	0.47	0.24	1.01	0.54	0.31	1.32	
0.27	0.47	0.20	0.71	0.48	0.20	0.75	0.38	0.11	0.40	0.46	0.19	0.68	0.53	0.25	0.93	
0.28	0.46	0.17	0.61	0.47	0.19	0.65	0.37	0.08	0.29	0.45	0.17	0.58	0.51	0.23	0.81	
0.31	0.45	0.13	0.42	0.46	0.15	0.46	0.35	0.04	0.13	0.43	0.12	0.37	0.49	0.18	0.57	
0.32	0.42	0.11	0.34	0.44	0.12	0.40	0.34	0.02	0.08	0.41	0.09	0.29	0.47	0.15	0.49	
0.31	0.39	0.08	0.25	0.41	0.10	0.32	0.33	0.02	0.05	0.37	0.05	0.17	0.44	0.12	0.40	
0.31	0.36	0.05	0.16	0.38	0.07	0.23	0.31	0.00	0.01	0.33	0.02	0.07	0.42	0.11	0.35	
0.27	0.32	0.05	0.19	0.34	0.07	0.28	0.29	0.03	0.09	0.30	0.03	0.13	0.42	0.15	0.56	
0.25	0.30	0.05	0.20	0.31	0.06	0.23	0.26	0.01	0.03	0.30	0.05	0.20	0.45	0.19	0.77	
0.22	0.31	0.09	0.42	0.32	0.10	0.44	0.24	0.02	0.09	0.30	0.07	0.33	0.46	0.24	1.07	
0.18	0.32	0.14	0.76	0.34	0.15	0.84	0.25	0.07	0.36	0.31	0.12	0.66	0.46	0.27	1.48	
0.17	0.37	0.21	1.23	0.37	0.21	1.23	0.29	0.12	0.74	0.35	0.19	1.12	0.45	0.29	1.71	
0.12	0.35	0.23	1.84	0.37	0.25	2.02	0.31	0.19	1.53	0.31	0.18	1.50	0.45	0.33	2.65	
0.25	$= \langle \lvert x \rvert \rangle$	*0.15*			*0.16*			*0.08*			*0.13*			*0.23*		*MAE*
		0.60			**0.66**			**0.31**			**0.53**			**0.93**		**RMAE**

Table 9.61: Experiment 11.08.07 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.10	0.26	0.15	1.47	0.25	0.15	1.43	0.19	0.09	0.84	0.26	0.15	1.46	0.33	0.22	2.15	
0.11	0.24	0.13	1.16	0.24	0.13	1.15	0.19	0.08	0.74	0.25	0.14	1.26	0.29	0.18	1.67	
0.10	0.23	0.13	1.36	0.21	0.12	1.17	0.20	0.10	1.00	0.28	0.18	1.80	0.27	0.17	1.72	
0.09	0.26	0.17	1.91	0.21	0.12	1.36	0.20	0.11	1.24	0.32	0.23	2.58	0.28	0.19	2.05	
0.06	0.30	0.24	3.92	0.24	0.18	2.94	0.21	0.15	2.42	0.37	0.30	4.97	0.27	0.21	3.48	
0.02	0.31	0.28	11.59	0.26	0.23	9.45	0.20	0.18	7.34	0.35	0.33	13.48	0.33	0.30	12.42	
0.03	0.31	0.29	11.52	0.26	0.24	9.48	0.20	0.17	6.89	0.33	0.31	12.26	0.38	0.36	14.26	
0.05	0.30	0.25	5.05	0.26	0.21	4.33	0.20	0.15	2.97	0.31	0.26	5.33	0.29	0.24	4.80	
0.07	0.29	0.22	3.05	0.26	0.19	2.66	0.19	0.12	1.73	0.30	0.23	3.19	0.24	0.17	2.43	
0.07	$= \langle \lvert x \rvert \rangle$	*0.21*			*0.17*			*0.13*			*0.24*			*0.23*		*MAE*
		2.94			**2.47**			**1.81**			**3.36**			**3.22**		**RMAE**

Table 9.62: Experiment 11.08.07 Deployment HH

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.11	0.05	-0.06	-0.57	0.07	-0.04	-0.33	0.23	0.12	1.12	0.04	-0.06	-0.58	0.01	-0.10	-0.91	
0.27	0.05	-0.22	-0.82	0.07	-0.21	-0.76	0.22	-0.06	-0.21	0.05	-0.22	-0.81	0.02	-0.25	-0.93	
0.28	0.06	-0.22	-0.78	0.07	-0.20	-0.74	0.22	-0.06	-0.21	0.06	-0.22	-0.79	0.02	-0.26	-0.94	
0.35	0.06	-0.29	-0.83	0.08	-0.26	-0.76	0.22	-0.12	-0.36	0.07	-0.28	-0.81	0.01	-0.34	-0.97	
0.37	0.07	-0.30	-0.82	0.09	-0.29	-0.77	0.22	-0.16	-0.42	0.07	-0.30	-0.82	0.02	-0.35	-0.94	
0.38	0.08	-0.30	-0.80	0.09	-0.29	-0.76	0.22	-0.16	-0.41	0.08	-0.30	-0.80	0.02	-0.36	-0.95	
0.34	0.08	-0.26	-0.75	0.09	-0.25	-0.73	0.23	-0.11	-0.33	0.08	-0.26	-0.76	0.01	-0.34	-0.98	
0.33	0.09	-0.23	-0.72	0.09	-0.24	-0.72	0.23	-0.09	-0.29	0.09	-0.24	-0.74	0.02	-0.31	-0.95	
0.30	0.09	-0.21	-0.69	0.10	-0.20	-0.68	0.23	-0.07	-0.24	0.10	-0.21	-0.68	0.02	-0.28	-0.94	
0.27	0.10	-0.17	-0.63	0.11	-0.17	-0.61	0.23	-0.05	-0.17	0.10	-0.17	-0.62	0.00	-0.27	-0.98	
0.25	0.11	-0.14	-0.56	0.11	-0.14	-0.57	0.22	-0.03	-0.13	0.11	-0.14	-0.56	0.01	-0.24	-0.96	
0.29	$= \langle \lvert x \rvert \rangle$	*0.22*			*0.21*			*0.09*			*0.22*			*0.28*		*MAE*
		0.74			**0.70**			**0.32**			**0.74**			**0.95**		**RMAE**

Table 9.63: Experiment 11.08.07 Deployment II

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.21	0.07	-0.14	-0.67	0.06	-0.15	-0.72	0.07	-0.15	-0.69	0.06	-0.15	-0.72	0.09	-0.12	-0.57	
0.18	0.08	-0.10	-0.54	0.07	-0.10	-0.59	0.06	-0.12	-0.68	0.07	-0.11	-0.62	0.10	-0.08	-0.44	
0.14	0.10	-0.04	-0.31	0.08	-0.06	-0.40	0.04	-0.10	-0.68	0.07	-0.07	-0.48	0.10	-0.04	-0.27	
0.10	0.10	0.00	0.03	0.08	-0.02	-0.17	0.04	-0.06	-0.61	0.08	-0.02	-0.20	0.10	0.00	0.03	
0.07	0.11	0.04	0.63	0.09	0.02	0.31	0.04	-0.03	-0.40	0.09	0.02	0.23	0.11	0.04	0.50	
0.07	0.12	0.05	0.83	0.10	0.04	0.55	0.05	-0.02	-0.25	0.09	0.03	0.44	0.11	0.05	0.72	
0.08	0.13	0.04	0.53	0.11	0.02	0.25	0.05	-0.03	-0.35	0.10	0.01	0.17	0.11	0.03	0.34	
0.08	0.12	0.04	0.52	0.11	0.03	0.36	0.07	-0.01	-0.09	0.11	0.03	0.35	0.11	0.03	0.43	
0.08	0.11	0.03	0.36	0.11	0.03	0.35	0.08	0.00	0.06	0.11	0.03	0.38	0.11	0.03	0.35	
0.07	0.11	0.04	0.49	0.11	0.03	0.43	0.10	0.02	0.31	0.11	0.04	0.51	0.10	0.03	0.39	
0.07	0.11	0.03	0.47	0.10	0.03	0.35	0.10	0.03	0.39	0.11	0.04	0.52	0.10	0.02	0.32	
0.11	$= \langle \lvert x \rvert \rangle$	*0.05*			*0.05*			*0.05*			*0.05*			*0.04*		*MAE*
		0.49			**0.45**			**0.49**			**0.47**			**0.40**		**RMAE**

Table 9.64: Experiment 11.08.07 Deployment JJ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err

0.07	0.16	0.08	1.13	0.07	-0.01	-0.09	0.09	0.02	0.28	0.24	0.17	2.32	0.20	0.13	1.76	
0.08	0.15	0.07	0.90	0.06	-0.02	-0.30	0.09	0.01	0.09	0.24	0.16	2.04	0.21	0.13	1.65	
0.06	0.15	0.08	1.32	0.05	-0.01	-0.14	0.08	0.01	0.24	0.24	0.18	2.85	0.21	0.15	2.37	
0.06	0.14	0.08	1.40	0.04	-0.02	-0.38	0.07	0.01	0.24	0.24	0.19	3.31	0.21	0.15	2.69	
0.07	0.13	0.06	0.88	0.03	-0.04	-0.53	0.06	-0.01	-0.11	0.25	0.18	2.50	0.20	0.13	1.86	
0.05	0.13	0.08	1.48	0.03	-0.02	-0.35	0.06	0.01	0.22	0.24	0.19	3.77	0.21	0.16	3.04	
0.04	0.13	0.09	2.39	0.03	-0.01	-0.30	0.06	0.02	0.54	0.24	0.21	5.49	0.20	0.16	4.41	
0.01	0.13	0.12	10.69	0.03	0.02	1.95	0.06	0.05	4.37	0.25	0.24	21.26	0.21	0.20	17.60	
0.04	0.14	0.10	2.63	0.04	0.00	0.05	0.07	0.03	0.72	0.25	0.21	5.43	0.21	0.17	4.40	
0.06	0.15	0.09	1.67	0.04	-0.01	-0.23	0.08	0.02	0.38	0.25	0.20	3.48	0.22	0.16	2.82	
0.08	0.16	0.08	1.07	0.05	-0.03	-0.32	0.08	0.00	0.04	0.25	0.18	2.27	0.22	0.14	1.82	
0.08	0.17	0.09	1.09	0.06	-0.02	-0.30	0.09	0.01	0.18	0.25	0.17	2.19	0.23	0.15	1.89	
0.08	0.18	0.10	1.30	0.07	-0.01	-0.13	0.10	0.03	0.32	0.25	0.18	2.24	0.23	0.15	1.95	
0.06	$= \langle \lvert x \rvert \rangle$	*0.09*			*0.02*			*0.02*			*0.19*			*0.15*		*MAE*
		1.46			**0.29**			**0.30**			**3.16**			**2.56**		**RMAE**

Table 9.65: Experiment 11.08.07 Deployment KK

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.08	0.03	-0.05	-0.60	0.08	0.00	0.02	0.07	-0.02	-0.20	0.06	-0.02	-0.23	0.05	-0.03	-0.40	
0.07	0.04	-0.03	-0.46	0.09	0.01	0.20	0.07	0.00	-0.02	0.06	-0.02	-0.21	0.05	-0.02	-0.34	
0.08	0.04	-0.04	-0.46	0.09	0.01	0.13	0.07	0.00	-0.06	0.04	-0.03	-0.43	0.04	-0.04	-0.46	
0.08	0.04	-0.03	-0.42	0.09	0.01	0.12	0.08	0.01	0.08	0.04	-0.04	-0.54	0.03	-0.04	-0.57	
0.08	0.05	-0.03	-0.39	0.08	0.00	0.06	0.08	0.01	0.08	0.03	-0.05	-0.60	0.03	-0.05	-0.64	
0.08	0.05	-0.03	-0.37	0.08	0.00	0.02	0.09	0.01	0.07	0.03	-0.06	-0.67	0.02	-0.06	-0.74	
0.08	$= \langle \lvert x \rvert \rangle$	*0.04*			*0.01*			*0.01*			*0.04*			*0.04*		*MAE*
		0.45			**0.09**			**0.09**			**0.45**			**0.53**		**RMAE**

Table 9.66: Experiment 11.08.07 Deployment LL

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.11	0.01	-0.09	-0.86	0.01	-0.09	-0.88	0.06	-0.05	-0.47	0.02	-0.09	-0.80	0.02	-0.09	-0.81	
0.04	0.02	-0.02	-0.46	0.02	-0.02	-0.45	0.06	0.03	0.69	0.02	-0.01	-0.38	0.02	-0.02	-0.45	
0.06	0.01	-0.05	-0.83	0.00	-0.05	-0.92	0.07	0.01	0.21	0.01	-0.04	-0.73	0.01	-0.04	-0.75	
0.04	0.02	-0.02	-0.60	0.01	-0.03	-0.74	0.08	0.04	0.89	0.02	-0.02	-0.53	0.01	-0.03	-0.67	
0.04	0.02	-0.02	-0.57	0.02	-0.02	-0.56	0.08	0.04	1.09	0.03	-0.01	-0.34	0.02	-0.01	-0.39	
0.05	0.01	-0.04	-0.76	0.01	-0.04	-0.85	0.09	0.04	0.82	0.01	-0.03	-0.70	0.01	-0.04	-0.73	
0.03	0.01	-0.02	-0.69	0.00	-0.03	-0.86	0.09	0.06	1.73	0.01	-0.02	-0.56	0.01	-0.02	-0.69	
0.07	0.02	-0.05	-0.69	0.02	-0.05	-0.75	0.10	0.03	0.41	0.03	-0.04	-0.62	0.02	-0.05	-0.71	
0.08	0.02	-0.06	-0.79	0.01	-0.07	-0.91	0.11	0.03	0.34	0.01	-0.06	-0.81	0.01	-0.07	-0.83	
0.09	0.01	-0.08	-0.85	0.01	-0.08	-0.92	0.12	0.02	0.26	0.02	-0.07	-0.81	0.01	-0.08	-0.89	
0.06	0.02	-0.04	-0.72	0.02	-0.04	-0.72	0.12	0.06	1.00	0.02	-0.04	-0.60	0.02	-0.04	-0.70	
0.02	0.02	0.00	-0.03	0.01	-0.01	-0.46	0.12	0.11	6.11	0.03	0.01	0.53	0.01	0.00	-0.24	
0.03	0.01	-0.02	-0.68	0.00	-0.03	-0.89	0.13	0.10	3.14	0.03	0.00	-0.09	0.01	-0.02	-0.79	
0.05	$= \langle \lvert x \rvert \rangle$	*0.04*			*0.04*			*0.05*			*0.04*			*0.04*		*MAE*
		0.73			**0.80**			**0.86**			**0.65**			**0.72**		**RMAE**

Table 9.67: Experiment 11.08.07 Deployment MM

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.14	0.08	1.16	0.15	0.08	1.24	0.29	0.22	3.31	0.15	0.09	1.30	0.02	-0.04	-0.65	
0.09	0.15	0.06	0.71	0.15	0.06	0.74	0.28	0.20	2.25	0.16	0.07	0.81	0.03	-0.06	-0.68	
0.09	0.16	0.07	0.79	0.16	0.07	0.76	0.27	0.19	2.10	0.17	0.08	0.87	0.03	-0.06	-0.63	
0.08	0.16	0.08	0.98	0.16	0.08	1.04	0.27	0.19	2.34	0.16	0.08	1.04	0.04	-0.04	-0.55	
0.09	0.16	0.08	0.89	0.16	0.08	0.92	0.26	0.17	2.02	0.17	0.08	0.98	0.04	-0.04	-0.51	
0.07	0.17	0.10	1.32	0.17	0.10	1.35	0.26	0.18	2.52	0.18	0.11	1.45	0.05	-0.03	-0.34	
0.09	0.17	0.08	0.90	0.17	0.08	0.87	0.24	0.15	1.65	0.17	0.08	0.87	0.05	-0.04	-0.42	
0.09	0.17	0.09	0.99	0.18	0.09	1.02	0.22	0.13	1.54	0.17	0.08	0.94	0.06	-0.02	-0.28	
0.09	0.17	0.09	0.95	0.18	0.09	1.05	0.21	0.12	1.29	0.16	0.07	0.83	0.07	-0.02	-0.24	
0.12	0.17	0.05	0.41	0.18	0.06	0.50	0.19	0.07	0.56	0.16	0.03	0.29	0.08	-0.05	-0.37	
0.16	0.16	0.00	-0.02	0.17	0.01	0.09	0.18	0.02	0.10	0.14	-0.02	-0.15	0.08	-0.08	-0.48	
0.21	0.16	-0.06	-0.27	0.17	-0.04	-0.20	0.16	-0.05	-0.23	0.13	-0.09	-0.42	0.09	-0.12	-0.57	
0.24	0.14	-0.10	-0.42	0.16	-0.08	-0.33	0.16	-0.09	-0.36	0.11	-0.13	-0.55	0.10	-0.14	-0.59	
0.25	0.12	-0.14	-0.53	0.15	-0.11	-0.43	0.15	-0.10	-0.41	0.09	-0.16	-0.63	0.10	-0.16	-0.62	
0.27	0.11	-0.16	-0.60	0.13	-0.14	-0.50	0.14	-0.12	-0.46	0.08	-0.19	-0.71	0.11	-0.16	-0.60	
0.26	0.10	-0.16	-0.62	0.12	-0.13	-0.53	0.15	-0.11	-0.43	0.07	-0.19	-0.74	0.12	-0.14	-0.55	
0.25	0.08	-0.18	-0.70	0.10	-0.15	-0.61	0.15	-0.11	-0.42	0.06	-0.20	-0.78	0.12	-0.13	-0.52	
0.25	0.06	-0.19	-0.74	0.09	-0.16	-0.65	0.15	-0.10	-0.40	0.05	-0.20	-0.81	0.12	-0.13	-0.50	
0.24	0.06	-0.18	-0.74	0.08	-0.16	-0.67	0.15	-0.09	-0.36	0.05	-0.19	-0.79	0.13	-0.11	-0.46	
0.24	0.05	-0.20	-0.81	0.06	-0.19	-0.76	0.16	-0.08	-0.34	0.05	-0.20	-0.80	0.13	-0.12	-0.48	
0.16	$= \langle \lvert x \rvert \rangle$	*0.11*			*0.10*			*0.12*			*0.12*			*0.08*		*MAE*
		0.65			**0.61**			**0.76**			**0.72**			**0.52**		**RMAE**

Table 9.68: Experiment 11.08.07 Deployment NN

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.11	0.02	-0.09	-0.84	0.01	-0.09	-0.88	0.08	-0.03	-0.27	0.02	-0.09	-0.82	0.02	-0.09	-0.81	
0.04	0.02	-0.02	-0.48	0.02	-0.02	-0.50	0.08	0.05	1.27	0.02	-0.01	-0.34	0.02	-0.02	-0.45	
0.06	0.01	-0.04	-0.75	0.00	-0.05	-0.94	0.09	0.04	0.63	0.01	-0.04	-0.78	0.01	-0.04	-0.75	
0.04	0.01	-0.03	-0.66	0.01	-0.03	-0.77	0.10	0.06	1.38	0.01	-0.03	-0.66	0.02	-0.02	-0.59	
0.04	0.02	-0.02	-0.45	0.02	-0.02	-0.57	0.10	0.06	1.54	0.02	-0.01	-0.38	0.02	-0.02	-0.47	
0.05	0.01	-0.04	-0.79	0.01	-0.04	-0.72	0.11	0.06	1.18	0.01	-0.04	-0.72	0.01	-0.04	-0.72	
0.03	0.01	-0.02	-0.59	0.01	-0.02	-0.59	0.12	0.08	2.49	0.01	-0.02	-0.69	0.02	-0.02	-0.51	
0.05	= <|x|>	*0.04*			*0.04*			*0.05*			*0.03*			*0.03*		*MAE*
		0.70			**0.76**			**1.02**			**0.67**			**0.66**		**RMAE**

Table 9.69: Experiment 11.08.07 Deployment OO

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.03	-0.04	-0.51	0.04	-0.03	-0.47	0.17	0.10	1.39	0.03	-0.04	-0.56	0.03	-0.04	-0.63	
0.08	0.04	-0.04	-0.49	0.04	-0.04	-0.45	0.17	0.10	1.20	0.04	-0.04	-0.55	0.02	-0.06	-0.77	
0.09	0.04	-0.05	-0.53	0.05	-0.04	-0.45	0.17	0.08	0.90	0.04	-0.05	-0.56	0.02	-0.07	-0.80	
0.06	0.04	-0.02	-0.26	0.06	0.00	-0.05	0.18	0.12	1.98	0.04	-0.02	-0.28	0.02	-0.04	-0.63	
0.08	0.05	-0.03	-0.39	0.06	-0.03	-0.32	0.18	0.10	1.18	0.05	-0.03	-0.40	0.02	-0.06	-0.77	
0.10	0.05	-0.04	-0.45	0.06	-0.04	-0.36	0.19	0.09	0.88	0.06	-0.04	-0.38	0.01	-0.09	-0.88	
0.08	0.06	-0.03	-0.33	0.07	-0.01	-0.17	0.19	0.11	1.27	0.06	-0.02	-0.28	0.02	-0.06	-0.73	
0.07	0.06	-0.01	-0.09	0.07	0.00	0.07	0.19	0.12	1.76	0.08	0.01	0.10	0.02	-0.05	-0.69	
0.06	0.08	0.02	0.25	0.08	0.02	0.29	0.19	0.13	2.16	0.08	0.02	0.36	0.01	-0.05	-0.80	
0.09	0.08	-0.02	-0.17	0.08	-0.01	-0.11	0.18	0.09	1.00	0.09	-0.01	-0.07	0.02	-0.07	-0.77	
0.13	0.09	-0.04	-0.34	0.09	-0.04	-0.28	0.18	0.05	0.36	0.09	-0.03	-0.26	0.02	-0.10	-0.82	
0.16	0.10	-0.07	-0.41	0.10	-0.06	-0.38	0.17	0.00	0.03	0.10	-0.06	-0.38	0.02	-0.15	-0.90	
0.17	0.10	-0.07	-0.43	0.10	-0.07	-0.39	0.15	-0.02	-0.14	0.10	-0.07	-0.39	0.02	-0.15	-0.88	
0.19	0.10	-0.09	-0.45	0.11	-0.08	-0.42	0.13	-0.06	-0.33	0.11	-0.08	-0.40	0.03	-0.16	-0.86	
0.20	0.11	-0.09	-0.46	0.12	-0.08	-0.42	0.12	-0.08	-0.41	0.12	-0.08	-0.42	0.03	-0.17	-0.86	
0.22	0.12	-0.10	-0.47	0.12	-0.10	-0.45	0.10	-0.12	-0.55	0.12	-0.10	-0.44	0.03	-0.19	-0.86	
0.23	0.12	-0.10	-0.46	0.13	-0.10	-0.45	0.08	-0.14	-0.64	0.12	-0.10	-0.45	0.04	-0.19	-0.83	
0.23	0.13	-0.10	-0.45	0.14	-0.10	-0.41	0.07	-0.16	-0.69	0.13	-0.11	-0.46	0.04	-0.19	-0.83	
0.23	0.13	-0.10	-0.42	0.14	-0.09	-0.39	0.06	-0.17	-0.73	0.12	-0.11	-0.47	0.05	-0.18	-0.80	
0.23	0.13	-0.09	-0.41	0.14	-0.09	-0.39	0.05	-0.18	-0.80	0.11	-0.12	-0.52	0.05	-0.18	-0.80	
0.25	0.13	-0.12	-0.48	0.15	-0.10	-0.41	0.05	-0.20	-0.82	0.11	-0.14	-0.55	0.06	-0.19	-0.78	
0.25	0.13	-0.12	-0.47	0.14	-0.10	-0.42	0.04	-0.20	-0.83	0.10	-0.15	-0.60	0.06	-0.19	-0.78	
0.25	0.12	-0.13	-0.53	0.13	-0.11	-0.46	0.04	-0.20	-0.83	0.09	-0.16	-0.64	0.06	-0.18	-0.74	
0.25	0.11	-0.13	-0.53	0.13	-0.11	-0.47	0.05	-0.20	-0.81	0.08	-0.16	-0.66	0.07	-0.17	-0.70	
0.23	0.11	-0.13	-0.55	0.13	-0.11	-0.47	0.06	-0.17	-0.74	0.07	-0.16	-0.69	0.08	-0.16	-0.67	
0.23	0.09	-0.14	-0.60	0.11	-0.13	-0.53	0.06	-0.17	-0.73	0.06	-0.17	-0.74	0.08	-0.15	-0.64	
0.16	= <|x|>	*0.07*			*0.06*			*0.12*			*0.08*			*0.13*		*MAE*
		0.45			**0.40**			**0.75**			**0.49**			**0.78**		**RMAE**

Table 9.70: Experiment 11.08.07 Deployment PP

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.04	0.29	0.26	7.26	0.32	0.28	8.05	0.27	0.23	6.58	0.27	0.23	6.59	0.30	0.27	7.54	
0.07	0.32	0.25	3.77	0.36	0.30	4.42	0.30	0.23	3.49	0.29	0.23	3.37	0.34	0.27	4.00	
0.07	0.36	0.30	4.52	0.41	0.35	5.31	0.34	0.27	4.19	0.32	0.25	3.85	0.37	0.31	4.67	
0.08	0.40	0.33	4.32	0.45	0.37	4.92	0.39	0.31	4.11	0.35	0.28	3.70	0.41	0.33	4.43	
0.07	0.44	0.37	5.04	0.48	0.40	5.49	0.43	0.36	4.87	0.40	0.32	4.41	0.45	0.38	5.12	
0.06	0.48	0.42	7.25	0.50	0.44	7.58	0.46	0.41	7.01	0.44	0.38	6.53	0.48	0.42	7.22	
0.05	0.49	0.44	8.83	0.49	0.44	8.94	0.49	0.44	8.87	0.47	0.42	8.47	0.49	0.44	8.80	
0.05	0.50	0.45	9.58	0.50	0.45	9.56	0.50	0.45	9.63	0.49	0.44	9.37	0.49	0.44	9.43	
0.05	0.50	0.44	8.43	0.48	0.42	8.04	0.50	0.45	8.45	0.49	0.44	8.30	0.50	0.44	8.41	
0.06	= <|x|>	*0.36*			*0.38*			*0.35*			*0.33*			*0.37*		*MAE*
		6.21			**6.60**			**6.02**			**5.71**			**6.28**		**RMAE**

Table 9.71: Experiment 11.08.07 Deployment QQ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.06	0.26	0.20	3.41	0.27	0.21	3.58	0.24	0.18	3.14	0.25	0.19	3.23	0.27	0.21	3.57
0.06	0.27	0.21	3.59	0.30	0.24	4.00	0.26	0.20	3.28	0.26	0.20	3.36	0.29	0.23	3.80
0.05	0.30	0.25	5.50	0.33	0.29	6.22	0.28	0.23	5.04	0.27	0.23	4.91	0.31	0.26	5.72
0.04	0.33	0.29	8.31	0.38	0.34	9.65	0.31	0.28	7.78	0.30	0.26	7.46	0.35	0.31	8.85
0.02	0.37	0.36	20.62	0.43	0.41	23.75	0.35	0.33	19.10	0.32	0.31	17.81	0.38	0.37	21.22
0.03	0.42	0.39	15.19	0.47	0.44	17.21	0.40	0.37	14.37	0.36	0.34	13.03	0.43	0.41	15.73
0.02	0.47	0.44	20.78	0.51	0.49	22.71	0.44	0.42	19.78	0.41	0.39	18.11	0.48	0.46	21.33
0.03	0.50	0.47	16.98	0.52	0.49	17.58	0.49	0.46	16.47	0.45	0.42	15.27	0.50	0.48	17.16
0.04	0.51	0.47	10.60	0.52	0.48	10.83	0.51	0.47	10.55	0.49	0.45	10.14	0.51	0.47	10.50
0.05	0.52	0.47	9.40	0.52	0.47	9.35	0.52	0.47	9.39	0.51	0.46	9.14	0.52	0.47	9.35
0.05	0.53	0.48	9.63	0.51	0.46	9.32	0.53	0.48	9.63	0.52	0.47	9.46	0.52	0.47	9.57

0.04	0.52	0.48	12.44	0.49	0.45	11.79	0.53	0.49	12.64	0.53	0.49	12.68	0.52	0.48	12.44	
0.04	$=\langle \lvert x \rvert \rangle$	*0.38*			*0.40*			*0.36*			*0.35*			*0.38*		*MAE*
		9.53			**10.05**			**9.21**			**8.85**			**9.71**		**RMAE**

Table 9.72: Experiment 11.08.07 Deployment RR

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.04	0.27	0.23	5.87	0.28	0.24	6.19	0.26	0.22	5.54	0.26	0.22	5.66	0.28	0.24	6.18	
0.04	0.29	0.25	5.53	0.31	0.27	6.03	0.27	0.23	5.06	0.28	0.23	5.21	0.30	0.26	5.73	
0.04	0.32	0.28	6.82	0.35	0.31	7.56	0.29	0.25	6.22	0.29	0.25	6.15	0.33	0.29	7.06	
0.05	0.35	0.30	6.26	0.40	0.35	7.39	0.33	0.28	5.94	0.31	0.27	5.56	0.36	0.32	6.60	
0.07	0.40	0.33	4.94	0.46	0.39	5.82	0.37	0.30	4.54	0.34	0.28	4.15	0.41	0.34	5.16	
0.08	0.45	0.36	4.39	0.50	0.42	5.05	0.43	0.35	4.16	0.39	0.31	3.69	0.46	0.38	4.54	
0.09	0.50	0.41	4.41	0.54	0.45	4.85	0.48	0.38	4.16	0.44	0.34	3.73	0.51	0.41	4.50	
0.09	0.54	0.45	5.14	0.55	0.46	5.28	0.53	0.44	5.03	0.49	0.40	4.63	0.54	0.45	5.17	
0.07	0.55	0.48	6.46	0.55	0.48	6.52	0.55	0.48	6.45	0.53	0.45	6.16	0.55	0.47	6.41	
0.07	0.56	0.49	7.06	0.55	0.48	7.01	0.56	0.49	7.07	0.55	0.48	6.92	0.56	0.49	7.07	
0.06	0.56	0.50	7.79	0.54	0.47	7.45	0.56	0.50	7.81	0.56	0.49	7.77	0.56	0.49	7.74	
0.06	0.55	0.49	8.22	0.52	0.46	7.80	0.56	0.50	8.34	0.57	0.51	8.51	0.55	0.49	8.23	
0.04	0.54	0.50	11.75	0.52	0.47	11.23	0.54	0.49	11.69	0.56	0.51	12.18	0.54	0.50	11.82	
0.04	0.52	0.48	11.00	0.50	0.45	10.32	0.53	0.49	11.10	0.55	0.51	11.62	0.53	0.49	11.11	
0.04	0.52	0.47	10.80	0.48	0.44	9.96	0.51	0.47	10.75	0.54	0.50	11.32	0.52	0.48	10.91	
0.04	0.50	0.46	11.53	0.47	0.43	10.55	0.49	0.45	11.23	0.53	0.49	12.10	0.51	0.47	11.59	
0.03	0.48	0.45	15.04	0.46	0.43	14.29	0.48	0.45	15.03	0.52	0.49	16.34	0.49	0.46	15.29	
0.06	$=\langle \lvert x \rvert \rangle$	*0.41*			*0.41*			*0.40*			*0.40*			*0.41*		*MAE*
		7.15			**7.24**			**6.99**			**6.96**			**7.26**		**RMAE**

Table 9.73: Experiment 11.08.07 Deployment SS

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.19	0.22	0.03	0.18	0.23	0.04	0.20	0.21	0.02	0.13	0.22	0.03	0.18	0.23	0.04	0.23	
0.18	0.23	0.06	0.32	0.23	0.06	0.33	0.22	0.04	0.25	0.23	0.05	0.28	0.24	0.07	0.38	
0.16	0.24	0.08	0.49	0.26	0.10	0.58	0.23	0.07	0.41	0.24	0.08	0.47	0.26	0.10	0.59	
0.15	0.26	0.11	0.73	0.28	0.13	0.85	0.24	0.09	0.61	0.25	0.09	0.62	0.27	0.12	0.80	
0.13	0.28	0.15	1.11	0.31	0.18	1.30	0.26	0.12	0.92	0.26	0.13	0.96	0.30	0.17	1.23	
0.13	0.31	0.18	1.37	0.35	0.22	1.65	0.29	0.16	1.20	0.28	0.15	1.14	0.33	0.20	1.51	
0.13	0.35	0.22	1.75	0.40	0.27	2.16	0.32	0.20	1.56	0.31	0.18	1.45	0.37	0.24	1.93	
0.12	0.39	0.27	2.22	0.44	0.32	2.62	0.36	0.24	1.93	0.34	0.22	1.82	0.41	0.29	2.36	
0.14	0.43	0.29	2.05	0.48	0.33	2.35	0.41	0.27	1.90	0.39	0.24	1.72	0.45	0.31	2.18	
0.14	0.48	0.33	2.36	0.50	0.36	2.53	0.45	0.31	2.19	0.42	0.28	1.99	0.48	0.34	2.40	
0.15	0.50	0.35	2.32	0.50	0.35	2.37	0.49	0.34	2.25	0.47	0.32	2.14	0.50	0.35	2.33	
0.14	0.50	0.36	2.60	0.50	0.37	2.62	0.50	0.36	2.62	0.49	0.35	2.54	0.50	0.36	2.59	
0.14	0.51	0.37	2.74	0.50	0.37	2.68	0.51	0.38	2.75	0.50	0.37	2.68	0.51	0.37	2.70	
0.13	0.51	0.38	2.97	0.49	0.36	2.82	0.51	0.38	2.98	0.51	0.38	2.94	0.50	0.37	2.91	
0.14	0.49	0.35	2.45	0.47	0.33	2.30	0.50	0.36	2.54	0.51	0.37	2.59	0.49	0.35	2.46	
0.13	0.48	0.35	2.64	0.46	0.33	2.47	0.49	0.36	2.68	0.50	0.37	2.77	0.48	0.35	2.60	
0.13	0.47	0.34	2.53	0.45	0.32	2.38	0.47	0.34	2.54	0.49	0.36	2.68	0.47	0.34	2.51	
0.13	0.46	0.33	2.44	0.43	0.30	2.24	0.46	0.33	2.47	0.48	0.35	2.63	0.46	0.33	2.48	
0.12	0.45	0.33	2.63	0.42	0.30	2.39	0.45	0.33	2.62	0.47	0.35	2.80	0.45	0.33	2.63	
0.14	$=\langle \lvert x \rvert \rangle$	*0.26*			*0.26*			*0.25*			*0.25*			*0.26*		*MAE*
		1.81			**1.86**			**1.74**			**1.73**			**1.86**		**RMAE**

Table 9.74: Experiment 11.08.07 Deployment UU

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.16	0.16	0.00	0.02	0.15	0.00	-0.03	0.04	-0.11	-0.72	0.16	0.00	0.02	0.24	0.09	0.54
0.16	0.16	0.00	-0.02	0.14	-0.01	-0.09	0.05	-0.11	-0.71	0.17	0.01	0.04	0.23	0.07	0.47
0.17	0.15	-0.03	-0.14	0.13	-0.04	-0.23	0.05	-0.13	-0.73	0.16	-0.01	-0.08	0.23	0.05	0.30
0.18	0.14	-0.04	-0.23	0.12	-0.06	-0.32	0.05	-0.13	-0.72	0.16	-0.03	-0.14	0.22	0.04	0.20
0.18	0.13	-0.05	-0.29	0.11	-0.07	-0.38	0.05	-0.14	-0.74	0.15	-0.03	-0.19	0.21	0.02	0.13
0.20	0.12	-0.08	-0.42	0.11	-0.09	-0.45	0.05	-0.15	-0.76	0.14	-0.06	-0.31	0.20	0.00	0.00
0.20	0.11	-0.09	-0.43	0.10	-0.10	-0.48	0.04	-0.16	-0.79	0.13	-0.07	-0.35	0.20	0.00	-0.02
0.20	0.11	-0.10	-0.47	0.10	-0.10	-0.51	0.04	-0.16	-0.80	0.12	-0.08	-0.41	0.19	-0.01	-0.05
0.19	0.10	-0.09	-0.47	0.10	-0.09	-0.49	0.04	-0.15	-0.78	0.11	-0.08	-0.40	0.20	0.01	0.05
0.19	0.09	-0.10	-0.50	0.09	-0.10	-0.53	0.03	-0.16	-0.82	0.11	-0.08	-0.44	0.21	0.02	0.08
0.19	0.09	-0.09	-0.50	0.09	-0.09	-0.49	0.03	-0.16	-0.85	0.10	-0.08	-0.44	0.22	0.03	0.16
0.20	0.09	-0.11	-0.54	0.10	-0.10	-0.49	0.03	-0.17	-0.86	0.10	-0.10	-0.51	0.24	0.04	0.22
0.19	0.09	-0.10	-0.54	0.12	-0.08	-0.39	0.02	-0.17	-0.89	0.09	-0.10	-0.52	0.26	0.07	0.35
0.21	0.10	-0.11	-0.54	0.13	-0.08	-0.38	0.02	-0.19	-0.92	0.09	-0.11	-0.55	0.29	0.09	0.42
0.20	0.12	-0.08	-0.41	0.14	-0.06	-0.31	0.01	-0.19	-0.95	0.09	-0.11	-0.53	0.33	0.13	0.66
0.19	0.12	-0.07	-0.36	0.15	-0.04	-0.22	0.01	-0.18	-0.94	0.11	-0.08	-0.40	0.37	0.18	0.97
0.19	0.13	-0.06	-0.31	0.16	-0.03	-0.15	0.01	-0.18	-0.94	0.12	-0.07	-0.37	0.43	0.24	1.24
0.18	0.15	-0.04	-0.19	0.19	0.01	0.06	0.01	-0.17	-0.94	0.13	-0.05	-0.28	0.49	0.30	1.67
0.19	0.16	-0.03	-0.14	0.22	0.04	0.19	0.02	-0.17	-0.91	0.14	-0.04	-0.22	0.52	0.34	1.83

0.19	0.19	0.00	0.02	0.25	0.06	0.33	0.01	-0.17	-0.93	0.16	-0.03	-0.16	0.55	0.36	1.95	
0.19	0.22	0.03	0.17	0.30	0.11	0.58	0.02	-0.16	-0.88	0.18	0.00	-0.02	0.56	0.38	2.02	
0.19	0.24	0.05	0.27	0.34	0.15	0.77	0.02	-0.17	-0.87	0.21	0.02	0.09	0.58	0.39	2.03	
0.20	0.28	0.09	0.44	0.39	0.19	0.98	0.03	-0.17	-0.87	0.24	0.04	0.20	0.59	0.39	1.98	
0.20	0.34	0.13	0.66	0.46	0.25	1.25	0.03	-0.17	-0.86	0.28	0.07	0.36	0.59	0.39	1.90	
0.21	0.38	0.18	0.84	0.52	0.31	1.47	0.03	-0.18	-0.87	0.33	0.12	0.56	0.59	0.38	1.82	
0.21	0.45	0.24	1.16	0.56	0.35	1.68	0.03	-0.18	-0.85	0.37	0.16	0.79	0.59	0.38	1.82	
0.19	= <|x|>	*0.08*			*0.10*			*0.16*			*0.06*			*0.17*		*MAE*
		0.40			**0.53**			**0.84**			**0.33**			**0.89**		**RMAE**

Table 9.75: Experiment 11.08.07 Deployment VV

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.23	0.81	0.58	2.56	0.82	0.59	2.61	0.64	0.41	1.81	0.79	0.57	2.51	0.89	0.66	2.94	
0.10	0.77	0.67	6.57	0.80	0.70	6.82	0.59	0.49	4.84	0.75	0.65	6.35	0.87	0.77	7.52	
0.10	0.72	0.62	6.41	0.74	0.64	6.61	0.56	0.47	4.79	0.70	0.60	6.20	0.82	0.72	7.42	
0.15	0.67	0.52	3.49	0.70	0.55	3.69	0.53	0.39	2.60	0.64	0.49	3.29	0.76	0.61	4.10	
0.21	0.58	0.37	1.73	0.61	0.40	1.90	0.50	0.29	1.37	0.56	0.34	1.63	0.72	0.51	2.40	
0.20	0.59	0.39	1.96	0.57	0.37	1.87	0.45	0.25	1.25	0.61	0.41	2.06	0.85	0.65	3.27	
0.16	0.77	0.61	3.94	0.68	0.52	3.34	0.47	0.31	2.01	0.80	0.65	4.17	0.86	0.70	4.50	
0.16	= <|x|>	*0.54*			*0.54*			*0.37*			*0.53*			*0.66*		*MAE*
		3.30			**3.31**			**2.28**			**3.25**			**4.05**		**RMAE**

Table 9.76: Experiment 29.08.07 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.06	0.49	0.43	7.02	0.41	0.35	5.64	0.43	0.36	5.91	0.60	0.54	8.71	0.52	0.46	7.44	
0.11	0.59	0.47	4.11	0.46	0.34	2.98	0.46	0.34	3.00	0.70	0.59	5.11	0.66	0.54	4.73	
0.19	0.60	0.41	2.13	0.50	0.30	1.57	0.48	0.29	1.51	0.63	0.44	2.26	0.74	0.55	2.84	
0.27	0.57	0.30	1.12	0.51	0.24	0.90	0.48	0.21	0.79	0.61	0.34	1.26	0.63	0.36	1.33	
0.35	0.58	0.23	0.66	0.51	0.17	0.48	0.49	0.15	0.42	0.61	0.26	0.76	0.61	0.27	0.77	
0.43	0.58	0.15	0.36	0.52	0.09	0.21	0.52	0.09	0.22	0.63	0.20	0.47	0.62	0.19	0.44	
0.48	0.61	0.13	0.26	0.54	0.06	0.12	0.54	0.06	0.12	0.66	0.18	0.38	0.64	0.16	0.34	
0.55	0.64	0.10	0.18	0.56	0.02	0.03	0.57	0.03	0.05	0.65	0.11	0.20	0.67	0.12	0.22	
0.56	0.65	0.09	0.15	0.60	0.04	0.06	0.62	0.05	0.10	0.58	0.02	0.03	0.62	0.06	0.10	
0.48	0.59	0.11	0.23	0.64	0.16	0.34	0.63	0.15	0.32	0.52	0.04	0.09	0.55	0.08	0.16	
0.47	0.52	0.05	0.11	0.62	0.15	0.32	0.58	0.11	0.24	0.49	0.02	0.03	0.50	0.03	0.07	
0.36	= <|x|>	*0.23*			*0.17*			*0.17*			*0.25*			*0.26*		*MAE*
		0.63			**0.48**			**0.47**			**0.69**			**0.71**		**RMAE**

Table 9.77: Experiment 29.08.07 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.42	0.58	0.15	0.36	0.57	0.15	0.35	0.59	0.17	0.39	0.59	0.17	0.39	0.54	0.12	0.29	
0.40	0.62	0.22	0.55	0.60	0.20	0.49	0.62	0.23	0.57	0.63	0.23	0.57	0.58	0.18	0.46	
0.40	0.64	0.24	0.62	0.63	0.24	0.60	0.64	0.24	0.62	0.63	0.24	0.61	0.62	0.23	0.58	
0.33	0.62	0.29	0.88	0.64	0.31	0.94	0.62	0.29	0.87	0.60	0.27	0.81	0.62	0.29	0.88	
0.35	0.57	0.22	0.63	0.60	0.25	0.70	0.57	0.22	0.63	0.55	0.20	0.56	0.57	0.22	0.63	
0.32	0.53	0.21	0.64	0.55	0.23	0.70	0.54	0.21	0.66	0.52	0.20	0.61	0.53	0.21	0.63	
0.32	0.51	0.18	0.57	0.52	0.20	0.60	0.52	0.19	0.60	0.50	0.17	0.53	0.50	0.18	0.55	
0.29	0.50	0.21	0.72	0.51	0.22	0.74	0.50	0.21	0.74	0.49	0.20	0.69	0.49	0.20	0.68	
0.29	0.48	0.19	0.64	0.49	0.20	0.68	0.50	0.20	0.68	0.48	0.19	0.64	0.48	0.18	0.63	
0.29	0.49	0.20	0.68	0.49	0.20	0.67	0.49	0.20	0.69	0.49	0.20	0.68	0.48	0.19	0.65	
0.28	0.50	0.22	0.79	0.50	0.22	0.79	0.50	0.22	0.81	0.50	0.22	0.80	0.49	0.21	0.76	
0.29	0.50	0.22	0.74	0.50	0.21	0.74	0.51	0.22	0.75	0.51	0.22	0.75	0.50	0.21	0.71	
0.29	0.51	0.23	0.80	0.51	0.23	0.79	0.52	0.23	0.81	0.51	0.23	0.79	0.51	0.22	0.77	
0.29	0.52	0.23	0.80	0.52	0.23	0.81	0.52	0.23	0.82	0.52	0.23	0.81	0.51	0.23	0.79	
0.31	0.53	0.21	0.68	0.52	0.21	0.67	0.53	0.22	0.69	0.53	0.22	0.70	0.51	0.20	0.64	
0.33	0.54	0.21	0.63	0.53	0.20	0.61	0.54	0.21	0.64	0.54	0.21	0.65	0.53	0.20	0.60	
0.33	= <|x|>	*0.21*			*0.22*			*0.22*			*0.21*			*0.20*		*MAE*
		0.66			**0.67**			**0.67**			**0.65**			**0.63**		**RMAE**

Table 9.78: Experiment 29.08.07 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	Sd1	err	%err	Sd2	err	%err	Sd3	err	%err	Sd4	err	%err	Sd5	err	%err
0.50	0.57	0.07	0.14	0.58	0.08	0.16	0.49	-0.02	-0.03	0.58	0.08	0.16	0.68	0.17	0.34
0.43	0.59	0.16	0.37	0.54	0.11	0.25	0.57	0.14	0.32	0.69	0.26	0.60	0.73	0.30	0.69
0.50	0.75	0.25	0.49	0.64	0.14	0.28	0.70	0.19	0.39	0.78	0.27	0.54	0.83	0.33	0.66
0.46	0.58	0.12	0.26	0.75	0.29	0.63	0.64	0.18	0.40	0.67	0.21	0.44	0.80	0.34	0.74
0.48	0.50	0.02	0.05	0.56	0.08	0.17	0.61	0.13	0.27	0.56	0.08	0.17	0.79	0.32	0.67
0.47	0.53	0.06	0.13	0.56	0.08	0.18	0.60	0.13	0.27	0.56	0.09	0.18	0.78	0.31	0.66
0.47	0.55	0.07	0.15	0.56	0.09	0.19	0.61	0.13	0.28	0.58	0.10	0.21	0.72	0.25	0.52
0.48	0.57	0.09	0.19	0.58	0.11	0.22	0.63	0.15	0.32	0.59	0.11	0.22	0.62	0.14	0.30
0.50	0.59	0.10	0.19	0.61	0.11	0.23	0.64	0.15	0.30	0.56	0.07	0.14	0.60	0.10	0.21

0.53	0.57	0.04	0.07	0.59	0.06	0.12	0.58	0.05	0.10	0.54	0.00	0.01	0.48	-0.05	-0.10	
0.48	0.54	0.05	0.11	0.55	0.06	0.13	0.52	0.04	0.07	0.48	-0.01	-0.02	0.45	-0.04	-0.08	
0.50	0.48	-0.02	-0.04	0.49	-0.01	-0.02	0.48	-0.03	-0.05	0.44	-0.06	-0.12	0.42	-0.09	-0.17	
0.48	0.45	-0.03	-0.05	0.46	-0.02	-0.04	0.46	-0.01	-0.03	0.45	-0.03	-0.06	0.39	-0.09	-0.19	
0.45	0.45	0.00	0.00	0.45	0.01	0.02	0.46	0.01	0.03	0.44	0.00	0.00	0.36	-0.09	-0.20	
0.44	0.45	0.01	0.03	0.45	0.01	0.03	0.46	0.02	0.06	0.44	0.01	0.01	0.32	-0.12	-0.27	
0.41	0.45	0.03	0.08	0.45	0.04	0.09	0.46	0.05	0.11	0.43	0.02	0.04	0.29	-0.12	-0.29	
0.39	0.44	0.05	0.14	0.45	0.06	0.15	0.46	0.07	0.18	0.42	0.03	0.08	0.28	-0.11	-0.29	
0.39	0.43	0.04	0.10	0.44	0.05	0.13	0.45	0.06	0.16	0.41	0.02	0.04	0.26	-0.13	-0.33	
0.36	0.42	0.07	0.18	0.43	0.07	0.20	0.45	0.09	0.26	0.40	0.04	0.12	0.25	-0.11	-0.30	
0.32	0.42	0.09	0.28	0.43	0.11	0.34	0.46	0.13	0.41	0.40	0.08	0.25	0.24	-0.08	-0.26	
0.29	0.42	0.13	0.44	0.43	0.14	0.50	0.47	0.18	0.61	0.42	0.13	0.44	0.24	-0.05	-0.17	
0.26	0.43	0.17	0.64	0.45	0.18	0.69	0.48	0.21	0.81	0.44	0.17	0.66	0.24	-0.02	-0.09	
0.25	0.46	0.21	0.86	0.47	0.22	0.89	0.51	0.26	1.04	0.48	0.23	0.93	0.26	0.01	0.05	
0.24	0.50	0.26	1.06	0.51	0.27	1.10	0.56	0.31	1.30	0.54	0.30	1.23	0.29	0.05	0.20	
0.25	0.56	0.31	1.20	0.57	0.31	1.23	0.60	0.34	1.35	0.59	0.34	1.32	0.34	0.09	0.34	
0.41	$= \langle \vert x \vert \rangle$	*0.10*			*0.11*			*0.12*			*0.11*			*0.14*		*MAE*
		0.24			**0.27**			**0.30**			**0.26**			**0.34**		**RMAE**

Table 9.79: Experiment 29.08.07 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.27	0.48	0.21	0.78	0.47	0.20	0.76	0.48	0.21	0.79	0.48	0.21	0.79	0.47	0.20	0.76	
0.27	0.48	0.21	0.81	0.48	0.21	0.81	0.48	0.22	0.82	0.48	0.22	0.82	0.48	0.21	0.81	
0.25	0.49	0.24	0.97	0.49	0.24	0.94	0.50	0.24	0.98	0.50	0.25	1.01	0.49	0.24	0.96	
0.22	0.51	0.29	1.29	0.50	0.28	1.23	0.52	0.29	1.32	0.53	0.31	1.38	0.51	0.29	1.29	
0.20	0.55	0.35	1.80	0.53	0.33	1.69	0.54	0.35	1.78	0.57	0.37	1.92	0.55	0.35	1.80	
0.18	0.59	0.41	2.34	0.56	0.39	2.20	0.59	0.41	2.33	0.61	0.43	2.44	0.59	0.42	2.36	
0.15	0.62	0.47	3.14	0.60	0.45	3.03	0.62	0.47	3.12	0.64	0.49	3.29	0.62	0.48	3.18	
0.15	0.66	0.51	3.39	0.64	0.49	3.22	0.66	0.51	3.36	0.69	0.54	3.58	0.67	0.52	3.42	
0.14	0.71	0.58	4.26	0.68	0.55	4.06	0.71	0.57	4.22	0.72	0.58	4.29	0.71	0.58	4.27	
0.12	0.71	0.58	4.71	0.72	0.59	4.76	0.71	0.58	4.69	0.69	0.57	4.56	0.71	0.59	4.73	
0.11	0.68	0.57	5.06	0.70	0.59	5.28	0.68	0.57	5.06	0.65	0.54	4.83	0.67	0.56	5.01	
0.09	0.64	0.55	6.09	0.66	0.57	6.35	0.64	0.55	6.15	0.62	0.53	5.90	0.63	0.54	6.06	
0.08	0.61	0.54	7.06	0.62	0.55	7.19	0.62	0.54	7.10	0.61	0.53	6.97	0.61	0.54	7.06	
0.05	0.61	0.55	10.29	0.61	0.56	10.41	0.61	0.55	10.33	0.60	0.55	10.22	0.61	0.55	10.30	
0.04	0.60	0.56	13.39	0.60	0.56	13.44	0.60	0.56	13.39	0.60	0.56	13.33	0.60	0.56	13.30	
0.04	0.60	0.56	13.56	0.60	0.56	13.58	0.60	0.56	13.61	0.61	0.57	13.73	0.60	0.56	13.45	
0.15	$= \langle \vert x \vert \rangle$	*0.45*			*0.44*			*0.45*			*0.45*			*0.45*		*MAE*
		3.05			**3.02**			**3.05**			**3.08**			**3.05**		**RMAE**

Table 9.80: Experiment 29.08.07 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.16	0.08	-0.08	-0.50	0.06	-0.11	-0.65	0.06	-0.11	-0.65	0.11	-0.06	-0.35	0.40	0.23	1.40	
0.22	0.09	-0.13	-0.59	0.09	-0.14	-0.61	0.05	-0.17	-0.76	0.10	-0.12	-0.54	0.38	0.16	0.71	
0.16	0.09	-0.07	-0.44	0.11	-0.05	-0.32	0.05	-0.11	-0.70	0.10	-0.06	-0.39	0.37	0.22	1.39	
0.18	0.09	-0.09	-0.50	0.12	-0.05	-0.31	0.04	-0.13	-0.77	0.10	-0.08	-0.46	0.36	0.19	1.07	
0.21	0.08	-0.13	-0.62	0.13	-0.08	-0.37	0.04	-0.17	-0.83	0.09	-0.13	-0.59	0.35	0.14	0.64	
0.25	0.08	-0.17	-0.67	0.12	-0.13	-0.51	0.03	-0.21	-0.86	0.09	-0.16	-0.65	0.33	0.08	0.33	
0.35	0.07	-0.28	-0.79	0.12	-0.23	-0.65	0.03	-0.32	-0.92	0.09	-0.26	-0.75	0.31	-0.03	-0.10	
0.44	0.07	-0.37	-0.85	0.11	-0.32	-0.74	0.03	-0.41	-0.93	0.09	-0.34	-0.79	0.32	-0.12	-0.27	
0.47	0.06	-0.41	-0.87	0.10	-0.37	-0.78	0.03	-0.44	-0.93	0.09	-0.38	-0.80	0.32	-0.15	-0.32	
0.59	0.06	-0.53	-0.91	0.10	-0.48	-0.83	0.03	-0.56	-0.95	0.11	-0.48	-0.82	0.33	-0.26	-0.44	
0.30	$= \langle \vert x \vert \rangle$	*0.23*			*0.20*			*0.26*			*0.21*			*0.16*		*MAE*
		0.75			**0.65**			**0.87**			**0.69**			**0.52**		**RMAE**

Table 9.81: Experiment 29.08.07 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.64	0.88	0.24	0.37	0.86	0.22	0.34	0.83	0.19	0.30	0.90	0.26	0.40	0.92	0.28	0.44
0.72	0.92	0.20	0.28	0.91	0.19	0.27	0.89	0.17	0.23	0.93	0.21	0.29	0.95	0.23	0.32
0.80	0.94	0.14	0.18	0.93	0.13	0.17	0.90	0.11	0.14	0.94	0.14	0.18	0.96	0.17	0.21
0.82	0.94	0.13	0.16	0.94	0.13	0.16	0.91	0.09	0.11	0.94	0.13	0.16	0.97	0.16	0.19
0.88	0.95	0.06	0.07	0.95	0.06	0.07	0.90	0.02	0.02	0.96	0.07	0.08	0.98	0.10	0.11
0.90	0.98	0.09	0.10	0.96	0.07	0.07	0.92	0.02	0.02	1.00	0.10	0.11	1.01	0.12	0.13
0.89	0.97	0.07	0.08	0.99	0.10	0.11	0.96	0.06	0.07	0.92	0.03	0.03	0.97	0.07	0.08
0.94	0.86	-0.08	-0.08	0.89	-0.05	-0.06	0.82	-0.12	-0.13	0.85	-0.09	-0.10	0.89	-0.05	-0.06
0.91	0.82	-0.09	-0.10	0.83	-0.08	-0.09	0.76	-0.15	-0.16	0.82	-0.09	-0.10	0.85	-0.06	-0.06
0.89	0.80	-0.10	-0.11	0.80	-0.09	-0.10	0.71	-0.18	-0.20	0.79	-0.10	-0.12	0.83	-0.06	-0.06
0.89	0.76	-0.13	-0.15	0.77	-0.12	-0.14	0.65	-0.24	-0.27	0.74	-0.15	-0.17	0.81	-0.08	-0.09
0.86	0.71	-0.16	-0.18	0.72	-0.15	-0.17	0.62	-0.24	-0.28	0.71	-0.16	-0.18	0.81	-0.05	-0.06
0.88	0.75	-0.13	-0.14	0.70	-0.18	-0.20	0.56	-0.31	-0.36	0.83	-0.05	-0.06	0.94	0.06	0.07
0.85	0.94	0.08	0.10	0.89	0.03	0.04	0.56	-0.30	-0.35	0.94	0.09	0.10	0.98	0.12	0.15
0.92	0.90	-0.02	-0.02	0.91	-0.01	-0.01	0.68	-0.24	-0.26	0.90	-0.02	-0.02	0.97	0.05	0.06
0.88	0.89	0.01	0.01	0.89	0.01	0.01	0.75	-0.13	-0.14	0.89	0.01	0.02	0.97	0.09	0.11
0.94	0.88	-0.06	-0.06	0.88	-0.06	-0.07	0.60	-0.34	-0.37	0.88	-0.06	-0.06	0.98	0.04	0.04

0.86	= <|x|>	*0.10*	*0.10*	*0.17*	*0.10*	*0.10*	*MAE*
		0.12	**0.12**	**0.20**	**0.12**	**0.12**	**RMAE**

Table 9.82: Experiment 29.08.07 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.05	-0.03	-0.39	0.05	-0.02	-0.28	0.03	-0.04	-0.60	0.04	-0.03	-0.42	0.07	-0.01	-0.10	
0.01	0.05	0.03	2.17	0.05	0.04	2.51	0.03	0.01	0.88	0.04	0.02	1.72	0.06	0.05	3.49	
0.09	0.05	-0.04	-0.46	0.05	-0.03	-0.37	0.03	-0.06	-0.65	0.04	-0.05	-0.53	0.06	-0.02	-0.25	
0.09	0.04	-0.05	-0.52	0.05	-0.04	-0.40	0.03	-0.06	-0.71	0.04	-0.05	-0.58	0.07	-0.03	-0.28	
0.12	0.05	-0.07	-0.59	0.05	-0.07	-0.56	0.03	-0.09	-0.74	0.04	-0.08	-0.69	0.06	-0.05	-0.47	
0.04	0.04	0.01	0.21	0.05	0.02	0.54	0.03	-0.01	-0.25	0.04	0.00	0.06	0.06	0.03	0.81	
0.07	0.04	-0.03	-0.40	0.06	-0.02	-0.25	0.03	-0.04	-0.60	0.04	-0.04	-0.52	0.06	-0.01	-0.13	
0.10	0.05	-0.05	-0.54	0.06	-0.04	-0.43	0.03	-0.07	-0.73	0.04	-0.06	-0.65	0.07	-0.03	-0.33	
0.09	0.05	-0.05	-0.51	0.06	-0.04	-0.38	0.03	-0.06	-0.67	0.03	-0.06	-0.65	0.06	-0.03	-0.32	
0.07	0.04	-0.02	-0.35	0.06	-0.01	-0.13	0.03	-0.04	-0.57	0.03	-0.03	-0.51	0.06	0.00	-0.04	
0.00	0.05	0.05	#DIV/0!	0.06	0.06		0.03	0.03	#DIV/0!	0.03	0.03	#DIV/0!	0.06	0.06	#DIV/0!	
0.13	0.04	-0.09	-0.68	0.06	-0.08	-0.57	0.03	-0.10	-0.79	0.03	-0.10	-0.77	0.06	-0.07	-0.52	
0.02	0.04	0.02	1.08	0.06	0.04	1.84	0.03	0.01	0.39	0.03	0.01	0.40	0.06	0.04	1.99	
0.07	0.04	-0.03	-0.39	0.06	-0.01	-0.14	0.03	-0.04	-0.57	0.03	-0.04	-0.56	0.06	-0.01	-0.09	
0.05	0.04	0.00	-0.09	0.06	0.01	0.22	0.03	-0.02	-0.46	0.03	-0.02	-0.45	0.06	0.01	0.30	
0.15	0.04	-0.11	-0.72	0.06	-0.10	-0.63	0.03	-0.12	-0.80	0.03	-0.13	-0.83	0.06	-0.09	-0.62	
0.04	0.04	0.00	-0.07	0.06	0.02	0.40	0.02	-0.02	-0.41	0.02	-0.02	-0.41	0.06	0.02	0.52	
0.09	0.04	-0.05	-0.55	0.06	-0.03	-0.37	0.03	-0.06	-0.71	0.03	-0.06	-0.72	0.06	-0.03	-0.37	
0.02	0.04	0.01	0.57	0.05	0.03	1.40	0.02	0.00	0.06	0.02	0.00	-0.07	0.05	0.03	1.42	
0.15	0.03	-0.11	-0.77	0.05	-0.10	-0.65	0.02	-0.12	-0.84	0.02	-0.13	-0.86	0.05	-0.09	-0.64	
0.01	0.03	0.02	1.75	0.05	0.04	3.28	0.02	0.01	0.76	0.02	0.01	0.67	0.05	0.03	2.82	
0.11	0.03	-0.08	-0.71	0.05	-0.06	-0.56	0.02	-0.09	-0.82	0.02	-0.09	-0.84	0.05	-0.06	-0.57	
0.11	0.03	-0.08	-0.75	0.05	-0.06	-0.56	0.02	-0.09	-0.85	0.02	-0.09	-0.84	0.04	-0.06	-0.59	
0.05	0.02	-0.02	-0.49	0.04	0.00	-0.06	0.01	-0.03	-0.69	0.01	-0.03	-0.71	0.04	-0.01	-0.15	
0.07	0.02	-0.04	-0.64	0.04	-0.03	-0.39	0.01	-0.06	-0.84	0.01	-0.05	-0.78	0.04	-0.03	-0.43	
0.11	0.02	-0.09	-0.83	0.04	-0.07	-0.65	0.01	-0.10	-0.89	0.01	-0.09	-0.87	0.04	-0.07	-0.65	
0.07	= <|x|>	*0.05*			*0.04*			*0.05*			*0.05*			*0.04*		*MAE*
		0.62			**0.54**			**0.72**			**0.70**			**0.52**		**RMAE**

Table 9.83: Experiment 04.06.08 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.14	0.15	0.02	0.11	0.15	0.02	0.11	0.12	-0.02	-0.15	0.15	0.02	0.11	0.22	0.08	0.61	
0.09	0.15	0.06	0.68	0.15	0.06	0.68	0.11	0.02	0.23	0.15	0.06	0.65	0.22	0.13	1.44	
0.10	0.15	0.04	0.42	0.15	0.04	0.40	0.11	0.01	0.08	0.14	0.04	0.37	0.22	0.11	1.09	
0.12	0.14	0.02	0.20	0.15	0.03	0.26	0.11	-0.01	-0.10	0.14	0.02	0.18	0.22	0.10	0.83	
0.14	0.14	0.00	-0.01	0.14	0.00	0.00	0.10	-0.04	-0.26	0.14	0.00	-0.03	0.21	0.06	0.45	
0.12	0.13	0.01	0.12	0.14	0.02	0.16	0.10	-0.02	-0.14	0.13	0.02	0.14	0.20	0.08	0.70	
0.09	0.13	0.04	0.42	0.13	0.04	0.42	0.09	0.00	0.02	0.13	0.04	0.42	0.20	0.10	1.11	
0.07	0.13	0.06	0.75	0.13	0.06	0.79	0.09	0.02	0.21	0.12	0.05	0.66	0.19	0.11	1.55	
0.16	0.13	-0.04	-0.23	0.12	-0.04	-0.24	0.09	-0.08	-0.47	0.12	-0.04	-0.27	0.18	0.01	0.09	
0.11	0.12	0.01	0.11	0.13	0.02	0.20	0.08	-0.03	-0.26	0.12	0.01	0.07	0.17	0.06	0.55	
0.12	0.12	0.00	0.00	0.12	0.01	0.06	0.08	-0.04	-0.36	0.11	-0.01	-0.08	0.16	0.04	0.35	
0.11	0.11	0.00	-0.02	0.12	0.01	0.06	0.07	-0.04	-0.36	0.10	-0.01	-0.10	0.15	0.03	0.28	
0.10	0.10	0.01	0.05	0.12	0.02	0.19	0.07	-0.03	-0.33	0.09	-0.01	-0.06	0.14	0.04	0.39	
0.18	0.10	-0.08	-0.44	0.11	-0.08	-0.41	0.06	-0.12	-0.67	0.09	-0.09	-0.51	0.13	-0.06	-0.31	
0.12	0.10	-0.02	-0.21	0.11	-0.01	-0.10	0.06	-0.06	-0.47	0.08	-0.04	-0.33	0.11	-0.01	-0.07	
0.11	0.09	-0.02	-0.20	0.10	-0.01	-0.08	0.05	-0.06	-0.51	0.08	-0.03	-0.30	0.10	-0.01	-0.09	
0.18	0.08	-0.10	-0.54	0.10	-0.08	-0.46	0.05	-0.13	-0.70	0.07	-0.11	-0.61	0.09	-0.09	-0.50	
0.14	0.08	-0.07	-0.46	0.09	-0.05	-0.35	0.05	-0.09	-0.65	0.07	-0.08	-0.54	0.08	-0.06	-0.41	
0.16	0.07	-0.09	-0.54	0.09	-0.07	-0.46	0.04	-0.12	-0.72	0.06	-0.10	-0.62	0.08	-0.08	-0.51	
0.12	0.07	-0.06	-0.45	0.08	-0.04	-0.36	0.04	-0.08	-0.64	0.05	-0.07	-0.57	0.07	-0.05	-0.40	
0.20	0.06	-0.14	-0.70	0.08	-0.13	-0.63	0.04	-0.16	-0.79	0.05	-0.15	-0.74	0.08	-0.12	-0.61	
0.19	0.06	-0.13	-0.69	0.07	-0.12	-0.62	0.04	-0.15	-0.79	0.05	-0.14	-0.76	0.08	-0.11	-0.60	
0.18	0.05	-0.13	-0.71	0.06	-0.12	-0.65	0.04	-0.15	-0.81	0.05	-0.13	-0.74	0.09	-0.09	-0.51	
0.22	0.05	-0.17	-0.78	0.06	-0.16	-0.72	0.04	-0.18	-0.84	0.05	-0.17	-0.77	0.09	-0.12	-0.57	
0.15	0.05	-0.10	-0.67	0.05	-0.09	-0.64	0.03	-0.11	-0.78	0.05	-0.10	-0.68	0.10	-0.05	-0.36	
0.15	0.05	-0.10	-0.69	0.05	-0.10	-0.64	0.03	-0.12	-0.79	0.05	-0.10	-0.65	0.10	-0.05	-0.31	
0.14	0.05	-0.09	-0.67	0.05	-0.09	-0.66	0.03	-0.11	-0.79	0.05	-0.09	-0.63	0.11	-0.03	-0.22	
0.03	0.04	0.02	0.57	0.05	0.02	0.59	0.03	0.00	0.00	0.05	0.02	0.83	0.11	0.08	2.82	
0.13	0.05	-0.09	-0.64	0.04	-0.09	-0.66	0.03	-0.10	-0.78	0.06	-0.08	-0.58	0.11	-0.03	-0.21	
0.13	= <|x|>	*0.06*			*0.06*			*0.07*			*0.06*			*0.07*		*MAE*
		0.44			**0.41**			**0.54**			**0.47**			**0.52**		**RMAE**

Table 9.84: Experiment 04.06.08 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.10	0.06	-0.04	-0.36	0.06	-0.04	-0.37	0.10	0.00	-0.03	0.05	-0.05	-0.47	0.07	-0.03	-0.27
0.11	0.07	-0.04	-0.34	0.06	-0.04	-0.39	0.11	0.00	0.01	0.06	-0.05	-0.43	0.06	-0.04	-0.39
0.06	0.07	0.02	0.32	0.07	0.01	0.21	0.11	0.06	0.98	0.07	0.01	0.25	0.05	0.00	-0.06

0.07	0.08	0.02	0.25	0.07	0.01	0.13	0.11	0.05	0.72	0.08	0.01	0.22	0.05	-0.02	-0.29	
0.13	0.09	-0.04	-0.32	0.08	-0.06	-0.43	0.12	-0.02	-0.12	0.09	-0.04	-0.31	0.05	-0.09	-0.66	
0.18	0.09	-0.08	-0.47	0.08	-0.10	-0.55	0.12	-0.06	-0.32	0.10	-0.08	-0.43	0.04	-0.14	-0.76	
0.16	0.10	-0.06	-0.37	0.08	-0.08	-0.48	0.12	-0.04	-0.26	0.11	-0.05	-0.33	0.04	-0.12	-0.73	
0.25	0.10	-0.14	-0.58	0.09	-0.16	-0.64	0.12	-0.13	-0.53	0.11	-0.14	-0.57	0.05	-0.20	-0.81	
0.17	0.11	-0.07	-0.39	0.09	-0.08	-0.46	0.11	-0.06	-0.35	0.11	-0.06	-0.35	0.05	-0.12	-0.70	
0.11	0.10	-0.01	-0.05	0.09	-0.02	-0.17	0.11	0.00	0.00	0.11	0.00	0.01	0.06	-0.06	-0.50	
0.09	0.10	0.02	0.21	0.09	0.00	0.06	0.11	0.02	0.25	0.11	0.02	0.25	0.06	-0.02	-0.29	
0.10	0.10	0.01	0.08	0.09	-0.01	-0.05	0.10	0.00	0.03	0.10	0.01	0.09	0.07	-0.03	-0.27	
0.18	0.10	-0.08	-0.42	0.09	-0.09	-0.50	0.10	-0.08	-0.44	0.10	-0.08	-0.46	0.08	-0.10	-0.58	
0.05	0.10	0.05	1.06	0.09	0.04	0.78	0.10	0.05	1.01	0.10	0.05	0.99	0.08	0.03	0.56	
0.00	0.09	0.09	#DIV/0!	0.09	0.09	#DIV/0!	0.10	0.10	#DIV/0!	0.09	0.09	#DIV/0!	0.08	0.08	#DIV/0!	
0.07	0.09	0.02	0.23	0.08	0.01	0.09	0.10	0.02	0.32	0.09	0.02	0.22	0.08	0.01	0.14	
0.01	0.09	0.08	14.43	0.08	0.08	13.84	0.10	0.09	16.98	0.09	0.08	14.89	0.08	0.08	13.71	
0.03	0.09	0.06	2.19	0.08	0.06	2.00	0.10	0.07	2.65	0.09	0.06	2.09	0.08	0.06	2.06	
0.00	0.09	0.09	#DIV/0!	0.08	0.08	#DIV/0!	0.10	0.10	#DIV/0!	0.08	0.08	#DIV/0!	0.09	0.09	#DIV/0!	
0.05	0.09	0.04	0.83	0.08	0.03	0.64	0.10	0.05	1.02	0.08	0.03	0.68	0.08	0.04	0.74	
0.07	0.08	0.02	0.24	0.08	0.01	0.16	0.10	0.03	0.45	0.08	0.02	0.22	0.08	0.02	0.22	
0.09	=<|x|>	*0.05*			*0.05*			*0.05*			*0.05*			*0.06*		*MAE*
		0.54			**0.55**			**0.53**			**0.53**			**0.69**		**RMAE**

Table 9.85: Experiment 04.06.08 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.05	0.07	0.03	0.56	0.07	0.02	0.49	0.08	0.03	0.71	0.08	0.03	0.64	0.05	0.01	0.13	
0.07	0.08	0.01	0.14	0.07	0.01	0.12	0.08	0.02	0.25	0.08	0.01	0.15	0.05	-0.01	-0.18	
0.02	0.07	0.06	3.47	0.07	0.06	3.33	0.08	0.07	3.94	0.07	0.06	3.49	0.05	0.04	2.16	
0.08	0.07	-0.01	-0.14	0.07	-0.01	-0.13	0.08	0.00	-0.01	0.07	-0.01	-0.14	0.05	-0.03	-0.35	
0.08	0.08	0.00	-0.02	0.07	-0.01	-0.11	0.08	0.01	0.09	0.07	0.00	-0.04	0.05	-0.02	-0.31	
0.04	0.07	0.03	0.70	0.07	0.03	0.62	0.09	0.04	1.02	0.07	0.03	0.63	0.06	0.01	0.29	
0.11	0.07	-0.03	-0.30	0.07	-0.03	-0.30	0.09	-0.02	-0.19	0.07	-0.03	-0.29	0.05	-0.05	-0.49	
0.10	0.08	-0.02	-0.24	0.07	-0.03	-0.29	0.09	-0.01	-0.12	0.07	-0.03	-0.28	0.06	-0.04	-0.42	
0.07	0.08	0.00	0.05	0.07	0.00	-0.02	0.09	0.01	0.15	0.08	0.00	0.03	0.05	-0.02	-0.29	
0.07	0.08	0.01	0.14	0.07	0.00	0.03	0.09	0.02	0.31	0.07	0.01	0.11	0.06	-0.01	-0.14	
0.14	0.08	-0.07	-0.46	0.07	-0.07	-0.51	0.09	-0.06	-0.39	0.08	-0.07	-0.47	0.06	-0.09	-0.60	
0.00	0.08	0.08	27.02	0.07	0.07	23.62	0.08	0.08	29.60	0.08	0.08	27.12	0.06	0.05	19.44	
0.07	0.08	0.00	0.04	0.07	-0.01	-0.09	0.09	0.01	0.20	0.08	0.01	0.07	0.06	-0.02	-0.22	
0.08	0.08	0.00	-0.02	0.07	-0.01	-0.14	0.09	0.01	0.10	0.08	0.00	0.01	0.06	-0.02	-0.26	
0.11	0.08	-0.03	-0.28	0.07	-0.04	-0.35	0.08	-0.02	-0.20	0.08	-0.03	-0.28	0.05	-0.05	-0.49	
0.03	0.08	0.05	1.95	0.07	0.04	1.68	0.09	0.06	2.40	0.08	0.05	2.13	0.06	0.03	1.30	
0.04	0.08	0.03	0.80	0.07	0.03	0.63	0.09	0.05	1.13	0.08	0.04	0.96	0.06	0.01	0.35	
0.00	0.07	0.07	#DIV/0!	0.07	0.07	#DIV/0!	0.09	0.09	#DIV/0!	0.08	0.08	#DIV/0!	0.06	0.06	#DIV/0!	
0.09	0.08	-0.02	-0.17	0.07	-0.03	-0.27	0.09	0.00	-0.05	0.08	-0.01	-0.12	0.06	-0.04	-0.37	
0.03	0.08	0.04	1.39	0.07	0.04	1.26	0.09	0.06	1.77	0.08	0.05	1.54	0.06	0.03	0.95	
0.00	0.08	0.08	39.05	0.07	0.07	36.64	0.09	0.09	44.99	0.08	0.08	42.58	0.06	0.06	30.52	
0.03	0.08	0.05	1.72	0.07	0.04	1.41	0.09	0.06	2.04	0.08	0.05	1.79	0.06	0.03	1.16	
0.03	0.08	0.05	1.85	0.07	0.05	1.70	0.09	0.07	2.48	0.08	0.06	2.19	0.06	0.04	1.33	
0.10	0.08	-0.02	-0.19	0.07	-0.03	-0.25	0.09	-0.01	-0.09	0.09	-0.01	-0.13	0.06	-0.04	-0.35	
0.06	=<|x|>	*0.03*			*0.03*			*0.04*			*0.03*			*0.03*		*MAE*
		0.55			**0.54**			**0.62**			**0.58**			**0.56**		**RMAE**

Table 9.86: Experiment 04.06.08 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.06	0.04	-0.02	-0.36	0.04	-0.02	-0.37	0.06	0.00	0.04	0.04	-0.01	-0.22	0.01	-0.04	-0.75
0.02	0.04	0.02	1.16	0.04	0.02	0.90	0.06	0.04	2.22	0.05	0.03	1.53	0.02	0.00	-0.11
0.19	0.04	-0.15	-0.78	0.04	-0.15	-0.79	0.06	-0.12	-0.66	0.05	-0.14	-0.72	0.02	-0.17	-0.91
0.06	0.05	-0.01	-0.14	0.04	-0.02	-0.28	0.07	0.01	0.20	0.05	-0.01	-0.11	0.02	-0.03	-0.58
0.07	0.05	-0.02	-0.34	0.05	-0.03	-0.35	0.07	0.00	-0.03	0.06	-0.02	-0.22	0.03	-0.05	-0.62
0.06	0.06	-0.01	-0.12	0.05	-0.02	-0.25	0.07	0.01	0.16	0.06	0.00	0.00	0.03	-0.03	-0.50
0.05	0.06	0.01	0.21	0.05	0.01	0.11	0.08	0.03	0.60	0.06	0.01	0.28	0.03	-0.01	-0.29
0.02	0.06	0.04	1.84	0.05	0.03	1.48	0.08	0.06	2.56	0.06	0.04	1.80	0.04	0.02	0.84
0.03	0.06	0.03	1.02	0.06	0.02	0.78	0.08	0.05	1.60	0.07	0.04	1.31	0.04	0.01	0.37
0.04	0.07	0.02	0.54	0.06	0.02	0.37	0.09	0.04	1.03	0.07	0.03	0.72	0.05	0.00	0.08
0.03	0.07	0.04	1.09	0.07	0.03	1.02	0.09	0.06	1.74	0.07	0.04	1.26	0.05	0.02	0.55
0.09	0.07	-0.01	-0.16	0.07	-0.02	-0.24	0.09	0.00	0.04	0.08	0.00	-0.04	0.05	-0.03	-0.39
0.01	0.08	0.06	4.45	0.07	0.05	3.81	0.09	0.08	5.63	0.08	0.07	4.80	0.06	0.05	3.15
0.02	0.08	0.06	3.82	0.07	0.06	3.40	0.09	0.08	4.69	0.09	0.07	4.23	0.06	0.05	2.72
0.02	0.08	0.07	3.95	0.08	0.06	3.56	0.10	0.08	4.97	0.09	0.08	4.52	0.07	0.05	3.12
0.03	0.09	0.06	1.84	0.08	0.05	1.56	0.10	0.07	2.25	0.10	0.07	2.14	0.07	0.04	1.39
0.03	0.09	0.06	1.91	0.08	0.05	1.69	0.10	0.07	2.38	0.10	0.07	2.29	0.07	0.04	1.30
0.01	0.09	0.08	8.68	0.08	0.07	7.75	0.11	0.10	10.27	0.10	0.09	9.39	0.08	0.07	7.69
0.01	0.10	0.09	9.17	0.09	0.08	8.24	0.11	0.10	10.48	0.11	0.10	10.14	0.08	0.07	7.66
0.04	0.10	0.06	1.76	0.09	0.05	1.45	0.11	0.07	2.13	0.11	0.07	2.09	0.09	0.06	1.62
0.04	0.10	0.07	1.98	0.10	0.06	1.71	0.11	0.08	2.21	0.11	0.08	2.23	0.09	0.06	1.62
0.07	0.10	0.03	0.40	0.10	0.02	0.29	0.12	0.04	0.55	0.12	0.04	0.55	0.10	0.02	0.30
0.03	0.11	0.07	2.22	0.10	0.07	2.02	0.12	0.09	2.55	0.12	0.09	2.56	0.10	0.07	2.04
0.00	0.11	0.11	#DIV/0!	0.11	0.11	#DIV/0!	0.12	0.12	#DIV/0!	0.12	0.12	#DIV/0!	0.11	0.11	#DIV/0!
0.07	0.11	0.05	0.72	0.10	0.04	0.55	0.13	0.06	0.89	0.13	0.06	0.89	0.11	0.04	0.63

0.07	0.12	0.06	0.83	0.11	0.04	0.66	0.13	0.06	0.90	0.13	0.06	0.93	0.11	0.05	0.70	
0.12	0.12	0.00	0.02	0.11	-0.01	-0.05	0.13	0.01	0.07	0.14	0.02	0.13	0.12	0.00	-0.02	
0.04	0.13	0.08	1.94	0.12	0.07	1.72	0.13	0.09	2.03	0.13	0.09	2.13	0.12	0.07	1.72	
0.08	0.13	0.05	0.59	0.12	0.04	0.51	0.13	0.05	0.67	0.14	0.06	0.76	0.13	0.05	0.62	
0.00	0.13	0.13	#DIV/0!	0.12	0.12	#DIV/0!	0.13	0.13	#DIV/0!	0.14	0.14	#DIV/0!	0.13	0.13	#DIV/0!	
0.09	0.13	0.05	0.53	0.13	0.04	0.43	0.13	0.05	0.53	0.14	0.05	0.62	0.13	0.04	0.50	
0.02	0.13	0.12	6.65	0.12	0.10	5.79	0.14	0.12	6.73	0.14	0.13	7.17	0.13	0.11	6.52	
0.00	0.13	0.13	#DIV/0!	0.13	0.13	#DIV/0!	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	
0.07	0.14	0.07	1.08	0.13	0.06	0.90	0.14	0.07	1.06	0.14	0.08	1.17	0.14	0.07	1.07	
0.05	0.14	0.08	1.57	0.13	0.07	1.40	0.14	0.09	1.63	0.15	0.10	1.82	0.14	0.09	1.64	
0.05	0.14	0.09	1.60	0.13	0.08	1.44	0.14	0.09	1.67	0.15	0.10	1.79	0.14	0.09	1.66	
0.06	0.14	0.08	1.38	0.13	0.07	1.23	0.14	0.08	1.39	0.15	0.09	1.53	0.14	0.08	1.40	
0.05	0.14	0.09	1.71	0.13	0.08	1.54	0.14	0.09	1.68	0.15	0.10	1.85	0.14	0.09	1.73	
0.08	0.14	0.06	0.74	0.13	0.05	0.60	0.14	0.06	0.71	0.15	0.07	0.85	0.15	0.06	0.79	
0.06	0.14	0.08	1.32	0.13	0.07	1.23	0.14	0.08	1.36	0.15	0.09	1.49	0.14	0.08	1.38	
0.02	0.14	0.12	5.31	0.13	0.11	4.98	0.14	0.12	5.41	0.15	0.13	5.88	0.15	0.13	5.72	
0.01	0.14	0.13	11.90	0.13	0.12	10.95	0.14	0.13	11.95	0.15	0.14	12.66	0.14	0.13	12.04	
0.00	0.14	0.14	#DIV/0!	0.13	0.13	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	
0.00	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	
0.00	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	
0.07	0.14	0.08	1.15	0.14	0.07	1.09	0.14	0.08	1.13	0.15	0.09	1.32	0.15	0.08	1.25	
0.00	0.15	0.15	#DIV/0!	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	
0.00	0.15	0.15	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.16	0.16	#DIV/0!	0.15	0.15	#DIV/0!	
0.00	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.16	0.16	#DIV/0!	0.15	0.15	#DIV/0!	
0.07	0.15	0.08	1.12	0.14	0.07	1.02	0.15	0.08	1.11	0.16	0.09	1.22	0.15	0.08	1.19	
0.02	0.15	0.13	6.36	0.14	0.12	5.86	0.15	0.13	6.18	0.16	0.14	6.72	0.16	0.14	6.59	
0.02	0.15	0.13	7.84	0.14	0.12	7.41	0.15	0.13	7.82	0.16	0.14	8.48	0.15	0.14	8.14	
0.02	0.15	0.13	7.84	0.14	0.12	7.21	0.14	0.13	7.61	0.16	0.14	8.45	0.15	0.14	8.28	
0.00	0.15	0.15	#DIV/0!	0.14	0.14	#DIV/0!	0.15	0.15	#DIV/0!	0.16	0.16	#DIV/0!	0.16	0.16	#DIV/0!	
0.04	= <|x|>	*0.08*			*0.07*			*0.08*			*0.09*			*0.08*		*MAE*
		1.97			**1.80**			**2.08**			**2.14**			**1.95**		**RMAE**

Table 9.87: Experiment 04.06.08 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.61	1.23	0.62	1.01	1.22	0.61	0.99	1.21	0.60	0.98	1.24	0.63	1.03	1.25	0.64	1.05	
0.68	1.29	0.61	0.91	1.29	0.61	0.90	1.27	0.59	0.88	1.28	0.60	0.89	1.30	0.63	0.93	
0.62	1.25	0.63	1.02	1.28	0.66	1.06	1.24	0.62	1.00	1.23	0.61	0.98	1.27	0.65	1.05	
0.67	1.22	0.54	0.81	1.24	0.57	0.85	1.19	0.52	0.78	1.19	0.52	0.78	1.24	0.56	0.84	
0.66	1.20	0.54	0.81	1.21	0.55	0.83	1.17	0.51	0.77	1.18	0.52	0.78	1.22	0.56	0.85	
0.70	1.17	0.47	0.67	1.19	0.50	0.71	1.14	0.44	0.63	1.14	0.44	0.63	1.20	0.50	0.71	
0.71	1.14	0.43	0.60	1.17	0.45	0.64	1.11	0.39	0.55	1.12	0.40	0.56	1.18	0.46	0.65	
0.62	1.12	0.50	0.80	1.15	0.53	0.84	1.08	0.46	0.74	1.09	0.46	0.75	1.15	0.53	0.85	
0.75	1.09	0.34	0.45	1.12	0.37	0.49	1.05	0.29	0.39	1.05	0.30	0.40	1.12	0.37	0.49	
0.72	1.05	0.33	0.46	1.09	0.36	0.51	1.01	0.29	0.40	1.02	0.30	0.42	1.10	0.37	0.52	
0.69	1.03	0.35	0.50	1.06	0.38	0.55	0.99	0.30	0.44	0.99	0.31	0.45	1.07	0.39	0.56	
0.68	1.00	0.32	0.47	1.04	0.35	0.51	0.96	0.28	0.40	0.97	0.29	0.42	1.05	0.36	0.53	
0.69	0.98	0.29	0.42	1.01	0.32	0.46	0.94	0.25	0.37	0.94	0.26	0.37	1.01	0.32	0.47	
0.71	0.93	0.22	0.30	0.96	0.25	0.35	0.90	0.19	0.26	0.89	0.18	0.25	0.96	0.25	0.35	
0.72	0.89	0.17	0.24	0.92	0.20	0.29	0.85	0.13	0.18	0.86	0.14	0.20	0.94	0.22	0.31	
0.67	0.88	0.22	0.32	0.91	0.25	0.37	0.83	0.16	0.24	0.84	0.18	0.27	0.92	0.26	0.38	
0.68	= <|x|>	*0.41*			*0.43*			*0.38*			*0.38*			*0.44*		*MAE*
		0.60			**0.64**			**0.55**			**0.56**			**0.65**		**RMAE**

Table 9.88: Experiment 04.06.08 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.10	0.06	-0.03	-0.36	0.05	-0.05	-0.52	0.07	-0.03	-0.29	0.07	-0.03	-0.27	0.07	-0.03	-0.27
0.10	0.07	-0.03	-0.31	0.05	-0.05	-0.50	0.07	-0.03	-0.28	0.07	-0.02	-0.24	0.08	-0.02	-0.23
0.12	0.07	-0.05	-0.42	0.05	-0.07	-0.59	0.07	-0.05	-0.42	0.07	-0.05	-0.40	0.08	-0.03	-0.27
0.12	0.07	-0.05	-0.41	0.06	-0.07	-0.54	0.07	-0.05	-0.44	0.08	-0.05	-0.38	0.09	-0.04	-0.31
0.12	0.08	-0.04	-0.37	0.05	-0.07	-0.56	0.07	-0.05	-0.41	0.08	-0.04	-0.34	0.10	-0.02	-0.19
0.17	0.08	-0.09	-0.53	0.06	-0.10	-0.62	0.07	-0.10	-0.57	0.09	-0.07	-0.44	0.11	-0.05	-0.31
0.18	0.08	-0.09	-0.53	0.06	-0.11	-0.66	0.07	-0.10	-0.58	0.10	-0.07	-0.42	0.13	-0.04	-0.24
0.11	0.09	-0.03	-0.23	0.07	-0.04	-0.37	0.08	-0.04	-0.32	0.11	-0.01	-0.06	0.15	0.03	0.31
0.13	0.10	-0.03	-0.20	0.07	-0.06	-0.44	0.07	-0.06	-0.43	0.12	-0.02	-0.12	0.15	0.02	0.14
0.14	0.12	-0.02	-0.14	0.07	-0.07	-0.48	0.08	-0.06	-0.45	0.12	-0.03	-0.18	0.16	0.02	0.12
0.13	0.13	0.00	-0.03	0.09	-0.04	-0.34	0.08	-0.05	-0.36	0.13	0.00	0.01	0.17	0.04	0.28
0.12	0.13	0.01	0.12	0.09	-0.03	-0.25	0.10	-0.02	-0.19	0.14	0.02	0.19	0.18	0.06	0.53
0.16	0.14	-0.02	-0.13	0.10	-0.06	-0.36	0.11	-0.05	-0.30	0.16	0.00	-0.03	0.19	0.03	0.19
0.21	0.15	-0.06	-0.29	0.12	-0.09	-0.44	0.11	-0.10	-0.45	0.17	-0.04	-0.20	0.20	-0.01	-0.04
0.22	0.16	-0.06	-0.26	0.13	-0.08	-0.38	0.12	-0.09	-0.43	0.17	-0.05	-0.22	0.21	-0.01	-0.04
0.26	0.17	-0.09	-0.34	0.15	-0.12	-0.44	0.12	-0.14	-0.53	0.18	-0.08	-0.32	0.22	-0.04	-0.15
0.32	0.18	-0.14	-0.43	0.15	-0.17	-0.54	0.13	-0.18	-0.58	0.18	-0.14	-0.43	0.23	-0.09	-0.29
0.31	0.18	-0.13	-0.42	0.15	-0.16	-0.51	0.14	-0.17	-0.54	0.20	-0.12	-0.38	0.24	-0.07	-0.23
0.20	0.19	-0.01	-0.05	0.16	-0.04	-0.18	0.16	-0.04	-0.22	0.21	0.00	0.02	0.25	0.05	0.27
0.42	0.20	-0.22	-0.52	0.17	-0.25	-0.59	0.17	-0.26	-0.61	0.22	-0.20	-0.47	0.26	-0.17	-0.39
0.31	0.21	-0.09	-0.31	0.18	-0.12	-0.40	0.17	-0.14	-0.45	0.23	-0.08	-0.25	0.26	-0.05	-0.15
0.30	0.23	-0.08	-0.26	0.19	-0.12	-0.38	0.17	-0.13	-0.44	0.24	-0.07	-0.22	0.27	-0.04	-0.13

0.19	= <|x|>	*0.06*			*0.09*			*0.09*			*0.05*			*0.04*		*MAE*
		0.32			**0.46**			**0.46**			**0.28**			**0.23**		**RMAE**

Table 9.89: Experiment 04.06.08 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.38	0.69	0.31	0.81	0.69	0.31	0.81	0.67	0.28	0.74	0.68	0.30	0.79	0.71	0.33	0.86	
0.35	0.67	0.32	0.92	0.68	0.33	0.95	0.65	0.30	0.86	0.67	0.32	0.90	0.70	0.35	1.00	
0.30	0.66	0.36	1.19	0.67	0.36	1.20	0.63	0.33	1.09	0.65	0.35	1.15	0.69	0.38	1.26	
0.41	0.64	0.23	0.55	0.65	0.24	0.58	0.62	0.21	0.50	0.64	0.22	0.54	0.66	0.25	0.61	
0.36	0.63	0.27	0.76	0.64	0.28	0.78	0.60	0.24	0.68	0.62	0.27	0.74	0.65	0.29	0.82	
0.41	0.62	0.21	0.50	0.62	0.21	0.50	0.59	0.18	0.43	0.62	0.20	0.49	0.65	0.23	0.56	
0.40	0.62	0.22	0.56	0.63	0.23	0.57	0.59	0.19	0.48	0.62	0.22	0.55	0.64	0.25	0.61	
0.45	0.62	0.17	0.39	0.62	0.17	0.39	0.59	0.15	0.33	0.61	0.16	0.37	0.64	0.20	0.44	
0.40	0.61	0.21	0.54	0.62	0.22	0.57	0.58	0.19	0.47	0.60	0.21	0.52	0.63	0.23	0.59	
0.39	0.59	0.20	0.53	0.60	0.21	0.54	0.57	0.18	0.47	0.58	0.19	0.49	0.61	0.22	0.57	
0.34	0.57	0.23	0.67	0.58	0.24	0.70	0.55	0.21	0.61	0.57	0.22	0.66	0.60	0.26	0.75	
0.45	0.56	0.11	0.24	0.57	0.11	0.24	0.54	0.08	0.19	0.56	0.10	0.23	0.59	0.14	0.30	
0.40	0.56	0.16	0.42	0.57	0.17	0.43	0.53	0.13	0.33	0.56	0.16	0.41	0.59	0.20	0.49	
0.41	0.56	0.15	0.36	0.56	0.15	0.37	0.53	0.12	0.29	0.56	0.15	0.37	0.59	0.18	0.44	
0.43	0.57	0.14	0.34	0.57	0.14	0.34	0.53	0.11	0.25	0.57	0.14	0.33	0.59	0.16	0.39	
0.45	0.57	0.12	0.27	0.57	0.12	0.28	0.54	0.09	0.21	0.56	0.11	0.25	0.58	0.13	0.29	
0.36	0.55	0.18	0.51	0.56	0.19	0.53	0.53	0.17	0.47	0.53	0.17	0.47	0.55	0.18	0.51	
0.32	0.51	0.19	0.61	0.52	0.21	0.66	0.51	0.19	0.61	0.50	0.18	0.58	0.52	0.21	0.66	
0.47	0.50	0.03	0.06	0.50	0.04	0.08	0.48	0.01	0.02	0.49	0.02	0.04	0.51	0.04	0.10	
0.38	0.49	0.11	0.30	0.49	0.11	0.30	0.47	0.09	0.24	0.49	0.11	0.30	0.52	0.14	0.38	
0.34	0.49	0.15	0.43	0.49	0.15	0.44	0.46	0.12	0.35	0.49	0.15	0.43	0.51	0.17	0.50	
0.36	0.49	0.13	0.36	0.49	0.13	0.36	0.46	0.10	0.29	0.48	0.12	0.33	0.50	0.14	0.40	
0.37	0.48	0.11	0.29	0.49	0.12	0.31	0.46	0.09	0.24	0.47	0.10	0.28	0.50	0.13	0.34	
0.36	0.47	0.11	0.30	0.47	0.11	0.32	0.45	0.09	0.26	0.47	0.11	0.30	0.49	0.13	0.37	
0.36	0.46	0.11	0.29	0.47	0.11	0.31	0.44	0.08	0.23	0.46	0.11	0.29	0.48	0.12	0.35	
0.36	0.46	0.10	0.29	0.46	0.10	0.29	0.44	0.08	0.22	0.46	0.10	0.27	0.48	0.12	0.35	
0.30	0.46	0.16	0.52	0.46	0.16	0.53	0.43	0.13	0.43	0.45	0.15	0.51	0.47	0.17	0.57	
0.29	0.45	0.16	0.54	0.45	0.16	0.55	0.43	0.14	0.47	0.44	0.15	0.52	0.46	0.17	0.60	
0.31	0.44	0.13	0.41	0.44	0.13	0.43	0.42	0.11	0.36	0.43	0.12	0.40	0.45	0.14	0.45	
0.24	0.43	0.19	0.76	0.43	0.19	0.78	0.41	0.17	0.70	0.43	0.18	0.75	0.45	0.20	0.83	
0.19	0.42	0.24	1.26	0.43	0.24	1.29	0.41	0.22	1.19	0.42	0.23	1.24	0.44	0.25	1.36	
0.32	0.42	0.10	0.32	0.42	0.10	0.32	0.40	0.08	0.25	0.41	0.10	0.31	0.44	0.13	0.40	
0.33	0.41	0.08	0.26	0.42	0.09	0.27	0.39	0.06	0.19	0.41	0.08	0.26	0.44	0.11	0.33	
0.21	0.41	0.20	0.95	0.42	0.20	0.96	0.39	0.17	0.81	0.41	0.20	0.92	0.43	0.22	1.01	
0.27	0.41	0.13	0.49	0.41	0.14	0.50	0.38	0.11	0.41	0.40	0.13	0.46	0.41	0.14	0.51	
0.31	0.39	0.09	0.29	0.40	0.10	0.31	0.38	0.08	0.25	0.39	0.09	0.28	0.40	0.09	0.30	
0.25	0.38	0.13	0.53	0.39	0.14	0.56	0.37	0.12	0.50	0.37	0.12	0.50	0.38	0.14	0.55	
0.28	0.37	0.09	0.32	0.37	0.09	0.34	0.36	0.09	0.31	0.36	0.08	0.31	0.37	0.10	0.36	
0.31	0.35	0.04	0.14	0.36	0.05	0.17	0.35	0.04	0.14	0.35	0.04	0.13	0.37	0.06	0.19	
0.04	0.34	0.30	6.84	0.35	0.30	6.89	0.33	0.29	6.63	0.34	0.30	6.73	0.36	0.31	7.17	
0.16	0.33	0.18	1.12	0.33	0.18	1.13	0.32	0.17	1.06	0.33	0.17	1.09	0.35	0.20	1.25	
0.29	0.33	0.04	0.13	0.33	0.04	0.14	0.31	0.02	0.07	0.32	0.03	0.12	0.34	0.05	0.18	
0.29	0.32	0.03	0.10	0.32	0.03	0.12	0.30	0.01	0.04	0.32	0.03	0.10	0.33	0.05	0.16	
0.31	0.31	0.01	0.02	0.32	0.01	0.03	0.29	-0.02	-0.05	0.31	0.00	0.00	0.32	0.01	0.05	
0.30	0.30	0.00	0.00	0.30	0.00	0.00	0.28	-0.02	-0.07	0.30	-0.01	-0.02	0.31	0.01	0.03	
0.22	0.29	0.07	0.29	0.30	0.07	0.32	0.28	0.06	0.25	0.29	0.07	0.29	0.31	0.08	0.38	
0.17	0.28	0.11	0.67	0.29	0.12	0.72	0.27	0.10	0.59	0.28	0.11	0.66	0.30	0.13	0.77	
0.33	0.28	-0.05	-0.16	0.28	-0.05	-0.16	0.26	-0.07	-0.21	0.27	-0.06	-0.18	0.29	-0.04	-0.11	
0.03	0.27	0.24	7.40	0.27	0.24	7.40	0.25	0.22	6.81	0.27	0.23	7.33	0.29	0.25	7.92	
0.34	0.26	-0.07	-0.22	0.27	-0.07	-0.20	0.24	-0.09	-0.28	0.25	-0.08	-0.24	0.28	-0.06	-0.18	
0.22	0.25	0.03	0.16	0.25	0.04	0.18	0.24	0.02	0.09	0.25	0.03	0.16	0.27	0.05	0.24	
0.26	0.25	-0.01	-0.05	0.25	-0.01	-0.04	0.22	-0.03	-0.13	0.24	-0.02	-0.07	0.26	0.00	0.01	
0.20	0.24	0.04	0.19	0.24	0.04	0.21	0.22	0.02	0.11	0.24	0.04	0.19	0.25	0.05	0.27	
0.20	0.23	0.03	0.16	0.23	0.04	0.18	0.21	0.01	0.06	0.22	0.03	0.13	0.24	0.04	0.23	
0.14	0.22	0.08	0.55	0.22	0.08	0.56	0.21	0.06	0.43	0.22	0.08	0.53	0.24	0.09	0.66	
0.17	0.22	0.05	0.29	0.22	0.05	0.29	0.19	0.02	0.15	0.21	0.04	0.26	0.23	0.07	0.39	
0.16	0.21	0.04	0.27	0.21	0.05	0.30	0.19	0.03	0.17	0.21	0.04	0.25	0.22	0.06	0.37	
0.19	0.20	0.01	0.06	0.20	0.01	0.08	0.18	-0.01	-0.04	0.19	0.01	0.03	0.22	0.03	0.18	
0.22	0.20	-0.03	-0.12	0.20	-0.03	-0.12	0.17	-0.05	-0.21	0.19	-0.03	-0.13	0.21	-0.01	-0.03	
0.30	= <|x|>	*0.13*			*0.14*			*0.12*			*0.13*			*0.15*		*MAE*
		0.44			**0.45**			**0.39**			**0.43**			**0.49**		**RMAE**

Table 9.90: Experiment 04.06.08 Deployment HH

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.42	0.91	0.48	1.14	0.93	0.51	1.19	0.86	0.44	1.04	0.89	0.47	1.10	0.95	0.53	1.25
0.47	0.95	0.48	1.01	0.95	0.48	1.02	0.90	0.43	0.90	0.95	0.48	1.01	1.00	0.53	1.12
0.52	1.08	0.56	1.08	1.06	0.54	1.05	1.02	0.50	0.97	1.10	0.59	1.14	1.12	0.61	1.17
0.47	1.20	0.73	1.55	1.18	0.71	1.51	1.16	0.69	1.47	1.21	0.74	1.58	1.23	0.76	1.61
0.57	1.26	0.69	1.21	1.25	0.68	1.19	1.24	0.67	1.17	1.26	0.69	1.20	1.28	0.71	1.24
0.54	1.24	0.70	1.30	1.26	0.72	1.34	1.24	0.70	1.30	1.22	0.68	1.26	1.24	0.70	1.30
0.63	1.19	0.56	0.89	1.21	0.58	0.92	1.18	0.56	0.88	1.17	0.54	0.87	1.20	0.57	0.91
0.59	1.17	0.58	0.98	1.18	0.59	1.00	1.15	0.57	0.96	1.15	0.56	0.95	1.18	0.59	1.00

0.68	1.14	0.46	0.67	1.16	0.48	0.70	1.12	0.44	0.64	1.12	0.43	0.63	1.15	0.47	0.69	
0.65	1.11	0.46	0.71	1.13	0.48	0.73	1.08	0.43	0.67	1.08	0.43	0.67	1.13	0.48	0.74	
0.59	1.08	0.49	0.83	1.10	0.51	0.87	1.06	0.47	0.80	1.06	0.47	0.80	1.10	0.51	0.87	
0.58	1.05	0.46	0.80	1.07	0.49	0.84	1.03	0.44	0.76	1.02	0.44	0.75	1.07	0.49	0.84	
0.56	$= \langle \lvert x \rvert \rangle$	*0.55*			*0.56*			*0.53*			*0.54*			*0.58*		*MAE*
		0.99			**1.01**			**0.94**			**0.97**			**1.03**		**RMAE**

Table 9.91: Experiment 04.06.08 Deployment II

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.65	1.13	0.48	0.74	1.15	0.50	0.77	1.07	0.42	0.64	1.11	0.46	0.71	1.16	0.52	0.79	
0.63	1.10	0.47	0.75	1.13	0.49	0.78	1.03	0.40	0.64	1.08	0.45	0.71	1.15	0.52	0.82	
0.66	1.07	0.41	0.62	1.10	0.43	0.65	1.00	0.34	0.51	1.04	0.38	0.57	1.12	0.46	0.69	
0.70	1.04	0.34	0.49	1.07	0.37	0.52	0.97	0.27	0.38	1.01	0.31	0.45	1.10	0.40	0.57	
0.80	1.02	0.22	0.28	1.04	0.24	0.31	0.94	0.14	0.18	0.99	0.19	0.24	1.07	0.27	0.34	
0.75	0.98	0.23	0.31	1.01	0.26	0.35	0.91	0.16	0.21	0.96	0.21	0.28	1.04	0.29	0.39	
0.68	0.95	0.27	0.39	0.97	0.29	0.42	0.88	0.19	0.28	0.92	0.24	0.35	1.00	0.32	0.47	
0.63	0.93	0.29	0.46	0.95	0.32	0.50	0.85	0.21	0.34	0.91	0.27	0.43	0.99	0.35	0.55	
0.68	0.90	0.22	0.32	0.93	0.24	0.36	0.83	0.15	0.22	0.87	0.19	0.28	0.96	0.28	0.40	
0.57	0.88	0.30	0.53	0.90	0.33	0.57	0.81	0.24	0.41	0.85	0.28	0.48	0.93	0.36	0.63	
0.56	0.84	0.28	0.49	0.87	0.30	0.54	0.79	0.22	0.40	0.82	0.25	0.45	0.88	0.32	0.57	
0.57	0.79	0.23	0.40	0.82	0.25	0.45	0.75	0.18	0.32	0.77	0.20	0.36	0.85	0.28	0.49	
0.57	0.77	0.20	0.34	0.79	0.22	0.39	0.71	0.14	0.24	0.74	0.17	0.30	0.84	0.27	0.47	
0.61	0.76	0.15	0.25	0.78	0.18	0.29	0.68	0.07	0.12	0.73	0.12	0.20	0.82	0.21	0.35	
0.55	0.73	0.18	0.33	0.76	0.21	0.38	0.67	0.12	0.21	0.71	0.16	0.29	0.79	0.23	0.43	
0.64	$= \langle \lvert x \rvert \rangle$	*0.28*			*0.31*			*0.22*			*0.26*			*0.34*		*MAE*
		0.44			**0.48**			**0.34**			**0.40**			**0.53**		**RMAE**

Table 9.92: Experiment 04.06.08 Deployment JJ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.55	0.05	-0.50	-0.91	0.05	-0.50	-0.91	0.07	-0.48	-0.87	0.06	-0.49	-0.90	0.03	-0.52	-0.95	
0.55	0.05	-0.50	-0.91	0.05	-0.50	-0.91	0.07	-0.48	-0.88	0.05	-0.50	-0.90	0.03	-0.52	-0.94	
2.38	0.05	-2.33	-0.98	0.05	-2.34	-0.98	0.07	-2.31	-0.97	0.06	-2.33	-0.98	0.03	-2.36	-0.99	
0.65	0.05	-0.59	-0.92	0.05	-0.59	-0.92	0.08	-0.57	-0.88	0.06	-0.59	-0.91	0.03	-0.61	-0.95	
1.53	0.05	-1.47	-0.96	0.05	-1.48	-0.97	0.08	-1.45	-0.95	0.06	-1.47	-0.96	0.03	-1.50	-0.98	
0.12	0.05	-0.06	-0.53	0.05	-0.06	-0.55	0.07	-0.05	-0.39	0.06	-0.06	-0.50	0.03	-0.08	-0.73	
0.12	0.05	-0.06	-0.53	0.05	-0.07	-0.59	0.08	-0.04	-0.35	0.06	-0.05	-0.47	0.04	-0.08	-0.70	
0.12	0.06	-0.06	-0.51	0.05	-0.06	-0.55	0.07	-0.04	-0.36	0.06	-0.05	-0.47	0.04	-0.08	-0.70	
0.12	0.06	-0.06	-0.51	0.05	-0.07	-0.57	0.08	-0.04	-0.34	0.07	-0.05	-0.43	0.04	-0.08	-0.68	
0.10	0.05	-0.04	-0.43	0.05	-0.05	-0.47	0.07	-0.02	-0.24	0.07	-0.03	-0.31	0.04	-0.06	-0.61	
0.10	0.06	-0.04	-0.42	0.05	-0.05	-0.48	0.07	-0.03	-0.26	0.06	-0.04	-0.39	0.03	-0.07	-0.67	
0.10	0.06	-0.04	-0.45	0.05	-0.05	-0.50	0.07	-0.03	-0.28	0.07	-0.03	-0.32	0.04	-0.06	-0.58	
0.09	0.06	-0.03	-0.32	0.05	-0.04	-0.43	0.07	-0.01	-0.14	0.07	-0.02	-0.20	0.04	-0.05	-0.56	
0.09	0.06	-0.03	-0.33	0.05	-0.04	-0.44	0.07	-0.01	-0.16	0.07	-0.02	-0.24	0.04	-0.05	-0.54	
0.09	0.06	-0.03	-0.35	0.05	-0.03	-0.40	0.07	-0.01	-0.14	0.07	-0.02	-0.18	0.04	-0.04	-0.51	
0.09	0.06	-0.03	-0.33	0.05	-0.04	-0.45	0.07	-0.02	-0.19	0.07	-0.02	-0.20	0.04	-0.05	-0.53	
0.09	0.06	-0.03	-0.29	0.05	-0.04	-0.42	0.08	-0.01	-0.12	0.07	-0.02	-0.22	0.05	-0.04	-0.48	
0.06	0.06	0.00	-0.03	0.05	-0.01	-0.21	0.07	0.01	0.15	0.07	0.01	0.18	0.05	-0.02	-0.27	
0.07	0.06	0.00	-0.04	0.05	-0.02	-0.24	0.08	0.01	0.14	0.07	0.01	0.08	0.05	-0.02	-0.27	
0.07	0.06	0.00	-0.04	0.05	-0.02	-0.24	0.07	0.01	0.13	0.07	0.01	0.13	0.05	-0.02	-0.30	
0.35	$= \langle \lvert x \rvert \rangle$	*0.30*			*0.30*			*0.28*			*0.29*			*0.31*		*MAE*
		0.84			**0.86**			**0.80**			**0.82**			**0.89**		**RMAE**

Table 9.93: Experiment 04.06.08 Deployment KK

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.07	0.01	0.08	0.08	0.02	0.23	0.08	0.02	0.26	0.06	-0.01	-0.09	0.06	-0.01	-0.10	
0.07	0.07	0.00	0.04	0.08	0.01	0.18	0.08	0.02	0.26	0.06	0.00	-0.04	0.06	-0.01	-0.12	
0.07	0.07	0.00	0.05	0.08	0.01	0.18	0.08	0.02	0.26	0.06	-0.01	-0.08	0.06	-0.01	-0.12	
0.08	0.07	-0.01	-0.12	0.08	0.00	-0.04	0.08	0.00	0.02	0.06	-0.02	-0.23	0.06	-0.02	-0.28	
0.08	0.07	-0.01	-0.16	0.07	0.00	-0.04	0.08	0.00	0.05	0.06	-0.02	-0.25	0.05	-0.02	-0.30	
0.08	0.07	-0.01	-0.13	0.07	0.00	-0.06	0.08	0.00	0.01	0.06	-0.02	-0.21	0.06	-0.02	-0.24	
0.25	0.07	-0.18	-0.73	0.07	-0.18	-0.70	0.08	-0.17	-0.68	0.06	-0.19	-0.77	0.05	-0.20	-0.78	
0.19	0.06	-0.13	-0.67	0.07	-0.12	-0.63	0.08	-0.11	-0.59	0.06	-0.13	-0.69	0.05	-0.14	-0.72	
0.19	0.07	-0.13	-0.66	0.07	-0.12	-0.62	0.07	-0.12	-0.61	0.06	-0.14	-0.70	0.06	-0.14	-0.71	
0.19	0.07	-0.13	-0.66	0.07	-0.12	-0.64	0.08	-0.12	-0.61	0.06	-0.13	-0.69	0.06	-0.14	-0.71	
0.19	0.06	-0.13	-0.67	0.07	-0.13	-0.65	0.08	-0.12	-0.60	0.06	-0.14	-0.71	0.06	-0.14	-0.71	
0.14	0.06	-0.08	-0.55	0.07	-0.07	-0.50	0.07	-0.06	-0.47	0.06	-0.08	-0.58	0.05	-0.08	-0.61	
0.16	0.06	-0.10	-0.61	0.07	-0.09	-0.57	0.07	-0.09	-0.56	0.06	-0.10	-0.65	0.06	-0.10	-0.65	
0.08	0.06	-0.02	-0.23	0.07	-0.02	-0.19	0.07	-0.01	-0.15	0.05	-0.03	-0.35	0.06	-0.03	-0.32	
0.08	0.06	-0.02	-0.28	0.07	-0.02	-0.20	0.07	-0.01	-0.15	0.05	-0.03	-0.35	0.06	-0.03	-0.33	
0.12	0.06	-0.06	-0.48	0.07	-0.05	-0.43	0.07	-0.05	-0.41	0.05	-0.06	-0.53	0.05	-0.06	-0.52	
0.13	$= \langle \lvert x \rvert \rangle$	*0.06*			*0.06*			*0.06*			*0.07*			*0.07*		*MAE*
		0.50			**0.47**			**0.45**			**0.54**			**0.56**		**RMAE**

Table 9.94: Experiment 04.06.08 Deployment LL

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.55	1.04	0.49	0.90	1.05	0.50	0.91	1.00	0.45	0.82	1.04	0.49	0.89	1.08	0.54	0.98	
0.52	1.13	0.61	1.17	1.13	0.60	1.16	1.09	0.57	1.09	1.15	0.63	1.20	1.17	0.65	1.25	
0.53	1.23	0.70	1.34	1.22	0.69	1.32	1.20	0.68	1.28	1.24	0.72	1.36	1.26	0.73	1.39	
0.49	1.29	0.81	1.65	1.29	0.80	1.64	1.28	0.79	1.62	1.29	0.80	1.65	1.31	0.82	1.69	
0.60	1.27	0.67	1.12	1.29	0.69	1.15	1.27	0.67	1.11	1.25	0.65	1.09	1.28	0.68	1.12	
0.59	1.24	0.65	1.09	1.25	0.66	1.11	1.22	0.63	1.07	1.22	0.63	1.06	1.25	0.66	1.12	
0.65	1.22	0.57	0.89	1.23	0.59	0.91	1.20	0.56	0.86	1.20	0.56	0.86	1.23	0.59	0.91	
0.61	1.19	0.58	0.96	1.21	0.60	0.99	1.18	0.57	0.93	1.18	0.57	0.93	1.21	0.60	0.99	
0.66	1.17	0.51	0.76	1.19	0.53	0.79	1.15	0.49	0.74	1.15	0.49	0.74	1.19	0.53	0.79	
0.65	1.15	0.50	0.77	1.17	0.52	0.80	1.12	0.47	0.73	1.12	0.47	0.73	1.17	0.52	0.80	
0.67	1.12	0.45	0.66	1.14	0.46	0.69	1.10	0.43	0.63	1.10	0.42	0.63	1.14	0.47	0.69	
0.68	1.09	0.40	0.59	1.11	0.43	0.63	1.06	0.38	0.55	1.06	0.38	0.55	1.12	0.43	0.63	
0.73	1.06	0.34	0.46	1.09	0.36	0.50	1.04	0.31	0.43	1.04	0.31	0.43	1.09	0.37	0.51	
0.66	1.04	0.38	0.58	1.06	0.40	0.61	1.01	0.35	0.53	1.02	0.36	0.54	1.07	0.41	0.62	
0.68	1.01	0.33	0.48	1.03	0.35	0.52	0.99	0.31	0.46	0.98	0.30	0.44	1.02	0.34	0.50	
0.73	0.96	0.23	0.31	0.98	0.25	0.35	0.94	0.22	0.30	0.93	0.20	0.28	0.98	0.25	0.34	
0.62	= <|x|>	*0.51*			*0.53*			*0.49*			*0.50*			*0.54*		*MAE*
		0.82			**0.85**			**0.79**			**0.80**			**0.86**		**RMAE**

Table 9.95: Experiment 04.06.08 Deployment MM

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.65	1.07	0.41	0.63	1.08	0.43	0.66	1.00	0.35	0.54	1.05	0.40	0.62	1.12	0.46	0.71	
0.71	1.04	0.33	0.46	1.05	0.34	0.48	0.97	0.25	0.36	1.02	0.31	0.43	1.09	0.38	0.53	
0.66	1.01	0.35	0.53	1.02	0.36	0.55	0.94	0.28	0.43	0.99	0.34	0.51	1.06	0.41	0.62	
0.68	0.98	0.30	0.44	0.99	0.31	0.46	0.92	0.24	0.35	0.96	0.28	0.41	1.04	0.36	0.52	
0.65	0.95	0.30	0.46	0.97	0.31	0.48	0.89	0.23	0.36	0.94	0.29	0.44	1.01	0.36	0.55	
0.71	0.93	0.22	0.32	0.94	0.24	0.34	0.86	0.16	0.22	0.91	0.21	0.29	0.98	0.28	0.39	
0.64	0.89	0.25	0.40	0.91	0.27	0.42	0.83	0.19	0.30	0.87	0.23	0.36	0.93	0.30	0.47	
0.65	0.84	0.19	0.30	0.86	0.21	0.32	0.79	0.14	0.21	0.83	0.18	0.28	0.90	0.25	0.38	
0.72	0.83	0.11	0.15	0.83	0.12	0.17	0.75	0.04	0.05	0.81	0.10	0.14	0.90	0.18	0.25	
0.69	0.82	0.12	0.18	0.83	0.14	0.20	0.74	0.05	0.07	0.80	0.11	0.16	0.87	0.17	0.25	
0.68	0.78	0.10	0.15	0.80	0.12	0.18	0.72	0.04	0.06	0.77	0.09	0.13	0.83	0.15	0.22	
0.61	0.75	0.14	0.23	0.76	0.15	0.25	0.69	0.08	0.13	0.74	0.13	0.21	0.81	0.20	0.32	
0.62	0.74	0.11	0.18	0.75	0.12	0.19	0.66	0.04	0.06	0.73	0.11	0.17	0.80	0.18	0.29	
0.66	0.73	0.08	0.12	0.74	0.09	0.13	0.66	0.00	0.00	0.73	0.07	0.11	0.82	0.17	0.25	
0.60	0.75	0.15	0.26	0.76	0.16	0.27	0.65	0.06	0.09	0.75	0.15	0.25	0.84	0.24	0.40	
0.55	0.77	0.23	0.42	0.78	0.23	0.42	0.66	0.11	0.20	0.77	0.22	0.41	0.79	0.24	0.44	
0.58	0.74	0.16	0.28	0.76	0.18	0.30	0.68	0.10	0.17	0.72	0.15	0.25	0.73	0.15	0.26	
0.56	0.68	0.12	0.21	0.69	0.13	0.23	0.70	0.13	0.24	0.67	0.11	0.19	0.73	0.17	0.30	
0.59	0.67	0.08	0.14	0.67	0.09	0.15	0.65	0.06	0.11	0.66	0.08	0.13	0.74	0.16	0.27	
0.56	0.68	0.12	0.21	0.69	0.13	0.23	0.60	0.04	0.08	0.68	0.12	0.21	0.72	0.16	0.29	
0.55	0.68	0.13	0.23	0.69	0.13	0.24	0.60	0.05	0.09	0.67	0.12	0.21	0.70	0.15	0.27	
0.53	0.65	0.12	0.24	0.66	0.13	0.25	0.62	0.09	0.17	0.65	0.12	0.23	0.70	0.17	0.33	
0.55	0.65	0.09	0.16	0.65	0.10	0.18	0.62	0.06	0.11	0.64	0.08	0.15	0.69	0.13	0.24	
0.51	0.64	0.14	0.27	0.65	0.14	0.28	0.59	0.08	0.16	0.63	0.13	0.25	0.67	0.16	0.32	
0.50	0.62	0.12	0.25	0.63	0.13	0.26	0.58	0.08	0.16	0.62	0.12	0.24	0.66	0.16	0.32	
0.45	0.61	0.16	0.35	0.62	0.17	0.37	0.58	0.12	0.27	0.60	0.15	0.33	0.66	0.21	0.46	
0.44	0.60	0.16	0.36	0.61	0.16	0.37	0.56	0.12	0.27	0.60	0.15	0.34	0.65	0.21	0.47	
0.49	0.60	0.11	0.23	0.60	0.12	0.24	0.55	0.07	0.14	0.59	0.11	0.22	0.64	0.15	0.31	
0.47	0.59	0.13	0.28	0.60	0.14	0.30	0.54	0.07	0.16	0.58	0.12	0.26	0.61	0.14	0.31	
0.52	0.58	0.06	0.12	0.58	0.07	0.13	0.54	0.02	0.04	0.57	0.06	0.11	0.58	0.07	0.13	
0.39	0.55	0.16	0.42	0.56	0.17	0.44	0.53	0.14	0.36	0.54	0.16	0.40	0.58	0.19	0.49	
0.43	0.52	0.10	0.22	0.53	0.10	0.24	0.52	0.10	0.22	0.52	0.09	0.21	0.60	0.17	0.39	
0.38	0.50	0.12	0.31	0.51	0.13	0.34	0.51	0.13	0.33	0.50	0.11	0.29	0.62	0.23	0.61	
0.48	0.51	0.02	0.05	0.52	0.03	0.07	0.48	0.00	0.00	0.49	0.01	0.02	0.62	0.14	0.29	
0.40	0.54	0.14	0.34	0.55	0.15	0.37	0.46	0.06	0.14	0.53	0.13	0.31	0.62	0.22	0.54	
0.41	0.57	0.16	0.39	0.57	0.17	0.41	0.42	0.02	0.04	0.56	0.15	0.37	0.60	0.19	0.46	
0.48	0.57	0.09	0.20	0.58	0.10	0.21	0.40	-0.08	-0.16	0.57	0.09	0.18	0.58	0.10	0.21	
0.40	0.56	0.15	0.39	0.56	0.16	0.40	0.40	0.00	0.00	0.56	0.15	0.39	0.56	0.16	0.40	
0.45	0.54	0.09	0.20	0.55	0.09	0.21	0.44	-0.02	-0.04	0.54	0.09	0.19	0.55	0.10	0.22	
0.45	0.53	0.08	0.17	0.53	0.08	0.17	0.48	0.03	0.07	0.52	0.07	0.15	0.56	0.10	0.23	
0.47	0.51	0.04	0.09	0.52	0.05	0.11	0.50	0.04	0.08	0.50	0.04	0.08	0.56	0.09	0.19	
0.43	0.50	0.06	0.14	0.50	0.07	0.15	0.50	0.06	0.15	0.49	0.06	0.13	0.57	0.13	0.30	
0.42	0.49	0.08	0.18	0.50	0.08	0.20	0.48	0.06	0.14	0.49	0.07	0.17	0.56	0.14	0.35	
0.41	0.50	0.08	0.21	0.50	0.09	0.22	0.46	0.05	0.12	0.49	0.08	0.18	0.57	0.16	0.38	
0.43	0.50	0.06	0.14	0.50	0.07	0.16	0.44	0.01	0.02	0.49	0.06	0.13	0.56	0.12	0.29	
0.43	0.50	0.07	0.17	0.51	0.08	0.19	0.43	0.00	0.01	0.49	0.06	0.15	0.55	0.12	0.28	
0.38	0.50	0.12	0.31	0.51	0.13	0.33	0.42	0.04	0.10	0.50	0.11	0.29	0.54	0.16	0.41	
0.37	0.51	0.14	0.37	0.51	0.14	0.39	0.41	0.04	0.11	0.50	0.13	0.36	0.53	0.16	0.44	
0.39	0.50	0.11	0.29	0.51	0.12	0.31	0.41	0.02	0.06	0.49	0.11	0.28	0.52	0.13	0.35	
0.42	0.50	0.07	0.17	0.50	0.07	0.17	0.41	-0.02	-0.04	0.49	0.07	0.16	0.51	0.09	0.21	
0.37	0.48	0.12	0.32	0.49	0.12	0.34	0.41	0.05	0.13	0.48	0.11	0.31	0.50	0.14	0.38	
0.52	= <|x|>	*0.14*			*0.15*			*0.08*			*0.13*			*0.19*		*MAE*
		0.27			**0.29**			**0.16**			**0.25**			**0.36**		**RMAE**

Table 9.96: Experiment 04.06.08 Deployment NN

S_{Radar}	Modelled - d1	Modelled - d2	Modelled - d3	Modelled - d4	Modelled - d5

	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.37	0.54	0.18	0.48	0.54	0.18	0.49	0.52	0.15	0.42	0.54	0.17	0.46	0.56	0.19	0.53	
0.38	0.53	0.15	0.39	0.53	0.15	0.40	0.51	0.13	0.34	0.52	0.14	0.38	0.54	0.17	0.44	
0.36	0.51	0.16	0.44	0.52	0.17	0.46	0.49	0.13	0.36	0.51	0.15	0.43	0.54	0.18	0.50	
0.40	0.51	0.11	0.27	0.51	0.11	0.27	0.49	0.09	0.22	0.51	0.11	0.28	0.53	0.13	0.32	
0.37	0.51	0.14	0.38	0.51	0.14	0.37	0.49	0.12	0.32	0.51	0.14	0.38	0.53	0.16	0.43	
0.43	0.51	0.08	0.18	0.51	0.08	0.18	0.49	0.05	0.13	0.51	0.08	0.19	0.53	0.10	0.23	
0.39	0.51	0.13	0.32	0.51	0.12	0.32	0.49	0.10	0.26	0.52	0.13	0.34	0.53	0.14	0.37	
0.33	0.51	0.18	0.55	0.51	0.18	0.55	0.50	0.16	0.50	0.52	0.19	0.56	0.54	0.21	0.62	
0.35	0.52	0.17	0.48	0.51	0.16	0.47	0.49	0.14	0.41	0.51	0.16	0.47	0.53	0.18	0.52	
0.39	0.51	0.12	0.31	0.51	0.12	0.32	0.49	0.10	0.27	0.51	0.12	0.32	0.53	0.14	0.36	
0.33	0.51	0.17	0.52	0.51	0.17	0.52	0.49	0.15	0.46	0.50	0.17	0.50	0.52	0.19	0.56	
0.40	0.50	0.10	0.25	0.50	0.10	0.26	0.48	0.08	0.21	0.50	0.10	0.24	0.52	0.12	0.29	
0.42	0.50	0.08	0.18	0.50	0.08	0.18	0.47	0.06	0.13	0.49	0.07	0.17	0.51	0.09	0.22	
0.36	0.48	0.12	0.33	0.49	0.13	0.35	0.47	0.11	0.30	0.48	0.12	0.33	0.50	0.14	0.39	
0.41	0.48	0.07	0.16	0.48	0.07	0.17	0.46	0.05	0.12	0.48	0.06	0.16	0.50	0.09	0.21	
0.39	0.47	0.08	0.20	0.48	0.08	0.21	0.46	0.06	0.16	0.47	0.07	0.19	0.49	0.10	0.24	
0.37	0.46	0.09	0.25	0.46	0.09	0.25	0.45	0.08	0.20	0.47	0.09	0.25	0.49	0.11	0.30	
0.47	0.46	-0.01	-0.02	0.46	-0.01	-0.03	0.44	-0.04	-0.08	0.46	-0.01	-0.02	0.48	0.01	0.01	
0.37	0.46	0.09	0.25	0.46	0.09	0.25	0.44	0.07	0.20	0.46	0.09	0.24	0.48	0.11	0.30	
0.42	0.46	0.03	0.08	0.45	0.03	0.07	0.43	0.01	0.02	0.45	0.03	0.07	0.47	0.05	0.12	
0.38	0.45	0.07	0.19	0.45	0.07	0.19	0.43	0.05	0.14	0.45	0.07	0.19	0.47	0.09	0.23	
0.40	0.45	0.05	0.13	0.45	0.05	0.13	0.43	0.03	0.08	0.44	0.05	0.11	0.47	0.07	0.17	
0.38	0.44	0.06	0.15	0.45	0.06	0.16	0.42	0.04	0.10	0.44	0.06	0.15	0.46	0.08	0.20	
0.40	0.44	0.04	0.10	0.44	0.04	0.10	0.42	0.02	0.05	0.44	0.04	0.10	0.45	0.06	0.14	
0.39	0.43	0.04	0.11	0.43	0.04	0.12	0.41	0.02	0.05	0.43	0.04	0.11	0.45	0.06	0.15	
0.43	0.43	0.00	0.00	0.43	0.00	0.00	0.40	-0.03	-0.06	0.43	0.00	0.00	0.45	0.02	0.04	
0.41	0.43	0.02	0.05	0.43	0.02	0.04	0.40	-0.01	-0.02	0.43	0.02	0.04	0.44	0.04	0.09	
0.41	0.42	0.01	0.02	0.42	0.01	0.03	0.40	-0.02	-0.04	0.42	0.01	0.02	0.45	0.03	0.08	
0.42	0.43	0.01	0.01	0.42	0.00	0.01	0.39	-0.03	-0.06	0.42	0.00	0.01	0.45	0.03	0.06	
0.38	0.42	0.04	0.11	0.42	0.04	0.11	0.39	0.01	0.04	0.43	0.05	0.12	0.45	0.07	0.18	
0.39	0.43	0.04	0.11	0.42	0.03	0.08	0.40	0.01	0.02	0.44	0.04	0.11	0.45	0.06	0.16	
0.38	0.43	0.05	0.14	0.43	0.05	0.14	0.40	0.02	0.06	0.44	0.06	0.15	0.46	0.08	0.21	
0.34	0.44	0.10	0.30	0.44	0.10	0.29	0.40	0.07	0.20	0.44	0.10	0.30	0.46	0.12	0.37	
0.38	0.44	0.06	0.17	0.44	0.06	0.16	0.42	0.04	0.10	0.45	0.07	0.18	0.46	0.09	0.23	
0.38	0.45	0.06	0.17	0.44	0.06	0.15	0.42	0.03	0.09	0.45	0.07	0.17	0.47	0.08	0.21	
0.38	0.45	0.07	0.18	0.45	0.07	0.19	0.42	0.04	0.11	0.45	0.07	0.19	0.47	0.09	0.25	
0.35	0.45	0.11	0.30	0.45	0.10	0.29	0.43	0.08	0.22	0.45	0.10	0.29	0.47	0.12	0.35	
0.39	0.45	0.06	0.15	0.45	0.06	0.15	0.43	0.03	0.09	0.46	0.06	0.16	0.47	0.08	0.19	
0.35	0.45	0.11	0.31	0.45	0.10	0.30	0.43	0.09	0.25	0.45	0.11	0.31	0.47	0.12	0.35	
0.36	0.45	0.09	0.24	0.45	0.09	0.25	0.43	0.07	0.19	0.45	0.09	0.24	0.47	0.11	0.30	
0.33	0.45	0.12	0.37	0.45	0.12	0.36	0.43	0.10	0.30	0.45	0.12	0.38	0.47	0.14	0.42	
0.32	0.45	0.13	0.39	0.45	0.12	0.39	0.43	0.11	0.33	0.45	0.12	0.38	0.47	0.15	0.45	
0.35	0.45	0.10	0.27	0.45	0.10	0.28	0.43	0.08	0.23	0.46	0.10	0.29	0.47	0.12	0.34	
0.31	0.46	0.15	0.48	0.45	0.14	0.47	0.43	0.12	0.40	0.46	0.15	0.48	0.47	0.16	0.52	
0.31	0.45	0.15	0.48	0.45	0.15	0.48	0.43	0.12	0.40	0.46	0.15	0.49	0.46	0.16	0.52	
0.36	0.45	0.09	0.24	0.45	0.09	0.24	0.43	0.07	0.19	0.45	0.09	0.24	0.46	0.09	0.25	
0.28	0.45	0.16	0.57	0.45	0.17	0.58	0.43	0.15	0.53	0.44	0.16	0.55	0.45	0.17	0.58	
0.34	0.44	0.10	0.30	0.44	0.10	0.31	0.43	0.10	0.29	0.43	0.09	0.28	0.44	0.10	0.29	
0.36	0.43	0.07	0.19	0.43	0.07	0.19	0.42	0.06	0.17	0.43	0.07	0.19	0.43	0.07	0.20	
0.34	0.42	0.08	0.24	0.43	0.09	0.26	0.42	0.08	0.23	0.42	0.08	0.23	0.42	0.08	0.24	
0.22	0.41	0.20	0.90	0.42	0.20	0.92	0.41	0.19	0.88	0.41	0.19	0.88	0.42	0.20	0.93	
0.28	0.41	0.12	0.43	0.41	0.12	0.44	0.40	0.12	0.42	0.40	0.12	0.42	0.41	0.12	0.43	
0.32	0.40	0.08	0.25	0.40	0.08	0.27	0.40	0.08	0.25	0.39	0.08	0.24	0.40	0.08	0.27	
0.40	0.39	-0.01	-0.03	0.40	-0.01	-0.02	0.39	-0.01	-0.03	0.39	-0.02	-0.04	0.40	0.00	-0.01	
0.28	0.38	0.10	0.38	0.38	0.11	0.39	0.38	0.10	0.37	0.38	0.10	0.37	0.39	0.11	0.40	
0.33	0.37	0.04	0.12	0.38	0.04	0.13	0.37	0.04	0.12	0.37	0.04	0.11	0.39	0.06	0.17	
0.36	0.37	0.01	0.02	0.37	0.00	0.01	0.37	0.00	0.01	0.37	0.00	0.01	0.38	0.02	0.06	
0.30	0.36	0.06	0.21	0.36	0.06	0.22	0.35	0.05	0.18	0.36	0.06	0.21	0.38	0.09	0.29	
0.31	0.36	0.05	0.15	0.36	0.05	0.16	0.35	0.04	0.12	0.36	0.05	0.16	0.38	0.07	0.23	
0.31	0.36	0.05	0.16	0.36	0.05	0.16	0.34	0.03	0.09	0.36	0.05	0.16	0.38	0.07	0.22	
0.31	0.36	0.05	0.16	0.36	0.05	0.16	0.33	0.03	0.09	0.36	0.06	0.19	0.38	0.07	0.23	
0.28	0.36	0.07	0.25	0.35	0.07	0.24	0.32	0.04	0.13	0.35	0.07	0.23	0.37	0.09	0.31	
0.28	0.35	0.07	0.26	0.35	0.07	0.26	0.33	0.05	0.17	0.35	0.07	0.26	0.37	0.09	0.32	
0.28	0.35	0.07	0.25	0.35	0.07	0.25	0.33	0.05	0.17	0.35	0.07	0.26	0.36	0.08	0.30	
0.31	0.34	0.04	0.12	0.34	0.04	0.12	0.32	0.01	0.05	0.34	0.04	0.12	0.36	0.05	0.17	
0.30	0.34	0.04	0.15	0.34	0.04	0.15	0.32	0.02	0.08	0.34	0.04	0.14	0.35	0.05	0.18	
0.29	0.33	0.04	0.13	0.33	0.04	0.14	0.31	0.02	0.07	0.33	0.04	0.13	0.35	0.06	0.20	
0.29	0.33	0.03	0.11	0.33	0.03	0.11	0.31	0.01	0.05	0.33	0.03	0.11	0.34	0.05	0.15	
0.25	0.32	0.07	0.28	0.32	0.07	0.27	0.31	0.05	0.22	0.32	0.07	0.27	0.34	0.09	0.35	
0.29	0.31	0.03	0.09	0.32	0.03	0.10	0.30	0.01	0.03	0.32	0.03	0.10	0.34	0.05	0.16	
0.27	0.31	0.04	0.15	0.31	0.04	0.16	0.29	0.02	0.08	0.31	0.04	0.16	0.33	0.06	0.23	
0.25	0.31	0.06	0.23	0.30	0.05	0.20	0.28	0.03	0.12	0.31	0.06	0.22	0.33	0.07	0.29	
0.26	0.30	0.04	0.14	0.30	0.04	0.15	0.28	0.02	0.06	0.30	0.04	0.15	0.32	0.05	0.20	
0.29	0.30	0.01	0.03	0.30	0.01	0.03	0.28	-0.01	-0.04	0.30	0.01	0.04	0.31	0.02	0.06	
0.26	0.29	0.03	0.11	0.29	0.03	0.10	0.27	0.00	0.01	0.30	0.03	0.12	0.30	0.04	0.13	
0.30	0.29	-0.01	-0.05	0.29	-0.02	-0.05	0.26	-0.04	-0.14	0.29	-0.02	-0.06	0.29	-0.01	-0.05	
0.23	0.28	0.05	0.23	0.28	0.06	0.25	0.26	0.03	0.12	0.28	0.05	0.23	0.29	0.06	0.27	
0.30	0.27	-0.03	-0.10	0.27	-0.03	-0.10	0.25	-0.05	-0.15	0.27	-0.03	-0.10	0.28	-0.02	-0.07	
0.24	0.26	0.02	0.09	0.27	0.03	0.11	0.25	0.00	0.01	0.26	0.02	0.07	0.28	0.03	0.13	
0.34	=<|x|>	*0.08*			*0.08*			*0.06*			*0.08*			*0.09*		*MAE*
		0.22			**0.22**			**0.18**			**0.22**			**0.26**		**RMAE**

Table 9.97: Experiment 04.06.08 Deployment OO

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.07	0.09	0.01	0.17	0.09	0.02	0.24	0.09	0.02	0.23	0.08	0.01	0.14	0.09	0.01	0.19	
0.18	0.09	-0.09	-0.52	0.09	-0.09	-0.49	0.09	-0.09	-0.51	0.08	-0.09	-0.52	0.09	-0.09	-0.50	
0.11	0.09	-0.02	-0.19	0.09	-0.02	-0.21	0.08	-0.03	-0.25	0.08	-0.03	-0.26	0.09	-0.02	-0.18	
0.03	0.09	0.05	1.62	0.09	0.06	1.75	0.09	0.06	1.70	0.09	0.06	1.71	0.09	0.06	1.83	
0.17	0.09	-0.08	-0.47	0.09	-0.08	-0.45	0.09	-0.08	-0.47	0.09	-0.08	-0.47	0.10	-0.07	-0.40	
0.01	0.10	0.08	5.57	0.10	0.08	5.56	0.09	0.07	5.04	0.09	0.08	5.37	0.10	0.09	5.93	
0.10	0.10	0.00	-0.04	0.10	0.00	-0.05	0.09	-0.01	-0.11	0.10	0.00	-0.04	0.11	0.01	0.09	
0.09	0.10	0.02	0.19	0.10	0.02	0.22	0.09	0.01	0.10	0.10	0.01	0.16	0.11	0.02	0.27	
0.11	0.10	0.00	-0.02	0.10	0.00	-0.04	0.09	-0.01	-0.11	0.10	-0.01	-0.05	0.11	0.01	0.08	
0.05	0.10	0.06	1.21	0.10	0.06	1.20	0.10	0.05	1.07	0.10	0.06	1.17	0.12	0.07	1.47	
0.05	0.11	0.06	1.11	0.11	0.06	1.16	0.10	0.05	0.97	0.10	0.05	1.02	0.12	0.07	1.39	
0.10	0.11	0.01	0.13	0.11	0.02	0.18	0.10	0.00	0.04	0.11	0.01	0.14	0.13	0.04	0.41	
0.12	0.11	-0.01	-0.05	0.12	0.00	-0.01	0.11	-0.01	-0.11	0.11	-0.01	-0.06	0.14	0.02	0.17	
0.11	0.12	0.01	0.06	0.12	0.01	0.05	0.11	-0.01	-0.05	0.12	0.00	0.03	0.14	0.03	0.25	
0.10	0.12	0.02	0.25	0.12	0.03	0.28	0.10	0.01	0.08	0.12	0.02	0.22	0.14	0.04	0.46	
0.09	0.12	0.03	0.34	0.14	0.05	0.51	0.11	0.02	0.20	0.12	0.03	0.28	0.15	0.06	0.61	
0.14	0.13	-0.01	-0.09	0.14	0.00	0.01	0.11	-0.02	-0.18	0.13	-0.01	-0.08	0.15	0.01	0.10	
0.11	0.13	0.02	0.18	0.14	0.03	0.31	0.11	0.00	0.04	0.13	0.02	0.21	0.16	0.05	0.48	
0.09	0.14	0.05	0.54	0.15	0.06	0.62	0.12	0.03	0.29	0.14	0.05	0.50	0.16	0.07	0.79	
0.14	0.14	0.00	0.01	0.15	0.01	0.05	0.12	-0.02	-0.18	0.13	-0.01	-0.04	0.16	0.02	0.14	
0.10	0.15	0.04	0.42	0.14	0.04	0.40	0.12	0.02	0.18	0.13	0.03	0.28	0.16	0.06	0.57	
0.11	0.14	0.04	0.36	0.16	0.05	0.48	0.12	0.02	0.17	0.13	0.03	0.25	0.16	0.06	0.54	
0.10	0.14	0.04	0.40	0.15	0.05	0.49	0.13	0.03	0.27	0.13	0.03	0.28	0.16	0.06	0.56	
0.15	0.14	-0.01	-0.09	0.16	0.00	0.01	0.13	-0.02	-0.16	0.13	-0.03	-0.18	0.16	0.00	0.01	
0.10	0.14	0.04	0.38	0.15	0.05	0.45	0.13	0.03	0.27	0.13	0.02	0.22	0.15	0.05	0.47	
0.15	0.14	-0.01	-0.09	0.15	0.00	0.02	0.13	-0.03	-0.17	0.13	-0.02	-0.16	0.15	0.00	-0.01	
0.12	0.14	0.02	0.16	0.15	0.03	0.28	0.13	0.01	0.06	0.12	0.00	0.00	0.14	0.02	0.20	
0.13	0.13	0.00	0.01	0.15	0.01	0.10	0.12	-0.01	-0.06	0.12	-0.01	-0.11	0.14	0.01	0.07	
0.12	0.13	0.01	0.07	0.14	0.02	0.21	0.12	0.00	0.01	0.11	-0.01	-0.07	0.14	0.02	0.15	
0.11	$= \langle \lvert x \rvert \rangle$	*0.03*			*0.03*			*0.03*			*0.03*			*0.04*		*MAE*
		0.28			**0.31**			**0.25**			**0.27**			**0.37**		**RMAE**

Table 9.98: Experiment 04.06.08 Deployment PP

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.09	0.19	0.10	1.06	0.18	0.09	0.99	0.13	0.04	0.49	0.19	0.10	1.06	0.28	0.19	2.08	
0.12	0.19	0.07	0.62	0.19	0.07	0.62	0.13	0.02	0.15	0.19	0.07	0.64	0.28	0.16	1.39	
0.11	0.19	0.08	0.73	0.19	0.08	0.76	0.13	0.02	0.17	0.19	0.08	0.73	0.27	0.16	1.49	
0.11	0.19	0.08	0.70	0.19	0.08	0.70	0.13	0.02	0.17	0.18	0.07	0.65	0.27	0.16	1.44	
0.09	0.18	0.09	0.94	0.19	0.10	1.01	0.13	0.03	0.34	0.18	0.09	0.94	0.26	0.17	1.78	
0.11	0.19	0.07	0.67	0.19	0.08	0.69	0.13	0.02	0.14	0.18	0.07	0.65	0.26	0.15	1.32	
0.11	0.19	0.08	0.69	0.19	0.08	0.69	0.12	0.01	0.12	0.18	0.07	0.61	0.25	0.14	1.25	
0.11	0.18	0.07	0.58	0.19	0.08	0.68	0.12	0.01	0.06	0.17	0.06	0.52	0.25	0.13	1.16	
0.02	0.17	0.15	6.78	0.18	0.16	7.20	0.12	0.09	4.16	0.16	0.14	6.35	0.23	0.21	9.30	
0.08	0.17	0.09	1.12	0.18	0.10	1.29	0.11	0.03	0.42	0.16	0.08	1.06	0.22	0.14	1.74	
0.10	0.17	0.07	0.77	0.17	0.08	0.82	0.11	0.02	0.16	0.15	0.06	0.60	0.21	0.11	1.19	
0.09	0.16	0.07	0.74	0.17	0.08	0.87	0.11	0.02	0.24	0.15	0.06	0.67	0.20	0.11	1.17	
0.05	0.16	0.11	2.18	0.17	0.12	2.46	0.11	0.06	1.23	0.14	0.09	1.90	0.19	0.14	2.74	
0.08	0.15	0.07	0.80	0.16	0.08	0.96	0.11	0.03	0.35	0.14	0.05	0.63	0.17	0.09	1.08	
0.09	0.15	0.06	0.70	0.16	0.07	0.83	0.11	0.02	0.29	0.13	0.04	0.50	0.16	0.07	0.82	
0.08	0.14	0.06	0.71	0.15	0.07	0.93	0.11	0.03	0.40	0.12	0.04	0.52	0.14	0.06	0.81	
0.06	0.13	0.07	1.29	0.14	0.09	1.51	0.11	0.05	0.89	0.11	0.05	0.95	0.13	0.07	1.24	
0.08	0.12	0.05	0.60	0.14	0.06	0.86	0.10	0.03	0.38	0.10	0.03	0.35	0.11	0.04	0.49	
0.10	0.11	0.01	0.10	0.13	0.03	0.31	0.10	0.00	0.03	0.09	-0.01	-0.08	0.09	-0.01	-0.07	
0.03	0.10	0.08	2.86	0.12	0.09	3.37	0.10	0.07	2.71	0.08	0.06	2.09	0.08	0.06	2.06	
0.04	0.09	0.05	1.21	0.11	0.07	1.83	0.10	0.06	1.42	0.08	0.04	0.93	0.07	0.03	0.75	
0.07	0.08	0.02	0.24	0.10	0.03	0.48	0.09	0.03	0.38	0.07	0.00	0.00	0.06	-0.01	-0.09	
0.07	0.07	0.01	0.08	0.09	0.02	0.32	0.09	0.02	0.24	0.07	0.00	0.00	0.06	-0.01	-0.17	
0.03	0.07	0.04	1.25	0.08	0.05	1.51	0.09	0.05	1.73	0.06	0.03	1.00	0.05	0.02	0.75	
0.07	0.06	0.00	-0.03	0.07	0.01	0.10	0.08	0.01	0.18	0.06	0.00	-0.06	0.06	-0.01	-0.12	
0.02	0.06	0.05	2.93	0.07	0.05	3.20	0.07	0.06	3.70	0.06	0.05	2.99	0.06	0.05	3.06	
0.02	0.06	0.04	2.57	0.06	0.04	2.58	0.07	0.05	2.95	0.07	0.05	2.95	0.08	0.06	3.38	
0.05	0.07	0.01	0.25	0.06	0.01	0.13	0.06	0.01	0.22	0.07	0.02	0.30	0.09	0.03	0.65	
0.05	0.07	0.02	0.45	0.06	0.02	0.35	0.06	0.01	0.29	0.07	0.03	0.57	0.09	0.05	0.98	
0.07	0.07	0.00	0.07	0.06	0.00	-0.04	0.05	-0.01	-0.21	0.08	0.01	0.19	0.10	0.04	0.57	
0.09	0.07	-0.01	-0.17	0.07	-0.02	-0.22	0.05	-0.04	-0.42	0.08	-0.01	-0.10	0.11	0.02	0.20	
0.06	0.08	0.02	0.35	0.07	0.02	0.26	0.05	-0.01	-0.13	0.09	0.03	0.48	0.11	0.06	0.97	
0.11	0.08	-0.03	-0.26	0.08	-0.03	-0.29	0.04	-0.06	-0.60	0.08	-0.02	-0.22	0.12	0.01	0.07	
0.07	$= \langle \lvert x \rvert \rangle$	*0.05*			*0.06*			*0.03*			*0.05*			*0.08*		*MAE*
		0.75			**0.85**			**0.43**			**0.66**			**1.13**		**RMAE**

Table 9.99: Experiment 04.06.08 Deployment QQ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.08	0.07	0.00	-0.06	0.07	0.00	0.00	0.04	-0.03	-0.44	0.07	-0.01	-0.10	0.10	0.03	0.34
0.16	0.07	-0.09	-0.56	0.08	-0.08	-0.52	0.04	-0.11	-0.72	0.07	-0.09	-0.59	0.10	-0.06	-0.35
0.06	0.07	0.02	0.29	0.08	0.02	0.34	0.04	-0.01	-0.23	0.07	0.01	0.21	0.11	0.05	0.87
0.17	0.07	-0.10	-0.58	0.08	-0.10	-0.56	0.05	-0.13	-0.74	0.07	-0.11	-0.61	0.11	-0.07	-0.38

0.05	0.08	0.03	0.70	0.08	0.03	0.73	0.04	0.00	-0.02	0.07	0.02	0.50	0.11	0.07	1.46	
0.09	0.07	-0.01	-0.16	0.08	-0.01	-0.08	0.05	-0.04	-0.42	0.07	-0.02	-0.20	0.11	0.03	0.29	
0.16	0.08	-0.08	-0.51	0.08	-0.08	-0.48	0.05	-0.11	-0.69	0.07	-0.09	-0.55	0.11	-0.04	-0.28	
0.07	0.08	0.01	0.09	0.08	0.01	0.17	0.05	-0.02	-0.33	0.08	0.00	0.07	0.12	0.05	0.65	
0.07	0.08	0.01	0.11	0.08	0.01	0.15	0.05	-0.02	-0.27	0.07	0.00	0.05	0.12	0.05	0.68	
0.14	0.08	-0.06	-0.43	0.09	-0.05	-0.39	0.05	-0.09	-0.65	0.08	-0.06	-0.44	0.12	-0.02	-0.16	
0.04	0.09	0.04	1.05	0.09	0.05	1.09	0.06	0.02	0.36	0.08	0.04	0.87	0.12	0.08	1.93	
0.13	0.09	-0.04	-0.33	0.09	-0.04	-0.29	0.05	-0.08	-0.60	0.08	-0.05	-0.38	0.12	-0.01	-0.06	
0.07	0.08	0.01	0.18	0.09	0.02	0.26	0.06	-0.01	-0.20	0.08	0.01	0.12	0.12	0.05	0.71	
0.10	0.09	-0.02	-0.17	0.09	-0.01	-0.10	0.06	-0.05	-0.46	0.08	-0.02	-0.21	0.12	0.02	0.16	
0.09	0.09	0.00	-0.05	0.09	0.00	-0.01	0.06	-0.04	-0.40	0.08	-0.01	-0.14	0.12	0.03	0.29	
0.12	0.09	-0.03	-0.23	0.09	-0.02	-0.18	0.06	-0.06	-0.51	0.08	-0.03	-0.30	0.12	0.01	0.05	
0.10	0.09	-0.01	-0.13	0.09	-0.01	-0.05	0.06	-0.04	-0.43	0.08	-0.02	-0.18	0.12	0.02	0.18	
0.14	0.09	-0.05	-0.39	0.09	-0.05	-0.34	0.06	-0.08	-0.58	0.08	-0.06	-0.42	0.12	-0.02	-0.16	
0.11	0.09	-0.02	-0.15	0.10	-0.01	-0.10	0.06	-0.05	-0.46	0.08	-0.02	-0.22	0.12	0.01	0.08	
0.09	0.09	0.00	-0.04	0.10	0.00	0.01	0.06	-0.04	-0.38	0.08	-0.01	-0.14	0.12	0.02	0.23	
0.12	0.09	-0.03	-0.26	0.09	-0.02	-0.21	0.06	-0.06	-0.52	0.08	-0.03	-0.29	0.11	0.00	-0.04	
0.13	0.09	-0.04	-0.34	0.10	-0.04	-0.27	0.06	-0.07	-0.55	0.08	-0.05	-0.40	0.11	-0.02	-0.14	
0.14	0.09	-0.05	-0.36	0.10	-0.05	-0.32	0.06	-0.08	-0.57	0.08	-0.06	-0.44	0.11	-0.03	-0.23	
0.13	0.08	-0.04	-0.35	0.09	-0.04	-0.29	0.06	-0.07	-0.54	0.08	-0.05	-0.41	0.11	-0.02	-0.17	
0.16	0.08	-0.08	-0.48	0.09	-0.07	-0.42	0.06	-0.11	-0.66	0.08	-0.09	-0.54	0.10	-0.06	-0.37	
0.17	0.08	-0.08	-0.50	0.09	-0.08	-0.47	0.06	-0.11	-0.65	0.07	-0.09	-0.56	0.10	-0.07	-0.40	
0.13	0.08	-0.05	-0.40	0.09	-0.04	-0.33	0.06	-0.07	-0.55	0.07	-0.06	-0.47	0.10	-0.03	-0.26	
0.20	0.08	-0.12	-0.60	0.08	-0.11	-0.57	0.06	-0.14	-0.72	0.07	-0.13	-0.65	0.09	-0.10	-0.52	
0.11	=<|x|>	*0.04*			*0.04*			*0.06*			*0.05*			*0.04*		*MAE*
		0.36			**0.32**			**0.54**			**0.39**			**0.33**		**RMAE**

Table 9.100: Experiment 04.06.08 Deployment RR

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.17	0.47	0.29	1.69	0.48	0.30	1.74	0.42	0.25	1.44	0.46	0.29	1.64	0.51	0.34	1.95
0.17	0.46	0.29	1.75	0.47	0.30	1.78	0.41	0.25	1.47	0.46	0.29	1.74	0.50	0.33	1.99
0.17	0.46	0.29	1.71	0.46	0.29	1.72	0.41	0.24	1.41	0.46	0.29	1.69	0.50	0.33	1.96
0.19	0.46	0.27	1.46	0.46	0.27	1.47	0.41	0.22	1.21	0.45	0.27	1.43	0.50	0.31	1.66
0.18	0.45	0.28	1.59	0.46	0.28	1.62	0.41	0.23	1.33	0.45	0.27	1.55	0.49	0.32	1.81
0.18	0.44	0.26	1.46	0.45	0.27	1.49	0.40	0.22	1.24	0.44	0.26	1.42	0.48	0.30	1.66
0.20	0.43	0.23	1.15	0.44	0.24	1.19	0.39	0.19	0.95	0.42	0.22	1.11	0.47	0.27	1.32
0.20	0.42	0.22	1.06	0.43	0.22	1.10	0.38	0.18	0.88	0.41	0.21	1.02	0.45	0.25	1.23
0.20	0.41	0.20	1.00	0.42	0.21	1.04	0.37	0.17	0.82	0.40	0.20	0.98	0.44	0.24	1.17
0.22	0.40	0.18	0.81	0.41	0.19	0.85	0.36	0.14	0.65	0.40	0.18	0.80	0.43	0.21	0.96
0.26	0.40	0.14	0.53	0.40	0.14	0.54	0.35	0.10	0.37	0.39	0.13	0.51	0.43	0.17	0.65
0.20	0.39	0.18	0.90	0.39	0.19	0.91	0.35	0.14	0.70	0.39	0.18	0.89	0.43	0.22	1.09
0.22	0.39	0.17	0.78	0.39	0.17	0.78	0.34	0.13	0.59	0.39	0.17	0.77	0.42	0.21	0.95
0.27	0.38	0.12	0.44	0.39	0.12	0.45	0.34	0.07	0.28	0.38	0.12	0.44	0.43	0.16	0.62
0.26	0.38	0.12	0.44	0.38	0.12	0.44	0.34	0.07	0.27	0.38	0.12	0.44	0.42	0.16	0.60
0.26	0.38	0.12	0.49	0.38	0.13	0.49	0.33	0.07	0.29	0.38	0.12	0.48	0.41	0.16	0.62
0.29	0.37	0.08	0.29	0.38	0.09	0.30	0.33	0.04	0.14	0.36	0.08	0.26	0.39	0.10	0.35
0.25	0.36	0.10	0.41	0.37	0.12	0.46	0.33	0.08	0.31	0.35	0.10	0.38	0.37	0.11	0.45
0.25	0.34	0.09	0.36	0.35	0.10	0.40	0.32	0.07	0.28	0.33	0.08	0.32	0.35	0.10	0.40
0.27	0.32	0.05	0.19	0.33	0.07	0.24	0.31	0.05	0.17	0.31	0.04	0.16	0.35	0.08	0.31
0.25	0.31	0.06	0.23	0.31	0.06	0.25	0.30	0.05	0.18	0.31	0.05	0.22	0.35	0.09	0.38
0.28	0.31	0.03	0.09	0.31	0.03	0.09	0.28	0.00	0.00	0.30	0.02	0.08	0.35	0.06	0.23
0.25	0.30	0.06	0.23	0.30	0.06	0.23	0.27	0.02	0.08	0.30	0.06	0.22	0.34	0.10	0.40
0.23	0.30	0.07	0.29	0.30	0.07	0.31	0.26	0.02	0.11	0.30	0.07	0.30	0.34	0.11	0.47
0.24	0.30	0.06	0.26	0.30	0.06	0.27	0.25	0.01	0.06	0.30	0.06	0.25	0.33	0.09	0.38
0.19	0.30	0.11	0.56	0.30	0.11	0.55	0.25	0.06	0.30	0.30	0.11	0.56	0.32	0.13	0.68
0.22	0.29	0.07	0.34	0.29	0.08	0.36	0.25	0.03	0.15	0.29	0.07	0.33	0.32	0.10	0.47
0.20	0.29	0.09	0.43	0.29	0.09	0.44	0.24	0.04	0.21	0.28	0.08	0.39	0.31	0.11	0.54
0.21	0.27	0.07	0.31	0.28	0.07	0.34	0.25	0.04	0.18	0.27	0.07	0.31	0.31	0.10	0.49
0.19	0.28	0.08	0.44	0.27	0.08	0.43	0.24	0.05	0.27	0.27	0.08	0.43	0.31	0.11	0.59
0.18	0.27	0.09	0.52	0.27	0.10	0.55	0.24	0.06	0.37	0.27	0.09	0.52	0.30	0.13	0.72
0.23	0.27	0.04	0.17	0.27	0.04	0.17	0.23	0.00	0.02	0.27	0.04	0.17	0.30	0.07	0.29
0.16	0.26	0.10	0.61	0.27	0.10	0.63	0.23	0.06	0.39	0.26	0.10	0.61	0.29	0.13	0.78
0.16	0.26	0.10	0.58	0.26	0.10	0.58	0.22	0.05	0.33	0.26	0.09	0.55	0.28	0.12	0.70
0.18	0.25	0.08	0.42	0.26	0.08	0.44	0.22	0.04	0.22	0.25	0.08	0.42	0.27	0.10	0.54
0.08	0.25	0.17	2.04	0.25	0.17	2.01	0.21	0.13	1.56	0.25	0.16	1.98	0.27	0.19	2.26
0.18	0.24	0.05	0.29	0.25	0.06	0.33	0.21	0.03	0.15	0.24	0.06	0.31	0.26	0.08	0.42
0.06	0.24	0.18	3.14	0.24	0.18	3.10	0.20	0.15	2.52	0.23	0.18	3.02	0.25	0.20	3.38
0.13	0.23	0.10	0.72	0.24	0.10	0.77	0.20	0.07	0.53	0.23	0.10	0.73	0.25	0.12	0.89
0.06	0.23	0.17	2.78	0.23	0.17	2.82	0.20	0.14	2.37	0.23	0.17	2.78	0.25	0.19	3.09
0.11	0.22	0.11	0.98	0.22	0.11	0.96	0.20	0.09	0.76	0.22	0.10	0.91	0.24	0.13	1.12
0.07	0.21	0.14	1.87	0.22	0.14	1.90	0.19	0.12	1.57	0.21	0.14	1.87	0.23	0.16	2.09
0.10	0.21	0.11	1.01	0.21	0.11	1.03	0.19	0.09	0.82	0.21	0.10	0.99	0.23	0.12	1.17
0.08	0.21	0.12	1.43	0.21	0.12	1.45	0.18	0.10	1.19	0.21	0.12	1.43	0.22	0.13	1.60
0.05	0.20	0.15	2.79	0.20	0.15	2.88	0.18	0.13	2.45	0.20	0.14	2.75	0.21	0.16	2.98
0.11	0.19	0.08	0.71	0.20	0.08	0.73	0.18	0.06	0.57	0.19	0.08	0.71	0.20	0.09	0.75
0.03	0.19	0.16	4.66	0.19	0.16	4.65	0.17	0.14	4.03	0.18	0.15	4.45	0.19	0.15	4.54
0.05	0.18	0.13	2.63	0.18	0.13	2.67	0.17	0.12	2.39	0.18	0.13	2.59	0.18	0.13	2.54
0.06	0.17	0.12	1.96	0.18	0.12	2.00	0.16	0.10	1.75	0.17	0.11	1.92	0.17	0.11	1.82
0.02	0.17	0.15	6.59	0.17	0.15	6.78	0.16	0.14	6.22	0.16	0.14	6.38	0.16	0.14	6.08
0.09	0.16	0.07	0.77	0.16	0.07	0.82	0.15	0.06	0.70	0.16	0.07	0.75	0.15	0.06	0.62
0.03	0.15	0.12	4.03	0.15	0.12	4.09	0.15	0.12	3.89	0.15	0.12	3.87	0.14	0.11	3.50
0.02	0.14	0.12	5.17	0.15	0.13	5.46	0.14	0.12	5.17	0.13	0.11	4.89	0.13	0.10	4.49

0.00	0.13	0.13	#DIV/0!	0.14	0.14	#DIV/0!	0.14	0.14	#DIV/0!	0.13	0.13	#DIV/0!	0.12	0.12	#DIV/0!	
0.12	0.13	0.01	0.05	0.13	0.01	0.08	0.14	0.02	0.14	0.12	0.00	-0.01	0.11	-0.01	-0.12	
0.03	0.12	0.08	2.54	0.12	0.09	2.64	0.13	0.09	2.84	0.11	0.08	2.35	0.10	0.07	1.95	
0.07	0.11	0.04	0.63	0.11	0.05	0.68	0.12	0.06	0.85	0.11	0.04	0.59	0.09	0.02	0.37	
0.00	0.10	0.10	#DIV/0!	0.10	0.10	#DIV/0!	0.12	0.12	#DIV/0!	0.09	0.09	#DIV/0!	0.09	0.09	#DIV/0!	
0.16	= $\langle\lvert x\rvert\rangle$	*0.13*			*0.13*			*0.10*			*0.12*			*0.15*		*MAE*
		0.81			**0.83**			**0.63**			**0.78**			**0.93**		**RMAE**

Table 9.101: Experiment 04.06.08 Deployment SS

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.55	1.19	0.64	1.16	1.18	0.63	1.14	1.16	0.61	1.11	1.20	0.65	1.17	1.22	0.67	1.21	
0.61	1.27	0.66	1.09	1.26	0.65	1.07	1.25	0.64	1.05	1.28	0.67	1.10	1.29	0.68	1.12	
0.67	1.29	0.62	0.93	1.31	0.64	0.96	1.28	0.61	0.92	1.27	0.61	0.91	1.30	0.63	0.95	
0.61	1.24	0.64	1.05	1.26	0.65	1.08	1.23	0.62	1.03	1.23	0.62	1.02	1.26	0.65	1.08	
0.68	1.22	0.55	0.81	1.24	0.56	0.83	1.20	0.52	0.77	1.21	0.53	0.78	1.24	0.57	0.84	
0.62	1.20	0.59	0.95	1.22	0.61	0.99	1.18	0.57	0.92	1.18	0.57	0.92	1.22	0.61	0.99	
0.69	1.18	0.49	0.71	1.20	0.51	0.73	1.15	0.46	0.67	1.15	0.46	0.67	1.20	0.51	0.74	
0.61	1.16	0.55	0.90	1.18	0.57	0.94	1.13	0.52	0.85	1.13	0.52	0.85	1.19	0.58	0.95	
0.71	1.13	0.42	0.59	1.15	0.44	0.62	1.10	0.39	0.54	1.10	0.39	0.55	1.16	0.44	0.63	
0.67	1.10	0.43	0.64	1.13	0.46	0.68	1.07	0.40	0.59	1.07	0.40	0.60	1.13	0.46	0.69	
0.67	1.08	0.41	0.61	1.10	0.43	0.65	1.04	0.37	0.55	1.04	0.37	0.56	1.11	0.44	0.66	
0.67	1.04	0.37	0.55	1.08	0.41	0.60	1.01	0.34	0.50	1.01	0.34	0.51	1.08	0.41	0.61	
0.71	1.02	0.31	0.44	1.05	0.34	0.48	0.99	0.28	0.40	0.99	0.29	0.41	1.05	0.34	0.49	
0.71	0.98	0.27	0.38	1.01	0.30	0.43	0.95	0.24	0.34	0.95	0.24	0.33	1.00	0.29	0.41	
0.66	0.93	0.27	0.41	0.96	0.30	0.45	0.90	0.24	0.36	0.90	0.24	0.36	0.97	0.31	0.46	
0.63	0.92	0.29	0.47	0.95	0.32	0.51	0.87	0.25	0.40	0.89	0.26	0.42	0.96	0.33	0.53	
0.65	= $\langle\lvert x\rvert\rangle$	*0.47*			*0.49*			*0.44*			*0.45*			*0.50*		*MAE*
		0.72			**0.75**			**0.68**			**0.68**			**0.76**		**RMAE**

Table 9.102: Experiment 04.06.08 Deployment TT

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.15	0.12	-0.03	-0.20	0.11	-0.04	-0.27	0.08	-0.06	-0.43	0.13	-0.01	-0.09	0.16	0.02	0.12	
0.12	0.12	-0.01	-0.05	0.10	-0.02	-0.14	0.08	-0.04	-0.35	0.13	0.01	0.09	0.16	0.03	0.28	
0.12	0.11	0.00	-0.01	0.10	-0.01	-0.12	0.08	-0.04	-0.30	0.13	0.01	0.11	0.15	0.03	0.29	
0.11	0.11	0.00	-0.04	0.10	-0.01	-0.11	0.08	-0.03	-0.30	0.13	0.02	0.18	0.15	0.04	0.33	
0.13	0.11	-0.02	-0.14	0.09	-0.03	-0.27	0.08	-0.05	-0.36	0.13	0.00	0.02	0.14	0.01	0.11	
0.13	0.11	-0.02	-0.13	0.10	-0.03	-0.23	0.08	-0.04	-0.35	0.13	0.01	0.07	0.14	0.02	0.13	
0.14	0.11	-0.03	-0.22	0.09	-0.05	-0.33	0.08	-0.06	-0.40	0.13	0.00	-0.04	0.15	0.01	0.05	
0.09	0.11	0.02	0.18	0.09	0.00	0.00	0.08	-0.01	-0.15	0.14	0.04	0.43	0.15	0.05	0.57	
0.14	0.11	-0.03	-0.18	0.09	-0.04	-0.32	0.08	-0.05	-0.39	0.14	0.00	0.01	0.15	0.01	0.10	
0.09	0.11	0.02	0.16	0.09	0.00	-0.02	0.08	-0.01	-0.13	0.14	0.04	0.47	0.15	0.06	0.62	
0.12	= $\langle\lvert x\rvert\rangle$	*0.02*			*0.02*			*0.04*			*0.02*			*0.03*		*MAE*
		0.13			**0.20**			**0.33**			**0.13**			**0.24**		**RMAE**

Table 9.103: Experiment 05.06.08 Deployment AA

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.12	0.13	0.01	0.07	0.10	-0.02	-0.20	0.13	0.01	0.11	0.17	0.05	0.44	0.13	0.01	0.06	
0.22	0.13	-0.09	-0.40	0.10	-0.12	-0.56	0.13	-0.09	-0.40	0.17	-0.04	-0.20	0.13	-0.08	-0.38	
0.17	0.13	-0.04	-0.24	0.09	-0.08	-0.46	0.13	-0.04	-0.25	0.17	-0.01	-0.03	0.13	-0.04	-0.24	
0.11	0.13	0.02	0.15	0.10	-0.02	-0.17	0.13	0.02	0.16	0.17	0.05	0.47	0.13	0.02	0.13	
0.29	0.13	-0.16	-0.56	0.10	-0.19	-0.66	0.12	-0.17	-0.57	0.17	-0.12	-0.42	0.13	-0.15	-0.53	
0.18	0.13	-0.05	-0.30	0.09	-0.09	-0.48	0.13	-0.05	-0.30	0.16	-0.02	-0.11	0.13	-0.05	-0.28	
0.22	0.12	-0.09	-0.43	0.10	-0.12	-0.55	0.12	-0.09	-0.44	0.15	-0.06	-0.29	0.13	-0.08	-0.39	
0.19	0.12	-0.07	-0.35	0.10	-0.10	-0.50	0.12	-0.07	-0.37	0.15	-0.04	-0.22	0.13	-0.06	-0.33	
0.21	0.12	-0.09	-0.44	0.09	-0.12	-0.55	0.12	-0.09	-0.43	0.15	-0.06	-0.29	0.13	-0.08	-0.40	
0.21	0.12	-0.09	-0.42	0.09	-0.11	-0.55	0.12	-0.09	-0.41	0.14	-0.06	-0.30	0.12	-0.08	-0.40	
0.19	= $\langle\lvert x\rvert\rangle$	0.07			0.10			0.07			0.05			0.07		*MAE*
		0.37			**0.50**			**0.38**			**0.27**			**0.35**		**RMAE**

Table 9.104: Experiment 05.06.08 Deployment BB

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.18	0.17	-0.01	-0.04	0.16	-0.02	-0.09	0.17	-0.01	-0.05	0.18	0.00	-0.01	0.17	-0.01	-0.05
0.22	0.17	-0.05	-0.24	0.16	-0.06	-0.26	0.17	-0.05	-0.23	0.17	-0.05	-0.21	0.17	-0.05	-0.23
0.14	0.16	0.02	0.16	0.16	0.02	0.14	0.17	0.03	0.20	0.17	0.03	0.18	0.16	0.02	0.15
0.18	0.17	-0.01	-0.05	0.17	-0.01	-0.06	0.17	-0.01	-0.06	0.17	-0.01	-0.05	0.16	-0.01	-0.08
0.22	0.17	-0.06	-0.25	0.17	-0.06	-0.26	0.17	-0.05	-0.23	0.17	-0.06	-0.25	0.17	-0.06	-0.25
0.18	0.17	0.00	-0.02	0.17	-0.01	-0.05	0.17	0.00	-0.02	0.17	-0.01	-0.05	0.17	-0.01	-0.05
0.21	0.17	-0.04	-0.18	0.17	-0.04	-0.18	0.18	-0.03	-0.14	0.17	-0.04	-0.19	0.16	-0.04	-0.20
0.16	0.17	0.01	0.05	0.17	0.01	0.04	0.18	0.01	0.09	0.17	0.01	0.05	0.17	0.00	0.01
0.17	0.17	0.00	0.01	0.17	0.00	-0.01	0.18	0.00	0.02	0.17	0.00	0.00	0.17	0.00	-0.02
0.15	0.18	0.03	0.20	0.18	0.03	0.21	0.18	0.04	0.25	0.17	0.03	0.18	0.17	0.02	0.16

0.18	0.18	0.00	0.00	0.17	0.00	-0.02	0.18	0.01	0.03	0.18	0.00	0.01	0.17	0.00	-0.02	
0.16	0.18	0.02	0.12	0.17	0.01	0.09	0.18	0.02	0.15	0.18	0.02	0.12	0.17	0.01	0.08	
0.18	0.18	0.00	0.02	0.17	0.00	-0.02	0.18	0.01	0.05	0.18	0.00	0.02	0.17	0.00	-0.01	
0.17	0.18	0.01	0.06	0.17	0.01	0.03	0.19	0.02	0.11	0.19	0.02	0.10	0.17	0.00	0.02	
0.19	0.18	-0.01	-0.04	0.17	-0.02	-0.08	0.19	0.00	-0.01	0.18	0.00	-0.02	0.17	-0.02	-0.08	
0.17	0.18	0.01	0.08	0.17	0.00	0.01	0.18	0.02	0.10	0.18	0.02	0.10	0.18	0.01	0.06	
0.22	0.18	-0.04	-0.20	0.17	-0.05	-0.23	0.18	-0.04	-0.17	0.19	-0.03	-0.15	0.17	-0.05	-0.22	
0.21	0.17	-0.03	-0.16	0.17	-0.04	-0.19	0.18	-0.03	-0.14	0.18	-0.02	-0.12	0.17	-0.03	-0.17	
0.20	0.18	-0.03	-0.13	0.16	-0.04	-0.20	0.18	-0.02	-0.10	0.18	-0.02	-0.09	0.17	-0.03	-0.15	
0.21	0.17	-0.04	-0.19	0.16	-0.05	-0.25	0.17	-0.04	-0.19	0.18	-0.03	-0.15	0.17	-0.05	-0.22	
0.27	0.17	-0.10	-0.36	0.16	-0.11	-0.40	0.17	-0.10	-0.36	0.18	-0.09	-0.32	0.17	-0.10	-0.37	
0.18	0.17	-0.01	-0.05	0.16	-0.02	-0.11	0.17	-0.01	-0.04	0.17	0.00	-0.01	0.16	-0.01	-0.07	
0.19	0.17	-0.03	-0.14	0.16	-0.04	-0.19	0.17	-0.03	-0.14	0.18	-0.02	-0.09	0.16	-0.04	-0.18	
0.25	0.16	-0.09	-0.35	0.15	-0.09	-0.38	0.16	-0.08	-0.33	0.17	-0.07	-0.30	0.16	-0.08	-0.34	
0.13	0.16	0.03	0.26	0.15	0.02	0.20	0.16	0.04	0.28	0.17	0.04	0.35	0.16	0.03	0.23	
0.25	0.16	-0.09	-0.36	0.15	-0.10	-0.40	0.16	-0.09	-0.35	0.17	-0.08	-0.32	0.16	-0.09	-0.36	
0.26	0.16	-0.10	-0.39	0.15	-0.11	-0.41	0.16	-0.10	-0.39	0.16	-0.10	-0.37	0.15	-0.10	-0.40	
0.22	0.15	-0.07	-0.30	0.14	-0.07	-0.34	0.15	-0.06	-0.29	0.16	-0.06	-0.27	0.15	-0.07	-0.32	
0.22	0.15	-0.07	-0.32	0.14	-0.08	-0.37	0.15	-0.07	-0.32	0.16	-0.06	-0.27	0.15	-0.07	-0.33	
0.17	0.15	-0.02	-0.14	0.14	-0.03	-0.18	0.15	-0.02	-0.15	0.15	-0.02	-0.11	0.15	-0.02	-0.14	
0.19	= <|x|>	*0.03*			*0.04*			*0.03*			*0.03*			*0.04*		*MAE*
		0.18			**0.20**			**0.18**			**0.16**			**0.18**		**RMAE**

Table 9.105: Experiment 05.06.08 Deployment CC

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.18	0.12	-0.06	-0.32	0.11	-0.07	-0.38	0.11	-0.07	-0.39	0.13	-0.05	-0.28	0.13	-0.05	-0.29
0.19	0.12	-0.07	-0.37	0.11	-0.08	-0.41	0.11	-0.08	-0.43	0.13	-0.06	-0.33	0.13	-0.07	-0.34
0.24	0.12	-0.12	-0.52	0.11	-0.13	-0.55	0.11	-0.13	-0.55	0.13	-0.11	-0.47	0.12	-0.11	-0.48
0.16	0.12	-0.04	-0.25	0.11	-0.05	-0.32	0.11	-0.05	-0.33	0.12	-0.03	-0.22	0.12	-0.03	-0.21
0.19	0.11	-0.08	-0.41	0.11	-0.08	-0.43	0.10	-0.09	-0.46	0.12	-0.07	-0.36	0.12	-0.07	-0.37
0.14	0.11	-0.03	-0.19	0.10	-0.04	-0.26	0.11	-0.04	-0.25	0.12	-0.02	-0.16	0.12	-0.02	-0.15
0.16	0.11	-0.05	-0.32	0.10	-0.06	-0.39	0.10	-0.06	-0.38	0.12	-0.05	-0.28	0.12	-0.05	-0.28
0.16	0.11	-0.05	-0.33	0.10	-0.06	-0.37	0.10	-0.06	-0.36	0.12	-0.04	-0.26	0.12	-0.04	-0.27
0.22	0.11	-0.11	-0.51	0.10	-0.12	-0.54	0.10	-0.12	-0.55	0.11	-0.11	-0.48	0.12	-0.10	-0.47
0.14	0.11	-0.03	-0.23	0.10	-0.04	-0.31	0.10	-0.04	-0.30	0.11	-0.03	-0.18	0.11	-0.03	-0.18
0.21	0.10	-0.10	-0.50	0.10	-0.11	-0.53	0.10	-0.11	-0.53	0.11	-0.10	-0.47	0.11	-0.10	-0.47
0.16	0.10	-0.06	-0.35	0.10	-0.06	-0.39	0.09	-0.07	-0.41	0.11	-0.05	-0.31	0.11	-0.05	-0.31
0.18	0.10	-0.07	-0.42	0.09	-0.08	-0.47	0.09	-0.09	-0.49	0.11	-0.07	-0.38	0.11	-0.07	-0.39
0.17	0.10	-0.07	-0.42	0.10	-0.08	-0.44	0.09	-0.08	-0.46	0.11	-0.07	-0.38	0.11	-0.06	-0.37
0.14	0.10	-0.04	-0.27	0.09	-0.05	-0.35	0.09	-0.05	-0.35	0.11	-0.03	-0.23	0.11	-0.03	-0.22
0.21	0.10	-0.12	-0.55	0.09	-0.12	-0.58	0.09	-0.12	-0.58	0.10	-0.11	-0.51	0.10	-0.11	-0.52
0.13	0.10	-0.03	-0.26	0.09	-0.04	-0.31	0.09	-0.04	-0.32	0.10	-0.03	-0.21	0.10	-0.03	-0.21
0.18	0.10	-0.08	-0.47	0.09	-0.09	-0.51	0.09	-0.09	-0.51	0.10	-0.08	-0.43	0.11	-0.07	-0.41
0.14	0.10	-0.05	-0.34	0.09	-0.06	-0.38	0.09	-0.05	-0.37	0.10	-0.04	-0.29	0.10	-0.05	-0.31
0.17	0.10	-0.07	-0.44	0.09	-0.08	-0.48	0.08	-0.09	-0.51	0.10	-0.07	-0.42	0.10	-0.07	-0.40
0.14	0.09	-0.05	-0.35	0.09	-0.06	-0.39	0.09	-0.06	-0.39	0.10	-0.04	-0.30	0.10	-0.04	-0.29
0.14	0.09	-0.04	-0.32	0.08	-0.05	-0.38	0.08	-0.05	-0.37	0.10	-0.04	-0.28	0.10	-0.04	-0.26
0.14	0.09	-0.05	-0.34	0.08	-0.05	-0.39	0.08	-0.05	-0.39	0.10	-0.04	-0.29	0.10	-0.04	-0.27
0.17	0.09	-0.07	-0.45	0.09	-0.08	-0.49	0.08	-0.09	-0.51	0.10	-0.07	-0.42	0.10	-0.06	-0.38
0.11	0.09	-0.02	-0.20	0.08	-0.03	-0.25	0.08	-0.03	-0.26	0.09	-0.02	-0.14	0.10	-0.01	-0.06
0.13	0.09	-0.04	-0.31	0.08	-0.05	-0.37	0.08	-0.05	-0.37	0.10	-0.04	-0.28	0.10	-0.03	-0.22
0.13	0.09	-0.04	-0.33	0.08	-0.05	-0.36	0.08	-0.05	-0.40	0.10	-0.04	-0.27	0.10	-0.03	-0.22
0.10	0.09	-0.01	-0.13	0.08	-0.02	-0.20	0.08	-0.02	-0.22	0.10	-0.01	-0.05	0.10	0.00	0.02
0.18	0.09	-0.09	-0.48	0.09	-0.09	-0.52	0.08	-0.10	-0.56	0.10	-0.08	-0.46	0.11	-0.07	-0.38
0.14	0.09	-0.05	-0.36	0.08	-0.06	-0.42	0.08	-0.07	-0.45	0.10	-0.04	-0.30	0.11	-0.03	-0.23
0.14	0.09	-0.05	-0.35	0.09	-0.05	-0.38	0.08	-0.06	-0.45	0.10	-0.04	-0.30	0.12	-0.02	-0.18
0.10	0.10	0.00	0.01	0.09	-0.01	-0.10	0.08	-0.02	-0.17	0.10	0.01	0.06	0.12	0.02	0.22
0.14	0.10	-0.04	-0.31	0.09	-0.05	-0.36	0.08	-0.06	-0.41	0.10	-0.03	-0.25	0.12	-0.02	-0.12
0.14	0.10	-0.04	-0.29	0.09	-0.05	-0.36	0.08	-0.06	-0.45	0.11	-0.04	-0.25	0.13	-0.01	-0.10
0.10	0.10	0.00	0.02	0.09	-0.01	-0.05	0.08	-0.02	-0.18	0.11	0.01	0.10	0.13	0.03	0.28
0.12	0.10	-0.02	-0.16	0.09	-0.03	-0.26	0.08	-0.04	-0.36	0.11	-0.01	-0.10	0.13	0.01	0.07
0.11	0.11	0.00	-0.01	0.10	-0.01	-0.10	0.08	-0.03	-0.24	0.12	0.01	0.10	0.14	0.03	0.27
0.10	0.12	0.01	0.14	0.10	0.00	0.00	0.08	-0.02	-0.19	0.12	0.02	0.16	0.14	0.04	0.35
0.11	0.12	0.01	0.07	0.10	0.00	-0.04	0.08	-0.02	-0.22	0.13	0.02	0.18	0.14	0.03	0.32
0.17	0.12	-0.05	-0.27	0.12	-0.06	-0.33	0.09	-0.08	-0.49	0.13	-0.04	-0.24	0.13	-0.04	-0.22
0.13	0.13	-0.01	-0.04	0.11	-0.02	-0.16	0.09	-0.05	-0.37	0.14	0.00	0.01	0.13	0.00	-0.03
0.16	0.13	-0.03	-0.16	0.12	-0.04	-0.24	0.09	-0.07	-0.42	0.14	-0.02	-0.10	0.12	-0.04	-0.24
0.22	0.14	-0.08	-0.37	0.13	-0.10	-0.43	0.09	-0.13	-0.60	0.14	-0.08	-0.35	0.11	-0.11	-0.48
0.18	0.14	-0.04	-0.22	0.13	-0.05	-0.27	0.09	-0.09	-0.48	0.14	-0.04	-0.22	0.10	-0.08	-0.42
0.24	0.14	-0.10	-0.42	0.13	-0.11	-0.45	0.10	-0.14	-0.60	0.13	-0.11	-0.44	0.10	-0.14	-0.58
0.22	0.14	-0.07	-0.34	0.14	-0.07	-0.34	0.10	-0.12	-0.54	0.13	-0.08	-0.39	0.09	-0.12	-0.56
0.28	0.13	-0.15	-0.53	0.14	-0.14	-0.50	0.10	-0.18	-0.63	0.12	-0.16	-0.57	0.09	-0.19	-0.68
0.27	0.13	-0.15	-0.54	0.14	-0.13	-0.48	0.11	-0.17	-0.61	0.11	-0.16	-0.60	0.08	-0.19	-0.70
0.19	0.12	-0.08	-0.40	0.13	-0.06	-0.31	0.12	-0.08	-0.40	0.11	-0.08	-0.42	0.08	-0.11	-0.58
0.24	0.11	-0.13	-0.54	0.13	-0.11	-0.46	0.12	-0.13	-0.52	0.10	-0.14	-0.58	0.08	-0.17	-0.68
0.18	0.11	-0.07	-0.41	0.12	-0.06	-0.34	0.13	-0.05	-0.30	0.10	-0.08	-0.46	0.07	-0.11	-0.59
0.17	0.10	-0.07	-0.40	0.11	-0.06	-0.33	0.13	-0.04	-0.23	0.09	-0.08	-0.46	0.07	-0.10	-0.57
0.11	0.09	-0.02	-0.16	0.11	0.00	-0.04	0.14	0.02	0.22	0.09	-0.03	-0.23	0.07	-0.04	-0.37
0.08	0.09	0.01	0.16	0.10	0.02	0.30	0.14	0.06	0.79	0.08	0.01	0.07	0.07	-0.01	-0.11
0.12	0.08	-0.03	-0.28	0.09	-0.02	-0.20	0.14	0.02	0.17	0.08	-0.04	-0.31	0.07	-0.05	-0.40

0.12	0.08	-0.04	-0.32	0.09	-0.03	-0.26	0.13	0.01	0.10	0.08	-0.05	-0.38	0.07	-0.05	-0.42	
0.13	0.08	-0.05	-0.37	0.09	-0.04	-0.32	0.13	0.00	0.00	0.08	-0.06	-0.42	0.07	-0.06	-0.44	
0.22	0.08	-0.13	-0.62	0.09	-0.13	-0.60	0.12	-0.09	-0.42	0.07	-0.14	-0.65	0.08	-0.14	-0.63	
0.16	0.08	-0.08	-0.50	0.09	-0.08	-0.46	0.12	-0.05	-0.29	0.08	-0.08	-0.52	0.08	-0.08	-0.49	
0.29	0.09	-0.21	-0.70	0.09	-0.20	-0.69	0.11	-0.18	-0.62	0.08	-0.22	-0.73	0.08	-0.21	-0.71	
0.20	0.09	-0.11	-0.54	0.09	-0.11	-0.54	0.11	-0.09	-0.46	0.09	-0.11	-0.56	0.09	-0.11	-0.55	
0.20	0.10	-0.11	-0.53	0.10	-0.11	-0.53	0.10	-0.10	-0.50	0.09	-0.12	-0.58	0.09	-0.11	-0.56	
0.30	0.09	-0.21	-0.70	0.10	-0.21	-0.68	0.10	-0.21	-0.68	0.09	-0.22	-0.71	0.09	-0.21	-0.71	
0.28	0.10	-0.18	-0.65	0.10	-0.18	-0.65	0.09	-0.18	-0.66	0.09	-0.19	-0.67	0.09	-0.19	-0.67	
0.36	0.10	-0.26	-0.72	0.10	-0.26	-0.73	0.09	-0.27	-0.75	0.09	-0.27	-0.74	0.10	-0.27	-0.74	
0.17	$= \langle \lvert x \rvert \rangle$	*0.07*			*0.07*			*0.08*			*0.07*			*0.07*		*MAE*
		0.40			**0.42**			**0.45**			**0.39**			**0.42**		**RMAE**

Table 9.106: Experiment 05.06.08 Deployment DD

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.33	0.88	0.55	1.70	0.90	0.57	1.75	0.78	0.46	1.39	0.87	0.54	1.65	0.96	0.63	1.93	
0.32	0.85	0.53	1.63	0.87	0.54	1.67	0.76	0.43	1.34	0.84	0.52	1.59	0.94	0.61	1.88	
0.22	0.84	0.61	2.74	0.85	0.63	2.80	0.74	0.51	2.29	0.82	0.60	2.68	0.91	0.69	3.06	
0.38	0.81	0.43	1.15	0.82	0.45	1.18	0.72	0.34	0.91	0.80	0.42	1.11	0.88	0.51	1.34	
0.40	0.79	0.38	0.95	0.80	0.40	1.00	0.71	0.31	0.77	0.77	0.37	0.92	0.85	0.45	1.12	
0.57	0.75	0.18	0.32	0.77	0.20	0.35	0.68	0.11	0.20	0.73	0.16	0.29	0.81	0.24	0.42	
0.70	0.71	0.01	0.02	0.72	0.03	0.04	0.65	-0.05	-0.07	0.70	0.00	0.00	0.77	0.07	0.10	
0.81	0.68	-0.12	-0.15	0.70	-0.11	-0.14	0.62	-0.19	-0.24	0.67	-0.14	-0.17	0.76	-0.05	-0.06	
0.81	0.67	-0.14	-0.18	0.68	-0.13	-0.17	0.59	-0.23	-0.28	0.66	-0.16	-0.19	0.74	-0.07	-0.09	
0.89	0.65	-0.24	-0.27	0.66	-0.23	-0.26	0.57	-0.32	-0.36	0.63	-0.25	-0.28	0.71	-0.18	-0.20	
0.91	0.62	-0.29	-0.32	0.63	-0.28	-0.31	0.55	-0.36	-0.40	0.61	-0.31	-0.34	0.68	-0.23	-0.25	
0.85	0.60	-0.26	-0.30	0.60	-0.25	-0.29	0.52	-0.33	-0.39	0.58	-0.27	-0.32	0.67	-0.18	-0.22	
0.85	0.58	-0.26	-0.31	0.60	-0.25	-0.30	0.50	-0.34	-0.41	0.58	-0.27	-0.31	0.67	-0.18	-0.21	
0.87	0.59	-0.28	-0.32	0.59	-0.28	-0.32	0.49	-0.38	-0.44	0.58	-0.29	-0.34	0.68	-0.20	-0.22	
0.79	0.59	-0.20	-0.26	0.60	-0.19	-0.25	0.49	-0.30	-0.38	0.58	-0.21	-0.26	0.70	-0.09	-0.11	
0.70	0.60	-0.10	-0.15	0.60	-0.10	-0.14	0.49	-0.21	-0.30	0.59	-0.10	-0.15	0.72	0.02	0.03	
0.65	0.62	-0.03	-0.05	0.62	-0.03	-0.05	0.49	-0.17	-0.26	0.63	-0.03	-0.04	0.66	0.00	0.01	
0.66	0.63	-0.03	-0.05	0.64	-0.02	-0.03	0.49	-0.17	-0.25	0.62	-0.04	-0.07	0.62	-0.04	-0.06	
0.66	0.58	-0.08	-0.11	0.60	-0.06	-0.09	0.51	-0.15	-0.23	0.57	-0.09	-0.14	0.63	-0.03	-0.05	
0.56	0.55	-0.01	-0.01	0.56	0.00	0.00	0.53	-0.03	-0.05	0.55	-0.02	-0.03	0.64	0.08	0.14	
0.53	0.55	0.03	0.05	0.56	0.03	0.06	0.53	0.01	0.02	0.55	0.03	0.05	0.63	0.10	0.20	
0.53	0.57	0.04	0.07	0.57	0.04	0.07	0.50	-0.03	-0.05	0.56	0.03	0.06	0.60	0.07	0.13	
0.59	0.57	-0.02	-0.03	0.57	-0.01	-0.02	0.48	-0.11	-0.19	0.56	-0.03	-0.05	0.60	0.01	0.02	
0.60	0.55	-0.05	-0.09	0.55	-0.04	-0.07	0.47	-0.13	-0.21	0.54	-0.06	-0.10	0.60	0.00	0.00	
0.66	0.53	-0.13	-0.19	0.54	-0.12	-0.18	0.48	-0.17	-0.26	0.53	-0.13	-0.20	0.58	-0.08	-0.12	
0.59	0.53	-0.06	-0.10	0.54	-0.05	-0.09	0.48	-0.11	-0.18	0.53	-0.06	-0.10	0.57	-0.02	-0.03	
0.59	0.52	-0.07	-0.11	0.53	-0.06	-0.10	0.48	-0.11	-0.19	0.52	-0.07	-0.12	0.56	-0.03	-0.04	
0.62	0.51	-0.10	-0.17	0.52	-0.10	-0.16	0.46	-0.15	-0.25	0.51	-0.11	-0.18	0.55	-0.07	-0.11	
0.60	0.50	-0.09	-0.16	0.51	-0.09	-0.15	0.45	-0.15	-0.24	0.50	-0.10	-0.17	0.55	-0.05	-0.08	
0.65	0.50	-0.15	-0.23	0.50	-0.15	-0.23	0.45	-0.20	-0.30	0.49	-0.16	-0.24	0.53	-0.12	-0.18	
0.62	0.49	-0.13	-0.21	0.50	-0.12	-0.20	0.45	-0.17	-0.28	0.49	-0.13	-0.21	0.52	-0.10	-0.17	
0.59	0.48	-0.11	-0.19	0.49	-0.11	-0.18	0.44	-0.16	-0.27	0.48	-0.12	-0.20	0.49	-0.11	-0.18	
0.59	0.48	-0.11	-0.19	0.48	-0.11	-0.18	0.43	-0.15	-0.26	0.47	-0.12	-0.20	0.45	-0.13	-0.23	
0.63	$= \langle \lvert x \rvert \rangle$	*0.18*			*0.17*			*0.21*			*0.18*			*0.16*		*MAE*
		0.28			**0.28**			**0.34**			**0.29**			**0.26**		**RMAE**

Table 9.107: Experiment 05.06.08 Deployment EE

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.59	0.38	-0.20	-0.35	0.34	-0.25	-0.42	0.38	-0.20	-0.35	0.43	-0.16	-0.27	0.38	-0.21	-0.36	
0.59	0.44	-0.15	-0.26	0.39	-0.21	-0.35	0.45	-0.14	-0.24	0.48	-0.11	-0.19	0.42	-0.17	-0.29	
0.55	0.48	-0.07	-0.12	0.45	-0.10	-0.18	0.48	-0.07	-0.12	0.46	-0.08	-0.16	0.46	-0.08	-0.16	
0.51	0.45	-0.06	-0.12	0.48	-0.03	-0.06	0.45	-0.06	-0.12	0.40	-0.11	-0.21	0.43	-0.07	-0.14	
0.47	0.39	-0.08	-0.17	0.43	-0.03	-0.07	0.39	-0.08	-0.17	0.36	-0.10	-0.22	0.38	-0.08	-0.18	
0.44	0.36	-0.09	-0.20	0.38	-0.06	-0.14	0.36	-0.09	-0.20	0.34	-0.10	-0.22	0.35	-0.10	-0.22	
0.58	0.34	-0.25	-0.42	0.35	-0.23	-0.40	0.34	-0.24	-0.42	0.33	-0.25	-0.43	0.33	-0.25	-0.43	
0.37	0.33	-0.05	-0.13	0.33	-0.04	-0.12	0.33	-0.05	-0.12	0.32	-0.05	-0.14	0.31	-0.06	-0.16	
0.45	0.32	-0.14	-0.31	0.32	-0.13	-0.29	0.32	-0.14	-0.30	0.31	-0.14	-0.31	0.30	-0.15	-0.33	
0.34	0.31	-0.03	-0.08	0.31	-0.03	-0.09	0.31	-0.03	-0.08	0.30	-0.04	-0.11	0.30	-0.04	-0.13	
0.34	0.29	-0.05	-0.14	0.31	-0.03	-0.10	0.31	-0.03	-0.09	0.29	-0.05	-0.13	0.29	-0.06	-0.16	
0.18	0.29	0.11	0.65	0.29	0.11	0.65	0.30	0.13	0.72	0.29	0.11	0.65	0.27	0.10	0.56	
0.15	0.29	0.14	0.90	0.28	0.13	0.87	0.30	0.15	0.99	0.29	0.14	0.93	0.27	0.12	0.80	
0.19	0.28	0.09	0.48	0.28	0.09	0.47	0.29	0.10	0.53	0.28	0.09	0.48	0.27	0.08	0.40	
0.11	0.28	0.17	1.49	0.28	0.17	1.49	0.29	0.18	1.57	0.28	0.17	1.47	0.26	0.15	1.30	
0.13	0.27	0.14	1.11	0.27	0.15	1.13	0.29	0.16	1.24	0.27	0.14	1.11	0.26	0.13	1.02	
0.37	$= \langle \lvert x \rvert \rangle$	*0.11*			*0.11*			*0.11*			*0.12*			*0.12*		*MAE*
		0.30			**0.30**			**0.31**			**0.31**			**0.31**		**RMAE**

Table 9.108: Experiment 05.06.08 Deployment FF

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err

0.23	0.08	-0.15	-0.66	0.08	-0.15	-0.66	0.16	-0.07	-0.30	0.08	-0.15	-0.64	0.02	-0.21	-0.90	
0.16	0.08	-0.08	-0.51	0.07	-0.09	-0.54	0.15	-0.01	-0.05	0.07	-0.08	-0.53	0.02	-0.13	-0.85	
0.21	0.07	-0.14	-0.68	0.07	-0.14	-0.67	0.14	-0.07	-0.34	0.07	-0.15	-0.69	0.03	-0.18	-0.87	
0.28	0.06	-0.22	-0.78	0.06	-0.22	-0.78	0.13	-0.16	-0.55	0.06	-0.23	-0.80	0.03	-0.25	-0.89	
0.27	0.05	-0.22	-0.81	0.06	-0.21	-0.79	0.11	-0.16	-0.58	0.05	-0.22	-0.81	0.03	-0.24	-0.87	
0.29	0.05	-0.24	-0.83	0.05	-0.24	-0.82	0.10	-0.19	-0.65	0.04	-0.24	-0.85	0.04	-0.25	-0.88	
0.26	0.04	-0.22	-0.85	0.04	-0.22	-0.83	0.09	-0.17	-0.64	0.04	-0.22	-0.84	0.04	-0.22	-0.86	
0.36	0.04	-0.32	-0.89	0.04	-0.32	-0.89	0.08	-0.28	-0.78	0.04	-0.32	-0.90	0.04	-0.32	-0.89	
0.34	0.03	-0.31	-0.90	0.03	-0.31	-0.90	0.08	-0.26	-0.77	0.04	-0.31	-0.89	0.04	-0.30	-0.88	
0.25	0.03	-0.22	-0.87	0.03	-0.22	-0.88	0.07	-0.18	-0.73	0.03	-0.21	-0.87	0.04	-0.21	-0.84	
0.20	0.03	-0.17	-0.86	0.03	-0.17	-0.86	0.06	-0.14	-0.69	0.04	-0.16	-0.82	0.04	-0.16	-0.80	
0.21	0.03	-0.18	-0.85	0.03	-0.19	-0.87	0.06	-0.16	-0.74	0.03	-0.18	-0.84	0.04	-0.17	-0.81	
0.27	0.03	-0.24	-0.87	0.03	-0.24	-0.90	0.05	-0.22	-0.81	0.04	-0.23	-0.85	0.04	-0.23	-0.84	
0.29	0.04	-0.26	-0.87	0.03	-0.27	-0.91	0.04	-0.25	-0.86	0.04	-0.25	-0.86	0.04	-0.25	-0.86	
0.37	0.04	-0.33	-0.89	0.03	-0.34	-0.93	0.04	-0.33	-0.90	0.05	-0.32	-0.87	0.05	-0.32	-0.88	
0.54	0.04	-0.49	-0.92	0.03	-0.50	-0.94	0.03	-0.50	-0.94	0.05	-0.49	-0.91	0.04	-0.50	-0.92	
0.48	0.05	-0.43	-0.90	0.03	-0.45	-0.94	0.03	-0.45	-0.93	0.05	-0.43	-0.89	0.04	-0.44	-0.91	
0.56	0.05	-0.51	-0.91	0.04	-0.53	-0.93	0.03	-0.53	-0.94	0.06	-0.50	-0.89	0.04	-0.52	-0.93	
0.56	0.05	-0.50	-0.90	0.04	-0.52	-0.93	0.03	-0.53	-0.94	0.06	-0.49	-0.88	0.04	-0.52	-0.93	
0.56	0.06	-0.50	-0.90	0.04	-0.52	-0.92	0.03	-0.53	-0.94	0.06	-0.50	-0.89	0.03	-0.53	-0.95	
0.46	0.06	-0.40	-0.87	0.04	-0.42	-0.91	0.03	-0.43	-0.93	0.06	-0.40	-0.86	0.03	-0.42	-0.92	
0.51	0.06	-0.45	-0.88	0.05	-0.47	-0.91	0.04	-0.48	-0.93	0.07	-0.45	-0.87	0.03	-0.49	-0.95	
0.52	0.06	-0.46	-0.89	0.05	-0.47	-0.91	0.04	-0.47	-0.92	0.07	-0.45	-0.87	0.02	-0.49	-0.95	
0.45	0.06	-0.39	-0.86	0.05	-0.40	-0.89	0.05	-0.41	-0.90	0.07	-0.38	-0.84	0.02	-0.43	-0.95	
0.36	= <|x|>	*0.31*			*0.32*			*0.29*			*0.31*			*0.32*		*MAE*
		0.86			**0.88**			**0.81**			**0.85**			**0.90**		**RMAE**

Table 9.109: Experiment 05.06.08 Deployment GG

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.31	0.80	0.49	1.56	1.04	0.73	2.36	0.27	-0.04	-0.12	0.56	0.25	0.80	1.19	0.88	2.84	
0.31	0.74	0.43	1.38	0.93	0.62	2.00	0.28	-0.03	-0.10	0.53	0.22	0.70	1.06	0.75	2.42	
0.49	0.74	0.25	0.52	0.88	0.39	0.81	0.28	-0.20	-0.42	0.54	0.06	0.12	1.01	0.52	1.07	
0.50	0.70	0.20	0.40	0.84	0.34	0.68	0.28	-0.22	-0.45	0.59	0.09	0.19	0.96	0.46	0.93	
0.75	0.68	-0.07	-0.09	0.81	0.06	0.08	0.28	-0.47	-0.63	0.57	-0.18	-0.24	0.91	0.16	0.22	
0.41	0.66	0.25	0.62	0.76	0.35	0.86	0.30	-0.11	-0.27	0.57	0.16	0.39	0.87	0.46	1.12	
0.20	0.63	0.42	2.08	0.72	0.51	2.51	0.40	0.19	0.94	0.55	0.34	1.67	0.83	0.63	3.08	
0.41	0.59	0.18	0.44	0.69	0.28	0.69	0.47	0.06	0.15	0.53	0.12	0.29	0.82	0.41	1.01	
0.53	0.57	0.04	0.07	0.67	0.14	0.27	0.47	-0.06	-0.12	0.50	-0.03	-0.06	0.79	0.27	0.50	
0.83	0.55	-0.28	-0.33	0.67	-0.16	-0.19	0.46	-0.36	-0.44	0.47	-0.36	-0.43	0.76	-0.07	-0.08	
0.47	= <|x|>	0.26			0.36			0.18			0.18			0.46		*MAE*
		0.55			**0.76**			**0.37**			**0.38**			**0.98**		**RMAE**

Table 9.110: Experiment 05.06.08 Deployment HH

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.77	1.16	0.39	0.50	1.19	0.42	0.55	0.96	0.19	0.24	1.13	0.35	0.46	1.30	0.53	0.68	
0.68	1.12	0.44	0.65	1.15	0.47	0.69	0.93	0.25	0.37	1.09	0.41	0.60	1.25	0.57	0.85	
0.53	1.08	0.55	1.04	1.12	0.59	1.11	0.90	0.37	0.70	1.05	0.52	0.98	1.20	0.67	1.28	
0.59	1.04	0.44	0.74	1.06	0.46	0.78	0.87	0.28	0.47	1.01	0.41	0.69	1.15	0.55	0.93	
0.73	1.00	0.27	0.37	1.02	0.30	0.41	0.84	0.11	0.15	0.97	0.25	0.34	1.12	0.39	0.54	
0.82	0.97	0.14	0.17	0.99	0.17	0.20	0.83	0.01	0.01	0.95	0.12	0.15	1.07	0.25	0.30	
0.88	0.94	0.06	0.07	0.96	0.08	0.09	0.82	-0.06	-0.07	0.91	0.03	0.04	1.01	0.13	0.15	
1.02	0.87	-0.15	-0.15	0.89	-0.13	-0.12	0.79	-0.23	-0.22	0.85	-0.17	-0.17	0.92	-0.10	-0.09	
1.04	0.79	-0.25	-0.24	0.82	-0.23	-0.22	0.75	-0.29	-0.28	0.77	-0.28	-0.27	0.88	-0.16	-0.15	
0.84	0.74	-0.11	-0.13	0.76	-0.08	-0.10	0.69	-0.15	-0.18	0.71	-0.13	-0.15	0.84	0.00	0.00	
0.84	0.70	-0.14	-0.17	0.72	-0.12	-0.14	0.62	-0.22	-0.26	0.67	-0.17	-0.20	0.80	-0.04	-0.04	
0.69	0.66	-0.03	-0.05	0.68	-0.01	-0.01	0.55	-0.14	-0.21	0.63	-0.06	-0.08	0.78	0.09	0.14	
0.60	0.64	0.04	0.08	0.66	0.07	0.11	0.49	-0.10	-0.17	0.62	0.02	0.04	0.80	0.21	0.34	
0.51	0.64	0.13	0.25	0.66	0.15	0.30	0.46	-0.05	-0.10	0.62	0.11	0.21	0.82	0.31	0.60	
0.56	0.66	0.10	0.18	0.68	0.12	0.22	0.45	-0.11	-0.20	0.63	0.08	0.14	0.87	0.32	0.57	
0.58	0.67	0.09	0.15	0.70	0.11	0.19	0.45	-0.13	-0.23	0.65	0.07	0.11	0.87	0.29	0.49	
0.48	0.71	0.23	0.47	0.74	0.26	0.53	0.45	-0.03	-0.06	0.68	0.20	0.41	0.81	0.32	0.67	
0.55	0.76	0.21	0.38	0.78	0.23	0.41	0.46	-0.09	-0.17	0.74	0.18	0.33	0.81	0.26	0.47	
0.45	0.74	0.29	0.63	0.74	0.29	0.63	0.47	0.02	0.04	0.73	0.28	0.62	0.82	0.37	0.82	
0.45	0.70	0.25	0.55	0.72	0.27	0.60	0.49	0.04	0.09	0.69	0.24	0.52	0.79	0.34	0.76	
0.68	= <|x|>	*0.22*			*0.23*			*0.14*			*0.20*			*0.30*		*MAE*
		0.32			**0.33**			**0.21**			**0.30**			**0.43**		**RMAE**

Table 9.111: Experiment 05.06.08 Deployment II

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.35	0.43	0.09	0.25	0.42	0.08	0.22	0.29	-0.06	-0.16	0.45	0.10	0.30	0.53	0.19	0.54
0.49	0.47	-0.02	-0.04	0.44	-0.04	-0.09	0.30	-0.19	-0.38	0.48	-0.01	-0.01	0.57	0.08	0.17
0.41	0.49	0.08	0.19	0.47	0.06	0.16	0.31	-0.10	-0.24	0.49	0.07	0.18	0.59	0.18	0.43
0.40	0.49	0.09	0.22	0.50	0.10	0.24	0.32	-0.08	-0.19	0.48	0.08	0.19	0.57	0.17	0.43
0.51	0.47	-0.04	-0.07	0.49	-0.02	-0.05	0.32	-0.19	-0.37	0.46	-0.05	-0.09	0.57	0.05	0.10

0.33	0.48	0.15	0.45	0.47	0.14	0.44	0.31	-0.01	-0.04	0.49	0.16	0.49	0.60	0.27	0.83	
0.42	0.49	0.07	0.17	0.49	0.07	0.18	0.30	-0.12	-0.29	0.45	0.03	0.07	0.55	0.13	0.31	
0.28	0.43	0.15	0.54	0.47	0.20	0.70	0.29	0.01	0.04	0.39	0.11	0.40	0.51	0.23	0.85	
0.29	0.38	0.09	0.31	0.41	0.12	0.41	0.28	-0.01	-0.05	0.36	0.07	0.24	0.50	0.20	0.69	
0.17	0.36	0.19	1.07	0.38	0.20	1.16	0.29	0.11	0.64	0.34	0.17	0.98	0.46	0.29	1.67	
0.09	0.33	0.25	2.80	0.36	0.27	3.07	0.26	0.17	1.94	0.33	0.24	2.70	0.45	0.37	4.17	
0.07	0.33	0.26	3.53	0.34	0.26	3.63	0.22	0.14	1.97	0.32	0.25	3.40	0.44	0.36	4.99	
0.07	0.32	0.25	3.50	0.33	0.26	3.63	0.20	0.12	1.73	0.31	0.24	3.34	0.43	0.36	5.02	
0.07	0.31	0.24	3.27	0.32	0.25	3.36	0.20	0.13	1.78	0.30	0.23	3.17	0.43	0.36	4.89	
0.08	0.31	0.23	3.03	0.31	0.24	3.06	0.19	0.12	1.52	0.31	0.23	3.00	0.43	0.35	4.51	
0.20	0.32	0.12	0.63	0.32	0.12	0.61	0.20	0.00	0.00	0.32	0.12	0.61	0.42	0.23	1.15	
0.20	0.32	0.12	0.62	0.32	0.13	0.65	0.19	-0.01	-0.05	0.32	0.12	0.61	0.42	0.22	1.14	
0.26	0.32	0.06	0.25	0.32	0.06	0.25	0.18	-0.08	-0.30	0.33	0.07	0.26	0.41	0.15	0.58	
0.17	0.34	0.16	0.96	0.33	0.16	0.93	0.19	0.01	0.08	0.34	0.16	0.94	0.40	0.23	1.33	
0.23	0.34	0.11	0.47	0.34	0.11	0.47	0.19	-0.04	-0.17	0.34	0.11	0.46	0.40	0.17	0.74	
0.33	0.34	0.01	0.03	0.34	0.01	0.04	0.19	-0.14	-0.43	0.34	0.01	0.04	0.38	0.06	0.17	
0.26	0.35	0.08	0.32	0.35	0.08	0.31	0.20	-0.06	-0.25	0.34	0.08	0.29	0.37	0.11	0.43	
0.29	0.34	0.05	0.18	0.35	0.05	0.18	0.21	-0.09	-0.30	0.34	0.05	0.17	0.36	0.07	0.24	
0.30	0.34	0.05	0.16	0.35	0.05	0.17	0.21	-0.08	-0.28	0.34	0.04	0.15	0.36	0.06	0.21	
0.38	0.34	-0.04	-0.11	0.34	-0.04	-0.10	0.22	-0.16	-0.41	0.33	-0.04	-0.12	0.36	-0.02	-0.05	
0.37	0.34	-0.03	-0.08	0.34	-0.03	-0.07	0.24	-0.13	-0.34	0.33	-0.04	-0.10	0.38	0.01	0.02	
0.28	0.33	0.05	0.17	0.33	0.05	0.19	0.25	-0.03	-0.12	0.32	0.04	0.15	0.39	0.11	0.39	
0.26	0.32	0.06	0.24	0.33	0.07	0.27	0.25	-0.01	-0.02	0.32	0.06	0.24	0.39	0.14	0.53	
0.31	0.32	0.00	0.01	0.32	0.00	0.01	0.26	-0.05	-0.17	0.31	0.00	-0.01	0.39	0.08	0.24	
0.35	0.31	-0.04	-0.11	0.31	-0.04	-0.10	0.28	-0.07	-0.20	0.31	-0.04	-0.10	0.38	0.04	0.10	
0.35	0.32	-0.03	-0.08	0.32	-0.03	-0.08	0.28	-0.06	-0.18	0.32	-0.03	-0.08	0.38	0.03	0.08	
0.45	0.33	-0.13	-0.28	0.32	-0.13	-0.28	0.29	-0.17	-0.37	0.33	-0.12	-0.28	0.36	-0.09	-0.19	
0.45	0.33	-0.11	-0.25	0.33	-0.11	-0.25	0.29	-0.15	-0.34	0.33	-0.11	-0.25	0.36	-0.09	-0.20	
0.54	0.34	-0.20	-0.37	0.34	-0.21	-0.38	0.30	-0.24	-0.45	0.34	-0.21	-0.38	0.35	-0.20	-0.36	
0.49	0.34	-0.16	-0.32	0.34	-0.15	-0.31	0.30	-0.20	-0.40	0.34	-0.16	-0.32	0.34	-0.15	-0.31	
0.58	0.33	-0.24	-0.42	0.34	-0.24	-0.42	0.30	-0.28	-0.49	0.33	-0.25	-0.43	0.34	-0.23	-0.40	
0.57	0.33	-0.24	-0.42	0.33	-0.23	-0.41	0.30	-0.27	-0.48	0.32	-0.25	-0.43	0.35	-0.22	-0.39	
0.65	0.32	-0.34	-0.51	0.32	-0.33	-0.51	0.30	-0.36	-0.55	0.31	-0.34	-0.52	0.37	-0.29	-0.44	
0.56	0.31	-0.25	-0.45	0.31	-0.25	-0.44	0.29	-0.27	-0.49	0.31	-0.26	-0.46	0.40	-0.16	-0.28	
0.49	0.30	-0.19	-0.38	0.31	-0.18	-0.37	0.29	-0.20	-0.42	0.30	-0.19	-0.39	0.46	-0.03	-0.06	
0.61	0.30	-0.32	-0.52	0.30	-0.31	-0.51	0.28	-0.33	-0.54	0.29	-0.32	-0.53	0.52	-0.09	-0.15	
0.48	0.29	-0.18	-0.39	0.29	-0.18	-0.38	0.28	-0.20	-0.41	0.29	-0.19	-0.40	0.53	0.05	0.11	
0.46	0.29	-0.17	-0.38	0.29	-0.17	-0.37	0.28	-0.18	-0.39	0.29	-0.18	-0.38	0.49	0.03	0.06	
0.49	0.28	-0.21	-0.43	0.29	-0.21	-0.42	0.29	-0.21	-0.42	0.28	-0.21	-0.43	0.43	-0.06	-0.12	
0.63	0.29	-0.35	-0.55	0.29	-0.34	-0.54	0.29	-0.34	-0.54	0.28	-0.35	-0.55	0.39	-0.24	-0.38	
0.51	0.29	-0.22	-0.42	0.29	-0.22	-0.43	0.30	-0.21	-0.41	0.30	-0.21	-0.41	0.36	-0.15	-0.30	
0.60	0.32	-0.28	-0.47	0.31	-0.29	-0.48	0.30	-0.30	-0.50	0.32	-0.28	-0.47	0.34	-0.26	-0.44	
0.68	0.35	-0.33	-0.48	0.34	-0.34	-0.50	0.30	-0.38	-0.56	0.36	-0.32	-0.47	0.33	-0.36	-0.52	
0.66	0.40	-0.26	-0.40	0.39	-0.27	-0.42	0.30	-0.36	-0.55	0.41	-0.25	-0.39	0.33	-0.33	-0.50	
0.78	0.46	-0.32	-0.41	0.44	-0.34	-0.43	0.30	-0.48	-0.62	0.47	-0.31	-0.39	0.33	-0.45	-0.57	
0.81	0.50	-0.31	-0.38	0.50	-0.31	-0.38	0.29	-0.52	-0.64	0.50	-0.31	-0.39	0.34	-0.47	-0.58	
0.84	0.48	-0.37	-0.43	0.49	-0.36	-0.42	0.28	-0.56	-0.67	0.47	-0.37	-0.44	0.34	-0.51	-0.60	
1.07	0.44	-0.63	-0.59	0.45	-0.62	-0.58	0.28	-0.79	-0.74	0.42	-0.65	-0.61	0.34	-0.73	-0.68	
0.61	0.39	-0.22	-0.36	0.40	-0.21	-0.34	0.27	-0.34	-0.56	0.38	-0.23	-0.38	0.34	-0.28	-0.45	
0.60	= <|x|>	*0.17*			*0.17*			*0.18*			*0.17*			*0.20*		*MAE*
		0.29			**0.29**			**0.31**			**0.28**			**0.33**		**RMAE**

Table 9.112: Experiment 05.06.08 Deployment JJ

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.33	0.19	-0.14	-0.43	0.19	-0.14	-0.43	0.16	-0.17	-0.53	0.19	-0.14	-0.42	0.27	-0.06	-0.19	
0.33	0.19	-0.14	-0.43	0.19	-0.15	-0.44	0.17	-0.17	-0.50	0.19	-0.14	-0.42	0.27	-0.07	-0.20	
0.43	0.19	-0.23	-0.54	0.19	-0.23	-0.54	0.16	-0.26	-0.62	0.20	-0.23	-0.53	0.27	-0.16	-0.37	
0.37	0.20	-0.17	-0.45	0.19	-0.18	-0.48	0.16	-0.21	-0.57	0.20	-0.17	-0.46	0.27	-0.10	-0.27	
0.40	0.20	-0.20	-0.49	0.20	-0.20	-0.50	0.17	-0.23	-0.59	0.20	-0.20	-0.50	0.26	-0.14	-0.34	
0.33	0.20	-0.13	-0.40	0.20	-0.13	-0.39	0.17	-0.17	-0.50	0.19	-0.14	-0.42	0.26	-0.07	-0.22	
0.40	0.20	-0.20	-0.51	0.20	-0.20	-0.49	0.17	-0.24	-0.59	0.19	-0.21	-0.53	0.25	-0.15	-0.36	
0.33	0.19	-0.14	-0.41	0.20	-0.13	-0.39	0.16	-0.17	-0.51	0.19	-0.14	-0.42	0.24	-0.09	-0.26	
0.46	0.19	-0.27	-0.59	0.20	-0.26	-0.57	0.16	-0.30	-0.65	0.18	-0.28	-0.60	0.23	-0.23	-0.50	
0.53	0.19	-0.34	-0.65	0.19	-0.34	-0.64	0.17	-0.36	-0.68	0.18	-0.35	-0.66	0.21	-0.31	-0.59	
0.58	0.18	-0.40	-0.69	0.19	-0.39	-0.68	0.17	-0.42	-0.72	0.18	-0.41	-0.70	0.20	-0.38	-0.65	
0.64	0.18	-0.46	-0.72	0.18	-0.45	-0.71	0.16	-0.48	-0.75	0.18	-0.45	-0.71	0.20	-0.43	-0.68	
0.64	0.17	-0.47	-0.73	0.18	-0.47	-0.72	0.16	-0.48	-0.75	0.19	-0.45	-0.70	0.23	-0.41	-0.64	
0.62	0.18	-0.43	-0.70	0.17	-0.44	-0.72	0.16	-0.45	-0.73	0.22	-0.39	-0.64	0.34	-0.28	-0.45	
0.57	0.21	-0.37	-0.64	0.18	-0.40	-0.69	0.17	-0.40	-0.71	0.27	-0.30	-0.53	0.36	-0.22	-0.38	
0.60	0.25	-0.35	-0.58	0.19	-0.41	-0.68	0.18	-0.41	-0.69	0.30	-0.29	-0.49	0.29	-0.31	-0.52	
0.56	0.29	-0.27	-0.48	0.23	-0.33	-0.59	0.21	-0.36	-0.63	0.31	-0.25	-0.45	0.27	-0.29	-0.52	
0.52	0.31	-0.22	-0.42	0.27	-0.25	-0.48	0.23	-0.30	-0.57	0.32	-0.20	-0.38	0.28	-0.24	-0.47	
0.63	0.31	-0.32	-0.51	0.30	-0.33	-0.52	0.25	-0.38	-0.60	0.34	-0.29	-0.46	0.28	-0.35	-0.56	
0.65	0.33	-0.32	-0.49	0.30	-0.35	-0.53	0.27	-0.38	-0.59	0.36	-0.29	-0.44	0.30	-0.35	-0.55	
0.63	0.35	-0.28	-0.44	0.32	-0.31	-0.49	0.28	-0.34	-0.55	0.37	-0.26	-0.41	0.31	-0.31	-0.50	
0.41	0.36	-0.05	-0.11	0.34	-0.07	-0.18	0.30	-0.11	-0.27	0.40	-0.01	-0.03	0.34	-0.07	-0.17	
0.37	0.38	0.01	0.01	0.35	-0.02	-0.05	0.33	-0.05	-0.13	0.43	0.06	0.16	0.37	0.00	-0.01	
0.74	0.41	-0.33	-0.45	0.36	-0.38	-0.51	0.34	-0.40	-0.53	0.49	-0.25	-0.34	0.40	-0.34	-0.47	
0.50	= <|x|>	*0.26*			*0.27*			*0.30*			*0.25*			*0.22*		*MAE*
		0.52			**0.54**			**0.60**			**0.49**			**0.45**		**RMAE**

Table 9.113: Experiment 05.06.08 Deployment KK

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.78	0.41	-0.36	-0.47	0.41	-0.36	-0.47	0.22	-0.55	-0.71	0.42	-0.35	-0.46	0.57	-0.20	-0.26
0.66	0.39	-0.26	-0.40	0.39	-0.26	-0.40	0.20	-0.46	-0.70	0.40	-0.26	-0.40	0.52	-0.13	-0.20
0.52	0.37	-0.16	-0.30	0.37	-0.15	-0.29	0.19	-0.33	-0.63	0.37	-0.16	-0.30	0.48	-0.04	-0.08
0.36	0.35	-0.01	-0.03	0.35	-0.01	-0.02	0.18	-0.18	-0.49	0.36	0.00	0.00	0.44	0.08	0.23
0.45	0.34	-0.11	-0.24	0.33	-0.12	-0.27	0.17	-0.27	-0.61	0.38	-0.07	-0.16	0.45	0.00	0.01
0.41	0.37	-0.04	-0.11	0.33	-0.08	-0.19	0.17	-0.24	-0.59	0.40	-0.01	-0.03	0.49	0.08	0.20
0.35	0.38	0.03	0.07	0.35	0.00	0.00	0.16	-0.19	-0.55	0.41	0.06	0.18	0.60	0.25	0.72
0.35	0.38	0.03	0.09	0.36	0.01	0.02	0.15	-0.20	-0.57	0.41	0.05	0.15	0.48	0.12	0.35
0.29	0.38	0.09	0.32	0.36	0.07	0.25	0.15	-0.14	-0.48	0.40	0.11	0.37	0.43	0.13	0.46
0.29	0.38	0.09	0.32	0.36	0.08	0.27	0.15	-0.14	-0.49	0.38	0.10	0.34	0.41	0.12	0.44
0.32	0.36	0.04	0.12	0.36	0.04	0.11	0.15	-0.18	-0.55	0.38	0.05	0.17	0.41	0.09	0.28
0.29	0.36	0.08	0.26	0.35	0.07	0.23	0.14	-0.15	-0.52	0.38	0.09	0.32	0.42	0.13	0.45
0.31	0.36	0.06	0.18	0.35	0.04	0.13	0.13	-0.18	-0.58	0.38	0.07	0.23	0.43	0.12	0.39
0.37	0.37	0.00	-0.01	0.35	-0.02	-0.04	0.12	-0.25	-0.66	0.39	0.02	0.06	0.44	0.07	0.19
0.30	0.38	0.08	0.27	0.35	0.06	0.19	0.12	-0.17	-0.58	0.40	0.10	0.34	0.44	0.15	0.49
0.31	0.38	0.07	0.24	0.36	0.05	0.17	0.13	-0.18	-0.57	0.41	0.10	0.31	0.42	0.11	0.37
0.29	0.40	0.11	0.36	0.38	0.09	0.30	0.14	-0.15	-0.50	0.40	0.11	0.39	0.39	0.10	0.35
0.31	0.40	0.09	0.31	0.38	0.07	0.24	0.15	-0.16	-0.51	0.39	0.08	0.26	0.35	0.04	0.14
0.31	0.39	0.08	0.26	0.40	0.09	0.29	0.16	-0.15	-0.49	0.37	0.06	0.19	0.32	0.01	0.04
0.33	0.37	0.04	0.12	0.39	0.06	0.17	0.17	-0.16	-0.50	0.34	0.01	0.02	0.30	-0.03	-0.09
0.18	0.34	0.16	0.91	0.37	0.19	1.09	0.18	0.00	0.01	0.31	0.13	0.71	0.29	0.11	0.61
0.28	0.32	0.03	0.12	0.35	0.07	0.24	0.19	-0.09	-0.32	0.29	0.01	0.02	0.28	0.00	0.00
0.28	0.29	0.01	0.03	0.32	0.04	0.13	0.20	-0.09	-0.30	0.28	-0.01	-0.02	0.27	-0.02	-0.06
0.20	0.28	0.08	0.39	0.30	0.10	0.47	0.22	0.02	0.08	0.27	0.07	0.34	0.26	0.06	0.31
0.27	0.27	0.01	0.02	0.28	0.02	0.06	0.23	-0.04	-0.14	0.27	0.00	0.01	0.25	-0.01	-0.04
0.25	0.27	0.02	0.08	0.27	0.02	0.10	0.24	-0.01	-0.02	0.26	0.01	0.05	0.25	0.00	0.01
0.23	0.26	0.03	0.11	0.27	0.03	0.14	0.25	0.01	0.06	0.26	0.02	0.10	0.24	0.01	0.03
0.22	0.25	0.04	0.18	0.26	0.04	0.20	0.27	0.05	0.25	0.25	0.04	0.17	0.24	0.02	0.09
0.27	0.25	-0.01	-0.05	0.25	-0.01	-0.04	0.29	0.02	0.08	0.25	-0.01	-0.05	0.23	-0.03	-0.13
0.26	0.25	-0.01	-0.02	0.25	0.00	-0.01	0.30	0.05	0.18	0.25	-0.01	-0.04	0.23	-0.03	-0.10
0.20	0.25	0.05	0.23	0.25	0.04	0.22	0.32	0.12	0.59	0.25	0.05	0.23	0.23	0.03	0.13
0.17	0.24	0.07	0.40	0.25	0.07	0.42	0.33	0.16	0.91	0.24	0.07	0.40	0.23	0.05	0.31
0.17	0.25	0.07	0.44	0.25	0.07	0.44	0.34	0.17	1.01	0.24	0.07	0.43	0.23	0.06	0.34
0.20	0.24	0.05	0.23	0.24	0.05	0.23	0.34	0.14	0.73	0.24	0.05	0.23	0.23	0.03	0.16
0.17	0.24	0.08	0.45	0.25	0.08	0.47	0.34	0.17	1.01	0.24	0.08	0.46	0.23	0.07	0.40
0.21	0.24	0.04	0.18	0.24	0.03	0.16	0.32	0.11	0.54	0.25	0.04	0.20	0.24	0.04	0.19
0.12	0.24	0.12	1.02	0.24	0.12	1.02	0.30	0.18	1.52	0.24	0.12	1.05	0.25	0.13	1.10
0.11	0.24	0.13	1.20	0.24	0.13	1.17	0.28	0.17	1.55	0.25	0.14	1.25	0.26	0.14	1.30
0.21	0.25	0.03	0.16	0.24	0.03	0.13	0.27	0.05	0.25	0.25	0.04	0.19	0.27	0.06	0.26
0.12	0.25	0.13	1.03	0.24	0.12	0.99	0.26	0.14	1.12	0.25	0.13	1.10	0.28	0.16	1.31
0.11	0.25	0.14	1.22	0.24	0.13	1.15	0.25	0.13	1.18	0.26	0.15	1.33	0.30	0.18	1.61
0.11	0.26	0.14	1.25	0.25	0.13	1.16	0.24	0.13	1.11	0.27	0.16	1.39	0.31	0.20	1.75
0.13	0.26	0.14	1.07	0.25	0.13	1.01	0.24	0.11	0.87	0.28	0.16	1.24	0.33	0.20	1.61
0.11	0.28	0.17	1.52	0.26	0.15	1.35	0.23	0.12	1.13	0.30	0.19	1.73	0.35	0.24	2.18
0.12	0.28	0.16	1.34	0.26	0.14	1.16	0.23	0.10	0.86	0.31	0.19	1.57	0.36	0.24	1.95
0.15	0.30	0.14	0.93	0.28	0.12	0.78	0.23	0.08	0.49	0.33	0.17	1.10	0.38	0.22	1.44
0.14	0.31	0.17	1.19	0.29	0.15	1.03	0.23	0.09	0.60	0.34	0.20	1.41	0.39	0.25	1.75
0.13	0.33	0.19	1.45	0.30	0.17	1.26	0.23	0.09	0.70	0.35	0.22	1.66	0.40	0.27	2.00
0.14	0.34	0.20	1.38	0.31	0.17	1.20	0.22	0.08	0.58	0.36	0.22	1.56	0.40	0.26	1.81
0.22	0.35	0.13	0.57	0.33	0.10	0.46	0.22	0.00	0.00	0.37	0.15	0.68	0.38	0.16	0.72
0.18	0.36	0.19	1.06	0.34	0.16	0.93	0.22	0.05	0.26	0.38	0.20	1.15	0.38	0.20	1.13
0.14	0.37	0.24	1.75	0.35	0.22	1.61	0.23	0.09	0.67	0.38	0.24	1.78	0.36	0.23	1.68
0.19	0.37	0.18	0.98	0.36	0.17	0.92	0.22	0.03	0.18	0.37	0.19	0.98	0.35	0.17	0.89
0.09	0.37	0.28	3.19	0.37	0.28	3.16	0.22	0.14	1.52	0.36	0.27	3.06	0.34	0.25	2.86
0.11	0.37	0.25	2.19	0.37	0.26	2.23	0.22	0.11	0.94	0.35	0.23	2.03	0.33	0.22	1.92
0.12	0.35	0.23	1.96	0.37	0.25	2.07	0.23	0.11	0.89	0.34	0.22	1.87	0.33	0.21	1.71
0.11	0.35	0.23	2.13	0.35	0.24	2.21	0.23	0.12	1.05	0.33	0.22	2.00	0.32	0.21	1.86
0.11	0.34	0.23	2.15	0.35	0.24	2.27	0.22	0.12	1.08	0.33	0.22	2.04	0.31	0.20	1.89
0.11	0.32	0.21	1.85	0.34	0.22	1.95	0.23	0.12	1.03	0.32	0.20	1.79	0.30	0.19	1.65
0.02	0.32	0.30	16.25	0.33	0.32	16.86	0.23	0.21	11.27	0.31	0.29	15.64	0.30	0.28	15.18
0.17	0.31	0.14	0.84	0.32	0.15	0.90	0.24	0.07	0.39	0.30	0.13	0.79	0.30	0.13	0.77
0.15	0.31	0.16	1.09	0.32	0.17	1.13	0.24	0.09	0.63	0.30	0.15	1.02	0.31	0.16	1.06
0.16	0.30	0.14	0.89	0.31	0.15	0.93	0.25	0.09	0.56	0.30	0.14	0.84	0.31	0.15	0.92
0.09	0.30	0.21	2.34	0.30	0.22	2.45	0.26	0.17	1.92	0.29	0.20	2.32	0.30	0.21	2.42
0.02	0.29	0.27	13.28	0.30	0.28	13.51	0.26	0.24	11.91	0.29	0.27	13.28	0.31	0.29	14.03
0.12	0.29	0.17	1.41	0.29	0.17	1.43	0.28	0.16	1.33	0.30	0.18	1.49	0.30	0.18	1.53
0.16	0.29	0.13	0.77	0.29	0.12	0.76	0.29	0.12	0.76	0.30	0.13	0.82	0.30	0.13	0.82
0.18	0.29	0.11	0.60	0.29	0.10	0.57	0.29	0.11	0.61	0.30	0.11	0.62	0.30	0.11	0.62
0.12	0.29	0.17	1.42	0.28	0.16	1.34	0.30	0.18	1.49	0.30	0.18	1.46	0.30	0.18	1.45
0.07	0.30	0.22	2.94	0.29	0.21	2.85	0.32	0.24	3.21	0.30	0.22	2.97	0.30	0.22	2.98
0.12	0.29	0.17	1.48	0.29	0.17	1.45	0.32	0.20	1.69	0.30	0.18	1.49	0.31	0.19	1.58
0.12	0.29	0.18	1.52	0.29	0.17	1.48	0.33	0.21	1.82	0.29	0.18	1.52	0.32	0.20	1.74
0.10	0.29	0.19	2.04	0.29	0.20	2.06	0.33	0.23	2.42	0.30	0.20	2.12	0.33	0.24	2.47
0.06	0.29	0.23	3.86	0.29	0.23	3.80	0.32	0.26	4.34	0.30	0.24	4.08	0.35	0.29	4.81
0.11	0.29	0.18	1.60	0.29	0.17	1.57	0.31	0.20	1.82	0.31	0.20	1.81	0.36	0.25	2.24
0.09	0.30	0.20	2.17	0.29	0.19	2.02	0.31	0.21	2.26	0.32	0.23	2.41	0.37	0.28	2.95
0.11	0.31	0.20	1.88	0.29	0.18	1.71	0.30	0.19	1.84	0.33	0.23	2.14	0.39	0.28	2.64

0.07	0.31	0.24	3.36	0.29	0.22	3.07	0.29	0.22	3.04	0.34	0.27	3.77	0.40	0.33	4.52	
0.06	0.33	0.26	4.07	0.30	0.24	3.67	0.28	0.22	3.42	0.35	0.29	4.50	0.40	0.34	5.27	
0.21	$= \langle \vert x \vert \rangle$	*0.13*			*0.13*			*0.15*			*0.14*			*0.15*		*MAE*
		0.64			**0.63**			**0.71**			**0.66**			**0.71**		**RMAE**

Table 9.114: Experiment 05.06.08 Deployment LL

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.30	0.74	0.44	1.48	0.75	0.45	1.50	0.66	0.36	1.19	0.74	0.44	1.46	0.83	0.53	1.76
0.23	0.75	0.52	2.31	0.74	0.52	2.29	0.66	0.43	1.91	0.75	0.53	2.33	0.83	0.60	2.66
0.20	0.76	0.56	2.84	0.75	0.56	2.82	0.67	0.47	2.38	0.76	0.56	2.86	0.83	0.64	3.23
0.09	0.78	0.69	7.90	0.77	0.68	7.77	0.69	0.60	6.85	0.80	0.71	8.12	0.87	0.79	8.98
0.15	0.83	0.68	4.70	0.81	0.67	4.59	0.72	0.58	3.99	0.83	0.69	4.74	0.91	0.76	5.26
0.15	0.80	0.65	4.39	0.82	0.68	4.53	0.76	0.61	4.10	0.78	0.63	4.20	0.83	0.68	4.56
0.17	0.75	0.58	3.39	0.76	0.59	3.45	0.71	0.54	3.19	0.75	0.58	3.39	0.81	0.64	3.74
0.16	0.76	0.60	3.66	0.75	0.59	3.62	0.69	0.53	3.23	0.77	0.61	3.73	0.83	0.67	4.10
0.38	0.77	0.39	1.05	0.77	0.39	1.04	0.71	0.33	0.88	0.76	0.39	1.03	0.81	0.44	1.16
0.29	0.74	0.45	1.52	0.75	0.46	1.57	0.70	0.41	1.39	0.73	0.44	1.49	0.79	0.50	1.69
0.20	0.73	0.53	2.72	0.73	0.54	2.74	0.68	0.48	2.47	0.73	0.53	2.71	0.78	0.58	2.98
0.14	0.72	0.58	4.18	0.72	0.58	4.19	0.66	0.53	3.79	0.71	0.57	4.13	0.76	0.62	4.48
0.24	0.70	0.46	1.88	0.71	0.46	1.90	0.65	0.41	1.68	0.70	0.45	1.86	0.74	0.50	2.05
0.22	0.69	0.47	2.18	0.70	0.48	2.21	0.64	0.43	1.97	0.68	0.47	2.15	0.73	0.52	2.38
0.27	0.67	0.40	1.46	0.68	0.40	1.48	0.62	0.35	1.27	0.67	0.40	1.44	0.72	0.44	1.62
0.34	0.66	0.32	0.93	0.66	0.32	0.95	0.62	0.28	0.81	0.65	0.31	0.91	0.69	0.35	1.02
0.44	0.63	0.20	0.45	0.65	0.21	0.48	0.60	0.16	0.38	0.62	0.19	0.43	0.64	0.20	0.46
0.65	0.59	-0.05	-0.08	0.61	-0.04	-0.06	0.58	-0.06	-0.10	0.57	-0.07	-0.11	0.57	-0.07	-0.11
0.69	0.54	-0.15	-0.22	0.56	-0.13	-0.19	0.56	-0.13	-0.19	0.52	-0.17	-0.25	0.52	-0.17	-0.25
0.90	0.49	-0.41	-0.45	0.51	-0.39	-0.43	0.52	-0.37	-0.42	0.47	-0.42	-0.47	0.51	-0.38	-0.42
0.87	0.45	-0.42	-0.49	0.46	-0.41	-0.47	0.48	-0.39	-0.45	0.43	-0.44	-0.50	0.64	-0.24	-0.27
0.91	0.41	-0.50	-0.55	0.42	-0.49	-0.54	0.44	-0.47	-0.51	0.40	-0.51	-0.56	0.74	-0.18	-0.19
0.87	0.40	-0.47	-0.54	0.39	-0.48	-0.55	0.43	-0.44	-0.51	0.45	-0.42	-0.49	0.72	-0.15	-0.18
0.93	0.61	-0.32	-0.34	0.48	-0.45	-0.49	0.45	-0.48	-0.51	0.66	-0.27	-0.29	0.67	-0.26	-0.28
0.93	0.56	-0.37	-0.40	0.64	-0.29	-0.31	0.56	-0.37	-0.40	0.49	-0.44	-0.48	0.64	-0.28	-0.31
0.89	0.44	-0.45	-0.50	0.45	-0.44	-0.49	0.60	-0.29	-0.33	0.44	-0.45	-0.50	0.61	-0.28	-0.31
0.84	0.41	-0.43	-0.51	0.43	-0.41	-0.49	0.57	-0.28	-0.33	0.40	-0.45	-0.53	0.59	-0.25	-0.30
0.76	0.37	-0.39	-0.51	0.38	-0.38	-0.50	0.55	-0.20	-0.27	0.36	-0.40	-0.53	0.59	-0.17	-0.22
0.80	0.33	-0.47	-0.59	0.34	-0.46	-0.57	0.52	-0.28	-0.35	0.33	-0.47	-0.59	0.59	-0.21	-0.26
0.73	0.31	-0.42	-0.58	0.31	-0.42	-0.58	0.50	-0.23	-0.32	0.31	-0.42	-0.58	0.61	-0.12	-0.16
0.76	0.30	-0.46	-0.61	0.30	-0.46	-0.61	0.49	-0.26	-0.35	0.31	-0.45	-0.60	0.64	-0.12	-0.15
0.79	0.30	-0.49	-0.62	0.29	-0.50	-0.64	0.51	-0.28	-0.36	0.32	-0.47	-0.60	0.65	-0.14	-0.18
0.72	0.32	-0.40	-0.56	0.30	-0.42	-0.58	0.57	-0.15	-0.21	0.34	-0.38	-0.53	0.60	-0.12	-0.17
0.80	0.34	-0.46	-0.57	0.32	-0.48	-0.60	0.61	-0.19	-0.23	0.37	-0.43	-0.53	0.58	-0.22	-0.27
0.77	0.38	-0.39	-0.50	0.35	-0.42	-0.54	0.56	-0.21	-0.27	0.41	-0.36	-0.46	0.56	-0.21	-0.27
0.76	0.41	-0.36	-0.47	0.39	-0.37	-0.48	0.50	-0.27	-0.35	0.40	-0.37	-0.48	0.54	-0.22	-0.29
0.82	0.38	-0.44	-0.53	0.39	-0.43	-0.52	0.46	-0.36	-0.44	0.37	-0.45	-0.55	0.51	-0.31	-0.37
0.69	0.35	-0.34	-0.49	0.37	-0.32	-0.47	0.43	-0.26	-0.38	0.34	-0.35	-0.51	0.49	-0.20	-0.29
0.66	0.32	-0.34	-0.52	0.34	-0.33	-0.49	0.41	-0.26	-0.39	0.30	-0.36	-0.54	0.47	-0.19	-0.29
0.74	0.29	-0.44	-0.60	0.31	-0.43	-0.58	0.39	-0.35	-0.48	0.29	-0.45	-0.61	0.46	-0.28	-0.38
0.67	0.27	-0.40	-0.59	0.28	-0.39	-0.58	0.38	-0.28	-0.42	0.27	-0.39	-0.59	0.44	-0.23	-0.34
0.91	0.26	-0.65	-0.71	0.27	-0.65	-0.71	0.37	-0.54	-0.59	0.25	-0.66	-0.72	0.42	-0.49	-0.54
0.85	0.24	-0.61	-0.71	0.25	-0.60	-0.71	0.37	-0.48	-0.56	0.25	-0.60	-0.71	0.40	-0.45	-0.53
0.76	0.24	-0.53	-0.69	0.24	-0.53	-0.69	0.37	-0.39	-0.51	0.23	-0.53	-0.69	0.38	-0.38	-0.50
0.87	0.23	-0.65	-0.74	0.23	-0.64	-0.74	0.37	-0.50	-0.57	0.22	-0.65	-0.74	0.37	-0.50	-0.57
0.79	0.22	-0.57	-0.73	0.22	-0.57	-0.72	0.36	-0.43	-0.54	0.22	-0.57	-0.72	0.37	-0.42	-0.53
0.94	0.22	-0.72	-0.77	0.21	-0.73	-0.77	0.35	-0.59	-0.63	0.22	-0.72	-0.77	0.37	-0.57	-0.61
0.84	0.21	-0.63	-0.75	0.21	-0.63	-0.75	0.34	-0.50	-0.60	0.21	-0.63	-0.75	0.36	-0.48	-0.57
0.84	0.21	-0.64	-0.76	0.21	-0.64	-0.75	0.32	-0.52	-0.62	0.21	-0.64	-0.75	0.35	-0.49	-0.58
0.79	0.21	-0.58	-0.74	0.20	-0.59	-0.75	0.31	-0.48	-0.61	0.21	-0.57	-0.73	0.35	-0.44	-0.56
0.71	0.21	-0.51	-0.71	0.20	-0.51	-0.72	0.30	-0.41	-0.57	0.21	-0.50	-0.70	0.33	-0.38	-0.53
0.71	0.21	-0.50	-0.71	0.20	-0.51	-0.72	0.29	-0.42	-0.59	0.21	-0.50	-0.71	0.32	-0.39	-0.55
0.75	0.20	-0.55	-0.73	0.20	-0.55	-0.73	0.28	-0.47	-0.63	0.20	-0.55	-0.73	0.35	-0.40	-0.54
0.65	0.20	-0.46	-0.70	0.20	-0.46	-0.70	0.27	-0.38	-0.58	0.19	-0.46	-0.71	0.50	-0.16	-0.24
0.67	0.19	-0.48	-0.72	0.19	-0.48	-0.72	0.26	-0.41	-0.61	0.19	-0.48	-0.72	0.62	-0.05	-0.07
0.69	0.18	-0.51	-0.74	0.19	-0.51	-0.73	0.25	-0.44	-0.63	0.18	-0.52	-0.75	0.62	-0.08	-0.11
0.55	0.17	-0.38	-0.69	0.18	-0.38	-0.68	0.25	-0.31	-0.55	0.16	-0.39	-0.71	0.60	0.05	0.08
0.63	0.16	-0.47	-0.75	0.17	-0.46	-0.74	0.24	-0.39	-0.62	0.15	-0.48	-0.76	0.58	-0.05	-0.08
0.62	0.15	-0.47	-0.76	0.16	-0.47	-0.75	0.23	-0.39	-0.63	0.15	-0.48	-0.76	0.57	-0.05	-0.09
0.64	0.14	-0.50	-0.78	0.14	-0.50	-0.78	0.22	-0.42	-0.65	0.13	-0.51	-0.79	0.57	-0.07	-0.11
0.68	0.13	-0.55	-0.80	0.14	-0.54	-0.80	0.21	-0.47	-0.69	0.13	-0.55	-0.81	0.56	-0.12	-0.18
0.70	0.13	-0.58	-0.82	0.13	-0.57	-0.81	0.21	-0.49	-0.70	0.13	-0.57	-0.81	0.57	-0.13	-0.19
0.64	0.12	-0.52	-0.81	0.12	-0.52	-0.81	0.20	-0.44	-0.68	0.13	-0.51	-0.80	0.57	-0.07	-0.11
0.67	0.12	-0.55	-0.82	0.12	-0.55	-0.83	0.20	-0.47	-0.70	0.12	-0.55	-0.83	0.58	-0.09	-0.13
0.61	0.12	-0.49	-0.81	0.11	-0.50	-0.81	0.20	-0.41	-0.67	0.11	-0.50	-0.81	0.60	-0.01	-0.02
0.54	0.11	-0.43	-0.80	0.11	-0.43	-0.79	0.20	-0.35	-0.64	0.11	-0.43	-0.80	0.59	0.04	0.08
0.51	0.10	-0.41	-0.80	0.11	-0.40	-0.78	0.20	-0.31	-0.62	0.10	-0.41	-0.81	0.52	0.01	0.02
0.40	0.10	-0.30	-0.75	0.10	-0.30	-0.75	0.20	-0.20	-0.51	0.09	-0.31	-0.77	0.48	0.08	0.21
0.45	0.09	-0.37	-0.81	0.10	-0.36	-0.79	0.19	-0.26	-0.57	0.08	-0.37	-0.82	0.47	0.02	0.04
0.43	0.08	-0.34	-0.81	0.09	-0.34	-0.79	0.20	-0.23	-0.54	0.08	-0.35	-0.82	0.45	0.03	0.07
0.40	0.07	-0.33	-0.82	0.08	-0.32	-0.80	0.19	-0.21	-0.51	0.07	-0.33	-0.82	0.43	0.03	0.08
0.45	0.07	-0.38	-0.84	0.07	-0.38	-0.84	0.20	-0.25	-0.55	0.07	-0.38	-0.85	0.41	-0.04	-0.09
0.33	0.06	-0.27	-0.82	0.07	-0.27	-0.80	0.21	-0.13	-0.38	0.06	-0.27	-0.82	0.39	0.06	0.18

0.38	0.06	-0.32	-0.85	0.06	-0.32	-0.84	0.21	-0.17	-0.45	0.05	-0.32	-0.86	0.37	-0.01	-0.02	
0.29	0.05	-0.23	-0.82	0.05	-0.23	-0.82	0.21	-0.07	-0.26	0.05	-0.24	-0.82	0.34	0.05	0.19	
0.59	= <|x|>	*0.46*			*0.46*			*0.36*			*0.46*			*0.28*		*MAE*
		0.77			**0.77**			**0.61**			**0.77**			**0.47**		**RMAE**

Table 9.115: Experiment 05.06.08 Deployment MM

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.34	0.54	0.19	0.56	0.53	0.18	0.53	0.47	0.12	0.36	0.58	0.24	0.69	0.61	0.27	0.78
0.42	0.66	0.24	0.59	0.58	0.16	0.39	0.50	0.08	0.19	0.73	0.31	0.75	0.72	0.30	0.73
0.39	0.72	0.33	0.83	0.72	0.33	0.84	0.65	0.26	0.67	0.68	0.29	0.74	0.75	0.36	0.91
0.20	0.67	0.47	2.33	0.68	0.48	2.40	0.47	0.27	1.33	0.66	0.46	2.29	0.74	0.53	2.66
0.58	0.66	0.08	0.13	0.66	0.08	0.14	0.43	-0.16	-0.27	0.65	0.06	0.11	0.73	0.15	0.25
0.44	0.64	0.20	0.47	0.65	0.22	0.50	0.43	0.00	-0.01	0.63	0.19	0.44	0.72	0.28	0.65
0.66	0.62	-0.04	-0.06	0.63	-0.03	-0.04	0.43	-0.23	-0.36	0.61	-0.05	-0.08	0.72	0.06	0.08
0.77	0.61	-0.16	-0.21	0.62	-0.15	-0.20	0.43	-0.33	-0.44	0.59	-0.18	-0.23	0.73	-0.04	-0.06
0.69	0.61	-0.08	-0.12	0.59	-0.10	-0.15	0.42	-0.27	-0.40	0.64	-0.05	-0.08	0.73	0.03	0.05
0.74	0.58	-0.16	-0.22	0.64	-0.10	-0.13	0.41	-0.33	-0.44	0.46	-0.28	-0.37	0.61	-0.13	-0.18
0.75	0.43	-0.31	-0.42	0.49	-0.26	-0.35	0.40	-0.35	-0.46	0.40	-0.35	-0.47	0.56	-0.19	-0.25
0.88	0.38	-0.50	-0.57	0.41	-0.47	-0.53	0.40	-0.48	-0.54	0.36	-0.52	-0.59	0.52	-0.36	-0.41
0.93	0.36	-0.56	-0.61	0.37	-0.56	-0.60	0.39	-0.54	-0.58	0.34	-0.59	-0.64	0.50	-0.43	-0.46
0.93	0.32	-0.61	-0.66	0.35	-0.58	-0.62	0.37	-0.56	-0.60	0.30	-0.63	-0.68	0.47	-0.46	-0.49
0.97	0.31	-0.66	-0.68	0.31	-0.66	-0.68	0.34	-0.64	-0.65	0.30	-0.68	-0.69	0.45	-0.52	-0.54
0.95	0.30	-0.65	-0.68	0.31	-0.64	-0.67	0.30	-0.64	-0.68	0.29	-0.66	-0.70	0.43	-0.51	-0.54
0.96	0.29	-0.67	-0.69	0.30	-0.66	-0.69	0.27	-0.69	-0.72	0.28	-0.68	-0.71	0.43	-0.53	-0.55
0.93	0.29	-0.65	-0.69	0.29	-0.64	-0.69	0.26	-0.68	-0.73	0.28	-0.65	-0.70	0.44	-0.50	-0.53
0.83	0.29	-0.54	-0.65	0.29	-0.53	-0.65	0.25	-0.58	-0.70	0.28	-0.55	-0.66	0.48	-0.35	-0.42
0.72	0.28	-0.44	-0.61	0.29	-0.44	-0.60	0.24	-0.48	-0.67	0.28	-0.45	-0.62	0.61	-0.12	-0.16
0.72	0.26	-0.45	-0.63	0.28	-0.44	-0.62	0.23	-0.49	-0.68	0.25	-0.46	-0.65	0.61	-0.11	-0.15
0.56	0.26	-0.31	-0.54	0.26	-0.30	-0.54	0.22	-0.34	-0.61	0.25	-0.31	-0.55	0.58	0.01	0.03
0.57	0.26	-0.32	-0.55	0.26	-0.32	-0.55	0.22	-0.36	-0.62	0.25	-0.32	-0.56	0.57	0.00	-0.01
0.55	0.26	-0.28	-0.52	0.26	-0.29	-0.52	0.20	-0.35	-0.63	0.26	-0.29	-0.53	0.57	0.02	0.04
0.63	0.28	-0.35	-0.56	0.27	-0.36	-0.57	0.19	-0.44	-0.70	0.27	-0.36	-0.57	0.57	-0.07	-0.10
0.73	0.29	-0.43	-0.60	0.29	-0.44	-0.60	0.17	-0.56	-0.77	0.29	-0.44	-0.60	0.55	-0.18	-0.25
0.56	0.31	-0.24	-0.43	0.30	-0.26	-0.46	0.16	-0.40	-0.72	0.32	-0.24	-0.43	0.54	-0.02	-0.03
0.75	0.43	-0.33	-0.43	0.36	-0.39	-0.52	0.16	-0.60	-0.79	0.43	-0.33	-0.44	0.56	-0.19	-0.25
0.74	0.47	-0.27	-0.36	0.48	-0.26	-0.35	0.15	-0.59	-0.79	0.47	-0.27	-0.37	0.53	-0.21	-0.28
0.89	0.40	-0.49	-0.55	0.42	-0.47	-0.53	0.14	-0.75	-0.84	0.41	-0.48	-0.54	0.47	-0.42	-0.47
0.86	0.41	-0.45	-0.52	0.40	-0.46	-0.54	0.13	-0.74	-0.85	0.41	-0.45	-0.52	0.43	-0.43	-0.50
0.83	0.42	-0.41	-0.49	0.42	-0.42	-0.50	0.12	-0.71	-0.86	0.43	-0.40	-0.48	0.41	-0.42	-0.51
0.89	0.43	-0.46	-0.52	0.43	-0.46	-0.52	0.12	-0.77	-0.87	0.44	-0.45	-0.51	0.37	-0.52	-0.58
0.83	0.42	-0.41	-0.49	0.42	-0.41	-0.49	0.13	-0.71	-0.85	0.42	-0.41	-0.49	0.35	-0.48	-0.58
0.80	0.40	-0.40	-0.50	0.41	-0.39	-0.49	0.14	-0.66	-0.83	0.41	-0.39	-0.49	0.33	-0.47	-0.59
0.65	0.39	-0.26	-0.40	0.39	-0.26	-0.40	0.15	-0.50	-0.77	0.39	-0.26	-0.40	0.32	-0.33	-0.51
0.56	0.37	-0.19	-0.34	0.38	-0.18	-0.32	0.17	-0.39	-0.70	0.37	-0.18	-0.33	0.30	-0.26	-0.46
0.65	0.35	-0.30	-0.46	0.36	-0.29	-0.44	0.18	-0.46	-0.72	0.35	-0.30	-0.46	0.29	-0.35	-0.55
0.46	0.32	-0.15	-0.32	0.33	-0.13	-0.29	0.20	-0.27	-0.58	0.32	-0.14	-0.31	0.29	-0.18	-0.38
0.54	0.34	-0.20	-0.38	0.32	-0.22	-0.41	0.21	-0.33	-0.60	0.35	-0.19	-0.36	0.28	-0.26	-0.47
0.11	0.33	0.22	1.97	0.34	0.23	2.12	0.25	0.14	1.28	0.32	0.21	1.93	0.29	0.18	1.65
0.18	0.29	0.11	0.63	0.31	0.13	0.70	0.31	0.13	0.74	0.29	0.11	0.64	0.31	0.13	0.74
0.10	0.28	0.17	1.71	0.28	0.18	1.75	0.37	0.26	2.57	0.28	0.18	1.71	0.34	0.24	2.35
0.21	0.26	0.05	0.26	0.27	0.06	0.28	0.39	0.18	0.85	0.27	0.06	0.29	0.39	0.18	0.89
0.24	0.26	0.02	0.07	0.26	0.02	0.09	0.39	0.15	0.63	0.26	0.02	0.08	0.45	0.21	0.86
0.21	0.25	0.04	0.17	0.25	0.04	0.19	0.42	0.21	0.97	0.25	0.04	0.18	0.46	0.25	1.19
0.28	0.24	-0.04	-0.16	0.24	-0.04	-0.15	0.45	0.17	0.59	0.24	-0.04	-0.16	0.46	0.18	0.65
0.37	0.21	-0.15	-0.41	0.23	-0.14	-0.38	0.46	0.09	0.26	0.22	-0.15	-0.41	0.47	0.10	0.28
0.24	0.20	-0.04	-0.15	0.21	-0.03	-0.12	0.45	0.21	0.90	0.20	-0.04	-0.15	0.47	0.24	1.00
0.27	0.19	-0.08	-0.30	0.19	-0.07	-0.28	0.43	0.17	0.62	0.19	-0.08	-0.28	0.48	0.21	0.79
0.29	0.18	-0.12	-0.40	0.18	-0.11	-0.38	0.42	0.13	0.44	0.17	-0.12	-0.42	0.48	0.19	0.64
0.31	0.16	-0.15	-0.49	0.16	-0.14	-0.46	0.41	0.10	0.33	0.16	-0.15	-0.49	0.49	0.19	0.61
0.36	0.14	-0.22	-0.61	0.15	-0.21	-0.59	0.37	0.01	0.04	0.14	-0.22	-0.61	0.49	0.13	0.37
0.35	0.13	-0.22	-0.63	0.14	-0.21	-0.61	0.37	0.02	0.07	0.13	-0.21	-0.62	0.50	0.16	0.45
0.34	0.12	-0.22	-0.65	0.12	-0.21	-0.64	0.36	0.02	0.07	0.12	-0.21	-0.64	0.52	0.18	0.54
0.35	0.11	-0.24	-0.67	0.12	-0.24	-0.67	0.34	-0.01	-0.02	0.12	-0.23	-0.66	0.48	0.13	0.38
0.36	0.11	-0.25	-0.69	0.11	-0.25	-0.70	0.33	-0.04	-0.10	0.11	-0.25	-0.69	0.45	0.08	0.23
0.18	0.11	-0.07	-0.40	0.11	-0.07	-0.40	0.32	0.14	0.81	0.11	-0.07	-0.39	0.43	0.25	1.43
0.38	0.10	-0.28	-0.74	0.10	-0.27	-0.73	0.32	-0.06	-0.15	0.10	-0.27	-0.72	0.41	0.03	0.09
0.27	0.09	-0.18	-0.66	0.10	-0.18	-0.65	0.31	0.04	0.15	0.10	-0.17	-0.64	0.40	0.13	0.49
0.29	0.09	-0.20	-0.68	0.09	-0.20	-0.69	0.30	0.01	0.03	0.10	-0.19	-0.65	0.38	0.09	0.31
0.26	0.09	-0.16	-0.64	0.09	-0.17	-0.64	0.29	0.03	0.13	0.10	-0.15	-0.60	0.37	0.11	0.44
0.25	0.10	-0.15	-0.61	0.09	-0.16	-0.64	0.27	0.02	0.09	0.11	-0.14	-0.58	0.35	0.11	0.43
0.24	0.10	-0.14	-0.58	0.10	-0.14	-0.59	0.26	0.02	0.07	0.11	-0.13	-0.56	0.35	0.11	0.47
0.23	0.10	-0.13	-0.58	0.10	-0.14	-0.59	0.24	0.01	0.03	0.11	-0.12	-0.52	0.34	0.11	0.46
0.08	0.11	0.02	0.27	0.10	0.02	0.21	0.23	0.15	1.76	0.11	0.03	0.31	0.34	0.26	3.07
0.08	0.10	0.03	0.35	0.10	0.03	0.34	0.22	0.15	1.95	0.11	0.04	0.51	0.35	0.28	3.69
0.11	0.11	0.00	-0.04	0.10	-0.01	-0.11	0.21	0.10	0.88	0.12	0.00	0.04	0.38	0.26	2.35
0.13	0.11	-0.02	-0.13	0.11	-0.02	-0.17	0.21	0.08	0.60	0.13	0.00	0.00	0.40	0.28	2.14
0.11	0.12	0.01	0.06	0.11	0.00	-0.02	0.20	0.09	0.77	0.13	0.02	0.18	0.44	0.33	2.98
0.15	0.13	-0.03	-0.17	0.12	-0.03	-0.22	0.19	0.04	0.28	0.14	-0.01	-0.08	0.44	0.28	1.88
0.23	0.13	-0.10	-0.42	0.12	-0.11	-0.46	0.19	-0.04	-0.17	0.15	-0.08	-0.35	0.43	0.20	0.87
0.13	0.14	0.01	0.11	0.13	0.00	0.03	0.20	0.07	0.57	0.17	0.04	0.34	0.43	0.31	2.42

0.19	0.16	-0.04	-0.19	0.14	-0.05	-0.28	0.20	0.01	0.03	0.21	0.01	0.07	0.44	0.24	1.26	
0.04	0.18	0.14	3.34	0.15	0.11	2.73	0.20	0.16	3.98	0.27	0.23	5.53	0.44	0.40	9.80	
0.08	0.22	0.15	1.87	0.18	0.10	1.27	0.21	0.14	1.73	0.32	0.25	3.17	0.45	0.37	4.75	
0.09	0.29	0.19	2.05	0.21	0.12	1.27	0.24	0.15	1.59	0.32	0.23	2.41	0.46	0.36	3.85	
0.14	0.32	0.18	1.25	0.28	0.14	0.95	0.31	0.17	1.18	0.29	0.14	1.00	0.46	0.32	2.22	
0.46	= <|x|>	*0.24*			*0.24*			*0.28*			*0.25*			*0.24*		*MAE*
		0.52			**0.51**			**0.60**			**0.53**			**0.52**		**RMAE**

Table 9.116: Experiment 05.06.08 Deployment NN

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.05	0.21	0.16	3.15	0.21	0.16	3.32	0.19	0.14	2.92	0.19	0.14	2.80	0.15	0.10	1.99	
0.09	0.21	0.12	1.38	0.22	0.13	1.48	0.19	0.11	1.19	0.20	0.12	1.31	0.16	0.07	0.77	
0.12	0.22	0.10	0.78	0.22	0.10	0.81	0.19	0.07	0.57	0.21	0.08	0.68	0.16	0.04	0.32	
0.08	0.22	0.14	1.62	0.23	0.15	1.72	0.20	0.11	1.32	0.21	0.13	1.50	0.16	0.07	0.87	
0.00	0.23	0.23	64.17	0.22	0.22	63.04	0.19	0.19	53.91	0.22	0.21	61.09	0.16	0.15	43.31	
0.15	0.23	0.07	0.48	0.22	0.07	0.43	0.19	0.04	0.26	0.22	0.07	0.43	0.16	0.00	0.01	
0.13	0.22	0.09	0.65	0.22	0.09	0.65	0.20	0.07	0.51	0.22	0.09	0.65	0.15	0.02	0.14	
0.07	0.23	0.16	2.30	0.22	0.15	2.18	0.20	0.13	1.95	0.22	0.15	2.22	0.16	0.09	1.37	
0.18	0.23	0.04	0.23	0.21	0.03	0.15	0.21	0.02	0.12	0.23	0.04	0.24	0.18	0.00	0.00	
0.06	0.22	0.16	2.47	0.21	0.14	2.29	0.21	0.15	2.32	0.23	0.17	2.68	0.19	0.13	1.99	
0.10	= <|x|>	0.13			0.12			0.10			0.12			0.07		*MAE*
		1.32			**1.30**			**1.09**			**1.26**			**0.71**		**RMAE**

Table 9.117: Experiment 05.06.08 Deployment OO

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.17	0.11	-0.06	-0.37	0.20	0.03	0.17	0.17	0.00	0.00	0.05	-0.12	-0.70	0.41	0.24	1.42	
0.18	0.12	-0.06	-0.36	0.20	0.02	0.10	0.17	-0.01	-0.06	0.05	-0.13	-0.73	0.40	0.22	1.20	
0.15	0.12	-0.03	-0.20	0.20	0.05	0.34	0.17	0.02	0.11	0.04	-0.11	-0.73	0.39	0.24	1.64	
0.20	0.11	-0.09	-0.43	0.19	-0.01	-0.06	0.15	-0.05	-0.25	0.04	-0.16	-0.80	0.38	0.18	0.90	
0.22	0.10	-0.12	-0.54	0.18	-0.05	-0.21	0.10	-0.12	-0.54	0.03	-0.19	-0.86	0.36	0.14	0.64	
0.17	0.10	-0.08	-0.44	0.17	0.00	-0.02	0.06	-0.11	-0.66	0.02	-0.15	-0.86	0.34	0.17	1.00	
0.26	0.09	-0.17	-0.66	0.16	-0.10	-0.39	0.11	-0.15	-0.56	0.02	-0.24	-0.92	0.32	0.06	0.24	
0.07	0.07	0.00	-0.03	0.15	0.08	1.16	0.16	0.09	1.33	0.01	-0.06	-0.81	0.31	0.24	3.38	
0.16	0.06	-0.10	-0.63	0.14	-0.02	-0.12	0.21	0.05	0.34	0.01	-0.15	-0.95	0.30	0.14	0.90	
0.25	0.04	-0.21	-0.82	0.13	-0.12	-0.47	0.26	0.01	0.02	0.01	-0.24	-0.97	0.29	0.04	0.17	
0.34	0.03	-0.31	-0.91	0.13	-0.22	-0.63	0.26	-0.09	-0.25	0.01	-0.33	-0.96	0.29	-0.05	-0.16	
0.33	0.02	-0.31	-0.93	0.13	-0.20	-0.61	0.25	-0.08	-0.23	0.02	-0.31	-0.94	0.31	-0.03	-0.08	
0.43	0.01	-0.42	-0.98	0.11	-0.32	-0.73	0.25	-0.18	-0.43	0.02	-0.41	-0.94	0.31	-0.12	-0.29	
0.28	0.01	-0.26	-0.95	0.10	-0.17	-0.63	0.24	-0.04	-0.14	0.03	-0.25	-0.91	0.31	0.03	0.12	
0.38	0.02	-0.36	-0.96	0.09	-0.29	-0.77	0.23	-0.15	-0.39	0.03	-0.35	-0.91	0.32	-0.06	-0.15	
0.43	0.02	-0.41	-0.95	0.06	-0.37	-0.85	0.23	-0.20	-0.48	0.03	-0.40	-0.92	0.34	-0.09	-0.21	
0.33	0.03	-0.30	-0.90	0.04	-0.29	-0.87	0.23	-0.11	-0.32	0.04	-0.30	-0.89	0.34	0.01	0.03	
0.53	0.04	-0.48	-0.92	0.03	-0.50	-0.95	0.22	-0.31	-0.58	0.04	-0.49	-0.93	0.38	-0.15	-0.28	
0.41	0.05	-0.36	-0.88	0.02	-0.39	-0.95	0.20	-0.21	-0.50	0.04	-0.37	-0.89	0.40	-0.01	-0.03	
0.49	0.06	-0.42	-0.87	0.01	-0.48	-0.98	0.18	-0.31	-0.63	0.05	-0.44	-0.90	0.41	-0.08	-0.16	
0.29	= <|x|>	*0.23*			*0.19*			*0.11*			*0.26*			*0.12*		*MAE*
		0.79			**0.64**			**0.39**			**0.90**			**0.40**		**RMAE**

Table 9.118: Experiment 05.06.08 Deployment PP

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.99	1.13	0.13	0.14	1.15	0.16	0.16	0.98	-0.01	-0.01	1.11	0.12	0.12	1.24	0.25	0.25	
1.01	1.08	0.07	0.07	1.10	0.09	0.08	0.94	-0.07	-0.07	1.07	0.05	0.05	1.19	0.18	0.18	
1.02	1.04	0.03	0.03	1.06	0.04	0.04	0.92	-0.10	-0.09	1.03	0.02	0.01	1.16	0.14	0.14	
1.00	1.01	0.02	0.02	1.03	0.03	0.03	0.89	-0.10	-0.10	0.99	-0.01	-0.01	1.10	0.10	0.10	
0.96	0.94	-0.02	-0.02	0.97	0.01	0.01	0.86	-0.10	-0.11	0.92	-0.04	-0.04	1.02	0.06	0.06	
0.91	0.87	-0.04	-0.04	0.89	-0.01	-0.02	0.80	-0.11	-0.12	0.85	-0.06	-0.06	0.96	0.05	0.06	
0.90	0.81	-0.09	-0.10	0.83	-0.07	-0.08	0.73	-0.18	-0.19	0.80	-0.10	-0.11	0.92	0.02	0.02	
0.86	0.78	-0.09	-0.10	0.80	-0.07	-0.08	0.66	-0.21	-0.24	0.76	-0.10	-0.12	0.88	0.01	0.01	
0.92	0.74	-0.19	-0.20	0.75	-0.17	-0.19	0.61	-0.32	-0.34	0.72	-0.20	-0.22	0.85	-0.08	-0.08	
0.80	0.72	-0.09	-0.11	0.73	-0.08	-0.09	0.57	-0.23	-0.29	0.71	-0.09	-0.12	0.85	0.05	0.06	
0.83	0.72	-0.11	-0.13	0.73	-0.10	-0.12	0.56	-0.27	-0.32	0.72	-0.11	-0.13	0.87	0.04	0.05	
0.71	0.74	0.03	0.04	0.74	0.03	0.04	0.56	-0.15	-0.22	0.73	0.02	0.03	0.92	0.21	0.29	
0.69	0.76	0.07	0.10	0.76	0.07	0.10	0.57	-0.13	-0.19	0.77	0.07	0.10	0.93	0.23	0.34	
0.75	0.82	0.08	0.10	0.82	0.08	0.10	0.58	-0.17	-0.22	0.82	0.07	0.10	0.85	0.10	0.14	
0.74	0.81	0.07	0.09	0.83	0.08	0.11	0.60	-0.14	-0.19	0.80	0.05	0.07	0.86	0.11	0.15	
0.74	0.76	0.02	0.03	0.76	0.03	0.04	0.63	-0.10	-0.14	0.75	0.02	0.02	0.87	0.13	0.18	
0.74	0.78	0.04	0.06	0.78	0.05	0.06	0.68	-0.05	-0.07	0.78	0.04	0.06	0.84	0.10	0.14	
0.86	= <|x|>	0.07			0.07			0.14			0.07			0.11		*MAE*
		0.08			**0.08**			**0.17**			**0.08**			**0.13**		**RMAE**

Table 9.119: Experiment 05.06.08 Deployment RR

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.68	0.40	-0.28	-0.42	0.30	-0.38	-0.56	0.58	-0.10	-0.14	0.48	-0.20	-0.29	0.00	-0.68	-1.00	
0.58	0.39	-0.19	-0.33	0.31	-0.27	-0.46	0.55	-0.02	-0.04	0.40	-0.18	0.00	0.00	-0.58	-1.00	
0.52	0.34	-0.18	-0.35	0.31	-0.22	-0.42	0.43	-0.10	-0.18	0.32	-0.20	0.00	0.00	-0.52	-1.00	
0.49	0.28	-0.21	-0.44	0.33	-0.17	-0.34	0.34	-0.15	-0.30	0.29	-0.20	0.00	0.00	-0.49	-1.00	
0.36	0.26	-0.10	-0.27	0.26	-0.09	-0.26	0.27	-0.09	-0.25	0.23	-0.12	0.00	0.00	-0.36	-1.00	
0.28	0.23	-0.05	-0.17	0.23	-0.04	-0.15	0.25	-0.03	-0.11	0.21	-0.07	0.00	0.00	-0.28	-1.00	
0.23	0.19	-0.04	-0.17	0.23	0.00	0.01	0.22	0.00	-0.02	0.19	-0.04	0.00	0.00	-0.23	-1.00	
0.03	0.17	0.14	4.84	0.20	0.17	5.85	0.19	0.16	5.50	0.18	0.15	0.00	0.00	-0.03	-1.00	
0.09	0.16	0.07	0.78	0.17	0.08	0.91	0.18	0.09	1.05	0.15	0.06	0.00	0.00	-0.09	-1.00	
0.20	0.15	-0.05	-0.26	0.16	-0.04	-0.20	0.17	-0.03	-0.15	0.13	-0.06	0.00	0.00	-0.20	-1.00	
0.29	0.13	-0.16	-0.55	0.14	-0.15	-0.53	0.16	-0.13	-0.45	0.13	-0.16	0.00	0.00	-0.29	-1.00	
0.12	0.12	-0.01	-0.04	0.14	0.02	0.13	0.15	0.03	0.26	0.12	0.00	0.00	0.00	-0.12	-1.00	
0.17	0.12	-0.04	-0.27	0.12	-0.04	-0.27	0.15	-0.02	-0.10	0.12	-0.05	0.00	0.00	-0.17	-1.00	
0.23	0.11	-0.12	-0.52	0.11	-0.12	-0.51	0.16	-0.08	-0.33	0.11	-0.12	0.00	0.00	-0.23	-1.00	
0.29	0.11	-0.18	-0.63	0.10	-0.18	-0.64	0.16	-0.12	-0.43	0.11	-0.18	0.00	0.00	-0.29	-1.00	
0.34	0.10	-0.24	-0.69	0.11	-0.23	-0.69	0.18	-0.17	-0.49	0.10	-0.24	0.00	0.00	-0.34	-1.00	
0.30	0.09	-0.21	-0.69	0.11	-0.19	-0.64	0.19	-0.11	-0.38	0.11	-0.19	0.00	0.00	-0.30	-1.00	
0.19	0.09	-0.10	-0.50	0.10	-0.09	-0.48	0.19	0.00	0.02	0.14	-0.05	0.00	0.00	-0.19	-1.00	
0.18	0.09	-0.09	-0.52	0.09	-0.09	-0.49	0.19	0.01	0.07	0.19	0.00	0.00	0.00	-0.18	-1.00	
0.12	0.09	-0.03	-0.26	0.08	-0.04	-0.32	0.19	0.07	0.54	0.18	0.06	0.00	0.00	-0.12	-1.00	
0.28	$= <\vert x\vert>$	*0.12*			*0.13*			*0.08*			*0.12*			*0.28*		*MAE*
		0.44			**0.46**			**0.27**			**0.41**			**1.00**		**RMAE**

Table 9.120: Experiment 05.06.08 Deployment SS

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.20	0.11	-0.10	-0.47	0.11	-0.09	-0.45	0.13	-0.08	-0.38	0.11	-0.09	-0.47	0.09	-0.11	-0.56	
0.26	0.10	-0.15	-0.60	0.10	-0.15	-0.60	0.12	-0.14	-0.53	0.10	-0.15	-0.60	0.08	-0.17	-0.68	
0.17	0.09	-0.08	-0.47	0.10	-0.07	-0.43	0.11	-0.06	-0.36	0.09	-0.08	-0.45	0.08	-0.09	-0.55	
0.20	0.09	-0.11	-0.54	0.09	-0.10	-0.53	0.10	-0.09	-0.47	0.09	-0.11	-0.55	0.07	-0.12	-0.63	
0.24	0.08	-0.16	-0.67	0.09	-0.15	-0.64	0.10	-0.14	-0.60	0.08	-0.16	-0.67	0.06	-0.18	-0.73	
0.16	0.08	-0.08	-0.52	0.08	-0.08	-0.48	0.09	-0.07	-0.45	0.08	-0.08	-0.50	0.06	-0.10	-0.61	
0.08	0.07	-0.01	-0.14	0.08	0.00	0.00	0.08	0.00	0.05	0.07	-0.01	-0.14	0.05	-0.03	-0.33	
0.04	0.06	0.02	0.63	0.07	0.04	1.03	0.07	0.04	1.00	0.07	0.03	0.83	0.05	0.02	0.44	
0.05	0.06	0.01	0.11	0.08	0.02	0.48	0.06	0.01	0.25	0.06	0.01	0.12	0.05	0.00	-0.08	
0.15	0.05	-0.10	-0.65	0.08	-0.07	-0.49	0.06	-0.09	-0.58	0.05	-0.10	-0.64	0.05	-0.10	-0.68	
0.19	0.05	-0.14	-0.73	0.08	-0.11	-0.56	0.06	-0.13	-0.69	0.04	-0.14	-0.76	0.05	-0.14	-0.75	
0.17	0.05	-0.12	-0.72	0.09	-0.08	-0.45	0.05	-0.12	-0.70	0.04	-0.13	-0.75	0.04	-0.13	-0.74	
0.22	0.05	-0.17	-0.77	0.10	-0.11	-0.53	0.05	-0.17	-0.77	0.04	-0.18	-0.82	0.04	-0.18	-0.81	
0.16	0.05	-0.11	-0.70	0.10	-0.05	-0.34	0.05	-0.10	-0.66	0.04	-0.12	-0.76	0.05	-0.11	-0.71	
0.20	0.05	-0.15	-0.76	0.11	-0.09	-0.44	0.05	-0.15	-0.75	0.04	-0.16	-0.81	0.04	-0.16	-0.79	
0.33	0.05	-0.28	-0.85	0.12	-0.21	-0.64	0.05	-0.28	-0.85	0.04	-0.29	-0.88	0.04	-0.29	-0.88	
0.26	0.04	-0.22	-0.84	0.13	-0.13	-0.50	0.05	-0.21	-0.80	0.04	-0.22	-0.83	0.04	-0.22	-0.85	
0.30	0.05	-0.26	-0.85	0.14	-0.16	-0.54	0.05	-0.26	-0.84	0.05	-0.25	-0.82	0.04	-0.26	-0.86	
0.34	0.04	-0.30	-0.87	0.14	-0.20	-0.59	0.04	-0.29	-0.87	0.06	-0.28	-0.83	0.04	-0.30	-0.89	
0.26	0.05	-0.21	-0.82	0.15	-0.11	-0.42	0.05	-0.21	-0.82	0.06	-0.20	-0.75	0.03	-0.23	-0.88	
0.20	$= <\vert x\vert>$	*0.14*			*0.10*			*0.13*			*0.14*			*0.15*		*MAE*
		0.70			**0.51**			**0.67**			**0.70**			**0.74**		**RMAE**

Table 9.121: Experiment 05.06.08 Deployment TT

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.23	0.08	-0.15	-0.64	0.10	-0.13	-0.57	0.10	-0.13	-0.57	0.08	-0.15	-0.66	0.07	-0.16	-0.70
0.26	0.08	-0.18	-0.68	0.10	-0.16	-0.62	0.10	-0.17	-0.63	0.07	-0.19	-0.72	0.07	-0.19	-0.74
0.27	0.08	-0.18	-0.69	0.10	-0.16	-0.61	0.09	-0.17	-0.64	0.07	-0.19	-0.73	0.07	-0.19	-0.72
0.33	0.08	-0.25	-0.75	0.11	-0.22	-0.66	0.09	-0.24	-0.72	0.07	-0.26	-0.78	0.07	-0.25	-0.78
0.31	0.08	-0.22	-0.73	0.12	-0.19	-0.62	0.09	-0.22	-0.70	0.06	-0.24	-0.79	0.08	-0.23	-0.75
0.38	0.08	-0.30	-0.78	0.12	-0.26	-0.68	0.09	-0.29	-0.77	0.06	-0.32	-0.83	0.08	-0.30	-0.79
0.45	0.09	-0.36	-0.80	0.13	-0.32	-0.71	0.09	-0.36	-0.80	0.06	-0.39	-0.87	0.08	-0.36	-0.81
0.64	0.10	-0.55	-0.85	0.13	-0.51	-0.79	0.09	-0.55	-0.85	0.06	-0.59	-0.91	0.09	-0.55	-0.86
0.63	0.10	-0.53	-0.84	0.15	-0.48	-0.77	0.10	-0.53	-0.84	0.06	-0.57	-0.91	0.09	-0.54	-0.86
0.73	0.11	-0.62	-0.85	0.15	-0.58	-0.79	0.11	-0.62	-0.85	0.06	-0.67	-0.92	0.09	-0.63	-0.87
0.82	0.12	-0.70	-0.86	0.16	-0.66	-0.80	0.11	-0.70	-0.86	0.06	-0.75	-0.92	0.11	-0.71	-0.87
0.89	0.13	-0.76	-0.85	0.16	-0.73	-0.82	0.13	-0.77	-0.86	0.06	-0.83	-0.93	0.11	-0.78	-0.87
0.80	0.14	-0.67	-0.83	0.17	-0.63	-0.79	0.13	-0.67	-0.83	0.07	-0.73	-0.91	0.12	-0.68	-0.85
0.78	0.15	-0.63	-0.81	0.18	-0.60	-0.77	0.15	-0.64	-0.81	0.07	-0.71	-0.91	0.13	-0.65	-0.83
0.80	0.16	-0.64	-0.80	0.18	-0.62	-0.77	0.16	-0.65	-0.81	0.07	-0.73	-0.91	0.14	-0.66	-0.82
0.77	0.16	-0.61	-0.79	0.19	-0.58	-0.75	0.16	-0.61	-0.79	0.08	-0.70	-0.90	0.15	-0.63	-0.81
0.79	0.17	-0.62	-0.78	0.19	-0.60	-0.76	0.17	-0.62	-0.79	0.09	-0.71	-0.89	0.15	-0.64	-0.81
0.81	0.18	-0.62	-0.77	0.21	-0.60	-0.74	0.18	-0.63	-0.78	0.10	-0.71	-0.88	0.16	-0.65	-0.80
0.87	0.19	-0.68	-0.78	0.20	-0.66	-0.76	0.19	-0.68	-0.79	0.11	-0.76	-0.88	0.17	-0.70	-0.81
0.84	0.20	-0.65	-0.77	0.21	-0.64	-0.76	0.19	-0.65	-0.78	0.11	-0.73	-0.87	0.17	-0.67	-0.80
0.86	0.20	-0.67	-0.77	0.19	-0.67	-0.78	0.20	-0.67	-0.77	0.12	-0.74	-0.86	0.19	-0.68	-0.79
0.91	0.19	-0.72	-0.79	0.19	-0.72	-0.79	0.20	-0.71	-0.78	0.13	-0.78	-0.85	0.19	-0.72	-0.79
0.91	0.20	-0.71	-0.78	0.18	-0.73	-0.80	0.20	-0.71	-0.78	0.14	-0.77	-0.85	0.18	-0.73	-0.80
0.83	0.20	-0.63	-0.76	0.17	-0.66	-0.80	0.20	-0.63	-0.75	0.14	-0.69	-0.83	0.18	-0.65	-0.78
0.88	0.19	-0.69	-0.79	0.15	-0.73	-0.83	0.19	-0.69	-0.78	0.15	-0.73	-0.83	0.19	-0.69	-0.79

0.91	0.19	-0.73	-0.80	0.14	-0.77	-0.85	0.19	-0.73	-0.79	0.14	-0.78	-0.85	0.18	-0.73	-0.80	
0.68	$= \langle \vert x \vert \rangle$	*0.54*			*0.52*			*0.54*			*0.59*			*0.55*		*MAE*
		0.79			**0.77**			**0.79**			**0.87**			**0.81**		**RMAE**

Table 9.122: Experiment 05.06.08 Deployment UU

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5			
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err	
0.30	0.46	0.16	0.53	0.45	0.15	0.50	0.41	0.11	0.36	0.46	0.16	0.53	0.47	0.17	0.56	
0.33	0.44	0.11	0.33	0.44	0.10	0.31	0.40	0.07	0.21	0.44	0.11	0.32	0.44	0.11	0.33	
0.34	0.43	0.10	0.28	0.42	0.09	0.26	0.40	0.07	0.19	0.44	0.10	0.30	0.43	0.09	0.27	
0.35	0.43	0.09	0.26	0.42	0.08	0.22	0.40	0.06	0.16	0.45	0.10	0.29	0.43	0.08	0.24	
0.39	0.45	0.07	0.17	0.43	0.04	0.10	0.42	0.03	0.07	0.48	0.09	0.23	0.44	0.05	0.12	
0.42	0.50	0.08	0.19	0.45	0.03	0.08	0.46	0.04	0.09	0.53	0.11	0.27	0.45	0.04	0.09	
0.46	0.55	0.09	0.20	0.50	0.04	0.09	0.52	0.05	0.12	0.56	0.10	0.22	0.50	0.04	0.08	
0.60	0.56	-0.04	-0.07	0.57	-0.03	-0.05	0.57	-0.02	-0.04	0.51	-0.09	-0.15	0.51	-0.09	-0.15	
0.46	0.50	0.04	0.08	0.55	0.10	0.21	0.52	0.07	0.14	0.45	-0.01	-0.02	0.46	0.01	0.01	
0.49	0.43	-0.05	-0.11	0.48	0.00	-0.01	0.46	-0.03	-0.05	0.41	-0.07	-0.15	0.42	-0.07	-0.14	
0.50	0.41	-0.09	-0.19	0.42	-0.08	-0.15	0.41	-0.09	-0.18	0.39	-0.11	-0.22	0.39	-0.11	-0.22	
0.43	0.38	-0.05	-0.11	0.40	-0.03	-0.06	0.39	-0.04	-0.10	0.37	-0.06	-0.14	0.37	-0.06	-0.13	
0.45	0.37	-0.09	-0.19	0.37	-0.08	-0.17	0.36	-0.09	-0.20	0.35	-0.10	-0.22	0.35	-0.10	-0.21	
0.37	0.35	-0.01	-0.04	0.35	-0.01	-0.03	0.35	-0.02	-0.05	0.35	-0.02	-0.05	0.34	-0.03	-0.07	
0.39	0.34	-0.05	-0.12	0.35	-0.04	-0.11	0.34	-0.05	-0.13	0.34	-0.05	-0.12	0.32	-0.07	-0.18	
0.37	0.35	-0.03	-0.07	0.35	-0.03	-0.07	0.34	-0.03	-0.09	0.33	-0.04	-0.11	0.31	-0.06	-0.16	
0.35	0.33	-0.02	-0.06	0.34	-0.01	-0.03	0.34	-0.01	-0.03	0.33	-0.02	-0.06	0.31	-0.04	-0.12	
0.39	0.34	-0.05	-0.13	0.34	-0.05	-0.12	0.34	-0.05	-0.12	0.34	-0.05	-0.13	0.30	-0.08	-0.22	
0.39	0.34	-0.05	-0.13	0.34	-0.04	-0.11	0.34	-0.05	-0.12	0.34	-0.05	-0.13	0.30	-0.08	-0.22	
0.38	0.34	-0.05	-0.12	0.34	-0.04	-0.11	0.34	-0.04	-0.10	0.32	-0.06	-0.15	0.30	-0.08	-0.22	
0.42	0.32	-0.10	-0.23	0.34	-0.09	-0.20	0.33	-0.09	-0.21	0.31	-0.11	-0.26	0.30	-0.12	-0.29	
0.40	0.31	-0.09	-0.22	0.33	-0.07	-0.18	0.32	-0.08	-0.20	0.30	-0.10	-0.25	0.30	-0.10	-0.26	
0.37	0.30	-0.07	-0.19	0.32	-0.06	-0.15	0.31	-0.06	-0.16	0.29	-0.08	-0.23	0.28	-0.09	-0.26	
0.36	0.28	-0.07	-0.20	0.30	-0.06	-0.16	0.30	-0.05	-0.15	0.28	-0.08	-0.22	0.26	-0.09	-0.26	
0.24	0.28	0.04	0.18	0.29	0.05	0.21	0.30	0.06	0.24	0.27	0.03	0.13	0.25	0.01	0.05	
0.32	0.28	-0.04	-0.13	0.28	-0.03	-0.11	0.29	-0.03	-0.10	0.26	-0.06	-0.18	0.24	-0.08	-0.24	
0.25	0.26	0.01	0.04	0.28	0.02	0.09	0.27	0.02	0.08	0.25	0.00	-0.01	0.24	-0.02	-0.07	
0.26	0.25	-0.01	-0.04	0.27	0.00	0.00	0.27	0.01	0.03	0.24	-0.02	-0.07	0.23	-0.03	-0.11	
0.24	0.25	0.01	0.02	0.26	0.02	0.07	0.26	0.02	0.08	0.23	-0.01	-0.04	0.22	-0.02	-0.10	
0.25	0.24	-0.01	-0.04	0.25	0.00	0.00	0.25	0.00	0.01	0.23	-0.02	-0.09	0.21	-0.04	-0.16	
0.26	0.23	-0.03	-0.13	0.25	-0.02	-0.07	0.25	-0.02	-0.07	0.22	-0.04	-0.16	0.20	-0.06	-0.23	
0.29	0.22	-0.07	-0.23	0.23	-0.06	-0.19	0.24	-0.05	-0.16	0.21	-0.08	-0.27	0.20	-0.09	-0.32	
0.19	0.21	0.02	0.09	0.22	0.03	0.14	0.23	0.04	0.18	0.21	0.01	0.06	0.18	-0.01	-0.05	
0.18	0.21	0.03	0.15	0.22	0.04	0.21	0.23	0.05	0.26	0.20	0.02	0.09	0.18	0.00	-0.01	
0.10	0.20	0.10	1.04	0.21	0.11	1.10	0.22	0.12	1.22	0.19	0.09	0.89	0.17	0.07	0.73	
0.12	0.19	0.07	0.60	0.21	0.09	0.75	0.21	0.09	0.73	0.18	0.06	0.52	0.17	0.05	0.39	
0.12	0.19	0.07	0.60	0.20	0.08	0.70	0.21	0.09	0.75	0.18	0.06	0.50	0.16	0.04	0.33	
0.09	0.18	0.10	1.10	0.19	0.11	1.23	0.20	0.12	1.34	0.17	0.09	1.02	0.15	0.07	0.76	
0.09	0.18	0.08	0.87	0.19	0.09	0.99	0.20	0.11	1.11	0.17	0.07	0.77	0.15	0.05	0.57	
0.10	0.17	0.07	0.70	0.18	0.08	0.80	0.20	0.09	0.94	0.17	0.06	0.63	0.14	0.04	0.41	
0.12	0.17	0.05	0.43	0.18	0.06	0.53	0.19	0.07	0.63	0.16	0.04	0.37	0.14	0.02	0.21	
0.11	0.17	0.06	0.50	0.17	0.06	0.54	0.19	0.07	0.65	0.16	0.05	0.41	0.13	0.02	0.18	
0.05	0.16	0.11	2.12	0.17	0.12	2.34	0.18	0.13	2.49	0.16	0.10	1.98	0.13	0.08	1.57	
0.30	$= \langle \vert x \vert \rangle$	*0.06*			*0.06*			*0.06*			*0.06*			*0.06*		*MAE*
		0.20			**0.18**			**0.19**			**0.21**			**0.20**		**RMAE**

Table 9.123: Experiment 05.06.08 Deployment VV

S_{Radar}	Modelled - d1			Modelled - d2			Modelled - d3			Modelled - d4			Modelled - d5		
	S_{d1}	err	%err	S_{d2}	err	%err	S_{d3}	err	%err	S_{d4}	err	%err	S_{d5}	err	%err
0.05	0.16	0.12	2.63	0.17	0.12	2.68	0.14	0.10	2.18	0.16	0.12	2.59	0.18	0.13	2.93
0.13	0.16	0.03	0.20	0.16	0.03	0.23	0.14	0.01	0.06	0.15	0.02	0.17	0.18	0.05	0.35
0.03	0.16	0.12	3.60	0.16	0.13	3.71	0.13	0.10	2.96	0.15	0.12	3.55	0.17	0.14	4.12
0.07	0.15	0.08	1.21	0.15	0.09	1.27	0.13	0.06	0.96	0.16	0.09	1.32	0.17	0.10	1.50
0.00	0.15	0.15	#DIV/0!	0.15	0.15	#DIV/0!	0.13	0.13	#DIV/0!	0.15	0.15	#DIV/0!	0.17	0.17	#DIV/0!
0.06	0.15	0.08	1.32	0.15	0.08	1.27	0.13	0.06	1.01	0.15	0.08	1.29	0.17	0.10	1.59
0.06	0.15	0.09	1.38	0.15	0.08	1.36	0.13	0.06	1.02	0.14	0.08	1.29	0.16	0.10	1.60
0.11	0.14	0.03	0.24	0.15	0.04	0.32	0.12	0.01	0.09	0.14	0.03	0.24	0.16	0.05	0.42
0.04	0.14	0.09	2.32	0.14	0.10	2.43	0.12	0.08	1.85	0.13	0.09	2.25	0.15	0.11	2.78
0.06	0.13	0.07	1.16	0.13	0.07	1.19	0.11	0.05	0.83	0.13	0.07	1.09	0.15	0.09	1.44
0.11	0.12	0.01	0.11	0.13	0.02	0.15	0.11	0.00	-0.03	0.13	0.01	0.13	0.15	0.04	0.33
0.03	0.12	0.09	3.15	0.13	0.10	3.25	0.10	0.07	2.51	0.12	0.09	3.10	0.14	0.11	3.81
0.10	0.12	0.02	0.20	0.12	0.02	0.21	0.10	0.00	-0.03	0.12	0.02	0.23	0.14	0.04	0.41
0.05	0.12	0.07	1.38	0.12	0.07	1.35	0.10	0.05	0.98	0.11	0.06	1.26	0.14	0.09	1.77
0.07	0.11	0.04	0.66	0.11	0.05	0.69	0.10	0.03	0.43	0.12	0.05	0.73	0.14	0.07	1.03
0.07	0.11	0.04	0.62	0.11	0.04	0.62	0.10	0.03	0.39	0.11	0.04	0.60	0.13	0.06	0.93
0.07	0.11	0.04	0.60	0.11	0.04	0.60	0.09	0.02	0.33	0.11	0.04	0.64	0.13	0.06	0.92
0.02	0.11	0.08	3.55	0.11	0.08	3.55	0.09	0.07	2.89	0.11	0.08	3.56	0.13	0.11	4.53
0.00	0.11	0.11	#DIV/0!	0.10	0.10	#DIV/0!	0.08	0.08	#DIV/0!	0.11	0.11	#DIV/0!	0.13	0.13	#DIV/0!
0.07	0.10	0.04	0.53	0.10	0.04	0.53	0.09	0.02	0.32	0.10	0.04	0.53	0.13	0.06	0.90
0.02	0.10	0.08	3.22	0.10	0.08	3.16	0.08	0.06	2.34	0.10	0.08	3.29	0.13	0.11	4.39
0.00	0.10	0.10	#DIV/0!	0.10	0.10	#DIV/0!	0.08	0.08	#DIV/0!	0.10	0.10	#DIV/0!	0.12	0.12	#DIV/0!
0.03	0.10	0.07	2.77	0.10	0.07	2.77	0.08	0.05	1.99	0.10	0.08	3.00	0.13	0.11	4.11

0.07	0.09	0.03	0.37	0.09	0.02	0.33	0.08	0.01	0.12	0.10	0.03	0.44	0.13	0.06	0.85	
0.00	0.09	0.09	#DIV/0!	0.09	0.09	#DIV/0!	0.07	0.07	#DIV/0!	0.10	0.10	#DIV/0!	0.13	0.13	#DIV/0!	
0.00	0.09	0.09	#DIV/0!	0.09	0.09	#DIV/0!	0.07	0.07	#DIV/0!	0.10	0.10	#DIV/0!	0.13	0.13	#DIV/0!	
0.07	0.09	0.02	0.35	0.09	0.02	0.33	0.07	0.00	0.05	0.10	0.03	0.51	0.13	0.06	0.92	
0.04	0.09	0.05	1.23	0.08	0.04	1.01	0.07	0.03	0.63	0.09	0.05	1.35	0.12	0.08	2.05	
0.00	0.09	0.09	#DIV/0!	0.08	0.08	#DIV/0!	0.06	0.06	#DIV/0!	0.09	0.09	#DIV/0!	0.12	0.12	#DIV/0!	
0.07	0.08	0.01	0.20	0.08	0.01	0.11	0.06	-0.01	-0.19	0.09	0.01	0.21	0.12	0.05	0.69	
0.08	0.08	0.01	0.07	0.08	0.00	-0.01	0.06	-0.02	-0.26	0.09	0.01	0.11	0.12	0.05	0.60	
0.00	0.08	0.08	#DIV/0!	0.07	0.07	#DIV/0!	0.05	0.05	#DIV/0!	0.08	0.08	#DIV/0!	0.13	0.13	#DIV/0!	
0.07	0.07	0.01	0.12	0.07	0.01	0.12	0.05	-0.01	-0.20	0.08	0.02	0.24	0.13	0.06	0.91	
0.08	0.07	-0.01	-0.09	0.07	-0.01	-0.11	0.05	-0.03	-0.37	0.08	0.00	-0.02	0.13	0.05	0.68	
0.03	0.07	0.03	0.99	0.07	0.03	0.97	0.05	0.02	0.44	0.08	0.04	1.24	0.14	0.10	2.95	
0.05	0.07	0.02	0.33	0.07	0.02	0.33	0.05	0.00	-0.08	0.08	0.03	0.53	0.14	0.09	1.76	
0.03	0.07	0.04	1.44	0.06	0.04	1.30	0.04	0.02	0.61	0.08	0.05	1.94	0.15	0.13	4.63	
0.11	0.07	-0.04	-0.38	0.06	-0.05	-0.46	0.04	-0.07	-0.62	0.08	-0.03	-0.25	0.16	0.05	0.48	
0.02	0.06	0.04	1.92	0.06	0.04	1.69	0.04	0.02	0.96	0.08	0.06	2.96	0.17	0.15	7.01	
0.07	0.06	0.00	-0.05	0.05	-0.02	-0.23	0.04	-0.03	-0.45	0.09	0.02	0.31	0.18	0.11	1.63	
0.02	0.06	0.05	2.49	0.05	0.03	1.70	0.04	0.02	1.14	0.09	0.07	3.82	0.19	0.18	9.62	
0.08	0.07	-0.01	-0.09	0.05	-0.02	-0.28	0.03	-0.04	-0.54	0.09	0.01	0.17	0.21	0.13	1.78	
0.08	0.07	-0.01	-0.17	0.05	-0.03	-0.38	0.04	-0.04	-0.55	0.09	0.01	0.17	0.25	0.17	2.12	
0.06	0.07	0.01	0.19	0.05	0.00	-0.06	0.03	-0.02	-0.43	0.10	0.04	0.68	0.30	0.24	4.19	
0.11	0.07	-0.04	-0.38	0.06	-0.06	-0.51	0.03	-0.08	-0.70	0.10	-0.02	-0.14	0.32	0.20	1.78	
0.08	0.07	-0.01	-0.10	0.05	-0.02	-0.29	0.03	-0.04	-0.59	0.10	0.02	0.30	0.32	0.25	3.26	
0.06	0.07	0.01	0.20	0.06	0.00	-0.03	0.03	-0.03	-0.45	0.10	0.05	0.83	0.30	0.25	4.30	
0.08	0.06	-0.01	-0.16	0.06	-0.02	-0.27	0.03	-0.05	-0.62	0.11	0.04	0.47	0.27	0.20	2.58	
0.10	0.07	-0.04	-0.36	0.06	-0.05	-0.47	0.03	-0.08	-0.72	0.11	0.01	0.07	0.25	0.15	1.40	
0.11	0.06	-0.05	-0.43	0.06	-0.05	-0.49	0.03	-0.08	-0.74	0.12	0.01	0.13	0.23	0.12	1.07	
0.05	0.06	0.02	0.42	0.05	0.01	0.16	0.03	-0.01	-0.33	0.13	0.08	1.79	0.21	0.17	3.70	
0.06	= <|x|>	0.05			0.05			0.04			0.05			0.11		*MAE*
		0.91			**0.92**			**0.80**			**0.98**			**2.01**		**RMAE**

Table 9.124: Experiment 05.06.08 Deployment WW

References

ABP, 1996. Southern North Sea Sediment Transport Study - Literature Review and Conceptual Sediment transport Model. R546, ABP Research and Consultancy Ltd / Oceanography Dept, University of Southampton, Southampton.

Ackers, P. and White, W.R., 1973. Sediment Transport: a new approach and analysis, proc. ASCE, pp. 2041-60.

Ahrens, J.P. and Cox, J., 1990. Design and performance of breakwaters. Journal of Coastal Research, 7: 61-75.

Axe, P., Ilic, S. and Chadwick, A., 1996. Evaluation of beach modelling techniques behind detached breakwaters, 25th Int. Conf. of Coastal Engineering. ASCE, pp. 2036-2049.

Bacon, J.C., 2005. The shore parallel breakwaters at Sea Palling: Interaction with tidal currents and their contribution to sand transport. PhD Thesis, University of East Anglia, Norwich, 227 pp.

Bacon, J.C., Vincent, C.E., Dolphin, T., Taylor, J., Pan, S. and O'Connor, B., 2007. Shore-parallel breakwaters in meso-tidal conditions: tidal controls on sediment transport and their longer term, regional impacts at Sea Palling, UK. Journal of Coastal Research(SI 50 (Proceedings of the 9th International Coastal Symposium)): 369 - 373.

Bacon, J.C., Vincent, C.E., Dolphin, T., Taylor, J., Shunqi-Pan. and O'Connor, B., 2004. The offshore breakwater scheme at Sea Palling, England; sand transport generated by tidal currents. In: J.M. Smith (Editor), Coastal Engineering, pp. 1897 - 1908.

Bell, P.S., 1999. Shallow water bathymetry derived from an analysis of X-band marine radar images of waves. Coastal Engineering, 37(3-4): 513-527.

Bernardes, M., Davidson, M., Dyer, K. and George, K., 2006. Towards medium-term (order of months) morphodynamic modelling of the Teign estuary, UK. Ocean Dynamics, 56(3): 186-197.

Blunden, L.S. and Bahaj, A.S., 2006. Initial evaluation of tidal stream energy resources at Portland Bill, UK. Renewable Energy, 31(2): 121-132.

Bricio, L., Negro, V. and Diez, J.J., 2008. Geometric detached breakwater indicators on the Spanish northeast coastline. Journal of Coastal Research, 24(5): 1289-1303.

Brière, C., Abadie, S., Bretel, P. and Lang, P., 2007. Assessment of TELEMAC system performances, a hydrodynamic case study of Anglet, France. Coastal Engineering, 54(4): 345-356.

Brown, J.M. and Davies, A.G., 2009. Methods for medium-term prediction of the net sediment transport by waves and currents in complex coastal regions. Continental Shelf Research, 29(11-12): 1502-1514.

Cambers, G., 1973. The retreat of unconsolidated quaternary cliffs. PhD Thesis, University of East Anglia, Norwich.

Cambers, G., 1975. East Anglian Coastal Research Programme - Report No. 3:Sediment Transport and Coastal Change. 8, University of East Anglia, Norwich.

Cambers, G., 1976. Temporal scales in coastal erosion systems. Transactions of the Institute of British Geographers, 1(2): 246-256.

Carr, A.P., 1981. Evidence for the sediment circulation along the coast of East Anglia. Marine Geology, 40: M9-M22.

CERC, 1984. Shore Protection Manual Volume 1, 1. US Army Coastal Engineering Research Centre.

Chaumillon, E., Bertin, X., Falchetto, H., Allard, J., Weber, N., Walker, P., Pouvreau, N. and Woppelmann, G., 2008. Multi time-scale evolution of a wide estuary linear sandbank, the Longe de Boyard, on the French Atlantic coast. Marine Geology, 251(3-4): 209-223.

Clayton, K.M., 1976. Norfolk sandy beaches: Applied geomorphology and the engineer. Bull. Geological Soc. Norfolk, 28: 49-67.

Clayton, K.M., 1989. Sediment Input from the Norfolk Cliffs, Eastern England - A century of coast protection and its effect. Journal of Coastal Research, 5(3): 433-442.

Clayton, K.M., 1993. Technical Report - Coastal processes and coastal management, Countryside commission, Northampton.

Clayton, K.M., McCave, I.N. and Vincent, C.E., 1982. The establishment of a sand budget for the East Anglian coast and its implications for coastal stability, Shoreline Protection. Thos.Telford, Southampton, UK.

Coughlan, C., 2008. Hydrodynamic processes and sediment transport around a headland - associated sandbank and implications for the neighbouring shoreline. PhD Thesis, University of East Anglia, Norwich, 204 pp.

Coughlan, C., Vincent, C.E., Dolphin, T.J. and Rees, J.M., 2007. Effects of tidal Stage on the Wave climate inshore of a sandbank. Journal of Coastal Research, SI 50: 751 - 756.

Craig-Smith, S.J., 1973. The role of wind waves and tidal currents on the evolution of part of the East Anglian coast. PhD Thesis, University of East Anglia, Norwich.

Dally, W.R. and Pope, J., 1986. Detached breakwaters for shore protection. IR 86-1, CERC, Vicksburg, Miss. USA.

Davies, A.G. and Villeret, C., 2003. Sediment transport modelling for coastal morphology, Proceedings of the Coastal Sediments Conference 2003, Clearwater Beach, Florida, US.

Delft, 1995. Review - Happisburgh to Winterton sea defences, Delft Hydraulics, Delft, Nederlands.

Dolphin, T., Taylor, J., Vincent, C.E., Bacon, J.C., Pan, S. and O'Connor, B., 2004. Storm scale effects on the shore-parallel breakwaters at Sea Palling, Proceedings of the 26th International Conference on Coastal Engineering, Lisbon, Portugal, pp. 2849-2861.

Dolphin, T., Vincent, C.E., Bacon, J.C., Dumont, E. and Terentjeva, A., under review. Medium-term impacts of a segmented, shore-parrallel breakwater system Coastal Engineering.

EDF-DER, 1998. Telemac 2D User Manual. EDF-DER.

EDF-DER, 2002a. TELEMAC-2D software: Version 3.0 principle note, EDF-DER.

EDF-DER, 2002b. TELEMAC-2D software: Version 5.2 user manual, Technical report. EDF-DER.

EDF-LNHE, 1998. MATISSE software: Version 1.0 user manual, EDF-LNHE.

EDF-R&D, 2010. ARTEMIS software: Version 6, Theoretical note and user manual, Technical report. EDF-DER.

Engelund, F. and Hansen, E., 1972. A monograph on sediment transport in alluvial streams, Technical Press, Copenhagen.
Fairley, I., Davidson, M. and Kingston, K., 2009a. The morpho-dynamics of a beach protected by detached breakwaters in a high energy tidal environment. Journal of Coastal Research(SI 56 (Proceedings of the 10th International Coastal Symposium)): 607 - 611.
Fairley, I., Davidson, M. and Kingston, K., 2009b. Video monitoring of overtopping of detached breakwaters in a mesotidal environment, Proceedings of Coastal Structures, Venice, pp. 1923 - 1932.
Fairley, I., Davidson, M., Kingston, K., Dolphin, T. and Phillips, R., 2009c. Empirical orthogonal function analysis of shoreline changes behind two different designs of detached breakwaters. Coastal Engineering, 56(11-12): 1097-1108.
Fleming, C. and Hamer, B., 2000. Successful implementation of an offshore reef scheme, Coastal Engineering 2000, pp. 1813-1820.
Fulford, E.T., 1985. Reeftype breakwaters for shoreline stabilisation, Coastal Zone 85. ASCE, pp. 1776-1795.
Garcia, M. and Parker, G., 1991. Entrainment of bed sediment into suspension. Journal of Hydraulic Engineering, 117(4): 414-435.
Garmin, 2003. eTrex personal navigator owner's manual.
Gourlay, M.R., 1981. Beach processes in the vicinity of offshore breakwaters and similar natural features, 5th Australian Conference on Coastal and Ocean Engineering, Perth, pp. 8-9.
Hajek, E.A., Huzurbazar, S.V., Mohrig, D., Lynds, R.M. and Heller, P.L., 2010. Statistical characterization of grain-size distributions in sandy fluvial systems. Journal of Sedimentary Research, 80(2): 184-192.
Halcrow, 1991. Final report on proposed sea defences, Sir William Halcrow and Partners Ltd.
Halcrow, 1995a. Happisburgh to Winterton sea defences - strategic monitoring. 9141314, Sir William Halcrow and Partners Ltd.
Halcrow, 1995b. Report on urgent works in stage 2 - volume 1 - summary report, Sir William Halcrow and Partners Ltd.
Halcrow, 1996. Happisburgh to Winterton sea defences - strategy review, Sir William Halcrow and Partners.
Halcrow, 2002a. Happisburgh to Winterton sea defences - strategy review, Sir William Halcrow and Partners.
Halcrow, 2002b. Happisburgh to Winterton sea defences stage 3 project appraisal report, Sir William Halcrow and Partners.
Halcrow, 2006. Kelling to Lowestoft ness Shore Management Plan - sediment sub-cell 3B Sir William Halcrow and Partners Ltd.
Halcrow, 2008. Happisburgh to Winterton sea defences - Stage 3B Project Appraisal Report, Sir William Halcrow and Partners.
Hallermeier, R.J., 1983. Sand transport limits in coastal structure designs, Coastal Structures. ASCE, Arlington, Virginia, pp. 703-716.
Harris, M.M. and Herbich, J.B., 1986. The effects of breakwater spacing on sand entrapment, Proc AHR Symposium '86 on Scale Effects in Modelling Sediment Transport, Toronto, Canada, pp. 24-34.
Heathershaw, A.D., 1981. Comparisons of measured and predicted sediment transport rates in tidal currents. Marine Geology, 42(1-4): 75-104.

Herbich, J.B., 1989. Shoreline change due to offshore breakwaters, 23rd congress of the Int. Assn. Hydr. Res., pp. 317-327.
Hervouet, J.M., 2000. TELEMAC modelling system: an overview. Hydrological Processes, 14: 2209.
Hervouet, J.M., 2007. Hydrodynamics of free surface flows; modelling with the finite element method. John Wiley & Sons.
Hoekstra, P., Bell, P., van Santen, P., Roode, N., Levoy, F. and Whitehouse, R., 2004. Bedform migration and bedload transport on an intertidal shoal. Continental Shelf Research, 24(11): 1249-1269.
HR Wallingford, 1999. SANDCALC Marine sands calculator interface, Hydraulics Research, Wallingford, UK.
HR Wallingford, 2002. Southern North Sea Sediment Transport Study, Phase 2 - Sediment transport report. EX4526, HR Wallingford, CEFAS/UEA, Posford Haskoning, D'Olier, B.
Hsu, J.R. and Silvester, R., 1990. Accretion behind a single offshore breakwater. Journal of Waterway, Port, Coastal and Ocean Engineering, 116: 362-380.
Hydrographic Office, 1995. NP158-TIDECALC. Tidal prediction program for the computation of daily tidal predictions, The Hydrographic Office, Taunton, UK
Jones, J.E. and Davies, A.M., 2006. Application of a finite element model (TELEMAC) to computing the wind induced response of the Irish Sea. Continental Shelf Research, 26(12-13): 1519-1541.
King, D.M., Cooper, N.J., Morfett, J.C. and Pope, D.J., 2000. Application of offshore breakwaters to the UK: A case study at Elmer beach. Journal of Coastal Research, 16: 172-187.
Komar, P.D., 1998. Beach Processes and Sedimentation. Prentice Hall.
Kuang, C.P. and Stansby, P.K., 2004. Modelling directional random wave propagation inshore. Proceedings of the Institution of Civil Engineers Maritime Engineering 157(3): 123 - 131.
Lee, E.M., 2008. Coastal cliff behaviour: Observations on the relationship between beach levels and recession rates. Geomorphology, 101(4): 558-571.
Lee, J.R., Booth, S.J., Hambin, R.J.O., Jarrow, A.M., Kessler, H., Moorlock, B.S.P., Morigi, A.N., Palmer, A., Riding, J.B. and Rose, J., 2004. A new stratigraphy for the glacial deposits around Lowestoft, Great Yarmouth, North Walsham and Cromer, East Anglia, UK, Bulletin of the Geological Society of Norfolk, pp. 3-60.
MacDonald, I.T., 2009. Flocculation of fine sediment in turbulent flows. PhD Thesis, Department of Civil and Environmental Engineering, School of Engineering, The University of Auckland, New Zealand, 294 pp.
Marques, W.C., Fernandes, E.H., Monteiro, I.O. and Möller, O.O., 2009. Numerical modeling of the Patos Lagoon coastal plume, Brazil. Continental Shelf Research, 29(3): 556-571.
McCave, I.N., 1971. Sand waves in the North Sea off the coast of Holland. Marine Geology, 10(3): 199-225.
McCave, I.N., 1978. Grain size trends and transport along beaches: Example from eastern England. Marine Geology, 28: M43-M51.
McCormick, M., 1993. Equalibrium response to breakwaters. Journal of Waterway, Port, Coastal and Ocean Engineering, 119: 657-670.

Onyett, D. and Simmonds, A., 1982. East Anglian Coastal Research Programme - Final Report No. 8:beach changes and longshore transport 1974-80. 8, University of East Anglia, Norwich.

Pan, S., 2008. http://www.research.plym.ac.uk/cerg/leacoast2/index.htm, pp. LEACOAST2 website.

Park, H.-B., 2007. Morphological behaviour of the Scroby (East Anglian) near-shore sandbank system. PhD Thesis, University of East Anglia, Norwich, 298 pp.

Pawlowicz, R., Beardsley, B. and Lentz, S., 2002. Classical tidal harmonic analysis including error estimates in MATLAB using T_TIDE. Computers & Geosciences, 28: 929-937.

Pilarczyk, K.W. and Ziedler, R.B., 1996. Offshore breakwaters and shore evolution control, 1. AA Balkema, Rotterdam, NL.

Pinto, L., Fortunato, A.B. and Freire, P., 2006. Sensitivity analysis of non-cohesive sediment transport formulae. Continental Shelf Research, 26(15): 1826-1839.

Pope, J. and Dean, J., 1986. Development of design criteria for segmented breakwaters, Proceedings of the 20th International Conference on Coastal Engineering. ASCE, pp. 2144-2158.

Pugh, D.T., 1987. Tides, surges, and mean sea level. John Wiley & Sons Ltd., 472 pp.

Robinson, A.H.W., 1966. Residual currents in relation to shoreline evolution of the East Anglian coast. Marine Geology, 4: 57-84.

Rosati, J.D., 1990. Functional design of breakwaters for shore protection. TR-90-15, CERC.

Sauvaget, P., David, E. and Guedes Soares, C., 2000. Modelling tidal currents on the coast of Portugal. Coastal Engineering, 40(4): 393-409.

Shih-Chiao, C. and Evans, G., 1992. Source of sediment and sediment transport on the east coast of England: Significant or coincidental phenomena? Marine Geology - Letter Section, 107: 283-288.

Smagorinski, 1963. General circulation experiments with the primitive equation, I. The basic experiment. Weather Review, 91: 99-164.

Smith, J.D. and McLean, S.R., 1977. Spatially averaged flow over a wavy surface. Journal of Geophysical Research, 82(12): 1735-1745.

Soulsby, R.L., 1997. Dynamics of Marine Sands, 1. Thomas Telford Publications, London.

Sternberg, R.W., 1966. Boundary layer observations in a tidal current. Journal of Geophysical Research: 2175 - 2178.

Suh, S.M. and Dalrymple, R.A., 1987. Offshore breakwaters in laboratory and field. Journal of Waterway, Port, Coastal and Ocean Engineering, 113: 105-121.

Sutherland, J., Peet, A.H. and Soulsby, R.L., 2004a. Evaluating the performance of morphological models. Coastal Engineering, 51(8-9): 917-939.

Sutherland, J., Walstra, D.J.R., Chesher, T.J., van Rijn, L.C. and Southgate, H.N., 2004b. Evaluation of coastal area modelling systems at an estuary mouth. Coastal Engineering, 51(2): 119-142.

Taylor, H.R. and Marsden, A.E., 1983. Some sea-defence works in eastern England, Shoreline Protection, Proceedings of a conference organised by the ICE. Thomas Telford, London, pp. 91-96.

Thomalla, F., 1999. Effects of shore-parallel breakwaters on beach morphology. Unpublished PhD Thesis Thesis, University of East Anglia, Norwich, UK.
Thomalla, F. and Vincent, C.E., 2003. Beach response to shore-parallel breakwaters at Sea Palling, Norfolk, UK. Estuarine, Coastal and Shelf Science, 56(2): 203-212.
Thorne, P.D. and Hanes, D.M., 2002. A review of acoustic measurement of small-scale sediment processes. Continental Shelf Research, 22(4): 603-632.
van der Molen, J., 2002. The influence of tides, wind and waves on the net sand transport in the North Sea. Continental Shelf Research, 22(18-19): 2739-2762.
Van Rijn, L.C., 1984. Sediment transport: part I: bed load transport; part II: suspended load transport; part III: bed forms and alluvial roughness. Journal of Hydraulics, 110.
Van Rijn, L.C., Grasmeijer, B.T. and Ruessink, B.G., 2000. Measurement errors of instruments for velocity, wave height, sand concentration and bed levels in field conditions, University of Utrecht/Delft Hydraulics Report.
Vincent, C.E., 1979. Longshore sand transport rates - a simple model for the East Anglian coastline. Coastal Engineering, 3: 113-136.
Vincent, C.E. and Hanes, D.M., 2002. The accumulation and decay of near-bed suspended sand concentration due to waves and wave groups. Continental Shelf Research, 22(14): 1987-2000.
Wang, B. and Reeve, D.E., 2010. Probabilistic modelling of long-term beach evolution near segmented shore-parallel breakwaters. Coastal Engineering, 57.
Wolf, J. and Bell, P.S., 2001. Waves at Holderness from X-band radar. Coastal Engineering, 43(3-4): 247-263.
Wolf, J., Thorne, P.D. and Bolanos, R., 2008. LEACOAST2 Sediment Fluxes, Proudman Oceanographic Laboratory.
Zyserman, J.A. and Johnson, H.K., 2002. Modelling morphological processes in the vicinity of shore-parallel breakwaters. Coastal Engineering, 45(3-4): 261-284.