SD13/TH/O4 – INSIGHTS INTO THE USE OF
GENETIC CLUSTERING TO DELINEATE SEISMOGENIC
SOURCE ZONES FOR INPUT INTO
PROBABILISTIC SEISMIC HAZARD ANALYSIS

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The delineation of seismic sources for input
into probabilistic seismic hazard analysis
(PSHA) is a process that unfortunately can be
applied inconsistently from region to region.
In many areas of high seismic risk, seismogenic
sources, be they areal zones, geometric
fault segments or distributed point sources,
may often be delineated via the best judgement,
or even a compromise judgement,
of a team of experts. Whilst much expertise
may be applied in this process, the zone models
themselves may often better represent
a compromise of judgement rather than "natural"
phenomena, and in doing so they may
also lack objective means of validation and
reproduction. Traditional methods of cluster
analysis have previously been applied to
this task, which, whilst more objective, are
limited in the extent to which they can utilise
other forms of geological and seismotectonic
information. A genetic clustering approach,
in the form of a modified genetic K-medoids
algorithm, can provide a framework by which
seismogenic sources are spatially partitioned
according to objective judgements regarding
the role of different sources of information.
Evolutionary-based clustering allows the algorithm
identify "better" partitions from a
population of seismogenic source models,
guiding the generation of new partitions on
the basis of the fitness criteria. The fitness
function provides a tool for integrating different
forms of seismotectonic (e.g. focal
mechanism) and geological data (e.g. rupture
plane), and can attempt to optimise
the cluster analysis in such a manner as to
best reconcile the observed seismicity with
the additional data. An additional clustering
heuristic is also used to achieve this objective.
Example applications illustrate how this
approach can maximise the information used
in the development of seismogenic sources
models, which often depends heavily on the
region in question, as well as the role that
expert judgement can play within the objective
framework. The algorithm is applied
to idealised earthquake data, in addition to
real earthquake data from different areas of
the globe. Issues in the development of this
prototype framework for source delineation
are addressed, including the translation of
seismicity partitions into source zones and
means of validation.