Knowing like a global expert organization:
Comparative insights from the IPCC and IPBES

Abstract

In this paper we draw on Science and Technology (STS) approaches to develop a comparative analytical account of the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES). The establishment of both of these organizations, in 1988 and 2012 respectively, represented important 'constitutional moments' in the global arrangement of scientific assessment and its relationship to environmental policymaking. Global environmental assessments all share some similarities, operating at the articulation between science and policy and pursuing explicit societal goals. Although the IPCC and IPBES have different objectives, they are both intergovernmental processes geared towards the provision of knowledge to inform political debates about, respectively, climate change and biodiversity loss. In spite of these similarities, we show that there are significant differences in their knowledge practices and these differences have implications for environmental governance. We do this by comparing the IPCC and IPBES across three dimensions: conceptual frameworks, scenarios and consensus practices.

We argue that, broadly speaking, the IPCC has produced a 'view from nowhere', through a reliance on mathematical modelling to produce a consensual picture of global climate change, which is then 'downscaled' to considerations of local impacts and responses. By contrast IPBES, through its contrasting conceptual frameworks and practices of argumentation, appears to seek a 'view from everywhere', inclusive of epistemic plurality, and through which a global picture emerges through an aggregation of more placed-based knowledges. We conclude that, despite these aspirations, both organizations in fact offer 'views from somewhere': situated sets of knowledge marked by politico-epistemic struggles and shaped by the interests, priorities and voices of certain powerful actors. Characterizing this 'somewhere' might be aided by the concept of *institutional epistemology,* a term we propose to capture how particular knowledge practices become stabilized within international expert organizations. We suggest that such a concept, by drawing attention to the institutions' knowledge practices, helps reveal their world-making effects and, by doing so, enables more reflexive governance of both expert organizations and of global environmental change in general.

Keywords: GEAs; expert cultures; science-policy interface; reflexivity; IPCC; IPBES; institutional epistemology

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1. Introduction

Over the past few decades, environmental concerns have contributed to the emergence of new transnational knowledge networks, infrastructures and epistemic practices (e.g. Edwards 2017). Expert institutions and networks, operating at multiple scales, have become constitutive of global environmental governance. Global environmental assessments (GEAs), in particular, have become one of the more significant innovations for organising the provision of policy-relevant knowledge and advice about multi-scale environmental concerns for governments and for shaping and servicing multilateral environmental agreements (Oppenheimer et al 2019). In this contribution we argue that there is a need to reveal and analyse more explicitly how knowledge is actually made in different institutional settings and the inclusions and exclusions that diverse knowledge practices effect for global environmental governance. Using IPBES and the IPCC as case studies, we develop the concept of *institutional epistemology* to provide a vocabulary for characterizing their knowledge practices and for facilitating reflection on their implications for the governance of environmental change.

GEAs first emerged in the field of atmospheric and climate science. The International Ozone Assessment, initiated in 1981 under the auspices of the World Meteorological Organization, is generally recognized as the first major GEA. The Ozone Assessment was arguably influential in triggering the development of an international regulatory regime for the stratosphere, leading to the reinforcement of the 1985 Vienna Convention for the Protection of the Ozone Layer and to the adoption of the Montreal Protocol (Litfin 1994). The IPCC, established in 1988, has likewise been instrumental in placing the issue of anthropogenic climate change on the international political agenda. The publication of successive IPCC Assessment Reports have become important events punctuating the life of the international negotiations on climate change conducted under the United Nations Framework Convention on Climate Change. In contrast, IPBES is a recent institution of global expert advice whose objective is to tackle the loss of biodiversity, the degradation of ecosystem services, and to improve human well-being. Formally established in 2012, IPBES seeks to build on previous assessment initiatives including the Global Biodiversity Assessment (1995) and the Millennium Ecosystem Assessment (2005), as well as on the experience of the IPCC. But IPBES is more ambitious than these earlier initiatives since it aspires to develop a model of expertise inclusive of more diverse forms of knowledge and which operates at multiple scales. In 2019, IPBES gained significant public visibility with the release, and substantial media attention, of its first global assessment on biodiversity and ecosystem services.

At first glance, GEAs all share some similarities. They seek to synthesise scientific knowledge for policymakers, and have explicit societal goals. Although IPCC and IPBES have different objectives, they are both intergovernmental processes geared towards the provision of knowledge to inform political debates about how, respectively, climate change and biodiversity loss should be addressed. Since the early 1980s, much has been learned about

GEAs -- both practitioners and academics have reflected on the challenges facing these organizations. While GEAs are increasingly in demand from policymakers, their authority and credibility have also been challenged in a number of ways, both internally – by participants of these GEAs - and externally, by diverse publics, including academics (see Scoones 2009; Hulme & Mahony 2010; Vadrot et al 2016; Löfmark and Lidskög 2017). GEAs are also sites of contestation where competing knowledge-claims and diverging values and interests are articulated. Following a first generation of 'top-down' GEAs conducted until the mid-1990s and dominated by elite scientific networks, more recent GEAs have attempted to respond to critics by adopting different approaches. The IPCC has been an example of a 'top-down', predominantly science-driven GEA. In contrast, IPBES attempts to engage with a broader range of actors and knowledges, developing several innovative features (Beck et al 2014).

In this article we do not seek to provide an historical account of these organizations. This is offered elsewhere, for example by Vardy et al (2017) for the IPCC and Vadrot (2014) for IPBES. Some work has been completed which compares the different ways GEAs have been conducted, focusing in particular on their design (e.g. mandate, scale, overarching policy framework, see Brooks et al 2014). Less effort, however, has been directed to studying, and comparing, their knowledge-practices. We contend that valuable insights can be derived from studying such knowledge practices, not only with regards to the functioning of these institutions, but also to better understand how knowledge for environmental governance is enacted in practice. We take on this challenge by drawing on science and technology studies (STS) approaches to develop a comparative analytical account of knowledge-making practices within the IPCC and IPBES. Our analysis draws attention to how particular institutions reproduce themselves through stabilized and recognizable practices of knowledge-making and knowledge-authorization. In international or intergovernmental organizations in particular, participants bring diverse disciplinary, political and epistemological norms and mobilise different methodologies and ways of validating knowledge. How, then, do these organizations translate this diversity of both knowledges and norms into products which bear the mark of the organization itself? What gets highlighted and what gets left out as knowledge-ways become institutionalized?

We seek to provide an empirical account of the different ways in which IPCC and IPBES produce regulatory knowledge, *i.e.* knowledge intended to be useful for policy formation and decision-making. By 'knowledge-ways' we understand a set of knowledge practices, *i.e*. ways of making and dealing with knowledge and expertise (see Table 2 in section 3), which become stabilized within particular institutional settings. Building on Jasanoff (2005), we call the stabilization of particular knowledge practices in these organizations *institutional epistemologies*. Both IPBES and IPCC provide sites at which to study contemporary mechanisms of international collaboration in the construction of globally credible and policy-relevant knowledge. Our motivation can usefully be read in relation to Merje Kuus's interrogation of transnational bureaucracies: 'How do we know what they know?' (Kuus

2015), which we see as an invitation to further explore how knowledge is enacted in transnational settings. It also resonates closely with interrogations surrounding the role of expert organizations for environmental governance. The increased demand for solution-oriented assessments, driven by the desire for identifying policy interventions, reinforces existing challenges and creates new ones (Kowarsch et al 2017; De Pryck and Wanneau 2017). One recurring debate regards whether, to be effective, GEAs should strive for consensus or else be explicit about divergent viewpoints (Lidskog and Sundqvist 2015).

The proliferation of GEAs provides the inspiration for our empirical analysis, but we see our conceptual contribution applying more widely. The ideas developed here may be relevant to characterize organizations which would not label themselves as 'expert organizations', but which have nonetheless developed knowledge practices and routines that have implications for the ways in which different issues (e.g. disaster risk reduction, poverty alleviation, environmental impacts) are managed: the emergency response procedures of NGOs such as the Red Cross, Oxfam or UNEP; the settlement surveys of an NGO such as Slum Dwellers International; the environmental reporting procedures of companies such as Danone or Total, for example.

The paper is structured thus. First, in section 2, we introduce some key concepts that have been used by STS scholars to think through relations between institutions, expertise and knowledge. Here we introduce the concept of institutional epistemology. Section 3 offers a methodological note on our approach. Section 4, the main body of the paper, develops comparative insights between the IPCC and IPBES along three dimensions: conceptual frameworks, modes of futuring, and handling controversies and reaching consensus. Section 5 discusses similarities and differences between the knowledge practices of the IPCC and IPBES and further discusses the concept of institutional epistemology. We offer some concluding comments in section 6.

2. Theoretical review: situating the concept of institutional epistemology

In STS, much attention has been directed to the *places* of knowledge-production, contributing to an understanding of science and technology as performative practices, *i.e*. practices which produce effects and have implications for the ways in which we make sense of the world (e.g. Shapin 1995). More recently, the 'new institutionalism' movement in sociology and political science has emphasized the role of institutions in structuring social action both within and beyond formal organizational boundaries (e.g. Meyer and Rowan 1977; O'Riordan & Jordan 1999; Scott 2013; Monck et al 2014). Building on this literature, STS scholars have developed a number of concepts to further characterize 'science-policy' organizations, often drawing on case studies from organizations operating in the environmental domain and reflecting on their implications for the ways in which environmental change is governed (Table 1). Underpinning these concepts is the idea that knowledge is never neutral, an assumption which is central to the coproductionist idiom: 'the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it' (Jasanoff 2004:2-3). While our understanding of GEAs, and expert organizations more generally, is consistent with this idiom, we argue that existing STS concepts mostly have a different focus. We therefore argue that there is currently a lack of vocabulary to characterize the different expert cultures and knowledge practices of these organizations.

The term 'institution' has a dual meaning. It can be understood to mean both a formal organizational structure, but also a more dispersed structure of habitual practice and unwritten rules (Kuus 2018). This speaks to a fundamental theoretical tension between structure and agency in understanding how institutions shape action, and vice-versa. In STS, Mary Douglas' work has proven influential in making sense of the role of social norms and interactions in the shaping of knowledge (Douglas 1986), which built on Fleck's earlier observations of the role of 'thought collectives' (*denkkollektiv)* in the genesis of socially-accepted facts (Fleck 1935). In the co-productionist idiom, institutions have been described as 'stable repositories of knowledge and power', with legal systems or research laboratories offering 'ready-made instruments for putting things in their places at times of uncertainty and disorder' (Jasanoff 2004:39-40). Jasanoff's description purposefully straddles the formal and informal meanings of institutions. It points to institutions being identifiable either by 'a sign above the front door' and/or by more intangible things like sets of legal rules and norms. Either way, institutions offer identifiable 'repertoires' of problem-solving and knowledge-making.

In this sense, 'civic epistemologies', which have been defined by Jasanoff as 'culturally specific, historically and politically grounded, public knowledge-ways' (2005:249), might also be considered institutions. Underpinning the concept is the idea that the public performance of science, and the ways in which experts are afforded credibility, result from historically-, politically- and culturally-situated processes. In doing so, the notion of civic epistemologies moves beyond the linear model of science for policy. It underlines the importance of context (for Jasanoff at the level of the nation-state) in the institutionalization of particular 'knowledge-ways'. Through case studies of biotechnology in Britain, Germany and the United States, Jasanoff outlines different dimensions of interest (e.g. 'styles of public knowledge-making', 'public accountability', 'expertise', etc) to account for differences in the making and using of knowledge between these three countries. More recently, the diversity of ways in which nation states have interpreted the science (and science advice) on COVID-19 is a clear manifestation of these civic epistemologies. With the concept of *institutional epistemology* we start from a similar conceptual angle, but our objective is to account for the diversity of knowledge-ways in the context of expert organizations, rather than within nation-states.

A reflection on the concept of 'boundary organization' (see definition in Table 1) is also useful for our purposes. Our concern is similar to Guston in the sense that we are interested in processes*, i.e.,* how a set of knowledge practices become stabilized. Organizations including the IPCC, the Netherlands Environment Assessment Agency (PBL), the US Office of Technology Transfer, the UK Climate Impacts Programme (and many more) have been described as boundary organizations. Efforts to map different types of boundary organizations exist and offer different ways to analyze science-policy arrangements (e.g. Pesch et al 2012; Hoppe & Wesselink 2014). Although the literature on boundary organizations has developed in different directions (see Gustafsson & Lidskög 2017), it does not focus on knowledge practices *per se* nor does it account for the similarities and differences between different organizations. For this reason we propose the concept of institutional epistemology to help remedy this gap. It offers a vocabulary and a framework by which to disclose the diversity of boundary organizations and their knowledge practices, possibly enabling more profound or probing comparative insights.

While the concepts of civic epistemologies and boundary organizations serve different purposes, they both come from what Jasanoff has termed the 'interactionist' tradition of co-productionist work in STS. They provide lenses for 'seeing' the ways in which science is used in public life. In this sense they are both concerned with the circulation of knowledge as much as with its production. In contrast, other concepts are directed more specifically at the micro-settings where knowledge production takes place. This is the case with the concept of 'epistemic culture' (Knorr-Cetina 1999) which describes how different disciplines produce knowledge, in laboratory settings for example. International relations scholar Peter Haas invented the concept of 'epistemic communities' (Haas 1992) to describe how particular networks of experts produce knowledge intended as policy-relevant, emphasizing the key role of shared norms for such networks to operate. However, when it comes to characterizing the knowledge practices of transnational organizations such as GEAs little vocabulary is available. Yet empirical and conceptual development in this area may help move forward debates surrounding effective actionable knowledge (Dewulf et al 2020). We suggest that the concept of institutional epistemology helps connect these places of knowledge production with the spaces of knowledge circulation. It helps draw attention to the ways in which synthetic knowledge -- emerging from different 'epistemic cultures' and 'epistemic communities' -- gets deployed in wider organizational settings, whether at local, national or global scales.

Table 1 - Key concepts stemming from STS literature on expertise and expert organizations. We include our new concept of institutional epistemology.

Concept	Focus	Definition
Boundary organization	Stabilization of science-policy interactions	Provides the opportunity and sometimes the incentives for the creation and use of boundary objects and standardized packages; second, they involve the participation of actors from both sides of the boundary, as well as professionals who serve a mediating role; third, they exist at the frontier of the two relatively different social worlds of politics and science, but they have distinct lines of accountability to each (Guston 2001:93)

Civic Epistemology	Institutionalization of knowledge-ways in nation states	The institutionalized practices by which members of a given society test knowledge claims used as a basis for making collective choices (Jasanoff 2005:255)
Epistemic Community	Production of policy-relevant knowledge	Transnational network of knowledge-based experts who help decision-makers to define the problems they face, identify various policy solutions and assess the policy outcomes (Haas 1992)
Epistemic Culture	Knowledge production	Those amalgams of arrangements and mechanisms (...) which, in a given field, make up how we know what we know (Knorr Cetina 1999:1)
Knowledge Infrastructure	Networks of experts, artefacts, institutions	Robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds (Edwards 2010:17)
Institutional Epistemology	Knowledge practices within organizational settings; Expert cultures of organizations	A stabilized set of practices through which participants in an institutional process produce, combine and negotiate knowledge.

Scholars from several disciplines have identified various challenges associated with the production of policy-relevant knowledge by expert organizations, including, for example, issues associated with their legitimacy, credibility, and effectiveness (Biermann 2001; Weichselgartner & Kaspereon 2010). Yet while their end products (e.g. reports, recommendations, indicators) are well known, the knowledge practices leading to their production have received less critical scrutiny, being often 'black-boxed' (see Pinch 1992). Global environmental assessments operate with a range of knowledge practices (Oppenheimer et al. 2019). Existing literature has honed in on what we characterize in Table 2 as 'scoping practices', concerning for example questions of participation and valid knowledge sources (e.g. Ford et al. 2011); 'standardization practices' by which diverse knowledge forms are made combinable and commensurable (e.g. Borie & Hulme 2015; Montana 2017); 'representational practices', such as visualizations and modes of conveying uncertainty and disagreement (e.g. O'Reilly et al 2012; Hollin and Pearce 2015; Mahony 2015) and 'public practices', such as communication strategies and data-sharing (e.g. Pearce et al. 2015), as well as practices of stage management (e.g Hilgartner 2000).

Table 2 describes concrete examples of these families of practices. In this paper, we are interested in providing a sharper picture of the ways in which these organizations perform a version of 'epistemic constitutionalism' (Miller 2009), offering ways of dealing with diversity while, in the case of GEAs, making it possible to construct and govern at new, supra-national scales.

Table 2 – Different knowledge practices that may be useful to characterize the institutional epistemologies of expert organizations (Our case study examples are in bold)

Knowledge practices		Description
Scoping practices	Participation	Geographical scope (global, regional, etc.) Disciplines Demographic diversity
	Assumptions regarding valid knowledge	Peer-reviewed material; Grey literature; Non-scientific knowledge
Standardization practices	**Conceptual frameworks**	How are problems framed? Indicates whether there is a common overarching vision or rather multiple framings
	Modes of futuring	Scenarios, modelling practices
	Strategies of coordination and harmonization	Guidelines, methodologies
Representational practices	Visuals	Data visualizations; mapping practices; conceptual diagrams
	Consensus/Dissensus	Resolution of expert disagreement; reporting of minority positions
	Argumentation	Who has a voice in validation processes, who can persuade and/or object
Public practices	Communication	Way of interacting with public sphere; Management of controversies
	Data sharing	For example traceability, authorization, open access

3. Methodological note: Characterizing institutional epistemologies

To begin characterizing these respective institutional epistemologies, in what follows we develop our comparative insights between the IPCC and IPBES for three practices: (i) *conceptual frameworks*; (ii) *scenarios;* and (iii) *controversies and consensus*. The rationale for these selections is explained below. The other practices outlined in Table 2 serve to emphasize the richness of future work that can be conducted to further characterize institutional epistemologies.

This paper is the outcome of a collaboration between the authors who have each either participated in, or closely studied, the functioning of the IPCC and/or IPBES, and integrates over 10 years of work. The paper develops novel comparative insights about the IPBES and IPCC drawing on the results of previously conducted empirical work by the authors in combination with existing literature. Our analysis is interpretative and informed by qualitative data that was initially collected in the context of two PhD theses, one dedicated to the IPCC and the other to IPBES, and a MA dissertation on scenario work in IPBES. Table 3 provides an overview of the data and key publications associated with previous work by the authors. Both PhDs adopted multi-sited ethnography as a research design and drew on interviews and document analysis, as well as different forms of participant observation. Regarding the latter, gaining access to IPBES plenary sessions was possible, unlike the IPCC where permission was refused. One of the co-authors was involved as a participant in the IPCC's Third Assessment Report, fulfilling several different roles. The MA dissertation also drew on qualitative research methods, such as semi-structured expert interviews and document analysis. The analysis presented here revisits some of the material collected for this previous work, as well as drawing on published literature. Our choice to elaborate on conceptual frameworks, scenarios, and consensus/dissensus for our comparative analysis was guided both by conceptual, *i.e.* they usefully illustrate the value of focusing on knowledge practices and the concept of institutional epistemology, and practical reasons, *i.e.* the prior collection by these previous studies of relevant material on these aspects.

Table 3 – Overview of previous work including data and key publications of the authors informing the comparative analysis presented here

	Data collection	Key Publications
IPCC	*Document analysis:* Corpus of ~400 documents collected between 2010 and 2018 including IPCC reports, expert and government review comments, government and policy papers, Earth Negotiation Bulletins and media articles. *Semi-structured interviews:* 43 semi-structured interviews with IPCC experts, civil servants and stakeholders conducted between 2011 and 2013. *Participant observation:* Author participant in IPCC as CLA, Review Editor and Task Force member. Independant ethnography not possible.	Mahony, M. (2013). *Epistemic geographies of climate change: the IPCC and the spaces, boundaries and politics of knowing*. Unpublished doctoral dissertation, University of East Anglia. Girod, B., Wiek, A., Mieg, H., & Hulme, M. (2009). The evolution of the IPCC's emissions scenarios. *Environmental science & policy*, *12*(2), 103-118 Hulme,M. (2013) Lessons from the IPCC: do scientific assessments need to be consensual to be authoritative*? pp.142-147 in: Future directions for scientific advice in* Whitehall (eds.) Doubleday,R. and Wilsdon,J., CSaP, Cambridge, 158pp.
IPBES	*Document analysis:* Corpus of ~200 documents including UNEP official reports, IPBES reports, workshop reports, delegations and stakeholders' comments, Earth Negotiations Bulletins. *Semi-structured interviews:* 36 semi-structured interviews with IPBES experts, high-level civil servants, representatives of delegations and stakeholders conducted between Nov. 2012 and Dec. 2014. 10 semi-structured interviews with experts contributing to the Methodological assessment report on scenarios and models and members of the ILK taskforce; conducted between May-July 2017 *Participant observation :* IPBES plenary sessions : IPBES-1, 2013 IPBES-2 2014 ; IPBES-3 2015 ; IPBES-7, 2019 Internship with IPBES Technical Support Unit, Bonn Secretariat (4 months in 2017-2018)	Borie, M. (2016). *Between Nowhere and Everywhere: The Challenges of Placing the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).* Unpublished doctoral dissertation, University of East Anglia. Borie, M., & Hulme, M. (2015). Framing global biodiversity: IPBES between mother earth and ecosystem services. *Environmental Science & Policy*, *54*, 487-496. Obermeister, N. (2019). Local knowledge, global ambitions: IPBES and the advent of multi-scale models and scenarios. *Sustainability Science*, *14*(3), 843-856.

(i) Conceptual frameworks

Whether implicitly or explicitly, all GEAs act within certain epistemic frameworks which enact particular forms of collaborative knowledge-making. These frameworks, which do not go uncontested, delineate whose knowledge and expertise should be included, or excluded, in the production of assessments. They have found visual expression -- for example the 'Bretherton diagram' of the climate system used implicitly by the IPCC (e.g. Castree et al 2014) or the 'Rosetta Stone' diagram adopted explicitly by IPBES (Diaz et al 2015a). What effects do these frameworks and visualizations have on the kinds of knowledges and expertise which are sought and how do they facilitate new forms of collaborative knowledge-making practice?

(ii) Modes of futuring

One of the key ambitions of these organizations is to help anticipate, predict, and adapt to future global environmental changes. To this aim many technologies whose purpose is to gain a better understanding of what the future might look like have been developed. These include modelling and forecasting techniques, scenarios and storylines. As with the IPCC, scenario construction for IPBES has become a core activity in the conduct of biodiversity and ecosystem services assessments.

(iii) Controversies and consensus

Both IPBES and the IPCC aspire to embrace cultural and geographical diversity in enlisted expertise, while simultaneously being accountable to scientific norms of accreditation and validation and also retaining policy relevance. In this context, the idea of consensus has become widely institutionalized – both in the practices of international knowledge making and in the decision-making processes of these institutions which operate under the same rules as UN organizations (e.g. Montana 2017). We identify the different ways in which IPBES and the IPCC have sought to handle conflicting views, controversies and disagreements to achieve closure.

4. The institutional epistemologies of IPBES and the IPCC

4.1. Conceptual frameworks: Bretherton diagram vs. the Rosetta Stone

4.1.1. IPCC & Earth System Sciences

According to Hulme (2008: 6), three main elements are central to the framing of climate change pursued by the IPCC:

> 'A globalized atmosphere (…) which offered the world a single depository for greenhouse gas emissions and which opened the way for predictive climate modelling; the goal of a stabilized

global climate as the centrepiece of policy; and the institutionalising of mitigation and adaptation as co-dependents in future global climate policy regimes'.

The first of these elements – the stabilization of predictive global climate modelling as a dominant epistemic strategy (see Shackley et al. 1998) – was an important prior condition for the other two elements of the IPCC's assessment framework. Although the IPCC has not officially adopted an explicit conceptual framework, the Bretherton diagram (Figure 1), which is a representation of the different geophysical components of the Earth System (NASA 1986), is often recognized as having influenced the framing of climate change adopted by the organization. Until relatively recently, the 'human dimension' was largely excluded from the picture (Nielsen & Sejersen 2012; Mooney et al. 2013).

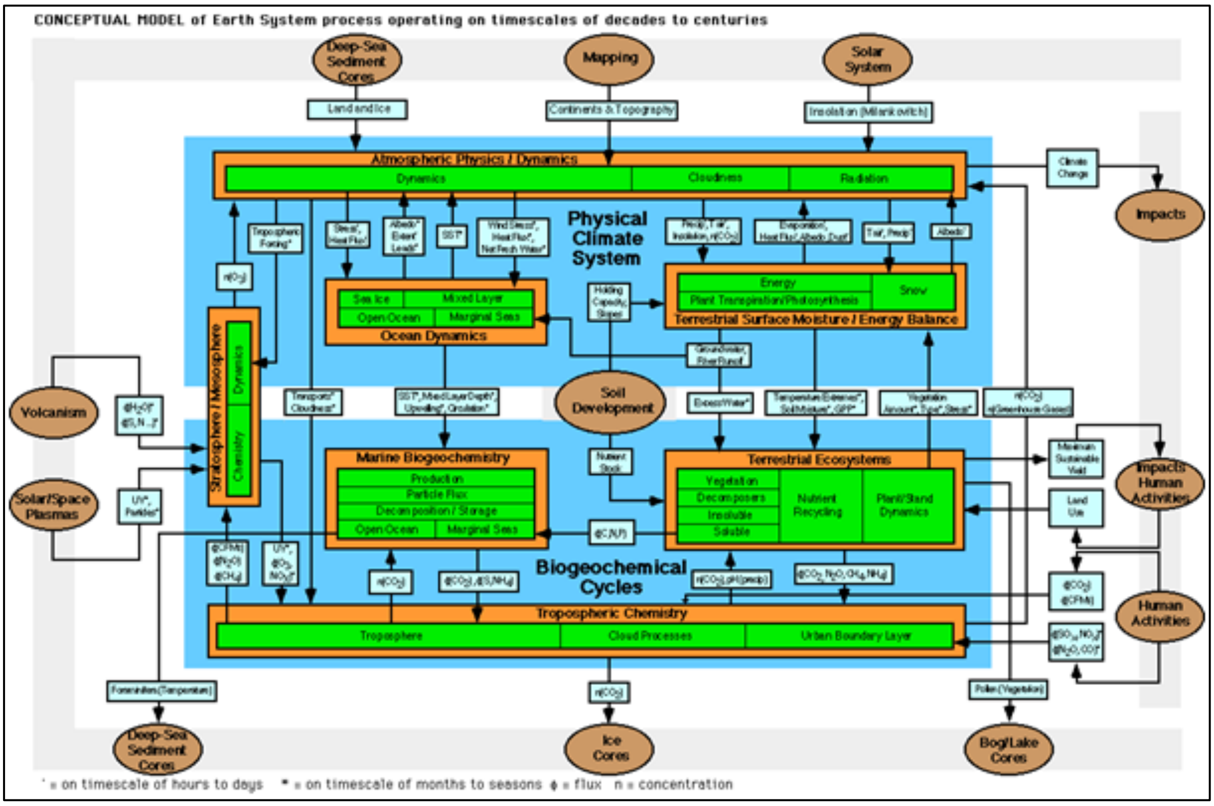

Figure 1. The 'Bretherton diagram' – a paradigmatic conceptual map of the 'Earth system' [Source: NASA, 1986]

Numerous scholars, most notably Jasanoff (2010), Hulme (2011), Beck (2011) and Nielsen & Sejersen (2012) have critiqued the epistemic effects and implications of this framing. Numerical calculations of future changes in the climate system are placed at the start of a causal chain by which, first, climates change and then, second, societies experience 'impacts' of these changes to which they then, third, attempt to respond or adapt. By so doing the IPCC has arguably contributed to 'climate reductionism' (Hulme 2011; Rigg & Mason 2018), a form of neo-determinism which simplifies complex relationships between societies, weather and climate, and which positions climate as the chief determinant of human fortunes and futures. The dominance of this framing may explain some of the exclusions or marginalization of alternative knowledge systems within the IPCC (Bjurström & Polk 2011; Ford et al. 2011; Russill 2016).

This reductionism is arguably most clear in the prominence which has been given to global mean surface temperature (GMST) as the index or icon of global change (see Hulme 2010; Schwartz 2017). Since the early days of climate model simulations (Hansen et al., 1981), GMST has been the key variable of interest (as opposed to, for example, ocean heat content, radiative forcing, or precipitation). Estimates of the equilibrium response of the climate system to a doubling of atmospheric carbon dioxide concentrations, measured by GMST, have remained remarkably stable over time (van der Sluijs et al. 1998; IPCC 2014). So too has GMST as the organising metric of international climate politics. This is reflected in controversies over the development of mitigation scenarios which showed that keeping GMST rise to under 2°C was still possible, albeit through the assumed deployment of as-yet largely untested 'negative emission technologies'. For some commentators this was an unfortunate instance of fitting science to policy, rather than the other way around (e.g. Geden 2015). It can also be read as an insight into the increasingly dominant role played by integrated assessment models (IAMs) in framing IPCC assessments. It also reveals the mutual reinforcement of GMST and global economic optimality as organising metrics in the scenarios produced by, respectively, climate and economic models (Hughes & Paterson 2017; Beck & Mahony 2018).

We further explore the politics of these 'modes of futuring' below. For now, we simply observe that while the initial exclusion of 'the social' from the IPCC's organising conceptual framework may be changing, and that earth (system) science has in many ways 'become a social science' (Oreskes 2015), the dominant ways in which society is (re)presented in IPCC assessments carries similarities to the Bretherton diagram. Climate is represented as a complex, multifaceted system which nonetheless tends towards equilibrium through the mechanistic resolution of multiple processes, and an outcome that can be captured in a single measure – whether this be global temperature, net global carbon emissions, or global economic output.

4.1.2. A Rosetta Stone for IPBES

IPBES has been more explicit in its search for a touchstone conceptual framework by which to structure its activities. One of the first decisions taken by Member States' delegations participating in IPBES was the development of a common conceptual framework that would provide the organization with an overarching vision that could be used across all IPBES functions:

> 'The Platform's conceptual framework is intended (…) to be a basic common ground, general and inclusive, for coordinated action towards the achievement of the ultimate goal of the Platform [i.e. Good quality of life].' (UNEP 2013b:2)

A short reflection on the idea of biodiversity is necessary here. In its conventional scientific understanding, biodiversity represents 'all life on Earth' and includes genetic, specific and ecosystems diversity. Some global indices have been constructed to monitor, for example, species declines, such as the IUCN Red List. However the constitution of a global form of biodiversity that relies solely on mathematical modelling is arguably more complicated and, one might argue, from a normative standpoint less desirable (Turnhout et al 2014). Some ecologists are trying to identify and develop global biodiversity indicators, such as 'Essential Biodiversity Variables' (Pereira et al. 2013). Others seek to develop global ecosystems models to simulate 'All life on Earth' in a way similar to global climate models in order to improve the capacity of ecology to act as a predictive science (Purves et al. 2013). But such developments are by no means straightforward or uncontested. Whereas for climate change it has been possible to construct a 'global' representation of climate change through global indicators, no equivalent established global metrics currently exist for biodiversity. Ecological processes have been described as more chaotic, less predictable, and more local (Coreau et al. 2009; Rosa et al. 2017). Largely for these reasons, IPBES and its wider community have called for multiscale models and scenarios for biodiversity and ecosystem services (IPBES 2016; Kok et al. 2017; Lundquist et al. 2017).

Within biodiversity and ecosystem services assessments, the formulation of a common conceptual framework was a core activity of the Millennium Assessment (MA). Participants in this initiative articulated a common conceptual framework organized around the notion of 'ecosystem services', which was defined as 'the benefits that people gain from ecosystems' (MA 2005). With this notion, the MA contributed to a conceptualization of biodiversity issues, not as a problem of biological conservation, but in relation to achieving the Millennium Development Goals -- hence adopting an anthropocentric framing for biodiversity (Watson 2005). The MA conceptual framework showed the relations between different types of services provided by ecosystems and different components of human well-being (MA 2003; Carpenter et al. 2009). Since this thinking has become hegemonic, some now ask whether the notion of 'ecosystem services' may provide a standardized framing, performing for biodiversity sciences and policy a role similar to GMST for climate change (Turnhout et al 2016). While this may be true, in promoting this approach the MA also explicitly recognized the value of different forms of knowledge to account for the relations between 'ecosystems' and 'human well-being'. While the Global Biodiversity Assessment (1995) mobilized mostly natural scientists, the MA facilitated more cross-disciplinary interactions (in particular between natural scientists and economists) and engaged with indigenous and local knowledge in its sub-global assessments (see Filer 2009). Building on the experience and shortcomings of the MA, IPBES aspires to develop this dialogue between diverse epistemic communities even further by weaving plural and local knowledge claims into its multi-scale assessments (e.g. Hill et al 2019).

Within IPBES the explicit search for a unified conceptual framework can therefore be seen as an attempt to find a common 'structuring device' facilitating collaboration between heterogeneous groups. At the same time it would allow some standardization in order to render possible, for example, a comparison of results of IPBES assessments in different regions. Although punctuated by numerous controversies (as will be explored in section 4.3), there was a willingness among IPBES members to develop the IPBES conceptual framework in a way that would be open to diverse voices and representative of diverse types of expertise and knowledges.

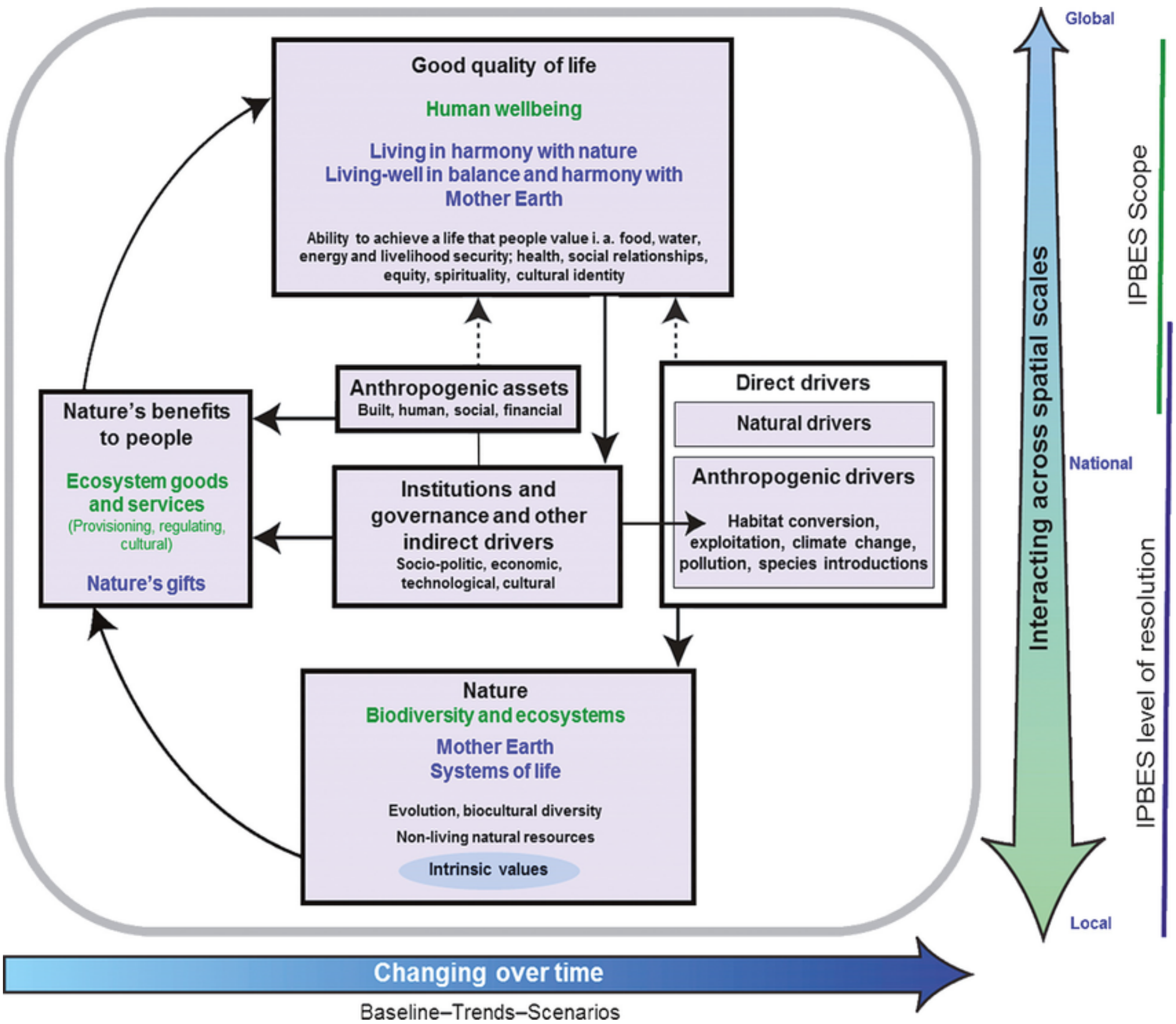

Figure 2. Conceptual Framework of the Intergovernmental Platform on Biodiversity and Ecosystem Services (Source: IPBES)

The final IPBES conceptual framework (Figure 2) aspires to bring together multiple framings of biodiversity by 'explicitly embracing different disciplines and knowledge-systems (including indigenous and local knowledge) in the co-construction of assessments' (Díaz et al. 2015:1; see also UNEP 2014). This framework explicitly recognizes different ways of knowing biodiversity: a utilitarian one organized around the concept of 'ecosystem services' and a more holistic one organized around the concept of 'Mother Earth'. For this reason, the IPBES framework was explicitly compared to a Rosetta Stone and this metaphor was used to emphasize the innovative nature of the framework:

> 'This model clearly builds on the highly influential Millennium Ecosystem Assessment (…). However, the CF [conceptual framework] further emphasizes the crucial role of human institutions as sources of both environmental problems and solutions. (…) Finally and crucially, the CF goes further than any previous initiative in the international environmental science–policy interface in its explicit, formal incorporation of knowledge systems other than western science, in an unprecedented effort towards crosscultural and crossdisciplinary communicability in the search for options and solutions' (Díaz et al. 2015a:2)

The IPBES framework explicitly legitimates different disciplines and recognizes that more than ecological science knowledge is needed to address biodiversity-related issues. In particular, the fact that 'institutions' are placed at the core of the diagram is meant to convey an understanding of biodiversity issues as related to institutional and governance settings. The expectation is that social and political scientists have a key role to play in documenting these aspects. This may be interpreted as an attempt, within IPBES, to develop an institutional epistemology inclusive of diverse ontologies and different ways of knowing biodiversity.

4.2 Modes of futuring: Scenarios

4.2.1 Scenario methodologies in the IPCC

While it can be argued that IPCC assessments of future climate change 'start' with numerical simulations of the climate system (see above), these simulations have to be based on quantified estimates of how the main drivers of anthropogenic climate change may evolve over time. The IPCC evolved emissions scenario methodologies to produce 'alternative images of how the future might unfold' in order to 'analyse how driving forces may influence future emission outcomes' (IPCC 2000: 3). Scenarios can be understood as 'disciplined speculation' about the future (Parson 2008) and their construction demands insight from various disciplinary perspectives. As Oreskes (2015) has pointed out, this challenges the IPCC's self-presentation of a linear relationship between physical and social science in the assessment of climate change. The emissions scenarios used by IPCC have conventionally relied on Integrated Assessment Models (IAMs) to develop plausible trajectories of future emissions as guided by narratives of possible economic, demographic and technological change. Subsequent emissions 'pathways' are then used to simulate the transient response of the climate, before the resulting climatic scenarios are used to drive impacts studies (see IPCC 2000; Mearns et al. 2003), often indexed back to GMST.

Scenario methodologies can be understood as one of the ways in which IPCC has sought to bridge gaps between disciplines. The practices and language of scenario construction have become a 'creole', facilitating interaction between experts from very different epistemological traditions. IPCC scenarios, such as the IS92 and the Special Reports on

Emissions Scenarios (SRES) scenarios, produced for the Second and Third Assessment Reports respectively, have sequenced the practices of assessment, often with serious time lags between initial socioeconomic modelling, climate modelling and impacts modelling. For example, although the SRES scenarios shaped the presentation of climate scenarios in AR3, there was insufficient time for the impacts community to absorb the new data and much of the Working Group II assessment was based on the earlier IS92 scenarios. It took ten years from the start of work on SRES (1997) for impacts studies using the scenarios to make it into an IPCC assessment (AR4; 2007). Nonetheless, the particular scenario methodologies employed by the IPCC have significantly shaped the social relations between IPCC participants, while having significant (although under-studied) effects on the wider conduct of both climate science and politics (Garb et al. 2008; Corbera et al 2016; Hughes & Paterson 2017).

More recently, the IPCC has adopted a different approach to scenario production. Following the release of AR4, the IPCC effectively commissioned the 'research community' to produce a new set of scenarios which would short-circuit some of the sequencing problems of previous work. Rather than starting with narratives of socio-economic development, 'Representative Concentration Pathways' (RCPs) were developed using IAMs to span a range of future radiative forcing possibilities. These concentrations and forcing pathways are not specific to any particular socio-economic scenario. A second, and somewhat delayed, process therefore followed to construct 'Shared Socio-economic Pathways' (SSPs) to answer the question: 'what are the ways in which the world could develop in order to reach a particular radiative forcing pathway?' (Moss et al. 2010: 747). In this sense, the RCP and SSP methodology has de-centred the social sciences from scenario production, returning attention to more easily quantifiable physical variables (see van Vuuren et al. 2017). But the ambition has been to instigate 'greater coordination' in order to 'facilitate additional scientific advances, including increased understanding of different types of feedbacks and improved synthesis of research on adaptation, mitigation and damages incurred' (Moss et al. 2010: 751).

The dominance of this particular approach has recently attracted controversy in the form of criticism about the dominance of IAMs in defining the political possibility space in relation to so-called 'negative emission technologies' (see Beck & Mahony 2018). Echoing STS work on the performativity of economic modelling (e.g. MacKenzie 2006), concerns have been raised that the often opaque assumptions of IAMs (such as discount rates or innovation diffusion curves) are actively shaping climate mitigation debates in ways which favour technological solutions rather than more radical economic transformation (e.g. Anderson 2015; Beck & Krueger 2016; Robertson 2020). In drawing attention to how particular knowledge practices get stabilized, the notion of institutional epistemology opens up the possibility of greater reflexivity about how the physical and social science content of IPCC scenarios actively shapes the physical and social worlds.

4.2.2. Scenarios methodologies in biodiversity and ecosystem services assessments

As in the case of the IPCC, scenarios have become a core activity in the conduct of biodiversity and ecosystem services assessments. Within IPBES, much emphasis is placed on the ability of these tools to illuminate possible futures while identifying policy options. This was already the case in the Millennium Ecosystem Assessment (MA) where one of the four working groups was specifically on scenarios. This group was inclusive of both natural and social scientists and developed different exploratory scenarios showing the evolution of the relations between 'human well-being' and 'ecosystem services' according to different governance and economic pathways. The definition of scenarios was imported from the IPCC and defined in the MA as:

> 'Plausible and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces and relationships' (MA 2005: 153).

MA scenarios were developed using a mix of quantitative and qualitative techniques and their respective storylines resonated to a certain extent with the IPCC SRES scenarios. Despite some similarities, the methodology used to develop the scenarios in the MA was different. In terms of social organization, scenarios were also approached as an opportunity to develop new forms of collaborations with the intended users, which included representatives of national governments, multilateral environmental agreements (e.g. CBD, Convention on Desertification) and the private sector (Carpenter et al 2006). Moreover, the MA scenarios were also developed at multiple scales (Biggs et al 2008).

IPBES sets out to catalyse the development of the next generation of models and scenarios for biodiversity and ecosystem services. This commitment includes the uptake of indigenous and local knowledge in those models and scenarios, as well as concerns over policy-relevance at multiple scales (Lundquist et al. 2017; Stenseke and Larigauderie 2017). Specifically, the *Methodological Assessment Report on Scenarios and Models* from IPBES highlighted the challenge of 'matching model complexity to policy and decision-making needs' (IPBES 2016: 143). This commitment to 'policy-relevance' is visible in the definition adopted by IPBES:

> '*Scenarios* are representations of possible futures for one or more components of a system, particularly, in this assessment, for drivers of change in nature and nature's benefits, including alternative policy or management options' (IPBES 2016: 64).

For this purpose, IPBES intends to use 'backcasting' techniques where the scenarios are developed according to particular policy objectives (e.g. Aichi Targets) and then potential pathways to reach these policy objectives are inferred. However, IPBES's ambitions go further than that and propose to use a variety of techniques while including diverse knowledge-systems:

> 'The new IPBES scenarios and modelling framework will shift traditional ways of forecasting impacts of society on nature to more integrative, nature-centred visions and pathways for the future of nature that are relevant for conservation policies and practice. […] Importantly, they will integrate the social-ecological feedback loops across drivers, biodiversity, ecosystems, ecosystem services, and human wellbeing, and incorporate multiple systems of knowledge.' (Lundquist et al., 2017: 12).

To those ends, a series of workshops have been organized - including a workshop on 'visioning futures for biodiversity and ecosystem services' in Auckland, New Zealand, which resulted in the derivation of a set of exploratory 'Nature Futures' scenarios (see Table 4, and Lundquist et al. 2017) and a pluralistic Nature Futures framework which explicitly aims at opening up possible 'pathways and policy options based on nature preferences' (Lundquist et al 2019).

Table 4: Illustrating two different modes of futuring: IPCC exploratory scenarios, based on the present, and IPBES normative scenarios, based on imagined positive futures.

IPCC Shared Socioeconomic Pathways (SSPs) (O'Neill et al. 2014)	**IPBES Nature Future Scenarios** (Lunqvist et al 2017)
SSP 1. Sustainability: taking the green road. The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural, and economic costs of environmental degradation and inequality drive this shift. **SSP 2. Middle of the road.** The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. **SSP 3. Regional rivalry: a rocky road.** A resurgent nationalism concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. This trend is reinforced by the limited number of comparatively weak global institutions, with uneven coordination and cooperation for addressing environmental and other global concerns. **SSP 4. Inequality: a road divided.** Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. **SSP 5. Fossil-fueled development: taking the highway.** Driven by the economic success of industrialized and emerging economies, this world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development.	**Nature-based Inclusive Prosperity**: A healthy world, where wealth and wellbeing is accessed fairly and natural resources sustain richly diverse cultures, societies and nature into the future. **Sustainable Food Systems**: a world without hunger based on a combination of sustainable supply chains (…), and supported by reciprocal agreements for sharing benefits. **ReFooding and ReWilding the Urban Rural Flows**: a world where urban and rural dwellers reconnect with nature, reconcile their interests and assist each other in improving quality of life in the cities and valuing the countryside. **Healthy Social-Ecological Freshwater Systems**: a world where rivers are awarded legal rights as living systems, water use and extraction are done efficiently at the microscale in a circular economy paradigm with no waste-water (…). **A Tasty World with Values:** a world where human-nature relations are based on reciprocity, harmony and relationality supported by educational systems infused by these values; (…) and governance systems share universal recognition of local small producers and indigenous peoples' sovereignty over territories, resources and knowledge. **Dancing with Nature:** a world in which nature is given space to thrive. Nature is connected and changing at multiple scales. Dancing with Nature requires dynamic people, infrastructure, and civilizations. **Healthy Oceans, Happy Communities**: a world where the oceans and coasts are full of life, ecosystem services

	are sustained through the adoption of long-term sustainability strategies by governments and businesses and the high-seas are closed to fishing.

While a number of challenges lie ahead for multi-scale model and scenario-building, for example with regard to the inclusion of indigenous and local knowledge, the social sciences, and the humanities (Obermeister 2017; 2019), the IPBES approach to scenarios therefore points towards a divergence from the mostly global, top-down traditions of its predecessors. Whilst the IPCC approach is still a source of inspiration for IPBES, the modes of futuring developed by IPBES participants differ from those developed in the IPCC in several aspects, for example in the attempt to make room for diverse epistemic practices while creating opportunities for deliberation between diverse social worlds. These differences contribute to what we claim are distinct institutional epistemologies between the two organizations.

4.3. Controversies and consensus

4.3.1 IPCC: Consensus as product

Since its establishment, the IPCC has been through several controversies and consequent reforms, resulting in major changes in its procedures in 1993, 1999 and 2010. Particular moments of contestation can be read as struggles over the nature and practice of consensus building, in a context where universal metrics are sought for a set of phenomena with complex and contested normative contours. In the IPCC Second Assessment Report for example, controversy arose over the economic valuation of human lives in estimates of climate impacts (Fankhauser and Tol 1998). Governments such as India objected to valuations in the Summary for Policymakers which suggested that OECD lives were more valuable than human lives in developing countries. Authors of the underlying chapter argued that it would be wrong to subvert accepted economic methodologies for constructing monetized estimates of loss. Yet IPCC lead author Michael Grubb would later argue that:

> 'Many of us think that the governments were basically right. The metric makes sense for determining how a given government might make trade-offs between its own internal projects. But the same logic fails when the issue is one of damage inflicted by some countries on others: why should the deaths inflicted by the big emitters — principally the industrialized countries — be valued differently according to the wealth of the victims' countries?' (Grubb 2005)

This reflection illustrates some of the ambiguities of consensus-making in intergovernmental settings like the IPCC. Established methodologies for measuring national economic projects can be stabilized in assessment processes, where both new forms of knowledge and new forms of political order are being co-produced. New metrics produce new ways of governing, and vice-versa. The antagonism through which new political orders emerge therefore permeates into questions of statistical representation and aggregation. This controversy echoed an earlier debate triggered by Indian environmental analysts who contested universalising metrics of greenhouse gas emissions, suggesting instead distinctions between 'luxury' and 'survival' emissions (Agarwal & Narain 1991). In response to controversies such as this the IPCC has developed mechanisms for dealing with disagreement. In Summary for Policy Maker (SPM) deliberations, dissenting government delegates can be taken aside by relevant authors to be persuaded to accept the dominant way of thinking. The IPCC has the capacity for issuing formal 'minority reports', although this procedure has not been utilized (Livingston et al 2018). In this way, techniques like the issuing of uncertainty guidelines attempt to codify representations of divergent opinions, although frequently disagreement and controversy, rather than being resolved 'internally', spills over into public debates about IPCC science (Hollin & Pearce 2015).

Yet among observers and participants of the IPCC, there are ambiguities about whether consensus statements reflect 'a lowest common denominator consensus view of the vast majority of scientists' (Edwards & Schneider 1997:13), or whether the IPCC 'brings controversy within consensus, capturing the full range of expert opinion' (Edwards 2010: xvii). Here we can see an important distinction between consensus-as-product ('lowest common denominator') or consensus-as-process (of negotiating controversy or disagreement) (Pearce et al 2017). This ambiguity about whether producing consensus is about capturing the 'lowest common denominator' about which everyone can agree, or the 'full range' of opinion, has played out in further public controversies, for example the controversy over IPCC estimates of future sea-level rise (O'Reilly et al. 2012).

James Hansen argued that the IPCC's sea-level rise projections in 2007 were troublingly conservative, as the need for consensus meant that emerging, uncertain work on ice sheet dynamics was discounted. Hansen painted the consensus projections as a lowest common denominator, identifying 'scientific reticence' in the avoidance of exploring more extreme possibilities (Hansen 2007). For Oppenheimer et al. (2007:1506) the need for potentially consequential information in the 'tails' of probability distributions means the 'establishment of consensus by the IPCC is no longer as critical to governments as a full exploration of uncertainty'. Relatedly, some have argued that IPCC projections have been shown to be consistently conservative, reflecting an institutionalized commitment to 'err on the side of least drama' (Brysse et al. 2013).

While controversies over processes like sea-level rise reflect uncertainties in different modelling strategies, controversies over the value of human lives, the contribution of different countries to atmospheric greenhouse gas levels, or links between climate change and violent conflict (Gleditsch and Nordas 2014), cast the problem of consensus in different light. Despite the apparent 'mechanical objectivity' of the scenarios and models which underpin such knowledge claims, a growing emphasis has been placed on 'expert judgment' as the key factor in generating consensual knowledge (Mach et al. 2017; Oppenheimer et al. 2019). In Working Groups II and III, disagreement can be observed over where exactly the boundary between 'facts' and 'values' lies, leading to many conflicts between authors and governments who perceive their interests being threatened by overly-subjective constructions of climate risks (Fløttum et al 2016). This boundary work can be read as the naked defence of political-economic power, or also as an expression of different expectations of what 'scientific assessment' is, and where science ends and politics begins. These expectations may be traced to different political traditions, or even to distinct civic epistemologies (Mahony 2015). In pursuing consensus therefore, the IPCC's Working Groups are not just engaged in mediating epistemic uncertainty, but also in mediating different ideals of what assessment and consensus mean in the first place (see Kowarsch et al 2017).

4.3.2 IPBES: consensus as process

By returning to the 'Rosetta Stone' developed by IPBES we can draw some comparative insights with the IPCC with regards to the interactions between controversies and consensus. The process leading to the formalization of the IPBES framework was punctuated by controversies and different versions of the conceptual framework were discussed. In particular, before the adoption of the final IPBES framework, a first version – the outcome of an earlier expert workshop – was presented to IPBES delegations and observers who were given the option to comment on it (Diaz et al 2015a). This initial framing resonated with the framework adopted in the MA, except that it placed 'institutions' at its core in an attempt to underline the importance of socio-institutional settings to address biodiversity-related issues (UNEP 2013a). While relatively well received by some delegations, this first diagram was nevertheless vehemently contested.

At the core of heated debates was the notion of 'ecosystem services'. Those participating in the development of the IPBES framework held a wide array of positions regarding this concept and a strong polarization emerged between those wishing to maintain and promote it further and those strongly advocating against. Many scientists who had already been involved in the MA were supportive of the ecosystem services approach and argued that it was important to preserve some epistemic continuity with this previous initiative. Here, 'ecosystem services' was defended as the most pragmatic approach to make environmental concerns relevant to policy and decision-makers (allowing, for example, to develop ecosystem services valuation practices). In contrast, some participants strongly rejected the concept and advocated for alternative framings. In particular, the Bolivian delegation argued that the notion of 'ecosystem services' was representative of a Western, neoliberal, approach to biodiversity and that such a framing was associated with performative effects, potentially leading to the commodification of nature. Contesting the Paris diagram, the Bolivian delegation put forward an alternative framework articulated around the notion of 'Mother Earth'. This explicitly aimed at opening-up a space for other ways of knowing, in particular for indigenous and local knowledges (Borie & Hulme 2015).

Despite the disagreements expressed above, there was a willingness to adopt a single conceptual framework and to find an agreement between diverging views. Yet a consensual agreement over a single framing or common terminology was elusive. Through the use of a colour code, both the 'ecosystem services and 'Mother Earth' perspectives were recognized. To some extent this can be interpreted as reflecting the idea that participants 'agreed to disagree'. This solution was perceived by some participants as being successful, a smart way of articulating diverging views and conflating them in a single diagram. As summarized provocatively by one ecologist (and IPBES expert) during an interview: 'Christians would say God, Muslims would say Allah'. Although there is no obvious commensurability between 'Mother Earth' and 'ecosystem services', the adopted solution nonetheless suggests that this process has perhaps facilitated the integration of what could be perceived as a 'minority position'. As we have argued elsewhere:

> 'This absence of convergence – the lack of an agreement over a singular framing – is illustrated by the very fact that a colour coding device was deemed necessary. (…). Each group refuses to give up its framing for the same reason: they are each perceived as too political by the other group. In this respect, the colour coding device – blue for Mother Earth, green for ecosystem services – appears as a solution to create an agreement out of disagreement, to create a consensus out of dissensus.' (Borie & Hulme 2015:9)

Reflecting on the ways in which diversity can be included in consensual processes and to find 'unity in diversity', Montana (2017) argues that IPBES operates with numerous typologies that play a key role in allowing participants to achieve closure and decide together. From that perspective, the IPBES conceptual framework can be understood as a typology of knowledge systems that allows the accommodation of diverse forms of knowledges. Similarly, the criteria to be eligible as an expert in IPBES can be understood as another typology. Such typologies both open-up and constrain how diversity is understood. As emphasized by Montana:

> 'There is a politics to typologies, which requires specific attention to how decisions are made (deliberation), who participates in them (participation), and the extent to which these participants are representative of broader knowledge and policy communities (representation). While the potential of typologies to accommodate consensus and diversity offers the hope of realising 'unity in diversity' for both environmental knowledge and policy, recognising the politics of their production is important for more equitable processes of environmental governance.' (2017:20)

We therefore conclude that whereas the IPCC displaced epistemic controversy into the wider, external cultural circuits of climate change politics, IPBES sought to gather disparate ontological and epistemological commitments to 'bring controversy within consensus' through internal processes. We again see different knowledge practices at work within these two organizations, pointing to the presence of different institutional epistemologies, an idea which we develop below.

5. Discussion

5.1 The view from nowhere vs. the view from everywhere?

Our analysis suggests some significant differences in the ways knowledge is made, ordered, and authorized in IPBES and in the IPCC (Table 5). First, more than being diagrams on a page, the conceptual frameworks used by these two institutions tell us something not only about the ways in which problems are framed, but also about whose knowledge is deemed relevant to address these problems. In this respect the IPCC ‘Bretherton diagram’ and the IPBES ‘Rosetta Stone’ are markedly different; they legitimate and mobilize different forms of knowledge and expertise.

Second, examining scenario practices tells us how possible futures are constructed by these two organizations and who can contribute to their construction. The extensive use of RCP scenarios in IPCC AR5 (and the rather greater profile being given to the SSPs in AR6) shows the influence of a particular knowledge practice on the production of a large, multidisciplinary and international assessments. And through the exercise of ‘symbolic power’ (Hughes & Paterson 2017) this approach influences the scientific community more broadly (e.g. Hausfather & Peters, 2020). In contrast, IPBES adopts a more diverse set of approaches for scenario building and recognizes the need to work at multiple scales. Contrasting the IPCC’s SSPs with IPBES’s Nature Future scenarios also shows how IPBES’s mode of futuring intends to start with positive visions of the future. This differs from the IPCC which adopts a range of exploratory scenarios extending from a past baseline (Table 4).

Finally, analyzing the interactions between controversies and consensus suggests different ways of managing dissent within these organizations. Instead of ‘bringing controversy within consensus’, the IPCC process displaces controversy to the assessments’ outsides, where very public controversies sporadically flare up over the content of IPCC reports. The IPCC’s pursuit of consensus-as-product can be interpreted as the result of a constitutional settlement which places ‘sound science’ at the start of a chain reaction of sure knowledge and determined action (Miller 2009; de Pryck 2020). This represents what might be thought of as a ‘lowest common denominator’ agreement among competing ideals of how scientific assessments should function. Whereas the IPCC has relied on generating a single voice for science which can function as the ultimate arbiter of political disagreement, we suggest that IPBES has adopted a more processual form of consensus making. For example, IPBES’s approach of ‘Nature’s Contributions to People’ can be read as an attempt to overcome and assimilate controversies surrounding ecosystem services (Pascual et al 2017).

As a result, we suggest that, broadly speaking, the IPCC has produced a 'view from nowhere'. This is accomplished through a reliance on mathematical modelling to produce a consensual picture of global climate change, which is then 'downscaled' for the consideration of local impacts and responses. By contrast IPBES, appears to seek a 'view from everywhere'. This is pursued through its contrasting conceptual frameworks and practices of argumentation, inclusive of diverse ontologies and different ways of knowing biodiversity. However IPBES operates under a similar intergovernmental regime as the IPCC, as well under the United Nations framework which is itself consensus driven. IPBES therefore continues to face a range of challenges to implement its innovative approach (Montana & Borie 2015; Vadrot et al 2016). We provide an overview of these differences that we suggest are representative of different institutional epistemologies (Table 5).

Table 5 - A sketch of some elements of institutional epistemology for IPCC and IPBES. Three of these are analysed in this paper (in bold) and the others are based on published literature (see citations) or are suggestive for future work.

Knowledge practices		**IPCC** **'View from Nowhere'**	**IPBES** **'View from Everywhere'**
Scoping practices	Participation	Biased towards global North and concerted efforts to expand participation from the global South, to ensure to ensure 'global credibility' (Ford et al. 2016)	Seeking geographic, disciplinary, and cultural diversity Stakeholder engagement strategy (Timpte et al 2018)
	Assumptions regarding valid knowledge	Peer-reviewed material in priority (Callaghan et al. 2020)	Peer-reviewed material and grey literature; Indigenous and Local Knowledge (Lofmarck & Lidskog 2017)
Standardization practices	**Conceptual frameworks**	Implicit, globalism; Bretherton diagram; linear model & interdisciplinary hierarchy (see Section 4.1)	Explicit with parallel ontologies; 'Rosetta Stone; multi-scalar approach; inclusivity (see Section 4.1)
	Modes of futuring	Scenario and pathway analysis to serve the needs of climate models (see Section 4.2)	Scenarios and modelling; willingness to develop 'backcasting', multi-scale, and participatory techniques (see Section 4.2.)
	Strategies of coordination/ harmonization	Uncertainty guidelines; scenario methodologies; cross-cutting boxes (e.g. on gender) (Kandiklar et al 2005)	Uncertainty guidelines; Explicit conceptual framework; guidelines to facilitate synergies between 'science' and 'ILK', Task forces (Montana 2017)
Representational practices	Visuals	Predominance of global-view graphs and maps (Walsh 2015)	*No known work on this yet*

	Consensus	Science speaking with one voice, lowest common denominator, consensus as product (see Section 4.3)	Aim to incorporate divergent ontologies and epistemologies within consensus positions. Consensus as process. (See Section 4.3)
	Argumentation	Reviewer and government objections (Livingston 2020)	Reviewer and government objections; Stakeholder comments (IPBES 2015a)
Public practices	Communication	Focus on communication of consensual and certain knowledge (Hollin & Pearce, 2015)	Interaction with multiple audiences (government, stakeholders, etc) via diverse channels including social media; diversification of formats (e.g. reports, podcast, tweets) (IPBES 2015b)
	Data sharing	*No known work on this yet*	Principles of accessibility & open access (IPBES 2020)

5.2 Sketching future uses of institutional epistemology

At its most basic level, the idea of institutional epistemology is an entry point to empirically describe the expert cultures of organizations. It extends the concept of civic epistemology and starts from a similar conceptual angle, but is focused on how particular knowledge practices are institutionalized and legitimized by expert organizations. Conducting a range of case studies to explore the character of institutional epistemologies in organizations beyond GEAs would be worthwhile. Such endeavour helps understand 'the production line' behind the construction of knowledge for governance. Of course, depending on context and on the type of organization under study, the knowledge practices of relevance will have to be adapted and added to beyond those suggested in this paper. A possible starting point for such case studies would be to follow and disclose the processes of accreditation: how do particular documents come to bear the mark of an organization? Documents that 'bear the mark' of the organization tend to actively conceal the individuals (and their relations to one another) responsible for these documents' production. This tacitly harmonises anterior asymmetries of power, effort and duty in the making of those documents (see Riles 2006; Shankar et al 2017). Yet a knowledge organisation's documents display and are imprinted with a particular institutional epistemology, as well as playing a role in the stabilization of working practices to begin with (e.g. Smith 1999).

Importantly, however, by institutional epistemology we do not mean a singular epistemology which belongs solely to a single institution. For example, within an organization like the IPCC significant differences exist between its three working groups (Fløttum et al 2016). There are also similarities between some specific knowledge practices developed by the IPCC and IPBES. Yet the structure and protocols of an organization like the IPCC contribute to the institutionalization of a set of practices (e.g. expert selection process, validation of reports, etc.) which, in turn, contribute to the emergence of a broader way of dealing with knowledge. In other words, a set of overarching practices become routine and dominant. These practices are not fixed and can evolve--the IPCC now is certainly not the same as the IPCC of 30 years ago--and will be influenced by other actors, organizations and political contexts. Revealing the institutional epistemologies of organizations might precisely help understand how organizations can also change and adapt.

6. Conclusions

As GEAs have become prominent actors in the field of global environmental governance, they face several challenges, including concerns regarding their effectiveness and their ability to provide meaningful, actionable knowledge to their global audience. They have also been targeted by a range of criticisms, in particular for being dominated by Northern experts and for adopting reductionist framings of 'global environmental change'. At the same time, GEAs have evolved in a number of different ways. While IPBES shares a number of similarities with the IPCC, it also aspires to further 'open-up' towards diverse types of knowledges and expertise. Our case studies of the IPCC and IPBES suggest that the IPCC produces a 'view from nowhere' through a reliance on mathematical modelling. This puts forward a consensual, singular view of global climate change, which is then 'downscaled' for consideration of local impacts and responses (see also Schneider & Walsh 2019). By contrast IPBES, through its contrasting conceptual frameworks and practices of argumentation, appears to construct a 'view from everywhere'. This seeks to be inclusive of epistemic plurality, facilitating a more heterogenous picture to emerge through the juxtaposition of more placed-based knowledges.

Despite this apparent distinction, both organizations in fact cannot escape offering 'views from somewhere'. They develop situated sets of knowledge marked by politico-epistemic struggles and by the interests, priorities and voices of certain powerful actors. Characterizing this 'somewhere', we argue, is aided through the concept of institutional epistemology which helps disclose how particular ways of knowing are rendered authoritative and become institutionalized in expert organizations.

In addition to offering a clearer understanding of these organizations' differences, institutional epistemology can also structure comparative scrutiny of their epistemic claims and the possible futures to which they draw political attention. Policy options for governing climate change and biodiversity are different depending on whether one adopts the 'view from nowhere' or the 'view from everywhere'. While the latter might open-up policy options, the former resonates with the idea of a 'one-size-fits-all' model of expertise. It is more likely to close-down the range of options and to limit institutional reflexivity (see Stirling 2008; Bellamy et al 2013). The assumption that assessments must be consensual to be widely held authoritative is debatable (Hulme 2013; Lidskog & Sundvist 2015; Pearce et al., 2017). An assessment which more openly represents alternatives views, including disagreements, might also strengthen its public legitimacy, whilst also accommodating a wider range of policy-options. From our comparison, there is to date no evidence that the pluralistic approach adopted by IPBES is less effective than the consensual one constructed by the IPCC. There is, however, a widely shared view that these organizations need to strengthen their reflexivity, an objective which might be faciliated by elaborating and challenging their respective institutional epistemologies.

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