12

Disciplines

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Overview

The knowledge that is used in the assessments of the Intergovernmental Panel on Climate Change (IPCC) predominantly stems from a wide variety of academic disciplines. Given the high scientific and political profile of the IPCC, the production of knowledge in disciplines is impacted by the existence and dynamics of the IPCC assessment process. In some cases, the dynamics between academic disciplines and the IPCC is characterised by the presence of positive feedback loops, where the production of knowledge is structured and programmed by the IPCC. The subsequent findings then receive a preeminent role in later IPCC assessments, and so the cycle continues. It is important to critically reflect on these dynamics, in order to determine whether visions of climate change's past, present, and future – for example, pathways for the climate change problem and its potential solutions, as far as they exist – have not been unduly constrained by the IPCC process. The IPCC runs the risk of unreflexively foregrounding some scientific and policy approaches at the expense of other approaches.

12.1 Introduction

Experts from different academic disciplines contribute to the IPCC via publications in the peer-reviewed literature and by being authors or reviewers in the IPCC assessment process. The IPCC reports' Lead Authors have a powerful authority to decide on which bodies of academic literature from different disciplines are most relevant for their chapters. And they have to weigh their reliance on disciplinary knowledge against the use of highly relevant, but non-disciplinary, expert knowledge – for example from practitioners, or Indigenous knowledge holders. The role of the review process is to ensure that author teams do not ignore relevant

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bodies of literature and expertise (see **Chapter 11**). This chapter critically analyses with which disciplines the IPCC engages and how it does this.

Within the IPCC, an epistemological hierarchy can be seen to be at play *between* and *within* different disciplines. In the IPCC, the physical sciences have typically been regarded as sitting at the top (the 'strongest' type of knowledge), with biological and ecological sciences, engineering, and economics being in the middle, and qualitative social sciences and humanities residing at the bottom (the 'weakest' type of knowledge). An example of an epistemological hierarchy *within* disciplines is that in Working Group I (WGI) – dealing with the physical science basis – estimates from process-based models have typically been awarded a higher status than other types of estimates (e.g. those based on past observations), as will be illustrated later. Furthermore, the IPCC process itself is having an impact on the practices of scientific research – that is, on the development of disciplines themselves. For example, visions of future 'solutions' to climate change are propagated by the IPCC and are impacting research agendas (see **Chapter 15**).

This chapter first reviews the extant literature on how the IPCC has engaged disciplines from both natural sciences and social sciences and humanities. Subsequently, the attention shifts to influences in the opposite direction – that is, the extent to which the IPCC has had an impact on the production of knowledge in disciplines.

12.2 Engagement with Natural Sciences

Climate (later Earth system) models have always been important within the IPCC (see **Chapter 14**). Bjuström and Polk (2011) have shown that the natural sciences, and in particular the earth sciences, have dominated the early assessment reports. In the 1990s, the use of complex climate models dominated the work of WGI (e.g. Petersen, 2000, [2006] 2012). For example, enacting an epistemological hierarchy, the IPCC modellers in WGI initially downplayed palaeoclimatological knowledge and studies on abrupt climate change in the past (Demeritt, 2001). It took until the Fourth Assessment Report (AR4) (2007) before there was a marked increase in the visibility and importance of palaeoclimate expertise within WGI assessments (Caseldine et al., 2010). But by that time the IPCC was still not ready to include expert judgements on rapid sea-level rise, which are partially based on palaeoclimatic expertise, instead preferring model-based assessments (see Box 12.1).

More generally, there has been a predominance within the IPCC of quantitative natural scientific knowledge. For example, 'attribution' studies have been very important, and increasingly so in recent assessment rounds. Initially, the attribution of global temperature change to human influences was the main focus; nowadays, attribution science has broadened to quantitatively attributing ecosystem and

Box 12.1

Expert judgement versus models on rapid sea-level rise

For decades, there have been palaeoclimatological studies of rapid sea-level rise in the distant past, including periods with several metres of sea-level rise in the timeframe of a century, which could provide useful information to assess future sea-level rise. But it has taken the IPCC six cycles of assessment, over 30 years, to integrate the results of these studies and provide – with the August 2021 release of the AR6 WGI report – a plausible upper estimate of sea-level rise in 2100 of 2 metres. (This is a much higher number than the 'likely' range, taking into account possible ice sheet instability.) More than 14 years earlier, in the IPCC WGI AR4 plenary session, I – as a Dutch government delegate – had not been able to convince the respective Lead Authors to provide their expert judgement, based on inputs from several disciplines including palaeoclimatology, as opposed to results from models with known limitations. This is evidenced by my diary entry, published shortly after the plenary:

> Early in the afternoon [of Wednesday 31 January 2007, acp] I have a conversation with two authors on the maximum height of the sea level rise in 2100. According to model projections the maximum sea level rise is 59 centimetres. This number does not include an estimate for the possible accelerated melting of Greenland and Antarctica. It seems that scientists really do not know what will happen with Greenland and Antarctica. But a possible accelerated meltdown could lead to a sea level rise of more than one metre. Should we mention that, without being able to say something about the probability? Or should we just say that we cannot identify an upper limit?
>
> The authors propose a text that now makes clear that we cannot give an upper limit. That is better than it was, but I still find it unsatisfactory. For readers it would be nice if we could give an indication of how much the sea level could maximally rise. But as IPCC we have a responsibility to say what is and is not known. The text on the ignorance regarding the upper limit appears acceptable to all delegations. Also to the Dutch – I do not push this further (Petersen, 2007: 21).

O'Reilly et al. (2012) later found that a (re-)organisation of chapters, assigning a central role to sea-level modellers, had made it harder to include an estimate for the upper limit of sea-level rise due to ice cap melting by 2100, in part because it did not consider information from palaeoclimatological studies. In a later publication, it was demonstrated how the difficulties of modelling accelerated meltdown of ice sheets had led to underestimates since the IPCC's beginnings (Oppenheimer et al., 2019). And due to an epistemological hierarchy that favoured process-based models over past observations it was hard to include palaeoclimatological evidence in the IPCC's expert judgement on the upper limit of sea-level rise.

human system changes (in WGII) and individual weather events (in WGI) to human-induced climate change.

12.3 Engagement with Social Sciences and Humanities

Social sciences and humanities scholarship has gradually been drawn in over the course of the different IPCC assessment cycles. Nevertheless, the relative autonomy of the separate WGs, combined with differences in their respective disciplinary mixes, has led social scientists to conclude that the interdisciplinary integration necessary for tackling climate change has been hindered by a 'unidisciplinary structure of work' (Godal, 2003). For example, in the context of designing greenhouse gas indices – which allow one to compare the warming effects of different greenhouse gases – the WG structure, with the exclusion of social science disciplines in WGI, made it harder to draw appropriately on existing interdisciplinary work to integrate damages and costs in greenhouse gas indices (on integration between WGs see **Chapter 18**). Another straightforward example of the lack of disciplinary interaction between different social scientific disciplines within the IPCC is that between the meta-policy domains of adaptation and mitigation, since these domains are covered by different WGs.

Epistemological hierarchies are evident both between WGs – with generally more authority being attributed to WGI – and within WGs. The Third Assessment Report (AR3) Report (2001) aimed to include a larger range of social sciences, but with mixed results (Rayner & Malone, 1998). AR4 (2007) was still weak on social science, which led to calls to the IPCC, as well as to the research community, to produce more studies on citizen participation, on culture, ethics and religion, and on the incorporation of more diverse actors (e.g. Hiramatsu et al., 2008). Economics has been predominant among the social sciences that have been mobilised by the IPCC (Yearley, 2009). It can certainly be argued that the IPCC engages less with social science disciplines than is possible or desirable. On the one hand, the IPCC is confronted with many questions that social science can address. On the other hand, it is also important to realise that some social science disciplines, such as political science, whilst important, do not address climate change as a central topic. More generally, because of ontological plurality in the social sciences, it can be harder to organise social-science knowledge compared to natural science (Victor, 2015). It also has not been easy to integrate the first philosophers into the IPCC process in the Fifth Assessment Report (AR5), as was evidenced by their different modes of working, both in the draft writing and in the plenaries. For example, their purview was typically not bound to assessing only the last few years of literature (Broome, 2020).

A major effect of the limited engagement with social science by the IPCC has been its poverty in terms of socio-technical visions. It has long been clear that the IPCC's integration of the topic of sustainable development has been limited (Najam et al., 2003) and that futures research has been only very modestly represented (Nordlund, 2008). The various sets of scenarios that have been constructed by, or for, the IPCC have also been constrained and focused on extreme 'business-as-usual' scenarios (Demeritt, 2001; Pielke & Ritchie, 2021). This critique parallels a growing prominence of integrated assessment modelling (IAM) analyses in subsequent IPCC reports (see **Chapter 15**). This has several causes, ranging from the particular features of these modelling approaches – including their flexibility, breadth, and hybridity – that allowed them an 'anchoring' function between WGs, to proactive behaviours by those involved in the discipline of IAM (van Beek et al., 2020a). This has had consequences. For example, Integrated Assessment Models do not pay much (if any) attention to the impacts of policies on land use, food security, human rights and investment costs, and the wider politics of developing new plantations and infrastructures. One consequence of this has been a large global reliance in the IPCC's projections of future development pathways – certainly since AR5 – on Bio-Energy Carbon Capture and Storage (BECCS) to stay below or return to global average temperature increases of 1.5 °C or 2 °C by 2100.

Note also that the IPCC does not only rely on knowledge deriving from academic disciplines but also – although until recently to a very limited extent – on knowledge that stems from elsewhere, for example various types of practitioners including legal experts or Indigenous knowledge holders. For example, Viner and Howarth (2014) argue that knowledge on climate adaptation from practitioners is relevant for IPCC reports and should be included centrally. And an answer is needed to the critique that expertise on Indigenous peoples has been brought in only obliquely and problematically through 'the narrative of pending catastrophe, the tropes of cultural loss and the urgent need for pan-global solutions' (Ford et al., 2016: 351; see **Chapter 13**).

12.4 Impact on Disciplines

Far from merely *assessing* existing published knowledge, the IPCC – directly or indirectly – shapes the types of questions research communities investigate and therefore has an active presence in determining what research gets funded. The IPCC's engagement with disciplines has an impact on their development. This becomes evident from the pervasiveness and dominance in the academic literature of a structural linearity of knowledge which moves from geoscience to impact, adaptation and mitigation, mirroring the IPCC WG structure (see, for example, the presentations at the Copenhagen Congress in 2009; O'Neill et al., 2010). IPCC reports are also regularly cited in the primary scientific literature, with a skewness

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towards geophysical sciences, although this skewness is gradually decreasing as the IPCC's assessments increasingly impact on the shaping of other disciplines (Vasileiadou et al., 2011).

Evolving policy needs, embodied in IPCC assessments, create selection mechanisms for climate science (Vasileiadou et al., 2011). The IPCC is regularly asked to treat subjects for which there is not yet a strong underlying research base (see **Chapter 5** on the reports process), especially in the social sciences. This has led to calls for bringing together descriptive and interpretive social science methods to usefully tackle questions on, for instance, vulnerability and adaptation (Malone & Rayner, 2001).

Early studies on the IPCC already observed that WGI anticipated reductions in scientific uncertainty about climate change that would come through particular national and international research programmes (Shackley & Wynne, 1996). This led to the introduction of new subjects in climate science research as a direct consequence of IPCC discussions (Shackley & Wynne, 1997). For example, funding for palaeoclimatological research has been framed in terms of its expected contribution to the testing of complex models necessary for IPCC assessments. In the 1990s, IPCC-influenced funding was also made available for reducing physical-science uncertainties, but not so much for studying uncertainties pertaining to the human dimensions of climate change, especially those that do not connect well to a natural science frame (Demeritt, 2001). Finally, in past decades, the main impetus behind climate modelling and model intercomparison projects (see **Chapter 14**) has come from the IPCC assessment process (Yearley, 2009). Funding opportunities for palaeoclimate research have increased more recently with the growing importance of palaeoclimate reconstructions within the IPCC (Caseldine et al., 2010).

A direct impact on knowledge generation of participation in the IPCC has been identified by social scientists, namely how IPCC authors flag gaps in the published literature and then pursue the called-for new research themselves in order to fill those gaps. For example, in the climate-mitigation field, individuals and institutions are organising their research, collaboration and publication strategies around the assessment of knowledge in IPCC reports. This makes climate-mitigation research, as a discipline, effectively dependent on the IPCC (Hughes & Paterson, 2017). The 2015 UNFCCC request to produce a special report on 1.5 °C signalled a shift from 'science-driven co-production' to 'policy-driven co-production' which has been most visible in the production of IAMs and associated scenarios – there has been a sharp increase in IAM publications ahead of each cycle of IPCC reports (van Beek et al., 2020a). The centrality of the IAM community to the IPCC's mapping of mitigation options – such as taking 2 °C and 1.5 °C as targets for pathway modelling – has constrained the research questions being addressed. In a circuitous way, this feedback loop has led to the prominence of BECCS among potential climate-change measures (Low & Schäfer, 2020). In sum, the IPCC, with its substantial involvement in emissions scenario production and use, has had a central role in orchestrating the scientific literature on climate change. Some important questions have not therefore been researched by the academic community that might otherwise have been (Hulme, 2016).

From a systems perspective, positive feedback loops can be identified. For instance, being a lead author leads to advantages in scholarly publishing, which leads such authors to become more influential within the IPCC, and so on (Hughes & Paterson, 2017). This is another instantiation of the 'Matthew effect' – the rich getting richer and the poor getting poorer – that has been studied in the sociology of science since the 1960s. At the institutional level, the IPCC plays a major role in the orientation, rhythm and domain of applicability of some fields of climate research (Cointe et al., 2019). For example, the current prominence of IAMs to explore low-carbon futures is a result of complex historic science–policy dynamics involving the IPCC, a central part of this being IAMs' anchoring of relationships among the three IPCC WGs (van Beek et al., 2020a). A similar positive feedback loop had also been observed earlier in the case of complex climate models (e.g. Petersen, 2000, [2006] 2012; Demeritt, 2001; Yearley, 2009).

On the other hand, there have also been calls for the IPCC to exercise a *larger* impact on academic disciplines. The lack of integration of disciplinary knowledge within the IPCC, beyond the natural sciences and economics, is partly related to the way academic institutions are organised around separate disciplines (Bjurström & Polk, 2011). For some scholars, a successful transformation within the social sciences and humanities towards systematic and integrated knowledge generation is seen as needed to help increase the policy relevance of IPCC assessments (Minx et al., 2017). The recent establishment in universities of numerous 'Schools of Sustainability' and similar academic units can be seen to contribute to this goal.

12.5 Achievements and Challenges

The IPCC, through its rigorous procedures, has been able to successfully create credible assessments of the evolving state of expert knowledge on climate change. However, there have been some drawbacks to the way that the IPCC has relied on academic disciplines. For example, the IPCC's focus on peer-reviewed publications has devalued other types of less academically formalised expert knowledge, such as practitioner and engineering expertise and legal reports, or Indigenous knowledge (Beck & Forsyth, 2015).

I suggest that major changes are needed in the way the IPCC engages with disciplinary and other expert knowledge. The information needs of decision-makers and practitioners around the world are varied and increasingly urgent. Yet, as these needs have expanded, there has been a widening gap between what most IPCC authors understand to be useful information and what decision-makers see as informative (Petersen et al., 2015). It has been argued that the addition of a fourth WG on 'historical, cultural, and social contexts' could assist in re-framing climate change as an ethical, cultural and political phenomenon. This could counter the observed epistemological hierarchy, with biases in the existing WGs towards physical and economic sciences (O'Neill et al., 2010).

However, I judge that this has only limited potential of success in terms of integration with the other IPCC WGs and its ability to function within the UN system. Since governments want to control the IPCC's statements about social behaviour, or statements that implicate policy choices, it is mostly politically non-controversial 'high confidence' statements that make it into the Summaries for Policymakers. Such statements are more likely to emerge from 'positivist' disciplines than from interpretative ones. A parallel process to the IPCC – but non-governmental – would be needed to address controversial topics such as how best to design international agreements or how to govern the use of geoengineering technologies (Victor, 2015).

Finally, the presence of positive feedback loops described in this chapter not only shows the presence of a potential conflict of interest – with for instance Lead Authors filling the research gaps that they themselves identify – but also highlights the fact that the IPCC has now increasingly become self-referential. This raises questions about the notion of the IPCC's 'policy relevance'. More specifically, who decides what policy relevance is? There is a danger that researchers – finding eager receptors in particular policymakers involved in UNFCCC processes – are deciding what disciplines are policy-relevant for IPCC assessments. The IPCC should find ways to become more reflexive about this issue, while a wide set of decision-makers should seek to construct a larger ecosystem of science–policy institutions that meet their practical needs.

Three Key Readings

Cointe, B., Cassen, C. and Nadaï, A. (2019). Organising policy-relevant knowledge for climate action: Integrated Assessment Modelling, the IPCC, and the emergence of a collective expertise on socioeconomic emission scenarios. *Science and Technology Studies*, 32(4): 36–57. http://doi.org/10.23987/sts.65031

This article provides an analysis, based on interviews, of the way the integrated assessment modelling community organised itself around AR5 (2014).

O'Reilly, J., Oreskes, N. and Oppenheimer, M. (2012). The rapid disintegration of projections: the West Antarctic Ice Sheet and the Intergovernmental Panel on Climate

Change. *Social Studies of Science*, 42(5): 709–731. http://doi.org/10.1177/0306312712448130

This article provides an analysis, based on interviews, of the way expert judgement lost out from modelling in estimating future sea-level rise in AR4 (2007).

Vasileiadou, E., Heimeriks, G. and Petersen, A. C. (2011). Exploring the impact of the IPCC Assessment Reports on science. *Environmental Science and Policy*, 14(8): 1052–1061. http://doi.org/10.1016/j.envsci.2011.07.002

This article applies bibliometric methods to identify the impact of IPCC reports (AR1–AR4) on academic disciplines, one of the very few studies that tackles this question.