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Citation for final published version:

Hughes, Hannah ORCID: <https://orcid.org/0000-0002-1771-2907> and Paterson, Matthew 2017. Narrowing the climate field: the Symbolic power of authors in the IPCC's assessment of mitigation. *Review of Policy Research* 34 (6) , pp. 744-766. 10.1111/ropr.12255/ file

Publishers page: <http://dx.doi.org/10.1111/ropr.12255>
< <http://dx.doi.org/10.1111/ropr.12255> >

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Narrowing the climate field: The symbolic power of authors in the IPCC's assessment of mitigation

This article provides a critical analysis of the IPCC as a boundary organization using Bourdieu's concepts of field, habitus and symbolic power. The paper combines quantitative, network and survey data to explore the authorship of WGIII's contribution to the IPCC AR5. This data reveals the dominance of a small group of authors and institutions in the production of knowledge that is represented in the AR5 report, and illuminates how the IPCC's centrality to the field of climate politics is shaping the research and publication strategies of researchers within that field. As a result, the study is able to identify organizational avenues for deepening the involvement and symbolic power of authors from the global South in IPCC assessments of climate change. While empirically, the results of this study lead us to question the IPCC as an assessor of knowledge. Theoretically, it suggests that particularly in the international sphere, the use of the boundary organization concept risks overlooking powerful networks of scientific actors and institutions and their broader implication in the politicization of science.

Key words: IPCC; climate change: mitigation; boundary organization; Bourdieu; field; symbolic power; knowledge inequalities

The IPCC identifies itself as the leading international body for the assessment of climate change knowledge (IPCC ND). As an intergovernmental assessment body, the IPCC does not conduct research, but assesses the published literature on “the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation” (IPCC, 2013). The IPCC’s success in providing a shared scientific basis for international political action has placed it at the centre of political and scientific interest in climate change (Hughes 2015). The effect of this interest on the organization has been documented in relation to climate scepticism (Edwards and Schneider, 2001; Skodvin, 2000a) and mistakes discovered in the Fourth Assessment Report (AR4) (Beck 2012). The impact on practices of climate science has also been documented in accounts of the dominance of Global Climate Models (Demeritt, 2001; Edwards, 1999; Petersen, 2006; Shackley and Wynne, 1995; Sundberg, 2007). However, there is limited research on the impact of this political and scientific interest on the authors themselves, the institutions supporting these actors and how this shapes the wider field of climate research and the IPCC’s assessment of this. In order to address this gap, this paper explores the authors of IPCC Working Group III (WGIII) for the Fifth Assessment Report (AR5) and the institutions that support this authorship in order to explore how authors’ interest and investment in the IPCC’s assessments of climate change mitigation is structuring research strategies and career pathways. This enables us to do two things: first, to identify authoritative actors within the authorship of WGIII and to explore what constitutes their symbolic power; and second, to begin to illuminate the ways in which the IPCC is shaping the field of climate change knowledge production.

As the first intergovernmental expert body of its kind, the IPCC has become an important site for exploring the relationship between science and politics in international environmental action. Two approaches have proven particularly influential in this body of research: the epistemic community model and the concept of boundary organization (BO). Reviewing the IPCC literature through these different approaches, while not providing a comprehensive review of IPCC research as available elsewhere (Hulme and Mahony, 2010), does offer an avenue for identifying the strengths and weaknesses of the BO concept. It also opens space for exploring how alternative thinking tools, in particular those of sociologist Pierre Bourdieu, may help us to situate organizations like the IPCC in the broader institutional landscape of global climate politics and help reveal the social-scientific forms of power that structure the authorship of its climate mitigation assessments.

Analytically, the epistemic community model and the notion of BO focus scholarly attention on different aspects of the IPCC. The epistemic community model identifies the role of transnational scientific actors in mobilising and facilitating a collective response to shared environmental problems (Haas, 1989; 1992). As such, this approach has been influential in understanding the politicisation of climate change during the 1980s, the formation of a network of climate scientists and their institutionalisation within the IPCC, as well as their impact on the intergovernmental climate negotiations (Lunde, 1991; Paterson, 1996; Haas, 2000; Newell, 2000). The notion of a BO on the other hand, is directed at understanding the organised intertwining of science and politics that takes place through the production of scientific knowledge for political action (Forsyth, 2003,

chapter 6; Guston, 2001; Miller, 2001). Scholars have used BO to explore the IPCC's role in generating the "global" meaning of climate change (Shackley and Wynne, 1995; Miller, 2004), to identify how science and politics are demarcated through the IPCC's assessment activities (Fogel, 2005; Skodvin, 2000b), and to assess member states evolving relationship to the organization (Siebenhüner, 2003).

The important distinction between these two approaches is that for the epistemic community model, usable knowledge is dependent on separating scientific knowledge production from political action (Haas, 2004). By contrast, for BO theorists, usable knowledge emerges from productive collaboration between the institutions of science and politics (Guston, 2001, p. 402; Lidskog and Sundqvist, 2015). Viewed through the lens of the epistemic community approach then, the intergovernmental nature of the IPCC prevents it from speaking truth to power (Haas, 2004; Haas and Stevens, 2011), while from the perspective of a BO, the IPCC reflects what is to be expected – a degree of both the scientization of politics and the politicization of science (Hoppe, Wesselink and Cairns, 2013).

Despite the success of the BO approach in illuminating the interplay between science and politics in the IPCC's constructions of climate change, Miller identifies a number of limitations its application has in the international context (Miller, 2001). Miller suggests the BO concept tends to lead analysts to seek out (and perhaps impose) "pure" forms of science and politics, thereby overlooking the "diverse array of hybrid and institutional types that relate to one another as well as to scientific and political institutions" (Miller,

2001, p. 484). An organization like the IPCC then, brings together multiple governments and national cultures of scientific and political practice. It also resides within a broader international field of climate activity that hosts other BOs, as well as less formalized networks that internationally link climate interested actors and ideas (Miller, 2001, p. 484; Hoppe, 2010; Hoppe, Wasselink and Cairns, 2013). The organizations and networks constituting the broader field of climate activity and their connection to the IPCC have been overlooked in boundary-oriented analyses, as have the power relations that influence how climate change is known and addressed.

In order to better situate the IPCC in the broader institutional landscape constituting international climate action, this study introduces Bourdieu's notions of field and habitus. The notion of regime complex has become a popular conceptual tool for mapping the array of actors and institutions invested in global climate governance, and could be useful in this context for positioning the IPCC (Keohane and Victor 2011, p. 10). However, unlike the regime complex concept, the sociology of Bourdieu enables us to both situate the IPCC in physical and analytical space within the international arena of climate politics and to explore the distribution of social power between the actors and institutions invested in climate mitigation knowledge. While application of Bourdieu to the study of global environmental politics remains limited compared to other sub-fields of IR (see Adler-Nissen, 2013; Bigo and Masden, 2011), the work that has been done identifies its potential (Epstein, 2008; Hughes, 2013, 2015). As Bourdieu's conceptual apparatus is outlined elsewhere (Pouliot, 2010; Leander, 2009; Williams, 2007), here we focus on

briefly outlining how field, interest, habitus and symbolic power inform this study of the IPCC's WGIII.

The notion of field, understood as a particular “space of social forces and struggles” (Bourdieu and Wacquant, 1992, p. 102), is both a thinking tool and an organizational concept. As a thinking tool, it requires the analyst to “*think relationally*” (ibid, p. 96). There is no field without interest. Interest is what motivates actors within a particular social universe into action and what generates contestation and struggle (Bourdieu, 1990a, p. 88). This struggle is over the political and economic meaning of the field's central object, in this case, the mitigation of climate change, and the authority to define it, which is ultimately a struggle over social order and an actor's position within it. The authority to shape or even determine the meaning of reality is what Bourdieu identifies as a symbolic power – “a power of constituting the given through utterances” (Bourdieu, 1991, p. 170). While field focuses analytical attention on an actor's position in social space, habitus draws scholarly attention to how social location structures actors' perceptions, values and understandings as internalised through social practice (Bourdieu, 1990b, p. 53-55). It is the everyday social activities of an actor's professional/cultural practice that structure – through habitus – individual and shared constructions of issues like climate change. The notion of habitus then, brings to the fore the situatedness of climate change knowledge and the relationship between perceptions of the issue and an actor's social location. While habitus sensitizes us to the social mechanisms structuring constructions of climate change, symbolic power enables us to explore how the authority to define climate change is distributed between actors and institutions, professions and

cultures.¹ It is through this notion of symbolic power that we are able to explore the basis of authors' authority in the IPCC assessment and its distribution across and between different groups of authors.

Organizationally, the concept of field enables us to position the IPCC within a global field of actors and institutions interested and invested in the global construction of and response to climate change (Hughes, 2015). Within this field, the IPCC occupies a central position because of its historical role in raising the scientific importance of climate change and mobilising social and political interest in addressing it (ibid). It is from the starting point of this centrality that we can explore the forces that authorship exerts on IPCC authors and on the field of climate mitigation research. The aim in this paper is to illuminate two related processes: 1) the formation of dominant actors and knowledges in WGIII's assessments of climate mitigation and 2) the impact of IPCC participation on author's career pathways and climate change mitigation research and in turn the effect of these on the IPCC's assessments of this knowledge. We begin unpacking the nature of climate mitigation expertise, the institutions that support these actors and their joint influence on IPCC constructions of climate mitigation by identifying the most connected and cited authors in WGIII for the AR5.

A previous study of WGIII used Social Network Analysis (SNA) to identify patterns of co-authorship between authors of the AR5 (Corbera et al, 2016). The study identified a small number of highly connected authors and offered tentative conclusions that this indicated that the careers of some WGIII authors had become structured around the IPCC

and in producing knowledge for its assessments of climate change. The study also identified a small number of institutions through which many of these authors had passed, and which appeared to have a role in organizing IPCC-related collaborations and knowledge production (ibid). In order to explore what constitutes the dominance of these actors and institutions and the impact it has on relations within the chapter teams and the report's production, we collected three further sets of data. First, we extended the data on authors' prior participation in the IPCC that was collected for the previous study, in order to explore the IPCC's role in constituting this group and its reproduction over time. Second, we collected data on the number of times authors are cited in the report. And third, we conducted a qualitative survey of 275 AR5 WGIII authors and co-chairs, from which we received a total of 62 responses (23%).

The first two sets of data on prior participation and citation identifies a group of 44 authors, composed of those with the 20 highest betweenness scores (see below on this measure of network centrality) in the co-author network from the earlier paper, plus all authors cited more than 15 times in the AR5 (see table 1).² The majority of this group are male (39/44) and European (27/44), while economics is the most prevalent discipline (17/44). The following sections combine the three data sets to illuminate how these characteristics, prior participation, citations and institutional affiliation translate into symbolic power over the IPCC's construction of climate mitigation.

The data presented in the paper comes from a number of sources. First, from CV data, as collected for our earlier paper (Corbera et al, 2016), with data for all but 15 authors.

Authors' CVs were collected from publicly available institutional or other websites, through email request, and information available via LinkedIn profiles. Data for citations and co-authoring patterns comes from CVs and from the bibliography to the AR5 report (Edenhofer et al, 2014). We analyse this data via a combination of SNA and descriptive statistics. SNA is a methodology that enables the systematic analysis of relational patterns amongst a set of actors (e.g. Scott, 2012). We use it to construct networks of authors as they are connected via co-authoring practices, and institutions as they are connected by authors both via their career paths and their co-authoring practices. We use some standard measures in SNA to make claims about the centrality of specific nodes (institutions or individuals) within these networks and about the structure of the networks themselves. Specifically, we use the measure of betweenness. A betweenness score in Social Network Analysis indicates that the node in question operates as an "obligatory passage point". The higher the betweenness score, the more likely it is that any journey across the network will have to pass through that node. So in the context of our co-author networks, it indicates that the person may: act as an important gatekeeper or broker of information or data; may be someone that other people identify as important to collaborate with; or may work in an institution that is capable of organising research teams via its funding or reputation. We also analyse the institutional networks via a core-periphery model which uses the overall patterns of connections between institutions to divide them into core and periphery. Conceptually, the core institutions are those that are densely connected both to each other and peripheral institutions while peripheral institutions are only connected to the core and not to each other. This enables us to

demonstrate the hierarchical relationships between institutions that provide expertise in the IPCC.

The group of 44

While according to the IPCC's own figures 73% of AR5 authors were new to the IPCC (IPCC, 2010), of the 44 highly connected, highly cited group, only 32% had no prior participation in the production of an Assessment or Special Report before the AR5, with 57% (25/44)³ participating in at least two previous assessment cycles, and 30% authoring three or more assessments (see table 1). These figures indicate that prior participation is a significant component of an author's dominant position and the survey data illuminates how it contributes to an author's symbolic power. Authors that have participated in prior assessments arrive at the first author's meeting knowing the process, what is required of them and the necessary skills to deliver the final product. They are also more likely to know others in their chapter team and across the WG as a whole (NLA.13g).⁴ These authors have internalised the appropriate way to conduct themselves and the assessment – or habitus – which is an important strategic advantage and a determinant of relations within the chapter teams. In contrast, authors from the global South outside of this group describe feeling “alone” (SLA.8e), and suggest that the most “eminent” authors took the lead and “mainly talked among themselves” (SLA.7c). For this reason, a number of developing country authors suggest that their experience of being an author in the AR5 will better qualify them to participate in the next assessment, as they will “understand how the ARs process works and how to better contribute” (SLA.8e).

TABLE 1.

The bibliography data collected from the AR5 WGIII report displays a number of patterns. First, a small proportion of the overall writing team dominate the citations of IPCC authors, and these cross-over with the “top20” in the team’s co-authoring networks (Corbera et al, 2016). The 38 authors within the WGIII writing team of 279⁵ who have over 15 papers cited in the report, account for 53% of total citations by IPCC authors within the report, as shown in Table 2. By contrast, 71 authors (25% of the WGIII author team) had no papers cited in the report itself (or only citation to previous IPCC reports). Indeed, three of the 35 Coordinating Lead Authors (CLAs) had no citations in the report. This means that, at least according to scientific practices of academic research, a quarter of IPCC AR5 WGIII authors were not themselves involved in producing research that could be cited in the assessment.

TABLE 2.

These figures are significant because according to the IPCC, its assessments are conducted by leading experts in the field. In reality, when selecting authors, the Working Group bureau must give consideration to other factors that impact the acceptability and legitimacy of IPCC knowledge, including geographical balance, incorporating a range of views, and appointing expertise new to the IPCC process (IPCC, 2013). This means that as well as appointing authors through self-nomination, government nomination and nomination by international organizations, bureau and TSU members identify authors

through their own academic and related networks to ensure that these criteria are met in the final author team (IPCC, 2013). The IPCC's attempts to attain geographical balance within author teams impacts the forms of expertise involved in the reports and perceptions of developing country authors, with citation patterns breaking down along North-South lines. In total, 178 authors were from the global North and 101 from the South. Of the 71 authors with no citations, 22 (31%) are from the North, while 49 (69%) are from the South. Put the other way round, 49% of Southern authors (49/101) had no citations in the report, while only 12% of Northern ones (22/178) did. The three CLAs with no citations were also from the South. This suggests that either authors from the global South are not as well published as their Northern counterparts, or that these publications are not cited in the report (for example, because they were not published in the English language). Scientific publications are an important measure of scientific prestige – identifying an author's contribution to the field. As such, they structure perceptions of whose perspectives are the most important and relevant to the assessment and act as an important ordering force within chapter team relations (Hughes, 2012). Knowing people – through prior participation, and being 'known' – through publications, are both important forms of symbolic power for IPCC authors, distinguishing them as an authoritative author on the subject they are appointed to assess.

When looked at regionally, the bibliographic data further highlights the dominance of EU authorship of WGIII's assessment for the AR5. Of the 38 most cited authors, 25 of them are based in the EU, 11 are in the US, and 2 are from BRICS countries (Brazil and South Africa, specifically), with none outside these three groups. Even for the entire writing

team, citations are dominated by EU authors, with 53% being of EU-based authors, 28% of North Americans, 9% from BRICS countries, and only 10% from the rest of the world. As well as highlighting regional dominance and the dominance of the English language (Ho-Lem, Zerriffi, and Kandlikar, 2011), the results also reflect a practice that has developed within IPCC authorship, and which is encouraged by those overseeing the reports, namely to publish material to fill gaps in knowledge identified through the assessment. This practice again privileges those authors that have previously participated in IPCC assessments, as these authors are already socialised into this practice and are well positioned within the network to mobilise the necessary collaborations in time for representation in the assessment.

It is useful to explore this through an illustrative example. Detlef VanVuuren was a lead author in the AR4 and also contributed to a special report. VanVuuren has 73 publications cited in the AR5 report (excluding previous IPCC reports), of which 93% were published after the publication of the AR4, from 2007 onwards. In this 7 year period VanVuuren published a total of 108 scholarly articles, with 58% of his total research output cited within the AR5.⁶ This data suggests that VanVuuren's career is organised around producing knowledge for citation in IPCC reports, which he is then likely to assess and cite in the next report. Other authors display a similar publishing practice. The survey data in table 3 identifies the investment that this group of 44 authors has made in the IPCC's assessments of mitigation. The data indicates that 67% of this group published material to address gaps identified in the AR5, compared to an average for other participants of 46%. This figure goes up to 92% when referring to the next

assessment report, compared to 46% overall, indicating that this group are already organised into collaborations and knowledge production for the IPCC's sixth assessment of mitigation. These results begin to demonstrate the extent to which individual author perspectives have the potential to dominate IPCC reports and brings into focus the fine line between the production of knowledge as a researcher and the assessment of that knowledge as an IPCC appointed author. The practice of publishing to fill gaps in the literature identified through participation in the IPCC process is effectively blurring the distinction between research generation and assessment in IPCC reports.

TABLE 3

The institutionalised organisation of the 44

Having identified some of the most highly connected, highly cited authors in the assessment, we now turn to identifying the key institutions in the field of climate mitigation knowledge. This data is important because much like publications, institutional affiliation serves to authorise certain authors and perspectives in the AR5. It also offers insight into how the climate mitigation knowledge assessed in this report is institutionally organised. We use CV data to reconstruct authors' career trajectories through different institutions, and construct an institutional network from this data.

IIASA emerges very clearly as the central institution in this network. 19 of the 279 WGIII author team have worked at IIASA at some point in their career, and 5 were working at IIASA during the preparation of the AR5 report. Of that 19, 10 are in the group of 44, three of whom currently work at IIASA – Krey, Nakicenovic and Riahi. We explore IIASA’s role in constituting influential authors below, and identify a network of other key institutions central in the production of WGIII authors and climate change mitigation knowledge. These institutions were identified in two ways. We identified institutions with at least 4 current employees in the AR5 process, and we identified institutions where at least 5 AR5 authors gained their PhDs. This identified ten institutions, as shown in Table 4. Below we expand on the descriptive statistics provided in table 4, and explore these institutions’ centrality to the overall co-author networks of the WGIII author team.

TABLE 4.

A number of aspects of the statistics provided in table 4 are worth highlighting. First, IIASA stands apart from the other institutions in a number of important respects. Over half (53%) of all authors who have worked at IIASA at some point in their career are in the group of 44 (the next closest is Stanford at 40%). 99 authors, or 36% of all AR5 authors, are in the co-authoring network centred on IIASA – a network that comprises both the authors who have worked at IIASA at some point during their careers, and all authors who have co-authored with those authors – a figure that goes up to 48% if we exclude the authors not cited in the AR5. Most strikingly, 77% (34) of the 44 are in this

IIASA-centred network, while 57% of the 44 who have no prior IPCC participation are in this network (8 out of 14). In other words, research collaboration with IIASA authors is strongly associated with being an IPCC author, and much more so than with any other institution. Finally, authors connected to IIASA are likely to be involved in the preparation of key parts of the WGIII report. Thus, 53% of authors for the Summary for Policymakers (SPM) are in the IIASA-centred co-author network, with a similar figure for the Technical Summary. This figure increases to 69% for the Annex II on Metrics and Methodology. Authors connected either directly to IIASA through employment, or indirectly through co-authoring with IIASA employees, are therefore most likely to be involved in constructing both *how* climate change mitigation is to be assessed by the IPCC and *what* that assessment concludes in terms of key IPCC messages for wider social and political dissemination. Figure 1 shows this visually, displaying the combined ego-networks of all IIASA associated authors. Comparing this figure in particular to figure 2 below, which shows the full co-author network, the IIASA-centred network covers a substantial part of the entire co-author network. As such, IIASA can be seen to play an important coordinating role in the production of the climate change expertise represented in WGIII.

FIGURE 1.

One important piece of the picture in demonstrating IIASA's role in the production of IPCC expertise and climate change mitigation knowledge is the *Global Energy Assessment* (GEA). Coordinated by IIASA, the GEA identifies itself as defining a “new

global energy policy agenda”, and was published in 2012 to coincide with the UN’s Rio+20 summit (Johanssen et al, 2012).⁷ The GEA was referenced in 14 out of the 16 chapters of the report and in the Annex II on Metrics and Methodology, with reference to the GEA plus 4 or more of its individual chapters made in the bibliographies of chapter 7 (Energy Systems), chapter 11 (Agriculture, Forestry and Land Use), chapter 12 (Human Settlements) and Annex II (Metrics and Methodology). Over one third of the 44 (16 authors) were involved in the production of the GEA. Three of these authors had no prior IPCC experience, again suggesting that participation in IIASA-coordinated research may act as a pathway both to becoming an IPCC author and to becoming a highly cited and/or a significant actor in the IPCC co-authoring network. Overall, figure 1 highlights the role that IIASA has in constituting the most significant IPCC WGIII researchers as a group, which it largely does through the coordination of a range of modelling exercises to do with global energy and carbon scenarios. The three most central current IIASA employees (Riahi, Krey, Nakicenovic) each worked on one of the three large-scale scenario modelling chapters (chapters 5-7) for the AR5. Three IIASA-related authors worked each on chapter 1 (introduction), chapter 2 (key framing concepts), chapter 7 (energy systems), with the others well spread across the report, working on 10 of the 16 chapters between them. In fact, of the group of 44, nearly a third (13) had some role in the production of chapter 6: Assessing Transformation Pathways (including contributing authors and review editors).

While IIASA is clearly the dominant institution in the production of authors and knowledge for the IPCC’s assessment of climate mitigation, as table 4 highlights,

institutional production and orchestration of mitigation knowledge is not simply an IIASA story. Demographically, the production of expertise is highly concentrated. 8% of all AR5 WGIII authors did their PhDs at two institutions, either Berkeley or Harvard, and fully 16% of all WGIII authors did PhDs at one of the 6 institutions where 5 or more authors were trained (Harvard, Berkeley, Stanford, Tsinghua, Tokyo and MIT).⁸ 29% of all AR5 authors currently work in one of 17 institutions, with each of these having at least 3 authors in the AR5. The top 10 institutions appear to cluster into two types. The first cluster comprises a densely connected pattern of research around the four US universities, plus IIASA and the US Department of Energy (DOE) Lawrence Berkeley National Laboratory. The second, a cluster less densely connected to the group of 44 authors, comprising UFRJ (Brazil), UNAM (Mexico), Tsinghua (China) and Tokyo. Authors associated with the first cluster of Northern institutions are likely to be a member of the 44. And authors in this group with no prior IPCC participation are likely to be found in one or more of these institution-centred networks, either as a pathway into IPCC participation or as an effect of having been selected as an IPCC Lead Author.

There are nuanced differences between the 5 US institutions and their role in mitigation knowledge production. Harvard disproportionately produces authors involved in chapters 13 and 15, the key policy chapters (on international cooperation and national policy-making respectively). 8 of the 17 authors associated with Harvard were involved in one of those two chapters (4 in each), meaning conversely that around a quarter of all authors in each of those two chapters has been at Harvard at some point in their career. Stanford's associated authors concentrate more on chapter 6 (the key modeling chapter on emissions

reductions pathways). The second cluster comprises institutions that are much less densely connected to the 44. The latter are UFRJ (Brazil), UNAM (Mexico), Tsinghua (China) and Tokyo. The structural position of Tokyo within the network is more or less identical to the universities from BRICS countries, and unlike the institutions from Europe or the US. Of the 44 connected to this cluster, only UFRJ has an author in this group (Schaeffer). A formal core-periphery model of these institutions as connected by the 44 in the co-author networks confirms the presence of a strong core-periphery relation, although it puts UFRJ in the core. Indeed, more fine-grained analysis of the institution-centred networks shows that, with the exception of the role played by Schaeffer, the BRICS institutional networks are connected almost entirely by a small number of key authors in the core institutions collaborating with authors from the peripheral institutions.

Beyond this core-periphery distinction, it is worth noting that these institution-centred networks are almost entirely composed of a single component (as visualized for the IIASA-centred network in figure 1), i.e. that all authors in those networks have paths connecting them to all other authors in the network. This is strongest with the research labs (IIASA and LBNL), but it is nevertheless strong for the universities as well. Thus, although we might expect large research universities to house multiple sites of expertise that would generate separate research networks, these are in fact relatively limited, which might suggest a degree of institutional coordination.⁹ This data signifies the existence of a closely connected set of institutions through which the career paths and research

collaborations of authors dominating the production of the WGIII AR5 are organized, as powerfully illustrated in Figure 2.

FIGURE 2

Figure 2 shows how the 44 connect up the research networks centred on each of the institutions. Each tie in effect shows how many of this group each institution-centred network shares. So for example the IIASA-centred network contains 99 authors, while the MIT-centred network contains 44. But these two networks have 21 of the 44 in common (i.e. 48% of the top44 authors in the MIT-centred network are also in the IIASA-centred network). When considering the figure as a whole, it suggests that the institutions collectively mediate this group of 44's collaborative activities. It also shows the core-periphery model effectively, since the peripheral networks centred on Tokyo, Tsinghua, UNAM, and to a lesser extent UFRJ, share far fewer of the 44 in their institution-centred networks (and these authors are all authors from the core institutions playing that linking role, not for example Mexican authors directly collaborating with Chinese ones). The most likely dynamic producing this structure is institutions in the core, notably IIASA and perhaps LBNL (given their location in the figure), strategically coordinating with authors from institutions in BRICS countries and Japan, reflecting geopolitical and funding requirements for such collaboration.

The existence of these closely connected research networks and this institutionally structured pattern, indicates that for researchers seeking to participate and become

authoritative authors within WGIII assessments there are powerful incentives to establish connections with the institutions identified. For developing country researchers this is a key route to gaining symbolic power in the IPCC, and is recognised as such. As one survey respondent indicates:

If I am invited I will try to establish some previous connections both with authors and with some related national and foreign institutions. As I wrote above this is very important in order to arrive to authors meeting with a better baggage of knowledge and understanding (SLA.7c).

This suggests that developing country authors are – through their participation in the assessment – identifying these institutions and collaborative research activities and internalising this as a strategy for increasing symbolic power in the next assessment. The results also suggest that the centrality of these institutions to knowledge production, and particularly IIASA, puts them in a position to act as gatekeepers to the authorship of WGIII’s assessment of climate change mitigation. The effect of these incentives and gatekeeping processes are most readily visualised when the 44 connecting these institutions are included, as shown in figure 3.

FIGURE 3

In figure 3, we see that those authors with no prior IPCC participation (circles) are relatively marginal to these networks. This indicates that collaboration within these networks may be part of the IPCC author selection story, both by raising actors’

awareness of IPCC author nomination processes and raising awareness of potential author's research to WGIII Bureau and TSU Staff that are putting together the chapter teams. We can also see that those actors involved in the GEA (yellow), mentioned above, are central to connecting up the institution-centred networks, dominating the space between these networks. Amongst GEA authors, the three with no prior IPCC participation (Victor, Hertwich, Haberl) are all on the edge of the GEA group, suggesting that participation in the GEA – coordinated by IIASA – may have provided an avenue for becoming an authoritative author within WGIII for the AR5.

It is unsurprising that inequalities exist in the representation of different institutions in the IPCC. However, given that climate change mitigation research is carried out internationally across a range of universities and research institutions, it is surprising how concentrated the production of influential authors is within the AR5 WGIII writing team. There are a considerably wider array of academic institutions with many researchers in the field of climate change mitigation research that are largely unrepresented in the central networks of the IPCC's latest assessment. The above analysis depicts a field in which a few institutions are producing the most symbolically powerful forms of climate change mitigation knowledge and expertise. Combined with the self-referencing identified through the citation data, this dominance would suggest that WGIII's report provides a limited assessment of the overall field of social, political and economic understandings of climate change mitigation.

The socialization of authors into IPCC norms and practices

This section aims to explore how participation within the IPCC's assessment process shapes authors' research and publication strategies. There is clear evidence that authors within the group of 44 are socialised into the IPCC's assessment practice. This is illustrated by the survey data in table 3, where 92% of these authors indicate that their research has, to some extent, been shaped by participation within the IPCC and 92% indicate that they are currently involved in collaborative activities to produce knowledge for the AR6. The question then becomes, is it possible to observe the process of socialisation in those new to the IPCC? Below we identify two methods for exploring this socialisation process. First we focus on two groups of authors through which we might identify co-authoring patterns that show them adapting to IPCC culture: 1) authors in the 44 who have not previously been involved in the production of IPCC reports, and 2) authors with between 3 and 10 citations in the report, who are research active, but less central than the group of 44. Second, we provide an illustrative example from one chapter team's activity that clearly demonstrates the process of coordination and socialisation.

Trends in co-authoring patterns

The results indicate that the research and publication strategies of both groups became more organised around the IPCC after author selection in 2010. This socialisation can be observed in two ways. The pattern of research and publication activity changes over time, both quantitatively and qualitatively, demonstrating how authors are internalising the IPCC practice of publishing for the assessment and structuring their research activities and outputs accordingly. Secondly, authors become significantly more enmeshed in

large-scale collaborative research activity, both with other IPCC authors and more broadly, thereby establishing the institutional and collaborative networks necessary for increasing symbolic power in the assessment.

For both groups, we divided the author's publications cited in the AR5 into pre- and post-2011, in order to detect whether there was a shift in author's publications before and after this date. WGIII authors were selected in 2010 and attended their first Lead Authors Meeting in July 2011. During this first meeting, authors were introduced to the IPCC's practice of publishing for the assessment. Those overseeing and managing the report invited chapter teams to consider "gaps in knowledge" relevant for their chapter or the report as a whole, and to think about how to address these gaps in the published literature by the assessment deadline of October 2013.¹⁰ We used changes in publication patterns before and after 2011 to observe whether authors adapted their research strategies to this practice. For the 14 authors of our group of 44 with no prior IPCC participation, the number of post-2011 publications cited is significantly higher than the pre-2011 publications, by an average of 1 per person (see table 5). The average for the entire writing team for AR5 WGIII was for no growth, so (allowing for the variation amongst the group), this subset of the team either becomes significantly more productive than the average author during this period, or organises their research output towards the IPCC significantly more.

For those authors whose number of publications cited in AR5 grew across the two periods, this growth appears connected to their involvement in the research networks

identified above: participation in these networks correlates positively, if modestly (0.165), to increased publications cited in AR5 from 2011 onwards. Beyond this quantitative shift in activity, more qualitative differences can be discerned. Those within this group who are less connected to the coordinated research activity of our institution-centred network tend to only be cited in their own chapter or one other, while those connected to the networks are cited across several chapters in the report, and as such, their research is able to have a broader impact on the assessment.

TABLE 5

The second group, those with 3-10 citations, contains a total of 95 AR5 authors. For this group, the results are perhaps more striking. They don't have more post-2011 citations compared to the pre-2011 period (an average decline in fact of 0.7 citations per author, which is unsurprising with the demands of the assessment), but the co-authoring patterns change significantly. First, the co-authoring networks, as represented in their citations in the AR5 bibliography, become noticeably denser across the two periods. Table 6 shows this according to a number of standard measures used in network analysis. On average, authors within the network become connected to about 50% more authors across the two periods, and this increased connectivity is driven by the greatly increased connectedness of a relatively small number of authors (as represented in the increases in maximum node degree and node betweenness, as well as the increase in network centralisation).

TABLE 6

Qualitative evaluation of these shifts identifies a number of drivers. In part, it is driven by the collaborative activities of chapter 11, discussed below. Beyond that, this increased collaboration by authors does not appear to be driven by their immersion into the large institution-centred networks identified above. Key authors in those networks do appear in this co-author network post-2011, but the increased amount of research collaboration for this group instead appears to be driven by particular individuals that generate new collaborative relationships across this group – AR5 authors like Catherine Mitchell (Exeter), Nick Eyre (Oxford), or Karen Seto (Yale) who are not in the group of 44. Some of these are not even AR5 authors themselves, suggestive that for pre-existing research teams, there may be strategic reasons to include IPCC authors in the team. It seems then that overall IPCC participation provides incentive and opportunity to become involved in large-scale collaborative research activity in order to address gaps identified through participation. This is most readily observed in one chapter.

Authors on chapter 11 (Agriculture, Forestry and Land Use Change) display a very particular pattern. Figure 4 shows the full co-author network for the WGIII AR5 writing team, with the colour indicating which chapter the author worked on. It shows that those authors working on chapters 5 (orange), 6 (white), 7 (cyan) and to a lesser extent 13 (yellow) are at the centre of the co-authoring networks, further indicating that the institution-centred networks identified in the previous section are focused on particular forms of mitigation knowledge in the report. Figure 4 also shows the chapter 11 writing team (red) as a densely connected cluster, with authors from this chapter brought into this

co-authoring cluster almost entirely via collaborations with two of the group of 44: Pete Smith and Helmut Haberl.

FIGURE 4

Exploring the bibliographic data further identifies one article co-authored by all chapter 11 authors, except the review editors (Smith et al, 2013). For four of the 17 authors of this chapter, it is their only citation in the report, and for another five (including the co-CLA Bustamante), it is one of only two citations in the report (excluding citations of previous IPCC reports). Smith and Haberl, the chapter authors central to the chapter's connections to the co-author network, are the first listed authors on the article, indicating their leadership in constituting the chapter team's research collaboration. This suggests that authors within the group of 44 may be key in initiating new collaborative research exercises and socialising authors new to the IPCC into its culture.

Conclusion

The results of this study identify a group of 44 IPCC authors that are highly connected and highly cited in the IPCC's Fifth Assessment Report of climate change mitigation. An important feature of this group is their involvement in previous IPCC assessment exercises. Thus, whereas 73% of the AR5 author team was new to the process, only 32% (14) of the group of 44 had not previously participated in an IPCC assessment or special report. In the paper we explore how this group's previous participation in the IPCC, patterns of citation and institutional affiliations constitute them as authoritative authors in

the IPCC's assessment practice. Previous participation in the IPCC makes an author a source of knowledge and authority on how the assessment is to be conducted, which puts them at an advantage over authors new to the process. The authorship meetings provide authors with an important networking opportunity, with network of co-authorships becoming denser over the course of the assessment, which means that authors become more connected with each assessment they participate in. Prior experience of the process also means that these authors are aware of the IPCC's practice of publishing for the reports and have the network connections to mobilise the necessary collaborative relationships to publish in time to fill these gaps. In fact, many of these authors are already undertaking the research necessary to fill the gaps in the next assessment before they have been selected as an author, indicating how these sources of symbolic power are reinforcing.

For authors new to the process institutional affiliation and publication record are important for being perceived as a serious author and having one's perspective represented in the chapter. As one author puts it, it is important to arrive in the group with the right "paraphernalia", which he identifies as "models, data, publications, networks, etc." (SLA.7c). While another author suggests that if you are "not from specific very rich countries, or male, or an economist, or ideally all of these, it was very hard to get your word heard or your point to count" (NLA.9c). This scientific habitus and the forms of authority it recognises tends to particularly disadvantage developing country authors. It is for this reason that a number of authors from the global South consider that they will be better positioned to contribute to the IPCC's next assessment of climate mitigation

because now they “know” the process, including what is needed to have a say in the report’s construction. These findings are important for the IPCC and its attempts to improve geographical representation. The IPCC aims to incorporate authors new to its assessment practice in order to avoid criticism that it is authored by the same old group, and it must balance this with the practical need to include experienced authors that have a proven record in delivering the final product. The findings of this study clearly identify the importance of ensuring that authors from the global South are also given the opportunity to gain from the experience of authoring multiple assessments and the advantages this offers. Such a strategy could prove critical in helping the IPCC identify and attract a broader network of developing country expertise, lessening the organization’s reliance on government nomination and the WG bureau, and increasing the likelihood that developing country authors are able to successfully challenge the dominant Northern perspectives in their chapter.

The findings of this study indicate the extent to which the IPCC is shaping the field of climate change mitigation research and its knowledge producing practices. It is clear that key actors and institutions within this field are organising their research, collaboration and publication strategies around the assessment of knowledge in IPCC reports. These actors and institutions are able to maintain and advance their dominance of the field through IPCC authorship. Authorship enables actors to both identify the significance of the knowledge they are producing and to ensure they maintain the relevance of their future research. It is this relationship between the production and assessment of knowledge that poses a challenge to the IPCC’s legitimacy. It is hard to continue to think

of the IPCC as an organization that is merely producing assessments of the state of current knowledge – as an organization separate from the fields of knowledge production that it is charged with assessing. Through its authorship and authorisation of the reports, the IPCC is defining both the terms of climate change mitigation knowledge production and global political action. It is here that we look back to the BO concept. From the perspective of the BO concept, scientific knowledge remains tethered by scientific interests and scientific practices – these are what stop it sliding down the slippery slope into politics, and vice versa. However, in focusing scholarly attention on the work done at the boundary between the science and politics *within* the IPCC, attention has not been given to the broader institutional landscape in which this “boundary organization” resides. It is not merely within the limits of the IPCC that the science and politics of climate mitigation are entangled. When the IPCC is positioned within the broader international field of climate mitigation research it makes apparent that the IPCC plays a central role in generating and channeling scientific interest in this field, which means that this field of expertise and knowledge production is effectively untethered.

Acknowledgements

We would like to thank our collaborators Esteve Corbera and Laura Calvet-Mir for allowing us to use data from our earlier paper (Corbera et al, 2016) in this paper. We would like to thank Xavier P.-Laberge for excellent research assistance in constructing the new dataset for this paper. We would like to thank the editors of this special issue, as well as two anonymous reviewers and the participants in the WIRES workshop in Brussels in August 2015, for excellent feedback on earlier versions of this paper. Some of

this research was funded by the Social Sciences and Humanities Research Council of Canada, under a project entitled “Cultural Politics of Climate Change”.

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Notes

¹ In reality, professional and cultural practices are deeply entwined.

² The threshold for inclusion, according to both of these scores, has a certain arbitrary quality. There was no obvious break in the scores for each that would create a “natural” cut-off point. However, the distribution for each measure is highly skewed, and we do not believe the analysis would be significantly different had we moved the threshold for each measure up or down.

³ The number is in fact 26, but Winkler participated in WII for the AR5 as well as WGIII, which only counts as one assessment cycle. Note that the calculation for these figures includes the main IPCC Assessment Reports and Special Reports.

⁴ We refer to our survey responses in the following way. NA indicates an author from the global North. SA indicates an author from the global South. The number indicates the chapter that the author worked on, with any letters following the number distinguishing between two different authors from the same chapter.

⁵ This figure includes Coordinating Lead Authors, Lead Authors, Review Editors, and the three Co-chairs. It also includes some members of the Technical Support Unit who are

themselves active researchers and whose research is cited in the report (these were excluded from the previous research so the number is different to that reported in that paper).

⁶ Data taken from VanVuuren's CV as available at: <http://www.uu.nl/staff/DPvanVuuren>, consulted 5 August 2015. These figures in fact understate the percentage, as they include publications through to 2015, and the cut-off date for inclusion in the IPCC report was papers' accepted for publication by late 2013. VanVuuren does have papers published in 2015 that are cited in the report, so publications in his CV are included, but 19 of his 108 publications are in 2015, many of which would have been accepted after the census date for the IPCC.

⁷ According to IIASA, the GEA "is the first ever fully integrated energy assessment that analyzes energy challenges, opportunities and strategies, for developing, industrialized and emerging economies. It is supported by government and non-governmental organizations, the United Nations Systems, and the private sector.". See <http://www.iiasa.ac.at/web/home/research/Flagship-Projects/Global-Energy-Assessment/Home-GEA.en.html>, viewed February 8, 2016. It operated much like the IPCC itself, with large chapter teams for each chapter and extended peer review processes.

⁸ In the earlier paper (Corbera et al, 2016) we showed that at the level of individual countries, the UK and the US dominate the training of IPCC authors. When explored at the level of individual institutions, however, UK institutions are absent, reflecting the considerably less hierarchical character of UK academia compared to the US, and thus the distribution of PhDs across a significantly wider range of institutions.

⁹ This connectedness is also represented in a network of these institutions as connected by the authors' career paths. In such a network of the group of 44 authors, 72% of all institutions are in a single component and 71% of the individuals are in a single component.

¹⁰ For inclusion in the report, research had to be accepted for publication by October 3rd 2013 (IPCC NA). One LA stood up in plenary to oppose this suggestion, arguing that it was inappropriate for the IPCC to skew the research process in this way (author's observation).