1 Introduction

The Intergovernmental Panel on Climate Change (IPCC) issued its first report in 1990: A definitive account of the state of expert knowledge about climate change, the scope of its impacts, and the range of solutions available. Before the IPCC's joint founding, in 1988, by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), climate scientists had been publishing research about anthropogenic climate change in peer-reviewed journals, workshop reports, and assessments for government and nongovernmental science agencies, but there was no established forum for taking stock of this work *en masse* and ensuring that governments of countries around the world consider it together. The IPCC changed that. It is the premier international body for assessing climate science. And in the ensuing decades, each new iteration of IPCC reports has provided increasingly robust, certain, and alarming assessments of our warming world.

IPCC reports have tremendous authority. The intergovernmental character of the IPCC means that virtually all the world's governments adopt the same scientific reports on climate change – a necessary, if not sufficient, baseline for the political agreements meant to lower greenhouse gas (GHG) emissions and slow or manage climate impacts. The IPCC has had notable successes. Its reports helped lead to the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, which organizes international political work around climate change, and in 2007, the IPCC won the Nobel Peace Prize jointly with Vice President Al Gore for advancing climate change knowledge. The IPCC continues to shape the UNFCCC's work, including the 2015 Paris Agreement, and to inform international global governance.

Yet public and policy responses have failed to meet the urgency of the situation. We are now in a critical decade in which, as IPCC reports make clear, rapid climate action is necessary to limit global warming to well below 2°C and secure a liveable future for all. No wonder, then, that United Nations (UN) Secretary-General António Guterres referred to the IPCC's most recent Sixth Assessment Report (AR6) as "a code red for humanity" (UN, 2021), "an atlas of human suffering" (UN, 2022a), and "a litany of broken climate promises" (UN, 2022b).

How do the authors of IPCC reports understand the disconnect between the science they lay out and the action that ends up being taken – or not taken – to mitigate the climate crisis? For that matter, how do they create the reports to begin with? In this Element, we examine the inner workings of IPCC assessment to gain insight into both the scientific and the political aspects of climate change. Drawing on sustained ethnographic work conducted over the five years

of the AR6 report cycle, in which we attended twelve Lead Author Meetings (LAMs) around the world and on Zoom, and conducted over 200 interviews, we explore the social and human sides of IPCC report writing, as well as the sociocultural practices that shape our understanding of climate change and of the solutions to tackle it.

From the outset, the IPCC's reports have been authored by three Working Groups (WGs): WGI, composed of mostly physical scientists, assesses the physical and natural sciences; WGII, composed of social and physical scientists, focuses on adaptation; and WGIII, composed of primarily quantitative social scientists and engineers, analyzes mitigation. The assessment report cycle ends with a Synthesis Report (SYR) that brings together a cohesive narrative about the three WG reports. This division is meant to parcel tasks out to experts from particular disciplines with particular skills, in manageable pieces, but it also embeds a key assumption into the very structure of the IPCC: The physical sciences are seen to start things off, determining the nature and scope of the climate problem, while the social sciences then add "the human element," exploring the impacts people will face and the actions we can take to solve it. But when examined from closer up, the picture becomes a little blurrier. The world doesn't fall into tidy dichotomies of science/politics, natural sciences/social sciences, or the physical climate system/human engagements with climate.

When we look behind the scenes at IPCC meetings, we can see how disciplinary norms shape the production of reports in particular ways – as well as how IPCC reports' emphasis has shifted from the physical sciences toward the social sciences over the organization's history. For example, some conventional representations of science assume that scientists can determine a "safe" amount of GHGs that can be released into the Earth's atmosphere, and that policymakers can then agree, through the rational application of this scientific knowledge, on ways to remain below that threshold. Indeed, these assumptions inform the view taken by some proponents in and of the IPCC. But in reality, climate knowledge cannot be compartmentalized in such a segmented manner.

In the sections that follow, we explore what the social and human sides of IPCC report writing look like, as a complement to understanding the authoritative reports that underwrite policy decisions at many scales of governance. By examining these dimensions, we can engage with the information produced more critically as well as more empathetically and understand what the IPCC offers to people interested in climate science, advocacy, and solutions. We can see how the social and human dimensions are in fact the main strength of the organization. By stepping back to reveal what goes into the making of climate

science assessments, we aim to help people develop a more realistic, and thus – we hope – more actionable, understanding of climate change and the solutions to deal with it.

Science, Politics, Policy, and Assessment

Scientists, through their work, seek to represent nature but cannot capture all its complexity. In other words, there is no single way that the natural world can be mapped through science (Sismondo, 2010). Relatedly, the social world is contingent upon the multiple, creative, and diverse agency of the humans who are constantly inventing new ways of being, even as they are constrained by social, political, and economic structures (Shove et al., 2012). For these reasons, science should be understood as a human endeavor that is always shaped by historical and social circumstances (Shapin, 2010).

There are significant differences between how science is discussed in public and how science is carried out. For example, the IPCC gains credibility and legitimacy by claiming that it maintains a clear boundary between science and nonscience (Sundqvist et al., 2015): IPCC leaders and authors frequently invoke the axiom that they produce "policy-relevant science advice." But the lines between natural sciences and social sciences, or between nature and culture, are not universally agreed upon (Latour, 1993). Rather, they are worked out in practice. Knowing this has several important consequences for how we engage with the IPCC.

First, the IPCC is a central actor in the struggle to understand the climate problem and identify climate solutions. While originally and primarily known for detecting the influence of humans on the climate, which altered the public perception about anthropogenic climate change, the IPCC is increasingly also involved in the definition of the solutions to tackle it. In the run-up to the Paris Agreement, which was signed in 2015, the IPCC turned its focus even more toward solution-oriented assessments.

Second, the IPCC as a community is neither unified nor homogeneous. Besides being divided into WGs, Technical Support Units (TSUs), chapters, the Bureau, the Secretariat, and the Panel itself, the IPCC is a networked organization that includes both formal and informal interpersonal networks, all of which are crucial for producing policy-relevant science advice that is accurate and understandable (Pelling et al., 2008; Venturini et al., 2023). The informal work that parallels formal IPCC procedures forms a crucial social dynamic that allows the work of assessment to carry on. We were able to explore how the IPCC produces reports through both formal and informal networks and processes.

Third, because of its high visibility, the IPCC has experienced attacks on its credibility over its history, including by well-funded climate contrarians (see Oreskes and Conway, 2011). This was seen in 2009–2010 with the "Climategate" scandal precipitated through contrarians hacking the email system of the University of East Anglia, as well as some errors found in AR4. While there was much written about that episode, one of the lessons it taught is that the authority of the IPCC, or the amount of credibility and trust that the public invests in it, is not guaranteed (Hajer and Strengers 2012). Rather, the IPCC must continually shore up its credibility and perform anew its role as scientific expert. This is a difficult thing to accomplish because there isn't just one scientific method, and science is not a sure road to certainty. That is, while science is often presented in public as if it produces uncontestable or incontrovertible facts, in actuality science is a complicated process that engages with uncertainty and contingency. This is especially true when dealing with something as complex and vast as climate change, the science of which spans from hundreds of millions of years ago to projections hundreds of years in the future. This means that the IPCC frequently finds itself engaging with the plurality of unruly and contingent social and natural sciences of climate change, on the one hand, while also presenting climate science to the public as if the science of climate change were as simple and straightforward as the law of gravity, on the other hand. In this Element, we travel back and forth between the complexity of climate science and its neat and tidy representation in IPCC assessment reports.

Fourth, the political contexts into which IPCC reports are being delivered matter and are changing over time. The 2015 Paris Agreement changed the landscape within which the IPCC works by increasingly turning the focus of the IPCC toward solution-oriented assessments, shifting the frameworks through which climate change is described as a problem and how solutions are consequently posed (Beck and Mahony, 2018; Hulme, 2016). The IPCC's institutional practices require authors to avoid policy prescription, so these human dimensions of climate solutions must be assessed carefully to avoid suggestions. However, as the climate crisis has gotten worse, the science is clear about what actions have become imperative to solve the problem. Yet just because the IPCC deems some solutions possible in a technical sense doesn't necessarily mean that they're socially or politically possible.

Finally, science is situated in the broader human experience (Haraway, 1988). The origin, culture, and socialization of experts influence how they participate in the assessment of science. This then raises important ethical questions about whose knowledge counts in the IPCC and in what way. This also means that authors experience the IPCC and its assessment process very differently depending on their gender, whether they are from the Global North or the

Global South, an early career scientist or an advanced scholar, a scientist or a practitioner.

While the social location of IPCC authors influences their participation in the IPCC, scientists are also influenced by the working cultures and norms associated with scientific practices. That is, they produce scientific assessments to inform international decision-making by borrowing practices from their scientific disciplines and epistemic communities (Haas, 1992). For example, authors assess information using skills learned through peer review and laboratory and field-group interactions, and solve the problem using their familiar research methods, such as statistics or modeling. However, IPCC authors and leaders also borrow practices from diplomacy, gesturing toward the final audience for their reports as well as the milieu of international organizations in which the IPCC is entrenched. Such practices include "red team/blue team" reports (in which two groups produce oppositional reports), perspective-taking in debates, and drafting language that is politically acceptable through the appearance of neutrality. As such, IPCC authors form an epistemic technocracy, in which experts utilize the form and content of bureaucratic organizations to mediate their scientific work (De Pryck, 2021; O'Reilly, 2017).

People in the IPCC do not just passively experience the institution: They shape it, negotiate with it, critique it, and improve it, working within, alongside, and outside the formal procedures agreed upon by governments. Given this heterogeneity, we argue that the IPCC and its working components (such as chapters) do not form traditional epistemic communities – groups of experts working with and on shared sets of knowledge (Haas, 1992), even as their practices – and many of the principles guiding IPCC work – assume they do. Instead, the IPCC intentionally values diverse perspectives and seeks to introduce multiple biases and achieve agreement *through* epistemological discord. The IPCC manages this primarily through author selection, choosing authors from all the world's regions, across disciplinary fields of inquiry, and according to other subjective criteria. The IPCC authors, writing in groups, represent their foundational epistemic communities (as well as the other social worlds), co-producing climate knowledge with other authors doing the same. The collective practices of international scientific assessment lend credibility to the robust scientific consensus on anthropogenic climate change and support an equally robust international political response to solve the problem the scientists convey with such care and precision.

Methods

Our ethnographic team consists of O'Reilly, an anthropologist; Vardy and Feital, sociologists; and De Pryck, a political scientist. While much has been

written about the IPCC (see, e.g., De Pryck and Hulme, 2022; Hughes, 2015), we have had a unique, sustained, and collaborative access to the organization that has allowed us to engage in original and thick description (Geertz, 1973). Research observers were not allowed into IPCC LAMs until our project.

Following an expert meeting on potential studies of IPCC processes, a special meeting at the IPCC Secretariat to construct guidelines for the Panel to consider, and consideration by governments at an IPCC plenary meeting, research access was granted to O'Reilly and her research team to study AR6 in 2018. We were not granted full access, however. We were allowed to attend the WG LAMs, but we were not given official access to the chapter and Summary for Policymakers (SPM) writing groups (though some of these groups chose to include us regardless).

We used predominantly ethnographic methods of observation and interviews to collect our data. At least two and sometimes three ethnographers attended each WG's LAM, observing the ritual of the week as it unfolded in plenary meetings, training meetings, breaks and mealtimes, and evening events. For each of the chapter writing teams that we consider as case studies, we interviewed each consenting member of the chapter at each LAM, creating an in situ oral history of each participant's experience in the IPCC at intervals in the process. We also conducted ad hoc interviews with the IPCC leaders, staff, and other chapter authors working on topics relevant to our study. After the coronavirus pandemic shut down global travel in 2020, we conducted our observations and interviews over Zoom, including observing the approval plenaries for each of the WGs. Additionally, some of us observed IPCC activities at UNFCCC meetings.

Even as we seek to introduce readers to the processes that help make scientific assessment relevant to decision-makers and the public, we note that our scholarly work often requires keeping the urgency of the climate crisis at arm's length. For example, our fieldnotes on IPCC meetings are usually quite rote, recording the formal negotiations close to verbatim alongside some general observations regarding tone, controversy, or asides. There is scholarly delight in the epistemic weeds of learning how scientific agreements and disagreements are presented in reports. But the implications of some of the discussions were often distressing. Fieldnotes from a communication meeting about crossing the 1.5°C threshold gained a tone of despair as one of us began to take on the gravity of the messages the IPCC authors grapple with communicating. Looking at a quadruple image of high-temperature projection maps, with extreme warming under every future climate scenario, she wrote, "all I see is the world on fire." Ethnographic writing – including some analytical distance – is a tool we engage to strive toward fuller description and comprehension, but our concern for the need for urgent, multidimensional, and just responses to the climate emergency drives our research.

Orientation to the Element

Section 2 describes IPCC author experiences and subjectivities, analyzing how their subject positions impact their perceptions and experiences of the IPCC process, as well as how representation matters for the quality of IPCC assessment reports. Section 3 considers WGI knowledge, demonstrating how authors navigate new and changing science in creating assessment reports. In Section 4, we detail the work undertaken by authors as they built trust and established a common vocabulary between WGI and WGII. This human effort is crucial because it can provide greater insight into how the risks of climate change are themselves changing. Section 5 interrogates the domain of WGIII, mitigation – considered a solution to anthropogenic climate change alongside adaptation. The IPCC reports generally frame climate solutions as a mix of economic policy and technological innovation, though there have been forays into cultural and behavior change in AR6. In Section 6, we analyze the relationship between governments and the IPCC, considering the malleability of expert knowledge as it moves from the authors to government approval. That the SPM is approved line-by-line by government delegates means that the text is edited to reach consensus, sometimes at the expense of clarity. However, this editing, and the intensive style of government approval, gives the text a particular kind of authority that allows the work of international climate action to proceed. In sum, we show the social complexities of IPCC assessment report writing to underscore the robust work undertaken to produce the highest quality science advice in the hopes of resolving the climate crisis as quickly and equitably as possible. Many of the authors spoke about the high stakes of their IPCC work, and we hope that this commitment comes through in our ethnographic account of AR6.

2 IPCC Authors

Writing reports for the Intergovernmental Panel on Climate Change (IPCC) is a sociocultural experience shared among authors. Being selected as an IPCC author is generally considered a high-status service gig, one that offers no financial compensation. To be an IPCC author is to be identified by your nation, which nominates you, and the IPCC itself, which confirms you, as a leading climate scholar. One author noted that "my university president now knows who I am," suggesting, at a minimum, reputational benefits to the role. Authors also note the serious fun of scholarly assessment, getting to know other climate experts, having the opportunity to travel, and helping to make a difference with one of the most critical issues of our time. Authors also often publish with members of their chapter team or other people they work with in the IPCC; so

along with the report citation, authors may get some publications or projects – the major expectation for university researchers' jobs – or secure new positions from the effort (Corbera et al., 2016).

Apart from the benefits, authors note the challenges of being an IPCC author – and many of these revolve around navigating the social complexities inherent in assembling experts on a topic. Academic expertise is hardly ever generalist and success often entails carving out and defending a particular perspective, making a unique contribution to one's field of study. That delineating and defense work does not translate easily into communicating more broadly about a scientific topic, balancing different views in the literature and in the author team. Gender, nationality, and career stage also impact the sociocultural dynamics of writing together, alongside personality, first language, and previous involvement with the IPCC. We observe that the experiences of IPCC authors are entangled with some of the same inequities that we see playing out in many international negotiations, particularly along the division of the Global North and South – categories that are overly simplified but nonetheless impactful at individual and collective scales.

Authors work in communities within the IPCC; they are part of chapter writing teams, Working Groups (WGs), and the IPCC itself. Each of these social formations has distinct subcultures that the leaders and people within the group construct. Each also brings together experts from similar, but also different, fields or epistemic communities (Haas, 1992). All these authors are highly trained experts, though this does not preclude hierarchical divisions within these groups. While the IPCC claims to not produce new knowledge, our previous studies disagree (Brysse et al., 2013; Oppenheimer et al., 2019; O'Reilly et al., 2012). The IPCC process and its reports synthesize and reorganize existing knowledge, drive research agendas, and inspire new research questions.

The IPCC functions, but it doesn't always function smoothly or in the same way for every author. Group practices established with the intention of facilitating diverse forms of communication and a full airing of expert views can fall by the wayside as deadlines approach – or pandemics emerge. Writing IPCC reports is hard, serious work, especially given that the authors are volunteers. This section explores some of the shared challenges in the author experience, followed by some additional, systemic barriers that confront authors. If representational diversity is important to producing climate science assessments of the highest quality, as IPCC claims, the organization is just getting started with creating the conditions that permit all authors to substantively participate.