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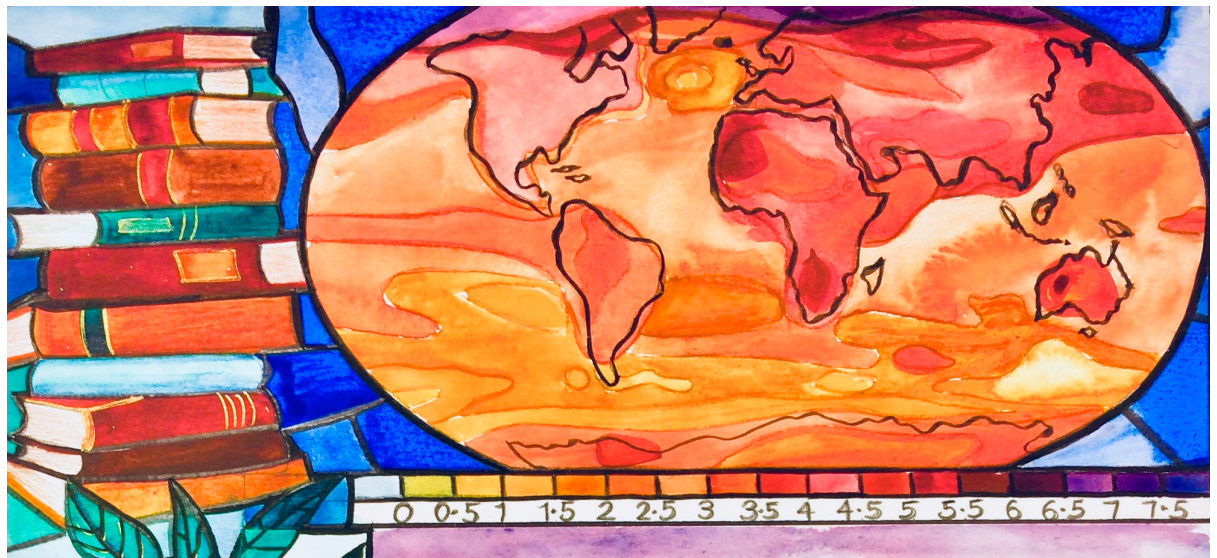
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Climate Science for Policy?

The knowledge politics of the IPCC after Copenhagen

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ENVIRONMENTAL SCIENCE | CEC | FACULTY OF SCIENCE | LUND UNIVERSITY



Climate Science for Policy?

The knowledge politics of the IPCC after Copenhagen

Jasmine Livingston



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DOCTORAL DISSERTATION

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Abstract <p>The rise of climate change as an issue of global concern has rested on scientific representation and understanding of the causes and impacts of, and responses to climatic change. The Intergovernmental Panel on Climate Change (IPCC), in particular, has been central to how climate change has become known as a global political problem. This thesis aims to critically examine the production, negotiation, and stabilisation of policy-relevant knowledge in international climate politics. It takes the IPCC as a global stage on which the knowledge politics of climate change plays out, drawing attention to the performative interactions which shape the relationship between knowledge production processes and policy making at the global level. Informed by social constructivist accounts, particularly from within the social studies of science, this thesis builds on the notion that science and politics can never be truly separated from each other, rather, they are co-produced. In turn politics is not confined to strategic interests and negotiating positions, it is instead a constitutive process taking place at many scales. Theoretically I advance the concept of knowledge politics, as a co-productive and performative interplay between knowledge and politics. This interplay takes place both in deliberations over what counts as science, knowledge, and policy on the global stages of the IPCC and the United Nations Framework Convention on Climate Change (UNFCCC), and in the selection and choices that take place when writing the IPCC assessment reports. Empirically I explore different backstage and frontstage sites which approach the knowledge-politics of the IPCC from different angles.</p> <p>This thesis finds that the relationship between science and politics in the climate change case is complicated and convoluted. Whilst the IPCC plays a central role in mediating between the scientific community and international climate politics it is not purely a vehicle of communication. Instead it is actively involved in shaping the knowledge on climate change that becomes known in the political realm. The IPCC's particular definition of policy relevant knowledge, and its ways of defining the science-policy relationship based on a separation of facts and values, has resulted in a tendency to favour abstract, scientific representations of climate change. This thesis has also shown, however, that this representation is often challenged backstage in the IPCC assessment process by both authors from different disciplines, and governmental representatives from different parts of the world. In turn, it also illustrates that since the Paris Agreement in 2015, there has seemingly been a shift in the way that the IPCC approaches policy relevant knowledge on climate change, through ensuring that conversations about interdisciplinarity, values, and deeply entrenched differences in how science is done are taking place, both frontstage and backstage. Overall, this thesis draws attention to how the decisions made backstage over knowledge play a key role in how climate change comes to be known as a political issue in the frontstage global climate politics. This interaction between the backstage and frontstage shows how the sites of politics can be extended to also include scientific deliberations and illustrate the co-productive relationship between the IPCC and climate change politics more broadly.</p>			
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Climate Science for Policy?

The knowledge politics of the IPCC after
Copenhagen

Jasmine Livingston



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List of Papers

- I. Thoni, T. and Livingston, J.E., Going beyond Science-Policy Interaction? An Analysis of Views among Intergovernmental Panel on Climate Change Actors (*Submitted to Critical Policy Studies*)
- II. Livingston, J.E., Lövbrand, E., Alkan Olsson, J., (2018). From climates multiple to climate singular: Maintaining policy-relevance in the IPCC synthesis report. *Environmental Science and Policy*, 90, 83–90. <https://doi.org/10.1016/j.envsci.2018.10.003>
- III. Livingston, J. E. and Thoni, T., Defining the Boundaries of Climate Change Expertise: Science-policy interaction in the Structured Expert Dialogue (*In revision at Climatic Change*)
- IV. Livingston, J.E. and Rummukainen, M., Taking Science by Surprise: The knowledge politics of the IPCC 1.5 Special Report (*manuscript*)

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Author Contributions

- I.** JEL and TT contributed equally to the design, data collection, analysis, and writing of the article.
- II.** JEL developed the idea for the article and undertook data collection and analysis. JEL wrote the article with input from EL particularly on the theoretical framing and direction. JAO provided input on direction and framing at a later stage. All authors refined and revised the article.
- III.** JEL and TT contributed equally to the design, data collection, analysis, and writing of the article.
- IV.** JEL and MR developed the idea for the article together. JEL undertook the data collection, analysis, and writing. Both authors refined and revised the manuscript.

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List of Abbreviations

AGGG	Advisory Group on Greenhouse Gases
AR4	Fourth Assessment Report
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
CLA	Coordinating Lead Author
CO ²	Carbon Dioxide
COP	Conference of the Parties
CWT	Core Writing Team
ENB	Earth Negotiations Bulletins
ENGOS	Environmental Non-Governmental Organisations
EU	European Union
FAR	First Assessment Report
GCMs	Global Circulation Models
IAC	InterAcademy Council
INC	Intergovernmental Negotiating Committee
IPBES	Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
LA	Lead Author
LTGG	Long Term Global Goal
NAS	National Academy of Sciences
NDC	Nationally Determined Contributions
PBL	Netherlands Environmental Agency
RCP	Representative Concentration Pathways
RINGO	Research and Independent Non-Governmental Organisations
SAR	Second Assessment Report
SB	Subsidiary Bodies (of the UNFCCC)
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SED	Structured Expert Dialogue
SPM	Summary for Policy Makers
SR15	IPCC Special Report on Global Warming of 1.5°C

STS	Science and Technology Studies
SYR	Synthesis Report
TAR	Third Assessment Report
TSU	Technical Support Unit
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Agency
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
WCP	World Climate Programme
WGI	Working Group I
WGII	Working Group II
WGIII	Working Group III
WMO	World Meteorological Organization

Popular Summary

Climate change will affect ecosystems and societies the world over. It is a problem which requires drastic and immediate changes to our way of life and the structures on which societies are built. It is, therefore, one which requires unprecedented political engagement in order to be addressed. Over the last 30 years, since the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 and the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, climate change has risen on the international political agenda. Science has played an important role in getting climate change to be understood and accepted as a political problem. Meanwhile, with the successive Assessment Reports released by the IPCC, the scientific basis surrounding climate change has grown ever stronger. The political context of recent years, characterised by a rise in populism and post-truth politics, however, has seen experts and expertise being increasingly dismissed and criticised. Thus, the role of science and experts is still the subject of much debate. This thesis can help to shed light on such tensions, through investigating the relationship between science and policy in the realm of international climate politics.

The thesis revolves around the work of the IPCC. The IPCC was established to provide summaries and assessments of the scientific evidence on climate change. It consists of three Working Groups which look at 1) the physical science, 2) the impacts and adaptation to, and 3) the mitigation, of climate change respectively. Since 1988, it has produced five full Assessment Reports and many Special Reports and methodological papers, which work with the goal of being ‘policy relevant but never policy prescriptive’. The IPCC’s reports bring together existing literature from a broad range of scientific disciplines and are written by pre-defined author teams. The report process involves government representatives from the member states of the IPCC, at the scoping, parts of the review, and approval stages of report writing. The IPCC provides its reports to its main audience in the climate policy sphere, the UNFCCC, with the purpose of informing policy makers on the current state of science of climate change.

This thesis is, however, not just concerned with the nature of science-policy interactions. It also recognises that the knowledge making practices of the IPCC are shaped and formed by a changing political context. Therefore the main aim of this thesis is to examine how policy relevant knowledge on climate change is

produced (the writing of the reports, and the doing of science), negotiated (decisions on what to include and how to present it), and stabilised (acceptance and recognition) in the context of international climate policy. In this thesis I see the IPCC as a stage on which these processes of knowledge production, negotiation and stabilisation play out. I do this in order to better understand the relationship between climate change knowledge production and policy making at the global level, the roles scientific experts and government negotiators play in these processes, how the frontstage negotiations interact with the backstage writing of IPCC reports, and how the IPCC therefore helps climate change become a political problem.

This study covers the timespan from the UN Climate Summit in Copenhagen (COP15) in 2009 to the publication of the IPCC Special Report on 1.5 degrees in 2018. This time has been a formative one for international climate politics, with the diplomatically disappointing outcome of Copenhagen overshadowing the years leading up to the UN Climate Summit in Paris in 2015 (COP21), which resulted in the well-publicised Paris Agreement. Over this period there has been much discussion about the role science, and particularly the IPCC, can play in providing evidence principally relating to a long term global temperature goal for climate change, and how this corresponds to the UNFCCC's characterisation of 'dangerous climate change'. The papers that make up this thesis examine cases which consider different aspects of what I term the knowledge politics of the IPCC, over this time. Paper I looks at the Review on the Future of the IPCC undertaken towards the end of its 5th Assessment cycle, Paper II the writing of the Synthesis Report of the 5th Assessment Report published in 2014, Paper III examines the Structured Expert Dialogue on the long term global goal undertaken within the UNFCCC between 2013 and 2015, and Paper IV the history and processes of preparing the IPCC Special Report on global warming of 1.5 degrees which was published in 2018. Together, these papers provide different perspectives on the IPCC process, and in particular how frontstage political negotiation interacts with backstage knowledge production.

My study has three main conclusions. Firstly, it finds that there has been a tendency to favour abstract, scientific representations of climate change. This has been justified through the IPCC's definitions of policy relevant knowledge, and a relationship between science and policy based on the separation of facts and values. My thesis has shown that this representation is often challenged by both those involved in the IPCC reports as scientists from different disciplines, and government delegates. Since the Paris Agreement, and the undertaking of the IPCC Special Report on 1.5 degrees, however, there has seemingly been a shift in the way that the IPCC approaches policy relevant knowledge on climate change, through ensuring that conversations about interdisciplinarity, values, and deeply

entrenched differences in how science is done are taking place both frontstage and backstage.

Secondly, this thesis shows that the relationship between science and policy is complicated, convoluted, and changing. The IPCC plays a central role in mediating between policy and the scientific community on climate change. It is, however, not just a vehicle of communication, instead it is actively shaping the knowledge on climate change that is brought into the policy realm. This shaping involves both scientific and policy actors – backstage in the writing and review process, and frontstage in negotiations and approvals of the final IPCC reports.

The final point this thesis raises is that decisions made backstage play a key role in how climate change is framed as a political issue. The IPCC authors' selections of which scientific findings should be brought forth to the policy community, or responses to government representatives' requests, are not neutral choices. In order to understand the relationships between science and policy better, it is therefore important not to limit study to public debate between experts and policy makers. It is also worthwhile, and indeed essential, to understand the practices of science and science for policy. This opens up new avenues for understanding the challenges that science faces in a broader societal setting.

Climate change continues to be a critical issue. As 2018 brought with it extreme weather, political tension, and the release of the IPCC report on 1.5 degrees, media and societal interest and attention has once more turned towards the impacts of climate change, and its required political response. Questions surrounding the role of science and experts in decision making thus continue to be of the utmost importance. Whilst there are still many questions to be answered, this thesis has shed light on the complexities of science-policy interactions, and draws attention to the unexpected sites where opportunities for engaging in fruitful debate on the role of science exist.

Populärvetenskaplig sammanfattning

Klimatförändringarna kommer att påverka ekosystem och samhällen över hela världen. Det är ett problem som kräver drastiska och omedelbara förändringar av vårt sätt att leva och av våra samhällsstrukturer, och därmed politiskt engagemang av aldrig tidigare skådat slag. Under de senaste 30 åren, sedan bildandet av Förenta Nationernas ramkonvention om klimatförändringar (Klimatkonventionen; UNFCCC) år 1992 och FNs klimatpanel (IPCC) år 1988, har klimatfrågan blivit en allt viktigare fråga för internationell politik. Vetenskapen har spelat en viktig roll i att klimatfrågan numera är både förstådd och accepterad som ett politiskt problem. Samtidigt som den politiska medvetenheten har ökat har även det vetenskapliga forskningsläget, utvärderat i IPCCs periodiska rapporter, vuxit sig allt starkare.

I kontrast till utvecklingen mot en stark roll för forskningen i politiken står dock de senaste årens politiska kontext, karaktäriserad av växande populism och så kallade post-truth politik – politik som färgas av personliga övertygelser och känslor snarare än fakta, även då fakta står emot den valda politiken – som istället har avfärdat och kritiserat experter och expertkunskap. Vetenskapens och expertens roll är alltså fortfarande föremål för diskussion. Genom att undersöka förhållandet mellan vetenskap och politik på den internationella arenan kan denna avhandling hjälpa till att förstå dessa motsättningar.

Avhandlingen kretsar kring FNs klimatpanel IPCCs arbete. IPCC grundades för att sammanfatta och utvärdera det klimatvetenskapliga läget. Dess arbete fördelas mellan tre arbetsgrupper. Arbetsgrupp 1 fokuserar på den naturvetenskapliga grunden, arbetsgrupp 2 på effekter av klimatförändringarna samt anpassningsmöjligheter och arbetsgrupp 3 på utsläppsminskande åtgärder. Sedan 1988 har IPCC tagit fram fem genomgripande utvärderingar av forskningsläget, samt ett flertal special- och metodrapporter, med målet att vara politiskt relevanta, men inte politiskt styrande. IPCCs rapporter sammanför litteratur från ett brett register av vetenskapliga discipliner, och skrivs av på förhand bestämda författarlag. Regeringsrepresentanter från IPCCs medlemsländer är involverade i flera steg av rapportskrivarprocessen – då innehåll och begränsningar bestäms i stora drag, under delar av granskningsprocessen, samt då rapporten ska godkännas av medlemsländerna. IPCC förser sin viktigaste läsekrets i den klimatpolitiskakontexten, nämligen FNs klimatkonvention, med sina rapporter,

med målet att informera beslutsfattare om det senaste på den klimatvetenskapliga fronten.

Denna avhandling handlar dock inte enbart om hur interaktionen mellan vetenskap och politik ser ut, utan belyser också att det sätt som IPCC tar fram kunskap på är färgat och format av ett föränderligt, politiskt sammanhang. Avhandlingens syfte är härmed att reda ut hur politiskt relevant kunskap om klimatet produceras (hur rapporterna skrivs och hur vetenskap skapas), förhandlas (genom beslut om vad som ska inkluderas och hur det ska presenteras), och stabiliseras (acceptans och igenkännande) på den internationella klimatpolitiska spelplanen. I avhandlingen behandlar jag IPCC som en scen där dessa processer – produktion, förhandling och stabilisering – spelas ut. Anledningen till detta är att jag vill bättre förstå förhållandet mellan kunskapsskapande och beslutsfattande på den globala nivån, de roller som vetenskapliga experter och regeringsförhandlare spelar i dessa processer, samt hur den del av förhandlingarna som står i rampljuset samspelar med IPCCs rapportskrivande bakom kulisserna, och hur IPCC därigenom medverkar till att klimatförändringarna blir ett politiskt problem.

Tidsmässigt fokuserar den här avhandlingen på IPCCs femte utvärderingscykel, som sträcker sig från FNs klimattoppmöte i Köpenhamn (COP15) år 2009 till publiceringen av IPCCs specialrapport om 1,5 graders uppvärmning år 2018. Under den här perioden – vilken innefattar åren i kölvattnet efter den diplomatiska besvikelsen i Köpenhamn fram till klimattoppmötet i Paris 2015 (COP21), som i sin tur slutade med det omtalade Parisavtalet - har internationell klimatpolitik stöpts om. Under den här tiden har vetenskapens roll diskuterats, och då i synnerhet hur IPCC kan ta fram information kring ett långsiktigt temperaturmål och hur det här temperaturmålet i sin tur hänger ihop med Klimatkonventionens bild av vad som utgör ”farliga klimatförändringar”. De papper som utgör stommen i den här sammanläggningsavhandlingen undersöker fall som behandlar olika aspekter av vad jag kallar IPCCs kunskapspolitik under den här perioden. I Papper I tittar jag närmare på översynen av IPCC framtid som genomfördes mot slutet av den femte utvärderingscykeln, i Papper II fokuserar jag på skrivandet av den femte utvärderingsrapportens syntesrapport, publicerad 2014, i Papper III undersöker jag klimatkonventionens så kallade strukturerade expertdialog (Structured Expert Dialogue) om klimatpolitikens långsiktiga mål arrangerad under perioden 2013 till 2015 och slutligen i Papper IV, studerar jag historien bakom och processen att ta fram IPCCs specialrapport om 1,5 graders uppvärmning, publicerad 2018. Tillsammans skildrar dessa papper olika perspektiv av processen kring IPCC, och då i synnerhet hur rampljusets politiska förhandlingar samverkar med kunskapsproduktionen bakom scen.

Min avhandling har tre huvudsakliga slutsatser. Den första är att det har funnits en tendens till att favorisera abstrakta och vetenskapliga bilder av klimatförändringarna.

Det här har motiverats av IPCCs definition av vad som är klimatpolitiskt relevant information, samt ett förhållningssätt mellan vetenskap och politik som bygger på en separation av fakta och värderingar. I min avhandling visar jag att de här bilderna av klimatförändringarna ofta utmanas, av såväl IPCC-författare från olika vetenskapliga discipliner som regeringsrepresentanter. Sedan Parisöverenskommelsen och framtagandet av IPCCs specialrapport om 1,5 graders uppvärmning tycks det dock ha skett ett skifte i hur IPCC tar sig an klimatpolitiskt relevant kunskap om klimatförändringarna genom att se till att tvärvetenskap, värderingar och djupt rotade skillnader i hur vetenskap tas fram diskuteras såväl i som utanför rampljuset.

Avhandlingens andra huvudslutsats är att förhållandet mellan vetenskap och politik är mångfacetterat, invecklat och föränderligt. Genom att medla mellan politiken och forskarsamhället spelar IPCC en central roll för klimatfrågan. IPCC fungerar dock inte enbart som kommunikationsapparat, utan formar aktivt den kunskap om klimatförändringarna som förs in i politikens värld. Det här formandet sker i en process där både politiska aktörer och aktörer från forskarsamhället ingår. Processen pågår såväl i rampljuset i form av förhandlingar och godkännande av de slutgiltiga IPCC-rapporterna, som bakom kulisserna i form av skriv- och granskningsprocesser.

Avhandlingens tredje och sista huvudslutsats är att beslut tagna bakom kulisserna, utanför rampljuset, är mycket viktiga för hur klimatförändringen ramas in som politiskt problem. IPCC-författarnas beslut gällande vilka vetenskapliga resultat som ska delges politiken, eller deras svar på förfrågningar från regeringsrepresentanter, är inte objektiva val. För att få bättre förståelse för förhållandet mellan vetenskap och politik är det därför viktigt att forskningen om det här förhållandet inte begränsas till studier av offentliga diskussioner mellan experter och beslutsfattare. Det är också viktigt, rent av nödvändigt, att förstå hur det vetenskapliga arbetet fungerar och praktiseras, och hur vetenskap för politik skapas. Det här förhållningssättet öppnar upp nya möjligheter för att förstå de utmaningar som vetenskapen står inför också i ett bredare, socialt sammanhang.

Klimatfrågan kommer att förbli en avgörande fråga. Då år 2018 har bjudit på extremväderhändelser, politiska spänningar och utgivningen av IPCCs rapport om 1,5-graders uppvärmning, har det mediala och samhälleliga intresset för klimatförändringens effekter och det nödvändiga politiska gensvaret återigen väckts. Frågor gällande vetenskapens och expertens roll i beslutsfattande kommer därför även fortsättningsvis vara mycket viktiga och relevanta. Även om det fortfarande finns många frågor kvar att besvara har den här avhandlingen bidragit med att belysa viktiga delar av den komplexa relationen mellan vetenskap och politik, och att uppmärksamma oväntade platser där möjligheter att ägna sig åt givande diskussioner gällande vetenskapens roll gror.

Introduction

Climate change is exceptional within environmental politics. The particular constellation of interests, policy, and scientific discussion that surround climate change make it an intriguing site to undertake analyses where interaction between political posturing, scientific findings and organisation are central. The history and development of climate change politics rest on scientific representation, and science has thus played a crucial role. The Intergovernmental Panel on Climate Change (IPCC), is central to how climate change has become known and established as requiring a political solution (Hecht and Tirpak, 1995; Agrawala, 1998a; Edwards, 2010). In this thesis I draw attention to the role of science in the climate change context. More specifically, using a performance metaphor, I approach the IPCC as a global stage where the politics of knowledge play out, where the science of climate change is discussed, negotiated, and stabilised, and through which climate change comes to be visible and legible as a political problem.

For the last 30 years, since its establishment in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP), the IPCC has become the foremost respected and authoritative body providing scientific information to the United Nations Framework Convention on Climate Change (UNFCCC). The IPCC has to date undertaken five full Assessment Reports, and is currently embarking on its Sixth. It has produced several Special Reports, Technology Reports and Methodology Papers. In addition to its outputs, as an organisation, the IPCC has weathered controversies, and undergone procedural changes. Nonetheless its general remit and goal has remained the same; *“...to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation”* (IPCC, 1998 para 2).

As the body of scientific knowledge presented by the IPCC has become larger and the uncertainties over anthropogenic interference in the climate system have decreased, calls have come from many directions – scientists, non-governmental organisations (NGOs), the media – asking why, if the science is so clear, have political negotiations on climate change progressed so slowly. By placing science in its wider societal and political context this thesis aims to show how the

processes of negotiating and enacting science for policy are not straightforward or clear cut. Rather this enactment is a product of the particular manifestation of the science-policy relationship brought about by the interplay between the different sites in which science for policy is negotiated, staged, and articulated. Thus, “the credibility of science in contemporary political life (is seen) as a phenomenon to be explained, not to be taken for granted” (Jasanoff, 2005, p. 250). This thesis, therefore, contributes to scholarship which recognises that climate science is shaped by, and in turn shapes, the political setting in which it operates (Miller and Edwards, 2001; Jasanoff, 2004; Jasanoff and Martello, 2004; Miller, 2004, 2008). It also recognises that co-production (Jasanoff, 2004) is evident in the set up and operation of the IPCC, its methods and approaches, as well as through the way that the IPCC has contributed to a particular representation of climate change.

In this thesis I acknowledge that the role of science in society cannot be taken for granted. I start from the perspective that it is generally hard to measure any direct impact or influence of the IPCC on climate policy-making. Rather than discussing the instrumental role that science has had in shaping policy outcomes, I am interested in how the IPCC has helped to create shared scientific understandings of climate change and provided a basis on which to frame discussions on climate change in political and societal arenas. Through the undertaking of assessments, bringing together knowledge, gathering experts and communication strategies, the IPCC has presented climate change as a physical phenomenon knowable and visible to larger political audiences. This ‘enlightenment function’ (Weiss, 1977) of the IPCC, and climate change science more broadly, has ensured that the IPCC’s definition of the problem of climate change has been effectively disseminated throughout society. In particular, the capacity for the IPCC to shape the way climate change is understood as a political problem has been discussed with regard to the potential limitations that a global framing of climate change, defined through Global Circulation Models, and the pursuit of a global mitigation goal, might have in connecting with societal and political priorities at a more local level (Hulme, 2010). As a result it is possible to say that the IPCC has played a defining role in demarcating an ontological ‘realm of the possible’ for climate politics. This thesis rests on a constructivist perspective which intends to open the ‘black box’ of IPCC knowledge production, to explore how this knowledge both shapes and is amenable to political developments in the post Copenhagen climate change landscape, and how this is related to, and affected by, particular constellations of the science-policy relationship.

Aims and Research Questions

The overall aim of this thesis is to critically examine the production, negotiation, and stabilisation of policy-relevant knowledge in international climate politics. I do so by approaching the IPCC as a stage where the knowledge politics of climate change play out between and among scientific experts and government negotiators. I intend to explore the performance of knowledge (or science for policy), and in turn climate change (the object of that knowledge), and do this by drawing attention to the performative interactions which shape the relationship between knowledge production processes and policy making at the global level, with a focus on post Copenhagen climate politics. The following research questions inform my study:

1. How is science for policy staged by the IPCC and what roles do scientific experts and government negotiators play?
2. How does the ‘frontstage’ negotiation over policy-relevant climate science interplay with the ‘backstage’ production of IPCC assessment reports?
3. To what extent has international climate politics after Copenhagen shaped the knowledge politics of the IPCC, and affected the staging of policy relevant knowledge?
4. How does the IPCC assessment process render climate change knowable and visible as a political problem?

The Political Context

The time span of this thesis is the period following the 2009 UN climate summit in Copenhagen (COP15) to 2018, around the time of the publication of the IPCC Special Report on Global Warming of 1.5°C (hereafter SR15). COP15 in Copenhagen was characterised as a disappointment: despite expressing political intent to address the climate issue, it was lacking substantive and legal basis and largely seen as a result of failed ambition (Bäckstrand and Lövbrand, 2016; Bäckstrand *et al.*, 2017). This failure was seen by some as seriously damaging the reputation of the UN approach to climate policy (Dimitrov, 2010a, 2010b). Despite the Summit’s disappointing outcome, Copenhagen served as an important political benchmark, shaping the policy context in which the IPCC produced its 5th Assessment Report (between 2008 and 2014), and in which the preparations for the Paris Agreement in 2015 were undertaken.

Although discussions surrounding the role of the IPCC in the UN climate negotiations were ongoing prior to the Copenhagen Summit (Agrawala, 1998b,

1998a; Hecht and Tirpak, 1995; Lahsen, 1999), the Copenhagen Accord's reference to 2 degrees as a desirable long term temperature target (Randalls, 2010) set in motion a discussion relating to science's involvement in Article 2 of the UNFCCC. Article 2 states that the ultimate objective of the Convention is to reach "*stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (...) within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner*" (UNFCCC, 1992). In the years since Copenhagen there has been much debate over the appropriateness of a 2 degree target as a measure of dangerous climate change, particularly from the perspective of developing countries and small island states (Mooney and Warrick, 2015; Tschakert, 2015). Between 2013 and 2015 a review of the adequacy of the long term global goal (LTGG) was undertaken by the UNFCCC which included a dialogue component bringing scientists and negotiators together to consider what scientific information was needed with respect to Article 2 (the Structured Expert Dialogue). With the signing of the Paris Agreement in December 2015, and increased ambitions for the LTGG to be "well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C" (UNFCCC, 2015), a goalpost was reached in the story of climate change politics. The bottom-up, or polycentric style and approach to international climate politics based on each country's Nationally Determined Contributions (NDCs), that we see following Paris, has been distinguished from the top-down approaches characterised by the Kyoto Protocol in the years before Paris (Jordan *et al.*, 2018). This change in approach has been one suggested reason for the relative success of the Paris Agreement, as it gives countries more ownership over their climate change response (Falkner, 2016). Through involving new actors, at local and national scales, the ways of doing climate politics are thus changing. This changing political setting has provided an interesting and important context in which the IPCC's enactment of science for policy, or policy relevant knowledge, is once again under scrutiny.

For the IPCC, the years following Copenhagen have been no less formative. Between 2008 and 2014 the IPCC undertook its 5th Assessment Report (AR5), and has since embarked on its 6th (AR6). The organisation was subject to review of its internal procedures in response to the Climategate controversy of 2009¹. Between

¹ Climategate is the name given to the occasion in November 2009 (a few weeks prior to the UN Climate Summit in Copenhagen (COP15)), when the servers at the Climate Research Unit at the University of East Anglia were hacked and the contents of emails posted to the blogosphere. Climate sceptics claimed that these emails purported to show that scientists were deceiving and misleading the public through manipulating data and suppressing critics, and that this proved that global warming was a conspiracy led by scientists.

2013 and 2015 a consultation was undertaken on the IPCC's future, and it underwent a change in leadership. Following Paris, a set of Special Reports commenced preparation, the Special Report on 1.5 degrees requested directly by the UNFCCC. Other events external to the climate debate, such as the adoption of the Sustainable Development Goals in September 2015 have also drawn attention to the need for cooperation and harmonisation between different international processes, and the implications for the IPCC's knowledge making practices. For instance, scholars have called for more solutions-orientated forms of scientific assessment; assessments which through collaborative processes can assess the potential associated with different policy alternatives and their consequences (Edenhofer and Kowarsch, 2015; De Pryck and Wanneau, 2017; Kowarsch *et al.*, 2017; van der Hel and Biermann, 2017).

Thus, the period surrounding Copenhagen and Paris has been a dynamic and interesting time to study the knowledge politics of the IPCC. In this thesis I demark this period as post Copenhagen, primarily to set my study in the context of the ambitions and hopes for climate diplomacy that followed the Copenhagen conference in the run up to Paris. This also set the IPCC in the period of writing, review, and publication of the AR5, a period of deliberations over its future, and the beginning of the AR6 cycle. A premise of the thesis is that there is an interaction between the knowledge production processes and the political negotiation on climate change at a global level, this period and the sites that it introduces, have provided locations, both in terms of time and space, from which to observe such dynamics.

What kind of critique does this thesis offer?

This is a thesis about politics and power. However, in contrast to much of the literature on international climate politics and diplomacy, politics is here not primarily understood in a rational sense as a strategic struggle between strategic actors advancing policy, competing interests, and negotiating positions (e.g. Lederer, 2015; Vogler, 2015). Informed by constructivist accounts, particularly within Science and Technology Studies (STS)², I instead approach politics as a productive process being undertaken at different scales. Politics is present everywhere, but it is by nature a process (Hay, 2002). The implications of

² Science and technology studies (STS), is an interdisciplinary approach to studying science and technology from a social perspective. It developed from branches of anthropology, sociology, philosophy and history which investigate how social, political and cultural aspects are involved in scientific research and technology, and how in turn science and technology impact society, politics and culture.

recognising politics' two fold nature for an investigation of science for policy is thus that science can itself be seen as a form of governance (Hajer, 2009; Jasanoff, 2015), rather than just subject to it (Jordan *et al.*, 2015). Climate science, which in itself is diverse and contested, is deeply tied up with the shaping of policy responses and priorities at both a state and international level (Miller, 2004; Grundmann, 2007; Jasanoff, 2015; Beck *et al.*, 2017).

In this thesis I follow in the footsteps of constructivist scholars of STS who have examined the ways in which knowledge making is both defined by, and defines, broader social and political order – it is co-produced (Miller and Edwards, 2001; Jasanoff, 2004, 2005). In the sections below I will advance my conceptualisation of knowledge politics, presenting this as a co-productive and performative interplay between knowledge and politics. This interplay takes place both in deliberations over what counts as science, knowledge, and policy on global stages such as the IPCC and the UNFCCC, and in the selection and choices that take place when writing the IPCC assessment reports. I advance the concept of performance (Hilgartner, 2000; see also Bijker *et al.*, 2009) in particular to draw attention to the interplay between interactional and rational accounts of staging of science for policy (making use of Hajer's (2009; 2012) concept of dramaturgy), and accounts of the performativities of knowledge (drawing on approaches developed by Bruno Latour and other sociologists of science). As I will argue, politics is inherent in the basic choices that are made about what counts as policy relevant knowledge, in the selections that take place in the writing of an IPCC assessment report, and in how the boundaries of what counts as science are drawn.

Science has been defined as “the organised, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles” (Wilson, 1998, p. 6). However, in this thesis I intend to place it in its social context and thus see it in a more fluid form. This is particularly important when considered alongside the concept of knowledge, which is generally seen to be something broader than science, encompassing information gained through experiences outside scientific method. Despite this, science and knowledge are often both used to refer to the same things in different places, and at different parts of the processes of science-policy interaction that this thesis engages with. Whilst this will be an aspect discussed more in detail in the sections that follow, generally science will be used when talking about interactions between science and policy in particular, or the role of the broader scientific community. Knowledge on the other hand is used in a more conceptual sense, recognising that science is only one aspect of the discussion, particularly relating to the concept of policy relevant knowledge.

As many whose research involves opening up the 'black box' of science, adopting a critical approach runs the risk of being taken as a critique of the underlying

science, or particularly the need to address climate change (see Demeritt, 2001, 2006; Pielke Jr, 2007). Undertaking interviews at UN climate conferences, I have been semi-seriously advised to ‘leave the science alone’. It is of course not the purpose of this research to shed doubt on the reality of climate change – as a researcher, my pursuit of this topic is based on a tangible concern over the impacts and inequalities that climate change brings. In a subsequent section I will outline in more detail how a social constructivist perspective can contribute to the understanding of climate change and the analysis of the IPCC. However here it suffices to say that the study of science and scientific practice is important because of the role science has had in forming contemporary societies, and thus in part “the scientific establishment’s own successes have opened science to deconstruction and to skepticism” (Yearley, 2005, p. 185). As such, a constructivist approach is not denying the scientific basis on which claims about the world are made. To study the role of science is indeed important because of the tendency in modern society to take for granted the ways in which it creates our view of the world and our assumptions about it (Star, 1991). At the very least, such research can help to develop a more nuanced understanding of the role of science, at the best, it might show that recognising science as a social, or indeed political, process is not detrimental to its role in the climate change debate. Understanding why politics does not deal with science in the way that it is expected by both some scientists, and society more broadly, might open it up to proper constructive debate on how they can work together more effectively in the future. Thus, whilst the aims of this thesis are primarily empirical, I do have some normative ambitions, namely to show that there are other ways to look at familiar sites. In turn, theoretically I also want to provide a way to bring different conceptions of performance into conversation with each other, and show how making use of these differing approaches shed light on the ways that science for policy is enacted in diverse contexts.

This brings me to the wider relevance of this study. In 2016 two events took place which had the effect of destabilising the political status quo, and highlighting that expertise and the role it plays in society needs to be better understood. First, on the 23rd June the United Kingdom (UK) voted marginally in favour of leaving the European Union (EU). This took place in the wake of a campaign characterised by misinformation and proclamations such as that by the former UK Justice Secretary Michael Gove who stated in a broadcast interview that “Britain has had enough of experts” (Mance, 2016). A few months later, on the 8th November, the United States (US) elected Donald Trump as president. Whilst Trump’s election, may indeed have had tangible effects on climate politics and research, through Trumps withdrawal from the Paris Agreement, or through impacts on research funding, it is the broader context to which I refer here. Both the EU referendum and the US election with their reference to ‘alternative facts’, and the rise of so called post-

truth politics, along with a general rise in populism, show that it is not wise to take expertise for granted in modern democratic societies. In fact, we cannot expect facts alone to solve problems which have a strong ideological side to them (Jasanoff, 2017; Jasanoff and Simmet, 2017; Sismondo, 2017) of which climate change is one. One reason for this is the inevitable conflict between ‘expertise’ and ‘democracy’ through expertise’s creation of elites, and hence inequalities between those who are on the inside of knowledge and those on the outside (Demeritt, 2001; Turner, 2001). Thus, aside from offering an interesting context for investigating the role of science and expertise in modern society, this thesis provides a cautionary tale against taking for granted the role of the expert, the nature of science-policy interaction, and what counts as policy-relevant knowledge in climate politics and more broadly.

Overview of thesis

This thesis consists of this introductory and framing chapter, the ‘kappa’, and four papers. The papers explore the research questions that aim to grasp the knowledge-politics of the IPCC from different angles and scales. **Paper I** examines the different epistemological ways in which the IPCC-UNFCCC relationship is performed and defined at a time of potential change, and how this relates to different ways of conceptualising the science-policy relationship. It does so by looking at the review on the future of the IPCC, which the IPCC conducted itself between 2013 and 2015. **Paper II** turns to how the relationship between the IPCC and UNFCCC is negotiated in practice. Using the site of the AR5 Synthesis Report, the paper examines the politics of making a large body of climate science relevant for international climate policy. Together these two papers highlight the limits of objective knowledge and of linear relationships between science and policy in the production of IPCC reports, and the enactment of science for policy. **Paper III** turns to when policy relevant knowledge is placed on the broader stage of climate politics, and examines how it fares in action. The paper offers a case study of the Structured Expert Dialogue (SED) of the 2013-2015 Review of the Long Term Global Goal of the UNFCCC (hereafter LTGG). It explores the relationships between different definitions of expertise and how the boundaries between the different roles of science and policy, and between science and other types of expertise, are negotiated and enacted in a diplomatic setting. **Paper IV** explores how science-policy interactions have defined and shaped the object of the LTGG, and in turn how the scientific community have rallied to respond to a surprising development in climate politics. Again extending the focus to the broader performance of science for policy in an overtly political setting, the paper

draws upon the request from the UNFCCC for the SR15, and also particularly considers the power of the IPCC to shape and alter scientific research agendas.

The purpose of the kappa is to synthesise the findings from these papers and set them within their wider theoretical, methodological, and empirical context. Its primary goal is to draw out the main themes from the papers and use these to address the overall aim of the thesis. However, it also expands in more detail on contextual parts of the argument which could not be addressed in detail in the papers. Following this introductory chapter, the kappa proceeds as follows. Chapter Two introduces the background to this study, starting by providing a short overview of the emergence of the IPCC, before situating my work in the wider literature undertaken on the IPCC. Chapter Three outlines my theoretical understanding of knowledge politics. Chapter Four will introduce the methodology and situate the thesis within social constructivist research traditions, and clarify how it speaks to environmental science, before moving on to the specific methods and analytical techniques used to investigate the topic of this thesis. In Chapter Five I link my empirical findings with the theoretical and methodological approaches. I here draw out the main themes in the four articles that allow me to address my research aims and questions, setting them in the context of the specific cases that the articles drew upon to tell the story of the staging of science for policy that developed over the period surrounding Copenhagen and Paris. In the final Chapter, I summarise the main themes and also consider the broader implications of my findings, suggesting avenues for future research.

Setting the scene: The IPCC as an object of study

This section introduces the main study site of this thesis in more detail – the IPCC. In order to set the scene, the section proceeds with a brief introduction to the IPCC and then continues by illustrating how science for policy can be conceptualised in different ways through bringing together the diverse and prolific literature undertaken on the IPCC to date. I have chosen to divide this review with respect to what I call the objectivist and constructivist views of science for policy. In doing this it is my intention to introduce some of the key debates surrounding the IPCC and science for policy more broadly, in particular framing the constructivist approach to analysis that this thesis takes, and which will be elaborated on further in the subsequent theory and methodology chapters.

The origins of the IPCC

Scientific interest in climate change can be traced as far back as 1824, when Jean-Baptiste Fourier theorised over the ability of the earth's atmosphere to trap heat, and thus is often credited with the discovery of the greenhouse effect. In 1896 Svante Arrhenius quantified the influence that different amounts of carbon dioxide (CO₂) would have on the Earth's surface temperature. The results of his experiments, that an increase in the release of CO₂ from the burning of fossil fuels could be enough to warm the earth, introduced a link between human activity and potential changes in the surface temperature of the earth. Whilst an in-depth presentation of the history of climate science is beyond the scope of this thesis it is suffice to illustrate that scientific research into the earth's atmosphere, and its potential for anthropogenic influence on warming was of interest long before climate change, or even environmental issues more broadly, became of political concern. Development of computers, the ability to model climatic processes and integrate them in General Circulation Models (GCMs) of increasing complexity fuelled attention to climatic change on a global scale (Edwards, 2010).

The political and scientific interest that led to the establishment of the IPCC, and the UNFCCC, are deeply intertwined. A brief historical account sets the scene for

how these interactions between science and policy have continued to the present day. Calls for research on climate change were made at several of the scientific and United Nations conferences in the latter part of the 20th Century. At the United Nations Conference on the Human Environment in Stockholm in 1972 the United Nations Environment Programme (UNEP) was established. This was followed shortly after in 1979 by the First World Climate Conference organised by the World Meteorological Organisation (WMO) in Geneva, the outcome of which was the World Climate Programme (WCP). This same year, the US National Academy of Sciences formed an Ad Hoc Study Group on Carbon Dioxide and Climate, which produced the first report summarising scientific results around climate sensitivity, followed by a National Academy of Sciences report, *Changing Climate*, published in 1983 (see van der Sluijs *et al.*, 1998). For many, the pivotal moment in precipitating policy interest in climate change took place at the Villach Conference in 1985 co-sponsored by the WMO, UNEP and International Council of Scientific Unions (ICSU). This conference initiated a community of expert scientists to start exploring the policy options of responding to climate change. In 1986 the Advisory Group on Greenhouse Gases (AGGG) was established, made up of seven well established experts. In 1988, climate change was raised as a matter of concern for the UN General Assembly by Malta, proposing a need for further systematic scientific research. In December of that year, Resolution 45/53 was endorsed establishing the IPCC.

The IPCC was set up under the auspices of the WMO and the UNEP. However, subsequent to the IPCC's formation and acceptance of its First Assessment Report by the UN General Assembly in December 1990, various events took place which resulted in changes to the IPCC and defined its position with regard to the science-policy interaction on climate change. Firstly an Intergovernmental Negotiating Committee (INC) for a Framework Convention on Climate Change was established, and the task of the previous Working Group III (WGIII), in preparing policy options, was to fall under its remit. As a result the IPCC was reformulated to include Working Group I (WGI) The Scientific Basis, Working Group II (WGII) Impacts, and Working Group III (WGIII) Mitigation, a structure which has been maintained until the present day.

As this short account has shown, the IPCC is central to interactions between science and policy and the story of how climate change became a global political concern. For these reasons it has been the subject of much and varied research. A number of earlier studies focused on its institutional design and procedure, outlining the scientific and diplomatic processes involved and how this has evolved in relation to the wider international climate policy arena as a whole (Hecht and Tirpak, 1995; Franz, 1997; Agrawala, 1998b, 1998a; Skodvin, 2000b; Bolin, 2008). Agrawala (1998a) examined why the IPCC was formed at this specific time, and why it evolved in the way it did. He outlined the importance of

the involvement of WMO and UNEP in negotiating the final structure of the IPCC, but also how the process was influenced by certain individuals and states. For instance, although Agrawala believes that there was enough scientific information available for political action following the Villach Conference in 1985, hesitation from some US Agencies led to an agreed need for further information and international participation. This assumed need for wider, international participation led to the IPCC's defining, and at least early on, unique, feature – its intergovernmental nature (Agrawala, 1998a). The role of strong leadership during early development is also outlined by Skodvin (2000a), who points particularly to the role of Bert Bolin, the first IPCC Chairman, as key to providing credibility and continuity to the IPCC's efforts. Bert Bolin's personal role is outlined further in his book, which takes a more personal perspective of the inception and development of the IPCC (Bolin, 2008). The political bargaining leading up to the creation of the IPCC is an important part of more rationalist accounts to the IPCC's knowledge making practices. Such accounts include at times overt interest politics and traditional political bargaining to shape, govern, control, and define the knowledge production of the IPCC. Although often such bargaining takes place frontstage in plenary negotiations, it also happens in backstage spaces in the closed negotiating rooms and IPCC processes of government review. The IPCC can therefore be seen as a stage on which the knowledge politics of climate change play out.

Nearly all accounts of the IPCC's origin and operation demonstrate that there exists a relationship between science and policy. Negotiations between science and policy were involved in deliberations over the IPCC's setup and early form, and have continued until the present day. The ideal form in which the relationship between science and policy is conceptualised and operates is the subject of much debate, often surrounding the existence of a linear model in which science can be seen to provide policy with useful and useable evidence, or not (Pielke Jr, 2007; Pregernig, 2014; Spruijt *et al.*, 2014). In order to explain such debates, and situate my work alongside them, I shall proceed here to introduce the IPCC literature in the context of such discussions on views of science for policy, and how these relate to underlying views on science.

The IPCC as science for policy in an objectivist sense

The traditional, empiricist view sees science as providing a mirror of the world. Data that is gathered exists ‘out there’ to be measured, and as a result this reality can be reflected through the data. In this case, uncertainty comes about through a lack of science. Science is distinguished from non-scientific knowledge through its methods, which have historically been the methods of natural science, conducted by ‘disinterested’ scientists who are detached from their context, politics, and personal characteristics. The American sociologist, Robert Merton, defined what he saw as the norms of science as being those of; 1) communism, or common ownership of scientific results and methods, 2) universalism, or the adherence to common norms of objectivity that is independent of personal characteristics, 3) disinterestedness, or the action of doing science for a collective enterprise rather than one’s personal gain, and 4) a culture of organised scepticism, or the need to scrutinise and prove right (Merton, 1942). Although this is of course a caricature, or at least one end of a spectrum of thinking, much of it is still considered to be the underpinnings of modern science, and has direct implications for how an institution like the IPCC was set up, and continues to be run today.

One of the main features of the traditional view of science which defines the relationship that science has with policy is that science should be protected against non-science. As, in this view, science makes epistemically superior claims it should be set apart and insulated so as to protect its truth making ability. This means that the provision of science for policy is seen as instrumental and a matter of transfer or translation of available knowledge, and changing opinion is just a matter of providing more evidence. The so called ‘linear model’ of science communication in which science is seen as speaking truth to power has underpinned many institutional designs for scientific assessment, including the IPCC (Skodvin, 2000b; Beck, 2011). The linear model assumes that, 1) human and scientific dimensions can be completely separated, 2) that the provision of science improves politics and political decisions, and 3) that science educates politics in a uni-directional, linear manner. In the IPCC the status of policy relevant knowledge is seemingly justified through its robust, scientific basis and a “pious reverence for science” (Demeritt, 2006, p. 445). That the IPCC claims to produce ‘policy relevant, but never policy prescriptive’ reports implies a particular resistance to discussion over the political, economic, and social implications of particular policy proposals (Beck, 2011), which, at least rhetorically, protects it from non-scientific political discussions. Its periodic encyclopaedic reports provide the successively updated facts on climate change, fill knowledge gaps, and provide a basis for informed decision making on climate change.

One way the IPCC has been conceptualised in this regard is through the concept of epistemic communities, introduced by Peter Haas (e.g. Haas, 1992; Haas and

Stevens, 2011). Epistemic communities are depicted as international communities of experts who have come together to assist in policy decisions surrounding complex issues which require technical or scientific information. These communities are brought together through shared principle beliefs, causal beliefs, common notions of validity, and in pursuit of a common policy enterprise (Haas, 2004) and provide a more convincing characterisation of how ideas influence policy making. Therefore, although here the epistemic community is acknowledged as having an overt political interest in itself (at least in terms of human welfare (Haas, 1992)), expert knowledge, and the epistemic community itself, is given a place of importance and power, as it interacts with states both through helping to articulate their interests, but also by shaping these interests in the first place. The characteristics of a successful epistemic community are seen to be independence, consensus and separation from political interests. The IPCC has been taken as an example of an international epistemic community – in particular it is designed on the principles of independence, consensus and separation. Paterson (1996) in an early account of the politics of ‘global warming’, for instance, describes the IPCC as an epistemic community at its most organised. He highlights that this was particularly so in the early days of the Villach Conference in 1985, as by bringing together a core number of experts to initiate discussion on climate change under a common goal, an epistemic community was formed. Here, in the context of a new issue which was yet to find representation within formal institutions, the idea of an epistemic community is useful to explain climate change’s rising international profile (Adler and Haas, 1992). In more recent years the IPCC’s influence as an epistemic community has been questioned, primarily from a supposed inability to keep science insulated from politics (Haas and Stevens, 2011), which was argued to result in a lack of political action because the IPCC’s work was not of sufficient scientific quality³. In particular, the intergovernmental nature of the IPCC, and political involvement in the climate issue, has stopped it from operating as a pure epistemic community (Haas, 2001; Haas and Stevens, 2011). For them, the development of political institutions for climate change within the UN illustrates this. Political involvement in the climate issue was reintroduced when the task to establish a convention on climate change removed from WMO and UNEP and given instead to the UN General Assembly and the creation of the INC. This has only been exacerbated through the processes of approval and acceptance that IPCC Summaries for Policy Makers (SPMs) and reports must go through, which is seen by some as diminishing the scientific quality of the IPCC’s products (e.g. Nature, 2010).

3 There is a broader critique related to the limitations to the epistemic community model itself as a model of the organisation of scientific communities (e.g. Lahsen, 2005). Such critiques have their basis in a more constructivist notion of science, and science for policy, which will be discussed in the next section.

The IPCC is designed to adhere to an objectivist account of the science-policy interplay. Changes in procedure and rules, often in reaction to criticism and controversies that emerged in the earlier years of the IPCC's existence, such as the introduction of Review Editors, changes to the Synthesis Report to include both a Summary for Policy Makers and underlying report, mechanisms of the 'adoption', of the underlying reports, as well as guidelines for the inclusion of grey literature, have been seen to both strengthen and in some cases undermine the IPCC's scientific authority (Skodvin, 2000a; Viner and Howarth, 2014; Howarth *et al.*, 2017). The development of the IPCC's peer review process for instance has been studied by Agrawala (1998b), who describes it as much more comprehensive than that normally present within regular scientific journals. In aiming for the protection of science from non-science, particularly in the face of criticism, the IPCC subjects itself to strict scientific norms and standards. In the same vein Brysse *et al.* (2013), in a study of the IPCC's presentation of the disintegration of the West Antarctic Ice Sheet, highlight that the "basic, core values of scientific rationality contribute to an unintended bias against dramatic outcomes" (p334) and the privileging of 'scientific conservatism' graduates towards existing knowledge rather than the presentation of new and potentially dramatic findings. The authors also suggest that this in built value system of objectivity, once translated into the policy realm, could be said to act against the precautionary principle which has historically been at the basis of environmental policy (Brysse *et al.*, 2013). These examples are often seen when the IPCC is seen protecting itself against external controversy, such as Climategate, or in the case of the human attribution of climate change in the Second Assessment Report (SAR) (Lahsen, 1999, 2007), through attempting to maintain its scientific, detached, and policy neutral stance and image.

If science is to be protected from non-science, then it is also seen as susceptible to politicisation by outside influences. Characteristics inherent to this traditional view of science – its objectivity, its truth claims, and its superiority have led to those who identify as sceptics of anthropogenic climate change attempting to draw on science to enhance their positions (see Pielke Jr, 2004; Lahsen, 2013). By framing the debate as one related to science, underlying agendas can be converted into the unquestionable claim to scientific truth. Science, instead of being separated from politics, is then brought to the centre of political debate as there is an assumption that winning a scientific debate will facilitate winning a subsequent political one (Lövbrand, 2007; Beck, 2011). Along these lines, critical accounts of the emergence and early development of the IPCC have also been offered. Sonja Boehmer-Christensen presents the IPCC as a self-serving and purely political organisation (Boehmer-Christiansen, 1994b, 1994a, 1997). Whilst Boehmer-Christiansen criticises the linear model of the IPCC's design for successfully ignoring politics, the accusations of the IPCC as being politicised also point to the

dangers of using scientists to answer political questions and failing to keep science insulated from politics. In a rebuke to these pieces, Shackley and Skodvin (1995) accused Boehmer-Christiansen of 'naïve scientism' which sees the good and the bad of the IPCC purely in terms of the intellectual consistency of its arguments and operations (p180). Accusations such as Boehmer-Christiansen's, and controversies such as Climategate, have made the IPCC very sensitive to how it is perceived externally, and have in many respects strengthened pursuit of its policy neutral and scientific image. One way this has played out is in its sceptical reaction to requests from researchers wishing to understand its workings from the inside (see Hulme and Mahony, 2013; Tollefson, 2013) as supposed criticisms of the IPCC are seen as being criticisms of the underlying science of climate change.

The final feature of this objectivist view of science, which is in some ways related to the above, is its uneasy relationship with the social sciences and humanities. As, in line with this view, scientific knowledge is privileged through its methods and claims of neutrality and objectivity, consequently there is an inherent tension with the approaches of some social science disciplines which do not necessarily lay claim to these particular characteristics of science, or at least approach them in a different way. Such a viewpoint has undoubtedly influenced the operation, set up, and products of the IPCC. Indeed, in an analysis of the Third Assessment Report (TAR) only 8% of references were found to be from social science disciplines (Bjurström and Polk, 2011b). Likewise, a paper by Hiramatsu *et al.* (2008) found that the TAR and AR4 SPMs privileged approaches to looking at climate change which automatically place natural science approaches over the social sciences and humanities, namely a focus on the carbon cycle and carbon concentrations, rather than a more human centred approach to looking at impacts and effects related to human systems.

The privileging of some types of science over others is likely a result of the broader structures of science in the climate change arena. For instance, an analysis of the abstracts submitted to the Copenhagen Climate Change Congress (held in the lead up to the Copenhagen COP15 in 2009) found disciplinary, geographical and gender biases associated with the climate change knowledge presented. Suggesting the presence of a knowledge hierarchy within climate research (see also O'Neill *et al.*, 2010). Similar observations have been made with respect to the IPCC and its inability to present a truly interdisciplinary perspective (Bjurström and Polk, 2011a). Whilst claiming to present interdisciplinary information suitable for the presentation of climate change, a co-citation analysis, also on the TAR, shows that the way that the report is designed is presented as multidisciplinary, but that it stems from a clear disciplinary base. The TAR was structured in accordance with the scientific community more generally and within strict disciplinary boundaries, and the IPCC's Working Group structure contributes to this (also criticised by Leemans (2008)). Bjurström and Polk suggest that the IPCC reports

could be made more relevant through setting them in the context of wider societal goals, and go about answering broader questions that are agreed upon early in the assessment process. The authors suggest that the broader strict disciplinary nature of scientific research may be a contributing factor. Humans and other organisms are considered separate from the physical elements of the climate system, and when integrated there is a belief that social science assessments should be based on the natural sciences. In other words, there is also a linear perspective of science itself.

Whilst these studies were undertaken on earlier IPCC reports, debates are ongoing regarding the social sciences' and humanities' potential to contribute to the IPCC, with perhaps even greater fervour (e.g. Victor, 2015). Whilst scientists, who are also IPCC authors, publish papers calling into question the IPCC's inability to properly capture the wealth of social science and humanities research on climate change that is available (Minx *et al.*, 2017; see also Mach *et al.*, 2017; Mach and Field, 2017) the authors still tend to put the blame on the knowledge making practices of the social sciences, in that they do not lend themselves to being incorporated into the objective, robust, and policy neutral reports that they claim the IPCC produces. This only continues to emphasise the prevalence of the traditional view of science that the IPCC is built upon.

The dominance of the objectivist view of science, and the linear model of science for policy, is by no means confined to the scientific realm. As discussions over epistemic communities above demonstrate, in many studies of science-policy relationships, science is also taken to be an independent source of power outside the social realm (Haas, 1990; Haas, 1992; Lowlands, 1994; and for further discussion see Miller and Edwards, 2001). The objectivist view of science is common among those in politics, who rely on scientific advice for making informed decisions, and underpins calls for evidence based policy. Access to objective science is used as a power source in the climate negotiations (Lövbrand, 2009) which has led to an inevitable scientisation of politics (Weingart, 1999). Indeed, Weingart (1999) argues that the IPCC is evidence of a kind of paradox in science-policy advice, whereby although it is clear that the continued provision of more information, or a reduction in uncertainty, will not directly lead to better policy making or trust in the organisation, it continues to be utilised in this way. In other words – although the linear model, and the traditional view of science, is clearly deficient, they still form the basis for the dominant model of science-policy interaction in practice. Belief in the linear model, therefore, is potentially more important than whether it can be said to 'exist' or not. There are, indeed, other ways that we can understand science for policy which are important for this thesis. It is to the constructivist view of science to which I will now turn.

The IPCC as science for policy in a constructivist sense

From a social constructivist perspective scientific findings are not just a mirror of the world. Instead of being read from nature, data is made, and it is the chosen methods that make the reality that we come to know and see. This is not to say, however, that there is no reality in a physical sense. Bijker *et al.* describe the relationship between scientific knowledge and nature as a map; “countless decisions have to be made when drawing a map, and although various maps of the same part of the world can be equally valid, the map is related to the reality it depicts. Given this logic, it is also true that not just any map is possible” (2009, p. 29). In this respect the greatest contribution of science has been that of ‘kind-making’ (see Miller, 2007) – the separating of the world into ontological entities which has allowed us to classify and reclassify, create new categories, analyse, compare to each other, and understand in new ways. In this sense science is a distinctly human endeavour, and knowledge is inherently political. To say that science is human or knowledge political is not to say that it is necessarily politicised, but it does mean that science and politics cannot be completely separated from each other – they are co-produced (Jasanoff, 2004). In this sense, to focus on the objectivity or pureness of scientific knowledge is to only see the end result and pay no attention to the context both of its production, the choices made when producing it, and its interpretation.

That the IPCC has come to be viewed as representative of the objectivist view of science, and as embodying linear interactions of science-policy is unsurprising, but at the same time limiting. The IPCC relies on interactions with policy makers at the scoping, author nomination, and approval, and review stages of an assessment round, and its history is deeply tied up with that of the climate negotiations (see above). Thus, although the overall model and design of the IPCC still rests on a linear understanding of science for policy, from a social constructivist perspective, there is scope for critique and a deeper analysis in this regard. What is taken to be policy relevant science and what is not, is not pre-defined, and the boundary between science and policy is changeable (see boundary work in the next chapter). If taken from this perspective, the failure of the IPCC as an epistemic community discussed above is not surprising given the assumptions of a linear relationship between science and policy. One of the main critiques from this perspective is that if we see the IPCC as a pure epistemic community we tend to ignore cultural specificity, and that providing a scientific basis for the causes and impacts of climate change does not automatically lead to agreement in particular contexts (Agarwal and Narain, 1991; Lahsen, 2004). Myanna Lahsen (2004, 2009) studied the scientific community in Brazil, illustrating how the epistemic community of the IPCC is rejected by national scientists, as it is seen as representing the interests of the North. In another study Lahsen (2007) suggests that positivist views of

science and science-policy interaction may be generally less accepted in developing countries. For instance, in China, there is a reaction against the ‘epistemic hegemony’ of the IPCC (Mayer and Arndt, 2009). In other words, the idea that one organisation can ‘rule’ the scientific world of climate change, or that of imposing ‘science’, methods, and process on a country, is seen as a way of exercising control, and has even been described as ‘environmental colonialism’ (Agarwal and Narain, 1991). This argument demonstrates that there are conflicting priorities between the local and the global when it comes to climate science, and that the epistemic community maintains its role through attaching promises of international recognition associated with it. It also indicates that the IPCC is far from a universally inclusive organisation (see also Yamineva, 2017). With regard to authorship, two recent studies showed, through social network analysis, that the author team of the AR5 WGIII is indeed representative of narrow geographical, institutional, and disciplinary settings, with some scientists, largely in the United States and Europe, organising their careers of publication and coordination around IPCC assessments (Corbera *et al.*, 2016; Hughes and Paterson, 2017). Whilst this indeed could be said to be evidence of an epistemic community of scientists in WGIII, the authors also point to the fact that the relatively narrow and harmonised representation of mitigation in the report still meet resistance, suggesting that although broadening author representation may not help to aid consensus, it would perhaps increase legitimacy and connection with the report’s findings. Thus, even what is presented as the ‘best possible science’ may be challenged. This is particularly apparent when it comes to the IPCC’s representation of adaptation. Beck and Goerg (2009) demonstrate that in this respect the IPCC cannot offer a complete picture of climate adaptation as there are such different information requirements, which cannot be answered through looking at predictions from climate models (see also Beck, 2011). At an even more fundamental level, the influence of an epistemic community of the IPCC on climate change politics has been limited in national settings, by a focus on local domestic politics, or broader trends in the use of knowledge in a particular national setting (Jasanoff, 2005). For instance, the strong presence of US scientists within the IPCC has not affected the US’s political position on climate change more generally.

Bearing in mind the problems associated with considering the IPCC as an epistemic community, an alternative approach is to consider it as a *boundary organisation*. Boundary organisations are those which hold a place between science and policy, and have a role in mediating and managing the message through co-production. As a result they produce meaning both for scientific and political audiences (Guston, 2001). Petersen (2011) describes the IPCC as embodying all the features of boundary organisations; making use of ‘boundary objects’ (Star and Griesemer, 1989), existing at the frontiers of, and being accountable to, both the political and scientific worlds, and through involving both

scientific and policy actors in scoping and plenary sessions. Alternatively, others have seen the IPCC as failing to operate properly as a boundary organisation as it has not engaged properly with values, from either a scientific or a political perspective, for example, its main engagement with equity has been through the distribution of technological solutions (Hoppe *et al.*, 2013). This limitation has stemmed from early images of climate change as a purely technical issue around the time of the IPCC's inception (*ibid.*, and see above). Similar critiques underpin many of those who address the IPCC and climate change science from a constructivist perspective.

The question of values is fundamental to discussions of science for policy, particularly in the climate change context where inequalities abound, and where responses require rethinking the basis on which societies are built. Whereas a traditional view of science assumes that it is one of science's main strengths that it is a value free and detached enterprise, a constructivist view claims that science can in fact never be said to be completely value free (Carolan, 2006, 2008). In fact, the 'kind making' that science is engaged in has very fundamental implications for how the world comes to be understood, and this process is not neutral. The IPCC has played a central role in this 'kind making', in its particular framings, and use of scenarios and models, but also through its truth claims. For instance, Beck and Mahony (2017) suggest that the IPCC's presentation of feasible technical solutions may have implications if the details of scenarios like the RCP2.6 or pursuit of the 1.5 degree goal rely on negative emissions technologies, of which the details are not made explicit and discussed with respect to their political and ethical implications. This, the authors say, leads to a 'politics of anticipation' whereby through its presentation as technical fact, the IPCC goes some way to creating and endorsing the future it envisions in its scenarios. Mike Hulme has argued something similar, as through the IPCC's presentation of climate change in global terms, the assumption has been made that there is a need for a global solution, evident in the desire for a global agreement on climate change in the Climate Negotiations, discussions on carbon trading, debates over the Long Term Global Goal or questions over the viability of geoengineering solutions (Hulme, 2010, 2012, 2014). This links to discussions above about the need to involve wider disciplinary expertise in the IPCC. Limiting the disciplines which are able to substantively contribute to an IPCC assessment, also means a limit on the types of responses, criticisms, and approaches to addressing climate change discussed in the reports. Such disciplinary limitations lead to a 'de-culturing' of climate change (Hulme, 2009b). This 'de-culturing' has implications for the communication and understanding of climate change in local and national settings, as scientific discourse does not connect with what is deemed meaningful at a local level (Victor, 2015). Victor believes that the lack of communication and connection can partly be addressed through embedding the social sciences and humanities, such as

sociology, political science and anthropology, in the IPCC process. Such fields have a greater focus on what it is that makes decisions on climate change difficult, and can enable more conversation over how the basis for disputes within negotiations are often the result of different value systems, as well as offering the ability to understand what such value systems are.

The constructivist approach to science is critical of the simplistic notion of a linear relationship between science and policy. However that science is assumed to be an advisor to policy, and therefore must come before politics is not the main problem. In fact, Jasanoff (2008) suggests that it is of course beneficial to think through evidence and come to conclusions before making decisions. The main problem with the linear model, however, is that it assumes that science is neutral, and that the assumptions and inbuilt values of science are not worthy of investigation (ibid). In this regard it is increasingly suggested that the IPCC's reliance on the objectivist traditions of science to satisfy its credibility, rather than on accountability and public trust in all parts of the world, is doing it a disservice (Jasanoff, 2010; Beck, 2012). As Edenhofer and Minx suggest, "the main challenge for the future of the IPCC is not one of organisation and procedures. The real challenge is how the IPCC conducts assessments and deals with entanglement of facts and values at the science-policy interface" (2014, p. 38). In the IPCC case, the question of neutrality is exacerbated through its goal to provide reports that offer both synthesis and consensus. Some authors suggest that this claim to being both rooted in objectivity and separation leads to the assessment becoming strongly biased in particular directions to the extent that it is no longer living up to its claim to not be policy prescriptive (Edenhofer and Kowarsch, 2015). Some authors have been less forgiving and labelled the IPCC a 'stealth issue advocate' for this reason (Pielke Jr., 2007). Edenhofer and Kowarsch appeal for what they call a pragmatic approach to assessment which asks for processes of cooperative knowledge production and mutual learning which present policy options. The authors, themselves prominent within the AR5 WGIII author team, highlight that to some extent this is already what the WGIII does, however it is evident that interpreting these differing approaches to assessment within the framework of the traditional view of science means that there is some danger of them being taken as read⁴.

Functowicz and Ravetz (2003) have called for what they call a 'post-normal science', which is able to deal with issues which involve high uncertainty, complicated and contested values, with high stakes, and the need for urgent decisions, such as climate change. The IPCC has been studied from a post-normal

⁴ The fact that other IPCC authors, particularly from WGI, accuse WGIII of not being scientific is just further illustration of how entrenched this traditional view of science is within the IPCC, as well as how resistant it is to change (see Review comments as material in Paper I).

science perspective, with authors coming to different conclusions depending on which aspects they choose to focus on. Yamineva (2010) suggests that the IPCC fails as an example of a post-normal science institution through a lack of reflexivity and interdisciplinarity. On the other hand the IPCC's focus on extended peer review and management of uncertainties have been described as good examples of the philosophy of post-normal science in practice (Saloranta, 2001). The management of uncertainties is one of the most well studied aspects of the IPCC. Adler and Hirsch Hadorn (2014) undertook a review of 39 papers published on the characterisation of uncertainty in the IPCC context. This was undertaken in the Context of a Guidance Note published by the IPCC in 2010 in preparation for the Fifth Assessment Reports which in its attempt to streamline and make consistent treatment of uncertainties across Working Groups they believe led to confusion rather than greater clarity. Adler and Hirsch Hadorn examined issues related to process, scope and purpose within the reviewed literature and suggest that this confusion is partly due to the fact that different disciplines portray and measure uncertainty in different ways. This suggestion that the standardisation of uncertainty leads to more confusion than clarity has also been illustrated in particular cultural settings, with the interpretation of the IPCC's probability phrases (comparing numerical ranges with the probability phrase i.e. 'likely', 'very likely' etc) differing more from the way they were intended in China than in the UK (Harris *et al.*, 2013). Similarly, in different disciplinary settings the uncertainties can also have substantially different meanings. For instance, while a 30% likelihood is considered 'not likely' in a physical science sense, when connected to human mortality this is considered a very high risk (Fløttum, *et al.*, 2016). Whilst creating norms and guidelines to help understand a complicated concept like uncertainty is considered an important part of making the scientific basis of the IPCC as objective as possible, it is clear that there are limitations associated with this in terms of interpretation and meaning. The complexities associated with uncertainty, also extend into how it is communicated. For instance, Hollin and Pearce (2015) examined the press conference following the Plenary in Copenhagen in 2014 where the Synthesis Report was approved. In the course of the press conference, IPCC authors attempted to connect with the broader audience by focusing on temporally local events, and shorter time scales. However, when questioned on the measured 15 year 'pause' in warming the authors attempted to stress the fact that these trends can be considered less scientifically relevant than longer term trends and projections. This presented the authors as having an "incoherently oscillating position" on the timescales involved in climate science (ibid, 2015: 3), illustrating the complexities and tensions between 'scientific certainty' and 'public meaning'. This example demonstrates that if the robustness of scientific concepts are important, then work at the boundary, in this case a press conference, can lead to confusions between science and nonscience (Guston, 2001). It also highlights the importance of trust in, and

credibility of, the messenger playing a vital role in the shaping of public dialogue on climate change, rather than just the articulation of scientific certainty.

The influence that the IPCC is assumed to have had is also an issue of interest with regard to the particular conceptualisation of science, or science for policy in focus. If a linear model of science for policy is being adhered to, it would follow that more science with successively lower uncertainties, should lead to better and more enduring policy decisions. However, in the case of climate change this is rarely seen to be the case. Skodvin (2000b), following a detailed study on the structure and agency of the early IPCC, concluded that the organisation can be described as fairly effective if we base this assessment on the attribution of anthropogenic climate change, and in terms of broad suggestions for policy and societal response. In other words, the IPCC has been effective in terms of diagnosing a problem, but not in terms of concrete actions and behaviour change. The next step in the chain, towards policy action, is seen to be missing. There are two main reasons for this, firstly perhaps simply because ensuring policy action cannot be solely solved through science, and secondly, that it is not possible to assess the effectiveness of the IPCC through its impact on policy because the relationship between science and policy is not this straightforward.

If then on the other hand we see the science-policy relationship as not linear, but constantly changing and co-produced, it is impossible to measure the impact of science on policy without at least being critical of what ‘impact’ is in the first place. From a constructivist perspective, the IPCC’s goal “...to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change”⁵, and its degree of success in fulfilling it, becomes a lot more complicated. In their 2010 review of the literature on the IPCC, Hulme and Mahony (2010) suggest that if influence is considered in a broader sense than just that of science-policy, then the IPCC has played a large part in influencing public discourses, and indeed on climate change knowledge more broadly. Hannah Hughes describes this broader ‘enlightenment function’ of the IPCC as its ‘symbolic power’ (Hughes, 2015). If the IPCC’s influence is taken as broader than just its direct impact on policy outcomes, it has also been described as potentially being *too* successful as although its definition of the problem of climate change has been disseminated throughout society, “its framing has also produced particular identities, delegated responsibilities, and prescribed specific remedies” (Lidskog and Sundqvist, 2015, p. 14) at the expense of others.

The broader, more conceptual framing of the influence of the IPCC has meant that it has acted as the role model for the creation for other intergovernmental science-

5 From IPCC homepage

policy institutions and large scale scientific assessments (Dahan-Dalmedico, 2008), such as the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES), established in 2012. Or to offer pointers as to how science for policy can be best undertaken in the case of anti-bacterial resistance (Pearce, *et al.*, 2018). With the creation of IPBES for instance the opportunity has been taken to attempt to redesign the model of science-policy to take into account elements of a more nuanced view of science for policy, and to some extent the IPCC's limitations have led to improvements and suggestions for changes. Beck *et al.* (2014) undertook a comparison of the IPCC and IPBES designs to highlight the need for reflexive thinking when it comes to designing assessment panels. They describe the transparent and open process of negotiations in the set-up of the IPBES which contrasted to the IPCC's relatively closed proceedings. In addition the IPBES has taken into account the potential for expertise to include more than pure scientific knowledge, and the need for multi scalar assessments including a conceptual framework for how to consider different knowledge systems (Borie and Hulme, 2015). Although it remains to be seen how these structures will be utilised as the IPBES matures, attempts to be more reflexive and responsive to the changing context and needs of policy illustrates a departure from the strict confines of a linear view of science for policy. Calls to be more responsive to changes in the political realm have also been made for the IPCC. For instance Devès *et al.* (2017) point to the need to reconsider how science for policy is done in the face of changing structures of climate governance from a top down to more bottom up approach (see introduction for more information on these changing climate politics and governance). Much of the recent work on the future of the IPCC suggests that the status of policy relevant knowledge in the climate change context needs to be justified through its co-construction and increased transparency rather than through its claims to objectivity and robustness, so called anti-boundary work (De Pryck and Wanneau, 2017). Beck and Mahony (2018a, 2018b) suggest that the IPCC's future engagement should follow a mode of 'responsible assessment', one which is both responsive to a changing political context and reflexive with regard to sensitive issues in climate politics. The fact that prominent authors of the IPCC (at least from WGII and WGIII) continue to draw attention to potential changes needed to the assessment processes of the IPCC, for instance to find ways to better incorporate different policy dimensions and aim to recognise the normative basis of these different viewpoints (Kowarsch and Jabbour, 2017; Kowarsch *et al.*, 2017), or drawing attention to the subjective nature of expert judgement in assessments (Mach *et al.*, 2017) shows that this debate has gone beyond critical social science, to also encompass those who are actively involved in IPCC assessments.

Theoretical framework and concepts: Theorising knowledge politics

This thesis aims to critically examine how policy relevant knowledge is produced, negotiated, and stabilised in international climate politics. I do so by situating my study within STS approaches that have taken an interest in the close interplay between environmental knowledge-making and decision making (e.g. Beck *et al.*, 2017). While work in this field is diverse, it often converges around a constructivist understanding both to analysis (see next chapter), and to science for policy (see above). As one of the leading proponents of STS, Sergio Sismondo, states, “because it does not separate epistemic and political processes, STS can genuinely study knowledge societies and technological societies rather than treat knowledge and technology as externalities to political processes” (2007, p. 26). Thus, in particular STS emphasises that through reintroducing the importance of context into discussions of science in society it matters *how* knowledge of global environmental problems is done, and in turn who does it, as this has had implications for how environmental problems come to be known and understood more broadly.

Most STS scholars question science’s ability to access the ‘truth’ and any efforts to strictly separate science from politics. Firstly the separation between these two domains creates a false dichotomy, and secondly, there is no direct route from science to policy, or from truth to power. As outlined by Lidskog and Sundqvist “there can be no direct path from science to policy as long as there are different ways of knowing and acting, which explains why the same expert knowledge receives different political responses in different social and political contexts” (2015, p. 10). Thus, the challenge of addressing climate change from a practical perspective is related to ontological and epistemological perspectives on what knowledge we consider relevant in a particular setting, as well as how this knowledge is contextualised within other value systems and power structures.

The IPCC occupies a central position within STS debates on environmental knowledge- and policy-making (Beck, 2015; Jasanoff, 2015; Beck *et al.*, 2017; Beck and Mahony, 2018a). The IPCC’s hybrid position at the intersection of science and politics has made it a particularly interesting place to examine how the micro- and macro-politics of knowledge constitute climate change as a political

problem. In order to understand this better, I will here introduce my conceptualisation of knowledge politics to bring together relationships between knowledge production, knowledge interpretations, and broader social order.

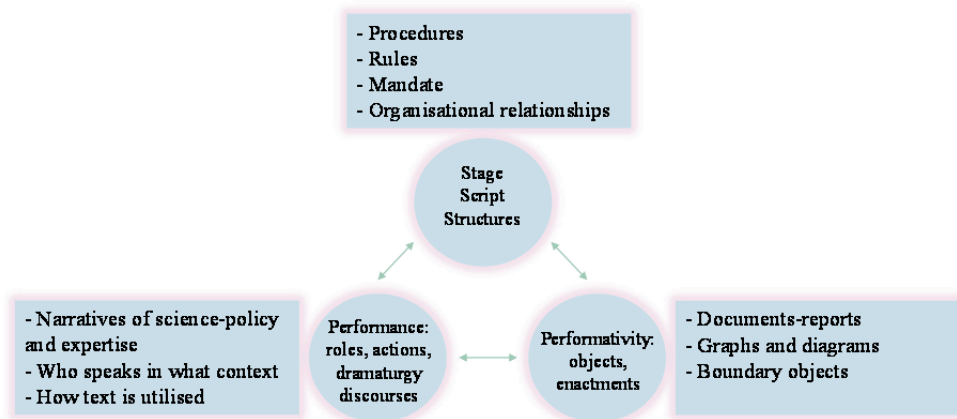
Knowledge politics

In this thesis I use the term knowledge politics to draw attention to both the decisions that are made, and the everyday practices performed, in the pursuit of policy relevant knowledge. These decisions are set within a broader infrastructure, and social and political context, which both facilitates and constrains. A core ontological assumption that underpins my conceptualisation of knowledge politics is that knowledge and socio-political order are co-produced (Miller, 2001a; e.g. Jasanoff, 2004; Miller, 2008; Mahony and Hulme, 2018). In line with Beck *et al.* (2017), I argue that “expertise does not simply lie in specific exercises of knowledge-making...but also the social conditions and institutional dynamics in which knowledge is rendered authoritative and unchallengeable” (p. 1069). In the field of climate science and politics, there is a simultaneous construction of epistemic and political authority. One of the leading proponents of the notion of co-production, Sheila Jasanoff (2004), makes a distinction between, what she terms, *constitutive* and *interactional* co-production. Constitutive co-production is concerned with the emergence of new facts and systems of thought, whilst interactional co-production is more concerned with the relationships between existing categories, such as between science and politics. They are thus dealing respectively with ontological and epistemological elements of knowledge politics (Jasanoff, 2004). Whilst my conceptualisation of knowledge politics engages mainly with the first of these – constitutive co-production – it also touches on the second particularly when discussing the directional elements of a science-policy relationship. My account of knowledge politics suggests that the interactional elements of co-production cannot be disentangled from the constitutive. Interactions between science and policy in the IPCC assessment process, and the decisions that are made over knowledge at different political scales, both within the IPCC and the UNFCCC, shape how climate change comes to be known as a political problem.

Co-production helps to draw linkages between the different settings and sites in which science for policy is, made, contested, and articulated (Jasanoff and Martello, 2004). In discussing the ways in which science is tied up with broader social order it draws attention to the identities, institutions, discourses and representations involved in these processes (Jasanoff, 2004). Miller (2008) has described the IPCC as an institution which is designed specifically to produce and validate knowledge in global politics. He outlines how the IPCC has done this

through a combination of, 1) standard-setting for international knowledge, 2) through creating new deliberative spaces, and 3) through making new global kinds. In this thesis I draw upon, and seek to advance Miller’s account of co-production by introducing the notion of performance and the performativity of IPCC knowledge. The IPCC in this context is primarily seen as a global stage on which performances of knowledge politics take place. It does this through firstly considering performance in a more discursive, and in some sense more rationalist sense, in which governments play central roles in the bargaining over knowledge, and scientists play the role of experts, secondly it introduces the idea of the performativity of knowledge politics with regard to how it is involved in constitutive enactments of climate change as a political problem. In particular these performances take place through interactions between the *stage or scripts* of knowledge politics – the procedures, rules, mandates, and organisational relationships; the *performances and roles* of knowledge politics – narratives of science for policy, who is an expert, who gets to speak, and in what context; and the *objects and enactments* of knowledge politics – the IPCC reports, their graphs, and the Long Term Global Goal (LTGG) (see Figure 1).

Figure 1: A conceptualisation of the constitutive parts of knowledge politics



In bringing together the stage, scripts, performance, roles, objects, and enactments of knowledge politics, I must touch briefly on the role of structure and agency in this thesis. Like other researchers in STS I see structure-agency as one of many false dualisms that exist within our social structures and subsequently research agendas⁶. Actors and structures are both important, and indeed depend on each

⁶ The deconstructing, or critique of what they see as false dualisms is central to many STS accounts, for instance deconstructing the nature/culture divide (Latour, 1991), divisions between socio and technical (Bijker et al., 1987; Pinch, 2008), or between science and politics (Jasanoff, 1990; 2004).

other for their existence. The use of the co-production idiom with its focus on the relationship between science and broader social order, and the performance metaphor which stresses the relationship between actions and context and naturally implies the importance of both. Agents are present within a context, and this provides both opportunities and constraints (see Hay, 2002). The papers that make up this thesis focus more or less on different aspects of this structure-agency interplay, but the one thing they all stress is that the most important aspect is the recognition that there is a complex interplay between them. The conceptualisation of knowledge politics which I develop here builds on this assumption – that the context in which the performance takes place and the particular actions or roles taken and performed are both important in mutually shaping and forming each other. In doing this, it puts particular emphasis on the process, the how, and the doing of this knowledge politics. It is also important to note that agency in this thesis is not confined to human subjects (see also Bijker, *et al.*, 1987; Latour, 1991; Pinch, 2008). Indeed, in emphasising the performativity of objects it introduces an agency to these objects which helps to see how they can prove formative in shaping elements of broader social life. This will be expanded upon below.

For the remainder of this chapter I will, firstly, outline what using the metaphor of performance adds to the knowledge politics of climate change, through presenting how this metaphor has been used before in the context of organisations engaging in science for policy. Following this, I will expand in more detail on how I perceive the different accounts of the performance, and performativity of knowledge politics, in this thesis, and how they can help to bring forward the interplays between the dramaturgy, objects, and enactments of knowledge politics. Finally I will reintroduce the idea of backstage and frontstage sites which situate the knowledge politics in relation to its context or stage, and where we can study it.

A performance metaphor

If co-production forms the ontological ground for my conceptualisation of knowledge politics, performance is the metaphor that I advance to analyse how co-production plays out in practice. Before I expand in more detail on how I make use of this term, I will first outline how it has been used previously and in turn how I see it as a useful addition to the knowledge politics lexicon.

Carl Death (2009, 2011) took the site of global summits as performances, sites where environmental governance is seen to play out. He argues that despite the seeming failure of conferences like COP15 in Copenhagen to yield any substantial, concrete outcome, their successes should also be seen in terms of the symbolic role they play in persuading their audience, on a global societal scale, of

the importance of action on environmental issues like climate change. The performances seen at global environmental summits like Copenhagen are a “tool of global environmental governance” (Death, 2011, p3). Death also highlights that often, the perception of performance taking place at such events, is seen in a negative light, as a way of hiding the ‘real’ politics and power present. Death highlights that approaching a global environmental summit primarily through a performative approach which takes the discursive and dramaturgy of the event seriously (Death situates his account in Foucault’s work on governmentality), means that the symbolic instead takes a central shaping role in the defining of “subjectivities, relationships, and world-views” (ibid, p6). Through this, it therefore shapes the norms and directions of global environmental governance.

Death’s account of the performative nature of global environmental summits, present these summits as extraordinary events taking place in the public eye, and thus highlight their centrality and importance in a broader environmental governance regime. However, the concept of performance has also been used specifically to look at the day to day practices of science advice. The notion of science advice as performance, and in particular its relationship to authority, has been studied with respect to the National Academy of Sciences (NAS) in the United States (Hilgartner, 2000) and the Health Council of the Netherlands (Bijker *et al.*, 2009). Both of these studies have drawn on the metaphor of performance to investigate how scientific advisors, and the bodies that they represent, present themselves to their audiences – in most cases the political and public realm, but also the wider scientific community and researchers on a variety of topics. The dual role that advisory bodies have, in making their work intelligible and authoritative in different contexts, is co-productive in an interactional sense, as the knowledge and advice that they produce is a result of mediation between these different contexts, and constitutive as, through particular ways of producing, performing, and subjecting to critique, this knowledge provides new ways of understanding the world. These studies draw attention to how an advisory body as a character has a varying set of interests and identity depending on the setting in which they find themselves, and the audience they are dealing with. The identities and interests of an advisory organisation are not fixed, particularly as they find themselves constantly having to define themselves, and their position between science and policy (Bijker *et al.*, 2009). In both Hilgartner and Bijker *et al.*’s studies the authors use the concept of *boundary work* in order to develop this interrelation. They see boundary work as an important aim in the performance of science advice which leads to how these organisations define authority in different settings. Originally developed by Gieryn (1983), boundary work looks at how through science is attributed certain characteristics through the work of practitioners, methods, values, and organisation. The two sides of boundary work – essentialism (demarcating science), and its constructivist critique (examining the

socially constructed boundaries) identified by Gieryn (1995) are very closely related to the objectivist and constructivist views of science discussed in the previous chapter. Boundary work takes place as the cognitive authority of science is challenged from different angles, through performative means, something that advisory organisations are constantly doing when situating themselves alongside policy, the public, or indeed the broader scientific community. Boundary work therefore has a main aim to maintain the cognitive authority of science advice, and this is, in line with performative approaches, very dependent on its context and specifics of the places where it is challenged. It is therefore a particularly useful concept to consider when considering the authority given to the IPCC, and the knowledge that it produces. I therefore see boundary work as a part of the performative work the IPCC engages in.

Performance can take place in the public eye, or frontstage, when knowledge is challenged and defended, and in many cases subsequently settled. One such place could be the environmental summits of Death's account. However, it can also take place behind the scenes, or backstage, in the meetings and writing that go into preparing advisory reports. When looking at advisory organisations, like the Netherlands Health Council and the NAS, although rhetoric and discourse are important parts of their performances of science for policy, the material and social techniques of boundary work are thought to be particularly important, and Bijker *et al.* propose extending the definitions of boundary work to also include them. Despite this, the emphasis on the performative capacity given to objects in these accounts is not something of primary prominence. One potential exception that Hilgartner presents is the performative capacity of written documents, which in their formalised structure and the permanence given to their final form, the history of their production tends to be concealed. Despite this "written texts not only become carriers of meaning but also means of social organisation implicated in effecting divisions between performers and audiences and structuring the relations among them" (2000: 19). Thus, documents are not only performative in the discursive and rhetorical sense, they also perform a material function in controlling what information is included or excluded – what Hilgartner terms information enclosure and disclosure (p19). Although the IPCC is not an advisory organisation in the same sense of the national examples studied by Hilgartner and Bijker *et al.* there are several similarities which make it an appropriate comparison, not least its unique location and the challenges it faces. As the IPCC is operating in an international space with a formalised intergovernmental aspect it is yet more complicated than the examples of the Netherlands Health Council and the NAS which operate in distinct national settings.

In the context of the IPCC therefore, and in line with the accounts by Hilgartner and Bijker *et al.* in particular, a useful aspect of the performance metaphor is that it introduces the idea of a frontstage and backstage. This frontstage and backstage

loosely translate respectively to formal and accessible and informal and restricted. These terms have been particularly useful methodologically as they have helped define the sites in which knowledge politics is played out. The claim that the IPCC takes a different form in different spaces and times, or indeed in the frontstage and backstage (Jasanoff, 1990; Lidskog and Sundqvist, 2015; Sundqvist *et al.*, 2017), can be examined using a performance approach. Both those who approach the IPCC as an epistemic community of experts separate from policy (Haas, 2004, also Haas and Stevens, 2011), and as a boundary or hybrid organisation mediating between science and policy (Guston, 2001; Miller, 2001b) see the scientific and political actions and identities as separate (either as external to or within the IPCC as an organisation). However, approaching the knowledge politics of the IPCC through performance does not automatically assume a distinction between these parts. Although the discussion that follows makes much of the language of the interaction between scientific and political elements⁷ it also draws attention to the mundane practices that could also be described as neither (see also Hughes, 2012). Finally, and connected to the previous point, the use of performance in this thesis allows an extension beyond just the IPCC. The IPCC's distinct political setting is one of the main motivations to approaching the knowledge politics of the IPCC through the performance metaphor. In turn, the global setting in which it operates brings it into contact with the theatrical stage of environmental summits like those outlined by Death, such as Copenhagen or Paris. Thus, the spaces in which the knowledge politics of the IPCC play out are often of central political importance in the articulation of climate change governance. As outlined above, the co-production between the IPCC's knowledge and its broader social setting, is central, particularly as it brings together more discursive accounts of performance, with those of the performativity of knowledge. It is to each of these respectively that I now turn.

Performing knowledge politics – the dramaturgy of knowledge politics

In order to look at the performance or dramaturgy of knowledge politics, I am inspired by Maarten Hajer's theory of policy making as performance. This approach extends his previous work on the discourse analysis of politics, setting it in the context of a world where the growth of media has led to new ways of thinking about policy and governance. This element of knowledge politics is essentially discursive, and is taken to be an interplay between discourse – what is being said, the particular vocabularies used, and what effects they have, combined with the dramaturgy – how it is said, where, and to whom (Hajer, 2009, see also

⁷ This is primarily because I recognise that science and politics are defining categories which have had a large influence on public discourse and therefore make use of the terms throughout the thesis.

Goffman, 1959 for early usage of the term). Hajer's original definition of discourse is as "an ensemble of ideas, concepts, and categorisations through which meaning is allocated to social and physical phenomena, and that is produced in and reproduces in turn an identifiable set of practices" (1995, p. 44). Adding an explicit consideration of 'the stage', the site, or the context in which discourse is articulated places more attention on the practices of language use (Hajer and Versteeg, 2005; Hajer, 2009) and the less rationalist aspects of notions and ideas that are specific to particular sites and contribute to the successive storage of particular meanings. In this context Hajer (2009) stresses how often it is the 'situations of dislocation' which draw attention to the performances – in other words, it is when discursive regularities apparent in particular structures or institutions of discourse are disrupted, as they act to disconnect and reconnect aspects of the discourse in different ways (Hajer and Versteeg, 2005). In this account involved actors make strategic use of both stages like the IPCC, and particular discursive articulations in order to articulate their agendas.

Although not born within STS, this particular approach to policy fits well with co-productive STS approaches, in particular because of its emphasis on the importance of context in shaping how reality comes to be known, in this case through language. In addition, and of vital importance to my conceptualisation of knowledge politics, is how the site in which contestations take place becomes central to how it is understood. There are many sites where politics happens, what Hajer calls a 'politics of multiplicities' (2009). Within STS the recognition of this geography to knowledge politics, and also how knowledge travels and circulates from one site to another, is of key importance (Mahony, 2013; Mahony and Hulme, 2018). Geography in this sense is related to the spatial aspect of the sites of politics that goes beyond the typical sites of politics. In this case, "events transpiring in the laboratory or in computer modelling centres can be as influential in shaping the landscape of global environmental governance as the meetings of international diplomats" (Miller and Edwards, 2001, p. 21). What is important in a performative sense here is that specific interactions between the acts of discourse utilisation and the scene, or context in which it takes place, means that actors may perform differently in different contexts and subsequently result in different types of meaning making (Hajer, 2009). If science, and the act of negotiating science for policy, is subject to this performative analysis it means that the roles and acts may indeed change in different settings. As a result, the assumption that authority in governance is not given, rather it must be performed, is central to this approach.

Although Hajer developed this performative metaphor with policy making in mind it is clear that there are parallels with the negotiation of science for policy, which makes it useful for my conceptualisation of knowledge politics. As is evident from the discussion in the previous section regarding the types of science, and science for policy, there is an authority given to science advice that can qualify it for being

seen as a type of governance, as well as it being subject to governance itself (Jasanoff, 1990; Hilgartner, 2000). In this sense a performative approach is automatically critical of any approach which assumes a linear and unidirectional relationship between science and policy. Science is a form of governance, and is therefore intimately tied up with the shaping of political responses – a point that is also central to co-production. Interestingly, Hajer, due to his personal role as head of the Netherlands Environmental Assessment Agency (PBL) at the time of Climategate, has made use of his performance metaphor to examine at how the IPCC's authority was challenged at this time (Hajer, 2012). He highlights that the IPCC being labelled an authority through scientific means did not help in this moment of disruption, it also had to act out this authority. He stresses that as the IPCC's scientific assessments are seen as a specific institutional 'practice' which is separate from science itself (Jasanoff, 1990; Miller, 2001b; see also Bijker, *et al.*, 2009) then it is not enough for the IPCC's authority to come purely from what it says or the science it presents. In this sense communication is more than argumentation on the basis of pure science, it has a performative aspect which comes about through its specific articulation in different contexts. Such a claim fits with constructivist claims that science is not just authoritative because it is based on objective facts which reflect the real world, and that as a consequence the science-policy relationship is more complicated than it has made out to be (see also Beck, 2012). The choice to stick to pure science in environmental assessments can also therefore be seen as a political choice (Hajer, 2012), and indeed a choice which has implications for the way that climate change is understood more broadly.

The performativity of knowledge politics – bringing in materiality

In the previous section I focused on performance where discussion and textual articulation are taken to be the objects of analysis (Hajer and Versteeg, 2005). However, only focusing on these primarily discursive elements of knowledge politics overlooks an aspect I consider to be important for the negotiation and stabilisation of science for politics, that is the objects themselves, their construction, articulation, and effects. This material dimension is not explicit in Hajer's accounts of the performativity of discourses although it is suggested in the studies of advisory organisations that I outlined above. To include this dimension I borrow from studies of the sociology of science which deal with how objects such as scientific reports, diagrams, or in some cases more abstract concepts like specific measurement systems, come to be stable things around which science is articulated and given meaning. A focus on materiality is still in essence a discursive approach, as the understanding of objects is ultimately reliant on the language that is used to describe them, of which science is one such language

(Latour and Woolgar, 1986). Here performativity is expanded to also include the objects themselves. In this sense the objects are not just, to use a theatrical metaphor, props, used to help articulate particular positions within discursive structures, although in many cases this is how they are utilised (see also Pinch, 2008). They are also able to acquire greater meaning, which means that in a performative sense they come to represent the reality of climate change, they also enact climate change (see also Mol, 2002).

Bringing objects into the centre of analysis is inspired in some sense by the work of Bruno Latour, in which non-human and human actors, or ‘actants’ are both seen as having agency and have a role in shaping outcomes, and therefore should be treated in the same way analytically (see Latour, 1987, 2005). The ‘politics of multiplicity’ that Hajer outlines, is thus also made visible by looking at localised technical practices and devices which are located in networks made up of both human and technical elements. It is only through looking in detail at these technical elements that we can see what ties society together. Latour’s work took place within a context of sociology’s focus on the human, and general resistance to including the non-human, technical, and mechanical in social analyses. However, recognition that creating artificial divisions between the human and natural world in terms of their inherent agency subsequently leads to a view of nature as pure also has implications for how we view the social within technical systems such as science. According to Latour and Woolgar (1986), in their seminal work based on an ethnography in a biology lab, what becomes known as scientific facts are a result of a combination of the social processes of persuasion, the particular equipment used, the existence of laboratories in the first place, and the paper publishing and citations that result from this work. This research, simultaneously draws attention to the role of objects and the social as equally important and can bring forward the mundane social practices of science (Latour and Woolgar, 1986) which are central to understanding how facts stabilise. Although this perspective stresses that attempts should be made to try to not distinguish between humans and non-humans, Latour argues that this ‘flattening’ is different from not recognising how humans and non-humans differ in an empirical sense. Indeed the use of particular technical objects has been recognised as one of the ways science has been defined as a distinctive community (Latour and Woolgar, 1986). As the distinction between the social and material is clearly important for my understanding of knowledge politics and in the context of interactions between science and politics, especially in connection with a more discursive approach to performance, the flattening is taken to be, in line with the constructivist approach to science outlined above, “a way of breaking down reified boundaries that prevent us from seeing the ways in which humans and machines are intermingled” (Star, 1991, p. 43).

Whilst I term this the ‘materiality of knowledge politics’, it goes beyond the material nature of objects. Indeed, whilst I recognise that objects can be both *physically* material (e.g. like a published report), or *conceptually* material (e.g. a diagram, measurement system, or a concept), it is not this distinction that is the focus, rather it is the way in which these objects are co-produced in and with their social settings. Therefore I use the terms object and materiality alongside each other. One way that social studies of science have dealt with this is through the concept of *boundary objects*. Developed by Star and Griesemer (1989), boundary objects were first discussed with respect to the development of a Natural History Museum in Berkeley as a way to ensure coherence and cooperation across different social worlds – of which science and politics are two. They are objects which are structured enough to ensure that there is some degree of consistency of identity across sites, but at the same time they are still flexible in the sense that specific meanings, in different localised settings can be attached to them (ibid, p 393). The consensus over these objects does not come from their reflection of nature, but rather through the work undertaken by diverse actors. The authors outline four different types of boundary object. Two of which are the most relevant in the context of science for policy, namely the *ideal type*, and the *standardised form*. The former is an object which has been abstracted so that it does not directly describe the specifics of any particular aspect and thus can mean something different in different settings, an example would be a diagram or an atlas. The latter, are those objects which have communication across social worlds in mind; such as methods, particular procedures, rules, or vocabularies. Thus, as outlined above, boundary objects can be both abstract and concrete in nature.

The notion of boundary objects has been used by researchers looking at the IPCC to explain how it becomes intelligible and accepted by different audiences. For instance Hoppe *et al.* (2013) describe the SPM as a boundary object that is not purely scientific, or purely political, but is an outcome of both of these processes and potentially more powerful as a result. The importance of visual representations of climate change in providing meaning at the boundaries has also been discussed with respect to the ‘burning embers’ diagram present in the SPM of WGIII of the 4th Assessment Report (AR4) (Mahony and Hulme, 2012; Mahony, 2015). The boundary nature of this diagram is not as an objective assessment of risks, but as an ‘epistemic thing’, condensing the complexity of the underlying assessment reports into a powerful visual image. The reduction in complexity is recognised as an important boundary step in the communication of climate change science to a wider audience, despite perhaps losing meaning in the process. The complex balance of maintaining credibility, impact and objectivity that the IPCC battles with is in some ways encapsulated in this one diagram. The complexities of climate change are translated into something meaningful, knowable, and comparable. To do this, standardisation is very important (Barry, 2001). Star

(2010) has elaborated on her earlier work to outline how boundary objects and standards are inextricably linked, as the process of scaling up and standardising boundary objects they become joined together in networks, and here infrastructure, universal standards, and processes are born.

In this sense, to include objects in my conceptualisation of knowledge politics has a threefold objective. Firstly, it recognises that both material and immaterial objects are essentially social creations and secondly, that they are often at the centre of the ‘situations of dislocation’ which Hajer (2009) highlight as analytical points of interest in a performative approach to discursive analysis. Indeed, in Hajer’s (2012) examination of the IPCC’s performance of authority particular numbers associated with the percentage of the Netherlands under sea-level and the date by which the Himalayan glaciers would disappear, which were established to be inaccurate, became central. The political is then taken to be the way that these artefacts, activities, or practices become ‘objects of contestation’ (Barry, 2001). Thirdly, if objects can be seen as being political in themselves then this extends the realm of the political beyond that which is conventional, and in turn recognises that focusing only on conventional sites may overlook where the real struggles are in controversies over knowledge, and that these struggles might take place simultaneously at different places (Barry, 2001, 2013).

The sites of knowledge politics – frontstage and backstage

The previous sections have suggested that knowledge politics is not just the largescale negotiations on the role of science in policy, but also negotiations over what is included in the IPCC reports, the settings where this happens, and ultimately the productive power of the IPCC within deliberations over what counts as policy relevant knowledge. Both Hilgartner and Bijker *et al.* in their respective studies of the NAS and the Netherlands Health council outlined above, highlight the importance of what they term ‘stage management’, as an interplay between the stage (or site), the actors themselves, and the techniques, props, and procedures used to structure scientific advice, and produce its authority. Stage management thus also involves an interplay between the frontstage – where the performance takes place, with the backstage – where the performance is prepared. It is possible to see the IPCC itself as engaging in stage management, acting as a mediator in the writing and negotiation of climate change knowledge. However, as I am concerned with the spaces within the IPCC, as well as those between it and science and policy the concept of stage management can only be taken to be one part of the story. Instead the frontstage and backstage of the science-policy interface are taken to present a set of micro-geographies where the knowledge politics of the IPCC plays out, not necessarily defined by physical or organisational spaces (Mahony, 2015). Boundary work, as a performance, can indeed take place both frontstage, in

the public (or political) eye, or backstage, out of sight and inside the ‘black box’ of science for policy (see also Weisser and Muller Mahn, 2017 in the context of the Paris COP21). I argue that to understand science for policy, it is essential to consider how the frontstage and backstage interact and how the formal and informal happenings play a role in shaping what becomes known as policy relevant knowledge. Neither of these frontstage or backstage sites are taken to be more important, or ‘real’ than the other. Rather, as in any performance, it is the interplay between them which helps us to understand the knowledge politics of the IPCC.

Overall, in this thesis I advance a notion of knowledge politics that draws upon both approaches to performance making use of dramaturgy and discourse, and those which deal with the more performative aspect, and in particular the material elements of the performance of science for policy. These approaches provide a theoretical framework in which investigation of the IPCC’s knowledge making practices can be explored from different angles, but with a base in constructivist approaches. Taking a performative approach to science for policy suggests that the IPCC is not just engaging in writing the science of climate change, nor is it a simple matter of translating it and offering different interpretations or interactional co-production, it is also where meaning is made. In other words there is an ontological aspect. This ‘ontological politics’ (Mol, 1999, 2002; Mol and Law, 2002), implies a constitutive co-production, in which the making of a particular ‘object’ (be this material or metaphorical) with infrastructures to support it and policy to frame it enables a particular definition of reality to come into being. Whilst this ontological aspect is not the main focus of my knowledge politics framework, it is an important one in both an epistemological and theoretical sense as it illustrates the links between the different elements of co-production, linking strands of thought within STS, and also how easy it is to move from claims of epistemological constructivism to those of ontological constructivism (discussed in the next section). Finally, and perhaps most importantly, it draws attention to the potential for the normative capacity of the policy relevant knowledge that the IPCC produces and its production of meaning on climate change (see for instance Beck and Mahony, 2017). All of these aspects will be taken forward in the discussions that follow.

Methodology, method, and material

A constructivist approach to inquiry

The previous section situates my thesis theoretically in the post-modern social constructivist research traditions of STS. Before I present the methodology and methods used to undertake this study I will discuss the implications of a social constructivist approach to the undertaking of this thesis. As a philosophy of science social constructivism has ontological, epistemological, and methodological implications for the way research is undertaken. Hay (2002) outlines how postmodernism is characterised by; firstly, an ontology of difference – whereby experiences are seen as culturally and socially specific and rather than taking reality to be something external, it becomes our reality through our experience of it; secondly, an epistemological scepticism – it considers that every type of knowledge has a context, even those which are truth claims; and thirdly, a deconstructivist methodology which does not aim to make grand claims, and instead provides a contextualised and alternative understanding of the world which it explores. As a consequence of taking this approach, and the topic of study in this thesis, the links between the ontological, epistemological, and methodological aspects are particularly important. In order to better shed light on how a constructivist approach can be used (and also defended) in social science inquiry, Demeritt (2006) identifies four different ways in which construction could take place. Firstly, one could refer to construction as in the construction of *social* reality; this means, for instance, the difference between sex as a social condition versus sex as a fundamental biological difference. Secondly, this could refer to *institutional* construction of the social within the traditions of science, such as the emergence of disciplines or of climate science in particular. Thirdly, construction could refer to the construction of *knowledge* and standards (epistemological construction), such as labelling as ‘laws’ of physics, or of Global Warming Potential as a concept. Finally, there is the most extreme example of the social construction of *objective* reality (ontological construction), or the idea that something only exists if it is talked about or believed in. Whilst each of these positions are considered more extreme than the previous one, Alvesson and

Sköldberg (2018)⁸ highlight how easy it is to move between the different types. This is indeed something that has become apparent over the course of this research, as whilst my account is mainly concerned with the epistemological level, i.e. knowledge as socially constructed, in an analytical sense it is easy to then move in an ontological direction, where that knowledge becomes reality.

Social science inquiry is crucial to understanding complex and multifaceted environmental problems such as climate change and the challenges of coming to solutions on how to respond to them (Victor, 2015; Eisenstein, 2017; Shwom *et al.*, 2017). It enables us to show that these responses are about more than just the best utility of available science, or the identification of gaps in our knowledge about natural processes, but also to examine the structures and institutionalisation of knowledge production. Undoubtedly, opening science, scientific concepts and environmental problems up to this particular kind of constructivist approach leads to complications, if not ontological and epistemological headaches and challenges from those who believe in science's ability to speak truth to power. However, the most potent criticism of science does not take place within the constructivist social sciences. Instead it happens when science comes under public scrutiny, when debates are had over the distinction between experts and lay people, when risk assessments and decisions are challenged or rejected within law courts, and when these controversies gain coverage and recognition in media (e.g. Lahsen, 1999; Pielke Jr., 2007; Leiserowitz *et al.*, 2013). As seen in the previous section, the tensions between science, politics, and the broader public, become easier to understand when approached from the perspective of STS. As argued by Jasanoff and Wynne they "...provide a more textured and useful account of how scientific knowledge becomes (or fails to become) robust in policy contexts" (1998, p. 74).

Another way in which an STS approach advances the study of environmental issues methodologically is to diminish the difference between the natural and social sciences, through recognising the social and cultural context of all research and its more reflexive understanding of science as social practice (Demeritt, 2001; Becher and Trowler, 2002). Often, the IPCC is referred to in passing or used as a key reference to highlight the importance of climate change as an issue of pressing societal concern. Whilst this thesis does not dispute these claims, it recognises that the IPCC is rarely properly problematised in environmental science circles, and that putting the IPCC at the centre of study is not detrimental to its overall goal of providing summaries of climate change science. This thesis was undertaken within an environment science department, using social science theory and methodology, but with a large focus on understanding the ontologies and epistemologies of

⁸ Alvesson and Sköldberg use a slightly different classification scheme of critical, social, epistemological, and ontological forms of constructivism, which correspond closely to those of Demeritt.

climate change science. As climate change science is in itself a composite of many different approaches and scientific disciplines (Jasanoff 2015), reflecting on the nature of disciplines is relevant from both a theoretical and practical perspective. Disciplines are seen to break the world into ‘epistemologically manageable parts’ (Carolan, 2008). Becher and Trowler (2002) outline how disciplines are somewhat like tribes in their tendency to create cultures and territories. In doing this, the professional roles for those engaging in these ‘tribes’ are defined by the tasks in which they engage. The mantras of inter- and trans- disciplinarity, espoused within subjects like sustainability science or environmental studies, are increasingly creating their own kind of disciplinary culture, with their own stories and traditions which aim to shed light on more integrated aspects and holistic understandings of environmental problems or their solutions. I argue that we should be open to this type of interdisciplinarity, which tries to push the boundaries of what, and how, we know about the world. However, when we do this, we must try to understand the ontological basis on which our various knowledge claims are based. In this way, my methodologies, context, theoretical approach, and aims are tightly linked.

To advance a social analysis of climate change, however, is not in itself interdisciplinary. In some ways this thesis is not situated in any specific discipline, instead it draws from several ways of thinking about the world, as outlined above. My aim is to speak to both environmental science, and a more theoretical social science audience, as well as hopefully being of interest to those involved more practically in the work of the IPCC and the UNFCCC. Overall, however, the types of questions that I ask, and the approach that I take, require answering with a qualitative methodology. While I recognise that my analysis is contextual both in time and place, and concerned with the qualities, processes, and meanings of the content of the particular cases I engage with (Denzin and Lincoln, 2011; Creswell, 2013) I hope that it will still provide the possibility for the existence of common dynamics in other cases besides that of climate change, or the IPCC. As suggested by Davies and Dodd (2002), it is difficult to apply strict levels of objectivity, neutrality, and rigour to qualitative research. This however does not mean that qualitative studies are not scientific, in the sense assumed by the models of physical sciences, or indeed quantitative social sciences (Davies and Dodd, 2002; DeLyser, 2010; also see previous discussions). Qualitative approaches gain their strength through carefulness, reliability, and openness of research practices and interpretation, meaning that, “if we reconceptualise what we often understand as weaknesses within qualitative research, we can begin to see them as the real strengths and rigour” (Davies and Dodd, 2002, p. 3). In the following sections I reflect in some detail upon the methodological approach, and specifics of method and material drawn upon in this thesis.

Overall methodological approach

This thesis argues that a combined analysis of the frontstage and backstage knowledge politics of the IPCC is necessary to fully understand how climate change is construed as a political problem. To examine both the frontstage sites of the IPCC knowledge politics – the IPCC and UNFCCC Plenaries, the published Assessment Report; and the backstage sites – processes of writing, draft reports, and submissions to internal reviews – allows me to open up and unpack taken-for-granted IPCC representations of climate change and explore how they come into being. My framework of knowledge politics, whilst assuming a co-productive lens (Jasanoff, 2004), draws on the notion of performance to bring science for policy together with its social context. Thus this performance has three aspects which encompass the methodological breadth of this thesis.

Firstly, the staging of negotiations over science for policy in the IPCC requires an investigation into the decisions made, its socio-political context, the history, and formulation of the rules and procedures that shape and constrain it (the stage or scripts of knowledge politics in Figure 1 above). Secondly, the performance, making use of Hajer's (2009) concept of dramaturgy, draw attention to what is said, by who, to whom, and how this is related to the broader structural context. Here, language is recognised as being an important way in which meaning is ascribed to the world, and is often taken for granted (Jorgensen and Phillips, 2002). Ideas about science for policy, identities, and vocabularies are important as they allow me to explore what this means for the kinds of choices and ideas that determine what makes policy relevant knowledge on climate change. In fact, in a fraught policy landscape, the emphasis on language and ideas on the construction of policy relevant knowledge is arguably even more important than if studying the making of science within its pure disciplinary context. Here, talk is seen as action rather than pure communication (Whatmore 2002), and has implications for how policy relevance, and subsequently climate change, becomes known in the world. Thirdly, the performativity of specific material practices are brought into the analysis to explore the intertextuality between language (the currency of human thinking and knowing) and the objects (the stuff of the world) (Whatmore, 2003) in the negotiation of science for policy. Drawing on semi-ethnographic approaches towards the object (e.g. Callon, 1984; Latour and Woolgar, 1986; Mol, 2002) the material aspect of science for policy sees the object as devices which themselves perform what climate change is, and in doing this enacts climate change in different ways. In methodological terms, a combination of the above implies a semi-ethnographic, multiple method approach; a methodology which utilises exploration of both texts (interviews, documents, IPCC reports, webcast transcriptions), and tracing the objects (IPCC reports, diagrams, devices) through various sites, and which place emphasis on both the backstage and frontstage sites

where this is performed. Drawing attention to the interactions between these can highlight the conflicts and tensions present in the negotiation of science for policy and identify the ‘situations of dislocation’ (Hajer, 2009) central to how climate change becomes known and articulated. The sections that follow describe the methods that I used in my study in some detail.

Material and Methods

The material for this thesis came from a variety of sources, including documents, participant observation, online webcasts, and interviews. The documents used for this study consist of published IPCC reports, draft reports, comments received from governmental and expert review rounds, country submissions to IPCC plenaries, agendas and reports from IPCC and UNFCCC plenaries and other meetings sessions, reports prepared for the IPCC and UNFCCC (in particularly the SBSTA and SBI sessions). Reports from IPCC and UNFCCC plenaries were also complemented by reports from other sources, such as the Earth Negotiation Bulletin (ENBs) to provide context to decisions made and discussions had at Plenaries which I did not attend (for a full list of documents included see Appendix 1 to this kappa). Participant observation was undertaken at the Conferences of the Parties (COPs) to the UNFCCC in Paris 2015 (COP21) and in Bonn 2017 (COP23), at two UNFCCC intersessional meetings in Bonn in 2014 and 2015 (SB40 and SB42), and one IPCC Plenary in Copenhagen in 2014 (40th Plenary). Webcasts from 13 joint sessions of the SBSTA and SBI during, and prior to this time, were also utilised to provide detailed contents of the Structured Expert Dialogue undertaken as part of the 2013-2015 Review on the Long Term Global Goal. In addition I undertook 19 semi structured interviews with members of the IPCC Core Writing Team and Technical Support Unit, and undertook informal discussions during my attendance at the IPCC and UNFCCC plenaries. Full details of this material is provided in Table 1 and Appendix 1 below. I will elaborate on the methods used to collect and analyse this material in more detail in the sections that follow, discussing their contributions, and also their challenges and limitations.

Interviews	
Individual and position	Date and Place
Co-Chair WGI and Member of SYR Core Writing Team	Bonn SB42 – 4th June
Member of Synthesis Report Technical Support Unit	Paris COP21 – 3rd December 2015
Co-Chair WGII and Member of SYR Core Writing Team	Skype Interview – 13th January 2016
Member of SYR Core Writing Team	Skype Interview – 13th January 2016
Member of SYR Core Writing Team	Skype Interview – 28th April 2016
Member of SYR Core Writing Team	Skype Interview – 9th May 2016
Member of SYR Core Writing Team	Skype Interview – 3rd May 2016
Member of SYR Core Writing Team	Skype Interview – 10th May 2016
Member of SYR Core Writing Team	Skype Interview – 6th September 2016
Coordinating Lead Author Chapter 2 1.5 Special Report	Skype Interview – 17th January 2018
Lead Author Chapter 1 1.5 Special Report	Skype Interview – 13th February 2018
Lead Author Chapter 1 1.5 Special Report	Skype Interview – 20th February 2018
Lead Author Chapter 2 1.5 Special Report	Skype Interview – 22nd February 2018
Review Editor Chapter 2 1.5 Special Report	Skype Interview – 18th March 2018
Review Editor Chapter 2 1.5 Special Report	Skype Interview – 23rd March 2018
Lead Author Chapter 2 1.5 Special Report	Response received in writing
Lead Author Chapter 4 1.5 Special Report	Skype Interview – 29th May 2018
Lead Author Chapter 3 1.5 Special Report	Skype Interview – 30th May 2018
Lead Author Chapter 4 1.5 Special Report	Skype Interview – 2nd July 2018
Webcasts of the Structured Expert Dialogue	
SED session	UNFCCC Session and Date
SED 1	SB 38, Bonn 5 June 2013
SED 2	COP 19/SB 39, Warsaw 12-13 November 2013
SED 3 Part 1	SB 40, Bonn 6 June 2014
SED 3 Part 2	SB 40, Bonn 7 June 2014
SED 3 Part 3	SB 40, Bonn 8 June 2014
SED 3 Part 4	SB 40, Bonn 8 June 2014
SED 4 Part 1	COP 20/SB 41, Lima 2 December 2014
SED 4 Part 2	COP 20/SB 41, Lima 3 December 2014
SED 4 part 3	ADP 2:8, Geneva 8 February 2015
SED 4 Part 4	ADP 2:8, Geneva 9 February 2015
SED 4 part 4	ADP 2:8, Geneva 9 February 2015
SBSTA and SBI special event on the 2013–2015 review (SED 5)	SB 42, Bonn 2 June 2015
UNFCCC and IPCC Sessions attended	
Session Attended	Dates
SB40 Bonn	4- 14 June 2014
IPCC 40th Plenary Copenhagen	24 – 31 October 2014
SB42 Bonn	1 – 11 June 2015
COP21 Paris	30 – November – 12 December 2015
COP23 Fiji / Bonn	6 – 17 November 2017

Table 1: Sources of interview, webcast, and participant observation data

Data collection

Documents

While the exact *documents* used depended in part on the particular case being studied, they generally cover the period 2008-2018 from the plenary decision to undertake a Fifth IPCC Assessment Report (AR5) in 2008, to the scoping and writing of the IPCC Special Report on 1.5 degrees in 2018. Overall this coincided conveniently with the period encompassing COP15 in Copenhagen and COP21 in Paris. Any documentation from outside this time came when I traced a specific aspect, like the LTGG, through the IPCC or UNFCCC's history. All documents used in this thesis are freely available for download from the IPCC, UNFCCC, or ENB archive of documentation on their websites. I gathered this documentation in order to develop accounts of the preparation of reports, the changes they undergo, the people involved, and, if available, information on tensions present. Thus the documents were used to structure accounts, provide background, and details. Whilst some documents (comments on reports) were available in their raw unprocessed form, the accounts told by documents are inevitably structured and polished accounts of events, which hide the complexities of their creation (Atkinson and Coffey, 2004). The nature of this documentation, particularly meeting reports, is such that they provide the reader with information on the tensions that are present. This and the draft reports and comments from review rounds provide windows in to the backstage deliberations of their creation. However there is much more that can be gained about the context and interactions than can be gleaned from written accounts in any form. Therefore the limitations of documentary sources can be addressed by combining them with other methods like interviews or observations.

Participant Observations

As outlined above *participant observations* were undertaken at four UNFCCC and one IPCC meeting between 2014 and 2017. These made up a part of the frontstage performance of science for policy. I attended all of these in the capacity of nongovernmental observer, and for the UNFCCC meetings as part of the Research and Independent Non-Governmental Organisation (RINGO) constituency. According to DeWalt and DeWalt (2011) participant observation is a method that involves taking part in "the daily activities, rituals, interactions, and events of a group of people as one of the means of learning the explicit and tacit aspects of their life routines and their culture" (p. 1). At the UNFCCC meetings this involved attending open negotiating sessions and events, in particular those from the Subsidiary Body for Scientific and Technological Advice (SBSTA), and joint sessions with the Subsidiary Body for Implementation (SBI). In addition to the formal negotiations I attended side events, particularly those run by the IPCC, or

other research organisations, relating to science, science-policy interactions and my cases. I also attended RINGO briefing meetings, and high level events with members of the UNFCCC Secretariat. At the IPCC meeting I observed the whole approval session for the AR5 Synthesis Report, the opening press conference event, and attended the reception at the town hall. Whilst at these meetings I took written field notes of every event I attended and photos where it was permitted. I took notes on who was in attendance, what was being discussed, and the layout and dynamics of the sessions which I wrote up on my return. Whilst my initial plan was to undertake interviews at these sessions, and had prepared questions, I found the circumstances to be too rushed and not conducive to getting in-depth into any topic. The few interviews that I undertook at these meetings were informal and not recorded. Despite this, I undertook informal discussions with several individuals which were included in my field notes, and used the opportunity to gain contacts which I followed up with formal interviews. Ethnographic research is by definition messy and comprises many different forms of data.

Including these meetings in my research design opened up the sites of analysis, and brought in new angles to the negotiation of science for policy. As Campbell *et al.* (2014) outline, these meetings can enable researchers to see the actual doing of environmental governance, as they provide a window into much broader networks and provide a place to examine these summits as new sites of politics (see also Death, 2009, 2011; Lövbrand, *et al.*, 2017; Schatz, 2009). Attending these meetings, in addition to reading the formal reports produced in preparation and summarising the happenings at these meetings, allowed me to study the process as well as the outcomes (Lie, 2013), an aspect important for both my methodological design and theoretical approach. In a practical sense undertaking this participatory observation served as a place for inspiration for the particular cases I pursued, or in the search for mysteries worthy of investigation (Alvesson and Kärreman, 2011), and as a place to assist in my understanding the context and complexities of the setting I was researching. Understanding this context was particularly useful when undertaking interviews with key actors as it increased my authority on the topic. More broadly, it gave me insight to the types of tensions, importance of interpersonal relationships, physical context, diverse actors coming together in space and time, and of the complex mixing of formal and informal elements in environmental governance. These insights added meaning beyond generalised understandings of politics and its effects (Schatz, 2009). Particularly in the context of a framework of performance these meetings proved important sites to examine the relationships between the symbolic, the staged, the spontaneous, and the material aspects of knowledge politics in the context of climate change governance (Death, 2011).

The challenges and limitations of undertaking ethnographic research are several, particularly in the context of the UNFCCC and IPCC. To start with there is a problem with access, as many parts of the meetings where the core negotiations take place are closed to observers. Thus observers are always at the mercy of others in what they are deemed permitted to see, an aspect which is perhaps more apparent here than when undertaking a more conventional ethnographic study as there are strict pre-set rules and procedures for the involvement of observers in UN meetings (see also Weisser and Müller-Mahn, 2017). As an observer in a specific setting you are never completely neutral, your role is to both be an observer and a participant (DeWalt and Dewalt, 2011). At UNFCCC or IPCC conferences you are already given an official status as ‘observer’ which automatically assigns a certain type of access and authority to your position. Despite this, as an observer you are given access to a setting (i.e. the conference as a whole) that is deemed inaccessible for many outside of the conference halls. Therefore you are given ‘peripheral membership’ to the research context (Adler and Adler, 1987) which enables a partial and differentiated access. To further complicate this my role changed from setting to setting within the conference. At a side event at a UNFCCC session I was a researcher authoritative on a certain topic, whilst in a negotiation setting at the same session I became an outsider to the political process playing out in front of me. This protected me from the dangers of ‘going native’ associated with a fully immersive participatory approach. Finally, as one person undertaking research at these meetings it is impossible to get universal coverage, and indeed as Campbell *et al.* (2014) outline even in undertaking their collaborative event ethnography utilising a team of researchers simultaneously, this is not the aim of ethnographic research. To claim to be able to gain universal coverage would be counterproductive to the epistemological approaches to in this thesis. As with the documents described above, observations are useful in combination with more in-depth interviews as the combination can help to shed light on how practices play out in real time, and interviews can provide “...commentary, fantasy, and clues as to what is not being directly manifested in behaviour and interaction.” (Alvesson and Kärreman, 2011, p. 109).

Semi-Structured Interviews and webcasts

To complement the use of documents and participant observations, I made use of data gathered through *webcasts* and *semi-structured interviews*. The *webcasts* from sessions of the Structured Expert Dialogue (SED) undertaken between 2013 and 2015, at the UNFCCC’s COPs and intersessionals, were a valuable source for investigation into the SED, forming part of the frontstage performance of science for policy. Although I attended sessions of the SED at the Bonn intersessionals (SB40 and SB42), and gained context from observing them in action, the availability of all the webcasts, the expert presentations and agendas online enabled me to fill in the gaps. A total of 34 hours of webcasts were available,

which took the form of a set of expert presentations, and a subsequent question and answer session. These webcasts were watched and listened to, and transcribed in NVivo⁹, thus they provided both textual and contextual data to my analysis which complimented official reports and documents associated with this SED. This enabled me to see both the performative and practical elements associated with these reports.

A large part of the data for this study came from *semi-structured interviews* with IPCC authors and members of the Technical Support Unit (TSU). For these I approached authors involved specifically in the AR5 SYR, the SR15, and the SED, therefore this was a purposeful sampling technique with an already pre-defined group of experts. Some individuals were approached in person at the UNFCCC and IPCC meetings, and then invitation to interview was followed up via email, others were approached directly via email. Most interviews were undertaken over Skype, and recorded at the interviewees' discretion. I approached the interviews with a loosely structured set of questions (see Appendix 2 for these guiding questions), which opened with the interviewees being encouraged to tell their story of their personal involvement within the IPCC. The presence of a set of guiding questions made it possible for some freedom to be added to the conversation, but also allowed me to steer them back if they went too far off track. I also allowed some freedom for additional follow up questions which I decided based on the particular conversation. In line with suggestions on elite or expert interviewing I allowed the interviewee to lead the conversation (Buckley Owen, 2011). Thus although each interview followed a similar overall structure, the content and style differed depending on the individual being interviewed. After the interview the recordings were transcribed directly in NVivo.

The interviews served the purpose of filling in the gaps between the formal presentations in documents and what was observed in the participant observations. They also enabled me to gain detailed stories of IPCC authors' involvement in the writing process and go beyond the finished text to open up the backstage of decisions and contestations made. The access that these interviews gave me to the backstage work of the IPCC and author team deliberations was their main benefit, however they also shed further light on frontstage deliberations at the Plenary sessions, albeit from each interviewee's particular perspective. There are of course challenges and limitations associated with using expert interviews. Involving humans as agents in the research process brings with it the challenges of power relations and interpersonal relationships, but yet has the added benefit of avoiding assumptions made when interpreting textual or observational data (Denzin and Lincoln, 2011; Creswell, 2013). Firstly, the responses that I received were in some ways strongly limited by who agreed to be interviewed. When approaching the

⁹ NVivo qualitative data analysis software; QSR International Pty Ltd. Version 11, 2017.

authors I sent many more requests to individuals than I intended to interview, in response I received a number of negative responses, some asking for further information, and in some rare cases immediate positive responses. Although interviewing experts in general is associated with a low response rate, the IPCC is a closed organisation, and approaching authors to comment on its workings is challenging, particularly when my questions related to a currently ongoing writing process. Many authors responded that they did not feel comfortable talking to an outsider about their work for the IPCC. There is also a gender aspect to this, as those authors who felt comfortable speaking to me were generally more senior male authors, and normally those who had been involved in the IPCC for a while. Although their seniority meant that they had detailed insight to the IPCC, this may have led to a certain viewpoint being presented¹⁰. The challenges of getting people to respond to my requests for interviews also raises another potential limitation – that those who agreed to be interviewed are those who feel like they have something specific to say on the issue (Berry, 2002). Whilst this does not seem to have been a particular issue in the interviews I undertook it is important to recognise that these interviews are always personal accounts and provide a particular picture of the IPCC and its workings. This however, does not make these accounts any less ‘true’.

In the paragraphs above I have outlined some of the potential limitations and challenges associated with the particular methods that I have used for data collection. Whilst possible extensions to this work will be suggested in the concluding pages there is one methodological point worth reflecting on here. Whilst attempts have been made, and requests put in motion to allow groups of researchers to undertake ethnographic research on the IPCC (see Hulme and Mahony, 2013; Tollefson, 2013), the IPCC remains a closed organisation, resistant to outsiders critique and inquiry. Whilst in order to truly understand the backstage settings where reports are written and the negotiation of what counts as policy relevant science it would be necessary to undertake ethnographic research at author meetings or the IPCC Secretariat, these still remain off limits for researchers. This thesis therefore has tried to make up for this by interviewing authors and asking about their first hand experiences, but the fact remains that this kind of research is always subject to others’ perspectives of these events and is thus limited in this regard.

Data analysis and interpretation

10 The closed nature of the IPCC I encountered in my data collection is worth reflecting upon in dialogue with the views of science that I discuss in my theory section, and in relation to questions over what policy relevant information is in the IPCC context. I shall reflect on this in the discussion section.

Taken together, the data I gathered using the methods outlined above allowed me to bring together different perspectives on how science for policy is negotiated in the frontstage and backstage sites of the IPCC. Although each paper utilised a slightly different analytical approach, here I will provide a brief overview of the ways in which my empirical data was brought into dialogue with the theoretical approaches, and what techniques were used for analysis.

As the interviews and webcasts resulted in transcripts which served as intermediaries between the researcher and the researched (Whatmore, 2003), the main analytical approach was that of thematic, textual analysis. For both the documents and transcripts, the analysis began with a thematic mapping of the texts, particularly looking for the understandings relating to science for policy, and taken-for-granted assumptions about what constitutes policy relevant knowledge. These understandings were identified through inductive coding of the transcripts and documents which provided the building blocks for interpretation. To do this I read the texts at first to get a general sense of the coding I would use, and as through the reading I identified other aspects of interest the coding became more detailed and complex. Although the analytical themes were not completely pre-defined prior to analysis, the approach to coding was abductive in the sense that it made use of an interplay and alternation between theory and empirical clues (Alvesson and Sköldbberg, 2018, p. 5). Thus my coding was both theoretically and empirically driven (Fereday and Muir-Cochrane, 2006). Combining the empirics from the interviews, documents, webcasts, and participant observations, allowed me to both develop chronological accounts of the specific cases, and give meaning to these accounts through attention to the stage on which they take place, and the discursive and material approaches that they use (Czarniawska, 2004; Hajer, 2009). These accounts also helped to identify how the specific objects of analysis are produced, understood, and taken for granted within physical and discursive structures. I was also careful to consider the analysis more than just a textual exercise, ensuring that I went beyond content to also recognise the performativities of both documents, and the objects such as graphs and maps included in my analysis (Weisser, 2014). In this sense recognising that documents are in fact always documents-in-use (Rapley, 2007), i.e. the context in which they are used plays an important part in understanding their role and place in performative approaches to the IPCC's knowledge politics. Overall, my analytical approach made use of an integrated collection and analysis of data and a zooming in and out between the empirics and theory, which allowed for specific aspects of interest to be explored in more detail, or for my methods to be refined. The analysis of qualitative data in this sense means taking accounts, deconstructing them, redrawing and transforming them in the context of my specific research questions and theoretical perspective, it is through this analytical process that meaning is produced (Crang, 2003; Czarniawska, 2004). For instance, it was generally

around moments of tension, or ‘situations of dislocation’ where there appeared to be a mismatch between some particular elements – be this within the theoretical debate, between science-policy, or backstage-frontstage, or within the scientific community – that stimulated my interest in a particular aspect of the construction, negotiation and stabilisation of policy relevant knowledge. These moments were then investigated in more detail, and framed to bring forward the ways in which they address questions about the knowledge politics of the IPCC.

Situating the researcher

This section started with outlining what a social constructivist approach to research means, before turning to a more practical presentation of the research methods used for collection and analysis. This thesis is concerned closely with the making of knowledge for policy, the choices that go into this making of knowledge, and the political implications that certain conceptions of knowledge have. Thus the perspective that methods are productive is an essential part of both the actual inquiry of this thesis, and the methodological approach I have taken. Therefore this positionality bears a little more reflexivity than perhaps standard within an environmental science thesis, as I believe that the performativity of methods needs to be discussed with respect to how we use empirical material, and even how we talk about data (Alvesson and Kärreman, 2011). Although the methods above are presented in an orderly fashion, the process is much more complicated, as to anticipate everything in advance will ultimately lead to something being missed (Clark, 2003). The first aspect here then is that, in the words of Law and Urry (2004) “...there are no innocent ‘methods’...” (p. 402), and second, the researcher is not disembodied, neutral, and detached from these methods. My personal identity – female, social scientist, European – undoubtedly impacted on the access I am given to particular accounts, physical access to particular events, and the responses I get from people I interviewed (see DeWalt and DeWalt, 2011). These are all aspects that I have felt at certain points within the research process. As a researcher, I see myself as actively involved in the production of this data instead of an external collector of data readily available to me (Alvesson and Kärreman, 2011; Neumann and Neumann, 2015). Whilst this is most obvious with regard to participatory observation, it also true for the other methods that I have used. The choices made over which methods to use in the first place, and how they are undertaken, are not free from values, or distinct from the context and cultural setting. It is this which helps to provide meaning to the research, as “if research could only be discussed in terms of its inner consistency, each research report, or each school of research, would become an island, closed in on itself, unable to participate in a broader discussion about knowledge and

society” (Jorgensen and Phillips, 2002, p. 174). By reflecting at length on the choices I made, the specific approaches to methods above I have attempted to stress that doing research is never detached and isolated, rather it shapes, and is shaped by, the choices we make, the approaches we use, and the way in which we choose to present it (see also Pryke *et al.*, 2003). Being open and explicit about such choices thus has the effect of strengthening rather than weakening the research. The remainder of this kappa is dedicated to presenting the outcomes of my research in more detail.

Staging Climate Science for Policy: The knowledge politics of the IPCC after Copenhagen

In the previous sections I have presented the context, background, and methodology used to approach the aims and research questions of this thesis. As this study is based on a collection of articles which all examined slightly different aspects of these questions, this section attempts to draw out the main themes from the articles and bring them together. This is not an exhaustive synthesis of all the issues raised in the articles, it focuses on the main aspects which bring them together, and on the main aim of this thesis, to critically examine the production, negotiation, and stabilisation of policy-relevant knowledge in international climate politics after Copenhagen, and more specifically in relation to the IPCC and the UNFCCC.

As the sections above have made clear, the realm of climate change science-policy deliberations, and the IPCC in particular, is a complicated one. The organisation and processes of the IPCC have been described in some detail before, and at various times in its history (Agrawala, 1998b, 1998a; Skodvin, 2000b; Hulme and Mahony, 2010; Hughes, 2012; Beck and Mahony, 2018a), however getting to know the workings of these organisations and their interaction has been a large part of the research undertaken in my thesis. Before I present the main themes from my papers, and by way of setting a stage on which to present the performative aspects of science for policy, I will first briefly describe the IPCC, and its spaces of interaction with the UNFCCC, in more detail. This will also serve the purpose of showing how my papers aimed to address different aspects of the knowledge politics of the IPCC.

The Stage: Organising the IPCC

The IPCC can be broadly divided into the Secretariat, the Executive Committee, the Bureau, the Technical Support Units (TSU) for the three Working Groups and the Task Force on National Greenhouse Gas Inventories, the authors and review

editors, and the IPCC member states (see figure 2 for the IPCC's official graphic of how these bodies relate to each other). The Secretariat is the only permanent structure of the IPCC. Housed at WMO's headquarters in Geneva, it consists of 13 members of staff working on communication, management, support, and organisation. These staff are the only individuals who receive monetary remuneration for their work with the IPCC. It also serves as a contact point, for both the focal points of the IPCC member states, observer organisations, and for other bodies within the UN system and in particular the UNFCCC. The Executive Committee was established in 2010 in response to the InterAcademy Council (IAC) review of the IPCC (which took place after Climategate) and is made up of the IPCC Chair and Vice-Chairs and the Co-Chairs of the three WGs, the heads of the TSUs, and the Secretary of the IPCC. Its purpose is to strengthen inter WG coordination and communication, to oversee the management of urgent issues, such as errors in completed reports, and communication and outreach (see IPCC, 2011). The Bureau comprises 31 members, made up of the IPCC Chair, the IPCC Vice-Chairs, the Co-Chairs and Vice-Chairs of the Working Groups and the Co-Chairs of the Task Force, and therefore whilst there is some overlap with the Executive Committee, its purpose is to provide scientific and technical support, advise on management and strategy, and to take decisions on specific issues assigned to it. The most important with respect to this thesis is the Bureau's role in developing and agreeing the list of authors for each Working Group report, and engagement with the broader scientific community in the countries and regions that they represent – providing a link between the IPCC and the scientists whose work contributes to assessments. The Bureau is elected for the duration of one assessment cycle, and aims to represent all regions of the world, as defined by WMO.

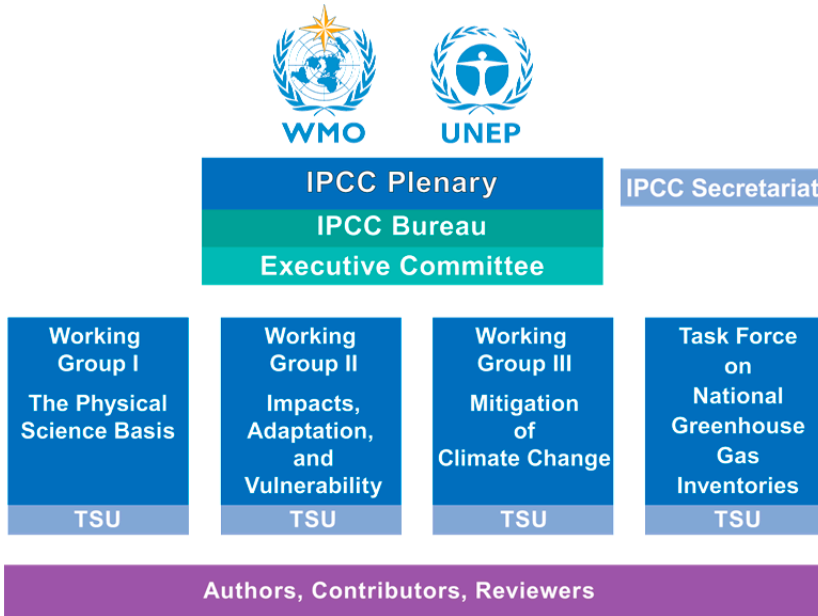


Figure 2: The IPCC's organisational structure (Image: IPCC Website)

The Technical Support Units (TSUs) are set up to support the preparation of the three Working Group Reports (and the Task Force), they are funded by the government of the developed country Co-Chair and hosted by an independent research institute within that country for the duration of an IPCC Assessment Cycle. TSUs are also set up for any Special Reports that the IPCC prepares. Although often overlooked as administrative and technical in many analyses of the IPCC, the TSU has a crucial role in the undertaking of writing an IPCC report (see Hughes, 2012), as they generally have a key, and influential, role in decisions over the final reports, and over the management of the WG author teams.

Author teams for each of the WGs are nominated by the IPCC member governments or by the Observer Organisations and selected by the Bureau members for the WG for which they are being considered for. Coordinating Lead Authors (CLAs), of which there are normally two per chapter, have the role of coordinating the chapter to which they are assigned, and are supported by a team of Lead Authors (LAs). Authors are chosen both for their scientific and particular disciplinary merit, but also taking into account gender and geographical balance. In addition, throughout the process Contributing Authors may be involved to provide more technical information regarding particular topics. The selection of authors has received substantial coverage in the scholarly literature, particularly with respect to the disciplinary or geographical representation of the author team (see Bjurström and Polk, 2011; Corbera *et al.*, 2015; Ho Lem, 2011). This research

focus is in part due to the authors' key importance in making the choices that shape the outcome of the report. Review Editors play a role in overseeing the selection of expert reviewers at various points during the preparation of the reports, and also have the task of managing the response to all review comments, as well as ensuring that contentious issues are dealt with suitably and, if needed, reflected in the IPCC report text.

The IPCC generally meets in Plenary once or twice a year. Although the agenda of these meetings varies from procedural matters, adopting new guidelines or rules, to the acceptance of the Summary for Policy Makers (SPMs) at particular times in the report preparation process (see below, and **Paper II**), these meetings bring a very important set of actors into the picture – namely the intergovernmental Panel, or the 195 IPCC member governments – who must approve and if necessary negotiate the decisions that the IPCC makes, with the aim of consensus.

Writing a report

Although it is important to have some idea of the IPCC's organisational structure in order to fully understand the context in which the IPCC operates and produces its reports, it is the processes of producing these reports, and the procedures and rules which govern them which is of more interest to the discussion of the IPCC's knowledge politics. Indeed, as a result of my focus on the processes of report preparation and the making and circulation of the IPCC's knowledge, it is amongst the Authors and Review Editors, outlined in the previous section, that my focus within the IPCC has been. While **Paper II** provides a more detailed account of the writing of one specific report – the AR5 Synthesis Report – in order to situate my cases and provide the context for the 'politics of multiplicities' present in the IPCC, I will now outline the IPCC's processes of report preparation more generally (see also Hughes, 2012).

The IPCC report begins with a scoping meeting, which is undertaken by experts who have been nominated by governments and selected by the Bureau. The output of this meeting is a series of bullet points of the main points to be included in the report, perhaps including suggested chapter titles, and thus a basic structure of the report. Following the production of this Outline, it is approved in Plenary. During this process, the desire to ensure that issues that are of policy relevance, yet not politically contentious, get coverage, can lead to changes or additions to the outline. However, if the issues raised by the governments at the scoping meeting are addressed at this early stage in the assessment process it is more likely that the report will pass smoothly through approval (Hughes, 2012, interviews for **Paper II**). After the Outline is approved potential authors are nominated by governments and observer organisations, and the final author team is selected by the Bureau. The writing of the report then commences, the whole process of writing and

review takes place over the course of 3-4 years. Following the IAC Review in 2010 and the scrutiny of errors in the AR4 the procedures for writing reports underwent substantial changes and formalisation. Although the main aim of authors is to focus on the synthesis of existing findings based on research largely published in peer reviewed journals, guidelines for including non-peer reviewed sources, such as industry reports, have also been published (IPCC, 2010). The audience of the IPCC reports are taken to be a technical, a largely interdisciplinary audience, given the broad overall scope of each Working Group report compared to scientific disciplines. In addition to the underlying report, which for AR5 reached more than 1000 pages per WG, there is a Technical Summary, and a 30 page Summary for Policy Makers (SPM). Although the author team is limited by the underlying literature available, and building on the government approved Outline, they have the freedom to make decisions about how to present the findings, and to select the points they see as most important to be brought forward in the SPM (**Paper II**). Therefore, the particular authors present, and the choices they make, have a very important, formative role in how climate change comes to be known and presented. Indeed, many authors, particularly CLAs in the Synthesis Report or Special Reports, have a more active connection with policy communities and science communication, than much of the scientific community (**Papers II, IV**). This means that there is often quite a steep learning curve for new authors. During the selection of authors, balance is also made between those who have been involved in previous assessment rounds, and those new to the process (**Paper IV**). The key role of well-established individuals and research groups in relation to the IPCC assessments cannot be underestimated, not least through their ability to lead and encourage research deemed relevant for coming assessments, indicating tight linkages between IPCC assessments and the research agenda of countries (**Paper IV**, see also Hughes and Paterson, 2017) which in turn feeds back in government review comments, approval sessions, and in sessions of the UNFCCC (**Paper III**).

Review procedures are an important part of the IPCC report cycle that help to ensure both the scientific rigour, and ultimately the political acceptability, of the report. The first draft of the report undergoes an expert review, which helps to identify which issues may need further coverage in the next draft (**Paper II**). The authors then prepare a Second Order Draft and the SPM which is subsequently reviewed by both experts and governments. The SPM is reviewed by the governments one more time in advance of the WG approval Plenary and the IPCC Plenary that accepts it. The Review Editors are tasked with ensuring that all the review comments are addressed and responded to, especially prior to the approval Plenary.

When the AR cycle is reaching its end, the main task of the Plenary sessions is line-by-line ‘approval’ of the SPMs for all the reports, section by section ‘adoption’ of the main body of the SYR, and overall ‘acceptance’ of the underlying WG reports.

As outlined in **Paper II**, this approval session, taking place over the course of a week, is a period of intense deliberation which brings governmental representative and author teams into close proximity with each other with the goal of agreeing on the text and figures of the SPMs. Although the authors have the final say on whether something can be included or not in the text, the desire for governments to see their policy priorities, both at an international and national level, sometimes leads to difficult exchanges which can only be resolved by smaller Contact Groups of selected authors and countries (**Paper II**). In turn, the desire to see certain aspects reflected in the text of the SPM only highlights its perceived value at a policy level. While the intergovernmental aspect of the IPCC could be seen as an obstacle in a scientific sense, this double edged approval – both by science and by policy has the role of placing the SPM in particular apart from both of those social worlds, allowing it to become something which is neither pure science, nor pure politics (Bolin, 2008). In other words the reports produced are a “new form of practice” (Hughes, 2012: 204), one which is quite clearly a work of co-production (Jasanoff, 2004). Once the reports are approved, adopted and/or accepted, as appropriate, they are published in their final form.

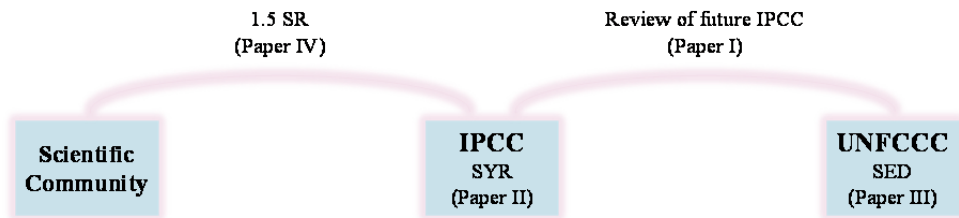
To explore the knowledge politics of the IPCC from a performative perspective, it is important to consider how the IPCC’s knowledge fares, and how the norms and processes that the IPCC is involved in forming affect those outside of the IPCC itself. The involvement of external experts and government reviewers goes beyond the production of reports and acceptance of procedural matters, to the consideration of what it is that the IPCC does. Following every assessment cycle the IPCC considers its future as an organisation, and from 2013-2015 it undertook an extensive consultation on its future. This is the focus of **Paper I**, which brings the discussions over the nature of IPCC knowledge and the organisation, particularly its positioning with regard to policy, but also its broader audience. Officially the IPCC’s main audience is the policy community and in particular the UNFCCC (this was redefined at the 33rd Plenary in 2011 in response to the IAC review, see IPCC, 2011). However, after publication the IPCC reports reach a much wider audience, including in the traditional print media (Hulme, 2009a; O’Neill *et al.*, 2015) and social media (O’Neill *et al.*, 2015; Pearce *et al.*, 2014), which brings the findings into the public realm. Government comments are received during the review and approval process of the IPCC outline and the reports often reflect the interests of the same countries in the climate negotiations, or in some cases their national priorities (**Paper II**). One way in which this played out in the UNFCCC is in the sessions of the Subsidiary Bodies (SBI and SBSTA), where the IPCC is situated in relation to other expert bodies. **Paper III** moves the focus from the IPCC itself into the parallel global stage of the UNFCCC, and in the case of the Structured Expert Dialogue (SED) where the negotiation of what is considered policy relevant knowledge is brought into conversation with the authority of expertise, and who is given the

capacity to speak on behalf of scientific knowledge on climate change. The IPCC's location and authority in the climate change arena, and outside of its immediate process and structures is also discussed in **Paper IV** which, while still focusing on IPCC authors, extends analysis into the 'back-stage' work of the IPCC's knowledge politics, particularly in relation to the scientific community more broadly.

The brief overview of the IPCC and its knowledge making practices reveals important sites in the IPCC's staging and performance of science-policy interactions – the reports themselves, the plenaries, the author deliberations, the SED and other UNFCCC negotiations. By studying these sites, this thesis examines how policy relevant climate science is articulated and how climate change is made governable as a result (see Figure 3 for a simplified graphical depiction how these sites fit together). It also reveals how the interplay between backstage and frontstage is important in shaping how climate change knowledge is put together and brought to a broader audience. Science-policy interactions take place both in the backstage sites of writing and review of IPCC report, and the choices climate change scientists make in their research agendas (**Papers II, IV**), and in the frontstage sites of political negotiation and approval of IPCC reports, presentation of knowledge in the SED, and articulation over the role of the IPCC and science more broadly (**Papers I, II, III, IV**). Through investigation of these sites, this thesis shows that the ability to make climate change governable happens both in the everyday decisions IPCC authors make over knowledge – what is selected to go into the reports, the ways this knowledge is made intelligible through visible and textual devices – and negotiation over what is considered relevant in a broader political or scientific setting – be this the climate negotiations, expert dialogues, or the scientific community shaping its future research agendas. Although, as made clear here, discussions over the knowledge politics of the IPCC go beyond the specific cases addressed in my four papers, much of the discussion over policy relevant science at an international policy level has, since the 2009 COP15 in Copenhagen, focused on the Long Term Global Goal of the UNFCCC. As one of the authors interviewed in **Paper II** stated, how to operationalise the LTGG, is possibly *the* most policy relevant question that the IPCC can currently engage in. In the sections that follow I will draw out the main themes from the articles, and with respect to the research questions.

It is not easy to separate particular parts of the IPCC's process or spaces in which the production, negotiation, and stabilisation of policy relevant climate science take place. Since the IPCC does not create scientific knowledge itself, the actions of production and negotiation are particularly intertwined, as it is through the negotiation over what becomes IPCC knowledge – performed and enacted at different stages in an IPCC report's preparation by authors, government representatives, or other experts – that climate change comes to be known.

Figure 3: Diagram of how sites and cases fit together



Therefore the IPCC can also be said to be involved in some sense in knowledge production. The stabilisation of policy relevant knowledge in this thesis takes place in various places, such as when the SYR is approved (**Paper II**), or when the SED results in a strengthening of the LTGG to 1.5 degrees (**Papers III and IV**). However it is always subject to being destabilised again – in this sense, the knowledge of the IPCC, and indeed scientific knowledge more broadly, is always provisional (Hulme, 2007). This destabilisation of knowledge can be seen as ‘situations of dislocation’, which may not always be as dramatic as the examples of moral outcry or breaches of trust that Hajer (2009) uses in his account of the performance of authoritative governance (see also Hajer, 2012). However, they are still evidence of the more every day places where “routines seem to be lifted from their solid institutional hinges, and where things occur that seem to disrupt a symbolic order” (Hajer, 2009: 5). One place where this was seen happening in my papers is in **Paper IV** when, following the Paris Agreement, the IPCC was requested to undertake a report on 1.5 degrees. The surprise expressed by many scientists in the wake of this request was seen as a wakeup call to much of the scientific community, to both consider their relationship with the changing political context, and for the IPCC more specifically to recognise when their norms of objectivity and detachedness are being challenged. In turn, in **Paper I** such disruptions come in discussions over the IPCC’s future, through fundamental challenges to the IPCC’s operations, particularly relating to involving more actors, a broader range of expertise, or questioning the usefulness of the IPCC’s mandate to remain policy neutral. In **Paper II** small scale disruptions are seen in discussions over the negotiation of particular diagrams or parts of the text, or in **Paper III** in the ‘boundary moments’ when particular countries request scientific information in order to justify their political position. At these points, the norms of science on which the IPCC is built find themselves questioned and challenged. However, these points are central to the ongoing negotiation of what counts as policy relevant knowledge.

Negotiating Policy Relevance

This thesis draws attention to the tensions and complexities associated with the IPCC's notion of policy relevant knowledge. In **Paper I** I showed how, at a time when key actors were reflecting on the IPCC's future, the notion of what is policy relevant was fundamentally contested. To some extent this depended on the role of the actor in question – as an author, or government representative. However this division was not as easy to make as might be expected. Instead this paper showed how views on what defined policy relevant knowledge related to underlying views on science, and its relation to policy and society, as being one of traditional, objectivist or more constructivist approaches. In this paper it was also possible to see how the underlying tensions over what constitutes an ideal relationship between science and policy are reflected in different interpretations, or utilisations, of the IPCC's mandate to be policy relevant but not prescriptive (see also Stocker in Nature, 2010). For instance in respondents who wanted both for the IPCC to maintain 'complete independence' and at the same time increase cooperation with stakeholders and produce reports based on policy requests (see response from Switzerland, **Paper I**). Whilst on the surface these tensions based on ontological differences may appear to be an overly theoretical claim, the actual practices through which these tensions play out were investigated in **Papers II, III, and IV**. In **Paper II** the scientific pursuit of robust knowledge claims, defined by the IPCC as “one that holds under a variety of approaches, methods, models and assumptions and is expected to be relatively unaffected by uncertainties” (IPCC, 2007: 72), was at odds to many policy relevant claims made by government representatives who wanted closer linkages to the physical changes they saw taking place at a national level. Thus, mismatches between scientific claims to robustness and policy relevant information was particularly so in the case of regional data, and often as a result of a lack of comparable data on which to base assessments of robustness on. For instance, the lack of coordination amongst the climate impacts community was referred to in both **Papers II and IV** as a reason for why the assessment of robustness was challenging. The problem of a lack of data was also seen in discussions over 1.5 degrees in the SED in **Paper III**, and with respect to the SR15 in **Paper IV**. Such discussions draw attention to how different scientific traditions, as encapsulated generally by the three WGs enact climate change in different ways, and the tensions between them.

In turn, therefore, one of the key aspects of the policy relevance of the IPCC's knowledge is its interdisciplinarity (**Papers II and IV**). In **Paper II** this dimension works as an important rationale for the SYR in the IPCC assessment cycle. Although the underlying WG reports reflect different disciplinary traditions (Bjurström and Polk, 2011a), the SYR (**Paper II**) and the SR15 (**Paper IV**) – are sites where interdisciplinarity has been fundamental to answering the types of

questions deemed important, particularly relating to impacts, responses, and potential policy pathways. When studying the backstage writing these two reports are scenes for the performance and negotiation of ongoing disciplinary conflicts, or epistemic constraints (see Carolan, 2008), which are not evident in the finalised and published report. Interestingly, these disciplinary tensions are often not evident to the governmental representatives either. The fact that climate science is in itself a composite of many different ways of seeing climate change, each with their own criteria for what entails work well done (Jasanoff, 2015) is kept backstage in the writing of the report. In **Papers II and IV**, authors of the SYR and SR15 referred to the challenges of settling disciplinary differences in the pursuit of a common goal as a barrier that had to be negotiated, but that when understanding was established it was beneficial to the pursuit of policy relevance. In some cases it was only through the constructive discussion between authors from different disciplinary backgrounds that the real questions deemed critical and policy relevant could be properly engaged with (for instance discussions relating to ethics in regard to 1.5 degrees in **Paper IV**). Although the nature of disciplines and their relationship to the WGs is something that this thesis did not engage substantially with, and is thus a place for further work, it connects to a broader discussion about what constitutes reliable knowledge in different contexts and what model of science and science-policy interactions are preferred. As such it has implications for how the IPCC is organised and continues its work, and fundamentally how policy relevant knowledge is staged and performed (**Papers I and IV**).

The challenges faced in the negotiation of policy relevant knowledge point to different understandings of what constitutes that knowledge, and contestations between scientific framing and political and societal relevance (see Victor, 2015). From a discursive perspective, the role of scripts and texts assigned to those involved in this negotiation is central. The scientific language of robust findings, or the importance of uncertainty language (see also Adler and Hirsch Hadorn, 2014) is something that not only differs between scientific and societal actors (Victor, 2015), but also between authors from different backgrounds. Therefore the stage on which these terms and practices are acted out is of central importance. This comes to the fore in contexts when either authors (**Paper II**), or the IPCC as a whole (**Paper III**) are challenged about what is policy relevant. In **Paper III** this was seen when representatives of the IPCC were questioned about topics that they did not feel they had enough information on which to base a robust and authoritative response, particularly comparing impacts associated with 1.5 and 2 degrees warming. When continually pushed on the need for science which shows comparisons between 1.5 and 2 degrees, they both recognised the limits of available science, exercised caution in providing predictions, and in some case deferred to different experts (**Paper III**). In some sense the reaction of authors to

such challenging could be seen as symbolic, as maintaining the IPCC's authority to speak on emerging scientific topics requires it to at least seem to speak with one voice (**Paper IV**). However this is also done for the practical reasons of trying to create order (Hajer, 2009) and as a result engaging in boundary work. The same example from **Paper III** illustrates this boundary work in the SED case as the IPCC authors who were present as experts generally acted in the uniform role of the IPCC as science in order to stress the lack of evidence on 1.5 degrees. That in the SED some individuals were more eager to provide contributions to such questions also points to the tensions between corresponding with IPCC norms of policy detachedness with the role of individual scientists desire to connect more directly to policy debates (see also **Paper I and IV**). Connecting act and scene through dramaturgy allows us to see how interactions taking place with their context can both challenge and reinforce already existing understandings of science for policy, and of climate change. In particular it draws attention to cases where the reaction, or act, is not as expected. For instance in **Paper IV**, when the scientific community was surprised by the strengthening of the LTGG to 1.5 and the request for the SR15, it is possible to see how the community reacts when its norms are challenged, or indeed what these norms being challenged are. Whether this act had the effect of challenging the authority of the IPCC, or in fact reinforcing the norms already present shall be discussed in the next section.

Enacting the authority of the IPCC

In Hajer's account of the IPCC's response to Climategate and the discovery of errors in the published AR5 in 2009 and 2010, we learn that at times of extreme pressure and controversy the authority of the IPCC is not given; instead it has to be enacted. This thesis shows how the IPCC's authority is also being enacted in mundane, procedural, everyday situations, and in different contexts and sites, be this the writing of a report (**Paper II and IV**), a science-policy dialogue in the UNFCCC (**Paper III**), or in a questionnaire on the IPCC's future (**Paper I**). Such observations reinforce claims that the IPCC has created an 'epistemic authority' based on its institutional set up, and what is said, how it is done, and what devices are used in the process (Hajer, 2009; 2012). One way in which the IPCC has established this epistemic authority is through articulating and enacting a particular notion of policy relevant knowledge in the climate realm. As can be seen in more detail in the papers that make up this thesis, between the Copenhagen COP15 in 2009 and the present, this enactment has played out in discussions surrounding the operationalisation of and definitions associated with the LTGG, both within the IPCC (**Papers II and IV**) and between the IPCC and the political and scientific realms more broadly (**Papers III and IV**).

Part of the way in which the IPCC's authority is enacted is through its particular identity in different settings. Discussions on the authority of the IPCC reveal a tension in the way the IPCC is perceived frontstage, and in turn on what basis its authority is performed. In this thesis the IPCC is generally presented as a stage on which the knowledge politics of the IPCC play out, for instance in **Paper I**, I show how in the discussion about its future, the IPCC is many different things to different people – it is seen as science, as closer to a policy entity, as a hybrid of the two, or indeed as a body made up of all of these different aspects (see also Sundqvist et al., 2017). Others (e.g. Haas, 2004) have suggested that the IPCC assumes a more scientific or political identity at different points in its process, this thesis demonstrates that instead the IPCC is sometimes assigned roles by different actors in the assessment process. Some of these roles may counter the IPCC's definition of a policy relevant and not prescriptive body. This identity is defined frontstage by clear separation between science and policy, and backstage, through close interactions among and between science and policy (see also Hilgartner, 2000; Jasanoff, 1990). In **Papers III and IV** I demonstrate how the frontstage identity of the IPCC is articulated and performed through its role as the 'voice of science'. In **Paper III** this role was assigned by both the expert and government representatives involved in the SED. On this global stage a hierarchy of expertise was created which stressed a difference between IPCC experts and non-IPCC experts. This 'voice of science' made no distinction for instance between the WG experts, of differences in the basis of policy relevant knowledge, treating the IPCC as a more or less unitary actor representative of neutral and objective science. In **Paper IV** the request to the IPCC to undertake the 1.5 degree Special Report is seen in the same light. When providing the scientific basis to the UNFCCC's discussions surrounding the LTGG, the IPCC is given the role of science. This is potentially problematic, particularly as, for much of the policy community, the IPCC's close involvement of governments in the scoping and approval of reports (see above) becomes the IPCC's main source of credibility. Thus, the backstage identity of the IPCC involves many non-scientific elements. The every-day practices and decisions involved in the production of an IPCC assessment report illustrate that seeing the IPCC as a unitary scientific actor, or the dichotomy between science and politics as maintaining the authority of a body like the IPCC is indeed an illusion (see also Bijker et al., 2009). This is particularly obvious in **Paper II** where I outline the negotiations surrounding the Article 2 Box or the Map of Impacts. The knowledge politics of the SYR was not only enacted by government representatives in the frontstage plenary process; in addition the backstage time pressures, disciplinary interactions, and communication challenges illustrate how the authoritative voice of science is interpreted, negotiated, and performed. Thus, the IPCC has different frontstage and backstage identities, and it is through careful management between these that it maintains its authority in global climate politics. It is important to note the important dramaturgical

separation between the roles government representatives and IPCC authors play in this process. While this separation of roles is central to the enactment of the science-policy boundary, there is a great deal of overlap on an individual level. Scientists who are engaged as authors in the IPCC process, can often play a central role as government experts, or facilitators, in the UNFCCC negotiations (e.g. Co-facilitators in the SED, **see Paper III**). Thus, these individuals also have different frontstage and backstage roles in the knowledge politics of climate change, differentiated in a performative sense through their acts and use of language in diverse settings and times.

The work that the IPCC engages in to maintain its identity as a producer of policy relevant knowledge can also be seen as boundary work. As outlined in the theory section above, boundary work is concerned with the demarcation of science from non-science, based on certain characteristics (see Gieryn, 1983; 1995). The papers included in this thesis illustrate the different frontstage and backstage practices of boundary work that the IPCC engages in to maintain its scientific authority. **Paper II** shows how the negotiation over what counts as policy relevant knowledge in the AR5 SYR took place bringing forward the techniques of negotiation which involve both discursive techniques and boundary objects like maps and diagrams. The papers also illustrate that the IPCC's unique position sees it engaging in several different kinds of boundary work, within different social worlds. **Paper I** highlights how the boundary work of the IPCC can draw on quite different conceptualisations of science-policy relationships, and that in some cases the goals of frontstage separation in pursuit of credibility and objectivity conflicts directly with the need to maintain a relationship with a broader societal audience beyond the policy-making community. **Paper III** identifies a series of 'boundary moments' which showed the actual discursive boundary work in which both those engaged as experts and the government representatives within the SED partook. The study illustrates the fluid nature of the boundary work between climate science and policy. In the process of deliberating the adequacy, and progress towards, the LTGG, boundaries are blurred, strengthened, and subsequently redrawn, and that the IPCC is seen as defining itself with respect to both policy, but also other types of expertise. This paper concluded that there was a need for boundaries, at least at a micro scale, in order to maintain the claim to scientific expertise in challenging situations. These boundary moments are a kind of performance engaged in by both strategic actions and words chosen by all participants in the SED, and the particular devices used to put forth the arguments which reinforce or blur the boundaries. **Paper IV** offers a slightly different story. Whilst in some ways this paper also presents how the IPCC engages in and facilitates boundary work *within* the scientific community, through encouraging the formation of core groups of researchers involved closely in IPCC work, it also hints at the potential changing dynamics of largescale assessment activities in a

Post Paris landscape (see also Beck and Mahony, 2018a). The request for the SR15 brought policy priorities and timescales more directly into the definition of scientific work than had previously been seen. In turn, to answer the type of questions associated with the question of 1.5 degrees in some ways aligns more closely with the definition of anti-boundary work (de Pryck and Wanneau, 2017), through better integrating disciplines and recognising the importance of transdisciplinarity in the search for a solution, rather than focusing on identifying the problem. Despite this, the IPCC SR15 was still undertaken on the global stage of the IPCC, and using the IPCC's particular scripts and procedures. Whilst this no doubt added to the SR15's credibility and impact, it suggests that its knowledge politics are still partially constrained. As discussed in **Paper I**, and in some respects **Paper III**, bringing in a broader set of voices in a more flexible way could be one approach for the future in order to overcome some of the limitations to knowledge that adhering to a strict science-policy relationship might bring.

In the methodology section of this kappa I outlined how the lack of access to the IPCC limited my study of its backstage knowledge politics. Although the IPCC Plenaries take place behind closed doors and out of the eyes of the public and the world's media, it is still a frontstage site which allowed me to study how the strategic bargaining and struggles over policy relevant knowledge intersects with the politics of knowledge production. My access to backstage knowledge politics, however, was only possible through a combination of documentary and interview data. This indirect access to the internal workings of the IPCC undoubtedly shaped the story I can tell. Limiting access to its internal knowledge politics is, indeed, an important boundary strategy for the IPCC. By restricting access to its backstage practices, the IPCC manages to present itself frontstage as an impenetrable edifice and hereby maintains its objectivity. The 'tribalism' of the IPCC gained criticism following Climategate and in the subsequent IAC review (Beck, 2012), and the response of refining a communications strategy has increased trust and accountability among national and international policy communities. However, the lack of transparency and protectiveness regarding internal processes still remains. This is particularly obvious at times of political contention, when the IPCC retreats to "a set of idealised, naïve, and oversimplified notions of what sound science is" (Beck, 2012: 166). Ironically, the reason for the political contention surrounding the SR15, may indeed be because it exposes the knowledge politics of the IPCC in exactly the way they hope to avoid (**Paper IV**). While the lack of access to the internal processes of the IPCC is a methodological challenge for a study of this kind, it offers an empirical example of the knowledge politics at play in the performance of policy relevant knowledge. It sheds light on the continuous and fluid boundary work of the IPCC, the institutional structures in which it operates, and how the IPCC's identity as the 'voice of science' limits and shapes its capacity for change.

Staging and performing science for policy

Overall this thesis is concerned with the ways in which science and policy interact, and how this interaction is shaped and performed through what I term the knowledge politics of the IPCC. The papers that make up this thesis show that the interactions between science and policy are more complicated and contested than often assumed. By drawing attention to different aspects of the knowledge politics of the IPCC, the papers demonstrate how policy relevant climate science is enacted and performed at multiple sites and in relation to different audiences. For instance in **Paper I** we see that the relationship between the IPCC and society more broadly is also deemed important in shaping the future understandings of the organisation. In **Paper IV** we see that the relationship between the IPCC and the scientific community is also centrally important to ensure that it is not just science that has an influence on policy, but also that policy plays a shaping and guiding role in the production of science. In **Paper III** the relationship between the IPCC and other types of expertise is important in both establishing the IPCC's position of authority in the international climate regime, but also in opening up the possibilities for involvement of different kinds of expertise in questions of technical importance. Overall this entangled picture illustrates the ongoing stabilisation and destabilisation which characterises the co-production of climate science and policy, and in particular the links between the IPCC and the political trajectories of the UNFCCC. In the following paragraphs I will bring these discussions together.

In a discursive sense drawing attention to scripts and meetings that the IPCC engages in shows how the language of policy relevance, scientific authority, and expertise used by the IPCC, does not 'float' in society (Hajer, 2009, p63). It is used in different settings and as a result takes on different meanings in these settings, progressing based on previous experiences (what Hajer calls indexing). The most obvious example of this is the story of 1.5 degrees (outlined most comprehensively in **Paper IV**). The changing status of 1.5 degrees as a policy goal can be seen in the way that, primarily IPCC authors and those engaged in a scientific capacity altered the way they talk about policy relevance through 1.5 degrees. During preparations for the SYR, questions relating to the LTGG in general were deemed important and central, particularly from the perspective of government representatives who contributed to the scoping, review, and plenary approvals. However the lack of a scientific basis and continued political contention surrounding 1.5 degrees meant that the IPCC authors expressed general tones of scepticism towards it. (**Paper II**). During the 2013-2015 Review, which took place at the same time as the finalisation of the AR5 cycle, the discourse began to change as the consideration of 1.5 degrees appeared to become more politically mainstream. The scientific reaction was still largely based on that which

dominated in the IPCC AR5 – that there was not enough scientific information available on which to make a judgement – and scepticism towards the need for this information in the first place (**Papers III and IV**). In other words, even though the question of the strengthening of the LTGG towards 1.5 degrees was deemed politically relevant, it was not considered more than a distraction from the main discussion of 2 degrees. Despite the continued scientific scepticism towards 1.5 degrees as a global policy goal, the authors did not express this concern frontstage in dialogue with the government delegates in the SED (**Paper III**). It was only following the Paris Agreement that the scientific discourse surrounding 1.5 degrees started to change, from one expressed in scepticism to one of surprise and acceptance of the need for more research on 1.5. Indeed the scepticism towards 1.5 degrees among many authors engaged in the SR15 was seen as an embarrassing reflection of their lack of political engagement as researchers involved at the science-policy interface (**Paper IV**). This story draws attention to both the changing language of policy relevance and also how the scientific discourse is of the IPCC is in part shaped by the political discourse. In each setting the context which has proceeded is never forgotten and is indeed highly political – it is this building of the co-produced political and scientific discourse over the course of several years which makes up the dramaturgy (Hajer, 2009) of the IPCC’s knowledge politics.

Symbolism is another discursive feature of the knowledge politics of the IPCC. When the IPCC was invited to partake in the SED, the IPCC became seen much more as a unitary actor performing a certain identity of itself as scientific expert, through enacting its authority and its particular vision of policy relevant knowledge, it reinforces this authority (**Paper III**). In the SED the IPCC as a whole had a role assigned to it. Although the SED recognised that individual participating IPCC experts do make up the body as a whole, the IPCC’s uncritical role as scientific expert in the climate policy community is important to shaping discourse on climate change at an international level. However, as the other papers illustrate, this role is much more spontaneous and contested than structured accounts of the IPCCs operations may suggest. Indeed, as science is known for making order out of disorder (Latour and Woolgar, 1986) it is not surprising that the outcome in the form of published IPCC reports take the form of organised, logical, and coherent accounts. My papers show how this process of making order is undertaken in the context of the IPCC, and in particular how it differs between the backstage and the frontstage. Another important dramaturgical aspect in this regard are the metaphors and catchphrases associated with robust, objective, and policy relevant science that are constantly alluded to in discussions between scientists and policymakers, between scientists and the IPCC, and among scientists, in these different backstage and frontstage sites. The IPCC’s mandate is one such aspect which means something different in differing settings. The

reference to reports that are ‘policy relevant, yet not prescriptive’ has become in some ways a mantra justifying the IPCC’s authority as science, a notion of policy relevance as defined through the scientific norms of robustness, and a relationship between science and policy based on a linear model of interaction. The limitations and contestations related to this interpretation are clearly present in this thesis, particularly when looking at the backstage, where the deliberative nature of the IPCC is most visible (see also Berg and Lidskog, 2018).

The other aspect of the performativity of knowledge politics as outlined in the theory section, is that of the objects, both material and immaterial, that are involved in the articulation of policy relevance. These objects – diagrams, maps, or even 1.5 degrees – play a particular role in both resolving conflict and helping to maintain both epistemic and political integrity. They are often used in discussions about what kind of political problem climate change is (**Papers II and III**). Although the words and phrases of the IPCC reports are central, science relies on graphical representations as a communication tool and the agency attributed to IPCC figures, as well as their ability to shape understandings of climate change and potential policy outcomes, has been noted before (e.g. Mahony and Hulme, 2012; Mahony, 2015; McMahan *et al.*, 2016). In this thesis I find that communication is not just important in shaping understandings of climate change, but also how the reality of climate change comes to be known. Since the physicality of climate change is not always obvious, it is epistemologically distant (Carolan, 2004), it requires processes of translation (Callon, 1999). Historically, figures like the hockey stick graph of temperature rise have proved formative in representing what climate change is, and in focusing the conflicts surrounding it (Demeritt, 2006; Mann, 2012; Wright and Mann, 2013). However, this also means that such representations are also politically contested, and often become ‘objects of contestation’ (Barry, 2001). In **Paper II** I showed how the Map of Impacts in the AR5 SYR found itself the centre of debates over how to best present the reality of the climate change impacts that can be seen on the ground in different areas of the world. In the negotiations over this map there was a perceived lack of correlation between the diagram’s summary of the scientific studies available for particularly African and South American continents, and the small island states, and the impacts that the representatives of these countries felt they were experiencing and hence believed to be the most policy relevant in their national context. These discussions do not only highlight the way in which the meanings associated with such figures are inscribed and reinscribed. They also show how the IPCC’s notion of policy relevance is subject to contestation and political controversy. **Paper III** illustrates how such contestation plays out in plenary settings. By referring to a controversy over a graph during the WGIII Approval Plenary in Berlin. Saudi Arabia managed to question the scientific robustness of

the IPCC findings and once again enact the boundaries between science and politics.

The sections above have demonstrated that science for policy is a profoundly social accomplishment that needs to be performed and enacted. What sets science apart from policy is the way in which it utilises technical concepts, and representations of its work (see also Latour and Woolgar, 1986). In the IPCC's case boundary work, and the way this boundary work makes use of boundary objects such as the 'ideal type', or 'standardised form' (as put forward by Star, 1991; 2010) is an important performative practice through which the IPCC ensures its authority. Although IPCC diagrams (particularly those which make it into the report SPMs) have the aim of being boundary objects, in the sense that they are meant to maintain meaning in both scientific and political settings, their complicated, technical visage maintains an element of exclusivity which ensures they will always be easier understood among an expert audience (**Papers II and III**, and interviews). That such objects are best understood through a technical, or scientific language, is also described by Latour and Woolgar (1986) as a way in which science maintains its cognitive distance from other social realms. However, in the case of the IPCC as the audience of its reports is broader than just a scientific one, this could perhaps be seen as a weakness. Discussions about the intelligibility of IPCC graphics were raised in **Paper I** as a way in which science and policy can be brought closer together through better communication. The importance of IPCC graphics in enacting the reality of climate change appears to have been recognised in the SR15 author team and TSUs who enlisted a team of psychologists and cognitive scientists to help with the graphics for this report (Harold *et al.*, 2016; IPCC, 2016, 2018).

Another, slightly different, boundary object is that of the LTGG itself. The 2 degrees target has been described as a boundary object (Cointe, *et al.*, 2011; Morsetto, *et al.*, 2017) as its lack of clear scientific or political basis has meant that it has been successfully used by both to ensure support for 2 degrees as a LTGG. The 1.5 degrees target is shown in **Paper IV** to have a similar story, but its birth among a small group of developing countries and continued strategic reference in the climate negotiations from Copenhagen onwards gives it a clear political basis. The request for the IPCC to undertake the SR15 has had the effect of increasing the complexity associated with a primarily symbolic political term by re-rooting it in science. Clearly the examples provided here are only a few of the numerous ways in which objects are performative, however it draws attention to how these boundary objects perform in different frontstage and backstage sites. It also illustrates a formative part of how IPCC knowledge is put together, performed, and how these objects are joined up to make climate change as an object of governance.

Although the IPCC is not involved in scientific knowledge production itself, the choices, selections, framings, objects it produces, and procedures for undertaking these that it has developed, have bearing on how climate change comes to be known as an object of governance. The performativity of an IPCC report as a whole can then be said to have an ontological aspect. Since the IPCC's inception in 1988 the framing of climate change has become one dominated by the norms of the traditional view of science as detached, objective, measurable, and abstracted beyond the local setting, to be a global problem, which requires a global solution (**Paper II**). The IPCC can be commended for the work it has done to provide a scientific basis for the existence of anthropogenic climate change, and in bringing climate change to the agenda as an issue that effects all areas of the world. However, in a world where inequalities and differential impacts are so clearly present, which in turn require different kinds of responses, the globalising tendency of the IPCC reports can be questioned. In **Paper II** I critiqued the IPCC for not making the most of these differences as it pursues policy relevance in the AR5 SYR favouring instead its global, aggregate, perspective (Fløttum, *et al.*, 2016; see also Devès *et al.*, 2017) particularly focused around global average temperature (Beck *et al.*, 2014). These tensions go beyond a conflict between scientific and political framing of climate change, as indeed the pursuit of political consensus in IPCC approval sessions also favours a singular framing of climate change (Oppenheimer *et al.*, 2007; O'Reilly, *et al.*, 2012; Berg and Lidskog, 2018). In some cases the inability to provide a singular framing was actually emphasised by the authors themselves, for instance in **Paper III** when asked about the possibilities of producing standardised and comparable methodologies, for instance for assessing climate risk, by government representatives in the SED, experts responded by stressing the impossibility of there ever being a singular methodology in some areas. All the papers in this thesis have shown that science is not singular, it produces multiple answers, through multiple methods, and in multiple different ways (see also Latour, 2013). In this sense it is also suited to presenting a multitude of different problems, experiences, and inequalities in different regions of the world. What this thesis has shown, is that the complexities of climate science are still there, particularly in the backstage sites of the IPCC. The choice to be made is therefore whether it is possible to bring forward these complexities to better serve a changing policy landscape. There are indeed signs that such pluralisation of climate knowledge is in fact happening (**Paper IV** also **Paper I** for a more theoretical take). With the consideration of 1.5 degrees and the SR15, climate change as a political object has become more complicated, subjective, and multiple. This altered political object of climate change requires a more far-reaching consideration of what is policy relevant and the type of knowledge that is required to best provide this (**Paper IV**). In a performative sense, the frontstage and backstage knowledge politics of the IPCC appear to be coming closer together. As approaches to knowledge which were once considered

out of the realms of the objective, linear model of the science-policy interface on which the IPCC is built, are helping to redraw the outlook of science-policy interactions for the future.

Conclusions

The main aim of this thesis has been to critically examine the production, negotiation, and stabilisation of policy-relevant knowledge in the context of international climate change politics. In particular I analysed the knowledge politics of the IPCC by drawing out the performative interactions which shape the relationship between knowledge production processes and policy making at the global level. My study is informed by a constructivist view of science, and a conceptualisation of the performance of knowledge politics encompassing the discursive and the material. In this final section I will highlight the main conclusions, offer suggestions for future work, and highlight the thesis' relevance within a broader theoretical and empirical context.

Over the last 30 years, since the formation of the IPCC and subsequently the UNFCCC, climate change has gained increasing traction as a political problem. As the previous sections of this kappa have shown, there has been a tendency to favour global and abstract scientific representations of climate change, those which keep out seemingly political consideration of values. Accounts of climate change have been justified through IPCC authority, expertise, and method and procedures, particularly its definition of policy relevance and view of the science-policy relationship. This thesis has drawn attention to the performative ways in which these processes and accounts have played out at different sites, from the frontstage climate negotiations, to the backstage selection that takes place by authors and in response to expert and government review. Although the staging of policy relevant knowledge remains tied to a global imagination, this framing is increasingly contested by both governments and scientists from different disciplines. In particular, the Paris Agreement's inclusion of 1.5 degrees temperature target and the process of producing the SR15 by the IPCC have forced challenging conversations to play out frontstage and backstage, conversations about interdisciplinarity, values, and deeply entrenched differences in how science is done.

In turn, this thesis has shown that the relationship between climate science and policy is complicated, convoluted, and changing. Whilst the IPCC's relationship with global climate policy has been defined by its mandate to be policy relevant and yet not policy prescriptive, the interpretation of this mandate is shifting. The linear model of science for policy is still alive, and is symbolically important in the frontstage knowledge politics of the IPCC. Backstage, however, the IPCC is in

constant deliberative boundary work with both the broader scientific community and the policy community. This shows that the IPCC both plays a central role, and is more than a pure vehicle of communication in shaping how climate change becomes known and understood. In the backstage the deliberative processes of knowledge production and negotiation overtly recognises the fluid co-produced character of policy relevant knowledge in a way that is not captured by the IPCC's frontstage work. The IPCC actively shapes the knowledge on climate change, and it is not unaware of this important role that it plays. Indeed, the IPCC's more deliberative acceptance of dissensus in its backstage work actively enables the kind of frontstage work it presents to the world. This conclusion clearly supports claims that presenting the IPCC as a pure boundary organisation, in which two clear distinctive realms of science and politics interact, is too simplistic (Berg and Lidskog, 2018; Hughes, 2012). Indeed, when studying the IPCC in detail, it is often the bureaucracy and mundane practices and decisions, as well as interpersonal relationships that come centre stage, rather than the supposed scientific or political worlds. Bijker *et al.* (2009) refer to the perceived mismatch between the intention of advisory organisations to provide up-to-date science to advise policy makers and their make-up as essentially social and political as a paradox. I instead argue that more attention should be drawn to the deliberative nature of the IPCC's backstage work – in terms of authors' deliberations over robust and relevant climate change knowledge, and their direct engagement with and staging of IPCC information to address political concerns at various points during the process. Recognising this dynamic nature, would help to distinguish the IPCC's work frontstage as not purely technical and scientific, but also social and political. Presenting its socio-political aspects more overtly, or a so called 'science with politics' (Latour, 2013), would perhaps be both beneficial to its public image, and make it more flexible to changes that it may face in the coming years.

Related to this, the final point that this thesis highlights is that decisions and deliberations made backstage play a key role in how climate change becomes known and acted on as a political issue. Authors' selections of which scientific findings should be brought forth to the policy community, or responding to government representatives' requests to adjust the presentation or positioning of a graph in the report for instance, are not value neutral choices. Such a point is particularly evident in discussions over the LTGG not least because of its high political stakes and relevance in the international negotiations, but also because of the particular ways that this global goal is interpreted and experienced in different places around the globe. Discussions about the IPCC's involvement with science associated with the LTGG, and the UNFCCC's Article 2 more broadly, have played a central role in initiating further deliberations over the role of science in policy, and also the role of policy within the scientific community. In a theoretical sense, this suggests that the sites of politics should indeed be broadened beyond the negotiating halls and policy

makers, to also include the backstage practices of science and science for policy, as this opens up new possibilities for understanding the reasons behind the contestations that scientific and expert advice face in broader social settings.

Possible extensions

There are several ways in which this study could be extended to explore further aspects of the staging and performing of climate science for policy, and the IPCC in particular. The first suggestion is a methodological one. As previously mentioned, in order to better understand the knowledge practices of the IPCC a more thorough and far reaching ethnography of the frontstage and backstage process of the IPCC would need to be undertaken. One which includes author meetings, contact groups at Plenaries, and meetings of the IPCC Secretariat and Bureau. Although it is unlikely that full access will ever be possible, perhaps with the exception of a few well-connected research groups, such studies would reduce the risk of misunderstanding the IPCC's knowledge making processes and shed light on the positive aspects of constitutive and interactional co-production in this context. Another way in which I would like to extend this work, is to understand better the implications of the IPCC's knowledge on different aspects of social life – what climate change means in different settings and how the IPCC's knowledge has been involved in shaping this. The IPCC's official role in international climate politics is acknowledged, and this thesis has shed further light on this, but there remains a wealth of areas which this thesis only hinted at – namely how this knowledge fares in different national contexts, but also in different scientific disciplines or IPCC WGs, and how the media and other communication mediums enable or effect this. That said, there is still more to be done to understand how particular scientific framings, and subsequent framings in other realms outside science, influence understanding and acceptance of different policy pathways and subsequently particular technologies. Whilst the potential role that the IPCC plays in shaping these ways forward has been suggested by some commentators (Geden, 2016, 2018, Beck and Mahony, 2017, 2018a, 2018b; Pielke Jr., 2018), more detailed analysis and tracing of this ontological aspect of climate knowledge could potentially provide more empirical claims to this ongoing work. The final potential suggestion is an empirical one. As the printing of this thesis coincides with the release of the SR15, the political and indeed the scientific story of this report and the negotiations it is intended to influence, as well as public and media opinion, is yet to come. As the implications and outcomes of this will undoubtedly play a central role in debates around climate science and policy in the months and years to come, it is a place in which future studies could indeed be focused.

Contributions and implications

This thesis has made both empirical and theoretical contributions. Empirically, this thesis has brought the well-studied case of the IPCC up to date, through engaging with new and ongoing cases, and through situating it in a broader context in relation to the social worlds of science and politics in which it inhabits. It has engaged with one of the most controversial and all-encompassing discussions taking place in the years following the UN Climate Summit COP15 in Copenhagen in 2009 – the operationalisation of the UNFCCC’s Article 2, and the role science plays in both defining and measuring it. In shedding light on the complicated and intertwined relationship between science and policy, through the notion of knowledge politics and a performative metaphor, theoretically this thesis has attempted to bring together more rationalist accounts of politics with those of the performativity of knowledge. In particular it has done so through interrogating the discursive and material ways in which science for policy is performed on a global stage such as the IPCC. Another contribution of this study is to bring environmental science into conversation with the social studies of science. Whilst this is by no means an easy conversation to have, it is one that requires further exploration, not least because environmental science’s empirical, and indeed normative, contributions are built on a need to provide advice which is deemed relevant and important for policy, practitioners, and the general public alike. Thus, it is a realm ripe for both critical and constructive investigation of how this is, and can be, undertaken. In particular I hope that this thesis draws attention to the need to not take the contexts of scientific production for granted, and sows the seeds for recognising that the particularities, and indeed peculiarities, of context play a role in the trust, acceptance, and understanding of science.

The years over which this thesis was undertaken have been marked with political turmoil, some of which had direct impacts on both the capacity to deal with climate change – politically through changing policy priorities and focus, and scientifically through reduced funding. Yet climate change continues apace. The summer of 2018 was marked with weather anomalies which brought media attention and public discourse around the world to engage more closely in the science of climate change than they had done in many years. The challenges of dealing with climate change in today’s political climate is becoming more and more apparent, and thus discussions surrounding the role of science, expertise, and organisations like the IPCC will not stop being relevant. In shedding light on some of the backstage and frontstage aspects of climate science for policy this thesis has highlighted its complexities, but also that often it is in unexpected places that the possibilities for engaging in fruitful debate exist.

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Appendix 1: Full list of documents used for analysis

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Appendix 2: Interview guides for semi-structured interviews

Interview Guide: for Interviews with SYR Report Authors (Paper III)

1. What was your background and role in the SYR process?
2. Can you describe the process of writing the SYR from Scoping to Plenary?
 - a. Probe – cooperation between WGs
 - b. Probe – how do you fill in the outline?
3. How do you make distinctions between major and minor findings?
 - a. Probe – what do you mean by robust?
4. How do you consider the policy maker audience when writing the report?
5. Can you elaborate on either the Map of Impacts / Box on Article 2?
6. What is it that makes the SYR policy relevant?
7. How has the IPCC shaped research engagement?

Interview Guide: for Interviews with 1.5 degree Special Report Authors (Paper IV)

1. What is your background with regard to research on 1.5?
2. Where in your view did the 1.5 goal come from? How did it become more than unrealistic goal?
 - a. Probe: What is the political implication of 1.5?
 - b. Probe: What is the scientific implication of 1.5?
3. How is this different from the 2 degrees target?
4. Is 1.5 understood in the broader research community? What is the role of the IPCC in instigating research on 1.5?
5. What do you think is the most important thing to research with respect to 1.5?
 - a. Probe: From a relevance point of view?
 - b. Probe: Bearing in mind what is missing?
6. What is the purpose of the 1.5 Special report?
 - a. Probe: Will it have an impact on the negotiations?
7. Can we stay below 1.5?

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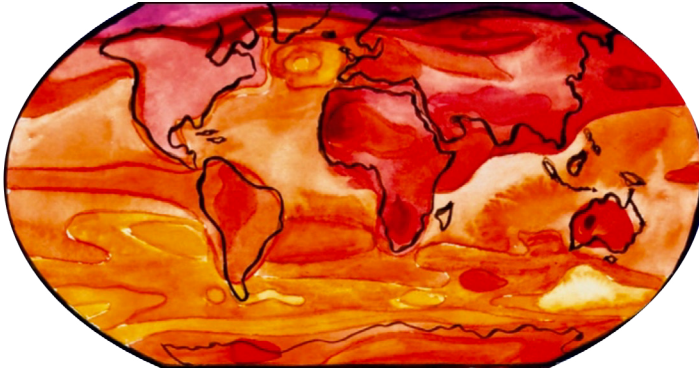
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Climate Science for Policy?

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