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Uncertainties and insufficiencies: making sense of climate adaptation

Thesis for the degree of Philosophiae Doctor

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Preface

This thesis is written as part of the research project "*Preparing for a Rainy Day? Configuring climate science for future society,*" financed by the Research Council of Norway through the NORKLIMA programme, and directed by Knut H. Sørensen, NTNU. I would like to thank the project group – Knut H. Sørensen, Marianne Ryghaug, and Robert Næss – for inspiring discussions, with an especially big thanks to Robert Næss for fruitful and inspiring co-operation in the interviewing and data-gathering process. I would also like to thank Marianne Ryghaug, for the consent to use her climate scientist interview data from 2005. The first paper in this thesis is written together with Marianne Ryghaug and Knut Sørensen. This is based on Ryghaug's interviews and on my own climate scientist interviews. Based on initial discussions with Ryghaug, I made summaries on the background of the interviews, and then Sørensen and I wrote the paper together – with input and comments from Ryghaug. Although the rest of the papers have me as the sole author, neither of them would have been possible without the rest of the project group.

I would also like to thank my informants for taking the time to talk to us. Without them sharing their thoughts and opinions, none of this would have been possible.

A thank you to the people at UC Davis – in particular Joe Dumit and Ben Orlove – but also the rest of the people I met there, who all made my visit at UC Davis memorable and fruitful. Thank you for comments and insights.

A special thanks to my supervisor, Knut H. Sørensen, who have been a constant source of ideas and input, and who has put up with my tendency to solve confusion and ambiguity by producing inordinate amounts of text. Vicky Carp has said that "When we read, we start at the beginning and continue until we reach the end. When we write, we start in the middle and fight our way out."[1] However, fighting your way out of the text by producing more text does not always work like fighting fire with fire, sometimes it produces quite the jungle of paper piles (sorry Knut, and sorry, trees!).

For helping me find my way through the paper pile jungle, I would like to thank Siri, Jenni, Adria, and Kristin for read-throughs and helpful comments.

As for my family and friends – thank you for your patience, support, and love. I am looking forward to spending more time with you and less with my text.

[1] As quoted by Jen Campbell on http://jen-campbell.blogspot.com/, accessed February 29th 2012

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Climate change – society matters

The Earth's climate is changing. The science on this point is settled (IPCC 2007). Also consensual is the fact that this change is induced by human activities, and that it will have impacts both on nature and on our way of life (IPCC 2007). Szerszynski (2010) notes that the Intergovernmental Panel on Climate Change in its Fourth assessment Report in 2007 "used far more categorical language than it had in its earlier reports" , indicating that this is a problem where the scientific evidence is mounting up, while the urgently needed action is failing to follow suit. While mitigation measures still may be the main focus of the climate change debate, the issue of how to adapt to the hanges that will come is rising on the agenda. This thesis examines how climate knowledge is disseminated and how it is appropriated, interpreted and used on a local level, addressing the question of if and how climate science is relevant and useable in local climate adaption efforts.

The largest body of climate change scholarship has concerned itself with climate from a natural science viewpoint, with economics answering most of the social-science questions (Urry 2011). However, the social is inextricably tied to climate change, both its causes and its impacts. "Society matters," writes Urry (2011, 1), in fact, in his opinion, "[e]nvironmental politics are predominantly about 'society'" (Urry 2011, 3). Human activities – development and inequalities, exploits and exploitations – are what drive CO_2 emissions to levels beyond what natural sources would have caused. Also, adapting to climate change impacts will be a social as well as technical problem, especially since climate change impacts are expected to exacerbate existing issues, tensions and challenges (Adger, Lorenzoni, and O'Brien 2009; Crate and Nuttall 2009c, 2009b)—being, as Crate and Nuttall put it, "a threat multiplier" (2009c, 11) that magnifies economic, political and environmental trends.

Climate knowledge is expected to play an important role in how people respond to climate change (Burton et al. 2002; Adger et al. 2007). According to Giddens (2009), the challenges concerning knowledge use are potentially larger when it comes to climate adaptation – adaptation, he contends, requires more research than mitigation to be done right. Norwegian climate policy documents seem to echo this point of view: The Norwegian Official Report (green paper) NOU 2006:18 *A Climate Friendly Norway* (2006) and the corresponding green paper concerned with adaptation, NOU 2010:10 *Adaptation to a Changing Climate* (2010). In the mitigation report, the scientists' job was, by and large, characterized as complete; in the adaptation report, on the other hand, it was characterized as only just begun.

How can social sciences help when we take on climate adaptation? Jasanoff and Wynne (1998) suggest that qualitative social sciences have much to offer to increase understanding of climate change and society: Among other things, they can give us insight into how problems are framed; how controversies arise and are solved; how risks and threats are recognized and acted upon; how scientific knowledge is produced and validated; and how scientific knowledge is taken up and given meaning locally and in policy decisions.

My entry point into the issue of climate adaptation and climate science knowledge is science and technology studies (STS). Studies of climate change and climate science from this field can be divided in two main strands, following Jasanoff's (2004b) taxonomy of science- and technology studies' scholarship. First, there are studies concerned with the establishment of natural order, and with "the emergence of new facts, things and systems of thought" (Jasanoff 2004b, 19), that is, in this case, the establishment of the scientific idea of anthropogenic climate change (Fleming 1998; Edwards 2001) and its related institutions, methods and tools (e.g. General Circulation Models) (Miller 2004a, 2001b; Shackley et al. 1998; Edwards 2001). Second, there are studies concerned with how to deal with "knowledge conflicts within worlds that have already been demarcated, for practical purposes, into the natural and the social" (Jasanoff 2004b, 19). Studies in this vein focus on how science advisory institutions for global climate policy should be organized (Miller 2001a, 2004a; Edwards and Schneider 2001), how scientists deal with uncertainty and balance authority and relevance at the science policy border (Shackley and Wynne 1996, 1997), and problems of "relocalization," that is, problems of creating local relevance and usability of scientific results brought about by a "globalized" scientific endeavor, and/or by scientific practice, norms, and institutional organization (e.g. Miller 2004b; Lahsen and Nobre 2007; Jasanoff 2010; Beck 2011).

It is mainly the second strand of STS climate science scholarship that I will be employing. Studying the dissemination and relevance making efforts of climate scientists, and how architects and local administration employees approach the issue of climate adaptation, I ask whether climate adaptation really is a case of, as Giddens suggested, a field where more research is needed. What kinds of tools are called for by local practitioners?

I will now provide summaries of the papers that make up this dissertation, before I go on to discuss their significance in relation to relevant earlier research and theoretical contributions.

Summaries of the papers: Objectivity, relevance, imagined publics, and sensemaking challenges

The papers making up this thesis are titled

1) Competing concerns? How scientists manage the relationship between objectivity work and relevance work
2) Controlling communication? Scientists' accounts of their media strategies
3) Concern and confidence. Architects making sense of climate adaptation
4) Insufficient, irrelevant, or useless? Local government views on climate science for climate adaptation

In the following cross-cutting analysis, they will be referred to as the objectivity—relevance paper (1); the scientist—media paper (2); the architect paper (3); and the local administration paper (4).

The first two papers focus on the scientist perspective and show in what ways relevance, use, and usefulness issues were viewed and addressed by climate scientists; the first concerning itself with the relationship between relevance concerns and objectivity concerns, the second with scientists' "imagined publics' and challenges tied to mass media communication activities.

The last two papers examine the user perspective. The first of them examine how architects made sense of the issue of climate adaptation with focus on how ideas about professional identity and context influenced this sensemaking. The last of the papers examined local government administration employees' view of the matter, with focus on how existing institutional context and users' ideas about science and the science–lay divide shaped users' views on the usefulness of climate science knowledge.

Paper no. 1: Competing concerns? How scientists manage the relationship between objectivity work and relevance work

This paper addresses how climate scientists viewed and addressed issues related to relevance and usability and how they considered the relationship between these and scientific quality. We introduce the terms 'relevance work' and 'objectivity work' to describe the scientists' efforts geared towards being relevant and scientific, respectively; and to discuss the relevance between the two. Based on a review of studies of changes in late modern scientific practice, and drawing on the concept of "epistemic drift" (Elzinga 1997), the paper also explores the extent to which there is

reason to fear that relevance work displaces objectivity work, and whether such "epistemic drift" is a worry for climate scientists.

We found that climate scientists were very concerned with relevance in the sense that they were engaged in efforts to make facts accessible and useful to the public as well as user groups, but they did not fear that this concern challenged their objectivity. Relevance was important because it provided meaning to the scientists' work – without engagement in relevance work the scientific effort might be less meaningful. However, objectivity was seen as a *prerequisite* for relevance. Objectivity work is what makes something science, and science being science is a prerequisite for science being relevant. Without a focus on objectivity work, they would lack a reliable and trustworthy basis from which to communicate, and they would be unable to provide relevant knowledge to users.

To a certain degree, an understanding of relevance as almost inherent in "good science" was prominent among the scientists we interviewed, that is: good science was seen as (potentially) useful. However, the scientists also expressed a view that science could become even more useful by being "tailored" to user's needs, in the sense of addressing research themes of interest to the public (indicated by Research Council programs), or even more specifically, engage in dialogue projects where scientists interacted more directly with users in, in order to arrive at research questions that would be directly relevant to the knowledge needs of e.g., local government administration.

Thus, the scientists showed signs of adhering to two different models of science communication/knowledge transfer: a monologue model with similarities of the "trickle down" understanding of knowledge transfer described by Rogers (1995) – exemplified by how the scientists relevance work was mainly oriented towards educating the general public, politicians, and professionals potentially engaged in climate mitigation and/or adaption, with the news media as the main channel – and a dialogue model with much in common with approaches to science communication described in the public engagement literature (see, e.g., Irwin 2008, for an overview).

Thus, relevance work does not displace objectivity work, and we did not find evidence of epistemic drift: relevance work did not represent a pressure towards a relaxation of scientific norms or objectivity work standards. Rather, the strive towards relevance made objectivity work even more important, not because the demand for relevance was a threat to the actual doing of science, but because of the scientists' concern about how engagement in relevance work might be perceived by outsiders. Engagement in relevance work could taint the standing of scientists

because they could be perceived to be too much involved with policy-making. This is perhaps the reason why scientists felt a need to stress their objectivity work, even though they did not themselves fear epistemic drift. For example, in their accounts of "tailoring"-style relevance work, the scientists underscored how they adhered to traditional scientific norms in their quests for new factual knowledge – for example how they retained control over choice of methods and the formulation of user's concerns into "doable" research questions.

To conclude, climate scientists are very much concerned with relevance, in the sense that they aim to do good science on issues people care about, answer society's knowledge needs/questions, and communicate their findings as much as possible. It does not, however, appear to have an impact on their identity as scientists, besides the fact that it gives meaning to their work, because it is not seen as changing the doing of science. Relevance, then, is in a sense "external" to science besides the inherent relevance "good science" in itself possesses.

Paper no. 2: Controlling communication? Scientists' accounts of their media strategies

This paper provides a more in-depth study of one of the climate scientists' relevance work strategies: the communication of climate science knowledge (including boundary work distinguishing climate science experts from non-experts) through the news media. Starting from the 2009 "Climategate" incident as a symptom of a (potential) crisis of trust for climate scientists, this study examines climate scientists' views on media science communication and their strategies for dealing with journalists and climate deniers or "climate skeptics."[2] Drawing on scholarly calls for openness and public engagement, particularly the concept of "socially robust knowledge," this article discusses how climate scientists weigh concerns of control, openness and transparency when considering how to best communicate with the public through the mass media.

The *objectivity—relevance paper* showed how climate scientists saw no problematic relationship between relevance work and objectivity work in the 'doing' of science, but pointed out that the scientists were apprehensive about relevance work in the context of 'explaining' their science, especially in media contexts. The relationship between climate science and the mass media can be characterized by the label

[2]When examining the 'Climategate debate', Nerlich (2010) found that 'climate skeptic' and 'climate skepticism' were commonly used as synonyms for 'climate denier.' Like her, I also use 'climate skeptic' here in the sense of 'climate deniers,' although there are differences between the two, as pointed out by Shermer (2010) and Kemp et al. (2010).

"medialization" (Weingart 2005; Schäfer, 2009) – involving increased coverage, increased number of (non-science) actors in the debate, and increased degree of reported controversy in the mass media coverage of climate science, and this paper examines how a charged context of reception influences scientists' dealings with the news media.

A major concern among the climate scientists was their worry that the general public lacked sufficient knowledge about climate change and climate science. They felt obliged to try to counter this deficit by informing about their research through the news media. However, these information attempts were undertaken with the explicit understanding that climate skeptics would scrutinize every detail of their arguments, looking for mistakes they could use to undo the proofs and undermine public trust in climate science. This situation demonstrates an important weakness with the concept of social robustness, namely the implicit assumption that science communication takes place in a situation in which all parties have a positive interest in learning. I argue that "socially robust knowledge" neglects the challenges of "medialization" of climate science, and propose that the climate scientists' strategy can better be described as attempts to achieve "politically robust" communication, pursuing openness in a cautious, controlled manner.

I characterize the climate scientists' efforts as going for what I will call *political robustness*, which involved fashioning unassailable statements, as well as engaging in public boundary work, that is, to attempt to educate the public about the difference between climate science experts and non-experts.

Paper no. 3: Concern and confidence. Architects making sense of climate adaptation

Does climate information impact how architects make sense of the climate adaptation issue? Not much, it seems: identity and contextual factors appeared to have more to say for how climate adaptation was made sense of than features of the issue itself. Although a few aspects of "the issue itself" – ideas about the rate of climatic change and concerns about scientific uncertainty – these were mainly important because of the way in which they were linked to identity and context-related factors. The architects longed for a building process where seeing wholes and weighing factors against each other were more central than optimization logics. At the same time, they were also pragmatically aware of the realities of economy as a determining factor in building processes. Their suggestions for how climate adaptation concerns could be included in their practice reflect these two aspects of their worldview.

When they made sense of architects' role and responsibilities concerning climate change, the architects interviewed drew on an identity discourse I have chosen to call "holistic." In this discourse, architects' expertise was seen as encompassing both aesthetic-creative dimensions and dimensions related to technical-craft-related aspects of building. Architects' distinctive expertise was argued to spring from their ability to see the building as a whole. "Good design practice" was conceived as including the detection and identification of the climatic conditions of a building site and adapting the building to those conditions. This holism identity – with its appurtenant practice ideal – was used as an argument for why architects would be able to take in and adapt to climatic changes. Several architects argued for the importance of reestablishing a focus on climate adaptation (in the sense of adaptation to current climatic conditions). Seen in the light of the holism identity discourse, this can be interpreted as an argument for renewing architects' status and influence in the building process – countering a trend towards decreasing professional influence for architects, reported by both my interviewees and by relevant scholarly literature.

When architects voiced concern about their professions' ability to deal with climate change, they implicitly and explicitly expressed concern about declining influence over the building process. An example of such concern was architects' criticism of how all-encompassing the cost-efficiency focus had become in the industry: Architects reported that they had proposed building qualities which had been brushed aside because of cost concerns. The experience – and expectation – of this situation appeared so common that many architects did not even suggest extra-cost measures, having, in a sense, accepted the "pragmatics of practice" (Imrie and Street 2011) and succumbed to the "tyranny of the project" (Koch 2004). In my interviewees' opinion, the cost-reduction focus was largely responsible for current buildings being of insufficient quality and poorly adapted to current climate.

This concern for the all-encompassing nature of the cost-efficiency focus was one of the contextual factors that played a role in how architects made sense of climate adaptation. Which contextual factors the architects saw as important was related to the interviewees' reasoning about what actors held sufficient power to propel – or stall – change. This was not, in general, seen to be architects – but builders, as exemplified above, and national authorities. The power of national authorities can be illustrated by how 'changes in the building regulations' was seen as one of the most important drivers for changes in the building industry, and national authorities was seen as the only actor powerful enough to counter the cost-reduction focus of the building industry. Thus, intervention by the national authorities in the form of new

regulations was proposed by some interviewees as a potential way of countering the neglect of climate adaptation that the cost-reduction logic caused.

National authorities were generally trusted. This trust in official sources – together with the lack of inclusion of drastic climate adaptation measures in these sources – appeared to substantiate the architects' reading of the situation as something they could address using their traditional ways of working. In this way architects' confidence in their own ability to address climate adaptation was supported. Thus, cues the architects derived from the national building regulations, together with the holism identity discourse, helped trivialize the challenge of climate adaptation. In contrast, the cost-efficiency focus was seen as a barrier to adaptation.

This points to an interesting feature of building regulations: they are part of the institutional framework and an actor with sufficient power to counter the cost-reduction focus of the industry; at the same time, they are also a "sense-giving" repository of cues about what climate adaptation should mean for architects and the building industry. Regulations were looked to for cues as to which issues that should be considered important, how they should be addressed, and how responsibility should be distributed. To use sensemaking jargon, the interviewees' appeared to read official sources like building regulations and codes for "cues" which was then used as input in their sensemaking. Thus, regulations play an important, double role in architects' sensemaking.

This indicates that building regulations influence the way climate science is interpreted and understood at a local level, indicating that they play a part in/have the potential to play a part in co-production of climate science.

Paper no. 4: Insufficient, irrelevant, or useless? Local government views on climate science for climate adaptation

Did we find the same kind of down to earth management of the climate adaptation issue in the local administration case? This paper, like the architect paper, examines how (potential) users – in this case local government employees – make sense of climate adaptation issue, but focused its analytic attention on whether climate science information was perceived as useful.

The paper found that the interviewees had cognitively appropriated the main findings of climate science, but that they perceived this as "background knowledge" and not particularly useful. 'Useful knowledge,' in this context, was understood by the interviewees as knowledge instrumentally helpful for problem-solving, or knowledge

that could help authorize adaptation measures – but, in the interviewees' opinion climate science fell short with respect to both these demands.

There was a widespread use of climate science as an informal interpretative device for changes in the weather – that is, they reported changes in the weather as indicators of climate change, but underscored that they themselves were not qualified to conclusively claim that the changes they saw were caused by climate change. Thus, they were reluctant to "officially" interpret extreme weather and nature hazards as climate change impacts, and likewise to "officially" label changes in their practice as "climate adaptation measures." While several reported that they, to some degree, had changed local practices in the face of, for instance increased precipitation, many felt that they could not legitimately label these changes as climate adaptation measures. Many interviewees did, in this way, express uncertainty about the legitimate use of the label 'climate adaptation' – in part because it was not, in their opinion, defined in any official source (e.g. building and planning regulations), but also because most of the interviewees considered themselves lay persons with respect to climate science. They called for guidelines as well as an official definition of what "climate adaptation" should mean for local government administration.

Like the architects, the local government interviewees looked to new guidelines, regulations, and standards for definitions of their "reality" – that is, their elbowroom and their most pressing concerns. The regulations and guidelines included little about climate adaptation. However, contrary to architects, the municipalities did not necessarily read this as a cue to relax and trivialize the climate adaptation challenge – rather, it increased their concern.

Calls for the inclusion of climate adaptation concerns in planning and building regulations show that national level policy-makers are expected to be agents translating knowledge into useful knowledge – in both the senses described above. They were expected to provide new norms and standards for local governments in climate adaption relevant areas and, by doing this, also help to define the issue at hand. Clearly, the usefulness of climate knowledge depends on a constructive co-production of science and policy. This paper shows how perceptions of relevance and usability are shaped by institutional factors like regulations, guidelines and budgets, indicating that co-ordination of science and policy – co-production – is necessary to achieve "use of climate science knowledge."

What we see in this case is that, firstly, the local government interviewees express a wish for national interventions that help to make the climate adaptation concern into an ordinary task. This was due to the interviewees' feeling that they did not have the

authority, power, and/or qualifications to bring this about. Secondly, the label "climate adaptation" in itself appeared to create some problems and to hamper the efforts to make climate adaptation into an ordinary task.

Labeling activities as "climate adaptation" appeared to link practices and activities to the scientized phenomenon of "climate change," carrying with it the whole range of relocalization challenges, among them invisibility, irrelevance, distance, the climate expert—climate skeptics debate, and not least, the question of who have are qualified to interpret weather observations and claim to "observe" climate adaptation (which, we might wonder, may perhaps be a result of climate scientists' boundary work as described in the *science—media paper*).

The local government employees' reflections about their status as lay persons as opposed to climate experts thus became an important element in their sensemaking. Their reflections share important features with a Public Understanding of Science discourse which Michael (1992) have described as the "Science-in-General discourse," something I will return to shortly.

*

The scientist papers show, first, that climate scientists are concerned about the relevance of their research and engage in practices, even though they may, in a sense, be criticized for taking the relevance for granted. They work hard to communicate their research, even when this proves uncomfortable for them personally. Secondly, these first two papers have displayed a potential challenge for climate science communication and translation: climate skeptics. The scientists' fear is that people will be confused by the climate skeptics' misleading messages about the state of climate research. A related concern may be whether the way climate scientists shape their communication efforts to avoid "skeptic attacks," in some ways inhibit translation of climate knowledge?

The user papers, on the other hand, show that to potential users of climate science knowledge, the knowledge is not obviously relevant. Furthermore, there are many factors –existing institutional context, professional identities and ideas about science and climate science, and aspects of the available science information – that shape the way in which people evaluate relevance. Furthermore, scientists are not particularly central in these evaluations.

There is, thus, an asymmetry between the scientist's engagement with relevance and the way users evaluate the relevance of climate science knowledge. How can we make sense of this?

Theoretical resources

While the natural sciences have an important role to play in regards to climate change and climate adaptation, there is also an increasing body of social science scholarship in this field. Many scholars have argued that studying how physical manifestation of change are "perceived, experienced, interpreted, and negotiated at community levels" (Crate and Nuttall 2009b, 394) and how people respond and adapt to the "climate change issue" (discourse) are central concerns (see e.g. Crate and Nuttall 2009a; Jasanoff 2010; Rayner and Malone 1998; Strauss and Orlove 2003; Adger, Lorenzoni, and O'Brien 2009; Pielke Jr. and Sarewitz 2005; Katz, Lammel, and Goloubinoff 2002).

There are many examples of local-level challenges and barriers to using climate science knowledge, like forecasts and scenarios (Agrawala, Broad, and Guston 2001; Aron 2006; Ashford et al. 2006; Callahan, Miles, and Fluharty 2001; Changnon, Changnon, and Changnon 1995; Demeritt and Langdon 2004; Gawith et al. 2009; Garbrecht and Schneider 2007; Lahsen and Nobre 2007; Marshall, Gordon, and Ash 2011; Moser and Tribbia 2007; Pulwarty and Melis 2001; Pulwarty and Redmond 1997; Rayner, Lach, and Ingram 2005; Rosentrater 2010; Ziervogel et al. 2010; Maibach et al. 2008; Shackley and Deanwood 2002).

Three standard explanations for the lack of use of climate science knowledge figure in the relevant research literature: Problems with the users, problems with the science, and problems with the "knowledge transfer" process.[3] The most common explanation, is to problematize the users and their ability to understand and/or utilize climate research (Pilli-Sihvola et al. 2010; Aall et al. 2009; Tribbia and Moser 2008; Arnell and Delaney 2006; Berkhout, Hertin, and Gann 2006; Shepherd, Tansey, and Dowlatabadi 2006; Demeritt and Langdon 2004; Lemos et al. 2002; Shackley and Deanwood 2002).

Although much of this literature does consider the social context in which users encounter science, they may not problematize "use" or "understanding," and "science" enough. Brian Wynne (1995) criticized positivist Public Understanding of Science-survey studies measuring the public's technical understanding and "correct use" of science for only problematizing "publics" and neglecting to problematize the "science" and "understanding" of "Public Understanding of Science." I will in the following take up Wynne's challenge to examine more thoroughly what role science

[3] See the *local government paper* for a more thorough overview of the literature

plays in “use of scientific knowledge,” the impact of different conceptions of “use of knowledge” and of the proper interaction between science and its publics and users.

These are questions that the interpretive or critical tradition of studies of Public Understanding of Science (PUS) has concerned itself with (Michael 2002; Wynne 1995). Interpretive studies explore the cultural context of public understanding of science and how people in different social settings experience and construct science’s meanings.

Interpretive PUS studies evolved from a critique of the positivist or traditional PUS, centered on survey research for only problematizing ‘publics’ and their cognitive processes and capabilities – deploying a deficit model. Wynne (1995) argue that public “understanding” need not mean understanding technical details and general conclusions; it may just as well mean understanding science’s methods, institutional characteristics, or social implications. Furthermore, non-use cannot be explained as an issue of narrow, technical “understanding” alone. People always encounter “science” in a social context, and scientific knowledge may turn out be culturally useless as a result of the “seemingly incommensurable cultural preconceptions and commitments” (Michael 2002, 360-361) of scientists’ and laypeople’s worlds. Laypeople may ignore scientific knowledge because they regard it as irrelevant, or knowledge may be rejected or ignored as useless “in the *absence of the necessary social opportunity, power, or resources to use it*” (Wynne 1995, 363). One way interpretive PUS may help us understand the problem at hand is, thus, through a focus on the local social, cultural, and practical usability and relevance – or lack of such – of scientific knowledge (e.g., Sørensen, Aune, and Hatling 2000). Non-use of climate science knowledge might be caused by lack of usability, irrelevance, inaccessibility, or by lack of social opportunities, power or resources to use it.

Another line of PUS-studies that provide a different understanding for non-use, is Michael’s (1992) examination of the ways in which laypersons differentiate between science and self when they talk about science. Michael (1992) describe two main ways in which people talk about science: the science-in-general discourse and the science-in-particular discourse. Both distinguish between the scientific and the lay world, but in different ways. In the science-in-general discourse, science is imbued with criteria for what can count as scientific knowledge so strict that laypeople can never hope to realize them. Science is, in this discourse, defined by essential characteristics – particularly scientific methods and a “scientific mind” or way of thinking – that sets it apart from lay people, who lack such knowledge or cognitive capacities. The knowledge lay people possess, cannot (in their own estimation) be

considered “real science” (Michael 1992, 318). Compared to this, the science-in-particular discourse also distinguishes between science and lay, but here the distinction is not explained as inherent differences. Rather, it is seen as a (pragmatic) “division of labor” (Michael 1992, 321). When people express “ignorance” in this framework, the ignorance is not ascribed to an inability to grasp the scientific insights, but rather reflect a relationship where the responsibility of knowing is ascribed to the experts. Following Michael’s argument, we might expect that lay persons’ explanations for a distance (or lack of such) between scientific experts and non-experts, will influence how they relate to and interact with science. Seen in this light, non-use of climate science or ignorance claims about said knowledge may spring from ideas about a division of labor between scientific experts or from lay-people’s self-exclusion from the group of people who can speak legitimately about climate science.

These are two ways in which PUS studies problematize “understanding.” There are also studies from this line of inquiry that turns their gaze to science itself, and examine how scientists understand their publics. Several scholars explore “scientists’ understanding of the public” (Young and Matthews 2007; e.g., Blok, Jensen, and Kaltoft 2008; Hilgartner 1990; Holliman and Jensen 2009; Maranta et al. 2003; Wynne 1993; Michael and Brown 2000). Just like ideas about publics and science, and the relationship between the two, shape the public’s interaction with and relationship to science, expertise and knowledge (Blok, Jensen, and Kaltoft 2008; Michael 1992, 1996), such ideas also shape scientists’ communication and interaction with the public (see Blok, Jensen, and Kaltoft 2008; Hilgartner 1990; Holliman and Jensen 2009; Maranta et al. 2003; Wynne 1993; Michael and Brown 2000). Maranta et al. (2003) use the term “imagined publics” to describe scientists’ representation of the public. Michael and Brown (2000) take the line of argument even further and argue that scientific discourse, even when it is not particularly concerned with publics, in effect constructs and performs a kind of “lay political science.” They argue that scientific discourse constructs not only nature, scientific facts, arguments, procedures, and communities, “but also versions of lay publics, policy domains, science proper (…) [and] particular models of the appropriate form that should be taken by the interaction” (2000, 3). This results in ideas about the “interaction, interfaces, or forms of dialogue that do and/or should pertain between science and non-science constituencies, especially the lay public” (2000, 3).

Wynne (1995, 363) argues that scientists often assume that their research is relevant, regardless of the challenges of local, societal relevance sketched above. If there is little contact between scientists and users, then – between users and producers of

knowledge – scientists may end up providing knowledge that is irrelevant to users' needs (McNie 2007; Sarewitz and Pielke 2007). A common way of understanding knowledge transfer: the linear model – in which scientists provide (automatically relevant) research and disseminates it, and decision-makers and the public take it up, take it into account and put it to use – is, many argue, a large part of the problem (McNie 2007; Sarewitz and Pielke 2007; Lahsen and Nobre 2007; Beck 2011). The linear model is not only a problem because it may propel the production of irrelevant knowledge, but also because invites inaction on the part of the users (Wynne 2010; Dessai et al. 2009; Sarewitz and Pielke Jr. 2000, 18). Lahsen and Nobre (2007) even show how this "linear model" is institutionalized, indicating that this is a hard-to-abate, deep-seated problem.

Jasanoff (2010) takes this critique one step further, and suggest that climate science knowledge may face particular challenges because of features of climate science. She suggests that the establishment of climate change as an abstract, global phenomenon has detached knowledge from meaning. This is hard to abate, not only because it is institutionalized (Miller 2004a, 2001b; Shackley et al. 1998), but because of the very practices that has been so successful in securing science's cognitive authority. This includes science's ability to "wrench" phenomena out of their specific contexts, and make ideas and objects "that reflect no one's unmediated observations of the world and yet are recognized and accepted as real" (Jasanoff 2010, 234). These features are now part of what is destabilizing climate change knowledge. The "impersonal, apolitical, and universal imaginary of climate change projected by science" comes into conflict with the "subjective, situated and normative imaginations of human actors engaging with nature" (Jasanoff 2010, 233).

Part of the problem with climate science, in Jasanoff's (2010) view, is that it is somehow *inherently* cut off from local relevance. Thus, if we are to do anything about the climate problem, more (irrelevant) science will not help us. This feeds into another strand of research from Science and Technology studies, that of Daniel Sarewitz (2010, 2004, 2011) (and to some degree, Naomi Oreskes 2004). Effective action on climate requires better politics, not better science, explains Daniel Sarewitz (2010). Some findings from studies of public understanding of the climate problem also point in this direction. For instance, Ryghaug, Holtan Sørensen, and Næss (2011) find that lack of political follow-up makes people doubt the severity of the climate problem. This indicates that political action may be crucial, like Sarewitz indicates, contrary to the common, "perversely self-fulfilling political assertion that 'we cannot take the political risk of radical positive policy actions, because citizens will not accept it'" (Wynne 2010, 301).

Another common explanation for the relocalization challenges of climate science is its invisibility (Giddens 2009; Ungar 2000; Beck 2009): that one of the reasons the climate issue fails to have an impact on policy and on people's lives is that it is invisible, knowable only "with the aid of science" (Jasanoff 2010, 235). However, unlike other invisible problems (see Beck 1992; 2009, for examples), one can argue that climate change is also very much visible through weather and other climate-related natural processes (Strauss and Orlove 2003; Solli and Ryghaug 2008; Yusoff and Gabrys 2011). However, the links between weather and climate are unclear. Hence, climate change is, in a sense, *at the same time* both visible and invisible, tangible and intangible, both knowable through experience and knowable only through science.

This suggests that the ways in which people grasp climate change are a result not of either science or the social, but both. Jasanoff (2004a, 2) argue that we gain explanatory power by considering the scientific and the social together.

Co-production is the study of the "necessary *parallelism* between goings on" (Jasanoff 2004b, 30) in knowledge and governance practices. In a co-production framework – the "reality" and relevance of science is not brought about solely by science but also by social organization. Co-production goes beyond the classic linear model's diagnosis there has to be something wrong with either the science, the users, the process, or the context. The point of thinking about this as co-production is that, in order to understand this in a meaningful way, we need to examine the way these elements – together with institutions, discourses, identities, and representations – work together and reciprocally influence each other. Relocalization problems and non-use of climate science knowledge is seen not as the fault of any one actor, but as a result of the way in which these elements work together. Sarewitz' (2010) call for climate policy more than better science is, in its essence, a call for co-production—for political institutions, identities, discourses and representations that make something happen. To think of this as a co-production problem entails that if scientific knowledge about climate change is to result in viable change in management strategies in e.g. local government decision-making, changes in institutions are necessary. In contrast to studies which see such institutional changes as changes in the "context" of scientific knowledge, a co-production view holds that such institutional changes that back up scientific findings and enables changes in management strategies that are in line with what the science says are not just changes in the context, but that they make the science more "real."

Co-production processes often take the form of the making of identities, the making of institutions, the making of discourses and the making of representations. At the same time, identities, institutions, discourses and representations also often serve as "ordering instruments" that structure the unknown in cases of chaos and uncertainty. These ordering instruments can "divide the world of hybrids and cyborgs into less ambiguous categories that can easily be dealt with in law and custom," (Jasanoff 2004b, 38-39), help along the accommodation of new knowledges and technological capabilities without tearing apart the legitimacy of existing social arrangements (Jasanoff 2004b, 39), "and also do metaphysical work in preserving critical boundaries between self and other, structure and agency, state and citizen" (Jasanoff 2004b, 38-39). In such ways, they are morally, metaphysically, politically, and symbolically sustaining.

Jasanoff argues that co-production is not a "theory," but "a way of interpreting and accounting for complex phenomena so as to avoid the strategic deletions and omissions of most other approaches in the social sciences" (Jasanoff 2004a, 3); a holistic, not a piecemeal, way of thinking about issues; an "idiom" rather than a concept; a tool to help us think rather than a rigid framework imposing a foregone conclusion on every new situation. However, Jasanoff's presentation of the idiom of co-production is not sufficient to help us fully realize her ambition for the concept. Although her theoretical chapter is only the first in a book providing several studies labeled co-production studies (Jasanoff 2004c), which she argues are exemplars to draw inspiration from for other studies of co-production, I have chosen to draw on another resource in order to attempt to follow up on her request to think holistically about issues: organizational sensemaking (Weick 1995). Jasanoff's focus on identities, institutions, discourses and representations as a fruitful starting point for analysis is helpful, but these themes – and the interaction between them – are also covered in Weick's (1995) account of organizational sensemaking. The strength of Jasanoff's (2004b) approach is that she pays particular attention to the parallelisms and the interaction between science and policy. The limit to her approach is that this might overshadow other important elements to situations of sensemaking – like professional identities, chance happenings, surprises from other sources than policy and science, etc. - which Weick's approach alerts us to. Taken together, the sensemaking approach and the co-production approach may be a fruitful set of strategies to approach the issue of the relocalization challenges of climate science, indeed.

I have found the analytic approach of organizational sensemaking to be a useful tool in this more in-depth co-production analysis. The sensemaking framework urges us to

pay attention to how for instance identity, language, ideas about others, rules and routines shape the way people perceive, make note of, interpret and act on phenomena—in short, how they make sense of things.[4] Stripped to the bone, sensemaking is about connecting some element (cue) to a larger meaning (vocabulary, frame). Weick (1995) emphasizes seven characteristics of sensemaking, and this is his definition of it: as a process that is grounded in identity construction, retrospective, enacted, social, ongoing, focused on and by extracted cues, and concerned with plausibility rather than accuracy.

There are many parallels between organizational sensemaking, as defined by Weick (1995), and the Jasanoff's co-production approach. Not least, they are both concerned with "structuring the unknown" (Waterman, 1990, p. 41, quoted in Weick 1995, p. 4), and both sensemaking and co-production are most visible in situations of instability and breakdown, interruption of the ongoing flow of things (Weick, 1995), the emergence of new phenomena (Jasanoff 2004), or situations of controversy (Jasanoff 2004).

Furthermore, echoes of the "ordering instruments" of co-production are found in the sensemaking framework. For one, both co-production and sensemaking is concerned with identity, both how it can help stabilize something new and unknown, and how it may itself be in need of stabilization/sensemaking. Secondly, Jasanoff's attention to language has its parallel in Weick's discussion of the substance of sensemaking (pp. 106-132) as well as in his discussion of the social quality of sensemaking processes (pp. 38-43). "Words induce stable connections, establish stable entities to which people can orient (…), bind people's time to projects (…), and signify important information," Weick quotes himself (1985: 128, quoted in Weick 1995, 41). Thirdly, Jasanoff's concern with how institutions put "things in their place at times of uncertainty and disorder" (2004b, 39-40) is more or less covered by Weick's whole book: his main concern is sensemaking in organizations, and he also points out that there are important parallels between organizations and sensemaking processes: "To organize is to impose order, counteract deviations, simplify and connect, and the same holds true when people may try to make sense" (1995, 82). This resonates nicely with Jasanoff's description of how,

> *Through institutions such as legal systems and research laboratories, societies have access to tried-and-true repertoires of problem-solving, including preferred forms of expertise, process of inquiry, methods of securing credibility, and mechanisms for airing and managing dissent.*

[4] See the *architect paper* for a more on sensemaking.

> *Solidified in the form of administrative routines, these repertoires offer constant fall-back positions from which responses to novel problems can be constructed. (2004b, 40)*

Lastly, representations – in the form of generalized others, prototypes, stereotypes, and roles – also play important roles in sensemaking, as is apparent in Weick's discussion of sensemaking as a social activity (pp. 38-43). Thus, the "ordering instruments" of co-production are attended to in a sensemaking framework.

Also, insights from public understanding of science (PUS) resonate nicely with Weick' descriptions of sensemaking processes. When Weick emphasizes how the imagined or implied presence of others, not only actual presence, is important in shaping interpretation and action, this is essentially the same argument that Maranta et al. (2003) put forth when they argue the importance of paying attention to scientists' "imagined publics." When Weick emphasizes both the importance of self-identity and the importance of stereotypes and the generalized others, this resonates nicely with Michael's (1992) description of the science-in-general discourse, in which both a stereotypical view of scientific method and way of thinking and an imagined, explicitly un-scientific lay identity serve to exclude lay people from the realm of science. Weick is also very attentive to context, as the thing by which the significance of something (for instance a knowledge object) is judged. This resonates nicely with interpretative PUS studies' focus on exploring the cultural context of public understanding of science and how people in different social contexts experience and construct science's meaning (Michael 2002; Wynne 1995). Thus, the Public understanding of science approach ties in with sensemaking (and co-production for that matter) through its concern for lay and expert identities (in general seen from lay persons' perspective) and (laypersons) discourses on science.

It is within the framework of these three approaches – Public understanding of science, co-production, and organizational sensemaking – that I position my thesis. The above discussion has provided three main ideas to pursue in my further discussion of the papers taken together.

First, concerning climate scientists, PUS studies indicated that imagined publics and envisions of appropriate modes of interaction with users and laypeople have potential effects on the relevance of the research – perceived or actual. Second, concerning "lay" users of climate science results, PUS studies indicate that we might find lack of local relevance, lack of usability, or lack of ability-to-use; or that we might find ways of understanding science that either delegate the responsibility of knowing

to other actors, or excludes actors from the group of people entitled to an opinion on climate knowledge questions.

Third, following the idiom of co-production we can look for institutions, identities, discourses, and representations that back up stabilize climate science findings, making something happen, but we can also, if we use the strengths of sensemaking approach, examine the workings of institutions, identities, discourses, and representation more in-depth at the user level, we can examine some of the micro-processes that shape and stabilize local interpretations of what climate adaptation is and how it can be dealt with.

The climate adaptation impasse: failed co-production of knowledge and politics?

In what ways do climate scientists engage in making their science relevant? The two science papers found that climate scientists have four "imagined audiences" in mind for their efforts to communicate climate science knowledge: the general public, professional users, politicians/decision makers, and to some degree journalists. Tied to these imagined publics were three models of interaction, described in the objectivity—relevance paper; informing and educating the public, politicians, and journalists; an approach involving dialogue with professional users and the tailoring of knowledge and research questions to their needs. In addition, we can see a "default mode" of providing knowledge to those who are interested.

Inherent in the modes of interaction were also views of the relevance of the climate science knowledge: In the provide approach relevance is presupposed as implicit and "automatic." The same holds, to some degree, for the information-education approach: the knowledge should be relevant and of interest to the public, but people forget, so the issue has to be kept on the agenda. In the dialogue-tailoring approach, however, relevance is not automatic. Although climate knowledge is presumed to have the potential to be relevant, achieving this in practice is seen as harder and, potentially, time consuming. In this model, relevance can be reached through technical "tailoring" of existing knowledge or new research questions to the needs of users. Through dialogue it is presumed that scientists can manage to understand the users' needs and translate these into "doable" (Fujimura 1996) research questions. The interviewees involved in this, experienced these dialogue efforts as successful, if time consuming.

In addition to the four imagined audiences described above, climate skeptics played a central role in shaping the climate scientists' communication strategies – especially

the communication taking place publicly – in the news media, but also talks and lectures. The "interaction" with climate skeptics took a negative form: climate scientists trying to shape statements in such a way that misuse and find-faults-attacks were avoided; education, to some degree, in the form of arguing back and trying to get the skeptics to "see reason;" and lastly, but very important, boundary work – educating the public about the proper delimitation between climate expert and lay, so they were not seduced by the climate skeptics' claims. In the eyes of the climate scientists, the main problem with climate skeptics was that they confused the general public about the facts of climate change, thus, mainly as a problem to the information-education approach. However, it may be that also the response of climate scientists to the presence of climate skeptics – boundary work – have exacerbated relocalization problems, a point I will return to shortly.

Obviously, scientists make an effort to be relevant. How are these efforts perceived by the user side? One thing that the user papers show very clearly is that scientists were not as central to questions of climate adaptation as one might have expected. Both the architects and the local government employees called for other translation agents besides climate scientists – that is, they called for national level building and planning regulation to settle the questions of what to adapt to and how, questions that scientists could be expected to answer. Although lack of practical local relevance and usability of climate science knowledge was pointed out as a problem, lack of the social opportunities, power or resources to use it – in short, lack of ability-to-use – was pointed out as the main "barrier" to knowledge use. The call for regulation should also be understood in light of this. Not only were regulations understood as a potential way of translating or "operationalizing" climate science knowledge by providing technical data and numbers directly applicable in daily practice, regulatory requirement were also seen as empowering and enabling in the sense that they could be used to pound the table, cut debate short, and "force" the inclusion of climate adaptation measures and thus the "use" of climate science knowledge.

The above call for regulation can be interpreted as an example of what Michael called a "division of labor" understanding of the relationship between users and producers or knowledge. However, there was an important exception: the ones given the responsibility for "knowing" and for making knowledge relevant were not only scientist but, to a very large degree, national authorities.

The interviewed architects mainly appeared to adhere to a discourse in which the main difference of importance between climate scientists and themselves were such a division of labor – a delegated responsibility for knowing. Several of the local

government interviewees, on the other hand, employed a lack-of-scientific-mind and lack-of-the-right-methods explanation for the expert—lay reminiscent of Michael's (1992) science-in-general discourse.

Mainly, such exclusion centered on discussions about whether observed changes in the weather could be said to be observations of "climate change" or not,[5] and about whether measures taken based on observations of worsened weather conditions could be called "climate adaptation." The employment of a science-in-general like discourse to talk about climate science, had the effect that the local government employees excluded themselves from the group of people able to decide whether and how the weather they observe can be tied to climate change. Moreover, the thought of having to decide whether and when climate science results were sufficiently certain to be usable as basis for decision-making, made several local government employees uneasy. Surprisingly, the solution proposed by the local administration users to manage these conundrums was to call for more and updated regulations.

Together, these examples of relocalization challenges – relevance, usability, ability-to-use, ideas about division of labor, and self-exclusion from the group of people knowledgeable about the climate – show that more and better knowledge will not be enough to ensure climate adaptation. Political action, for example in the form of regulation and codes, will also be important. Does this mean that the problem at hand is a co-production problem?

If we search for climate adaptation "ordering instruments" – stabilizing identities, institutions, discourses, or representations – in line with the co-production approach (Jasanoff 2004b), it seems that climate adaptation lacks them. This might indicate

[5] The arguments the local government employees used to exclude themselves from the group of people entitled to "observe" climate change, bear much resemblance to the climate scientists' boundary work strategies described above. We might therefore wonder if this exclusion is not perhaps an effect of the local government employees having appropriated the climate scientists' boundary-work-distinction between scientists and lay people. If this is the case, it is a turn of events that shares similarities with Beck's notion of reflexive modernization, which involve the successes of modernization coming back to haunt it. The local administration paper seem to show a parallel tendency regarding scientists boundary work; that is, that the success of the climate scientists' boundary work in establishing a lay—science divide may be increasing the problem of relocalizing climate science knowledge.

that the problem is a lack of co-production. There appeared to be confusion about what climate adaptation should entail and mean, how it should be done, and by whom. Thus, a definite 'climate adapter' identity appeared to be lacking. Although the architects argue that climate adaptation was already part of their professional identity, this was with current climate in mind, and built on a conception of climate change as happening slowly and manageably. The absence of a climate adapter identity was perhaps more keenly felt among local government employees, who felt that they should perhaps assume such a role, but were very uncertain about what such a role should entail. Similarly, it appeared to be unclear which institutions – whether researchers, national administration institutions, or others – were, or should be, responsible for climate adaptation, indicating a lack of "climate adaptation institutions." Such institutions were called for. For instance, both architects and local government employees called for regulations which included climate adaptation concerns. We also saw in the interviews with both architects and municipal administrators that there was confusion about what exactly 'climate adaptation' should mean. For instance, it was hard to draw the line between "ordinary" measures to address weather- and natural hazards vulnerability, and "climate adaptation," making climate adaptation into something exceptional and rather remote. The difficulty of using weather observations as "proof" of climate change appeared to play some role in hampering the relocalization of climate, thus adding to the remoteness and intangibility of climate change. There was also a discourse on lack of translation of available knowledge.

Read in this way, as a superficial "checklist" for a "proper" co-production process and measuring the way in which the climate adaptation issue falls short, we might conclude that the challenge climate adaptation is facing – in light of the co-production framework – is to enroll a broad array of allies, to bring central governments into the fold, and to create politics that back up, certify and solidify the climate adaptation issue. In this manner, one would make it more "real" and tangible while at the same time "depoliticizing" it and providing local level users with concrete tools they can use to back up their climate adaptation concerns.

However, just to point out that "co-production is lacking," seems unsatisfactory. Part of what makes the co-production framework so fruitful is that it can help us study things better by opening the analysts' eyes to elements that might be excluded from more standard analytical approaches. This advantage is hard to utilize when the findings are of a more "negative" kind as referred above. Noting that co-production is lacking hardly gives us a richer understanding of the situation at hand. Is the co-production framework useless for the matter at hand, then? Maybe not. If we follow

Jasanoff's (2004b) invitation to examine what institutions, identities, discourses and representations *do*, e.g. how they play a part in defining situations, and how they themselves are defined in turn, we can still use the strengths and tools of co-production analysis to throw light on what's happening here, especially if we, in parallel, draw on organizational sensemaking (Weick 1995).

If we examine the workings of institutions, identities, discourses, and representations at the user level more in-depth, to uncover some of the micro-processes that shape and stabilize local interpretations of what climate adaptation is and how it can be dealt with – what do we see? Weick (1995) argues that sense, cut to the bone, consists of three elements: (1) a something – be it an event, an action, and observation, an assignment, or a question; (2) something bigger out there that it can be connected to – e.g., a climate science, weather observations, past experiences, "a prototypical past moment" (Weick 1995, 111), a story, etc.; (3) and the link between them: "The combination of a past moment + connection + a present moment creates a meaningful definition of the present situation" (Weick 1995, 111).

Problems of sensemaking can arise when there is a lack of a frame in which to place the observation, assignment, event, or question, or when there are too many such frames and it is unclear which is the most appropriate. The first situation is one of ignorance or uncertainty – there are too few interpretations, the second one of ambiguity: there are too many interpretations (Weick 1995, 99). A third problem might be one that Weick does not touch upon, but which nevertheless occurs here: the problem of establishing the link between frame and event, as was the case when local government employees excluded themselves from the group of people able to link weather observations to climate change, or changes in practices to "climate adaptation."

In the case of climate adaptation, there appear to be two main frames it can be linked to: weather and "the climate issue." This appears to create a situation of ambiguity. Climate adaptation can be and is connected to both at the same time. However, since the link between climate change and weather is unclear, this creates ambiguity.

Since climate adaptation links – and may link – climate change/climate science and the weather, it has been proposed as a potential solution to the relocalization challenges facing climate science (e.g. Yusoff and Gabrys 2011; western-world politicians paraphrased by Wynne 2010). Right away, that sounds sensible: Yussuf and Gabrys maintain that climate change can easily be perceived as a general, "global imaginary" (Yusoff and Gabrys 2011, 517), or as something with relevance (only) to

distant places such as the Arctic or Sub-Saharan Africa. Adaptation, they argue, may be able to bring the climate issues "home", showing the relevance of the issue for every scale and locality, thus making it something "in here", "entangled in contemporary practices and future possibilities" (Yusoff and Gabrys 2011, 517). Linking climate change and weather ties climate change to something with immediate and tangible relevance (everybody has experience with the weather) and with a well-functioning "center of calculation" (Latour 1987, 2005) (most people deal reasonably with weather forecasts and the meteorological institute). Linking climate change to weather can be enabling, because it lets people base measures on currently observed weather, thus deferring discussions about whether we are really seeing climate changes or not which might arise if measures were called "climate adaptation." Thus, adaptation based on current weather may be climate adaptation to those that need climate adaptation to happen and "common sense" to those who think "climate adaptation" is unnecessary.

Thus, linking climate adaptation to the weather make climate adaptation as well as climate science into something ordinary, connected to everyday life. The architect paper shows examples of this. The architects linked climate adaptation to weather in ways that anchored it and made into an ordinary concern. They argued that, since their profession was used to dealing with weather, architects would be able to handle climate adaptation as well. The local government interviewees, on the other hand, also made links between climate adaptation and the weather, but rather than simplify the issue and make it normal, their linking of climate change and weather "scientized" the weather. This made local government interviewees questioning their ability to link weather observations and climate change, complicating their observations of the weather.

These two very different linkings show how this is not straightforward. Linking climate change and weather may simplify the issue but also make it more complex.

In short, linking (or attempting to link) climate change and weather here changes what could have been common sense activities into something larger and more challenging. Local government employees are caught between science as something complex, distant, exclusive, and politicized and a need to bring the issue down to earth, making it manageable and ordinary. What this shows is that adaptation is not necessarily something that can "ground" the climate change issue locally. It is just as likely that the climate issue appears so large that it makes the related local-level issues tied to it loose their foothold. Labeling something "climate adaptation" may just as well connect this something to the whole scientized-politicized climate-science

discourse, making implementation more difficult, not easier. Labeling something which could have been just "common sense and respect for the planning and building act"[6] (e.g., maintenance and heeding weather), may in itself change things, and potentially create challenges. It may very well be that a linking together of weather and climate, or of linking "common sense" practices such as maintenance and heeding weather to climate change, can scientize and complicate them. Linking weather adaptation and maintenance to climate ties climate adaptation to a body of knowledge that is characterized by apparent uncertainty, making it difficult to decide that something is "certain enough." Moreover, as the local administration paper showed, this linking may reduce the number of people with the power to make such decisions to climate scientists and national authorities.

Weick (1995) stresses that in ambiguous situations, more knowledge or information will not necessarily be helpful.

> *To resolve confusion, people need mechanisms that "enable debate, clarification, and enactment more than simply provide large amounts of data" (Daft & Lengel, 1986, p. 559). (…) To remove ignorance, more information is required. To remove confusion, a different kind of information is needed, namely the information that is constructed in face-to-face interaction that provide multiple cues. (Weick 1995, 99)*

Weick's point here resonates with the point made by Sarewitz (2010) that effective action on climate requires better politics, not just better science (see also Pielke Jr 2007; Sarewitz 2004). In Weick's account of ambiguity, face-to-face meetings are the best way forward. However, my data seems to back Sarewitz' (2010) point that what is needed is more politics, or more and better policy options (Pielke Jr 2007).

We see an example of the potential for politics to solve questions of ambiguity in the users' calls for the inclusion of climate adaptation concerns in building and planning regulation. Building and planning regulations were central to how both architects and local administration employees made sense of climate adaptation. The sensemaking of climate change was made difficult not only by the fuzzy relationship between weather and climate (change), but also by the apparently contradictory signals from climate science and the institutional context. Regulations were not used only instrumentally – they were also used strategically (Weiss 1979). Even more importantly, they were read as "political text," (Moore and Wilson 2009, 2616; Imrie

[66] Kronholm and Stalsberg, researchers from the research project GeoExtreme, in Norwegian climate information magazine *Klima* 3-2009 (p. 34)

and Street 2011, 284) that is, for cues to guide sensemaking concerning how to respond to the climate adaptation charge. Thus regulation may not only counter the "politicization" of climate adaptation and weather observation that happens when weather and climate, and maintenance and climate, are linked in the application of the label "climate adaptation." It may also remove ambiguity and stabilize the meaning of "climate adaptation," serving as an "ordering instrument" in the co-production sense.

Based on the above cross-cutting analysis, I have two main points to make: one empirical and one theoretical. First, my empirical analysis shows that the ways in which potential users make sense of the climate adaptation issue makes it hard to solve it with science alone. This means that more focus on politics is necessary, in particular on building- and planning regulations and building codes, but also on the necessary, accompanying funds. A call for "more politics" may sound like a repetition of "co-production is lacking" point that I above criticized for being a little too simplistic – however, the point here is a more complex one, although perhaps a little convoluted. My point is not that co-production is necessary because this is always, *a priori* the case, but because the climate adaptation is interpreted, understood, made sense of, and co-produced in such a way that co-production – in the sense of politics that can stabilize the issue of climate adaptation – is necessary.

My theoretical point relates to the combination of the co-production and the sensemaking approach that I have employed to arrive at this conclusion. My analysis shows how sensemaking is a fruitful supplement to co-production as a theoretical approach, and – perhaps – as a way of studying things and issues that *could have been* co-produced, but where that is not yet the case.

Methods

The overall aim of the project that this dissertation is part of was, initially, to study translation and co-production processes linked to climate science knowledge. Since calls for relevance and usability are more explicit when it comes to climate adaptation (see, e.g., NOU 2006:18 2006; Giddens 2009), climate adaptation was considered an interesting choice of case for studying these matters. We wanted to attain insight into climate science translation processes by studying the issue from two angles: climate scientists and their intended users. The plan was to utilize climate science interviews from an earlier project (*Coping with the Threat of Climate Change*, project manager Knut H. Sørensen) and extend this data with new interviews to address the science side; and to address the (potential) user side, to do a two-step data gathering process, starting, first, with an extensive round of relatively short telephone interviews – to assess what the practices of climate adaptation looked like, how many engaged in them, and to start to form an idea about what challenges was involved in "translating" the available climate knowledge into something useful – and, secondly, moving on to more in-depth face-to-face interviews about the challenges involved. The choice of such a two-step process with a broad-scope, more "preliminary" stage and a more "in-depth" second stage, was based on a, perhaps naïve, idea we – the project manager Knut Sørensen, my colleague Robert Næss and I – had that climate adaptation would be a relatively definite set of practices that local practitioners either did or did not engage in.

However, a challenge arose which upturned this method plan. "Climate adaptation" was not, after all, a definite set of practices to the practitioners involved. This lack of clarity changed everything: The initial overarching research question for this project initially was: how is climate science knowledge appropriated, understood, and used for climate adaptation (in Norway)? But when most of the interviewees in the "preliminary" interviews raise some version of the question "what does climate adaptation mean anyway," this question becomes less meaningful and sensemaking as an overarching frame – both analytically and methodologically – comes to the fore.

How can we study sensemaking? Weick (1995, 172) points out grounded theory as one example of methods suited for studying sensemaking. He lists several characteristics suggestive of a mindset for methodology well-suited for investigating sensemaking (1995, 172-173) – with the most central being that "observers mobilize a set of methodological tactics that enables them to deal with meanings rather than frequency counts" (1995, 173), among these:

1. Making an effort to preserve action situated in context land maintain the richness of both the action and the context, aiming for explanations that imply person—situation interactions and/or transactions.
2. Giving participants' "texts," that is, definitions, actions, meanings, etc. more weight than researcher specified measures.
3. Working "in close," doing empirical not theoretical, "armchair" work.
4. Describing findings in terms of patterns rather than hypotheses—the goal is not to test findings against *a priori theories.*
5. Settings are chosen more for their access to sensemaking phenomena than for their representativeness. (Weick 1995, 172-173)

In the following, I will discuss three methodological issues of particular relevance to this study: First, I will discuss the challenge of interviewing about an issue which is unclear, still in the process of being-made-sense-of, or even where the process-of-being-made-sense-of may be induced by our interview questions about it. Second, I will address concerns regarding the quality of telephone interviews. Thirdly, I will describe in what ways my analysis strategy can be called "grounded theory methods."

Qualitative, 'active' interviews

Together, I and my colleague Robert Næss have done 136 interviews in this project, in addition to 17 climate scientist interviews conducted by Marianne Ryghaug, initially for a different research project (*Coping with the threat of climate change*). The interviews cover 10 different categories of respondents: architects, local government administration interviewees (telephone interviews), local government administration interviewees (face-to-face interviews), climate scientists, effects scientists, insurance companies, electricity grid companies, the building industry, central administration, and county governors. Three of these have been directly used for the dissertation papers (architects, telephone interviews with local government administration, and climate researchers). The other interviews have played more of a sensitizing, background role. Table 1 shows an overview of the interview categories. A more in-depth overview of the interviews is found in the appendix. The respective papers also have their own independent methods section, which describe method and methodological issues particularly pertinent to their analyses. The following description covers more over-arching concerns and issues, pertaining to this thesis and project as a whole.

Table 1 - Overview of interview categories

Group of interviews	No. of int.	Time period	Interviewer(s)[7]
Architects	37	Mar—Aug '08	SET, RN
Local government admin. (phone)	44	May—Aug '08	SET + RN
Climate scientists I	14	Apr—Nov '05	MR
Climate scientists II	4	Sep '09	SET
"Effects scientists" I	3	Apr—Nov '05	MR
"Effects scientists" II	5	Sep '09	SET
Local government admin. (Face-to-face)	11	Feb '08—Des '09	SET, RN, SET+RN
Insurance companies	6	Mar—Jun '08	SET
Electricity grid companies	13	Feb—Mar '08	RN
The Building Industry	6	Feb '08—Jan '10	RN+SET, RN+JS, SET
Central administration	6	Jun '08—Dec '09	SET, RN+SET, RN+JS
County Governors	3	Dec' 08—Jan '09	SET

As is apparent from the list of interviews here and in the appendix, there is more interview data gathered than what has been directly used in the dissertation papers. This is due to the relative extensive amount of interview data collected and to the limited time-frame of a PhD-project. I chose to focus, in part, on the data that was collected by me personally (architects, the 2009 scientist interviews), but also included the municipality data that I had taken part in collecting, and the 2005 climate scientist interviews.

The interview as sensemaking occasion

Interviews are sensemaking occasions. Weick, quoting Louis and Sutton (1991, p. 60), summarize the three conditions for sensemaking – "three kinds of situations in which actors are likely to become consciously engaged" (Weick 1995, 90). First, sensemaking often occurs in situations when something novel, unfamiliar or

[7] The 'Interviewer(s)' column shows which researcher conducted the interview in question. RN is Robert Næss. SET is Sunniva Eikeland Tøsse. JS is Jøran Solli, employed at a sister project at the Department of Interdisciplinary Studies of Culture: *Climate Knowledge on the Road?: Scientific knowledge, transdisciplinarity and the performance of expertise*. MR is Marianne Ryghaug, who was involved part-time *Climate Knowledge on the Road*, part-time in *Rainy Day,* as well as in the research project *Coping with the threat of climate change* mentioned above.

A '+' connecting interviewer initials indicates that the interviews were conducted by both two persons; separation by a comma indicates that the sample contains interviews conducted by different interviewers.

unprecedented happens; secondly, sensemaking occurs in situations of discrepancy – unexpected failures or lack of expected outcomes; thirdly, sensemaking occurs "in response to an internal or external request for an increased level of conscious attention – as when people are 'asked to think' or 'explicitly questioned.'" (Weick 1995, 91) This, then means that the interview is a good place to study sensemaking because sensemaking can be prompted in the course of the interview by explicitly questioning interviewees or 'asking them to think,' thus, to borrow words from Holstein and Gubrium (1995, 18) "inciting narrative production" and meaning-making occasions, but also that some reflection about how we as respondents and interviewers contribute to the meaning of the concept as constructed in the course of the interview is due.

Qualitative interviewing is a good method choice for gaining insight in respondents' sense-making processes with respect to climate adaptation, especially since 'climate adaptation' appears to be a still relatively undefined issue, making unlikely that to crop up in regular, everyday conversations and documents. The interview has the advantage that it is an occasion where one can incite sense-making and interpretive practice on issues that are not casually topical. Thus, interviews are better suited to catch this phenomenon than observation and document studies, since it can be expected that climate adaptation is not causally topical. In an interview, a researcher can incite interpretation, sense-making and the articulation of thoughts and meanings, which "might emerge too rarely to be effectively captured "in their natural habitat," so to speak" (Holstein and Gubrium 1995, 18).

It has been argued that interviews and observations are very different methods, yielding very different data, with observations and naturally occurring talk being considered more "realistic" or "authentic." Holstein and Gubrium argue that interviews and observation are less different than what is often argued, and that naturally occurring talk and interactions "are not necessarily more "realistic" or "authentic", but simply take place in what have been recognized as indigenous settings" (1995, 17-18). If naturally occurring talk appear less "staged" and more spontaneous than an interview, "this is true only in the sense that such interaction is staged by persons other than an interviewer" (1995, 17-18).

Highly structured formats may render important aspects of meaning-making invisible (Holstein and Gubrium 1995, 52). In order to make visible actors' sense-making and interpretive work with respect to climate science, climate adaptation and the climate issue as such, we chose a qualitative format.

Collaborative construction of 'climate adaptation'

It is often acknowledged that all interview situations unavoidably include some collaborative aspect – that the meanings produced in the course of an interview is influenced and shaped by the respondent and the interviewer both. However, it is still relatively rare that this insight is put to good use (Holstein and Gubrium 1995). However, if the "unavoidably collaborative" character of the interview situation is consciously acknowledged, bias ceases to be a meaningful concept, Holstein and Gubrium argue, since "[t]he respondent can hardly "spoil" what he or she is, in effect, subjectively creating" (1995, 8), that is—"if the interview responses are seen as products of interpretive practice, they are neither preformed, nor ever pure. They are practical productions" (Holstein and Gubrium 1995, 18). We should think of the interview respondents as active, and of the interview situation as an instance of collaborative meaning-making or "storytelling", Holstein and Gubrium argue. What are the procedural implications of this?

Holstein and Gubrium (1995) argue that in an active interview the distinction between the tasks and roles of interviewer and respondent are less clear than in the traditional view of the interview process (this is one of the ways of making the most of the fact that they both contribute to meaning-making): Both parties access a greater range of interpretive activities. The interviewer directs and constrains the interview with respect to the topical agenda, objects and queries of the research, challenging the respondent, pointing him/her in promising directions, and giving an idea of the interpretive 'terrain', in short: providing precedence, incitement, restraint and perspective. The active interview is not without organization, but it is "not so much dictated by a predesigned set of specific questions as it is loosely directed and constrained by the interviewer's topical agenda, objectives, and queries" (Holstein and Gubrium 1995, 28-29).

In the active perspective on interviewing, interviewers contribute to the meaning of the concept constructed in the course of the interview as much as the interviewees, since "socially constructed meaning is unavoidably collaborative (…) [and] it is virtually impossible to free any interaction from those factors that could be construed as contaminants" (Holstein and Gubrium 1995, 18). This is of particular interest in the case of our interviews since 'climate adaptation' turned out to be a relatively undefined concept for the respondents. How did we, as interviewers, address this issue in the interview situations?

There are several definitions of 'climate adaptation' in the literature (Adger et al. 2007; Leary 1999; Smit et al. 2000; Adger, Arnell, and Tompkins 2005). Adaptation is

defined by the IPCC as “adjustments or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate" (Adger et al. 2007, 720), but it can also be defined even broader is all human responses (individually or collectively) to climate change that may not be categorized as mitigation (Leary 1999, 307). Furthermore, climate adaptation can be hard to single out from people’s actions in general, because adaptation to a changing climate is not something that happens with only the changing climate in view, but “tend to be on-going processes, reflecting many factors or stresses, rather than discrete measures to address climate change specifically" (Adger et al. 2007, 720): “Adaptation to climate change is seldom undertaken in a stand-alone fashion, but as part of a broader social and development initiatives. (...) The capacities for adaptation, and the processes by which it occurs vary greatly within and across regions, countries, sectors and communities” (Adger et al. 2007, 737). To complicate things even further, Smit et al. note that

> *“Adaptation” could be (and sometimes is) applied to altering activities related to greenhouse gases (here called “mitigation”). “Adaptation” is also sometimes used to refer to adjustments, particularly by businesses, to changes in the political-economic environment associated with the climate change issue (notably policies promoting measures to mitigate). In this paper, adaptation refers to adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts. These differing applications of the term "adaptation" reinforce the need for users of the term to specify adaptation in what, and to what. (Smit et al. 2000, 224-225)*

Since we were interested in how the interviewees themselves defined “climate adaptation” and not whether they got it wrong or right compared to some official definition, we tried in our interviews, to not defined ‘climate adaptation’ at the outset, but instead to elicit the interviewees’ tentative definitions of what climate adaptation might mean for them. If we had approached the interview with a ready definition of “climate adaptation”, it might have been easier for them to answer “yes” or “no” to whether were engaged in it. Approaching them with an open-ended “are you engaged in climate adaptation activities (implied: whatever these may be to you)?” we enabled them to present their own definition of it or develop one in the course of the interview, in this way bringing sense-making to the foreground, even provoking it. However, since ‘climate’-related issues were often thought of as pertaining to mitigation measures (i.e. questions of energy-efficiency and greenhouse gas emissions reductions), we often ended up prompting respondents to talk less

about emissions reductions and more about issues related to weather, natural hazards, and changes in such. Thus, we may have helped create a narrower definition of 'climate adaptation', than some scholars argue is wise. Karen O'Brien and Johanna Wolf (2010), for instance, argue that it is unhelpful to consider adaptation to climate-change induced weather, biology, and natural hazards changes, etc., as climate adaptation while neglecting to consider values and ideas about what is worth preserving. However, in its broadest definition, all those actions or changes in practice that individuals or organizations undertake with future potential climate changes in mind which does not fall into the category of mitigation measures might be considered climate adaptation (Leary 1999) – prompting the interviewees to talk about those actions that they did with climate change in mind that did not have anything to do with emissions reduction, is maybe not so problematic. Also, it appears that the needs tied to knowledge differs in situations where the knowledge is to be used as a basis for mitigation efforts and for adaptation effort (see, e.g., NOU 2006:18 2006; NOU 2010:10 2010), making it pertinent to attempt to introduce a distinction between mitigation efforts and adaptation efforts.

Another reason the active interview approach is a very appropriate choice here, is the considerable ambiguity among the respondents with respect to whether practices should be called climate adaptation or not, what 'climate adaptation' should entail, and who (if any) were qualified to interpret the weather. An active interview is not seeking coherence and unambiguousness. Rather, it is a goal for the interviewer to "converse with respondents in such a way that alternate considerations are brought into play" (Holstein and Gubrium 1995, 17) – to get respondents to activate different aspects of their stock of knowledge, and take different roles, positions or viewpoints during the course of the interview by providing an interview environment that is conductive to a production of a range of meanings and complexities of meanings relevant to the issue. As an active interviewer it becomes central to take account of differing coding schemes and contrasting narratives. This is how we gain insight into interpretive practice and sensemaking:

> *Signs of confusion, contradiction, ambiguity, and reluctance should (...) be noted, because problematic conversation often signals occasions where meanings are being examined, reconstituted, or resisted (Holstein and Gubrium 1995, 79).*

Active interviews of short duration – theoretical sampling for inciting rich meaning-making

A core feature of the active interview as defined by Holstein and Gubrium (1995) is that it can draw on earlier interviews to incite meaning-making. When Holstein and Gubrium discuss the strengths of the active interview approach in this fashion, they draw heavily on examples from single, long interviews in which the respondents have been prompted to assume different narrative positions during the course of the interview. The strength of our approach is the number of different interviews and therefore different views we were able to assess. Given that numbers is our strength, in a sense, it is relevant to discuss whether we have been able to employ to good purpose the strengths of Gubrium and Holstein's active interview approach. Quantification was not a goal, even though we have tried to maintain a certain representative sample in the sense that we have striven to include an as broad picture of the problem field as possible by including interviewees with different views – interviewees from different areas, from firms of different sizes, and from municipalities with different economic elbowroom.

A way of making the most of the active interview approach, even in interviews as short as ours, is to use the grounded theory method of "theoretical sampling" (Corbin and Strauss 2008) as a way of inciting and inviting rich sensemaking also in short interviews, taking advantage of background knowledge, insights and interesting concerns, issues, and themes from prior interviews "to pose concrete questions and explore facets of respondents' circumstances that would not otherwise be probed" (Holstein and Gubrium 1995, 46). Theoretical sampling involves analyzing interviews soon after they have been conducted and adjusting the interview guide and sampling process to include questions and lines of inquiry that arises from the analysis. In this way, the researcher moves back and forth between data collection and analysis, the data collection being led by ideas the researcher gets during analysis (Corbin and Strauss 2008). The aim of theoretical sampling is conceptual and theoretical development, not statistical, representativeness for generalization.

Although question formulations were suggested in the interview guides, the actual interviews were just as often guided by the topical "headers" of the interview guide – the overarching themes we wanted to cast light on. New questions were sometimes added – sometimes on the fly, sometimes more permanently as follow-ups to utterances by the current interviewee or from other, earlier interviews.

In the architect interview process this question-elaboration process was explicit and conscious – and is logged in a series of drafts and working versions of the interview

guide, going through two major revisions, resulting in three different interview guides and several smaller adjustments in the interviews to elicit as rich descriptions and as much meaning-making as possible. Some relevant literature was scoured for potential questions/themes and question formulations – in particular Marianne Ryghaug's doctoral thesis *Towards as sustainable aesthetics: architects constructing energy efficient buildings* (2003, Trondheim: NTNU). In this process, I took inspiration for the interview guide revisions from Corbin and Strauss' (2008) description of theoretical sampling. I asked later respondents to elaborate on themes introduced by respondents earlier in the process. Though the interviews were not analyzed consecutively, elements of interest not included in the initial interview-guide were included in later interviews (see appendix). Also, background knowledge from prior interviews was taken advantage of "to pose concrete questions and explore facets of respondents' circumstances that would not otherwise be probed" (Holstein and Gubrium 1995, 46).

In the local government interviews, we did not follow a theoretical sampling approach, but I would still describe our interview strategy as "active," since it was used more as an anchor for the interview process – to keep the focus on the agreed-upon themes. Since we were two interviewers who had to coordinate our questions, this seemed a practical solution. Also, more of the analysis of the local government interviews took place after the interviews had been undertaken, recorded, and transcribed, than with the architect interviews where some analysis was done parallel to the interview process, justifying calling it a theoretical sampling parallel to interview-analysis process.

In a sense, the 2009 climate scientist interviews can also be seen as part in a theoretical sampling data-gathering-analysis process. With respect to the climate scientist part of the project, I wanted to make use of interviews with climate scientists carried out by Marianne Ryghaug in 2005 for the project *Coping with the threat of climate change: technological strategies and cultural responses*. The second round of interviews came after the 2005 interviews had been analyzed, and the 2009 questions were drafted to address interesting questions that had arisen in this first analysis.

Telephone interviews: sufficiently qualitative?

The project was designed as one where the research interest was not only qualitative interviews to provide insight into meaning-making practices tied to the use of climate knowledge and the climate adaptation challenge more generally, but also to access a

broad range of views from firms and municipalities all over the country. This led to a decision to use telephone interviews.

Telephone interviews as a format have both advantages and drawbacks. The advantage is that they are cost-effective, since one does not have to travel to reach the respondents. However, potentially valuable non-verbal communication is lost (Sturges and Hanrahan 2004). Also, telephone interviews are "attention intensive" due to the absence of non-verbal communication (Christmann 2009). This means that it is hard to have telephone interviews last longer than 20-30 minutes, something that again limits the number of questions it is possible to ask when telephone interviews is chosen as a format. Taken together, these two reservations indicate that telephone interviews may provide insufficiently rich material for a qualitative analysis. Complex issues and puzzlement in interviewees have also been shown to be easier to capture in face-to-face interviews than in telephone interviews (Shuy 2001). Other issues include difficulties with hard-of-hearing and elderly respondents, with minority respondents, and with sensitive questions (Shuy 2001). These are less relevant to the case at hand.

Several aversions to telephone interviews are tied to an idea that such interviews are necessarily more structured, leading to an asymmetrical distribution of interactive power between the interviewer and the interviewee (see Shuy 2001). Also, face-to-face situations are considered more "natural" than a phone conversation. These issues need not be relevant. We have attempted to achieve an active interview despite the telephone format, that is, a format where the interactive power is more symmetrically distributed. An active interview approach abate some of the challenges tied to telephone interviews that have been pointed out, though studies that examine the extent to which an active interview approach and telephone interview format go together are scarce (Shuy 2001).

Shuy (2001) reject the notion that there are large, insurmountable differences between telephone interviews and face-to-face interviews, and that some of the shown differences between telephone and face-to-face interviews lie in the uses the different formats have been put to, rather than essential characteristics of the formats as such. Shuy argues that the question of whether telephone interviews are adequate to the task at hand depends on the goal of the study.

Since the number of questions we wanted to ask was relatively limited number of questions, we deemed qualitative telephone interviews to be an appropriate format for much of the data gathering. We also have interviews of both kinds in the local government dataset. The differences between the two interview formats in that data

set appeared to be small. The face-to-face interviews were longer, more questions could be asked, and the length of responses to open-ended questions somewhat longer. But both kinds of interviews were rich in description and could be considered sufficiently "qualitative" to be useful for our research purpose. This was important, since some of our most central findings – related to the varying meanings of 'climate adaptation' – would have been impossible to uncover without a qualitative method. Thus, for our purposes, the use of telephone interviews was well suited for investing the matter at hand since the interview themes incited sensemaking on the meaning of climate adaptation—making the interviews very rich in description on this matter.

Grounded theory analysis and theory

Since 'grounded theory,' strictly speaking, refers to the finished product of an analysis process, Charmaz (2006) suggested that one should call the steps taken to arrive at this product should be called grounded theory methods (GTM). Further, Charmaz (2006) argues that GTM should most of all be understood as a set of systematic and flexible, practical tools and guidelines for data analysis and gathering that can be applied regardless of the theoretical or epistemological background of the researcher. The most common tools of GTM are: theoretical sampling, different levels of coding, and the writing of memos and making of diagrams (2008; 2006) (see also Clarke 2005).

GTM was originally devised as a critique of "ungrounded" speculative, arm-chair theories, and thus its initial emphasis was on the inductive aspect of the theory (Corbin and Strauss 2008, 326). However, that does not mean that "the literature," e.g. earlier research, theoretical frameworks and the like have no relevance in a grounded theory (inspired) study. (The relationship between grounded theory analysis and theory has been discussed at length by Heindereich 2010.) Corbin and Strauss (2008, 35-38) describe how literature plays roles in grounded theory analysis, and put their most important point across by quoting Becker (1986, 149) saying "Use the literature, don't let it use you" (Corbin and Strauss 2008, 36). They list the following as ways in which literature can be used in grounded theory studies (2008, 37):

- As a source for making comparisons.
- To enhance sensitivity.
- To provide a cache of descriptive data with very little interpretation.
- To provide questions for initial observations and interviews
- To stimulate questions during the analysis

- To suggest areas for theoretical sampling
- To confirm findings, or – vice versa – the "findings can be used to illustrate where the literature is incorrect, simplistic, or only partially explains a phenomenon" (2008, 37).

In his book *Re-Assembling the Social* (2005), Latour gives an argument for grounded theory methods as superior to the "application" of theoretical frameworks. Latour argues that theoretical frameworks either play a relevant role in the situation at hand, or don't. If they don't, it is rather arrogant of sociologists to think they can force their explanation of what is really going on onto the situation, Latour argues. Thus, this should be avoided. On the other hand, if theoretical frameworks *do* play a relevant role for the situation at hand, this will be evident from the grounded analysis. In such a case theory does not have to be "applied", it can be induced from the data. If a theory is a relevant way in which the actors interviewed understand the problem at hand, for instance, it is obviously useful. This is not exactly Corbin and Strauss's (2008) point, but their suggestions for how literature can be used in a grounded theory study will provide some of the result Latour calls for when he wants to abolish the "application" of theoretical frameworks. Such an "antitotalizing" spirit, encouraging "a theoretical minimalism that guards against both a priori assumptions and deterministic modeling" (Gubrium and Holstein 1997, 212) is also fronted by other interpretivist frameworks, for instance Gubrium and Holstein's (1997) *The New Language of Qualitative Method.*

Have I "applied" theory in the way that Latour finds so problematic, that is; have I forced my theories/frameworks on the data? I think not. First of all, "sensemaking" is not a theory of the kind Latour criticizes, because it studies interaction of things and people and does not presuppose fixed identities or contexts. Secondly, because when I have used other literature and previous research, this has been either as inspiration for searching for and seeing new things in my own data (and as such as inspiration for higher level codes, but whether or not theoretically generated codes ended up as useful, depended on whether they "stuck" to the material in meaningful ways) (i.e. the use of Cohen et al. 2005; Weick 1995; Imrie and Street 2011, in the architect paper), and as "theoretical context" for my own research in the sense that it could be used to confirm my own findings (i.e. Berkhout, Hertin, and Gann 2006, in the architect paper) or where my findings could point out shortcomings in other theory (i.e. Nowotny, Scott, and Gibbons 2001, in the scientist–media paper).

The writing of memos is one of grounded theory's main analytical tools, intended to both stimulate and document the analytical thinking process (see Corbin and Strauss

2008; Charmaz 2006). Corbin and Strauss (2008) argue that the writing of memos is as important as the data gathering process in itself – because the writing of memos forces the researcher to start analyzing, providing a low-threshold way to start formulating ideas, thoughts, questions, interesting concepts, codes, categories etc., but most crucially because qualitative analysis includes complex and cumulative thinking that is very hard to keep track of without using memos (Corbin and Strauss 2008). The writing of memos also forces the researcher to work with concepts rather than raw data, making memos the vessel that "moves the research from raw data to findings" (Corbin and Strauss 2008, 123), enabling the researcher to think about the data in "lean ways"; "that is, in a manner that reduces the data to their essence" (2008, 125). Compared to Corbin and Strauss' (2008) description of the process of memo-writing, I worked with quotes and chunks of interviews with "headlines", with the more memo-like writing taking place of comparing quotes on the same themes, in slightly longer texts, in addition to quickly jotted down notes of thoughts, theories, potential overarching themes etc. not yet clearly related to the material at hand, dated and saved in another folder.

Concluding remarks on methodology

In this section, I have addressed three main methodological issues: (1) the unclear/ambiguous definition of "climate adaptation" and challenges tied to interviewing about an issue which is in the process of being-made-sense-of, (2) the quality of telephone interviews with "theoretical sampling" as a way to incite rich meaning-making in shorter-length interviews, and (3) in what ways my analysis strategy can be called "grounded theory methods." As the account above shows, the ambiguity of the concept of "climate adaptation" was not a problem, rather, its ambiguity became a central object of analysis. Furthermore, the use of telephone interviews was no problem for investing the matter at hand since the interview themes incited sensemaking on the meaning of climate adaptation—making the very interviews very rich in description on this matter. Thus, I would argue that the chosen methodology is well-suited to back my research findings.

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Chapter 2: Competing concerns? How scientists navigate between relevance work and objectivity work

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Abstract

This paper analyses how scientists may view and address issues related to relevance and usability as well as how they consider the relationship between relevance and scientific quality. We introduce the terms 'relevance work' and 'objectivity work' to describe these efforts. Through the analysis, we identify the kind of activities that scientists put into the two categories as well as the kind of concerns they express. Drawing on studies of changes in late modern scientific practice, the paper also explores the extent to which scientists indicate 'epistemic drift' in their work. The analysis is based on interviews with climate scientists in Norway. We found that climate scientists were very concerned with relevance, and that they did not fear that this concern challenged their objectivity. Quite on the contrary, objectivity was seen as a prerequisite for relevance, while relevance was important as it gave meaning to their work. Dissemination to the public, policy-makers and professional audiences also considered an obligation that they tied to relevance work.

A difficult act of balance?

«Can scientists produce objective knowledge in a world where their research is increasingly directed towards making money or meeting social needs?» asks John Ziman (1996). Such concerns echo a fundamental issue of modern science, the struggle for scientific autonomy from economic, political and religious pressures in order to achieve freedom for truth-seeking (see, e.g., Merton 1942). On the other hand, science's phenomenal growth in the 20th century has been based on implicit (and increasingly explicit) assumptions that scientific efforts produce useful and profitable insights (Guston and Keniston 1994). Arguably, this has changed the

relationship between science and society as well as the practice of academic work (Nowotny et al. 2001; Mirowski and Sent 2002). However, the nature of these changes is not clear.

Hessels and van Lente (2008) identify several approaches to describe such changes, in particular related to reorientations of science systems towards strategic goals and of academic work to produce relevant knowledge. What seems to be at stake is how to do science («internal relations»), how to make science relevant («external relations»), and the interaction between the two. The above quote from Ziman raises the concern that efforts to be relevant may reduce the quality of scientific knowledge. However, Hessels and van Lente show that many other contributors to the debate do not share this fear.

Are there reasons to worry about such changes? The increased commercialization of science (see, e.g., Mirowski and Sent 2002) and the advent of what Slaughter and Leslie (1997) call academic capitalism definitely suggest so. The heated controversies related to climate science (Conway 2005; Lahsen 2008; Ryghaug and Skjølsvold 2010) indicate a strained relationship with politics and policy-making. However, it is not clear how such features actually affect scientists and their work. In this paper, we shall discuss this on the basis of interviews with climate scientists in Norway. Do climate scientists feel that they are forced to be relevant in a way that interferes with their academic work? Do they recognize a commercial and/or political pressure that interferes with their scientific efforts? Do they experience what Aant Elzinga (1997) calls epistemic drift; the replacement of internal criteria of quality with external criteria of relevance?

There are good normative (e.g., Latour 2004) as well as empirical (Knorr-Cetina 1995) reasons to be careful about invoking clear-cut distinctions between internal and external aspects of scientific work. Thus, in this paper, we propose, as an alternative, to use the concepts 'objectivity work' and 'relevance work.' Objectivity work designates the efforts of scientists to do research according to the pertinent scientific standards of their field in order to be considered objective in the sense of producing trustworthy results. Relevance work refers to the kind of activities scientists may engage in for their research to be considered useful or socially significant. The relationship between objectivity work and empirical work should be considered an empirical issue, even if there may be strong norms that demand scientists to engage with both.

The comprehensive science studies literature provides a rich source of insights into objectivity work, including how it is shaped by and may differ across epistemic

cultures (Knorr-Cetina 1999). Scientific efforts are not strictly objective in the sense of being independent of the sites of their performance. However, scientists nevertheless strive for objectivity in the sense of adhering to methodological standards shared within their community and thus in principle resisting epistemic drift. Whether this resistance actually is successful, is another matter.

The category of relevance work — what it means for scientists to be relevant — is less clear. The most widespread understanding seems to be that relevance is about instrumental benefits, for example in terms of new technologies or procedures (e.g., Guston and Keniston 1994). It may also be considered in a participatory sense, where relevance is achieved through scientists engaging in dissemination of their research into public domains, even taking part in political controversies (e.g., Schneider 2009). Latour (2004) proposes to co-construct truth and relevance through a reorganization of science and the science-society relationship. While this may make the relationship between objectivity work and relevance work messy, his model nevertheless links objectivity work to perplexity (posing questions) and institution (establishing facts) and relevance work to consultation (considering relevant value issues) and hierarchy (linking facts and values). In any way, relevance work is not the same as applied science.

Another way of approaching the issues is to claim that late modern science is changing in a fundamental way. The argument is that we are moving from a situation where 'normal science' is increasingly replaced with post-normal science (Funtowicz and Ravetz 1993), post-academic science (Ziman 2000), or Mode 2 science (Gibbons et al. 1994; Nowotny et al. 2001). These contributions suggest, in different ways, a changing role of objectivity work and relevance work, with the effect that 'external' concerns and criteria exercise a greater influence on scientific work. Though this might be creating epistemic drift, the changes are mainly seen as positive in the sense of that they make science more relevant.

These issues seem to be particularly pertinent with respect to climate scientists. Climate science may be seen as an extreme case because of the particular and critical attention it is met with (see, e.g., Conway 2005; Ryghaug and Skjølsvold 2010). In addition, the call for climate science to be relevant, useful and applicable is strong and possibly growing (e.g., Miller 2004b; Agrawala et al. 2001; Hartmann et al. 2002; Lahsen and Nobre 2007; Lövbrand 2004; Niederberger 2005; Wolfe et al. 2001). Since climate science is also accused of being politicized (e.g., Lahsen 2008; Ryghaug and Skjølsvold 2010), we might expect the demand for usefulness and relevance to be met with prudence.

Most if not all scientists have to balance objectivity work and relevance work. However, the above observations suggest that climate scientists may face particular challenges with respect to striking a balance. Thus, they are a pertinent case to study for assessing whether the relation between objectivity work and relevance work is experienced as troublesome and whether an epistemic drift may actually be observed. Is objectivity work threatened by a strong focus on relevance?

Late modern science: relevance rather than truth?

Is objectivity under threat from demands of relevance, or is it rather scientists who neglect relevance? The latter view seems to be implicit in Stephen Schneider's concept of the 'double ethical bind' (Schneider 1988), which he used to describe a situation where climate scientists were torn between the need to be heard and quoted in the media and the need to adhere to traditional scientific communication norms. This tension arose from climate scientists' special situation as discoverers of an important challenge which ought to be taken seriously by the world. In the editorial in Climatic Change (Schneider 1988),, where Schneider first introduced this term, his audience was, presumably, "ivory tower"-minded researchers fearful of being "tainted" by politics if they stepped out of the tower's bounds.

However, for quite some time, scholars have argued that, increasingly, the sciences have abandoned their ivory tower self-understanding, and started to focus on relevance for industry and society (e.g., Slaughter and Leslie 1997; Gibbons et al. 1994; Nowotny et al. 2001; Etzkowitz and Leydesdorff 2000). Gibbons et al. – the scholars whose argument along these lines have received the most attention – maintain that this development has lead to a new mode of knowledge production – 'Mode 2' – where the emphasis on 'problem-solving in the context of application' might imply less concern for traditional – 'Mode 1' – science quality criteria like objectivity, autonomy and peer review (Gibbons et al. 1994).

In Mode 2 knowledge production, the relevance of scientific knowledge is supposed to follow from the emphasis on 'problem-solving in the context of application.' When research is carried out with a specific purpose or problem in mind, defined through reflections on the context in which the results are going to be applied, relevance is integrated into science in a fundamental sense. In Nowotny et al.'s (2001) view, this is a necessary development. Critics of the Mode 1/Mode 2 theory, however, worry that increased emphasis on social accountability and relevance – Mode 2 style – may lessen the concern of doing "good science" (see Hessels and van Lente 2008, for an overview). Like Schneider, these critics seem to believe that it is difficult to balance objectivity work and relevance work, but unlike Schneider, their main worry is that

objectivity or scientific quality is under siege from the new demands of relevance, not the other way around.

There are various ways in which to assess such claims. One vein of scholarship hold that even though the call for relevance has entered science policy documents in several European countries, this call for relevance does not do away with traditional scientific norms (Irwin 2006; Hagendijk 2004; Jasanoff 1987). For example, Benner and Sandström (2000b) show that although applicability, utility and demands from 'customers' have been added to the list of assessors' concerns, research councils preserve collegial control and evaluation of research quality as their core orientation. Hagendijk (2004) and Irwin (2006) who analyzed EU and UK science policy documents, respectively, did not find evidence of a shift from Mode 1 to Mode 2 concepts. Rather, they found a juxtaposition of the concepts, with an 'inclusive' voice arguing for the consideration of the context of use and of public concerns and an opposing 'scientistic' voice pointing to the special role of scientific knowledge relative to social concerns. These voices competed for notice in the same document.

One problem may be that those who are nervous about the status of objectivity work overlook the achievements of such work. For example, Harry Collins' (1992) concept of 'experimenter's regress' may serve as a reminder that when scientific results are challenged, it leads to a focus on the quality of the empirical work and the appropriateness of the applied methods. Lentsch and Weingart (2011) in their discussion of scientific advice to policy-makers, emphasize the importance of what they call 'epistemic robustness.' This concept is invoked to stress the importance of reliability and quality of scientific knowledge. In addition, Lentsch and Weingart claim the need for political robustness, which emanates from legitimacy and organizational trustworthiness – comparable to our concept of relevance work.

Similarly, studies of "boundary-work" (Gieryn 1999, 1983) between science and society observe that the relationship between objectivity and relevance should not be seen as mutually exclusive but rather as co-existing. Scientists who try to broaden the outreach and usability of science depend on boundary-work to maintain their legitimacy as proper scientists. In particular, efforts to police the boundaries of science seem important when scientific authority is contested (see, e.g., Miller 2004a; Jasanoff 1987; Edwards and Schneider 2001). Such observations support the claim that objectivity work would remain important even if scientists are called upon to be relevant. Boundary-work provides a basis to distinguish between insiders and outsiders, which in turn allows identification of legitimate spokespersons for science,

of what counts as good science, and of whom that may be recognized as scientifically competent in the field under scrutiny.

In this paper, we analyze empirically how the interviewed scientists account for their engagement in objectivity work and relevance work, respectively. First, we ask what they mean by 'objectivity work' and 'relevance work.' Second, we inquire into the relationship between these two concerns. Do climate scientists see the concern for relevance as competing with an emphasis on objectivity? Or do they operate in a Mode 2 world, where relevance – understood as problem solving in the context of application – is the main rationale for science? Or is it like in the boundary-work understanding that objectivity work is needed to engage in relevance work?

Method

This paper is based on in-depth interviews with Norwegian scientists that are engaged in climate science research. The Research Council of Norway – the main source of funding and science policy for Norwegian scientists – define climate change research as consisting of 1) natural science research on the climate system and climate modeling, and on its potential effects on organisms and environments; 2) social science and economics based research focusing on how to mitigate greenhouse gas emissions and on the effects of climate change, including possible adaptation efforts; and 3) research and development with respect to mitigation technologies (the Research Council of Norway 2000, 2006). We have mainly focused on scientists belonging to the first two categories, particularly scientists engaged in basic rather than applied research, since that seemed most appropriate to illuminate our research questions.

Institutions involved in climate research activities range from universities and research institutes to government agencies. We have done interviews at all the most prominent centers for climate research in Norway as well as in relevant university departments and applied research institutes. 23 scientists and research managers from 13 different institutions have been interviewed, most of them with considerable experience from climate research. Thus, there is a bias among the interviewees towards established scientists. We thought this appropriate given our research questions, since experience is a key to be knowledgeable about the issues in focus here.

The interviews were conducted face to face, with the exception of two which were conducted by telephone. The interviews were recorded, transcribed and coded for analysis. The interviewees have been made anonymous and given fictive names. Each

interview lasted between 50-90 minutes. The questions revolved around research methods, policy use of knowledge, relevance work strategies (dissemination, dialogue and collaboration strategies), how to deal with the alleged politicization of climate science, and how to deal with the uncertainty inherent in climate models and -predictions.

The interviews were conducted in two turns; in 2005 and in 2009. After analyzing the interviews done in 2005, we wanted to extend the number of institutions included in the sample to provide a greater scope of contexts for climate scientists. In addition, we wanted updated and supplementary information from two of the most prominent climate scientist in Norway, who consequently were interviewed twice. With respect to the main research questions, there were no important differences between data obtained in 2005 and 2009, and thus, we do not differentiate in the analysis between the two data sets.

The rest of the paper is structured as follows: First, we discuss the practice of relevance work. What was considered to be relevance work and how was it perceived by the interviewees? Second, what may we characterize as objectivity work? Third, what was the relationship between objectivity work and relevance work? Was this relationship seen as troublesome and challenging or as symbiotic?

Relevance work: A contractual obligation?

Most assertions about changes in modern science are linked to assumptions that scientists increasingly need to engage in some form of relevance work because this is demanded through science policy or by funding agencies or employers. In this context, we would expect scientists to engage with relevance work because they have to and that relevance is about being useful in a fairly instrumental sense. Participation in 'problem-solving in the context of application' (Gibbons et al. 1994) would be an example. On the other hand, when Schneider (1988) proposed the idea of a 'double bind,' his point of departure was a suspicion that most scientists preferred to focus singularly on research. Thus, he wanted scientists to see that they had a moral obligation to engage in communication with wider audiences and make their research relevant for the purpose of educating the public.

These expectations – engagement in relevance work either because it is required or because it is a moral obligation – may both be correct. In the following, we analyze how the interviewed climate scientists accounted for relevance work. Did they engage in such work for instrumental or educational purposes, or both? Were

expectations perceived in a positive way or were they resisted because the scientist wanted to spend more time doing research?

To begin with, it should be noted that all of the interviewees were engaged in doing what we termed relevance work: The interviewees reported that they participated in news media coverage of climate issues, wrote feature articles, and gave popular talks to diverse audiences. The educational purpose was most outspoken, but some also interacted with professional users as well as politicians for instrumental purposes. Relevance work was seen as an obligation—as research scientist Nannestad put it: «I feel a responsibility to inform society».

Dissemination to educate was thus seen as an important part of what socially responsible scientists should do, but it was also an institutionalized activity. For example, Professor Pettersen told that his institute had tried to include news media engagement into the definition of what it meant to be a good scientist:

> *[With regard to] participating in the media … Here [at my institute], we have tried to make it into something important. Everybody is urged to do it, (…) and generally, we give a positive response when someone is in the news, so you won't be shot to pieces. I feel it has turned out well. I think we have created a culture and an acceptance that dissemination is a very important part of what we do.*

The responsibility to disseminate was seen as related to the fact that the institute and their research projects mainly were funded by money from the government and the Research Council of Norway. However, Professor Pettersen added that the importance and urgency of the climate change issue should be sufficient reason for scientists to take on dissemination. Thus, there were at least a double set of moral obligations.

How was relevance work considered? Was it seen as a strain? Actually, most of the interviewees talked about relevance in positive terms as a meaningful and rewarding activity. Some were quite enthusiastic, like research director Dolmen: "Popular dissemination is important to us, and as a manager, I've emphasized this activity because I think it is an enjoyable thing to do."

In theories of new ways of doing science, like the Mode 2 model, putting science to use is not so much a moral issue as something that is built into the organization of research. This was also the case for the interviewed scientists. For example, most of

the institutes employed people whose main responsibility was to endorse popular dissemination. The institutes also had established channels of communication with professional users, for example with public administration and policy-making institutions. Relevance work, as we have seen, included a diversity of activities, often, but not always, supported by institutional arrangements.

So how was relevance work performed, and what kind of tasks was included? How was the relationship between instrumental and educational activities handled and portrayed? As we have seen, public education in the form of dissemination was very important. To what extent was 'problem-solving in the context of application' seen as a relevant way of performing relevance? The relevance work outlined in the various interviews included accounts of input to policy and instrumental use related to practical problem-solving. Thus, some form of engagement with problem-solving in the context of application did take place, although education was considered to be the most important. It was the general public which was the main target audience of most news media communication. Some of the scientists recounted that what they wanted to achieve through popular dissemination was an improved understanding of the ways the climate system works, and of the reality, importance and urgency of the problem of global warming. This, they hoped, would lead to increased awareness of and insight into the climate issues, and hopefully to a change in people's and organizations' ways of engaging with the world. It was not the specific findings of individual scientists or institutes that were considered to be of interest for dissemination, but rather findings from climate science in general – background, basic knowledge.

Providing input to policy-making was largely seen to overlap with the efforts to educate the general public. When the public became more aware of and concerned about the climate issue, it was hoped that they would demand a more effective climate policy. Thus, policy-makers would be influenced indirectly. Professor Pettersen described the dynamics in the following way:

> *I see my role as being performed at the lowest level, in a three level structure. My level is concerned with knowledge and its distribution; that's what I should do as a climate scientist. But this distribution, I hope and believe, will lead to increased awareness, and if there's increased awareness among many, then there will be action at the political level.*

Again it was the findings of climate science in general that was expected to permeate policy, to contribute to the agenda-setting of policy, and to influence all relevant areas of policy making. Professor Pettersen seemed to believe that this kind of

awareness-raising through public enlightenment was the most important way to influence climate policy. However, many of the interviewees were also more directly engaged with policy-making by participating in committees giving advice to the government or to the Research Council of Norway. Several interviewees also mentioned consulting and the provision of advice on a more informal basis as other direct ways of interacting with policy-makers.

Relevance work related to practical problem-solving took place most frequently through interaction with local government politicians and administrators, and it was mainly related to climate adaptation. To make such audiences engage in climate adaptation, it was believed that climate science knowledge had to be made relevant and usable to them. With respect to this challenge, several of the activities at the research centers where we interviewed were geared towards trying to develop numerical estimates or ranges of uncertainty regarding climate changes in ways that hopefully would be of use to planners, water managers, etc. Often, local government decision-makers asked for estimates of outcomes of climate changes, or some uncertainty interval, in order to take climate change and its effects into consideration. However, several interviewees told that they had experienced how the research centers' 'best available knowledge' often was not as accurate, certain and detailed as practitioners wished for. The point of departure for these numbers was mostly regional scale climate models, where downscaling was an important basis for the best guesses provided to local level decision-makers.

Thus, relevance work related to practical problem-solving primarily consisted of providing information that scientists assumed would be of use to practitioners. The task was to produce sufficiently downscaled and "certain" estimates thought to be applicable. This information was often distributed through publically available reports, but the institutes and research centers had also tried direct collaboration with users like local government administration or even rein-deer herders. This, more "tailoring"-style approach, as research manager Nordheim put it, was based on meetings between scientist and practitioners where they tried to find ways to bridge the gap between what the scientists meant they could offer of information and the articulated needs of the users. This engagement, which was much less frequent than dissemination through news media, we interpret as 'problem-solving in the context of application,' Mode 2 style. It could involve either face-to-face discussions with practitioners or a third mediating party going back and forth between the scientists and the users, helping them arrive at a common understanding of what processes possibly influenced by climate change could be of interest to users – like, e.g., local governments.

Was this dialogue-and-tailor model considered to be a problem to research work or as a threat to scientific objectivity? Did the scientists consider that they lost too much control? We did not observe much worry in the accounts of the scientists engaged in the use of tailoring approaches. Maybe this was due to the fact that users were not included "all the way" into the scientific efforts. In the end, it was the scientists who would develop doable (Fujimura 1996) research questions and provide answers. Nevertheless it is important to inquire more broadly whether relevance work was considered a problem to the practice of climate science. We do so by analyzing accounts of what we have termed objectivity work. What activities were included, and to what extent and why was objectivity work considered important?

Objectivity work – under siege by concerns for relevance?

Models of 'late modern' science, like Mode 2 or post-normal science, suggest a more modest role for objectivity work. For example, the emphasis on 'problem-solving in the context of application' implies that peer-reviewed publication becomes less prominent (Gibbons et al. 1994). Also, as we saw in the review in the introduction, there is apprehension about the possibility of epistemic drift (Elzinga 1997) and worries about commercialization (e.g., Mirowski and Sent 2002). However, like Hessels and van Lente (2008), we believe that there is a need for more empirical analysis of these issues, given that the debate has tended to be fuelled by theoretical expectations.

It is clear from the accounts of the scientists we interviewed that they were extensively engaged with relevance work. However, in the final instance, they saw themselves primarily as scientists doing research in the best possible manner, with a goal of actively contributing to international scientific progress:

> *First and foremost, we want to stand out as a research institute and not as a company engaged in reviews or consulting. This implies that we have to participate internationally … to participate in the [scientific] debate, to publish actively, to attend and contribute to international conferences, and all that means that we continuously acquire knowledge. It is a part of the knowledge generating process and the appropriation of knowledge produced by others (research director Dolmen).*

We did not find support for the assumption that climate scientists in general were operating according to the Mode 2 model. The "tailoring" style approach was not

much used. Also, the interviewees did not provide indications of epistemic drift. Commercial concerns were not present either, which could be attributed to the fact that Norwegian climate science is publically funded. With respect to the doing of science, the scientists' accounts were pretty traditional, given their professional fields. When the interviewed scientists talked about their research, it was in terms of comprehensive collection of new data, statistical analysis to observe new patterns, development of improved models, and so on. Implicit in their accounts was also an endorsement of the idea of scientific progress and activities leading to such progress, like in the following quote from research manager Brekke, where he stressed both what he considered to be the scientific potential of engaging with models and the importance of validating models through comparison with empirical observations:

> *Our research group has become increasingly focused on models (…). Models may teach us more about the processes. (…). So, I'm very concerned that there has to be a kind of continuous feedback between model and observation, and when you are doing model runs, you have to sit down and look: what was really happening here, what, why did we get these results?*

Engagement with models was important to many of the scientists but so was working with and improving instruments for measurements and analysis of data:

> *We work a lot with new measurement techniques … For example; we have worked a lot with satellite observations, but also validation of satellite measurements by ground stations. Here, we have quite a large activity. Then we have other things going on with respect to developing measurement techniques at the ground level (research scientist Andersen).*

In such ways, the interviewees talked about what we have called objectivity work, which mainly is about doing proper science according to the standards of the profession. Research scientist Nannestad described this in a very straightforward manner:

> *We only try to be scientific and try to be as objective as possible and cultivate knowledge. To us, the important thing is to get true knowledge or the best possible correct knowledge.*

When the scientists talked about relevance, it was in a positive way. They would argue that their research was potentially useful so that it was important to engage in popular dissemination. Concerns for relevance were not said to disturb the doing of

scientific work. The possibility of such disturbance appeared to be a non-issue to the interviewees; it was never raised.

In this manner, engagement in what we call objectivity work was taken for granted – more so than relevance work. While relevance work was considered an obligation as well as an interesting and rewarding activity, objectivity work was self-evidently what scientists did. Consequently, it was not so much an object of reflection. Neither were issues like epistemic drift. Objectivity work was a defining quality of being a scientist. Moreover, objectivity work was argued to be a prerequisite for doing relevance work. What was implied in this argument?

As we have seen, the interviewed scientists engaged in both objectivity work and relevance work. However, to describe this as a 'double bind' like Schneider (1988) would be misleading, since the scientists did not see the relationship between objectivity work and relevance work as problematic or strained. Rather, the two were seen as integral parts of the scientific endeavor. They were seen as better integrated than e.g. Irwin's (2006) observations of their parallel existence in science policy documents would imply (see also Benner and Sandström 2000a; Hagendijk 2004). How was this integration argued?

First, as noted above, objectivity work was seen as a necessary premise for relevance work because relevance work had to be based on facts, and facts were what scientists should be expected to supply. Also, adherence to scientific standards was considered useful by the scientists because it represented an important line of defense when their work came under attack by so called 'climate skeptics.' 'Climate skeptics' were seen to criticize climate science for being too political, too influenced by non-scientific concerns, in short, for doing bad science as a consequence. Thus, many of the climate scientists said they had to be extra careful to do their objectivity work properly to defend their case in such controversies. Perhaps unsurprisingly, climate scientists' engagement in relevance work in a context of controversy was seen to make objectivity work particularly important.

However, there were challenges involved in pursuing objectivity work and relevance work in parallel. One such challenge was balancing a concern for effective dissemination to users or media with adherence to the scientists' own criteria for objective dissemination. This challenge was perhaps most salient with regard to demands for providing 'best guesses' useful to local and regional level decision makers. The scientists experienced a tension between supplying estimates with a reasonably low uncertainty range, while simultaneously ensuring that the uncertainty range was not *too narrow* so that users or the public would take the science to be

more accurate than it actually was and make bad judgments because of this. An additional worry was that providing numbers and uncertainty ranges of this sort could give skeptics yet another opportunity to attack climate scientists for overstating the certainty of climate science. How did the climate scientist deal with such challenges?

Ingredients of boundary-work

Basically, the strategy of the interviewed scientists involved boundary-work (Gieryn 1983, 1999) to construct a distinction between 'real' climate scientists and others that were making claims about the nature of climate change. This boundary-work was intended to make it difficult to attack climate science as unprofessional or unscientific, which in turn was a prerequisite for the performance of relevance work. We found two main types of arguments underlying the performance of boundary-work. The first was to deflect criticism by referring to the (strict) quality criteria of the research community. The second was to use objectivity work as a boundary device to separate climate scientist from those who do not 'stick to the facts' or misunderstand or misrepresent the facts and observations of climate science. In the following, we describe these arguments in greater detail in order to further explore the scientists' accounts of how they managed the relationship between relevance work and objectivity work.

Professor Pettersen emphasized in the interview that if climate scientists engaged in relevance work – which meant that they were "in the public eye" – it was important that they were recognized as scientists who participated in the relevant international research community:

> *One should, for one, be a good scientist, at least a scientist – one should preferably publish and participate internationally, be a part of the research field.*

Since scientists, in particular those who had an international reputation, were subjected to strict measures of quality control, this should, in his opinion shield them from accusations of being overly political or unscientific. The same kind of argument was also used by research director Dolmen to explain why interaction with policy makers was not a problem:

> *There is a tension between science and politics, of course. And for an institution like [my institute] that is a discussion we often have among ourselves: are we perceived as being too intimately linked to environmental management institutions? (…) Some have accused us of*

supplying research that suits the politicians. And we do make a lot of reports, and we do write suggestions to public hearings of governmental documents. In that manner, we communicate and disseminate a lot of research. But you may say that, by that very fact that we are part of a larger international research community … It is not the case, or extremely rarely, that our results are of tremendous importance and have to be presented to the politicians immediately. That's not the way science works. We provide input to the larger [scientific] debates, and then knowledge evolves, slowly but surely, over time, (…) and it is that [peer reviewed knowledge] we try to communicate to policy-makers.

By pointing to scientific autonomy, education, and peer review as quality ensuring mechanisms the interviewed scientists referred to "the way science works" to deflect skeptics' critique. Since these quality ensuring measures were integral to the scientific community, participation in the community became in itself a shield against critique.

The interviewed scientists insisted that even when they were engaged in contract research, they retained autonomy over the actual shaping of the scientific work, including the choice of research questions and how these questions should be approached. In addition, peer reviewing was considered vital in identifying scientific knowledge and knowledge practices. A clear example was provided in the interview with Professor Carstensen when he was talking about the provision of knowledge about climate change to the public:

I consider it extremely important that if one establishes [institutions to provide knowledge about climate change to the public] that they are grounded in communities such as ours or that of the Norwegian Meteorological Institute or the Institute of Marine Research or others with solid, fundamental competence. So that scientific results will be reviewed. I think it would be very dangerous if one just established an industry of climate advisors who just picks information from random sources and wraps it up nicely and leave uncertainty and method unaccounted for.

Again we see how boundary-work was intended to facilitate the doing of relevance work in a proper way, based on peer review as the basic institution to secure factual knowledge. Moreover, the identification of 'real' climate scientists that legitimately and properly engage in relevance work was based on who published in peer reviewed international journals.

However, there were also issues with respect to how scientists should perform when disseminating knowledge and making statements, for example, to the press. One concern was how to present climate science. Professor Fredriksen described the challenge as finding a middle course in describing the state of knowledge:

> *All climate science is easily labeled as uncertain. So I don't think it is beneficial to read too much into results or selectively (...) pick the results that give the most extreme climatic changes (...) [or] what gives the least changes, the least reason to worry. Both ways are disadvantageous. So what scientists have to master is to provide a plausible development trajectory, a mean value, and then say something about the uncertainty.*

Another problem was that interacting with policy-makers could give climate scientists an air of being 'activists.' To deal with this problem, Professor Carstensen emphasized the importance of sticking to the facts as a way of emphasizing the difference between scientists and activists. This would distinguish scientists from activists who engaged in «more or less selective evaluation of available research." To Carstensen, it was a challenge that the media did not distinguish well "between scientists and science on the one hand, and on the other hand research results translated and spread by the environmental movement":

You may find newspaper articles saying 'research report says this and that' and then
> it's actually a report made by an NGO, based on their more or less selective evaluation of research. But it's not a research based product. And the difference between those kinds of reports and the IPCC reports is important to propagate.

Professor Pettersen outlined some similar guidelines for scientists making public statements:

> *Our ground rule is to [let statements] be based on facts, mainly those of our own fields. If we go beyond our fields, we have to make sure we are making a correct rendering. (…) When we participate in debates, we bear in mind that we participate as a professional, presenting the research, so that we clearly differentiate between our personal opinion and values, and what we can justify from looking at the [scientific] literature.*

The main thing was to make statements that were based solely on facts and to be sure that scientific findings were rendered correctly. This insistence on sticking to the facts served a double purpose. On the one hand, it was used to distinguish scientists from environmental activists, which the climate scientists saw as important because they thought that environmental activists tended to engage too much in scaremongering and overstating. Since climate skeptics accused climate scientists of such practices – maybe because they confused the two groups – it was considered vital to make such distinctions. On the other hand, sticking to the facts was also useful for providing a demarcation line against climate skeptics, since knowing about and sticking to the facts gave scientists a privileged position from which they could criticize people who misunderstood, misinterpreted, or ignored facts and observations:

> *When the topic is past events (…) we criticize harshly those who misinterpret observations or who do not relate to the observations that exist. (…) We 'arrest' them – Whether it is the editorial in a newspaper claiming that 'the temperature is not rising', or some politician or scientists – we are there, and we address it, and we point to the observations (Professor Pettersen).*

Gieryn (1999) reminds us that boundary-work emerges from credibility contests and proposes the existence of three genres: (1) expulsion, (2) expansion, and (3) protection of autonomy. As we have seen, the climate scientists we interviewed drew on all three genres, but mainly on the two first; they argued to expel people outside of climate science as legitimate spokespersons for climate change, and they tried to expand the territory where climate science should be considered credible. The genre of expulsion was linked to objectivity work, while the genre of expansion was related to relevance work. Thus, an important finding is the suggestion that the expansion of the area of credibility of climate science into policy-making and environmental management depended on the ability of climate scientists to police climate science and expel, for example, climate skeptics.

Science extended?

Claims have been made that science is changing to accommodate social demands related to democratization as well as relevance (e.g., Funtowicz and Ravetz 1993; Nowotny et al. 2001; Ziman 1996). The changes have been conceptualized in several ways. Elzinga (1997) suggested that the outcome could be understood as epistemic drift, which would imply that what we have called objectivity work would lose out to scientists' increasing engagement with relevance work. In a different vein, Nowotny

et al. (2001) propose that we observe the coming of new way of doing science – what they called Mode 2. In Mode 2, the concern for relevance is supposed to become increasingly dominant, resulting in a scientific practice focused on 'problem-solving in the context of application,' perhaps to the detriment of objectivity work. Did we find that relevance work was becoming increasingly important, to the disadvantage of objectivity work?

It was clear from the interviews that the climate scientists we studied found relevance work important and gratifying. They engaged in such efforts, mainly in the form of dissemination to the public, policy-makers and relevant groups of professional, but some of them also occasionally took part in practices resembling "problem-solving in the context of application." Still, what we have called objectivity work – the engagement in scientific inquiries like measurements, data analysis, modeling, etc. according to the professional standards of their scientific fields – was the dominant form of activity. Not the least, objectivity work was seen to involve publishing findings in peer-reviewed international journals.

The interviewed scientists found that they needed to engage substantially both in objectivity work and relevance work, in accordance with previous analysis of boundary-work (Gieryn 1983, 1999). This double engagement was considered appropriate but also effective. Through relevance work, the scientific endeavors were rendered meaningful and important. However, without a focus on objectivity work, climate scientists would lack reliable and trustworthy facts to disseminate as well as the credibility needed to persuade others to accept the facts. Thus, relevance work depended on objectivity work, while the importance of objectivity work understood as the adherence to professional norms was reinforced by experiences from doing relevance work. Relevance work did not represent a pressure or a temptation to relax scientific norms, rather the opposite.

In this paper, we have observed that relevance is included as a vital part of the scientific effort, but such activities do not imply any fundamental change in the way scientific investigations are done. For example, the interviewed scientists claimed to retain autonomy with regard to how research questions should be approached and what methods to apply. Furthermore, publications in international peer-reviewed journals were seen as a proof of scientific quality and thus as aproof of scientists' potential to be relevant in a trustworthy way. Objectivity work was also rhetorically important to the way the climate scientists performed boundary-work. What are the implications of our findings with respect to the reviewed theories that claim fundamental changes in late modern science?

To sum up, we observed a practice among the interviewed climate scientists that confirmed considerable time and energy spent on making their scientific findings relevant to other audiences. However, we did not find clear indications of changes in the scientists' accounts of objectivity work, which previous research would lead us to expect. We conclude from this that climate science is a not new form of science. In the language of Nowotny et al. (2001), climate science does not appear to have entered Mode 2, but actually remains a quite traditional Mode 1 practice. As an alternative to claim fundamental changes in the way science is being done, we propose to see this combination of objectivity work and relevance work as an expansion of science. We have not studied whether this engagement is larger than that of scientists of previous periods, but with that reservation, we suggest to describe late modern science as science extended.

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Chapter 3: Aiming for Social or Political Robustness? Media Strategies among Climate Scientists[8]

Abstract

This study examines climate scientists' views on media science communication and their strategies for dealing with journalists and climate deniers. Drawing on scholarly calls for openness and public engagement, particularly the concept of "socially robust knowledge," this article discusses how climate scientists weigh concerns of control, openness and transparency when considering how to best communicate with the public through the mass media. I argue that "socially robust knowledge" neglects the challenges of "medialization" of climate science, and propose that the climate scientists' strategy can better be described as attempts to achieve "politically robust" communication.

Suggested keywords: climate science; science communication; mass media; scientists' understanding of publics; socially robust knowledge

"Climategate": A Crisis of Trust?

The so-called Climategate affair can be seen as a symptom of a crisis of trust in climate science. In November 2009, documents, e-mails and data from a backup server at the Climatic Research Unit (CRU) at the University of East Anglia were unlawfully made public by either a hacker or an insider. Climate denialists, or "skeptics", dubbed the affair "Climategate," to indicate a large-scale scandal, and attempted to use the climate scientists' private e-mails to debunk the theory of anthropogenic climate change. Such "attacks" on climate science are not new. Nevertheless, the e-mails provided climate deniers "with a golden opportunity to voice their views and challenge climate science" (Nerlich, 2010, pp. 420-421), giving them material they could spin as a "smoking gun that revealed a global conspiracy by scientists to dupe the world about man-made climate change" (Pearce, 2010, p. 4), and the assault on climate science was helped along by the news media, who adopted the framing created by the deniers (see Pearce, 2010; Ryghaug & Skjølsvold, 2010).

[8] *Accepted for publication in Science Communication*

The CRU climate scientists and the University of East Anglia were cleared of all charges by review committees (House of Commons Science and Technology Committee, 2010; Russell, Boulton, Clarke, Eyton, & Norton, 2010). Nevertheless, it is feared that Climategate, together with other similar exposés (e.g. "Glaciergate"), has contributed to a drop in public belief in the reality of anthropogenic global warming. Thus, "Climategate" can be said to represent a continuation of a long-standing, heated media situation with respect to climate science. This article is an attempt to study the strategies used by climate scientists to deal with the news media and similar public communication spaces. How does a charged context of reception influence scientists' dealings with the news media?

Openness versus Control: Two Divergent Approaches to Addressing the Trust Deficit

To alleviate the damage of Climategate and to avoid similar backlash-type events in the future, review committees and independent scholars alike have all called for more openness. It has been argued that more openness would increase the public's understanding of the processes and practices of science and scientists (Hulme & Ravetz, 2009), as well as improve their reputation (Russell et al., 2010). Sheila Jasanoff suggests that:

> *It will not be enough for climate scientists to be still more scrupulous and transparent toward their peers. Adding more new forms of expertise may increase the credibility of the field, but it will not fully address the third component of accountability, which involves relations between science and its publics. (2010, p. 696)*

As early as in 1998, Sheila Jasanoff and Brian Wynne argued that if one wanted to avoid such a backlash, one should instead aim for "inclusion rather than exclusion, (...) participation rather than mystification and (...) transparency rather than black boxing" (1998, p. 77).

This call for openness has been heeded. Arguably, there has been a turn toward public engagement in European science policy, concerned with dialogue and deliberation, in which generally, but not always, activities also referred to as science communication or public understanding of science are included, proposed as solutions to declining public confidence in science (e.g., Stilgoe, Irwin, & Jones, 2006). An example of one of the suggested approaches to public deliberation, is the concept "socially robust knowledge", developed by Michael Gibbons and collaborators (1994). They argue that more science communication, more openness and transparency, and

the inclusion of the public in deliberations about scientific results and directions, will result in scientific results which are more easily accepted and trusted, i.e., "socially robust." Gibbons et al. use the metaphor of Athen's *agora* to describe space where science and the public meet; the social sphere in which dialogue and participation can bring about agreement about science's goals and methods. Does climate science follow an opening-up strategy to deal with climate skepticism and declining trust in climate science?

The relationship between climate science and the mass media can be characterized by the label "medialization" – a term Weingart (2005) applied to a connected set of changes in mass media coverage of science which have also been pointed out by other scholars (see Schäfer, 2009, p. 477 for an overview of relevant scholars). Medialization has three main dimensions, widely agreed on in the respective literature:

> "1. *Extensiveness:* Science is said to be increasingly represented in the mass media.
> 2. *Pluralization:* Media coverage on science is said to be increasingly diverse in terms of actors and content.
> 3. *Controversy:* Media coverage on science is seen as increasingly controversial." (Schäfter, 2009, p. 478)

Scholars like Antilla (2005), Boykoff and Boykoff (2004) and Ryghaug (2006) show that there is indeed an increase in the amount of coverage, in the number of (non-science) actors in the debate, and in the degree of reported controversy in the mass media coverage of climate science. Thus, although there is little research dealing directly with climate scientists' views of mass media communication, we can fruitfully draw on studies concerned with other scientific fields where medialization is strong, such as biomedical sciences, nanotechnology or aquaculture to throw light over the issue. What can we learn from research on science's views of science communication and public engagement in these fields?

This research has shown that scientists are often quite open to stakeholder engagement, conceiving such activities as important and have the potential to improve science (Burchell, Franklin, & Holden, 2009; Young & Matthews, 2007). In one sense, then, this research has revealed that the so-called deficit model – a conception of the public as undifferentiated and generally in need of more knowledge and education – is increasingly replaced by an image of intelligent, supportive and scientifically capable publics (Burchell et al., 2009; Davies, 2008;

Young & Matthews, 2007). However, Young and Matthews (2007) showed that even if scientists are quite open to stakeholder engagement, they can still be skeptical of increased openness in communication through the media. Other studies have found that scientists fear that the public cannot understand and cope with uncertainty (Boer, McCarthy, Brennan, Kelly, & Ritson, 2005; Frewer et al., 2001; Stilgoe, 2007) and that they are vulnerable to malignant actors such as anti-science groups and mass media who are held to misunderstand and sometimes willfully misrepresent available science (Boer et al., 2005; Burchell et al., 2009; Petersen, Anderson, Allan, & Wilkinson, 2009; Young & Matthews, 2007). This shows that it is better to see "new" (public engagement) and "old" ("deficit model") understandings as juxtaposed, perhaps complementing each other, than to see one as replacing the other (see also Irwin, 2006). Which of these conceptions of their publics do climate scientists adhere to?

Some studies of scientists' dealings with the public, and especially with the mass media, appear to indicate that issues of control is still central to many scientists strategies for dealing with mass media and other actors perceived as malignant (Young & Matthews, 2007). Why is that?

Most increased openness strategies, including "social robustness," is based on an idea that a loss or lack of trust is caused by public alienation from science. However, climate skeptics are not necessarily alienated individuals. Several studies show that they often have vested interests, either in "carbon capitalism" (Jacques, Dunlap, & Freeman, 2008; Oreskes & Conway, 2010; Urry, 2011, p. 92) or in traditional power relations between science and society, wishing to "stem the tide" of changes in the science—policy relationship (Lahsen, 2008). Neither is the climate science—public "agora" an uncharged context. Antagonistic audiences will often "read" utterances in radically different ways from the intended meaning, and mobilize because of what it has heard, thereby creating difficulties for maintaining authority and being persuasive (Hajer, 2009, p. 9). A problem with openness strategies' conception of public deliberation, is that they conceive of the public space as one in which the participants have some shared goals and norms, e.g. rational deliberation and a wish to come to an agreement. Gibbons et al.'s concept of the "agora", for instance, does not allow for some groups in the agora to be interested in exactly the opposite, namely, hampering agreement, which is often the case.

Clearly, this might make openness a less likely strategy, not least in light of studies like Holliman's (2011). Holliman found politicized scientific fields, whose scientific findings were continually challenged, were considerably more resistant to ideas of

openness and transparency. Holliman argued that in such contexts, scientists will be less willing to share raw data and information for fear of how it may be used. Such a fear among scientists of misuse and misinterpretation of their results has also been found in other studies (e.g., Davies, 2008; Young & Matthews, 2007). Furthermore, studies of scientists' discursive strategies in controversies (e.g., Gilbert & Mulkay, 1984) indicate that often scientists close up more, not less, in situations of controversy, using demarcation strategies to deal with controversy and critics (Burchell, 2007a, 2007b; Michael & Birke, 1994a, 1994b). Gieryn called such demarcation strategies "boundary work", defined as "the attribution of selected characteristics of the institution of science (i.e., to its practitioners, methods, stock of knowledge, values, and work organization) for purposes of constructing a social boundary that distinguishes some intellectual activity as non-science" (1983, p. 782). As we have seen, many scholars argue that climate scientists should choose an openness strategy, managing the potential trust deficit by opting for social robustness. On the other hand, much previous research suggests that climate scientists will instead choose a strategy of closing up to retain control of the interpretation of their results, which is can be at least partly explained by scientists' adherence to variants of the deficit model of public understanding of science.

Previous research has in common that what is shows is how *conceptions of the public* influence scientists communication and engagement practices. Michael and Brown (2000) argued that such conceptions are part of scientists "lay political science", and Maranta et al. (2003) called them "imagined publics". In this article, I explore how the scientists construct their audiences – their imagined publics – and how they perceive the challenges of reaching those publics. How do scientists weigh concerns of control and openness when they consider how to best communicate with the public through the mass media? Do they aim for social robustness, or do we need another way of characterizing the scientists' communication strategies?

Data and Methods

I have chosen to address these questions by way of a case study of Norwegian climate scientists' views on the challenges of climate science communication. The Norwegian context is characterized by Norwegian policy and the Norwegian political debate exhibiting a considerable amount of acceptance with regard to climate science's conclusions (e.g., Ryghaug & Sørensen, 2008). Further, the Norwegian general public shows a general acceptance of anthropogenic global warming as a fact, but with an "undercurrent of doubt" and some hesitancy with respect to the seriousness of the issue (Norgaard, 2006, p. 372; Ryghaug, Sørensen, & Næss, 2010).

Lastly, the media context is fairly similar to that of other countries, with the public debate on climate science marked by the presence of climate skeptics (Ryghaug, 2006).

The prevailing definition of climate science in Norway involves: a) studies of natural processes relevant for achieving an understanding of the climate system, b) studies of the potential effects of climate change, c) studies of ways to mitigate greenhouse gas emissions, and d) studies outlining potential adaptation measures (the Research Council of Norway, 2006). The scientists who are most "under attack" from skeptics are natural scientists who are studying or modeling the climate system or climate system-relevant processes. Scientists of this kind are also the scientists who engage most in climate science communication in Norway. For both these reasons scientists

Table 1 - The interviewed scientists (the names are pseudonyms to retain their anonymity)

Year when interviewed	**Interviewees**	**Age when interviewed**	**Media exposure**	**News media hits 2001-2011**
2005	"Dolmen" – research director	50-60	extensive	334
2005, 2009	"Pettersen" – research manager/ professor	40-50	extensive	152
2005	"Nannestad" – scientist	30-40	extensive	123
2005	"Jonassen" – research director	50-60	extensive	82
2005, 2009	"Carstensen" – research manager/ professor	50-60	extensive	73
2005	"Finstad" – professor	60-70	extensive	63
2009	"Nordheim" – research manager	40-50	some	28
2005	"Falkberg" – professor	50-60	some	17
2005	"Fredriksen" – professor	30-40	some	16
2005	"Brekke" – research manager	50-60	some	15
2005	"Bakken" – professor	50-60	some	13
2005	"Nilsen" – research dir./professor	50-60	little	10
2009	"Namdal" – department manager	60-70	little	8
2005	"Kronstad" – professor	60-70	little	7
2005	"Andersen" – research scientist	40-50	little	6
2005	"Aass" – research scientist	50-60	little	1

of this kind were considered to have most views on the challenges of climate science communication, and the case study interviewees are climate scientists of this type.

Table 1 gives an overview of the scientists interviewed. Sixteen scientists and research managers from six different institutions have been interviewed. All of the important climate institutions were covered. Most of the interviewees have considerable experience with climate research. Since we were most interested in the views of scientists who had some experience with media contact, there is a bias in the sample towards established scientists. All of the interviewees were men, with the exception of one. Their professional background covers biology, climate modeling, physics, meteorology, climatology, geophysics, paleoclimatology, atmospheric physics, atmospheric chemistry and oceanography. For reasons of anonymity, this information is not used in the analysis, but no important insights are lost because of this.

The interview guide contained questions about research methods, science communication efforts and media contact. The interviews lasted between 50-90 minutes, were conducted face to face, recorded and transcribed verbatim. All interviews were conducted in Norwegian and have been translated into English by the author.

The interviews were conducted in two turns, a first round in 2005 and a second in 2009. The 2005 interviews were conducted by Marianne Ryghaug, the interviews from 2009 by the author. The 2009 interviews extended the number of interviewees in the sample, and provided supplementary information from two of the most prominent climate scientists in Norway. There were no important differences between the data obtained in 2005 and 2009 with respect to the main research questions, so there was no need to differentiate between the two samples in the analysis.

All of the interviewees had some experience with media contact. Their degree of media experience was assessed by counting the number of news media hits they each had through the Norwegian news media database, *Retriever ATEKST*. A query was carried out for each of the interviewees' full name using climate or weather as the search criteria. The search was done with respect to newspapers with national coverage over the time span from January 1, 2001 to October 1, 2011. The query results comprise all texts printed in the period containing the climate researcher's name, and include journalists' articles and interviews as well as letters to the editor and feature articles. "Extensive" media experience is defined as more than 50 hits,

"some" media experience as 11-50 hits and "little" media experience as less than or equal to 10 hits.

Table 1 shows that a little more than one-third of the interviewees have "extensive" media experience. Not unexpectedly, these respondents talked more about challenges with news media communication than then respondents with less experience. Consequently, the six individuals with the most experience are quoted more frequently in the analysis than the others. Even so, there were few disagreements among the interviewees. The main difference between those with a lot of experience and the rest was that the first group had more to say about the issues raised in the interviews.

The analysis was inspired by a grounded theory approach (Charmaz, 2006; Corbin & Strauss, 2008): A qualitative content analysis yielded insight into the elements of climate scientists' mass media strategy. The theoretical overarching concepts of "control," "closing up" and "openness" were then applied, thus attempting to find an overarching concept to characterize their media strategy. This kind of theoretically informed but grounded approach to qualitative content analysis has been called "abduction" (Dey, 2004).

Communicating Climate Science through the News Media: Aims and Reasons

Table 1 reveals a considerable variation in news media engagement among the interviewed scientists, but none of them had zero hits. While some of the interviewees expressed uneasiness with respect to being in the media, there was a general agreement that the news media was a crucial channel for increasing public knowledge about and interest in climate science and climate change. "It is in the mass media that it happens. One newspaper or TV newsflash is worth a 100,000 brochures" (Research Scientist Aass).

Most of the interviewees' research institutions employed a media consultant – often a person with journalistic background. However, though most of the interviewed scientists mentioned these consultants and described them as important, we shall here focus on the strategies involving direct contact between scientists and news media, like commenting and answering questions, giving interviews, taking part in radio and TV debates and writing feature articles.

The scientists appeared to have an idea of a collective news media strategy, which involved some division of labor concerning who had greater responsibility for contact with the media. There were two main arguments for this division of labor: one formal, and one "personal." First, the two most central climate research institutions were

considered more responsible for climate science dissemination than others. One of these had such dissemination as part of the organization's formal mandate, which its research director described as a "double mandate":

> *One part is to do research and obtain knowledge which is useful for the government administration and society, and the other part is that we shall engage in communication and dissemination about climate and climate change and climate science.*

The researchers at these two climate research institutions emphasized how it was part of their policy to urge their scientists to engage in science communication activities, particularly media contact.

Further, it was common to hold that not all scientists could handle media interaction scientists who were able to popularize climate science and could handle the personal stress of being in the media were sought after. Interaction with the mass media was not something scientists should be forced to do. It appeared that scientists believed that it should be left to those who were more suited to the task.

Apart from this element of a collective media strategy, there was also a general feeling that scientists had a moral responsibility to communicate their research results to some degree:

> *It is my opinion that all research institutions ought to have a responsibility to engage in knowledge dissemination. (Research Director Dolmen)*

Scientist Nannestad expressed this as a wish to give the taxpayers their money's worth, giving something back to society:

> *I believe most of us have some degree of professional pride and feel a sort of citizen responsibility. The taxpayers pay my salary, so I feel a duty to inform society. (...) A great deal of our work is [of course] publication of results in international journals. That is the backbone of research, publication. But I also think that it is important to disseminate the results, that that is an important part of the job.*

Furthermore, the importance of the issue of climate change itself provided an added responsibility to inform the public for some interviewees such as Professor and Research Manager Pettersen: "Personally, I feel that at present it is incredibly important. (…) If there was one point in time where I, in retrospect, could not defend doing nothing un-technical it would be now". Several interviewees expressed that

they believed that it was "necessary to increase the level of knowledge in the general public" (Professor Finstad). "Clearly, the current situation implies that the general public does not take this as seriously as they should," stated Research Director Dolmen. It appeared that knowledge was believed to increase an awareness of and general belief in the seriousness and urgency of the climate problem, thus possibly helping to spur political action and lead to changes in individuals' behavior.

The general public dominated in the interviewed scientists' discourse about their communication efforts, as the scientists apparently considered the general public to be their primary target audience. Policymakers and politicians were less often explicitly mentioned when scientists spoke of their news media communication efforts. Instead, the groups were implied through references to, e.g. "policy," "political action" and "being on the political agenda." The lack of explicit considerations for politicians and policymakers could arise from scientists' beliefs that this group would be less confusable and gullible than the public, or from a belief that they would also get through to politicians and policymakers by attempting to reach the general public in the best possible way.

Communicating Climate Science through the Media: The Challenges

The scientists interviewed were clearly motivated to communicate climate science knowledge, not least because they felt morally obliged to do so. However, and not surprisingly, they found climate science communication through the news media to be a challenge. This view appeared to arise from their experiences with – and ideas about – their various "imagined publics" (Maranta et al., 2003), that is, the groups they had to deal with and think about when carrying out climate science communication.

To begin with, we should note that the scientists referred to several publics/audiences when they talked about the challenges of climate science communication through the news media. In addition to the general public, considerations of journalists, environmentalists and "climate skeptics," guided the climate scientists' media strategies. These various groups were considered to pose different challenges for climate science communication.

With respect to journalists, the scientists interviewed complained about the unreflexive application of media norms, as well as journalists' lack of knowledge about science in general and climate science in particular. Journalists' misunderstanding of science was seen as primarily arising from their lack of knowledge. The scientists provided examples of problematic misconceptions about

science and scientists among journalists, and of the harms they considered to arise from this. One example given example of journalists' lack of knowledge was how they often claimed that a particular weather incident was caused by climate change, even though that can never be said with scientific certainty. It was feared that such coverage could give the impression that climate science frequently claimed more than it could prove, leaving it open to attacks by skeptics, in addition to leading the public to believe that climate scientists readily exaggerated their findings. For instance, Research Scientist Nannestad feared that the way climate change had been "played up in the media lately" had led people to disbelieve climate scientists.

Research Manager Carstensen also complained that journalists often wrongly believed that one new research result would change the whole of science:

> *I should have liked for the media to follow the Research Council over a longer period of time so that they would have a network of experts among their contacts and acquire more comprehensive knowledge, because research is based on knowing the totality of the picture. One result does not necessarily change everything completely. But the media often does that [make it sound like that is the case], and thus the media depicts scientists as much more fickle than they really are.*

Another complaint was how "it is easy for 'uncertainty' to be read as 'controversy'" *(Professor Fredriksen)*, that is, how journalists often conflated the two terms, thus indicating that knowledge was lacking and the science unsettled. Lastly, journalists were seen as unreflexive and uneducated because of their tendency to give scientists and "skeptics" equal coverage, without questioning the so-called climate skeptics' professional background and scientific merits. According to Research Manager Carstensen, "Many of those [climate skeptics] are not [climate] professionals. They may be scientists in other fields. The media is sometimes a little too uncritical with respect to who the scientists are and what merits they have." This emphasis on always hearing "both sides", and giving them equal weight, was widely unpopular. Research Director Dolmen expressed the sentiment vehemently:

> *Journalists have it almost as a reflex that they should present for and against and that they should polarize, and that that is what's interesting. Now you must not misunderstand me as meaning that those who are skeptical should not be heard, they should, but on the other hand the consensus on this [man-made global warming] is so overwhelming that one should not give the impression that this is a research community*

divided in the middle, and they are very polarized; and that is simply not the case.

The interviewed scientists feared that attempts to create "balance" by giving "mavericks" the same amount of coverage as established climate scientists would confuse the public by presenting a biased picture as to the degree of scientific consensus. Did this mean that they saw the general public through the lens of the deficit model?

In general, yes. Although the general public was also considered to be interested in weather, climate and climate research, like Research Manager/Professor Carstensen observed: "The general public is very interested. Everybody forms their own ideas and makes their own observations," absence of behavioral changes among the general public was generally read as a sign that man-made global warming is not understood and taken seriously, as expressed by Research Manager Brekke:

If you consider what we work with at these climate research institutions, and when you look at the increase in CO_2 that Norway is responsible for, we have to say that the knowledge is ignored here in Norway. (...) I believe that the general public in many ways doesn't grasp how serious this really is.

Although, scientist Nannestad initially offered a different explanation for the lack of behavioral change in the public, seeing it more as an action deficit than a knowledge deficit: "People know about it, but don't want to do anything about it. If people had taken it in, and believed in the reality of climate change, they would probably change their behavior," Nannestad, too, end up emphasizing how people would probably change their behavior if only they really understood the issue and took it seriously.

The general public was thus seen as lacking in knowledge, especially in-depth natural science knowledge, and lacking a grasp of "how serious this really is" (Research Manager Brekke). They were also seen as gullible to the "creation of doubt" strategies of climate deniers:

Average Joe reading the paper might get the impression that there are two views here: The one view is that one has climate change, the other is that one is not having climate change. Or, that one [either] has man-made climate change, or that it's natural. And if you look to the research community, the view is quite different. In the research community, I would say that there is something like 99.9% agreement that what we

see today is climate change that is in part induced by human emissions. (Professor Fredriksen)

The interviewees argued that increasing the knowledge level of the public would make them less gullible and vulnerable to seduction efforts by the climate skeptics. Several said that they tried to communicate to "straighten the record" (scientist Nannestad), or "get some realism into it [the debate]" (Research Manager Brekke). In accordance with the deficit model, they seemed to have a public education goal for their communication efforts.

It was seen as a challenge for science communication that the public appeared to want juicy and catchy information. Research Director Dolmen articulated the challenge thus:

> *I have faith in dissemination and knowledge, but then there is the question of the form of the dissemination. That can always be debated. Should you frighten the wits out of people or should you do matter-of-fact enlightenment that isn't very exciting, but has much seriousness to it, or what should you do?*

An accurate presentation of scientific facts was seen as potentially too boring, but on the other hand could make dissemination efforts look more serious.

Clearly, varieties of the deficit model were quite pervasive among the scientists interviewed, even if more positive observations about a great interest in weather and climate issues were articulated in the construction of the imagined general public. This construction did not seem to invite social robustness strategies, but not closing up strategies either. The main idea seemed to be to increase openness by increasing media visibility and public communication, but with the fairly traditional goal of educating the public. Yet, when climate skeptics were considered, the situation changed.

This change was due to a feeling among the interviewed climate scientists that climate skeptics increased the difficulty of getting the climate science message across to the general public. In part, the difficulty was seen to be that the skeptics might confuse the public, but, more importantly, that the skeptics made the scientists' job of deciding what to say to the press, and how to say it, even more difficult and painstaking. The interviewees defined climate skeptics as rather hostile individuals or groups who willfully overlooked facts, misinterpreted climate science results, presented contrarian views in the media, and accused climate scientists of exaggeration and scaremongering and of feathering their own nests. The skeptics

were seen as dangerous seducers capable of confusing the general public about the science of climate change. The interviewees believed that since the general public did not know all the relevant facts, they would have a hard time deciding whose knowledge claims to take seriously. The worry was that the public would take climate skeptics' claims about uncertainty and falsehoods at face value, and conclude that the science of anthropogenic climate change was not yet settled, or worse, that climate science was a fraud.

Perhaps more surprisingly, environmentalists were construed by the scientists interviewed as yet another challenge. Climate skeptics were seen as readily accusing climate scientists of exaggeration and scaremongering actually committed by environmental activists. Such activists were seen to point much too frequently to the most extreme scenarios, overstating the scientific certainty and exaggerating the severity of potential impacts. This worried Professor Fredriksen:

> *[Environmental organizations] often have more extreme statements than what you find in the research communities or in scientific results. (...) That can have an undermining effect. It easily leads to newspaper and media publicity that may go too far in the wrong direction.*

The scientists feared that such media coverage might have an undermining effect because it could give climate research a bad name, giving the impression that climate scientists were involved in scaremongering and underselling the scientific uncertainty.

Furthermore, Research Manager/Professor Carstensen also feared that confusion about whether climate messages came from climate scientists or from environmental activists was exacerbated by the mass media:

> *The media does not distinguish well between researchers and research on the one hand, and research translated and spread by the environmental movement. And then you can get exaggerations, and you can get articles in the press saying "research report says this and that," and then it's really a report made by an NGO, based on their more or less selective evaluation of research. But it's not a research-based product.*

The interviewed climate scientists felt that their most important task – educating a potentially interested general public – was being made difficult by the three other publics described above: journalists, climate skeptics and environmentalists. What impact did the challenges have on issues of openness and control/closing up in the climate scientists' communication strategies?

Communicating Climate Science: Strategic Considerations

As we have seen, the interviewed climate scientists pointed out four sources of problems of climate science communication through the mass media: journalists' misinterpretations and misrepresentation of climate science due to lack of knowledge and norms of "balanced" coverage, the general public's lack of knowledge, environmentalists' exaggerations of the climate science results, and climate skeptics' assaults on climate science. How did the scientists address these problems?

With respect to journalists, the main strategy was concerned with control, which was pursued in two main ways. First, many interviewees hoped that if journalists knew more about climate science, this might reduce misunderstandings and help improve climate science reporting. One research institution had created a kind of "exchange program" to educate journalists: a few climate scientists spent some weeks at the office of the local newspaper, and some journalists spent some weeks at the institute. Education efforts of such kinds would, it was hoped, lead to better science coverage, since journalists would then understand more of science, and get it "right" more often. This could be seen as attempts to "control" journalists' climate science representation.

Second, since the interviewees felt that the media gave climate skeptics too much exposure, but that their own ability to control the media –"change the way the media works" in Carstensen's words – was limited, they chose instead, as an effort to gain some control over the public's reading of the media coverage on climate science, to try and educate the public to be able to distinguish between experts and non-experts:

> *We try all the time to inform based on the facts and we try to comment on what we see as provably wrong. (…) We criticize harshly those who misinterpret observations or who do not relate to the observations that exist. (…) I think that it is important to raise doubt about those who misinterpret the observations or don't relate to the observations. (Professor/Research Manager Pettersen)*

Of course, to educate the public to recognize certified expertise is also a way of educating about climate science. With respect to communicating with the general public, such efforts are not obviously about control. Rather, since the climate scientists could not rely on scientific authority, they had to perform some type of public proof, thus pursuing social robustness.

However, the arguments also had to be interesting. The scientists needed to combine proof and drama, which Professor Fredriksen articulated in the following way: "The

fact that the mean temperature will increase by two degrees is not interesting to the general public, only to a weather scientist. It is the extremes that are the most catchy, so to speak." At the same time, there was a danger of "going too far." Research Manager Nordheim described the challenge of being both scientific and interesting in the following way:

> *I notice that I become apprehensive about maximizing the problem and afraid of not being taken seriously by going too far. (…) If we natural scientists formulate our message much stronger, we get arrested by those who sit and look for slips, right? And then that is used as an example of the way we maximize the crisis and you should not listen to what we say and everything. (…) We truly cannot tabloidize this because it becomes too easy to attack.*

This quote emphasizes that there are risks involved in overstepping the line and overstating scientific findings. This exemplifies challenges of doing science communication in situations of heated political controversy. Such risks made the climate scientists engage in boundary work with respect to environmentalists:

> *"It is clear that environmental organizations play an important role in keeping this issue [global warming] on the agenda. I think they could be even better at giving a realistic picture of what it is about. A little too easily it becomes – not doomsday prophesies, perhaps – but a little too much crisis maximization. (Research Director Dolmen)*

Professor Fredriksen argued similarly that:

> *Researchers, and climate researchers especially, are often accused of scaremongering. And that applies to the environmental organizations as well. At least, some of them are much better than us at fear mongering and scare scenarios. So I will say we ought to stick to a neutral line, indicating the most probable development, and then say something about the uncertainties. (...) We have learned that all climate research can easily be labeled as "bad science." I think it is very unfortunate that people misinterpret results [in these ways].*

Of course, such statements are in accordance with the ethos of science. However, instead of fearing correction by their peers, the interviewed climate scientists' concerned was what climate skeptics would make out of statements that went beyond accepted scientific results. Climate skeptics were seen as readily accusing climate scientists of exaggeration and of underplaying uncertainty. This seemed to

make the striking of a proper balance between popularizing and staying sufficiently scientific particularly acute.

Clearly, it was the general public that was the main audience of the climate scientists. By reaching out to them, the interviewed scientists mean to fulfill moral obligations with respect to dissemination, but also to influence policy and induce behavioral changes. Yet, this communication could not be carried out unless three other publics were considered: First, the journalists who populated the main channel of dissemination of knowledge – the news media; second, environmentalists who might be confused with climate scientists; and third, climate skeptics who were seen as eager to distort the dissemination of climate science.

Hence, while a kind of social robustness strategy – based on public proofs – could be used with respect to the general public, the public proofs could not be performed without considering the other three publics and how they might intervene in the process. As we have seen, this was considered to call for caution. The interviewed scientists' response was to formulate their statements about climate science in ways that made it difficult for climate skeptics to criticize or counter them on seemingly scientific grounds. They tried to achieve this by avoiding what could be considered weak spots – errors, exaggerations or omissions – whereby the validity of climate science could be challenged. In addition, they engaged in boundary work with regard to both environmentalists and climate skeptics to make their own expertise trustworthy as science, in contrast to the two other parties, characterized as unscientific.

The interviewed climate scientists emphasized the need to avoid factual errors and exaggerations to the degree that their main communication strategy could be described as a "guarded approach." The ideal was to always be a "credible supplier of facts that no one manages to criticize" (Research Scientist Aass). In this sense, the main object of control was the group of the scientists themselves. Such control was necessary because the scientists engaged in what could be called a guarded, or controlled, openness. As we saw above, the climate scientists emphasized the need to be open about uncertainties while being clear about what was certain – anthropogenic global warming – in a manner that preempted challenges. This suggests that the contrast between openness and control, introduced earlier in this paper, is over-simplified and needs to be revisited. The communication strategies of the interviewed scientists seemed to contain elements of both. How can we best characterize this?

From Social to Political Robustness

As noted in the introduction, climate science has been under assault. It has been proposed that the potential trust deficit which may emerge from events such as "Climategate" should be met with more openness. The concept of social robustness (Gibbons, 1999; Gibbons et al., 1994) contains some fairly concrete ideas about what more openness could mean, namely making research work more transparent to the public, including an increased emphasis on the conduct of public proofs. How do such ideas about openness compare with how the climate scientists interviewed accounted for their efforts to publically communicate climate science?

With respect to the general public, a major concern among the climate scientists was their feared lack of knowledge about climate change and climate science. The interviewed climate scientists felt obliged to try to counter this deficit by informing about their research, which they largely did through the news media. We can see this effort as an engagement in public proofs, but – judging from the scientists' accounts – increased transparency with respect to their research work was not considered important. Moreover, the attempts to give public proofs were undertaken with the explicit understanding that climate skeptics would scrutinize every detail of their arguments, looking for mistakes they could use to undo the proofs and undermine public trust in climate science.

This situation demonstrates an important weakness with the concept of social robustness, namely the implicit assumption that science communication takes place in a situation in which all parties have a positive interest in learning. The main problem with the argument of Gibbons et al. (1994) is that they conceive of the agora – the place where science and society should interact – as being based on rational communication. The experience of the climate scientists interviewed was that they instead had to educate the public in a highly political space, filled with conflicting interests. This made them pursue openness in a cautious, controlled manner. Rather than using a communication strategy based on social robustness, we could characterize their efforts as going for what I will call *political robustness*.

Political robustness supplements the concept of social robustness by introducing the need to cope with a communication situation characterized by social, economic and political conflict. Even so, political robustness is not a back-to-the-ivory-tower strategy. It ensures some openness: we saw in the previous analysis how scientists accepted public accountability and openness in the sense of communicating their findings and interacting with the news media. This parallels the findings of Young and

Matthews' (2007) interesting study which revealed that distrust of the news media agora does not necessarily imply a rejection of public engagement activities.

The concept of political robustness addresses some of the potentially problematic issues with respect to how to exercise some control over how scientific information is received in situations where other parties incessantly try to deconstruct and debunk the information. Table 2 summarizes the argument by comparing the normative concept of social robustness and my, empirically grounded, concept of political robustness.

Table 2 - Social and political robustness – summary of main dimensions.

	Social robustness (after Gibbons, 1999 and Gibbons et al., 1994)	**Political robustness**
Role of the public	Included/involved – speaking back	Included as recipients of information, but not intended to speak back.
Strategy for making knowledge	Knowledge is constructed in dialogue with the public.	Knowledge is ready-made and fashioned to minimize misunderstanding, misuse and distortion.
Contestation	Controversy is seen as positive since it contributes to increased robustness of knowledge in the long term. Society should be allowed to speak back to science.	Controversy is considered dangerous since it may erode the public's confidence in science.
Strategy for communication	Emphasis on openness in the sense of transparency and participation, boundary work not important.	Cautious openness, emphasis on control of knowledge transfer, follows an education format, boundary work is important.
Openness rationale	Transparency and participation	Public accountability
Reasons for communication	Including public concerns into science	Educating the public, influencing policy, attitudes and behavior

The findings in this article should not be interpreted as a dismissal or falsification of social robustness as a potential ideal for science communication. However, what we empirically observe is that the climate scientists interviewed consider such openness as too risky. This is above all due to the strong medialization of climate science, with a high degree of controversy and politicization. Multiple groups of actors, with different political agendas and views, produce a high level of conflict. Scientists hence adopt political robustness as their main communication strategy to cope with this situation, while maintaining what they see as their public accountability and their obligation to deal with the perceived knowledge deficit. Social robustness may appear as a strategy that is too novel and unproven. Maybe it stands a better chance in other, less conflict-ridden scientific areas?

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Chapter 4: Concern and confidence: Architects making sense of climate adaptation

Abstract

Drawing on the analytical concept of "sensemaking" as defined by Weick (*Sensemaking in Organizations,* 1995, Sage, Thousand Oaks, CA), and on scholarship concerning architect identity discourses and the regulatory context of architecture, this paper examines how architects make sense of the issue of climate adaptation. I found that architects' identity discourses and context appeared to shape the way climate adaptation was made sense of, more than the other way around. Also architect identity and contextual factors were more important than features of the climate adaptation issue itself in architects' sensemaking. Most important among the identity-related element of architects' sensemaking was the conception of architects' expertise as holistic – encompassing both aesthetic-creative and technical-craft-related dimensions. Among contextual factors in architects' sensemaking, national building regulations and the industry's focus on cost-efficiency were the most central.

Keywords: climate adaptation, architecture, professions, sensemaking, identity, discourse, regulation, organizational theory

Introduction

In this paper I will examine how architects make sense of climate adaptation, with particular focus on how they conceive their own role and responsibility with respect to it. If and how do architects incorporate climate adaptation into their existing ideas "of what architecture is for and how it happens" (Cohen et al. 2005, page 793)? Do new concerns – like climate adaptation – change architects' view of themselves, their practice, and their responsibilities?

The interpretation of an issue is crucial to the implementation of measures aimed to solve it (Weick, 1995; see Berkhout et al., 2006; West and Hovelsrud, 2010 for examples). "[O]rganizational life is as much about interpretation, intellect, metaphors of theory, and fitting our history into an understanding of life as it is about decisions

and coping with the environment" (March, 1984 quoted in Weick, 1995, page 8). Climate adaptation is a concept with many meanings and definitions, divergent in conceptions of who and what adapts, what to, and how (Smit et al., 2000). If what "climate adaptation" means for architects is not given, we need to examine the "interpretive work" (Berkhout et al., 2006) or "sensemaking" (Weick, 1995) of architects to understand how the problem is and can be managed. Do professionals' identity and practice shape the way new concerns – like climate adaptation – are and can be made sense of?

Sensemaking and architect identity

In the following, I draw on the analytical concept of "sensemaking" as defined by Weick (1995, page 18) as a process which is grounded in identity construction, retrospective, enactive of sensible environments, social, ongoing, focused on and by extracted cues, and driven by plausibility. Literally, sensemaking means the making of sense – the structuring of the unknown (Waterman, 1992, page 41), into comprehensible events through e.g. framing, information seeking, meaning ascription, or action. Importantly, sensemaking does not only concern the issue "out there" but also, largely, identity. "Depending on who I am, my definition of what is 'out there' will also change," and – vice versa – "to define it is also to define self" (1995, page 20).

If the "establishment and maintenance of identity is a core preoccupation in sensemaking" (Weick, 1995, page 20), we need to know more about architects' self-understanding and identity. Cohen et al. (2005) have identified three different "identity discourses" that architects draw on to make sense of, negotiate, and accommodate changes to their profession and the context around them (see also Imrie and Street, 2011; Jones and Livne-Tarandach, 2008). These identity discourses are (1) architecture as creative endeavor, (2) architecture as business, and (3) architecture as public service (Cohen et al., 2005, page 792). The last of these discourses figured mainly in Cohen et al.'s interviews with architects working in the public sector. Since all the architects interviewed for this paper work in the private sector, I expect this last discourse to be less prominent and will mainly focus on the first two.

In the architecture-as-creative-endeavor discourse creativity is seen as fundamental to architecture – its legitimate and legitimating core – with creative-aesthetic sensibility and skill as architects' differentiating characteristic. This makes their status in the social relations of the construction process both vulnerable and invulnerable: invulnerable because "within the creative discourse, the architect is seen as expert" (Cohen et al., 2005, page 784); vulnerable because, in an economic climate where

commercial concerns guide decision-making, the creative dimension of building processes – and architects with it – is easily and often sidelined. Some scholars suggest that architects' (potential) irrelevance in the new reality of the building industry is even partly caused by the creativity identity discourse (Habraken, 2005; RIBA, 2005; Till, 2009), since it may have made architects detach themselves from the needs of the "field" (Habraken, 2005).

The other identity discourse of interest to this paper is the architect-as-business discourse. This discourse was mainly drawn on by practitioners working in private-sector firm, whereas the creativity discourse cut across organizational contexts and hierarchical levels (Cohen et al., 2005). In the architecture-as-business discourse, creativity was seen as one among many facets of architecture, with e.g. financial management, technical know-how, and market sensitivity as just as important parts of architects' business and skill set. In the business discourse no distinctive values assure architects a privileged position; their role is more blurred, and architects are further down the "pecking order" of the building industry – fighting for control and influence. At the same time, the business discourse is more inclusive than the creativity discourse with respect to what can be deemed to lie within the domain of architects' responsibilities: "activities considered to be outside of the boundaries of architecture are still part of the business" (Cohen et al., 2005, page 786), whereas the creativity-aesthetic identity discourses has been blamed for the problems of including environmentalism and sustainability concerns into mainstream architecture (e.g. Owen and Dovey, 2008; Ryghaug, 2003).

The business discourse shows a sensitivity to the social context that architecture is embedded in, which the creativity discourse lacks (e.g. Habraken, 2005; Till, 2009). This brings us to the second source of input to the sensemaking process I will consider here: the context of architect work. Responses to new concerns – like climate adaptation – are made against, and shaped by, a number of other drivers of change, e.g. changing technologies, shifting consumer expectations, emergence of new competitors, and changing regulations (Imrie and Street, 2011; see also, e.g., Arnell and Delaney, 2006; Berkhout et al., 2006; Keskitalo, 2008) for examples of how contextual factors shape the choice of climate adaptation measures). What are the important contextual factors to consider if we are to understand how architects make sense of climate adaptation?

New knowledge and new risks, lead to more complex regulations and increased risk management. Nation states attempt to ensure sustainable, safe, quality housing and to address societal concerns like climate change, sustainability, and crime prevention

by broadening the scope of regulatory controls (Imrie and Street, 2011). Firms attempt to respond to the increased (perception of) risk with increased risk management, including e.g. the creation of "paper trails" which enables auditing of the building process (Imrie and Street, 2011). They also respond to the increased complexity of both risk and regulations that appears with larger, more complex project teams in which architects no longer are in charge, but work in partnership with other professionals such as project managers and specialist engineering consultants (Imrie and Street, 2011). Together, the felt impact of these changes has been described as a "regulatory overload" (Imrie and Street, 2011, page 279).

Together with increased focus on cost-efficiency, time economy, throughput and output (Imrie and Street, 2011, page 204; Koch, 2004), which may further decreasing differentiation between design and building and minimization of 'pure design' in project work, the abovementioned organizational changes have been interpreted as contributing to a reduction in the status and professional autonomy of architects (RIBA, 2005, 2011). It is feared that the traditional focus of architects – aesthetics and building design – may be supplanted by prosaic and pragmatic tasks related to development, delivery, implementation of building projects, and issues of risk and regulation. Dent and Whitehead (2002) see this as part of a broader set of changes which have destabilized the status of traditional professional occupations.

Are architects really losing status, power and autonomy? Some factors indicate that they may be. However, as Cohen et al. (2005, page 776) point out, many of those who worry the most about destabilization of the status of traditional professions have studied the subject matter on a macro level (see Cohen et al., 2005, page 776 for an overview; e.g. Dent and Whitehead, 2002). Studies examining how such apparent changes affect professions like architects in more detail, discover a picture "less about wholesale change and more [about] negotiation and accommodation" (Cohen et al., 2005, page 793), cf. how architects do not ascribe to one identity discourse alone, but use several to define – and defend – their identity and status (Cohen et al., 2005; see also Imrie and Street, 2011). Nevertheless, contextual factors called attention to by the more macro-level studies will undoubtedly play a part in architects' sensemaking.

To summarize: Along with changing regulations, market contexts, and political contexts, climate change may be one of several new elements that threaten to change the context of the architect profession and thus also architecture identity. However, it may also have more specific importance. How do contextual factors and architects' sense of identity influence how climate adaptation is made sense of? And;

does the process of making sense of climate adaptation change how architects make sense of themselves and their work? Is climate adaption a window through which architects' identities may be observed, or is the concern for climate adaption something that change architects' professional identities?

The case: Norwegian architects and climate adaption – context and methodology

My case to examine these questions is Norwegian architects. Although Norwegian society is in general believed to be "weatherwise," i.e. be familiar with extreme weather conditions, (Lisø et al., 2003; Aall et al., 2009), and Norway is generally considered to have high adaptive capacity, it does not necessarily follow that this will lead to successful adaptation to climate change (O'Brien et al., 2004). Even though Norway's varied climatic conditions – caused by rugged topography – historically have caused variations in building practice throughout the country (Lisø et al., 2003, page 207), external climatic impact causes more than 75% of Norwegian building defects (Ingvaldsen, 2008). This makes it reasonable to doubt the weatherwiseness of the Norwegian building industry. With regional scenarios for climate change over the next 50 years in Norway indicating increased risk from extreme weather and intense precipitation (RegClim, 2005), there is reason for concern about the building industry's ability to respond to the climate adaptation challenge (Lisø et al., 2003, page 207).

Previous research on climate adaptation in the building industry in Norway give several potential reasons for poor building quality: the ever-present demand for cost-effectiveness in the construction industry (Lisø et al., 2003, pages 206-207); the reform to the legal framework (Groven, 2005; Lisø, 2006; Øyen et al., 2005), which has increased the complexity of the rules making them "more difficult to enforce or easier to evade" (Lisø, 2006, page 5); and inadequate governmental supervision of the building industry's internal control (Groven, 2005; Øyen et al., 2005). Also, the Norwegian self-image of weatherwiseness may also in itself be a problem. With the 1997 reform of the building regulations to a performance-based system, the responsibility for quality standards is given to the responsible applicant – designers or contractors (Øyen et al., 2005). This makes these building industry actors' interpretation of climate adaptation very central to how, and indeed whether, climate adaptation can and will happen.

Øyen et al. (2005) express concern about the fact that "[m]ost companies are confident that they are fully adapted; [even though] the degree of adaptation varies greatly within the small sample of cases examined" (2005, page 7). Her worry is that building industry actors may be overrating their own adaptation and adaptive capacity. This concern is backed by findings from other studies of Norwegian actors' interpretations of their own adaptive capacity (e.g. West and Hovelsrud, 2010; Aall et al., 2009). If actors' judgment of their own resilience and capacity to adapt as strong may be possible barriers to climate adaptation, studying their sensemaking processes will be central for gaining understanding into how climate adaptation can happen.

Climate adaptation is generally defined as "adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities" (Adger et al., 2005, page 78; McCarthy, 2001). However, such official definitions are not of much interest here since my concern is how the interviewees themselves define and relate to the issue.

My analysis of architects' sensemaking regarding climate adaptation builds on 36 qualitative interviews with architects from a sample of different size private sector firms with various regional backgrounds (see Tables 1 and 2). However, all companies were engaged in design of buildings. The interviewees were chosen from a list of 805 firms derived from a search for architect firms on the Yellow pages, restricted to the largest cities in five regions of Norway: West, East, South, Central, and North. Three interviews were conducted by colleague Robert Næss, the rest by the author. Initial contact with the chosen firms was by e-mail, whereas the interviews were by telephone, except the three interviews conducted by Robert Næss which were face-to-face. The interviews were carried out in 2008, lasted between 10 and 40 minutes, were recorded with the interviewees' consent, and transcribed verbatim for the analysis. Translation of the interviews from Norwegian into English is by the author.

Table 1

Western Norway	12
Eastern Norway	6
Southern Norway	2
Central Norway	11
Northern Norway	5
Total	**36**

Table 2

Pseudonym	**Role**	**Firm size**
Andersen	Partner	Small
Amundsen	Partner	Small
Antonsen	Partner	Small
Bakken	Partner	Small
Berg	Partner	Small
Christensen	Manager	Small
Dahl	Manager	Small
Danielsen	Manager	Small
Eliassen	Manager	Small
Eriksen	Manager	Small
Fredriksen	Employee	Small
Gundersen	Manager/partner	Small
Halvorsen	Manager	Medium
Hansen	Manager/partner	Medium
Henriksen	Manager	Medium
Holm	Manager	Medium
Iversen	Partner	Medium
Johnsen	Manager	Medium
Jacobsen	Manager	Medium
Johannessen	Partner	Medium
Karlsen	Manager	Medium
Lund	Manager	Medium
Larsen	Partner	Medium
Moen	Manager	Medium
Madsen	Employee	Large
Mathisen	Manager	Large
Nygaard	Manager	Large
Nielsen	Manager	Large
Orheim	Manager	Large
Olsen	Employee	Large
Paulsen	Manager	Large
Pedersen	Manager	Large
Rasmussen	Manager	Large
Svendsen	Partner	XLarge
Solheim	Head of Arch. Dept.	XLarge
Vik	Head of Arch. Dept.	XLarge

The interview guide consisted of four topics of interest: (1) how the architects considered that climate change would affect their line of business, (2) what they considered to be important sources of knowledge on climate change, (3) what they perceived to help or hinder climate adaptation, and (4) how they dealt with weather and natural hazards issues in their daily practice. In line with a grounded theory approach (Corbin and Strauss, 2008), the interview questions were altered as the parallel interview-analysis process progressed in order to focus the line of inquiry and elaborate on interesting features from earlier interviews.

Through a qualitative content analysis, I first categorized the interviewees' different interpretations of climate change, their attributions of responsibility for climate adaptation, and their reasons for worrying or being confident about their ability to handle climate adaptation. Secondly, I used concepts drawn from relevant literature – identity, context, and issue – to create larger categories of 'sources of reasons.'

The rest of the paper is structured as follows: First I will discuss how questions of identity influenced the way in which architects made sense of climate adaptation. Secondly I will examine what role contextual factors, and aspects of the issue itself, played in their sensemaking, before I go on discuss my findings more broadly.

Climate adaptation and architect identity

The creativity and identity discourses as described by Cohen et al. (2005) suggests that it may not be straightforward how architects will make sense of new concerns like climate adaptation. How did this play out in the interviews with architects reported here? Did the architects dismiss climate adaption as outside their area of concern or did they argue that this issue easily could be integrated into standard practice? Most of the interviewees pursued the latter line of argument and expressed confidence about architects' ability to handle the demands of climate adaptation. This confidence was based on a generally shared conception of adaptation to current local climatic conditions as an integral part of "good building" and good design process.[9] Many of the interviewees explained how "we always work on climate adaptation when designing a building";[10] "it is engrained in the building regulations and in good building tradition and experience";[11] "it is already integral, almost second nature."[12]

[9] Andersen, Berg, Christensen, Dahl, Johannessen, Larsen, Lund, Nielsen, Nygaard, Paulsen
[10] Larsen
[11] Paulsen
[12] Christensen

> *If you design a school in Trondheim, that roof needs to have a different construction from the roof that you will design in Bergen, for instance. (…) There are always climate factors such as these, which influence what kind of construction you choose. (Andersen)*

The fact that climate adaptation, as Andersen put it, was "part of the picture the whole time" supported faith in architects' ability to address climate adaptation concerns: "The houses should in principle be water tight, so I don't know [if climate change] will be that important."

With good design process defined as being responsive to the local environmental and climatic conditions, it follows that architects, by conforming to good practice, would be able to detect relevant local climatic changes and adjust their building designs to adapt to these detected changes.[13]

> *All physical challenges – the outdoor environment, climate – will influence the building process. You evaluate the situation: Where is it good to place a building on this site with regard to wind, snow, geo-technical considerations? (...) We are used to doing local studies in an area and on the site where the building will be, on the plot, and I don't think there will be any other ways of gaining knowledge about such things. (…) And when the climate changes, all these parameters will change, too. (Nygaard)*

Their definition of good design process provided architects with an identity discourse in which they were sensitive and responsive to climatic conditions and changes in it. This was different from the identity discourses centered on creativity or business, like the ones described by Cohen et al. (2005). Rather, it was an expression of identity centered on the idea that architects, as opposed to other actors in the building industry, have the ability to consider the totality of the building "as a whole." Thus, the central identity discourse articulated in architects' sensemaking with respect to climate adaptation was a holistic identity discourse. This holistic identity discourse was what substantiated the architects' confidence about their ability to handle climate adaptation. It was also the reason why some architects argued that architects had a particular responsibility for ensuring that climate adaptation concerns were addressed in the design- and building process.[14]

[13] Danielsen, Nygaard

[14] Johannessen, Larsen

Another argument the architects used to substantiate why they could deal with climate adaptation was that they were used to harsh weather,[15] e.g. "we are used to shitty weather here in Bergen. (…) It can't become worse here."[16] As Norwegians in general often view themselves as used to bad weather (e.g. Lisø et al., 2003; Aall et al., 2009), the interviewees' claim to weatherwiseness might stem from being Norwegians, rather than from being architects. However, given the interviewees' depiction of a good design process as encompassing sensitivity to climatic conditions, we may accepts architects' claim to weatherwiseness as based on their professional practice-based experience with local climate.

Thus, the interviewed architects generally claimed to be able to cope professionally with climate adaption. What varied was the degree to which the interviewees considered that they – or architects in general – did in fact adhere to "good design practice" in which climate adaptation was central. The degree to which the architects practiced what they preached varied. Some architects emphasized how *their* firm took this issue particularly seriously,[17] with some contrasting their firm's practice to that of others' who, in their opinion, did not take the issue seriously enough.[18]

> *I can't make a comment about architects [in general], because I feel that most don't think along those lines, but I can say something about our small office. We live on the West coast, and we have not designed a single house with a flat roof, because we – even before the climate change [concern] – considered it irresponsible. (Berg)*

Others upheld that climate adaptation was important; but that it did not require particular consideration in, e.g., urban areas or areas where no-one had experienced special climate adaptation needs.[19] For instance, Mathiesen explained how "in an ordinary project in the middle of a city, I don't think it has that much to say. When there are houses there already, and things work out OK, I don't think it will be given much consideration today."[20] However, these actors, too, included climate adaptation in their depiction of a good design process, but in a more convoluted form – they viewed the consideration of whether climate adaptation was necessary as part of good design process, allowing for the fact that, in many, even most, cases it was not.

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[15] Arntzen, Berg, Christensen, Dahl, Iversen, Johannessen, Nielsen

[16] Christensen

[17] Arntzen, Berg, Dahl, Johannessen, Iversen, Nielsen

[18] Berg, Dahl, Johannessen

[19] Gundersen, Mathiesen

[20] Mathiesen

Did the interviewees see potential challenges for climate adaptation connected to architects' way of thinking and working? As noted, adaptation to current climatic conditions was considered an element of good design practice, although its attributed importance and the degree to which architects lived up to this ideal varied. Some of the respondents who emphasized their own firms' climate adaptation efforts, criticized mainstream architecture for its lack of consideration for climate, and feared that the knowledge of architects in general of how to adapt buildings to climatic conditions was deteriorating:[21]

> *When the sheathing felt [insulating paper] came, everybody believed houses could be built anywhere and they forgot the old principles, where they – Norwegians – used to build between hills and mountains and not on top of them. (...) If there is to be more and rougher weather (...) you should at least think about where they used to place houses in the landscape, and not necessarily court disaster. (Dahl)*

Several respondents noted that issues of waterproofing, humidity, wind and other climate-related concerns had been neglected lately,[22] though who the interviewees held particularly responsible for this neglect was not easy to assess from the interviews. Some did mention external factors. Johannessen explicitly put a large portion of the blame on the architect educational system which, in his opinion, focused too much on form to the detriment of the knowledge about climate adaptation. Nielsen promoted a different kind of outlook, arguing that the globalization of the building industry was a potential threat to climate adapted buildings. Thus, he feared the loss of local knowledge that might result from not using local architect firms.

In general, however, the architects' concerns for the profession's ability to deal with climate adaptation, was less tied to concerns about shortcomings in the profession as such. The interviewees did not refer to the creative or business identity discourses as challenges to their engagement with climate adaption. Rather, they put forward a holistic identity discourse to argue their ability to make sense of and deal with climate adaption issues. However, they did see potential economic or institutional barriers to carrying their shared "ideal building process" into effect. What contextual issues were mobilized in their accounts?

[21] Berg, Dahl, Johannessen
[22] Arntzen, Berg, Dahl, Eliassen, Johannessen, Nygaard, Svendsen

Climate adaptation and the context of architect work

The most dominant reason for concern about the ability of architects – as part of the building industry – to address the climate adaptation concern, was the cost-reduction focus of the industry.[23] Henriksen described how "what it boils down to in projects is costs, really. (…) We can propose whatever we want, but in reality, that's what counts."[24] Cost restrictions were seen as tied to a range of different phenomena which made current buildings poorly adapted to climatic stresses, for instance the proliferation of minimum solutions;[25] poor craftsmanship due to, among other things, time pressures in the building phase;[26] and neglect of local climate adaptation needs.[27] Since climate adaptation efforts might add extra qualities to a building and therefore extra costs – "they are extra qualities that have to be added, you know," Johannessen explained, the cost-efficiency focus of the industry was seen as a major obstacle to ensuring buildings better adapted to a future climate.[28] Solheim gave an example of how this might go:

> *Some of my architects tell me that when they try to introduce a climate focus, the builder is interested initially, and when he or she discovers that is has a cost, it gets dropped. (Solheim)*

When architects voiced concern about their professions' ability to deal with climate change, in this way, this can be interpreted as concern tied to declining architect influence over the building process. This concern for loss of architect influence appeared to underlie architects' criticism of how all-encompassing the cost-efficiency focus had become in the industry. The experience – and expectation – of this situation appeared so common that many architects did not even suggest extra-cost measures, having, in a sense, accepted the "pragmatics of practice" (Imrie and Street, 2011) and succumbed to the "tyranny of the project" (Koch, 2004).

Both these concepts appear applicable to the situation at hand – especially "pragmatics" – since the interviewees' reasoning about whose responsibility climate adaptation was centered pragmatically on the actors considered to hold sufficient power to propel change. This was not, in general, seen to be architects: "It depends on the authorities and the builders, really. I don't think it depends that much on architects anymore," Rasmussen conceded. The actors powerful enough to drive – or

[23] Gundersen, Hansen, Henriksen
[24] Henriksen
[25] Dahl, Hansen
[26] Nielsen
[27] Arntzen, Eliassen, Olsen, Svendsen
[28] Gundersen, Henriksen, Johannessen, Larsen, Mathiesen, Solheim

stall – change was considered to be the builders/developers and the national authorities.

The power that architects considered national authorities to have can be illustrated by the fact that several architects indicated that 'changes in the building regulations' might be among the most important drivers for changes to their practice and for the building industry more generally.[29] National authorities were seen as the only actor powerful enough to counter the cost-reduction focus of the building industry. Several of the interviewees held that climate change would only come about if building regulations were changed to include demands for particular climate adaptation measures. [30]

> *I do feel (…) that the business is somewhat in suspense, like with the energy issue. People are a little careful and a little afraid to take initiatives which are difficult to defend cost-wise. If there were to be governmental requirements, it would be much easier to heed, because they [the governmental requirements] have to be fulfilled. (…) Building projects are heavy affairs with much prestige and money involved, (…) If we try to bring about [too] much that is not prevalently accepted, that can be hard. (…) The authorities, for instance guidelines or regulatory amendments or other things, will be important, that's for sure. (Larsen)*

A few respondents also called for intervention by the national authorities in the form of new regulations to counter the "tyranny" of the cost-reduction building project logic, and improve the handling of climate adaptation in the industry, like Larsen quoted above.[31]

Beyond what architects could address through good design practice and based on local assessments, climate adaptation was seen as the responsibility of the authorities,[32] particularly national level authorities in charge of making and updating building codes and regulation.[33] Contrary to builders/developers, national authorities appeared to be generally trusted, both in a short- and longer-term perspective. For example, Andersen displayed trust in the adequacy of the current regulatory system's control mechanisms when he explained how he reckoned that "there are so many control mechanisms (…) that it will be discovered if there are any problems."[34] With

[29] Antonsen, Eliassen, Eriksen, Gundersen, Henriksen, Nygaard, Paulsen, Solheim
[30] Gundersen, Johannessen, Rasmussen
[31] Larsen, Johannessen
[32] Andersen, Hansen, Johnsen, Mathiesen, Nygaard, Rasmussen
[33] Andersen, Hansen, Nygaard, Rasmussen
[34] Andersen

respect to climate adaptation challenges in a more long-term perspective, confidence in national authorities was shown through beliefs that relevant knowledge of large-scale change would be "reflected in the regulations."[35] This indicated a trust in the national authorities' ability to bring about necessary climate adaptation on a "higher level" which was also shared by other interviewees.[36] However, a few interviewees expressed doubt whether the regulatory control of the quality of building processes and products was sufficiently enforced.[37]

This trust in national authorities and in the adequacy of building codes, together with the lack of inclusion of drastic climate adaptation measures in building regulations, appeared to confirm the architects' reading of the situation as something they could address using their traditional ways of working – thus, endorsing architects' confidence in their own ability to address climate adaptation. To use sensemaking jargon, the architects appeared to look to the building regulations and codes for "cues" which was then used as input to help them determine what climate adaptation might mean for them and how it should be addressed. Examples of such reading-for-sensemaking-cues are how some interviewees described changes to the regulations – for instance to wind and snow-loads – as "climate impacts" for the architect profession.[38] "What happens in our business, how it [climate change] will affect us, is something we primarily discover when new regulations hit us," Nygaard put it. Moreover, a few interviewees even indicated that "impacts" from changes in regulation might be the most relevant ones for the industry and the profession.[39]

As such, regulations played an important role in architects' sensemaking, not only as organizational context, but also as a repository of cues about what climate adaptation should mean for architects and the building industry. Regulations thus play a double role in architects' sensemaking – both as tools and as sense-giving "text." This dual-role feature of codes and regulations have been noted by Moore and Wilson, who argue that "codes of all kinds are both an index of changing values and at the same time a strategy to enforce those values" (2009, page 2617; see also Imrie and Street, 2011, page 284).

The issue itself – how important for sensemaking?

So far, we have observed how the interviewed architects made sense of climate adaption though a holistic identity discourse but also through contextual factors,

[35] Nygaard
[36] Andersen, Hansen, Mathiesen, Nygaard
[37] Nielsen, Solheim
[38] Johannessen, Holm, Nygaard, Henriksen
[39] Eliassen, Johannessen, Paulsen

above all costs and regulations. The architects' confidence in their own ability to address climate adaptation concerns also appeared intimately tied up with their view of the issue itself, that is, their view of how climate change would impact Norwegian local climatic conditions. Above, I referred several interviewees expressing confidence in their own weatherwiseness along the lines of "we are used to it."[40] Implicit in such confidence in the relevance of experience with and knowledge of current local climatic conditions, is a view of climate change as slow and governable. For example, a couple of interviewees expressly assumed that the frequency of extreme weather events might increase, but not their severity:[41]

> *A hurricane is a hurricane. There are several places where the houses are tethered to the ground today, and were a hundred years ago, and where people will keep doing that. I don't think there will be that much change. (Bakken)*

Others explicitly stated that they believed that (relevant) change would happen slowly[42] or at least sufficiently slowly for architect practice to be able to pick up the signals and adapt in time. For instance, Orheim said he did not think the profession would change much due to climate change. He believed architects' role and practice – their "way of handling things" – would stay the same, even though climate might change. A view of climate change as gradual and relatively slow was central to such confidence.

Another aspect of the issue also appeared to be important for architects' sensemaking: their perception that there were scientific uncertainties inherent in predictions of the climate impacts for a particular locality. This appeared to be an important problem mainly because it was exacerbated by the cost-efficiency focus. Of course, scientific uncertainties could also be an obstacle to architects' climate adaptation sensemaking. For example, Gundersen expressed a belief that climate adaptation in a long-term perspective would not be a major concern for architects since "it is so unpredictable." Further, Larsen expressed how lack of certain knowledge made him worry about whether architects would be able to "solve the problem" of climate adaptation "correctly."[43] By that he meant that currently available knowledge failed to clarify what architects ought to adapt to and pay attention to:

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[40] Arntzen, Bakken, Christensen, Nielsen, Vik

[41] Bakken, Lund

[42] Christensen, Holm, Mathiesen, Orheim

[43] Gundersen, Hansen, Henriksen, Larsen, Mathiesen

> *We are supposed to build houses that can take more weather strain, but how much more weather strain, and what kind of weather strain? We are dependent on knowing that if we are to solve this properly. (Larsen)*

Scientific uncertainty doesn't have to be a problem. People make decisions based on "good enough" science all the time (e.g. Dessai et al., 2009; Oreskes, 2004). When extra expenses have to be defended, however, scientific uncertainties can become a major obstacle to implementation of climate adaptation measures because it becomes more difficult to defend such measures:[44]

> *If you construct a family house in Bærum [urban area near Norway's capital Oslo] you do not take exceptional safe-guarding measures with a view to how climatic conditions might be in fifty years that will cost the builder several hundred thousand [NOK] more, you know? (Gundersen)*

Larsen described how the cost considerations of builders necessitated that someone with sufficient authority substantiated or rendered probable the need for extra qualities to ensure climate adaptation. This need for "proof," induced by the cost-efficiency focus, resulted in an exploitation of scientific uncertainties to brush aside suggestions to add climate robustness enhancing qualities:

> *I think there is enough knowledge to (…) turn things up a notch, but I don't think we have enough knowledge to evaluate what's realistic – what we should design and plan for. That brings us back to the distribution of responsibility in a building process: because this will generally have some form of economic consequence for the building, (…) and that quickly brings us to someone having to render probable that we pick the right level [of prudence] – that the builders' expenses are what they should be. (Larsen)*

In short, as Henriksen put it, "as of today (…) there is too much back and forth about these issues for people to commit themselves to this a hundred percent."

As we have seen, there were two aspects of the climate adaptation issue itself that played a part in architects' sensemaking; the view of the climatic system as relatively slow-changing and the idea about scientific uncertainties regarding climate change. The two aspects were mainly important because of the way they were linked to identity and context related factors. The view of climate change-induced local change as slow was central to both architects' trust in their own ability to address climate

[44] Hansen, Henriksen, Johannessen, Larsen, Mathiesen

adaptation and in the ability of the national regulatory systems to handle it. Likewise, the main reason architects worried about scientific uncertainty with respect to climate change was because of a context where builders were looking for reasons to dismiss cost-increasing suggestions. The assumption that climate change was scientifically uncertain could be an argument against adding robustness enhancing qualities to buildings. Thus, architects' identity and practice appeared to have a greater influence on the way climate adaptation was made sense of than climate adaptation challenges changed the way architects saw themselves, their practice and responsibilities. How should we understand the implications of this?

Confidence under siege? Climate adaptation and the ebb of holism as design regime

Previous literature (e.g. Cohen et al., 2005) described the creativity identity discourse as the most prevalent among architects. However, my interviewees, when they made sense of their role and responsibilities concerning climate change as architects, did not draw on this discourse. Rather they mobilized the identity discourse that I called holistic. In the holistic identity discourse, architects' expertise was seen as encompassing both aesthetic-creative dimensions and dimensions related to technical-craft-related sides of building – architects distinctive expertise springing from their ability to see the building as a whole. "Good design practice," in this conception, includes detecting and identifying the climatic conditions of a building site and adapting the building to those conditions. This idea(l) of "good practice" was used as an argument why architects are used to bad weather and sensitive to changing weather conditions. In turn, these two skills – weatherwiseness and climate sensitivity – together with the definition of "good design practice" were used to argue why architects were able to understand and adapt to climate changes.

Given how concerns like sustainability have been (discursively) excluded from the core of architect practice by the creativity-aesthetic identity discourse (see, e.g., Owen and Dovey, 2008; Ryghaug, 2003), it is perhaps surprising that climate adaptation appeared to be considered a natural concern for architects. However, discussions about climate adaptation – as opposed to, for instance highly standardized responses – may be an example of "conflict about professional remit (…) hidden within apparent conflict over technical issues" (Fischer and Guy, 2009, page 2590). When the interviewed architects ascribed to a holistic identity discourse and at the same time argued the importance of climate adaptation, they were at the same time claiming the need for renewing architects' status and influence in building processes. Thus, when the interviewed architects voiced concern about their

professions' ability to deal with climate change, they expressed concern about their declining influence of building processes at the same time. Although this concern was seldom explicitly voiced, it was an undercurrent in the architects' criticism of how all-encompassing the cost-efficiency focus had become in their industry. An example of such criticism was interviewees' reports about how building qualities they had proposed, or would have liked to propose, had been brushed aside due to increased costs. The experience – and expectation – of this situation appeared common.

The interviewees' reasoning about whose responsibility climate adaptation was, centered pragmatically on the actors considered to hold sufficient power to propel change. In general, this was not seen to be architects (although a few respondents argued that architects did have a special responsibility since they entered the building processes early and thus had the potential for influencing decisions), the powerful actors able to drive – or stall – change was considered to be builders and national authorities. The perception of the power of national authorities was evident from the common idea that "changes in the building regulations" was among the most important drivers for changes in the building industry. The power of the builders on the other hand was articulated by interviewees as references to the pervasive focus on cost-efficiency and the building qualities architects would have liked to add – climate resilience enhancing qualities among them – if not for builders' cost considerations. As such, the power of builders was generally viewed as more obstructive than helpful when it came to climate adaptation. In my interviewees' opinion, the cost-reduction focus was largely responsible for current buildings being of insufficient quality and poorly adapted even to the current climate.

The national authorities were seen as the only actor powerful enough to counter the cost-reduction focus of the building industry. Thus, intervention by the national authorities in the form of new regulations was proposed by some interviewees as a potential way of countering the neglect of climate adaptation that the cost-reduction logic caused. Stricter regulatory requirements could provide legal redress for concerns that architects wished to pursue.

The above description indicates that architects are willing to help with climate adaptation, but that contextual constraints make them doubt whether they are able to. In this light, it is necessary to develop a regulatory regime that supports and empowers architects – perhaps by freeing them from single-minded cost-efficiency concerns. But is it possible to develop a regulatory system supportive of architects' holistic approach – a regulatory system where there is room for architects to exercise holistic expertise?

The interviewed architects' description of their situation may also be interpreted as a warning about a situation where cost-efficiency singularly prevails. The architects made suggestions about how they – by virtue of being architects – could help climate adaptation along. This would require either that they regained a responsibility for the building as a whole or received legal backing for considerations they held important. This was based in a belief in architects' ability to balance concerns and their discernment for the building as a whole. However, this may be difficult to achieve in a world that privileges cost-effectiveness above all.

Making sense of climate adaption

I suggested in the introduction that when architects made sense of climate adaption, they would draw on their identity discourses. This has proven to be true, but rather than employing the creativity or business approach suggested by Cohen et al. (2005), they made references to what I called a holistic identity discourse. However, the sensemaking process was more complex than that, mainly due to the importance of context. To begin with, two ideas about how building processes could be managed can be gleamed from the architects' account: one regime in which concerns are balanced with a view to the building as a whole and one regime where costs are the governing factor. In the first of these regimes, where many concerns are considered simultaneously, expert judgment is the only possible way of making decisions. This is because it is impossible to quantitatively optimize more than one factor at a time. In this regime, architects, with their holistic approach to buildings, made claims to be at the center of decision-making processes. However, since the system based on expert judgment is non-transparent and hard to audit, it is vulnerable to distrust. Since distrust seems to be the order of the day and, consequently, auditing systems are the current trends in social and institutional developments (Dent and Whitehead, 2002; Imrie and Street, 2011; Power, 1997, 2004), this model becomes difficult to sustain. Furthermore, there is an increase in risks which are "knowable only with the aid of science" (Jasanoff, 2010, page 235). This means that specialist input is needed to properly manage relevant concerns. In turn, the ideal of the single human in charge of an entire building process becomes harder to sustain.

Power (1997, 2004) argues that what he calls the audit society in part emerges from the risk society and the concurrent trend towards "risk management of everything". This is based, among other things, on the fear of litigation and reputational damage. With an increasing focus on risk, measurability and auditability becomes more important. Cost-focused management regimes are auditable, because they are based on statutory regulatory requirements and, beyond that, the optimization of one

single variable: profit. If trust is the exception and distrust the normal state a system based on trust becomes difficult to defend and the auditability of a regime becomes paramount. This, then, might be a reason for why the cost-efficiency-centered system of managing the building process is as pervasive as it appears to be.

Imrie and Street argue that architectural firms' involvement in risk based regulation provide them with "opportunities to demonstrate capabilities as 'self-reflective and self-improving' organizational actors that can be trusted" (2011, page 177). However, if one of the defining characteristics of architect practice is, as I have implied here, its reliance on the architects' expert judgments based on seeing the building as a whole, architects' practices are hard to audit. This makes it harder to demonstrate trust-worthy behavior than what Imrie and Street suggests. In turn, this creates difficulties for architects' engagement in climate adaption, given the link between such engagement and the promotion of the holistic identity discourse and the idea of architects as conductors of building processes.

In the interviews, the architects juxtaposed two ideal regimes for managing building processes; an holistic and a cost-focused. Considering the juxtaposition of these two ideal regimes, the architects' calls for more regulation appears ambiguous. On the one hand, they expressed a wish to be given greater trust, independence and power in a holistic building management regime, asking for a regulatory system to support such a regime that would give them greater freedom. On the other hand, the architects argued the need to curb the freedom to minimize costs at the expense of building qualities. Seemingly, the interviewees wanted actors in the building industry to have both more and less freedom. However, this does not need to be inconsistent. The climate adaption issue brought forward a critique of present practices emphasizing two weaknesses. One was the focus on cutting costs, which impeded any form of change. The other was a call for spokespersons for climate adaption, which was a role the architects thought they could fill.

Thus, making sense of climate adaption made the interviewed architects ambivalent. On the one hand, they thought they could manage the issues fairly well as a continuation of current practices. Importantly, this made them invoke the holistic identity discourse rather than talking about creativity or business pragmatism. On the other hand, because they felt being on the defensive with respect to power and influence in the building industry, the interviewees were uncertain if the context of their work would allow that climate adaption concerns were really taken into consideration. This was mainly complaints about the dominant cost centered regime. However, it also seemed that the architects saw the climate adaption concern as a

new opportunity for architects to (re)gain a powerful conductor role in building processes.

Thus, when the interviewed architects tried to make sense of climate adaption, they also tried to make sense of their own profession. Climate adaption was doable to architects, but only if they took on a role as caretakers of the totality of the building process rather than as creative artists. Also, they needed to be empowered as holistic professionals and relieved from the pressure of building as cheaply as possible. In addition, they needed to be able to argue from a climate science that could claim climate change without too much scientific uncertainty. In the final instance, it was uncertain if architects could be expected to be leading with respect to do climate adaption in the building industry.

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Chapter 5: Insufficient, irrelevant, or useless? Local government views on climate science for climate adaptation

Abstract

Climate science is expected to be instrumentally useful for climate adaptation. However, it has been argued that climate science faces relocalization challenges, and earlier research paints a fairly bleak picture of the usefulness of climate science for local level climate adaptation efforts. This article examines the perceived usefulness and the effects of climate science knowledge on, local government decision-making, sense-making and everyday activities, and attempts to cast the net a bit wider by, first, including non-instrumental utilization and, second, being sensitive to the role of non-human elements in the process of moving of climate science knowledge to local government offices.

Introduction

An explicit goal behind the establishment of the International Panel of Climate Change (IPCC) was that climate science should have an impact on policy (Miller 2004a). Climate science is also expected to be instrumentally useful for climate adaptation (e.g., the Research Council of Norway 2008, 4). However, Jasanoff and others have argued that such utility is by no means obvious. The argument is that, due to its fairly abstract and general quality, climate science faces "relocalization challenges" (Jasanoff 2010; see also Lahsen and Nobre 2007; Miller 2004b). In this article, I shall examine one aspect of such relocalization challenges by examining how the usefulness of climate science for local government climate adaptation activities is perceived by local government employees in Norwegian municipalities.

Climate adaptation has been suggested as an antidote to climate change's abstract out-thereness, since it may be able to bring the climate issues "home" (Yusoff and Gabrys 2011, 517). Nevertheless, the general, globalized nature of climate science may inhibit the degree to which adaptation can be able to play this role, as well as its usefulness for addressing current climatic and weather-related risks as "climate adaptation." This may hamper the ability of climate adaptation of bridging the gap between local (vulnerability) and global (climate change and climate science). In light of this, I will analyze how local government employees engage with climate

adaptation and perceive climate science knowledge. Does climate science affect their work, and if so, how? What relocalization challenges are present, and how may such challenges be met?

Most studies of climate adaptation and use of climate knowledge find that the application of climate knowledge is challenging. Although a few studies claim to find some direct use of climate science (e.g. Pilli-Sihvola et al. 2010), the main role of climate science seems to be as rather ineffectual "background knowledge" (Pilli-Sihvola et al. 2010; Gawith et al. 2009; Callahan, Miles, and Fluharty 2001; Tompkins and Amundsen 2008; Storbjörk 2007; Arnell and Delaney 2006).

Three standard explanations for the lack of use of climate science knowledge figure in the relevant research literature: First, climate science has been accused of failing to provide intelligible, applicable and relevant results to local level decision-makers (Agrawala and van Aalst 2005; Demeritt and Langdon 2004; Lemos et al. 2002; Pulwarty and Melis 2001; Callahan, Miles, and Fluharty 2001; Jones, Fischhoff, and Lach 1999).

Second, weaknesses in the knowledge transfer processes – like lack of communication, lack of access to information, lack of dialogue, and, occasionally, lack of intermediaries or boundary organizations – have been pointed out (Pilli-Sihvola et al. 2010; Gawith et al. 2009; Lemos and Morehouse 2005; Allman, Fleming, and Wallace 2004; Demeritt and Langdon 2004; Callahan, Miles, and Fluharty 2001; Pulwarty and Redmond 1997).

The third, and most common explanation, is user-side barriers to decision-makers' ability to adapt and/or utilize climate research, with institutional constraints and regulatory, political, and economic context the most frequently reported (Pilli-Sihvola et al. 2010; Aall et al. 2009; Tribbia and Moser 2008; Arnell and Delaney 2006; Berkhout, Hertin, and Gann 2006; Shepherd, Tansey, and Dowlatabadi 2006; Demeritt and Langdon 2004; Lemos et al. 2002; Shackley and Deanwood 2002). Unclear responsibilities, and the lack of clear national level guidelines, legislation and suitable government frameworks may also be a barrier to the use of climate science in climate adaptation efforts (Fünfgeld 2010; Aall et al. 2009; Storbjörk 2007). Pulwarty and Melis (2001) point out organizations' experiences of "past events (both societal and physical) condition management flexibility and receptivity to new information" (p. 307). Also, organizations' perceptions, interpretations, and attitudes with respect to climate change, risk, and expertise, may influence organizations' climate adaptation activities. It has been argued that short-term goals are often prioritized over long-term risk aversion in local level planning and decision making,

making climate change difficult to include (Boulanger and Penalba 2010; Storbjörk 2007; Wilson 2006). Moreover, users have been shown to be skeptical of the trustworthiness and usefulness of external advice when it comes to questions of climate risks (Aall et al. 2009; Innbjør 2008; Pulwarty and Melis 2001; Subak 2000). Additionally, organizational culture and routines may influence climate adaptation work (Berkhout, Hertin, and Gann 2006; Shackley and Deanwood 2002). Institutions may have an aversion to new tools (Agrawala 2001) or be organizationally conservative (Rayner, Lach, and Ingram 2005), or tend to choose adaptation responses that minimize challenges to prevailing routines, beliefs and existing frames of reference (Berkhout, Hertin, and Gann 2006; Shackley and Deanwood 2002). Climate adaptation can also be dismissed as lying outside of the respondents' area of responsibility (Tøsse 2011; Pilli-Sihvola et al. 2010). Further, perceptions of own vulnerability, capacity to adapt, and ability to act has been shown to be important. Perceptions of strong resilience and capacity to adapt, has been pointed out as a possible barrier to climate adaptation (West and Hovelsrud 2010; Aall et al. 2009). But also the view of climate risks as a fatality against which it is difficult to protect oneself may result in climate risks not being addressed (Boulanger and Penalba 2010).

Clearly, there are important barriers to the utilization of climate science in climate adaptation efforts. However, one reason why the reviewed studies find so little use of climate knowledge may be that they start out with a too narrow definition of what it means to use knowledge. Theories about transfer and utilization of scientific knowledge suggest a broader approach.

Transfer and utilization of scientific knowledge

The issue of transfer and use/non-use of scientific knowledge outside academic communities has remained a long-term interest of social scientists. Non-use is often explained by reference to varieties of "two communities" theory (Caplan 1979). Two communities theory holds that there is a cultural gap between the "user world" and the "scientist world," created by differing goals, time frames, and attitudes toward complexity, uncertainty, and details. This inhibits the use of scientific knowledge.

Two communities theory may be criticized for conceiving the use of scientific knowledge too narrowly. For example, Weiss (1979) argues that there are several ways of employing (social) science knowledge. Although instrumental application of research results is the most common conception of knowledge utilization, Weiss argues that when scientific knowledge is applied strategically as an argument in a political conflict or to back a decision, this should be considered use just as well. Weiss further argues that enlightenment – when concepts, theoretical perspectives

and findings of a field as a whole permeates a context of application rather than just findings of a single or a few studies – ought to be included in what is conceived of as use.

Most of the studies reviewed above are not explicit about what they mean by use of scientific knowledge. If traces of explicit use were observed, this conception tended to be of the instrumental kind (e.g., Lahsen and Nobre 2007; Rayner, Lach, and Ingram 2005; Landry, Lamari, and Amara 2003; Callahan, Miles, and Fluharty 2001). Weiss' typology of uses of scientific knowledge offers a broader understanding of what use might entail, which may enable us to find more use of climate science knowledge.

Probably, the most widespread idea about transfer of scientific knowledge is trickle down or diffusion theory (Rogers 1995). However, if climate science knowledge "trickles down" and becomes unreflexively absorbed, this may make knowledge transfer difficult to observe. On the other hand, if diffusion of climate science knowledge follows the standard S-curve distribution and is at an early stage, it should be possible to identify early adopters as relatively more knowledgeable than the rest.

Often, when studying efforts to bridge science and user worlds, creating relevance and usability of scientific knowledge, only communication activities are considered. Science and technology studies, in particular actor-network theory (ANT), broaden our view of what such bridging might entail. ANT emphasizes the work involved in moving scientific knowledge as well as the role of non-human elements as intermediaries. This means we ought to consider organizations, laws, standards, guidelines, weather, nature, technology, etc. as potential intermediaries or carriers of scientific knowledge, in addition to human actors (e.g., Latour 1987; Callon 2007 [1986]). Moreover, ANT purports that 'knowledge transfer' and 'knowledge dissemination' are misleading terms since they suggest that scientific knowledge may be treated as stable objects. A more appropriate term according to Latour (1987) and Callon (2007 [1986]) is the concept of translation to describe the kind of efforts involved in moving knowledge. According to Callon, translation is a process where other actors and their relationship to the scientists' knowledge have to be defined (*problematization*), and where acceptance for these defined identities and relationships have to be achieved (*interessement* and *enrolment*).

As we saw in the introduction, previous research paints a fairly bleak picture regarding the use of climate science in climate adaptation efforts. Here, I have argued that we may need to cast the net a bit wider by following Weiss (1979) and include possible non-instrumental utilization. Also, we need to be sensitive to the possibility

of S-curve logic and the existence of early adopters. Finally, I propose to use translation theory (ANT) to provide a more comprehensive understanding of the dynamics that may be involved in the moving of climate science knowledge to local government offices. This includes increased sensitivity to the role of non-human elements, what Becker and Clark (2001) call "the little tools of knowledge."

Method

To examine how local level decision-makers viewed the transfer and translation of climate science knowledge for climate adaptation, Norwegian municipalities were chosen as a case study. The author and colleague Robert Næss interviewed 41 employees from 44 different municipalities by telephone. The municipalities were chosen semi-randomly, ensuring that the sample included municipalities of different sizes, with differing resources, from different counties, and with differing geography. We interviewed one employee in each municipality. A couple of the interviewees held positions in multiple municipalities (usually two), which is why the number of municipalities is larger than the number of interviewees. The interviewees had a background in either technical operations, municipal planning, or environmental management. 13 of the respondents were environmental managers or environmental consultants; 18 worked with municipal planning; and 10 were from technical operations, working with e.g. water and sewage, and buildings.

Telephone interviews were chosen to obtain data that was both relatively comprehensive and at the same time relatively in-depth. The telephone interview is a "hybrid" format, combining elements from the in-depth interview and the survey. The advantage is time effectiveness and lack of need to travel. Drawbacks are loss of non-verbal communication and briefness (Christmann 2009). Long telephone interviews are difficult, since such interviews are "attention intensive" due to the absence of non-verbal communication. Christmann (2009) suggests that telephone interviews should not last longer than 20-30 minutes because of this, something that limits the number of questions it is possible to cover. However, recent literature shows that telephone interviews actually can provide sufficiently rich data (e.g., Shuy 2001). We deemed qualitative telephone interviews to be an appropriate data gathering format since we were only searching for answers to a limited number of questions and wanted to access a broad, geographically diverse range of views. Our telephone interviews lasted between 15 and 25 minutes, and the responses were rich in description due to a mix of closed and open-ended questions.

The interviews were carried out in 2008, between January and August. They were recorded, with the consent of the interviewees, and transcribed in verbatim. The

interviews were conducted in Norwegian and have been translated into English by the author. The interviewees and the municipalities have been made anonymous, and are referred to in the text by the employees' position and an interview number.

The questions included whether climate change would influence the interviewees' everyday work and how, whether they had any strategies for adapting to future climate change, what their main sources of knowledge were, and how they evaluated that knowledge with regard to its usefulness for them.

The analysis has been inspired by grounded theory (Corbin and Strauss 2008). The diverse ways in which the interviewees viewed and dealt with the climate issue and used climate knowledge has been described and categorized through a qualitative content analysis. We did not observe any clear effects of the characteristics of the municipalities, like size or geography, except with respect to examples of possible expected climate changes. Thus, such characteristics are not pursued in the presented analysis. Some municipalities were argued to be less vulnerable to climate changes than others, and this had some effect on how interviewees perceived the usefulness of climate science. We shall return to this shortly.

The local usefulness of climate science knowledge

Is climate science knowledge useful for climate adaptation? The theoretical approaches reviewed above suggested ways to understand usefulness and use, not the least the importance of being sensitive to non-instrumental applications. In the interviews, we invited the local government employees to reflect about what it would take to consider climate science as useful. What did they want climate science to deliver? What kind of knowledge would they consider helpful and for what purposes?

Ryghaug et al. (2011) show that the Norwegian public largely sees global warming as human-made but also that they are hesitant with respect to the seriousness of the issue. However, the interviewees in our study did not call for further information about the general conclusions of climate science. Rather, they called for instrumentally useful knowledge relevant to their work.

> *I feel that I know a lot about it [climate change], but it is difficult to... how to deal with it in practice and in the individual cases? For instance in the individual land-use plan, how should you handle it?*[45]

This planner was obviously aware that climate changes were happening and that climate adaptation was important. What she felt was lacking was knowledge about

[45] Planner, int. 330135

how to integrate climate adaptation concerns in, e.g., a land-use plan for a municipality. Several interviewees expressed, in similar ways, how they wanted to be told what 'climate adaptation' should entail locally and how they could address it.

The interviewees did not only call for instrumentally useful information, but also for information that could legitimize actions and measures, and persuade reluctant individuals to agree to act: "It would have been nice to have some definite knowledge, because when you discuss this [climate change] and try to convince others of the importance of paying attention to the environment and climate, concrete numbers are very often needed.[46] Since politicians are part of the Norwegian local government planning process, knowledge that could legitimize adaptation efforts appeared very central. To persuade local politicians, "who have to prioritize between equally important issues and make things happen,"[47] an environmental manager called for "something more definite to present,"[48] more certain, concrete, and relevant knowledge.

Overall, the interviewees portrayed the currently available climate research knowledge as less useful. Though the general conclusions of climate science were well known, this general knowledge was not seen as particularly relevant to the enactment of adaptation efforts. "I only know that this [climate science] is something in the background that we need to take into account, but I don't know definitely what it is, what it means, and what we must do,"[49] one planner put it. The general conclusions of climate science told them that they had a problem, but not what they ought to do about it. Such absorption of general conclusions and terms might be considered enlightenment use (Weiss 1979), but the interviewees seemed not to do so. Currently available knowledge was described as "hardly useable in practice."[50] It was seen as insufficiently "substantial,"[51] "too broad and (…) fragmented,"[52] "too theoretical,"[53] and too complex to be really useful in the local government context.

However, some interviewees gave a more positive appraisal. This seemed to reflect the degree to which the knowledge provided challenges to their everyday practice or whether climate science knowledge was contested or confronted locally. In some cases, we were also told that climate scientists had informed interviewees that their

[46]Forestry and climate planning manager, int. 330103
[47]Environmental manager, int. 330107
[48]Int. 330107
[49]Int. 330115
[50]Real estate division manager, int. 330100
[51]Planning and industry manager, int. 330101
[52]Planning manager, int. 330001
[53]Real estate division manager, int. 330100

municipality was not particularly at risk from climate change. These interviewees usually said that they found climate science useful:

> *Of course 'wetter, warmer, wilder' will have consequences for all municipalities. But we have found that we are not particularly vulnerable. We have no large rivers, and we have no quick clay deposits. We will experience some things, too, but compared to many others, we are not particularly vulnerable.*[54]

Such positive assessments seemed caused by the feeling that such information meant that they did not need to ask further questions related to climate change issues. It was the interviewees who had not received such comforting information who were critical, and they were in the majority. People who didn't get such confirmations of low vulnerability usually expressed that they found the knowledge insufficient. The more worried the interviewees were about climate change and climate adaptation, the less they considered the currently available knowledge satisfactory.

Climate science knowledge also appeared to be more adequate for those who were already convinced about the necessity of taking measures:

> *I don't feel that we lack any knowledge in this field. It is not a difficult topic where you are met with opposition, neither from the media nor from the citizens, so that you have to explain everything all over again.*[55]

Many interviewees felt that they had enough knowledge to convince themselves as well as others of the necessity of dealing with the climate issue, unless they met with sceptics. One environmental coordinator said, "the knowledge is usable for my own sake, but that is because I am interested in it. But I feel that it is hard to get through in groups with less interest in the issue."[56] In arguing with-those-unwilling-to-take-action, available climate science knowledge was experienced to fall short.

Thus, the interviewees provided a fairly but not entirely critical discourse with respect to the applicability of climate science. They acknowledged that climate science knowledge was agenda-setting, with some reservation regarding the authority of the knowledge to achieve local political acknowledgement of the need to act. Like in previous studies, the interviewees provided two main reasons for lack of instrumental utility. First, they pointed to deficiencies of climate science: apparent scientific uncertainty, insufficient knowledge about local changes, and lack of

[54] Environmental consultant, int. 330097.
[55] Technical operations manager, int. 330132.
[56] Environmental coordinator, int. 330105.

communication and accessibility. Second, budget constraints and insufficient staffing was argued to give local governments little leeway for adding or modifying existing practices based on new knowledge. "There is an obvious need for more hands, enhanced competence, and more funds in order to carry initiatives into effect. Why, we are simply drowning in plans!"[57] an environmental consultant exclaimed. Such institutional constraints – lack of time, resources and expertise – appeared as just as critical for the interviewees' ability to tackle climate adaptation and accommodate climate science knowledge.

Several interviewees argued that their day-to-day work was so "rule governed" [58] that it would be very difficult to take on climate adaptation concerns without being legally required to do so.[59] It was seen as very difficult to put down requirements stricter than national regulations. Thus, in a way regulations defined the local administrations' reality with respect to climate adaptation:

> *[Our work] is rule governed and (...) we just act in accordance with the rules and decisions that are there. And to gain approval for new issues, at least those with a cost or any form for expenses, if they are to have any chance of winning through in local politics, decrees ought to come from the central level.*[60]

One planner pointed out how regulations often even decided whether she took the time to learn about a subject or not:

> *At the moment, I am in the middle of working on a plan where it is demanded that we follow the new guidelines, [though] they have not come into force yet (...). This fall I expect to learn a lot, because I now have to acquaint myself with this. Earlier, I have had no use for such knowledge. Something I've observed is that you don't read up on something unless you need it for a particular task."*[61]

It appears that for climate adaptation to be taken seriously, it has to be included in national regulations, standards, and funds allocations.

As we have seen, climate science knowledge was expected to legitimize climate adaptation measures. However, apparent scientific uncertainty was considered a

[57] Int. 330116
[58] Planner, int. 330137
[59] Int. 330001
[60] Planner, int. 330137
[61] Int. 330115

major obstacle for climate science playing that role. Political authorization of climate science knowledge through laws and regulations could help overcome this problem. In general, the interviewees called for institutions that could vouch for the credibility of available climate knowledge:

> *What I want is … credible, good information. If it's written in a periodical, it is not something we can automatically build on. Also much of what you find on the internet is not something you can take to be true. You know, you can do that, with a textbook and with clean-cut research reports and official information. There is a lot of good stuff on the internet that you can't trust one hundred percent, and that is something I desire: information that you can trust, that can't be questioned in any way.*[62]

Science products like text-books and research reports exemplify such authorized knowledge, but official information can also be trusted, and, crucially: not be questioned. In this way politics, as well as science, appeared capable of authorizing scientific results. A political authorization might involve a decision about, e.g., what forecast numbers, and level of caution with respect to future sea level should be used in land-use plans. This legitimates some scientific findings as "good enough," and also makes the issue of one hundred percent scientific certainty less pertinent. In this way, regulations appeared able to be both effectuating and enabling, in the sense that they, by describing which climate knowledge should be used, what knowledge was sufficiently certain to be used and how, made it possible to use available climate knowledge. By translating the climate knowledge into laws and guidelines, usefulness would be created also in the sense that municipal administration staff would have an easier task of persuading local politicians to consent to climate adaptation measures, avoiding discussions about the relative importance of the climate problem.

How can we make sense of this role of regulations and institutional context? It appears be more complex than just an enabler or a source of constraints. According to Jasanoff (2004b), institutions are equally important in defining lived reality as science: the scientific and the social order co-produce each other. Institutions like ministries and directorates help accredit or discredit the validity of new knowledge and shape accepted rules of behaviour in face of this knowledge. Thus, such institutions play a crucial role in the sense-making processes of actors and organizations. Together with scientific knowledge, institutions help define reality. Consequently, perceived lack of institutional efforts may pose a problem to

[62] Construction and building manager, int. 330126

individuals grappling with a new, emergent, as-yet-unordered issue. To the local government employees, lack of change with respect to regulations, funds, and availability of local expertise was seen as providing a counter-message to climate science. This influenced the degree to which climate adaptation was seen as a relevant issue.

Returning to the theoretical issues, clearly, the two communities theory is given some support by our data. However, this theory does not provide a good understanding of the fact that climate science to some extent is considered useful. Trickle down or diffusion theory does not work well either, since the differences in points of view among the local government employees hardly seem to be about early or late adoption of climate science. Weiss (1979) is helpful since we have observed several instances of non-instrumental use, for example with respect to agenda-setting or climate science as argument to engage with climate adaptation. Translation theory comes closest to make sense of the necessary co-production of knowledge and policy, as a tool to mobilize support for climate adaptation.

However, discussing (explicit) use and usefulness is probably not the best way of examining what role climate science plays in local governments. Rather, we might search for more subtle outcomes. When usefulness results from co-production rather than climate science as such, it would be better to look for changes in the local government administrations' discourse, identity, practice and organization that reasonably can be concluded to be co-produced by climate science and political institutions.

Climate science effects and the meaning of climate adaptation

Even if the local administration employees did not conceive of climate knowledge as particularly useful, the knowledge nevertheless appeared to have effects. All interviewees were aware that climate change might pose problems in the future, that something called climate adaptation might be necessary. Most also held that climate adaptation would lie within their area of responsibility. Also, the interviewees reported changes in their way of thinking, in their practice, and in how they thought about their practice.

Several interviewees described small changes in current practice brought about by considerations of possibly worsened future climate conditions, by observations of more harsh weather conditions or changes in flood patterns, or in anticipation of stricter demands on risk- and vulnerability policy in coming regulatory updates. Knowledge about the climate adaptation challenge had led them to focus more on

current natural hazards risks, and to increase the degree to which they required measures to address such risks. These elements had always been seen as relevant challenges but were now "maybe made a little more explicit than earlier."[63] Interviewees also stated that they increasingly made sure that the national level regulation requirements were met, to a degree that they had not before. It seemed that climate science knowledge – together with stricter national regulations – helped make nature risks and climate vulnerabilities more visible than before. In turn, this made local level government administration officials "stricter," [64] and "more thorough"[65] than before.

In a way, we could say that climate science knowledge provided an alternative interpretation of measures to deal with weather, risk, and natural hazards. Climate science knowledge seemed to provide a new context for measures that had always been taken to protect inhabitants and infrastructure against natural hazards:

> *Risk and vulnerability analysis, you say. If you mean land slide assessments, that is something we have done before this, and we are assessing flooding. But these are things that have happened earlier as well. It is nothing new, except now with climate included. Climate adaptation puts things in a broader perspective, and puts them in context.*[66]

The quote above indicates that climate adaptation was seen as nothing new, that the challenges climate change posed were already known and that they could be addressed, or already sufficiently covered by known measures. But how to draw the line between "nothing new" and "nothing new, except now with climate included"? Even if traces of the latter definition of climate adaptation, the dominant understanding was that it actually was something new. Thus, if actions were to count as climate adaptation, they ought to be explicitly based on climate science results or be an issue not previously addressed. Sea-level rise considerations were an example of the latter. It was, among all the different potential climate adaptation candidates, the only measure unequivocally labeled climate adaptation.

With respect to flooding, landslides, surface water and the like, the interviewees apparently found it difficult to draw a line between climate adaptation and a general precautionary-principle approach to climate and weather:

[63] Planner, int. 330133
[64] Planner, int. 330121
[65] Planner, int. 330121
[66] Int. 330121

> *In development projects we always evaluate what we see as elements of risk. But to say that we have taken climate change into consideration, or whether this is simply a precautionary principle with respect to the climate we already have, I feel it is difficult to distinguish between the two.*[67]

Many interviewees seemed to think that most current measures could not be called climate adaptation because they were based on their own observations. Also, if the measure concerned things the local administration already was – or ought to be – addressing, it was difficult to label it climate adaptation. Even interviewees, who explicitly stated that their increased attention to an issue was driven by a concern for future climate conditions, found such labeling difficult:

> *Something I have improved in the last years is to start using the NGU*[68] *internet-available landslide maps more often, and try to be more strict with respect to that, and also to be better at making demands within these areas, even though that does not have that much to do with climate. Although we do know that climate change, and especially more heavy rain, may lead to more landslides in the future.*[69]

A planning and industry manager described how flooding concerns had influenced decision-making in the administration where he worked. This was "based on a realization that the floods are coming more often than they used to."[70] However, he also stressed how this experience was not sufficient to conclude whether there was a trend and where it was headed. In particular, the observations were most definitely insufficient to conclude that increased flooding was happening because of climate change. "The basis for an opinion is insufficient," he said. "There are no statistics on changes and local effects, and climate change is not proven – it is difficult to say that that's why it happens."[71] The lack of clear links between observed non-normal weather events and climate change led to confusion about whether the applied measures should be considered climate adaptation or not. Increased focus on current weather and vulnerability to natural hazards was seen by some but not everybody as related to climate change.

Observations could legitimize the need for taking weather and natural hazards into account, thus ensuring some climate adaptation efforts. What everybody could see

[67] Real estate division manager, int. 330100
[68] Norwegian national institution for geological knowledge
[69] Planning and environmental manager, int. 330128
[70] Planning and industry manager, int. 330101
[71] Planning and industry manager, int. 330101.

was trustworthy and easier to use to motivate adaptive action than distant climate science. However, one of the elements that exacerbated the difficulties of telling whether measures addressed at increasing weather and natural hazards could be considered climate adaptation, was the way climate science was insufficiently co-produced with policy. Who had the right to speak with authority on matters of climate science? Where to draw the line between climate science and knowledge claims from other sources? Even though the interviewees reported changes in their practices, a very strict definition of climate adaptation often prevented the labelling of such changes as climate adaptation.

As we have seen, climate knowledge provided an alternative interpretation for measures dealing with extreme weather and nature hazards. Similarly, climate knowledge also provided an alternative interpretation for occurrences of extreme weather, land-slides, rock-falls, avalanches, flooding and spring tides, and other natural disasters. Events that had, until recently, only been viewed as "non-normal" weather events, could now be interpreted as indicators of climate change: "Even though it is a little short-sighted, I hold that one can already notice a change in precipitation. There is much more precipitation than before."[72]

However, the 'effects of climate change'-interpretation did not replace the 'non-normal events' interpretation. Rather, the two co-existed, and it was hard to decide when to prefer one interpretation over the other:

> *I can't say that we can say: 'this is extreme weather and climate influence'. Every year we have avalanches and rock falls, so it is on our minds, and we are aware that if the weather changes and this intensifies, we will be hit. (...) This last year we have had a good deal of intense of precipitation, with water choosing paths it usually doesn't, but there haven't been any crises or anything. Just now we had a large flood-induced landslide. But I can't say that it was a climate effect.*[73]

Thus, the interviewees told that they faced two frames of interpretation, natural variations and climate change. In general, they felt that they lacked the proper expertise to choose between these two frames. They were well aware of links between weather and climate but also that these links were not straightforward and that non-normal events could lie within the bounds of natural variability:

[72]Construction and buildings manager, int. 330126
[73]Planner, int. 330133

> *We have these terms, two-hundred-year flood et cetera. And the flood 200 years ago was not caused by climate change, right? But now we may be seeing a pattern where we get fairly large amounts of water in the drainage basin for the waterways, and we may suspect that that has something to do with climate change. But it is difficult to distinguish between the natural variations … and what is caused by [anthropogenic] climate [change]. That is something that needs to be analyzed and determined [by experts].*[74]

Climate expert analysis was seen as necessary to distinguish climate change from natural variations. In this way, the interviewees distinguished clearly between proper science and their own observations and thoughts. As non-experts, they could not themselves observe climate change. They had to rely on climate scientists to detect climate change. On the other hand, this view of the proper role of lay people, e.g. as abstaining from making fact claims based on personal observation, stood in the way of letting weather and observations be a relevant translation of climate science. A strict, science-based definition of climate adaptation inhibited the use of this label with regard to new practices, while the climate change frame of interpretation of extreme weather and nature hazards would have made it easier call changed practices climate adaptation. If local government employees as lay people cannot be sure of what they see, they cannot name it either.

Thus, the interviewees expected other actors to make climate science locally useable. To some degree this translation expectation was directed at climate scientists, who were accused of not understanding the reality facing local government administrators:

> *We know there is a lot of research in this field, but (...) the available scientific research is written in such a way that it is of very little use for the sections of the local administration (...). The material is too obscure and inaccessible ... [and] so theoretical that it hardly can be transferred to the reality we have to deal with, where the main factor is the municipality's limited finances. (...) There is little understanding in academia for our situation.*[75]

However, it was more common to see that translation of climate science results was the responsibility of national authorities:

[74]Environmental manager, int. 330110
[75]Real estate division manager, int. 330100

> *If I could have it my way, I would like a, well, an outline from national authorities – regarding 'What should the local level governments pay attention to? What should we bear in mind concerning the future with regard to these questions?'*[76]

When this call for regulations and standards was not met, this even tempted some of them to postpone adaptation actions:

> *Basically, we await [new standards], because the moment we have new standards our work will be easier. Now we have to prove, substantiate, and render probable that the old standards are no longer sufficient, et cetera.*[77]

In classical ANT (Callon 2007 [1986]; Latour 1987), translation is what scientists do to make their research effective – to gain accept and move knowledge. The local government employees that we interviewed at best saw this translation effort as insufficient. However, most of them also called for a more broadly orchestrated translation involving above all national public administration, perhaps also other levels of government. Moreover, they asked for material translation outcomes like texts that could guide and set standards for climate adaptation. How should we understand this?

Can climate science guide climate adaptation?

This article has examined the perceived usefulness and the effects of climate science knowledge on local government decision-making, sense-making and everyday activities. The review of previous research suggested that the findings would be negative, that is, that local government employees would view climate science mainly as irrelevant. Other theoretical approaches suggested that the use of scientific knowledge might have been considered too narrowly. Actor network theory (ANT) proposed that we look for intermediaries and/or allies in the translation process, including what Becker and Clark (2001) called "the little tools of knowledge". How does our findings relate to the previous research and the theoretical frames?

To begin with, the interviewees had cognitively appropriated the main findings of climate science, but they did perceive this as "background knowledge" that was not particularly useful. 'Usefulness' in this context was understood as instrumentally helpful for problem-solving but also helpful for authorizing adaptation measures.

[76] Planner, int. 330137
[77] Technical operations and agriculture consultant, int. 330099

Climate science was seen as deficient in these respects. A significant reason for this perceived deficiency was that national level policy-making failed to transform climate science knowledge into new guidelines and standards. This made many respondents unsure about the legitimate use of the label 'climate adaptation', also because most of the interviewees considered themselves lay persons with respect to climate science. Thus, they were reluctant to interpret extreme weather and nature hazards as climate change. While they in part had to change local practices in the face of, e.g., increased precipitation, many felt that they could not legitimately label these changes as climate adaptation measures. Still, there was a widespread use of climate science as an informal interpretative device as well as a linguistic accounting resource.

The lack of co-production (Jasanoff 2004a) of stable climate knowledge and a stable climate adaptation order could from a classical ANT perspective be interpreted as a translation failure on the part of the scientists. From this perspective, climate scientists have failed to mobilize and enroll national policy-makers as well as local government employees to act on knowledge about global warming. However, interestingly, the people we interviewed mainly called for relevant national bodies to take on the translation challenge, through providing new norms and standards for local governments in climate adaption relevant areas. Regulations, guidelines, flood maps, and the like does here play a role reminiscent of Becker and Clark's (2001) "little tools of knowledge." However, it is not knowledge per se that needs to be stabilized in this case. I am not concerned with a knowledge production process, but with a process of co-production of meaning and use. I will thus be more accurate to use the phrase "the little tools of co-production."

Broadening the view of what should be considered uses of scientific knowledge did not really make climate science appear more useful in the local government context. This does not imply that any of the theories are misleading, only that they do not help us make sense of the science—policy relationship which seems to be at work in this situation. A possible conclusion is that we need to modify translation theory. Clearly, the usefulness of climate knowledge depends on a constructive co-production of science and policy, and we should not expect scientists to be able to achieve this on their own. Relevance and usability are also shaped by institutional factors like regulations, guidelines and budgets. Consequently, other "translation agents" than scientists are needed to transform climate science into climate adaptation.

Calls for inclusion of climate adaptation concerns in planning and building regulations show how the interviewees expected translation efforts from policy-makers. Rather than seeing translation as driven by scientists, we should perceive this process more

broadly, with a more diverse set of actors engaged. What the local government employees are calling for could be described as *distributed translation*, drawing on the concept distributed action and the idea that loosely linked actors contribute to achieving particular outcomes (Latour 2005). Climate science needs to be linked to sciences positioned to specify adaptation measures, like engineering sciences, but also to public institutions whose responsibility it is to produce standards and guidelines for the physical planning that local government administration carries out. Climate science needs allies to co-produce the "little tools of knowledge" that are needed to achieve climate adaptation.

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Appendix

The interviews: an overview

Being part of a larger research program – *Preparing for a Rainy Day?: Configuring Climate Science for Future Society*, I took part in more interviews than what has been directly used in the thesis papers. My colleague Robert Næss and I also shared the interview-load somewhat between us, as is apparent from the following tables. I also utilized some interviews conducted by Marianne Ryghaug in 2005 were collected as part of the research project *Coping with the threat of climate change: technological strategies and cultural responses*.

Guide to the interview-overview

The interview number includes a letter to denote which group of interviews it belongs to. Within each group, the interviews are numbered chronologically. The time is given as the month and year of the interview. The information provided is, in the case of the data that I have used myself, the same as the information that is provided accompanying the quotes. In some cases (e.g. the architect interviews, the researcher interviews) the interviewees have been given pseudonyms. In other cases, the interviewee is referred to by job title and the interviews distinguished by the interview number (e.g. municipalities/local government). Large 'N' in the information column stands for 'Norway.' The duration of the interviews is given for all interviews conducted in this project, in the following format [Hours:Minutes]. 'Type' denotes what format the interview had, whether face-to-face (F-t-F) or telephone interview (Phone). The 'Interviewer' column shows which researcher conducted the interview in question. RN is Robert Næss. SET is Sunniva Eikeland Tøsse. JS is Jøran Solli, employed at a sister project at the Department of Interdisciplinary Studies of Culture: *Climate Knowledge on the Road?: Scientific knowledge, transdisciplinarity and the performance of expertise*. MR is Marianne Ryghaug, who were involved part-time *Climate Knowledge on the Road*, part-time in *Rainy Day,* as well as in the research project *Coping with the threat of climate change* mentioned above.

GENERIC INTERVIEW GUIDE – SCIENTISTS

Production of knowledge

- How? What tools? What data?
- What activities are they involved in?
- What connections to the international scientific community? (2005)
- What role in communicating the knowledge from the international research community?

Demand

- Who demands the knowledge you produce?
- Towards whom do you orient your communication?
- Strategies to make yourselves understood?

Utilization

- How is the knowledge used? Is it utilized well enough? Why/why not?
- What users do you have contact with?
    - Environmental organizations?[78]
    - Industry?[1]
    - Technology-R&D actors?[1]
    - Local government decision-makers?[79]
- What are your experiences with this contact?

Politics

- Opinions on Norwegian climate policy? Strengths and weaknesses?
- Are changes happening? Who is responsible for them?
- What role does the climate problem play in shaping Norwegian energy policy?
- Do you play a role in creating good climate policy[80]
- Ideas about the roles of science in society [2]

Technology[1]

- Will technology be able to solve the climate problem? How? What is needed for success?
- Do you (as climate scientists) play any role in this?

[78] 2005 interviews
[79] 2009 interviews
[80] New as of 15.11.2005

Media (and knowledge dissemination[2])

- Opinions on media coverage of the climate problem
- Their relationship with the news media
- How do they deal with them
- Strategies for communicating (general or tailored?)
- Views on the main challenges of getting climate knowledge into politics and everyday lives?[2]
- Communication of uncertainty[2]

Network (national)[1]

- Who are the important players in the (scientific) field? How is the cooperation between them?
- Do you have cooperation partners?
- Who should I talk to next

[1] 2005 interviews (MR)

[2] 2009 interviews (SET)

GENERIC INTERVIEW GUIDE – USERS

- Will climate change have importance for their practice? Why/why not? In what ways?
- Have they changed their practice with an eye to climate change/as a result of climate change or of the focus on climate change?
- Strategies to meet climate change?
- Sources of knowledge, evaluation of that knowledge: usefulness, shortcomings, lacking knowledge.
- Barriers to climate adaptation according to the interviewees

ADDITIONAL, SPECIFIC QUESTIONS for the LOCAL GOVERNMENT interviews

- Prior experiences with flooding, extreme weather, power outages and the like? How was this dealt with?

ADDITIONAL, SPECIFIC QUESTIONS for the ARCHITECT interviews[81]

- Trends/changes in the industry
- Factors that influence changes in the industry
- What challenges weather poses for architecture and architect practice
- What criteria are used to judge building quality/"a good building"

[81] Added in the course of the interview process

Climate researchers (april-november 2005, september 2009)

No.	Time	Info	Type	File name	Inter-viewer
R1	Apr. 05	Dolmen" – research director	F-t-F	MARR0029	MR
R2	Apr. 05	"Jonassen" – research director	F-t-F	MARR0030	MR
R3	Apr. 05	"Nannestad" – researcher	F-t-F	MARR0032	MR
R4	Apr. 05	"Falkberg" – professor	F-t-F	MARR0035	MR
R5	Apr. 05	"Karlstad" – professor	F-t-F	MARR0036	MR
R7	Apr. 05	"Nilsen" – research dir./professor	F-t-F	MARR0038	MR
R8	Sept. 05	"Pettersen" – research manager/professor	F-t-F	DS330005	MR
R9	Sept. 05	"Fredriksen" – professor	F-t-F	DS330006	MR
R10	Sept. 05	"Finstad" – professor	F-t-F	DS220008	MR
R11	Sept. 05	"Bakken" – professor	F-t-F	DS330010	MR
R12	Sept. 05	"Brekke" – research manager	F-t-F	DS330011	MR
R13	Sept. 05	"Carstensen" – research manager/professor	F-t-F	DS330012	MR
R14	Nov. 05	"Aass" – research scientist	F-t-F	DS330014	MR
R15	Nov. 05	"Andersen" – research scientist	F-t-F	DS330015	MR
R18	Sept. 09	"Pettersen" – research manager/professor	F-t-F	DS330050	SET
R19	Sept. 09	"Carstensen" – research manager/professor	F-t-F	DS330051	SET
R20	Sept. 09	"Nordheim" – research manager	F-t-F	DS330052	SET
R21	Sept. 09	"Namdal" – department manager	F-t-F	DS330053	SET

Architects (March—August 2008)

No.	Time	Info	Dur-ation	Type	File name	Inter-viewer
A1	Mar. 08	"Andersen" – partner, small firm	*[1:15]*	F-t-F	330073	RN
A2	Mar. 08	"Hansen" – manager/partner, medium-size firm	*[0:44]*	F-t-F	330087	RN
A3	Apr. 08	"Arntzen" – partner, small firm		Phone	[no tape]	SET
A4	Apr. 08	"Fredriksen" – employee, small firm		Phone	[no tape]	SET
A5	Apr. 08	"Orheim" - manager, large firm		Phone	[no tape]	SET
A6	Apr. 08	"Holm" – manager, medium-sized firm	*[0:09]*	Phone	A0006	SET
A7	May 08	"Madsen" – employee, large firm	*[0:10]*	Phone	B0007	SET
A8	May 08	"Danielsen" – partner, small firm	*[0:08]*	Phone	C0008	SET
A9	May 08	"Berg" – partner, small firm	*[0:18]*	Phone	C0009	SET
A10	May 08	"Antonsen"– partner, small firm	*[0:22]*	Phone	C0009	SET
A11	May 08	"Eliassen" – manager, small firm	*[0:23]*	Phone	C0010	SET
A12	May 08	"Halvorsen" – manager, medium-sized firm	*[0:21]*	Phone	C0011	SET
A13	May 08	"Jacobsen" – manager, medium-sized firm	*[0:14]*	Phone	A0012	SET
A14	June 08	"Olsen" – employee, large firm	*[0:11]*	Phone	330003	SET
A15	June 08	"Bakken"– partner, small firm	*[0:11]*	Phone	330005	SET
A16	June 08	"Pedersen" – manager, large firm	*[0:16]*	Phone	330006	SET
A17	June 08	"Rasmussen" – manager, large firm	*[0:12]*	Phone	330007	SET
A18	June 08	"Iversen" – partner, medium-sized firm	*[0:16]*	Phone	330008	SET
A19	June 08	"Nygaard" – manager, large firm	*[0:19]*	Phone	330010	SET
A20	June 08	"Larsen" – partner, medium-sized firm	*[0:36]*	Phone	330011	SET
A21	June 08	"Vik" – head of architecture dept., x-large firm	*[0:35]*	F-t-F	330013	SET
A22	June 08	"Mathisen" – manager, large firm	*[0:31]*	F-t-F	330113	RN
A23	June 08	"Moen" – manager, medium-sized firm	*[0:12]*	Phone	330015	SET

No.	Time	Info	Dur-ation	Type	File name	Inter-viewer
A24	June 08	“Nielsen” – manager, large firm	*[0:15]*	Phone	330016	SET
A25	June 08	“Gundersen” – manager/partner, small firm	*[0:19]*	Phone	330027	SET
A26	June 08	“Paulsen” – manager, large firm	*[0:13]*	Phone	330020	SET
A28	June 08	“Johnsen” – manager, medium-sized firm	*[0:22]*	Phone	330021	SET
A29	June 08	“Lund” – manager, medium-sized firm	*[0:17]*	Phone	330022	SET
A30	June 08	“Eriksen” – manager, small firm	*[0:13]*	Phone	330023	SET
A31	June 08	“Svendsen” – partner, x- large firm	*[0:27]*	Phone	330024	SET
A32	June 08	“Henriksen” – manager, medium-sized firm	*[0:22]*	Phone	330025	SET
A33	June 08	“Christensen” – manager, small firm	*[0:24]*	Phone	330027	SET
A34	June 08	“Karlsen” –manager, medium-sized firm	*[0:17]*	Phone	330029	SET
A35	June 08	“Solheim” – head of arch. dept., x- large firm	*[0:26]*	Phone	330030	SET
A36	July 08	“Dahl” – manager, small firm	*[0:26]*	Phone	330031	SET
A37	Aug. 08	“Johannessen” – partner, medium-sized firm	*[0:33]*	Phone	330032	SET

Local government administration, telephone interviews (May—August 2008)

No.	Time	Info	Dur-ation	Type	File name	Inter-viewer
M1	May 08	Environm. and planning consult., inland, eastN	*[0:15]*	Phone	330089	RN+SET
M2	May 08	Mayor, coast, westN	*[0:39]*	Phone	330093	RN+SET
M3	May 08	Planner, inland, eastN, *2 munic*	*[0:34]*	Phone	330091	RN+SET
M4	May 08	environmental manager, coast, southN	*[0:11]*	Phone	330095	RN+SET
M5	May 08	planning and purchases manager, centrN	*[0:22]*	Phone	330096	RN+SET
M6	May 08	environmental consultant, coast, centrN	*[0:18]*	Phone	330097	RN+SET
M7	May 08	forestry and environm. manager, inland, centrN	*[0:15]*	Phone	330098	RN+SET
M8	May 08	technical operations and agriculture, coast, centrN	*[0:25]*	Phone	330099	RN+SET
M9	May 08	real estate division manager, coast, northN	*[0:33]*	Phone	330100	RN+SET
M10	June 08	planning and industry manager, inland, southN	*[0:32]*	Phone	330101	RN+SET
M11	June 08	technical operations manager, northN	*[0:08]*	Phone	330102	RN+SET
M12	June 08	planning manager, inland, eastN	*[0:14]*	Phone	330001	SET
M13	June 08	forestry and climate plan manager, inland, southN	*[0:30]*	Phone	330103	RN+SET
M14	June 08	technical operations manager, inland, eastN	*[0:17]*	Phone	330104	RN+SET
M15	June 08	environmental coordinator, inland, eastN	*[0:12]*	Phone	330105	RN+SET
M16	June 08	agricultural manager, coast, south-eastN, *2 munic*	*[0:15]*	Phone	330106	RN+SET
M17	June 08	environmental manager, inland, eastN	*[0:10]*	Phone	330107	RN+SET
M18	June 08	planning manager, inland, eastN	*[0:14]*	Phone	330108	RN+SET
M19	June 08	environmental consultant, coast, eastN	*[0:11]*	Phone	330109	RN+SET
M20	June 08	environmental manager, inland, eastN	*[0:31]*	Phone	330110	RN
M21	June 08	mayor, coast, southN,	*[0:15]*	Phone	330111	RN
M22	June 08	environmental consultant, inland, eastN	*[0:11]*	Phone	330112	RN
M23	June 08	planner, coast, centrN	*[0:25]*	Phone	330115	RN

No.	Time	Info	Dur-ation	Type	File name	Inter-viewer
M24	June 08	environmental consultant, coast, southN	*[0:27]*	Phone	330116	RN
M25	June 08	planning manager, coast, southN	*[0:22]*	Phone	330118	RN
M26	June 08	technical operations manager, coast, westN	*[0:20]*	Phone	330119	RN+SET
M27	June 08	technical operations manager, inland, eastN	*[0:08]*	Phone	330120	RN+SET
M28	June 08	planner, coast, westN	*[0:11]*	Phone	330121	RN
M29	June 08	planning consultant, coast westN	*[0:12]*	Phone	330122	RN
M30	June 08	planner, coast, westN	*[0:17]*	Phone	330124	RN
M31	June 08	real estate divisions manager, coast westN	*[0:12]*	Phone	330125	RN
M32	June 08	construction and buildings manager, coast, eastN	*[0:25]*	Phone	330126	RN+SET
M33	June 08	planning manager, coast, westN	*[0:15]*	Phone	330127	RN
M34	June 08	planning and environm. manager, coast, northN	*[0:18]*	Phone	330128	RN
M35	June 08	technical operations manager, inland, northN	*[0:22]*	Phone	330130	RN
M36	June 08	municipal planner, coast, northN, *2 munic.*	*[0:19]*	Phone	330131	RN
M37	July 08	technical operations manager, inland, eastN	*[0:19]*	Phone	330132	RN+SET
M39	July 08	planner, coast, westN	*[0:31]*	Phone	330133	RN
M40	July 08	building and developm. consultant, inland, westN	*[0:34]*	Phone	330134	RN
M41	July 08	planner, municipality, inland eastN	*[0:16]*	Phone	330135	RN
M42	Aug. 08	planner, coast, northN	*[0:23]*	Phone	330136	RN
M43	Aug. 08	planner, coast, centrN	*[0:09]*	Phone	330137	RN
M44	Aug. 08	technical operations manager, coast, northN	*[0:10]*	Phone	330138	RN