Regional Climate Service

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Abstract: In this article, we discuss the advisory capacity of climate science for political, economical and societal decisions. To provide options, open up perspectives and to enhance the understanding for the dynamics of climate is a task we name *climate service*. After a general discussion, experiences of providing this service on a regional and local scale during the last few years are reviewed. Key components of this regional climate service are the establishment of a regional climate office, the coordination of regional IPCC-like assessment reports on knowledge about regional and local climate change, and the integration of detailed homogeneous data sets describing regional changing weather statistics (i.e., climate) in past decades and in perspectives for the next several decades.

Our climate and ecology are changing; societies are changing as well. The speed with which each is being transformed appears to accelerate. Necessary political and economic decisions are about ways of dealing with *uncertain* future events and its multitude of *contentious* challenges and pathways. Uncertainty resides in nature and society. In society uncertainty is rooted in the unpredictability of social life, that is, in human agency. The collective consciousness of the risks faced from nature and by society has reached an unprecedented level. The representation of the risks we face, our conception of what uncertainty happens to be, is to a large part a matter of social construction.

The different societal challenges, far from being driven only by ecological changes, include transformations in the foundations of the economy, changing values and perceptions, technological advances, and the rearrangement of geopolitical and global economic structures. These transformations take place on different time and spatial scales. The dilemma is that the likely consequences of political and economic actions taken today may be judged unfavorably just a few years later - even if they are based on a broad societal and international consensus. Specific contemporary strategies may be judged to be mistaken at a future time, when they do not comprise flexibility enabling future generations and societies to adapt attitudes and pathways consistent with their own values and perceptions. This might happen even when these strategies are based on what appear to be timeless universal ideals such as international and intergenerational justice and equity as criteria for political decisions.

The climate issue is often communicated as a fundamentally different political problem or, better, it is framed as a non-political issue. Climate change is presented as an existential threat that is far worse than anything else humankind has ever been confronted with. Even more, it is considered as different from other political issues in being associated with a dominant *calculative* and rationalist *conception of uncertainty*. This also accounts for the dominance of economist among social scientists engaged in climate research. In economics a rationalist model of uncertainty has long been dominant. The future uncertainty constitutive for political issues has been removed. In this mindset, only a single pathway is acceptable, for example, the reduction of global greenhouse gas emissions until the year 2100 to a level corresponding to an increase of global mean temperatures of 2^{o}C compared to the pre-industrial level. Consequently, this is considered the only way to avoid the serious societal repercussions of global warming. Political assessments and judgments are virtually pre-empted and not required. Instead, they are mostly replaced by the findings of a climate science that clearly excludes any alternatives. Politics has been eliminated by science.

Even in times of globalization, people still live in different cultures. This diverse worldwide public is aware of the profound changes underway. In the case of the currently dominant discussion of climate change, people are confronted with a sociopolitical order that is less conscious of the values, visions and diverse aspirations such as the desire of the poor to gain access to affordable energy and clear water, to economic well-being, to education, to human rights and to live in harmony with their environment.

In the past, at high-level scientific and political meetings agreement on the principle of 2^{o}C was easily reached, whereas in practice hardly any progress is made. Current atmospheric CO_2 concentrations are increasing unabatedly (Butler, 2009). Only recently, the international conference COP-15 in Copenhagen failed, and the US Senate has once again failed to pass its climate bill on cap and trade. It is highly unlikely that another effort will succeed. Increasingly, different groups of scientists, politicians, social movements and the public are puzzled on how to adopt the international political agenda to the diverse realities we live in (Geden, 2010a,b). Even worse, the insistence on only a single solution is counterproductive in that it discourages societies to examine alternative pathways of dealing with climate change (Prins and Rayner, 2007), such as exploiting the ubiquitous process of modernization (Grossmann, 2001) and regionally or sectoral specific approaches (Prins et al., 2010).

1 The role of climate science in planning for the future

As Roger Pielke jr. (2007), Luhmann (1997) and Grundmann and Stehr (2011) have argued, shifting the responsibility for a societal problem to the scientific community is based on a "linear model" or instrumental model of the science-policy interaction. Such a model banks on a technocratic solution and thereby both depoliticizes policymaking and politicizes science. Depoliticizing policymaking leads to a lack of political debate with a disclosure of economic interests, ideological commitments and cultural values. It can also lead to deepening of opposing views (clad as scientific conflict), and eventually to a lack of broad social acceptance (see also Sarewitz,

2004). In turn, the politicization of science leads to an exaggerated encroachment of political, economic and social utility into the scientific research and the interpretation of scientific findings. Science and civil society commitments converge to some extent, as exemplified by the unopposed references to politically motivated grey literature in the WG-II report of the IPCC.

In both instances, societal systems, science and policymaking are suffering. It is recommendable to reconstitute a reasonable division of labor between science and society, which will have advantages for both systems. A new societal contract between society and climate science is needed, based for instance on a renewal and adaptation of traditional concepts (Mooney, 2010). Such an agreement should acknowledge the post-normal state of contemporary science (Funtovicz and Ravetz, 1985; Ravetz, 2006) and reconsider the potential utility of the general norms of science as presented by Merton (1973; see also Stehr, 1978; Grundmann, 2010; von Storch and Stehr, 2010).

Postnormality describes a situation, in which the uncertainty of scientific knowledge is inherently large, the societal demand for answers is urgent and – at the same time – the implication of any conclusions drawn from such science are costly and societally of great significance. Climate science is clearly in a postnormal phase (Bray and von Storch, 1999). Furthermore, interest-driven forces act upon science, and try to make it a supportive tool for preconceived agendas and political agendas.

In this situation, it is imperative to reconsider Merton's four scientific norms as summarized by Grundmann (2010):

"Universalism: Truth claims are to be subjected to pre-established impersonal criteria.

Communism: is the nontechnical and extended sense of common ownership of goods; the products of competition are communized („public domain“); there is an imperative for communication of data and research findings.

Disinterestedness: The virtual absence of fraud in the annals of science has to be attributed to a distinctive pattern of institutional control; it is in the interest of scientists to conform on pain of sanctions.

Organized Skepticism: Research is checked by rigorous, structured scrutiny of peers. This principle pervades into other spheres of society, unfolding its critical powers."

Such an agreement would imply that science is not *a priori* taking into account the political (or more generally: societal) utility of scientific answers but only the political utility of the questions. Even though there are diverse views on Merton’s writings, his ethos of science is a useful contribution to a guideline of social conduct. Even if these norms are not strictly met in practice, this does not constitute sufficient reasons to give them up, According to Pielke jr. (2007), one role for scientists is acting as ‘honest *brokers’* – primarily through authoritative institutions -- in the exchange with society and politics, instead of acting as (stealth) advocates or pure ‘ivory tower’ scientists. This implies that science recognizes the always-existing possibility of new future findings that may lead to revisions of the current body of know-

ledge and an expansion of policy options. Science answers with the current knowledge questions about the dynamics of climate, the effect of certain societal activities on climate (emissions, land use change), and the effect of the present and possible future climate on societal activities (impacts). Science helps to work out response options enabling societies to choose solutions consistent with their values and goals. Instead of imposing an abstract order on society, climate science finally helps to localize and to root climate change and its effects in society in order to enable adequate regional and local responses (Krauss 2009, 2010).

In this sense, science is playing an important but supportive role; the decisive role is still with policymakers and society at large. Thus, science offers a knowledge-based service; science offers knowledge about climate dynamics, change and impact; while recognizing the possibility for revision, it both contributes to the societal contextualization of such knowledge, and accepts feedback into the scientific arena of socio-politically significant issues. We call this bundle of tasks and competencies **Climate Service**.

The societal conceptualization of climate change takes the form of possible response strategies – which could incorporate efforts to avoid climate change (mitigation; abatement), or to adapt to climate risks (adaptation) by reducing vulnerability to extreme weather events such as rain storms, flooding, wind storms, hail, or droughts (Hasselmann, 1990). Abatement can be accomplished by limiting the agent of change, i.e., the emissions, or by geo-engineering. Both approaches need political consensus and will only be effective on the international scale. Adaptation is dominantly a regional or local challenge, since climate risks manifest themselves mostly on a scale corresponding to individual landscapes, extending rarely across more than a few hundred kilometers.

Addressing the former, abatement, its potentials, options and perspectives, is mostly subject of Global Climate Service, whereas the science-society interaction revolving around at local and regional adaptation and mitigation is what we call ***Regional* Climate Service.** In the following we will deal with how such a service can be implemented.

2 Regional Climate Service

The following presentation of regional climate service activities is based on several years of climate service practice, done at the Institute of Coastal Research of the GKSS Research Center (http://coast.gkss.de) together with the Center of Excellence "Integrated Climate System Analysis and Prediction" (CliSAP; http://www.clisap.de). A short summary of the concept behind these activities is provided by von Storch and Meinke (2008).

These activities comprises

1) a "**North German Climate Office**" (http://www.norddeutsches-klimabuero.de/), which establishes a dialogue with stakeholders in the region of Northern Germany (Meinke and von Storch 2008). This office has by now been complemented by a

series of three other regional climate offices in the Helmholtz Association – see http://www.klimabuero.de and Schipper et al., 2009).

2) Regional assessment reports on the **current knowledge about regional climate** – as a kind of regional mini-IPCC report. The *BALTEX Assessment of Climate Change for the Baltic Sea Basin* (BACC) was the first of such reports (see BACC author team, 2007, or Reckermann et al., 2008). An update as well as other reöorts are under preparation (see below)

3) a **data base** describing the regional weather stream, including the sea weather (storm surges, waves) in the past 60 years, as well as scenarios of possible future climate until 2100 (coastDat, see http://www.coastdat.de/index_home.html.en and Weisse et al., 2009).

In the following we will discuss these activities in some more detail.

2.1 Regional Dialog through Regional Climate Offices

When establishing a dialog between science and the public, the effort should be based on elements like these listed in Mooney (2010):

1) *Heterogeneity.* It is important to remember that both the "public" *and* the "scientists/technologists" are heterogeneous. ·

2) *Trust.* The scientific community must build and maintain the public's trust.

3) *Education.* Just as the public must be educated on scientific topics, so must the scientific community be educated on public attitudes and opinions.

4) *Communication.* There is a need to improve the forums for public communication.

In this spirit, the Institute of Coastal Research of the GKSS Research Center, as a scientific institution with competence in the field of regional climate research, has set up the North German Climate Office as an interface between science and practice. The intention was to allow for communication and discussion about climate change impacts and risks for Northern Germany. In this region risks are especially related to storms, storm surges and ocean waves, but also to flooding, droughts and heat waves as consequence of a changed energy and water cycle. These issues are part of the competence field of the Institute of Coastal Research.

Thus that public need and part of the work done at the institute match well. Additionally, a group at the institute is monitoring regional perceptions, and is engaged in Integrated Coastal Management research.

A special group at the Institute of Coastal Research is the North German Climate Office, which is integrated in these research activities and is also part of the Klima-Campus Hamburg. Fulfilling its task, the communication between science, on the one side, and the public and stakeholders, on the other side, needs a base on the current scientific knowledge. There are two main tasks of the dialogue between science and the public – which is accomplished by the knowledge broker "North German Climate Office". One task is to convey the content of scientific knowledge into the

public, to media and to stakeholders. This includes communicating the limitations of such knowledge, the known uncertainties and the unknowable, as well as the limited role of science in complex social decision processes. The other task is to explore the range of perceptions, views, questions, needs, concerns and knowledge in the public and among stakeholders about climate, climate change and climate risks. This includes communicating the limitations of such knowledge, the known uncertainties and the unknowable, as well as the limited role of science in complex social decision processes.

Beside these quantitative analyses, qualitative approaches are applied in the North German Climate Office. Also, conceptual precision was found to be an important dimension of this dialogue. Concepts, which are particularly important, but often misunderstood, refer to forecasts and scenarios (which is even among scientists often mixed up; cf. Bray and von Storch, 2010), time and space scales, data inhomogeneity, change of statistics, detection and attribution of anthropogenic climate change, role of single extreme events.

An important internet tool, which is online since 2009, is the North German climate atlas (see http://www.norddeutscher-klimaatlas.de and Meinke and Gerstner 2009). It allows users an interactive access of regionalized changes of various climate variables at different seasons and time windows in the future for the North German region. The change is presented as ranges defined by the minimum and maximum changes among all incorporated scenarios as the scenario nearest to the ensemble mean.

2.2 Regional Climate Knowledge Basis – Climate Reports

While the fourth Assessment Report of the Intergovernmental Panel on Climate Change provided much needed knowledge about climate, climate change and impact, the need for such knowledge about regional and local conditions are generally missing. Such knowledge about regional results and scenarios are asked for by local decision-makers and stakeholders (von Storch and Meinke, 2008). Mimicking the IPCC, an outstanding example of a regional assessment is the BALTEX Assessment of Climate Change for the Baltic Sea Basin (BACC; Reckermann et al., 2008), which was compiled by a consortium of 84 scientists from 13 countries around the Baltic Sea (BACC Author Team, 2008). The assessment covers various disciplines related to climate research and related impacts.

The Baltic Sea Basin represents an old cultural landscape, and the Baltic Sea itself is among the most studied sea areas of the world. Thus, there is a wealth of information, in thousands of publications, concerning past climate conditions in the region. A large part of the information is not in English and also had not been available for western researchers, as the eastern part of the Baltic Sea basin had been behind the iron curtain until the early 1990s. The challenge was to install a writing team that could do “paper mining” in their home countries and compile the material into a comprehensive, well-written assessment book. Besides looking at past and current climate change, the BACC report presents climate projections until the year 2100

using regional climate models, and an assessment of climate change impacts on terrestrial, freshwater, and marine ecosystems of the Baltic Sea basin.

The results of the BACC assessment process were not biased by political or economic interest groups, and it relies exclusively on published scientific evidence. The BACC report brings together consolidated knowledge which has broad consensus in the scientific community. At times, though, this consensus takes the form of "consensus on dissensus", meaning that for certain points contradicting opinions could not be resolved, as for instance in case of the degree of the past warming of Baltic Sea surface waters.

The BACC report made no recommendations for how to deal with the ongoing and expected future changes. Instead the BACC project liaised with the intergovernmental Baltic Marine Environment Protection Commission (Helsinki Commission, HELCOM), which used the BACC report as the basis for the "HELCOM Thematic Assessment 2007" on Climate Change in the Baltic Sea area which was officially adopted by representatives of Baltic Sea riparian states in March 2007.

The BACC assessment report has led to the launch of other, similar initiatives, for example, a climate report for the metropolitan region of Hamburg, Germany, on the climate of the North Sea and an 2nd BACC report on the Baltic Sea region.

2.3 Regional Climate Knowledge Basis – Detailed Data Sets

Various stakeholders, ranging from governmental agencies to companies and representatives of economic sectors, as well as regional scientific institutions are regularly asking not only for perspectives of future development but also about recent and current risks and potentials (e.g., concerning off-shore wind energy or other large-scale constructions). As a response to these inquiries, a data set named coastDat with coastal weather analyses and climate change scenarios for the future for Northern Europe has been compiled.

This data set contains no direct measurements but results from numerical models that have been driven either by observed data in order to achieve the best possible representation of observed recent and current conditions (typically 60 years) or by climate change scenarios for the near future (typically 100 years). The model system used features a regional atmospheric model, a model of the hydrodynamics of continental shelf seas (North Sea) and wave models. The key part of the coastDat data set comprises regional wind, wave and storm surge hindcasts and scenarios mainly for the North Sea. A comparison with the limited number of observational data points to the good quality of the model data in terms of long-term statistics such as multi-year return values of wind speed and wave heights.

These model data provide a unique combination of consistent atmospheric, oceanic, sea state and other parameters at high spatial and temporal detail, even for places and variables for which no measurements have been made. In addition, coastal scenarios for the near-future complement the numerical analyses of past conditions in a consistent way.

A variety of coastal and offshore applications have taken advantage of these data sets. Examples comprise applications in ship design, oil risk modeling and assessment, or the construction and operation of offshore wind farms, marine energy use, coastal protection, water quality studies and navigation safety (Weisse, 2010).

3 Epilogue

Establishing climate service on regional and local levels implies that science might play a role as provider of scientific knowledge but also as an honest *broker* of action alternatives and thus a facilitator between politics, stakeholders and society. The climate problem is associated with a conception of uncertainty and has to be regionally embedded in different cultures. The different values, visions and diverse aspirations are crucial for the development of regional adaptation and mitigation strategies. In the context of the reconstitution of the reasonable division of labour between science and society, science has a more supportive role. Science can not provide answers in the sense of what to do and how to do it. As Merton puts it, the ethos of science is to be “the guideline of social conduct” (see Grundmann 2010).

For scientific knowledge about climate change to become part of society’s perception of risk and uncertainty, the regional experiences, memories and values have to be understood and analyzed. The information provided by science should be presented in an understandable way and be focused on the specific relevant regional impacts. Science can provide scientific insights on a regional level without pretending that the delivered information are static and fixed truths, but as part of the basis for political and societal action. In dialogue with regional politics and stakeholders, science becomes part of the negotiation process of how to adapt to climate change and to foster mitigation strategies. In doing so, climate change and its effects enter the political arena, with interdisciplinary climate science being a valuable contributor among others in the democratic process. In the realm of regional climate politics, science can provide scenarios and possible outcomes of societal decisions and ambitions. Climate Service is not restricted to greenhouse gas emissions; instead, climate change as a regional challenge entails also the social actors and their cultures.

In conclusion, regional climate service requires the understanding not only of the dynamics of the regional geo-system but also of the socio-cultural dynamics of the respective areas. The linear model, according to which the natural science analysis is sufficient to determine the "right" way of action vis-à-vis the specter of anthropogenic climate change, does not adequately describe the complexities of the problem. Instead, the application of this model de-politicizes the societal problem "Global Warming" and inhibits an openly value-based debate and decision process. At the same time, this model leads to a science constrained by its client's interests.

As we have shown in this article, Climate Service has to be based on a transdisciplinary approach involving both natural and socio-cultural scientists. Our examples of the Climate Services in Northern Germany during the past few years provide insights how this challenge can be met.

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