2. Regional Climate Knowledge for Society

by Hans von Storch[13]

Abstract

The present misconception of climate science and its interaction with the public is addressed. While the knowledge base about the dynamics of climate and its sensitivity to elevated greenhouse gas concentrations has been greatly expanded with broad consensus in the scientific community, the communication with the public and policy makers has not led to the implementation of efficient measures to limit man-made climate change. It is suggested that a different position be adopted, namely the building of a regional climate service, which allows public and stakeholders to consider climate knowledge in the process of dealing with climate-related problems, where this is appropriate. Thus climate science should not be the avant-garde of climate policy but support the political process by providing a knowledge broker service.

2.1 Climate Change and the IPCC

The Intergovernmental Panel on Climate Change, IPCC, documents and assesses scientific knowledge about ongoing climate change and perspectives thereof. The range of issues covered by the IPCC is very broad and the degree of confidence that is met by the reports of the different working groups varies substantially. In particular, the report of Working Group 1, on the "science", enjoys broad acceptance, with a number of key assertions, namely

- strong consensual evidence that the climate system is warming,
- most of this warming cannot be explained without the increase in GHG concentrations – with the present knowledge,
- therefore, because of the ongoing human emissions of greenhouse gases (GHG) in the foreseeable future, the warming of the climate system will continue many decades into the foreseeable future.

The strength of agreement among climate scientists to both the fact that there is global warming ("manifestation") and that its explanation needs the effect of elevated greenhouse gas concentrations ("attribution"), has been determined over the years in a series of surveys, which have been summarized by Bray.[14] While back in 1996, manifestation was accepted by some 62% of all respondents, and attribution only by 38%, both numbers have risen to well above 90% in 2010. Thus, acceptance that warming and greenhouse gases are the major cause is almost universal among climate scientists.

Unfortunately, the IPCC failed to be explicit in documenting, for instance in its "Summary for Policy Makers", consensus on questions *lacking consensus*, such as the fate of ice sheets, sea level projections, present change of hurricanes, present change in different types of extremes. The other two working groups have achieved less scientific authority. The unfortunate und badly managed errors in the AR4 Report of Working Group II, on impacts, as well as the failure of the Chair of Working Group III to rebuke claims of manipulation, have led to less respect among scientists for the work of these two working groups.[15] [16]

2.2 Deciding on Climate Policy

Many, in particular among physical climate scientists, apply the "linear model", according to which knowledge about climate dynamics, in particular the link between greenhouse gas concentration and warming, sea level and other significant state variables, can be translated directly into a set of needed policy

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[14] Bray, D. "The Scientific Consensus of Climate Change Revisited." Env. Sci. Pol. 13 (2010): 340-350.

[15] von Storch, H. "Climate Science, IPCC, Postnormality and the Crisis of Trust.", In: N. Roll-Hansen, 2011: *Status i klimaforskningen. Kunnskap og usikkerhet, vitenskapelige og politiske utforderinger*, Det Norske Videnskaps-Akademi, Novus forlag - Oslo, (2011) 151-182.

[16] Klimazwiebel. Still No Reaction to Richard Tol's Assertion About Incorrect Statements by Edenhofer in ZDF. <http://klimazwiebel.blogspot.com/2010/10/still-no-reaction-to-richard-tols.html>.

and market instruments. This set would minimize the sum of adaptation and abatement costs.[17] [18] Indeed, in the public discourse, the impression is raised that after the unequivocal findings of the IPCC – as given above – a mandatory political course would be clear, namely a reduction of greenhouse gas emissions as much as possible, so that temperature increase would peak at 2 degrees or less, and then stabilise.

But, in spite of a massive public campaign based on – what is called, at least in the West: – a scientific consensus and conclusion, concrete and efficient manifestations of such policy remain rare and unconvincing. Obviously, the linear model does not work. One reason is that the world is seen as essentially one-directional, namely that decisions and thus "action" would essentially flow directly from scientific understanding. Also, it is based on a rather idealized understanding of the interaction between science and the public; one idealization is that on the side of the knowledge-providers there are no conflicts about what the "facts" are; science as a knowledge-broker appears monolithic.

In my understanding, the political process does not make use of scientific "truth" – whatever that may be – but on perceptions and on knowledge claims that are the result of a metamorphosis of scientific knowledge. The issue has become an issue of competing knowledge claims, which are by themselves subordinate to certain worldviews and sets of value preferences. Indeed, this had to be expected after climate science found itself in a post-normal situation, where *stakes are high, facts uncertain, decisions urgent and values in dispute*.[19] Interest-led utility is a significant driver in the research area in a post-normal phase, less so "normal" curiosity.

2.3 Different Knowledge Claims

In my understanding, *climate change is a "constructed" issue*. People hardly experience "climate change". There are different classes of *constructions*.[20] One is *scientific*, i.e. an "objective" analysis of observations and interpretation by theories. The other is *cultural*, in particular maintained and transformed by the public media.

The *scientific construction* describes a climate that is subject to the influence of greenhouse gases (GHGs), with the primary effect of higher temperatures and related facets associated with higher GHG concentrations, and secondary effects related to dynamic changes related to cloudiness, circulation etc. In this description, humankind is responsible for the elevated GHG presence, and can limit the effect of man-made climate change by regulating the emissions of greenhouse gases. However, since substantial amounts of GHGs have already been released, the effect cannot be stopped within a few decades or years. Given the inertia of the climate as well as the economic system, the warming will continue for a while. A very substantial effort has to be made to limit the warming to 2 degrees over preindustrial levels, even if there is some doubt that it is possible at all. Thus, not only efforts for reducing the flux of GHGs into the atmosphere have to be explored by science, and possibly implemented by societies, but also measures for dealing with the unavoidable changes of the possibly limited man-made climate change need to be studied and tested.

In the scientific construction, adaptation to climate change and mitigation of man-made climate change are both key aspects of the climate issue.

The *cultural construction* describes a different system, namely a sinful humankind, which is mistreating nature – which eventually strikes back, in an act of global justice. Nature, or more specifically climate, strikes back with all kinds of extremes, prominent among them being storms and hurricanes but also floods and droughts; with rising sea levels, which will in the near future destroy large coastal and island territory. All this can be halted if GHG emissions are dramatically reduced; then, and only then, can the climate crisis, or catastrophe, be managed, and further adaptation measures will not be needed, at least no significant ones.

Of course, the two constructions are not separate; both influence each other – as is common in a post-normal situation.

The present failure of science to really influence policymaking constructively and effectively may be related to the following observations:

[17] Hasselmann, K. "How Well Can We Predict the Climate Crisis?" Environmental Scarcity - the International Dimension. Ed. H. Siebert. Tübingen: JCB Mohr, 1990. 165-183.
[18] Nordhaus, W. D. "To Slow or Not to Slow: the Economy of the Greenhouse Effect." Econ. J. 101 (1991): 920-937.
[19] Funtowicz, S. O., and J. R. Ravetz. "Three Types of Risk Assessment: a Methodological Analysis." Risk Analysis in the Private Sector. Eds. C. Whipple, and V. T. New York: Plenum, 1985: 217-231.
[20] von Storch, H. "Climate Research and Policy Advice: Scientific and Cultural Constructions of Knowledge." Env. Science Pol. 12 (2009): 741-747. <http://dx.doi.org/10.1016/j.envsci.2009.04.008>.

- The science-policy/public interaction is not an issue of the linear model of "knowledge speaks to power".
- The problem is not that the public is stupid or uneducated.
- Science has failed to respond to legitimate public questions and has instead asked: “Trust us, we are scientists”.
- The problem is that scientific knowledge is confronted on the "explanation market" with other forms of knowledge. Scientific knowledge does not necessarily “win” this competition.
- The social process "science" is influenced by these other knowledge forms.

I would suggest that this situation should give rise to a change in thinking among scientists, namely to give up plans to persuade societies to implement specific policies, but to support the societal process of finding solutions to the “climate problem” by answering as objectively as possible questions about the consequences of different policies, and options and needs for regional and local adaptation measures. Instead of trying to “solve” political problems on the backstage of scientific debates, science should return to its role of an honest broker (Pielke jr., 2007) and build a dialogue with the public, which goes under the name of *regional climate service*.[21] [22]

2.4 Regional Climate Service

The concept of “climate service” emerged first in North America, with initial publications in governmental documents in the early 1980's and earlier (for a historical perspective, refer to Changnon et al., 1990).[23] Its mission and scope may be summarized as: “A N[ational] C[limate] S[ervice] identifies, produces, and delivers authoritative and timely information about climate variations and trends and their impacts on built and natural systems on regional, national, and global space scales. This information informs and is informed by decision-making, risk management, and resource management concerns for a variety of public and private users acting on regional, national, and international scales. The stakeholders (and the constituency for an NCS) include public and private individuals and organizations at federal, state, and local levels … with sensitivity to and need for climate-related information.” (Miles et al., 2006).[24] Stakeholders on different scales take different viewpoints, with national and international actors being more interested in issues related to mitigation of man-made climate change and regional and local actors more engaged in adaptation measures.

The main elements of such a climate service are (Miles et al., 2006): [25]

1. “Serve as a clearinghouse and technical access point to stakeholders for regionally and nationally relevant information on climate, climate impacts, and adaptation; developing comprehensive databases of information relevant to specific regional and national stakeholder needs.
2. Provide education on climate impacts, vulnerabilities, and application of climate information in decision-making
3. Design decision-support tools that facilitate use of climate information in stakeholders’ near-term operations and long-term planning
4. Provide user access to climate and climate impacts experts for technical assistance in use of climate information and to inform the climate forecast community of their information needs
5. Provide researcher, modeler, and observations experts access to users to help guide direction of research, modeling, and observation activities
6. Propose and evaluate adaptation strategies for climate variability and change.”

This concepts fits well into the linear model discussed above, which stipulates that knowledge about the dynamics in the Earth-society system together with an understanding about the incurred costs for adaptation and mitigation, would “solve” the climate problem, and provide decision makers with directions on how to rationally and cost-effectively respond

[21] Pielke, Jr., R. A., ed. The Honest Broker: Making Sense of Science in Policy and Politics. Cambridge University Press, 2007.
[22] von Storch, H., I. Meinke, N. Stehr, B. Ratter, W. Krauss, R.A. Pielke jr., R. Grundmann, M. Reckermann, and R. Weisse. “Regional Climate Services illustrated with experiences from Northern Europe.” Zeitschrift für Umweltpolitik & Umweltrecht 1 (2011): 1-15.
[23] Changnon, S. A., P. J. Lamb, and K. G. Hubbard. “Regional Climate Centers: New Institutions for Climate Services and Climate-Impact Research.” Bulletin of the American Meteorological Society 71.4 (1990): 527-537.
[24] Miles, E. L., A. K. Snover, L. C. Whitely Binder, E. S. Sarachik, P. W. Mote and N. Mantua. “An Approach to Designing a National Climate Service.” Proceedings of the National Academy of Sciences 103.52 (2006): 19616-19623.
[25] Ibid.

to the perspective of anthropogenic climate change.

As part of the Climate Service data collection, quality control and archival activities, dissemination and guidance for using such data, scenario of climate change and impacts, and links to applied research often are listed.[23] Regional and global data sets, describing recent, ongoing and possible future climate changes and impacts are important elements enabling an efficient climate service.[26]

2.5 Our Activities at the Institute of Coastal Research at the Helmholtz Zentrum Geestacht

The Institute of Coastal Research at the Helmholtz Zentrum Geesthacht (near Hamburg, Germany) describes its mission in this way:

> » Coastal systems are under constant pressure from short and long term natural influences, including erosion or sea level rise due to climate change, and from human endeavours, for example, transportation, land use patterns, tourism, etc. As a means to identify the potential for change, sustainability, and adaptation, coastal research provides the tools, assessments, and scenarios for managing this vulnerable landscape.
> Research activities span both the natural and human dimensions of coastal dynamics, analysing the coastal system in global and regional contexts, conducting assessments of the state and sensitivity of the coastal system to natural and human influences, and developing scenarios of future coastal options.

As such, the Institute claims to generate useful knowledge, which can be used mostly in regional and local contexts for managing coasts, in particular with respect to climate change. Being confronted with the issue discussed above, special efforts were developed and implemented – with partners from the social sciences and humanities.

These efforts comprise:

1. Analysis of the *cultural constructions of climate, climate change and impact*, including common exaggeration in the media (e.g., Neverla and von Storch, 2010).[27]
2. Determination of *response options* on the local and regional scale: mainly adaptation but also regional and local mitigation (e.g., von Storch et al., 2010).[28]
3. *Dialogue* of stakeholders and climate knowledge brokers in "Klimabureaus".[29] [30]
4. Analysis of *consensus* on relevant issues (climate consensus reports)..[31] [28]
5. Description of *recent and present changes* as well as projection of *possible future* changes, which are dynamically consistent and possible ("scenarios") ("CoastDat")[32]
6. Direct exchange and discussion about climate science and climate policy with individuals via a weblog.[33]

2.5.1 North German Climate Office

The North German Climate office was set up in 2006 as an institution that enables communication between science and stakeholders, that is: making sure that:[34] [29]

- science understands the questions and concerns of a variety of stakeholders
- stakeholders understand the scientific assessments and their limits.

The office deals specifically with issues that are covered scientifically by the home institute, i.e., various aspects dealing with climate change and climate impact in the Ger-

[26] von Storch, H., and I. Meinke. "Regional Climate Offices and Regional Assessment Reports needed." Nature Geosciences 1.2 (2008): 78, doi:10.1038/ngeo111.

[27] Neverla, I., and H. von Storch, eds. Wer den Hype Braucht. Die Presse, 24. Juli 2010.

[28] von Storch, H., M. Claussen, and KlimaCampus Autoren Team, eds. Klimabericht für die Metropolregion Hamburg. Springer Verlag Heidelberg Dordrecht London New York, 2010:321, doi 10.1007/978-3-642-16035-6.

[29] Meinke, I., and H. von Storch. "Regional Cimate Offices as Link Between Climate Research and Decision Makers." Extended Abstract for International Desaster Reduction Conference (IDRC), Davos, Switzerland, 25-29 August 2008: 938-941.

[30] Schipper, J.W., I. Meinke, S. Zacharias, R. Treffeisen, Ch. Kottmeier, H. von Storch, und P. Lemke. "Regionale Helmholtz Klimabüros bilden bundesweites Netz." DMG Nachrichten 1 (2009): 10-12.

[31] BACC author team. Assessment of Climate Change in the Baltic Sea Basin. Springer Verlag Berlin-Heidelberg, 2008: 473.

[32] Weisse, R., H. von Storch, U. Callies, A. Chrastansky, F. Feser, I. Grabemann, H. Günther, A. Plüss, T. Stoye, J. Tellkamp, J. Winterfeldt, and K. Woth. "Regional Meteo-Marine Reanalyses and Climate Change Projections: Results for Northern Europe and Potentials for Coastal and Offshore Applications." Bull. Amer. Meteor. Soc. 90 (2009): 849-860. <http://dx.doi.org/10.1175/2008BAMS2713.1.>.

[33] <http://klimazwiebel.blogspot.com/).>.

[34] <http://www.norddeutsches-klimabuero.de>.

man coastal regions. As such, typical stakeholders entail representatives and stakeholders in coastal defence, agriculture, offshore activities (energy), tourism, water management, fisheries, and urban planning.

A special product is the North German Climate Atlas (http://www.norddeutscher-klimaatlas.de/), which is available in German language, to meet customers' demands.[35] This web-based atlas describes possible climatic futures, as given by – so far – 12 regional climate projections, for different regions in Northern Germany (plus a region straddling the Polish/German border). Scenarios are described by an ensemble means, but also by minimum and maximum changes in the set of scenarios.

2.5.2 Regional Climate Consensus Reports

In scientifically legitimate knowledge about climate, climate change and climate impacts are screened in an IPCC-like process. All literature, not only in English, is considered as long as it is published in regular scientific journals or by reputable scientific institutions (such as weather services). In a series of chapters, with responsible lead authors, issues like past and ongoing regional change, possible future change, and climate related changes in terrestrial and marine ecosystems are covered. Prior to publication, the reports are anonymously reviewed, and presented to the regional scientific public. Political or management recommendations are not made, but scientifically contested areas are emphasized. The reports are conveyed to political bodies, which use them as a basis for further deliberations.

So far, two such reports have been completed.

- *The Climate Change Assessment: Report for the Baltic Sea Catchment - BACC.* Approximately 80 scientists from 10 countries documented and assessed the published knowledge, which was published in English in 2008.[31] [36] The assessment has been employed by the intergovernmental Helsinki Commission / Baltic Marine Protection Commission HELCOM for the Baltic Sea as a basis for its future deliberations.[37] [38]

  For 2013 the publication of an updated assessment report (BACC II) is presently being prepared. [39]

- *Climate Assessment for the Metropolitan Region of Hamburg.* In 2007-2010 a climate assessment report about the scientifically documented knowledge of climate change in the region of Hamburg was prepared – as an activity of the Climate Centre of Excellence CLISAP at the University of Hamburg, jointly operated with the Helmholtz Zentrum Geesthacht and the Max Planck Institute of Meteorology.[28]

  The Senate of Hamburg and the Environmental Ministry of Schleswig Holstein used the results for climate adaptation planning.

2.5.3 CoastDat. Regional and Local Conditions in the Recent Past and Next Century.

Using a modelling strategy that processes homogeneous multi-decadal analyses of large-scale circulation with a regional climate model (dynamical downscaling), a realistic description of the weather stream since 1948 until (almost) today is constructed. This description is not error free, but the statistics of these errors remain uniform throughout the entire time. In a similar way, scenarios of possible future conditions are generated.

The whole data set, which covers atmospheric and oceanographic data, is named CoastDat (http://www.coastdat.de/index_home.html.en; Weisse et al., 2009).[40] [32] It features long (60 years) and high-resolution reconstructions of recent offshore and coastal conditions mainly in terms of wind, storms, waves, surges and currents and other variables in Northern Europe, and scenarios (100 years) of possible consistent futures of coastal and offshore conditions. Efforts are underway to extend the data set, so as to cover ecological variables, but also other regions such as the Baltic Sea, East Asia and Laptev Sea.

Users of this data are various *governmental/municipal* coastal *agencies* dealing with coastal defence and coastal traffic, *companies* with needs for the assessment of risks (ship and offshore building and operations) and opportunities (wind energy) and finally the *general public / media*, who ask for explanations of causes of change and perspectives and options on how to deal with change.

[35] <http://www.norddeutscher-klimaatlas.de/).>
[36] Reckermann, M., Isemer, H.-J., and von Storch, H. "Climate Change Assessment for the Baltic Sea Basin." EOS Trans. Amer. Geophys. U. 2008: 161-162.
[37] <http://www.helcom.fi/)>.
[38] Helsinki Commission. "Climate Change in the Baltic Sea Area. HELCOM Thematic Assessment in 2007." Baltic Sea Environment Proceedings 111 (2007).
[39] <http://www.baltex-research.eu/organisation/bwg_bacc2.html>.
[40] <http://www.coastdat.de/index_home.html.en>.

The CoastDat-effort is pursued in cooperation with a variety of governmental agencies and also with companies. Applications cover issues such as ship design, navigational safety, assessment of offshore wind potentials, interpretations of measurements, assessments of oil spill risks and chronic oil pollution, assessment of ocean energy perspectives as well as scenarios of possible future surge and wave conditions.

2.6 Concluding Remarks

When discussing the issue "knowledge for society", one has to determine what the task of science should, or could be, when interacting with society. My perspective is that this task is to:

- offer explanations for a complex world, its dynamics, links and dependencies.
- state what can be done, not what needs to be done.
- establish measures to ensure the quality of science by insisting on scientific method (cf. Merton's CUDOS).
- keep in mind that the capital of science is not the utility of the scientific findings but the methodology used to obtain such findings.

Merton CUDOS-norms are repeated here; certainly no strict rules, but a guidance, and with question marks as to what extent these rules are actually applied by wide segments of science.[41] [42]

- **"C**ommunalism: the common ownership of scientific discoveries, according to which scientists give up intellectual property rights in exchange for recognition and esteem.
- **U**niversalism: according to which claims to truth are evaluated in terms of universal or impersonal criteria, and not on the basis of race, class, gender, religion, or nationality.
- **D**isinterestedness: scientists, when presenting their work publicly, should do so without any prejudice or personal values and do so in an impersonal manner.
- **O**rganized **s**kepticism: all ideas must be tested and are subject to rigorous, structured community (peer review) scrutiny."[43]

I suggest using these rules in particular in climate sciences, as this may be a way to leave the swirl of post-normal sciences and help to lead climate science back to normal conditions. In the present situation, the policy making process points to science when decisions are needed, even if there are difficult, value-based problems (*scientising policymaking*)..[21] Science cannot solve these problems. But when it tries it sells out the capital of science, namely the trust of the public that science will deliver in the spirit of Merton's rules. On the other hand, if science openly takes value-based positions in favour of one or other political agenda (*politicising science*), the foundations of good science will be destroyed.

My take-home messages for the reader are:

- The societal service of science is to provide explanation of complex phenomena, using the scientific methodology as per Merton (CUDOS).
- Climate science operates in a post-normal situation, which goes along with a tendency of politicizing science, and scientising politics. Cultural science needs to support climate science to deal with this challenge.
- Climate Science needs to offer "Climate Service", which includes the establishment of a dialogue with the public (direct or via media) and stakeholders – *recognizing the socio-cultural dynamics of the issue*.

[41] Merton, Robert K. "The Normative Structure of Science". The Sociology of Science. Ed. N. W. Storer, Chicago, IL: University of Chicago Press, 1974: 267-273.
[42] Stehr, N. "The Ethos of Science Revisited Social and Cognitive Norms." Sociological Inquiry 48 (1978): 172-196.

[43] Grundmann, R., pers. comm.