Workshop

"Post-normal science: the case of climate science"

4-6 May 2011, Hamburg

Collection of Abstracts

Silke Beck

From Truth to Trust: IPCC under Trial

Public trust and the IPCC's credibility eroded dramatically after November 2009 with the events that became known as 'climategate'. The events have contributed to reinforce the back and forth between *depoliticized politics* and *politicized science* and to distract attention climate from the real problems that exist within the IPCC. Although *intergovernmental* in name and exercising a remarkable amount of 'delegated' authority, the IPCC is subject to none of the legal political requirements that constrain, but also legitimate, national expert committees. The need for mechanism to warrant accountability nowadays is more critical than ever, not least because climate scientists are now highly exposed to public scrutiny and criticism. The paper discusses how the IPCC tries to rebuild public trust into the credibility of climate science. Given these challenges, the IPCC reform efforts are too narrowly focused on internal aspects in order to regain public trust. Based on case study on the German response to 'climategate,' it then shows why improving internal transparency and accountability is a necessary but not sufficient condition for the trust into global policy relevant knowledge.

The paper finally explores the challenges and changes that will be needed to build trusted knowledge for climate policy. It discusses what the alternatives and options are discussed in social science? And, last but not least: Does *extended peer review* candidate as mechanism for warranting public trust in a globalizing world?

Anne Blanchard

Climate change: A magnifying glass for reflection

For my individual presentation, I would like to present a paper that is soon to be submitted for publication. The idea of climate change can be deployed as a creative force to stimulate new thinking across all facets of humanity. In his book, 'Why We Disagree About Climate Change', Mike Hulme (2009) introduces the metaphor of climate change as both a magnifying glass and a mirror; it at once demands examination of each of our human projects, and reflection on their objectives.

In this presentation, I will apply Hulme's metaphor to the particular human project of science, and more particularly, the collection of natural sciences composing the climate sciences, and their mobilisation in support of our collective decision-making. It begins by demonstrating how climate change as a magnifying glass has focussed climate scientists to (a) rethink their own norms relative to ontological, epistemological, and methodological features, and (b) reconcile their framing of climate change relative to other competing narratives within a politicised science-policy interface; as embodied within notions of boundary work. Afterwards, I will look at how climate change as a mirror has inspired critical reflection amongst climate scientists on the purposes of scientific endeavours, and how their own personal stories may influence scientific means. The essay concludes that climate change has presented a context within which climate sciences have developed.

Getting from applied science to post-normal science: The case of Japan, 2011

The recent nuclear catastrophe in Japan highlights the need for climate sciences' knowledge to be transferable to professional practice, and beyond, to accommodate a post-normal perspective.
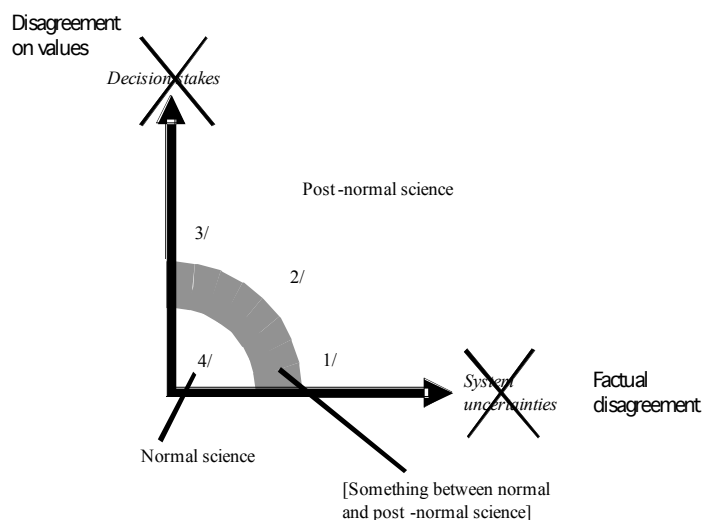
In designing a protective seawall, coastal engineers and geomorphologists consider the risks of it being overtopped. To what degree is sea-level rise included in those designs, and what level of risk is acceptable?

Now consider the seawall is protecting a nuclear power plant, close to one of the most populous cities in the world, then the limitations of professional practice alone become obvious, and a post normal perspective is required in order to integrate all the issues and discuss all the possible actions and agendas. Might it be, perhaps, that it is not appropriate to cite a nuclear power plant on the coast at all?

Tom Boersen

Postnormal science considers uncertainty, value loading, disagreement, and a plurality of legitimate perspectives as intrinsic to contemporary science. The essence of PNS is often captured in the dictum "Facts are uncertain, values in dispute, stakes high, and decisions urgent", which again is graphically represented in the postnormal science diagram, where we on the x-axis have the degree of uncertainty and on the y-axis have decision stakes. In this proposed contribution to the session on postnormal concepts and theory I will argue that we need one more diagram to capture the essence of postnormal science, as both axis of the existing diagram are ambiguous regarding disagreement. Agreement as well as disagreement can exist regarding both the level of uncertainty as well as the decision stakes connected to a problem and its potential solutions. The postnormal science diagramme do not illustrate varying degrees of disagreement, which often is characterizing postnormal situations. Hence, I will propose, discuss, and illustrate with examples from the climate change debate a supplementary postnormal science diagram that aims at graphically represension of disagreement regarding what is considered respectively facts and values:

Supplementary Post -Normal Science Diagram

Disagreement
on values

Decision stakes

Post -normal science

3/

2/

4/   1/

System uncertainties   Factual
disagreement

Normal science

[Something between normal
and post -normal science]

Disagreement on what counts as a fact may regard:

1. opposing views concerning the choice of methods relevant and appropriate for investigating a certain problem.
2. differences in theoretical framework.
3. differences in the interpretation of empirical results.
4. opposing views concerning the legitimacy of scientific results generated by computer models.
5. opposing views concerning the adequacy of the reviewing process, which gives legitimacy to a scientific conclusion.
6. opposing views concerning the competences required in order to be able to legitimately contribute to a given scientific debate.

Disagreement on the values side may include:

1. differences in views concerning epistemic values and virtues.
2. different views concerning the ethical principles contextually tied to a scientific controversy.
3. different views concerning the political principles contextually tied to a scientific controversy.
4. different views concerning the norms of scientific integrity and the borderlines of legitimate institutional and industrial affiliations.
5. opposing views concerning the relevance, urgency and importance of dealing with a certain problem.
6. different patterns of public communication of scientific results.

Dennis Bray

PN? context and praxis: the case of climate science

Science is a social activity, and so then, logically, is climate science. The addition of the prefix *post-normal* implies something different from 'normal'. The scientific issues dubbed 'post normal' (for it is no longer a moniker applied only to science) are loosely characterized by claims of high levels of risk and high levels of uncertainty, the uncertainty perhaps deriving from the immaturity of the science and the perceived risk from subsequent *hypothetical-facts*. Being a social activity, and under such conditions, to qualify as a post normal science also calls for a change in science praxis, suggesting the (old-standard) truth-to-power model of science is no longer appropriate in light of evolving post-normal issues, in this case climate change. This presentation first assesses the development of post-normal nomenclature and then assesses to what extent climate science qualifies as being a post normal science in terms of both (post normal) issue and (post normal) praxis.

Amy Dahan

The Role of Science in the Climate Arenas

I will present two examples of discussions about scientific results in climate arenas.

1. One is the question of the frequency of extreme events which has been addressed in particular at Poznan in a side event with scientists, leaders of developing countries and activists from NGO's. This moment showed the importance of the reference to the scientific expertise, but also its vulnerability to political disagreements, illustrating the complexity of the relationships between science and politics, and the difficulty to establish a frontier between them
2. The second is the question of the "dangerous barrier" of 2°C . Without depicting the whole story of co-construction of this threshold, I would like to come back on how people in the last climate arenas mobilize this target.

Martin Döring

Post-normal Futures:
Looking at climate futures instead of looking into climate futures.

Research in the area of sustainability could be characterised to hold a strong drive to motivate institutions and social actors to approach knowledge-making and knowledge-using processes in ways that pay special attention to their risk-laden, ideologically heterogeneous and uncertain socio-natural contexts (Frame/Brown 2008). This set of problems represents a challenge which has extensively been addressed in so-called post-normal approaches as initially outlined by Jerry Ravetz and Silvio Funtowitz (Ravetz 1987, Funtowitz/Ravetz 1990, 1993, 1994). Funtowitz and Ravetz – and subsequent research – argue that the state of so-called post-normal science requires new techniques and approaches that address a qualitative change in the way science and policy-making are carried-out. The post-normal approach consequently puts emphasis on uncertainty and values as main characteristics in research on issues of sustainability. These aspects, however, did to date not attract much attention and have often been downplayed or ignored in environmental management: the complexity of natural and cultural environments has so far often been acknowledged but rarely become a basic ingredient in the research process because the emphasis on complexity includes a widening of the discourse from relevant core experts to the public and private sphere. Acknowledging complexity in sustainability research would involve different social groups, techniques and forms of institutionalisation for sustainable management and this would give rise to new forms of public engagement with science and the concept of sustainability itself.

Clever solutions do not seem to be at hand and the role of science is, in this shift from government to governance, reduced to a relevant but not exclusive kind of knowledge making new participatory approaches and post normal sustainability technologies necessary. Among these participatory or collaborative approaches Integrated Assessment Techniques, Dialogic Accountings and Futuring (Marien 2002) can be regarded as loosely connected approaches. The latter forms the starting point of the present paper which combines current trends in futuring techniques with the sociology of expectations (Brown 2003; Brown/Michael 2003). The main aim consists in complementing the theory and methodology of futuring techniques

(Selin 2006) with a linguistically motivated form of social analysis that puts emphasis on how futures are conceptualised and imagined among different stakeholders. Such an approach might provide an opportunity for a "thick" description and analysis (Geertz 1973) of climate futures as seen through various stakeholder's eyes and at the same time offers an occasion to identify linkages and characteristic patterns of interpreting climate futures in particular contexts. A "thick" description, in terms of a future-oriented language analysis, offers a possibility "to shift the analytical angle from looking *into* the future to looking *at* the future". How is the future imagined? And how is it currently mobilised to deploy resources, coordinate activities and cope with uncertainty in a variety of social and politic al arenas? Such an embedded and empirical foresight approach complements and informs post normal sustainability technologies and represents a theoretical and methodological asset to the study of futures. Furthermore, looking *at* climate futures instead of looking *into* the climate futures challenges traditional expert-led approaches, calls for shifts in governance and opens-up "spaces for deliberating desirable futures" (Höijer et al. 2006: 364-365)

References:
- Brown, N. (2003): Hope Against Hype – Accountability in Biopasts, Presents and Futures, in: Science Studies, 16, 3-21.
- Brown, N. / Michael, M. (2003): A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects, in: Technology Analysis and Strategic Management, 15, 3-18.
- Frame, B. / Brwon, J. (2008): Developing Post-Normal Technologies for Sustainability, in: Ecological Economics, 65, 225-241.
- Funtowitz, S.O. / Ravetz, J.R. (1990): Uncertainty and Quality in Science for Policy. Dordrecht: Kluwer.
- Funtowitz, S.O. / Ravetz, J.R. (1993): Science for the Post-Normal Age, in: Futures, 25, 739-755.
- Funtowitz, S.O. / Ravetz, J.R. (1994): The Worth of a Songbird, in: Ecological Economics as a Post-Normal Science, in: Ecological Economics, 10, 197-207.
- Geertz, C. (1973): The Interpretation of Cultures. New York: Basic Books.
- Höijer, B. / Lidskog, R. / Uggla, Y. (2006): Facing Dilemmas: Sense-Making and Decision-making in Late Modernity, in: Futures, 38, 350-366.
- Marien, M. (2002): Futures Studies in the 21st Century: A Reality-based View, in: Futures, 34, 261-281.
- Ravetz, J.R. (1987): Usable Knowledge, Usable Ignorance: Incomplete Science with Policy Implications, in: Clark, W.C. / Munn, R.E. (Eds.): Sustainable Development of the Biosphere. Cambridge: Cambridge University Press, 415-432.
- Selin, C. (2006): Trust and the illustrative force of scenarios, in: Futures, 38, 1-14.

Katharine Farrell

Experimental existentialism and Parliaments of Things

The aim of this intervention is to sketch out an experimental ontology of Climate Science that might serve as a useful basis for theorising 'extended peer review methodology as political theory.' Two premises underlie the argument: 1. it is presumed that a coherent ontology of the phenomenon of Climate Science (not to be confused with an accurate one) can enhance the ability of climate scientists, political decision makers, concerned individuals and affected communities to understand the drivers and cope effectively with the consequences of the current phase of global climate change; 2. it is presumed that democratic procedures of political engagement are both ethically and epistemologically superior to all other procedural options for organising such work. Turning to the ontology: the very idea that the earth's climate might be described – for that is what science does – reflects a general shift in how the relative status of humans and nature is perceived by the communities concerned with Climate Science: "in the late-industrial societies of the late twentieth and early twenty-first centuries… technology – a product of the human project to subdue nature – has replaced nature as the dominant other." (Farrell, 2011: 73). This provides for the first component of the

experimental ontology – the proposition that humanity is now actively responsible for consciously directing its own forward going evolution (sic Marcuse, 1969[1955]). Next, building on arguments already advanced by Lovelock and Margulis (1974; Lovelock, 1972; 1979) and Crutzen and Stoermer (2000), concerning the phenomenon Gaia, and considering her characteristics both before and during the anthropocene, using the analogy of biological evolution to discuss the advent of the anthropocene, a distinction can be made between coordinated human impacts sufficiently powerful to lead to changes in Gaia's manifested attributes (i.e. phenotype), and those sufficiently powerful to lead to changes in her operating dynamics (i.e. geneotype). Based on this distinction, a variety of possible roles for Climate Science in the work of doing human evolution (Farrell, 2005) are considered and a selection of democratic procedures by which local and global communities of humans might choose to assign Climate Science one or another of these roles are proposed.

Rainer Grundmann

When conceptualizing the relation between knowledge and decision-making, we need to be aware of how we make distinctions and what we think is desirable. This means that our concepts, typologies and theories are heavily dependent on the basic distinctions we make and that there is always a descriptive/analytic element to this as well as a normative. We thus always need to ask two questions: is this framework a good description of reality? And: is this framework desirable and helping us to improve things?

In my contribution I will use the basic distinction between *decision making processes* on the one hand and *levels of uncertainty* on the other (note that I tweak basic distinctions of PNS little: PNS starts from the distinction between *decision stakes* and *systems uncertainty*). In the dimension of decision making we can imagine traditional, top down and participatory approaches as important. And we can assume low or high uncertainty (obviously, there a grey areas in between).

Looking at possible configurations from these assumptions we can identify *normal* technocratic (top down, low uncertainty) politics; *normal* democracy and stakeholder involvement (participatory, low uncertainty). PNS has drawn our attention to the fact that we should not assume low uncertainty as normal. I would like to draw the attention to the fact that in social policy we always deal with (high levels) of uncertainty. It was perhaps a surprise for (policymakers, scientists, and observers) that decisions which were thought to be science based also had to deal with high levels of uncertainty. The technocratic reaction is to invoke science when dealing with this problem. In contrast, PNS wants to extend the social policy model to science based decisions, by making the decision process open to stakeholders. Models such as Actor network theory and co-production models concur.

Others do not emphasize decision making but give science much more prominence. The foremost example is Collins/Evans's 'third wave', Peter Haas's 'epistemic communities', perhaps to some extent also Roger Pielke's 'honest broker'. These models reflect, in different ways, attempts by scientists, engineers, managers and policy makers to pretend that uncertainty could be tamed within the framework of risk assessment and risk management where priority is given to scientific knowledge and expertise.

Which of these models is desirable? Which would improve the current state of affairs? This is a question I have to leave open for now.

Corinna Lüthje

Mediatization of post-normal science

Mediatization of science must be seen as a fundamental and radical process of transformation concerning the self-conception of scientist as well as their everyday practices. Mediatization as a historical, ongoing, long-term meta-process in which more and more media emerge and are institutionalized (Krotz 2007) affects traditional (normal, disciplinary) science in many ways: development of new media, online publication and the practice of producing scientific texts, forms of scientific texts, communication via new media (allowance of scientific organisation despite regional boundaries), and knowledge production (data gathering, storage and analysing). Also the relationship between science and the public sphere is transforming within mediatization by changing science coverage and science's response to media attention (Rödder/Schäfer 2010). Aim of this proposal is to analyse conditions and signs of mediatization of post-normal science using the example of climate research.

Irene Neverla

Science is not the only social field offering narratives to deal with facts, values, stakeholders, decisions. There are other fields in the public sphere holding similar functions with different means. One highly elaborated field is journalism; another upcoming field is Web 2.0 including various sorts of social media.

In my presentation I will explain the 'logic' of journalism and try to explain the 'logic' of Web 2.0 (as far as we can make out for the time being). The logic of journalism is to observe every field of society, mainly politics, economy, law and science - and to select topics that seem to be of general interest. Journalism is an early-warning-system, focusing on novelty and facts which seem to be social relevant. Journalism transforms these facts from various social fields to make them understandable for any other member in society. In this process journalism applies certain professional practices and rules (just like science does) to select topics, to investigate and prove information and to transform facts into narratives.

While journalism is based on the division of labour between the journalists as producers and translators vs. the consumers and media users, Web 2.0 is based on relations between equal participants. However, empirical studies seem to prove that journalism still holds a hegemonial position in defining the agenda of the public discourse, while Web 2.0 is increasingly important in the process of debating, assessing, evaluating and framing the topics.

The overall questions I want to raise and debate are whether the concept of postnormal science may be applied to journalism as well (and thus to any field of knowledge in modern societies); and whether journalism may be a counterpart of postnormal science, by dealing and discussing uncertainty in different ways than science does.

Blogging as a PNS situation

In 2004 I asked the students in my graduate seminar on Science and Technology Policy to come up with a term project in the form of a deliverable. It could be a paper, a website, a talk, etc. One student proposed to create a "Web-Log." At the time I thought that this was a convenient excuse for a project that would allow him to avoid doing some real work.

His project was adopted as the blog for our Center, and I quickly became the primary contributor. The blog was very basic with occasional posts for almost one year. Early in 2005 my friend and colleague Chris Landsea asked if he could post an open letter on our blog explaining his reasons for resigning from the IPCC. I said "sure" and posted his letter. No sooner did this happen that our blog received remarkable attention. We had arrived in the land of post-normal science.

Since 2004 I have become an avid blogger, with a good share of that time spent as a participant/observer in the "climate wars." I am a scholar who publishes in the peer-reviewed literature, a partisan with well-formed views on climate policy and politics, and a critic of the role of climate science in the debates over climate politics. Blogging has been an integral part of these various roles, and in fact, was essential to the writing of my latest book, The Climate Fix. Here I describe a few lessons from my journey to and back from the climate wars in the blogosphere.

1. The blogosphere is a merciless form of peer review

The scientific community often prides itself on the authority that it commands in public debate via the virtue of its collected wisdom, which in publishing is expressed through the process of anonymous peer review.

In my experience, there is no more rigorous or through peer review that an academic will face than through the blogosphere. Such review lacks the formality of the conventional peer review process, and many of its niceties, and is often accompanied by a considerable degree of chaff along with the wheat. But make no mistake; it is far more rigorous than most academics will face in the traditional review process. How such review is handled by the blogger determines whether this review can be turned to the bloggers advantage and benefit, or not. Both outcomes are possible.

2. The blogosphere makes explicit that which conventional peer review often leaves implicit, and that is the values dimensions associated with scientific research.

Blogs have often come to be segregated according to political orientations in the minds of both contributors and readers. In climate science, these orientations are clearly delineated and understood, with every effort made by most participants to segregate blogs into two opposing camps. What the blogosphere does is to make claims of objectivity or neutrality untenable. Participants must explain their values orientation or face having that done on their behalf. This can frustrate the scientist seeking to claim – unbelievably – to be an objective observer focused on science and absent of values. But it forces issues in science into the political arena, where they often, but not always belong. Blogging is unavoidably a political act.

3. Today, blogs are a primary location where post-normal science takes place as post-normal science.

Peer-reviewed journals try to keep up the pretense of being above the political fray. Such a perspective often fails the simple tests of common sense. I can cite many examples based on my own experience. On blogs issues of uncertainty and values conflict are unavoidable, even if efforts are made to avoid them. Understanding what is going on in blogs – the interactions, the debates, the personalities, etc. – is as complex as understanding any human interactions. This should come as no surprise. What blogging has changed is that it is has forced such characteristics which were once well hidden behind the walls of the academy out into the open. This forces scientists to deal with a new context, one outside the ivory tower, but at the same time it forces the rest of society to deal with it as well. Situations of post-normal science can be disruptive for all involved.

Jerry Ravetz

Post-normal science – a critical review

The existence of this workshop shows that 'post-normal science' is still worth examining and criticising. The idea is now nearly thirty years old, and seems to be really coming in from the margins. Because it had not previously been exposed to the systematic criticism of students or of colleagues, many obscurities in its original formulation have remained. Recent studies by colleagues, organised by John Turnpenny, and criticisms on the blogosphere, notably by scientistfortruth and Willis Eschenbach, have stimulated me to serious reflection. This is an appropriate occasion for these obscurities to be aired.

First, the organisers of this workshop have distinguished between PN 'situations' and PN 'practice'. This distinction improves upon the original, where the term PN 'science' (itself somewhat provocative) covers both meanings. One reason for this damaging ambiguity is that in our writings we said very little about PN practice, even though there were already examples (mainly in community-based research on health and safety issues) available to be cited and analysed.

The most salient problems with contemporary PN theory have to do with its interpretation in policy issues. It has proved to be all too easy for the 'extended peer community' to be interpreted as a shallow 'political correctness' or even as 'political determination' along the lines of Lysenko. Supporters of PNS have on occasion strayed into the former, and hostile critics on the blogosphere have seen the latter. Again, by failing to anticipate these misinterpretations (or better, alternative interpretations), we did not erect warnings. Worse, when colleagues were making these interpretations, we did not make public clarifications. As a result, it was natural for critics on the blogosphere to make PNS doctrine responsible for what they saw as the dishonesty and corruption of AGW science.

One reason for the absence of clarity on this issue was our failure to offer a serious discussion of Quality. If Quality does not relate to Truth, then what can it be other than popularity? It is not easy to give a simple definition of Quality other than 'fitness for function', which presupposes far more than it explains. When challenged, I failed to respond appropriately. A proper essay on Quality would demonstrate its complex and recursive properties, and relate its practice to Integrity. Elswhere (in the *No-Nonsense Guide to Science*) I did discuss quality in PN situations, invoking 'negotiation in good faith' as a principle.

Another related serious error was in my casual jettisoning of Truth. I was aware of a century of philosophical discussion of science in which that idea has been sidelined, but my

correspondents in the blogosphere were not. Also, there is a personal interpretation of Truth, which might be called 'truthfulness', which is very relevant here, and also relates to Integrity. By invoking that I could have managed many criticisms.

Shorn of the traditional epistemological foundations for ethics in science, my account of PNS lacked defences against the question, "Why not cheat?". Indeed, I have been seen by some as the corrupter-in-chief of the climategate scientists. Here my defending argument would have been along the lines of science as one of the 'fiduciary professions', where the maintenance of trust is essential, although not always present. In my old book I argued that in the absence of morality, quality would suffer, and in the absence of quality, research would become vacuous. Thus our objective knowledge depends on the subjective commitments of the researchers. A nice paradox!

Then there was a misunderstanding about 'Normal'. For most people it has the connotations of being the right sort of thing. For me, however, it refers (partly!) to Kuhn's image of a dogmatic, myopic practice.

In summary, it is hardly surprising that some people took PNS to be a thoroughly confused and pernicious doctrine! Of them, I have said (paraphrasing the Jewish motto) with such enemies who needs friends? Seeing it all in historical context, now that such issues are clear for me, there is a chance that I could belatedly build a philosophically interesting theory of PNS out of the original practical insight.

Mike Schäfer *& Ana Ivanova, Inga Schlichting, Andreas Schmidt*

Post-Normal Media Relations? Results from a Survey of German Climate Scientists.

Climate science has been under intense scrutiny from the broader public for a while. The mass media function as a crucial link between the scientific community and the public in this process. Their importance, of course, is also perceived within science – and increasing media requests as well as the chances to use the media as an instrument might lead to a change in scientists' media relations.
Peter Weingart and others have described this (potential) change as an ongoing "mediatisation" of science in general. It involves more media experiences and contacts as well as an adaptation of scientists to the media. For example, they might be willing to adapt to the media needs to a degree that compromises scientific norms, and/or make research decision based on (assumed) media reactions.
Drawing from an online-survey of some 1,100 German natural and social scientists whose research is related to climate change, the presentation will assess whether such phenomena can be found within climate science, and how widespread they are.

Reimund Schwarze

Is Post-Kyoto Post-Normal policy making?

The Kyoto-Protocol is about to collapse (at least in its previous structure and composition) during the upcoming conference in Durban (COP17). International climate politics transforms successively into a global discourse on sustainable development. The mechanisms to translate global discourses into international legal frameworks are still lacking, the outcomes weak - as a survey on the work of the UN-Commission on Sustainable Development demonstrate. Similarily, the links between CSD processes and UNFCCC are weak and eclectic. This talk will summarise the current state of international climate politics and contemplate about how a 'bottom-up' mode of climate policy making could be more effective and more coherent with international frameworks on sustainable development.

Richard Tol

How Social Scientists deal with postnormal problems

Social scientists deal with the "post-normal" problem in two ways. First, it is a central part of university education. Second, having been taught and teaching this problem, the community is acutely aware. There are a number of more concrete recommendations. (1) Self-reflection is dangerous. Academics are peculiar people, unrepresentative of the masses. Their opinions are probably not shared by the majority. (2) Passion is dangerous. Young scholars should be led to subjects that fascinate their brains rather than to topics that excite their hearts. (3) Play devil's advocate – not just in the lab and in academic papers, but even more vigorously when advising policy. Teach your audience how to overturn your recommendation – and leave them to judge the plausibility of the assumptions. (4) Embrace dissensus. Policy advice is best not given by an individual. Groups are better. Groups that disagree are better still. (5) Focus on quality. Low quality research is irrelevant. Second-rate analysts are just that.

Shelly Ungar

Post-Normal Viral Science and Public Resistance

Viral outbreaks are as old as history, but recent scientific breakthroughs have created conditions congruent with post-normal science. Virologists can now rapidly identify and sequence new viruses and track their mutations and virulence. Critically, viral mutations remain unpredictable, and medical authorities, armed with their new discoveries and fixated on the 1918 Spanish Flu, have treated recent non-seasonal viral outbreaks (SARS, Avian flu and 2009 H1N1) as all but apocalyptic threats demanding urgent responses. But none of these fears materialized, and the accumulating "errors" seem to have diminished public faith and trust in the efforts of scientists. An examination of public responses to 2009 H1N1 in Toronto suggests that in coupling uncertainty and sensational claims, creating a compendium of the worst that could happen, authorities lost control over the portrayal of the problem. First the

flu itself came to be deemed mild in public discourse; then the safety of the vaccine was challenged as far fewer people than expected got inoculated; finally, the role and interests (financial and otherwise) of the leading guardians of public safety were queried, and scientific spokespersons were compelled to defend the claim that the pandemic was "real". In the realm of viruses at least, the public has seemingly intuited that the level of stakes cannot be determined independent of the amount of uncertainty that exists. Presumably, scientific claims about climate change also run the risk of engendering public reactance.

Jeroen van der Sluijs

Fruitful dissent:
a pluralistic and uncertainty-aware approach to governance of climate risks

A break-through is needed in understanding and appreciation of deep uncertainty and scientific dissent on climate change. This will help science and society forward from perceiving uncertainty and scientific dissent as a paralyzing problem that hampers progress in science and stalemates policy making, towards engagement in a fruitful dialogue between conflicting yet legitimate scientific views on an inherently complex issue.
Two strategies dominate current practice of scientific fact finding on climate change: uncertainties are either downplayed to promote radical climate policies (enforced consensus/overselling certainty) or they are overemphasised to prevent government intervention in the economy. Both promote policy strategies that have extreme error-costs for society.
For the governance of climate risks, the "Modern model" of scientific knowledge as perfection, determinism and predictability [speaking truth to power] is increasingly untenable and unfit. This mismatch promotes an infinite loop of demand for more research and sustained doubt whether the limited state of knowledge can justify any interventions. In view of complexity and deep uncertainty, it needs to be replaced by a model of pluralistic knowledge production, aiming at enhancement of quality and relevance of knowledge for policy, while fully acknowledging pluralism of relevant views of reality, complexity, and incompleteness of our understanding [working deliberatively within imperfections]
From this, one can develop new joint scientific insights on complexity and new robust and resilient uncertainty-aware and socially robust science-based decision strategies for governance of complexity.

Hans von Storch

Climate Services under Post-Normal Conditions

After climate science has left the ivory tower for good, knowledge about climate, climate change and climate impact has become an important staple for the decision and planning process among stakeholders. Such knowledge is asked for for determining and preparing response options for both adaptations to climate risks and for mitigation of global and local

climate change. Providing such knowledge to stakeholders and the public is one of the tasks of Climate Services. Another task is the determination of questions among stakeholders and the public about climate issues as input for the scientific agenda.

In general, this may be a relatively simple effort of a straight forward exchange of technical details, and it is often seen in scientific quarters as such, which may be confronted with some minor mainly pedagogical obstacles. When facts and interrelations are properly explained, an uneducated audience will eventually understand the issues, the significance and draw the "right conclusions".

This "linear model" has been found inadequate. In particular in post-normal situations, the communication task amounts to a major challenge, because of the omnipresence of interest-led and culturally based competing knowledge claims. These claims are not only communicated by interested parties directly to stakeholders and the public; they are often also part of, and consistent with, culturally hold views about climate, its impact and causes for change – not only in the public but also in the scientifically educated population. The effect is not only that some scientists adopt advocate positions, but also that the communication of scientific findings, which have passed something like the traditional Mertonian rules of credibility, finds a reluctant and skeptical audience, while explanations by advocates are more welcome.

Of course, it is not really possible to separate "scientifically" and "culturally constructed" knowledge claims. Most scientific results are based to some extent on cultural constructions. The influence of culture is ubiquitous, also in scientific circles. A science in a post-normal phase is well advised to have mechanisms for self-reflection in place, to allow scientific actors being aware of the social dynamics, of which they are part of, and possibly limit the influence of alternative knowledge claims in their scientific practice.

Thus, climate services under post-normal conditions must guard itself against the intrusion of scientifically contested but culturally favored knowledge claims – which will be unavoidable to some extent – but in its communication practice deal with alternative knowledge claims, which are present among stakeholders and the public. Climate Service is a service to both, stakeholders and the public on one side, and the scientific community on the other side.

Eduardo Zorrita

Learning how to play hockey - a contact sport in climate science

The public image of the 'hockey stick', the reconstruction of the Northern Hemisphere mean temperature in the past millennium, has undergone a remarkable transition since it was put forward by Mann, Bradley and Hughes more than 10 years ago. Initially, it became the iconic proof of the human influence on climate, to be later demonized as a typical example of the sloppiness and politicization of the whole of climate science. I, together with Hans von Storch, experienced during these years many of the side effects that the hockey-stick had and still has on the climate debate, and could be a close witness of the degree of instrumentalization, from both sides of the debate, that a scientific study like the hockey stick has brought about. I will try to summarize in this short talk my personal experiences and learning curve surrounding the hockey stick and the lessons.

From my perspective, the basic message from this experience is unfortunately rather negative. I could follow through these years the growing degree of confusion, and half-truths wielded by interested parties of all kinds and colours. To this particular issue, the hockey-stick, I could always discern who was conveying a more or less honest view and who was just meddling in troubled waters. These roles, interestingly, also flipped over time. Along this experience I

became very well aware of the futility of scientific debates within the society as a whole, and thus about the limitations of democracy in a technologically advanced world: In any other scientific debate, say about stem cells, genetically modified crops, etc., in which my expertise would just match the average educated person, I would feel overburden and confused - as many people now feel about climate science. And yet I would have to participate, as a citizen of a democratic society, on decision processes knowing that I am hopelessly disinformed.