Europe Adapts to Climate Change

Science–policy interactions in national adaptation policy

September 14 - 15, 2009 Academy building, Utrecht, the Netherlands

- Workshop proceedings -

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Content

Introduction

According to the PEER study "Europe adapts to climate change: Comparing National Adaptation Strategies", science-policy interactions form one of the core themes that are of importance in developing and implementing adaptation strategies. The study showed that countries have very different approaches in facilitating the science-policy interactions to support the development of adaptation strategies at all levels of governance. However, the study also showed there has hardly been exchange of experiences between countries. Through a workshop, the experiences from different countries that are considered to be frontrunners in climate change adaptation were brought together.

There are perhaps no other examples in the environmental sciences where the science and policy relationship is stronger than for climate change. Humans are only able to observe current weather and weather changes in the recent past, but our current understanding of anthropogenic climate change is also framed by long-term future climate change projections. Scientific evidence of long-term changes in the climate system and associated impacts makes climate change a scientifically constructed policy problem. The overwhelming scientific evidence gathered in the last decades has pushed climate change high on political agendas and created a sense of urgency for sectors, regions and individuals vulnerable to climate change.

However, the relationship between science and policy is full of challenges. When the boundaries between science and policy get blurred, the credibility and legitimacy of both scientific research results and policy decisions are questioned in public debates. How does the politicization of science and the scientification of policy affect the decisions on climate change adaptation? Second, there is the issue of uncertainty: although climate change is one of the most researched environmental issues to date and climate change is assessed to be unequivocal, considerable uncertainties remain in rate and scope of future changes that pose serious dilemmas to policy makers. Would it be necessary to gain more knowledge about climate change to reduce uncertainty? If so, what kind of knowledge is needed and how should it be presented? If not, how can we prevent that uncertainty is used as excuse for doing nothing? Would better communication of these scientific uncertainty increases the likelihood of successful adaptation? Finally, how should the science-policy interface be best designed to address the challenges of credibility, legitimacy and uncertainty? What are successful examples of these practices? What can we learn from each other?

Therefore the aim of this workshop is to share experiences of the science-policy interface between scientists and policy makers of countries that are relatively well advanced in climate adaptation strategies. A mixture of policy makers and scientists that operate at the boundary of science and policy was invited. These people – the boundary workers – can fulfill a prominent role in the current discussions on climate change and navigate through the many challenges scientists and policy makers face in discussions on climate change adaptation. We hope this workshop has shown some of the state of the art science, some practical approaches, experiences of boundary workers and new insights that advance the discussions within and between both communities.

These proceedings summarize the results of the workshop 'science-policy interactions in national adaptation policy' held September 14-15, 2009, Utrecht, the Netherlands. These proceedings include the abstracts of the presentations. In the few cases where no abstracts were submitted, we added a short summary based on powerpoint presentations. All presentations are available on the Knowledge for Climate website[1]. We kindly thank all speakers and participants for their efforts, discussions and food for thought. Our thanks also goes out to the reporters, Marjolein Pijnappels and Kirsten Hollaender, for taking detailed notes during the presentations and discussions. This workshop would not have been possible without the financial support of the Dutch 'Knowledge for Climate' research programme, the CIRCLE research programme and the Finnish ministry of Agriculture and Forestry. Finally, we also like to thank Ineke van Bijssum for her assistance in organizing this meeting.

Wageningen (The Netherlands), October 2009

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[1] (http://knowledgeforclimate.climateresearchnetherlands.nl/nl/25222857-Workshop_Science_Policy_interactions.html


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Plenary session 1: Working at the boundary of science and policy

The aim of this session is to understand the problem and complexity of developing adaptation policy within countries. The relationship between science and policy is one of the most discussed subjects in coping with complex (environmental) problems. More or better scientific research results on climate change will not automatically result in more effective adaptation policy. For information to become useful, mechanisms need to be established that facilitate communication, translation and mediation of this information across existing boundaries between science and policy. Moreover, the need for knowledge needs to be articulated to fit the epistemic communities. This session introduces theory and practice of science-policy interactions in climate change adaptation and reports on the development of science-policy in some of the frontrunner countries of the European Union.

Welcome by Pier Vellinga (WUR, NL)
Pier Vellinga, one of the directors of the Dutch Knowledge for Climate research programme, welcomes the participants to the workshop. He stresses the fact that a great number of activities are taking place in Europe recently, however, the science-policy interface has yet not received a lot of attention. But, communication and even more importantly listening to each other are vital for successful adaptation. Co-creation of knowledge by science and society is absolutely essential in adaptation to climate change effects. There is a great need for mainstreaming climate knowledge. Adaptation strategies are needed on all governance levels.

1.1 Theories on science-policy interactions in climate change adaptation
Chris West (UK Climate Impacts Programme, UK)

Chris West supports the transition from Lenny Smith's paradigm 'Predict, Optimise, Relax' as a suitable strategy for adaptation to climate change to a new paradigm 'Assess, Hedge, Review'. Adaptation is never finished and uncertainty can never be reduced to zero. Uncertainty should be made explicit so policy makers can be empowered to act. Right now scientists promise current uncertainties will be reduced in the future, which disempowers policy makers to act.

According to Chris, one could argue that the implementation of the new paradigm could be the sole responsibility of either scientists or policymakers, but implementation will be most efficient if scientists and policy makers are equally involved. A third important player is the practitioner, e.g. the manager of an actual climate change adaptation project. Practitioners have to actively participate in the process of adaptation to climate change to make it a success. Most important though is that people start listening to each other. Scientists and policy makers are too often convinced of their own view point, even though every human being has *two* ears and but *one* mouth, which should teach us something about the importance of listening versus speaking.

One way to assess species (animals, plants, bacteria, etc.) is to divide them into K- and r-species. The former are very specialised, which is a very useful strategy in a stable environment which doesn't automatically rule out the weaker individuals. In a quickly changing environment it is a useful strategy to breed as quickly as possible, to enhance the chance that at least a few of your offspring are well-adapted to the change: this is what the r-species do. Humans could learn from this example: we live in an increasingly changing environment, where resilience gains in value and efficiency (specialization) looses, even though we have been moving towards more and more efficiency and specialisation, disfavouring resilience. Ironically, from other perspectives humans are an example of a species that has actually moved from K- to r-species: we are reproductively very efficient and have

managed to colonize a number of different environments due to our technology and health care system.

Models, scenarios and projections are still useful methods for adaptation to climate change, but the timing of use of these tools is very important. The new probabilistic climate scenarios of UKCIP are very useful, but the policy makers should not learn about them too soon. Better adaptation strategies are likely to emerge if policy makers identify potential risks first and only after that analysis take the (probabilistic) projections/scenarios into account. They will then understand and use these scenarios better.

1.2 The role of research in implementing the Finnish National Adaptation Strategy

Tiia Yrjölä (Ministry of Agriculture and Forestry, Finland)

Abstract
Finland's National Strategy for Adaptation to Climate Change, published in January 2005, gives a detailed account of the impacts of climate change in different sectors and presents measures to be taken until 2080.The objective of the strategy is to reinforce the adaptive capacity of the society and minimize the adverse impacts of climate change as well as, where appropriate, take advantage of its benefits. Priorities identified for improving the adaptation capacities include (i) mainstreaming climate change impacts into sectoral policies; (ii) targeting long-term investments; (iii) coping with extreme weather events; (iv) improving monitoring systems; (v) strengthening research and development and (vi) international cooperation.

The preparation of the Adaptation Strategy coincided with the implementation of the research project FINADAPT (2004 - 2005). The project gave significant inputs to the preparation process and some of the researchers involved were also the same. Different sectors of society - e.g. agriculture, forestry, water resources and environment - are currently implementing the strategy primarily through sector-specific programmes. For example, the Ministry of the Environment together with the Ministry of Agriculture and Forestry has prepared an action plan of concrete measures in order to adapt in fields such as biodiversity, land use and construction, environmental protection and the use and management of water resources. The implementation process is being gradually extended into the regional and local levels and even into institutional action plans.

The Coordination Group for Adaptation to Climate Change follows and promotes the implementation of the Adaptation Strategy. The Group also conducted the evaluation of the implementation in winter 2008-2009. The evaluation of the implementation of the Adaptation Strategy was concerned with whether and how the measures presented in the strategy have been launched in different sectors. The most advanced sector in the implementation of the Adaptation Strategy has been water resources management, where adaptation to climate change is well integrated into the decision-making. In the transport sector, spatial planning and agriculture and forestry the implementation of the Adaptation Strategy has also proceeded quite well, but in most sectors the work is only getting started. The private sector, including tourism and insurance sectors, is capable of adapting to the risks posed by the changing climate quite rapidly, even if less action were taken in the public sector. The Evaluation of the Implementation of the Adaptation Strategy does not include the adaptation measures launched in the private sector, which is why the view of the level of adaptation in these sectors may be incorrect. According to the preliminary adaptation indicator developed in the context of this work, Finland, on average, is on step 2 in adaptation (on a scale from 1 to 5). This means that among the decision-makers there is at least some understanding of the impacts of climate change and the need for adaptation measures has been recognised, at least to a certain extent. Some

practical adaptation measures have also been identified and plans have been made or even launched for their implementation.

The implementation of the Adaptation Strategy should be enhanced by increasing the resources allocated to adaptation research and awareness of climate issues in decision-making at all levels. The implementation of adaptation measures in practice also calls for more cooperation between sectors, especially at the regional level. Finland's National Strategy for Adaptation to Climate Change will be reviewed in 2011–2013 and, besides the new needs identified in Finland, the content of the strategy will be revised on the basis of the adaptation strategy work in the EU and more extensive international cooperation in the context of climate change adaptation.

The Climate Change Adaptation Research Programme (ISTO 2006–2010)
The precondition for launching the adaptation measures is the recognition of the need for adaptation to climate change in different sectors, which in turn must be based on applied research on adaptation and communication of the results in a way that allows their utilisation in decision-making. The Climate Change Adaptation Research Programme (ISTO 2006–2010) implements the Adaptation Strategy by providing funding for research aimed to produce information in support of the planning of the practical adaptation measures. In 2006–2009 the Ministry of Agriculture and Forestry, Ministry of the Environment, Ministry of Transport and Communications and Ministry for Foreign Affairs funded 28 projects under the ISTO programme by about 0.5 million euro's a year. The Coordination Group for Adaptation to Climate Change also functions as the steering group of the Climate Change Adaptation Research Programme ISTO, as well as supports the preparation of the adaptation policy in general. This enables exchange of information between the ISTO programme, researchers, ministries and other funding organisations.

The Climate Change Adaptation Research Programme ISTO has produced a lot of useful information in support of the adaptation measures, but the smaller resources than was envisaged have not allowed comprehensive studies on all relevant sectors. The mid-term evaluation of the ISTO programme was conducted by an external party in 2008. According to the evaluation, the ISTO programme has, despite the limited resources, succeeded quite well in raising the awareness on climate change and the required action. However, the funding for the programme has been only about a third of the planned level, which has been directly reflected in the research projects launched and small number of sectors covered. Of the 20 fields of research defined in the planning document of the research programme only 9 had been covered. Fields that have not been addressed include, for instance, the health sector, many fields of business life and cross-sectoral research.

According to the mid-term evaluation of the ISTO programme, towards the end of the programme period the focus should be on the actual adaptation measures and studies should be launched on issues identified in the planning document which have so far been neglected. In particular, the resources for producing regional climate change scenarios needed in the local adaptation measures and studies on adaptation in different sectors should be ensured for the last years of the ISTO programme.

Future research on adaptation
According to the evaluation, the current resources of the programme and the two years (2009 and 2010) of the programme period are insufficient relative to the needs. The development of long-term climate policy and decision-making on this requires a well-defined plan on how the sufficient information and the resources for the implementation of the adaptation to climate change will be ensured in future. The Advisory Board for Sectoral Research was established in 2007 to coordinate the overall steering of state sectoral research. Its action is geared to support and strengthen performance management of sectoral research in each field of administration. The aim is to improve

ministries' commissioning know-how, enhance the targeting of sectoral research and step up the utilisation of research over administrative boundaries. The Advisory Board will launch a call for a climate research programme in 2009. The new climate research programme aims to continue the applied research that is important for the implementation of the Adaptation Strategy.

The Academy of Finland is preparing a new, extensive multidisciplinary climate programme FICCA, which will get started in 2010.

References:

Ministry of Agriculture and Forestry.(2005) Finland's National Strategy for Adaptation to Climate Change. Available at www.mmm.fi

Ministry of Agriculture and Forestry (2009) Evaluation of the implementation of Finland's National Strategy for Adaptation to Climate Change. Available at www.mmm.fi

Discussion

The role of scientists is very relevant, however should be in line with the aim for concrete results and guidelines in order to assist decision makers. It is very important to have results that are easily accessible. These results go beyond data and also include recommendations for actions. Finland is ahead of Europe with adaption, this may be due to a great momentum for adaption. Additionally, coordination takes place within the ministry, at a high policy level.

1.3 Science-policy interactions for climate-proofing the Netherland

Peter Driessen/Kees van Deelen (Knowledge for Climate, the Netherlands)

The Knowledge for Climate (KvK) programme has been initiated from the science institutes, but tries to involve society (stakeholders such as policy makers and the private sector) by starting out with projects in eight designated 'hotspots'. There is also an international component. The next phase of the programme, which has just started, takes on a more scientific approach. Consortia have been given the opportunity to write research proposals for an open call. Consortia are obliged to allocate 5 percent of the budget to international projects/research.

In the Netherlands there are or have been several projects, programmes and committees which try to tackle the climate challenges of this country. The Knowledge for Climate programme tries to come up with useful adaptation strategies after studying the effects and consequences of climate change for the Netherlands. Secondly, a second Delta Committee was established, which recommended a strategy to keep the Netherlands safe in the centuries to come. The Committee proposes an investment of 100 billion euros over the coming 80 years to keep the Netherlands safe. There is close cooperation between the second Delta Committee and the Knowledge for Climate programme. The chairman of the second Delta Committee, Cees Veerman, is also the chairman of the supervisory board of the Knowledge for Climate programme. The Programme participated in making the sea level rise scenarios. The second Delta Committee took a national top down approach, Knowledge for Climate will provide the regional solutions.

Transboundary cooperation is very important for adaptation strategies for transboundary rivers. The Knowledge for Climate programme includes an extensive Rhine river management research project, in which also German stakeholders are involved. Another project where cooperation with Germany is important is the hotspot Wadden Sea. In the South-Western Delta cooperation takes place with Belgium.

An important thing that should be considered when devising adaptation strategies is the cost of inaction. This will also be taken into account in the research projects of Knowledge for Climate. In the scientific phase that is to start soon, there are two crosscutting (of eight in total) themes in which the social sciences play a dominant role, and in which this aspect will certainly be taken into account. In some of the other themes some social-economic aspects will also be taken into account. Cross-linkage with social and economic sciences is valuable, but difficult and a real challenge. Knowledge for Climate has only just started to bring in the economics. Cost/benefit-analyses have been performed in the past, but with mixed success because of numerous difficulties quantifying future benefits (or costs of inaction), amongst other reasons because of difficulties with selecting future interest rates. For the first call a closed tender approach was used (the hotspot call). This was done for two reasons: first of all the programme showed it had real trust in the eight designated hotspots to come up with good ideas and because the programme wanted to stimulate the hotspots as much as possible to come up with good ideas.

1.4 Norwegian adaptation policy: where is the research?

dr. *Grete K.Hovelsrud* and *Halvor Dannevig*, CICERO, Center for International Climate and Environmental Research-Oslo

Abstract

In this short paper we explore the connections between science and policy in placing adaptation on the governmental agenda. We examine the various processes within government and scientific institutions, such as the Norwegian Research Council, and discuss how the science have informed or have been instrumental in shaping the focus of the current policy on adaptation.

Adaptation to climate change emerged as a research topic in Norway at the beginning of this decade, spurred by the emphasis given to adaptation in the IPCC 2001 report. Several smaller research projects was initiated that resulted in various publications from 2003 and onwards. This was also the year when adaptation fully emerged on the agenda at the governmental level in Norway, through a whitepaper from the Ministry of Justice and Police (Report to the Storting no. 39-2003-2004, Husabø 2008). The whitepaper recognizes that climate change would have an effect on all areas of the society, and that it therefore was to be considered as a matter of "security". The report was partly written by officials at the Directorate for Civil Protection and Emergency Planning (DCPEP), and the responsibility for follow up work was assigned to DCIP. An official governmental report in 2006 (NOU 2006:6) also states that climate change possess a new security threat, but few concrete measures was presented in this report. In 2007 a cross-ministerial working group administered by the ministry of Environment was established, with a secretariat administered by the DCPEP. This secretariat coordinates what is now called the "Norwegian Climate Adaptation Programme". In 2005 the Arctic Climate Impact Assessment (ACIA) was presented to the Norwegian Parliament, which clearly stated that the temperature rise is substantially higher in the Arctic than the global average, and that the arctic areas of Norway would be heavily affected by climate change. It was decided to make a Norwegian follow-up, NorACIA, which since then has produced reports on climate change in the Norwegian Arctic, impacts on the Barents Sea and marine ecosystems and consequences for people and communities In 2008, the government issued an official statement on the national adaptation policy with three goals: 1) Map vulnerability and incorporate adaptation into planning 2) create more knowledge on climate change and adaptation and 3) stimulate to coordination, information and competence building. Then in 2009, a Governmental commission on climate change vulnerability and adaptation (named "Flæte Commission" after the chair O. Flæte) was created by the Minister of Environment, which will present their report to the government late 2010. In early 2009, the Adaptation Programme launched a web portal on adaptation (www.Klimatilpasning.no) , which presents research results targeted at decision makers in public and private sector, best practices on

adaptation and information from ongoing adaptation related projects. The government's current policy, as it is stated by the Adaptation Programme (DCEP 2009), is that i. all levels of government and sectors have an independent responsibility for adaptation, ii. that the government will work to strengthen the flow of information vertically and horizontally across sectors and levels of government, and iii. would get more knowledge on the consequences of climate change and adaptation.

With respect to research, the most important effort has been the ten year long NORKLIMA program for research on climate change and climate change impacts in Norway. The program was launched by the Norwegian Research Council in 2004 with an annual budget on 70-95 mill NOK (amounting to approximately 10 mill euro). The program had initially little funding for social sciences in general and virtually nothing on adaptation in particular. But the calls gradually started to include this, after lobbying by the DCEP and the leading climate research institutions. In 2007 and 2008 several large adaptation and vulnerability research project were funded, all targeted at policy making. But at the moment there is no more funding available in the program for new research projects on adaptation.

Thus, many processes have taken place in the recent years, both within government and science. Strategies and planning documents have been generated and scientific programs have been created. The different processes have resulted in the establishment of the governmental commission on adaptation in January 2009. Even though adaptation has been on the agenda since 2003, it is fair to suggest that at the policy level, adaptation is still in its early face in Norway. There are few concrete measures taken in respect of economic incentives, laws and regulations and clarification of responsibilities between sectors and different levels of government for the purpose of adaptation. The Norwegian approach to adaptation has been to gain more knowledge and understanding about the consequences of climate change. The lack of concrete policy measures for adaptation and the relative large effort given to adaptation research suggest that Norwegian adaptation policy can be characterized as a "need to know before we act"-approach. Even though statements from the Minister of Environment (Dannevig 2008) and official reports (Ministry of Environment 2005) clearly states that there is a need to act simultaneously with gathering and creating more knowledge. With respect to the relationship between research and policy development, IPCC 2001 and 2007 reports, the ACIA report from 2005 and the Stern review from 2006 have been instrumental in pushing adaptation forward on the government's agenda. Climate change research results have as well been important in framing the need for adaptation across different sectors. The effect of adaptation research results on the current adaptation policy is at the other hand hard to identify, even though the adaptation research is targeted at policy needs.

References

Dannevig, H. 2008. Brukerkonferanse om klimakonsekvenser. *Klima* 4-2008, pp. 39

Directorate for Civil Protection and Emergency Planning. 2009. About the Norwegian Climate Adaptation Programme. Accessed at http://www.regjeringen.no/nb/dep/md/kampanjer/klimatilpasning-norge/mer-om-klimatilpasningsportalen.html?id=540010, 30.08.2009

Husabø, I. A., 2008, Exit War, Enter Climate? Institutional Change and the Introduction of Climate Adaptation in Norway's Public System of Civil Protection, WNRI Report 9/08. Western Norway Research Institute, Sogndal.

Ministry of Environment. 2005. Rapport om sårbarhet for og tilpasning til klimaendringer i sektorer i Norge En oppfølging av interdepartementalt seminar 31. august 2005 om tilpasning til klimaendringer

Ministry of Justice and Police. 2004. Samfunnssikkerhet og sivilt-militært samarbeid. Stortingsmelding nr 39.2004. Det kongelige norske justis- og politidepertatement.

Report NOU. 2006. Protection of critical infrastructures and critical societal functions in Norway. submitted to the Ministry of Justice and the Police by the government appointed commission for the protection of critical infrastructure on 5th of April 2006. English Summary.

Discussion

Currently, Norway is in the midst of preparing for general elections. To date, in the pre-election campaigns climate change and adaptation barely play a role. Two years ago, there was much more attention for this topic. The ministry shows great concern for cost effective measures, however focuses more on carbon capture and sequestration technology development instead of climate science. Thus, the funding situation is difficult. For instance, Norway potentially is also suitable for wind energy, however this potential is not being realized. Apparently, efforts are not well coordinated. There is a cross-ministerial working group on adaptation which amongst others coordinated different ministries and supported the development of a web page service on research results, but this seems to be in an early phase. It might be due to the fact that this is done top-down, such measures are normally not as easily picked up as bottom-up initiatives.

1.5 Science-policy interactions for climate change adaptation in Sweden

Louise Simonsson (Centre for Climate Science and Policy Research, Sweden)

Abstract

In Sweden, the 2005 storm 'Gudrun' had severe consequences for society and individuals, with the forestry and insurance sectors particularly affected. The aftermath of Gudrun led to the governmental initiation of the Swedish Commission on Climate and Vulnerability, which – alongside other national and international events and publications on climate change and climate risk (e.g. the IPCC AR4, the Stern Review) – introduced and emphasized the need for adaptation to occur alongside mitigation, which hitherto had been the main focus for Sweden's climate debate. The main conclusion from the Commission was that '*It is necessary to make a start on adapting to climate changes in Sweden. The principal features of the climate scenarios, despite uncertainties, are sufficiently robust to be used as a basis*.' (p. 11 in SOU 2007:60[2]). The launch of the Commission, taken together with other newly launched political documents, such as the proposals from the Climate Committee (SOU 2008:24[3]) and the Climate Bill (Prop. 2008/09[4]) suggest and instruct about responsibilities and distribution of roles in Swedish context. These documents are not an adaptation national policy *per se* but they show that all levels of Swedish society have become included in the management of climate change.

Knowledge base on adaptation to climate change in Sweden

The approach to research approaches on climate adaptation in Sweden has mainly been 'top-down' where the research before the Commission was initiated primarily was focused on climate modelling and development of regional climate models and scenarios together with some studies on impacts and identification of vulnerable biogeophysical systems. The Commission ordered several studies in order to be able to fulfil its task of assessing vulnerability and adaptation options and costs in Sweden. During the last couple of years these studies have become complemented with 'bottom-up' research of the other aspects of adaptation such as adaptive capacity, social vulnerability, socio-

[2] SOU Swedish Government Official Reports 2007:60 (2007) Sweden facing climate change – threats and opportunities. Final report from the Swedish Commission on Climate and Vulnerability, Stockholm

[3] SOU 2008:24 (2008) Svensk klimatpolitik. Miljödepartementet. Ministry of Environment, Stockholm, Sweden.

[4] Prop. 2008/09:162. (2009) En sammanhållen klimat- och energipolitik. Miljödepartementet. Ministry of Environment, Stockholm, Sweden.

economic factors, institutional response, social learning etc. However, much research is still directed towards modelling and down-scaling of climate, impacts and also economy. Since few of especially the social science projects are not yet finalized, or findings ready for implementation, public and private sectors mainly seem to rely on information sources for adaptation strategies and policy from the IPCC, National Authorities, the Commission on climate and vulnerability, the Climate Bill, sectoral studies and occasional site-specific academic studies.

Who is responsible for adaptation to climate change in Sweden?
Besides national authorities, the Commission also suggested that municipalities and County Administrative Boards take on additional responsibilities for adaptation which have been implemented to various degrees. Beyond the requirement that local and regional authorities have plans in place for dealing with accidents and extreme events, these authorities provide only weak legislative support for adaptation measures. However, while explicit mention of climate change is missing in the supporting legislation, there is nothing to stop local and regional actors from exploring and implementing adaptation measures. In the absence of both national legislation and guiding regional policies, such action has had to be primarily based on local initiatives and the locally perceived need for adapting to a changing climate. Thus some municipalities in Sweden have come quite far in their formulation of policies and discussions on implementation of adaptation to climate change into their existing activities. Also, mitigation and adaptation are often referred to in combination where Energy and Crisis Management Preparedness Plans can be entry points to formulation of Climate Strategies.

The Commission on Climate and Vulnerability also identified a number of regional and national organizations and authorities that have a direct role in facilitating national adaptation processes, as well as those actors that indirectly will have to integrate climate considerations in daily decisions. The work done by the Commission was performed with stakeholder involvement. However, who the adaptation stakeholders are in Sweden naturally varies depending on who is defining them. The Commission states that it is clear that the division of responsibilities is distributed between individual citizens, business, municipalities and the state (ibid p. 617). However in a study of the Stockholm region (Simonsson et al forthcoming 2010[5]) a stakeholder mapping with some of the concerned actors responsible for the implementation of adaptation mentioned the following bodies and actors as important for adaptation: the EU; National Government and Ministries; Public Authorities; Regional Administration; Regional organizations; Commercial and Industrial life; Municipalities; Public Water Companies; Developers; Property Owners; Citizens; Schools and Education; Universities and Research; Media; Trade Unions and NGOs. However, the importance of the mentioned stakeholders varies, some being more directly involved and/or having more influence.

Implementation of adaptation measures
Sweden is a highly developed country, with a high degree of social capital and adaptive capacity that can serve as foundations for successful adaptation responses. However, Simonsson et al's study indicates that, of all the factors that appear to be obstacles to effective adaptation, issues of organization (e.g. too little coordination within organizations and between actors); conflicting interests; and lack of will and opportunity to prioritize adaptation measures are the most difficult to solve. In contrast, it seems it is possible to solve problems around technology, information and funding if there is a will to do so. The fact that legislation and division of responsibilities is still weak

[5] Simonsson, L., Klein, R.J.T., Gerger Swartling, Å., André, K. and Wallgren, O. (2010) Perceptions of climate risk and adaptation obstacles to climate change – Case studies of two Swedish urban regions. IN Ford, J. and Berrang-Ford, L (Eds) Climate Change Adaptation in Developed Nations. Springer publishing. *Forthcoming*.

and unclear, or not yet implemented, is another obstacle to adaptation. At present, actors must to a large extent rely on individuals' personal commitment and perceptions of the severity of risks and the need for adaptation. It seems that better coordination on adaptation issues within and between municipalities, between local, regional, national and international levels and concerned private companies is essential.

Discussion
Sweden doesn't have a National Adaptation Strategy – and probably will never develop one either. The country does have a Climate and Vulnerability Commission and a Climate Bill. Swedish climate research was not very extensive until about 2005 (few articles, mostly focusing on climate and vulnerability abroad). Moreover, studies on climate change focused on modelling and impact studies rather than on adaptation. Slowly adaptation is taken into account by policy makers at the level of the municipalities. There is however a tendency of the stakeholders to want still more accurate information before taking action. This may be due to the way modellers and scientists communicate about uncertainties: 'if we downscale some more, we may reduce uncertainties about vulnerability'.

1.6 Science-policy interactions for climate change adaptation in Germany

Henk van Liempt (BMBF, Germany)

Abstract
The messages of the latest IPCC reports are clear: climate change is happening, it is accelerating and, in its current form, it is most certainly to a great extent by mankind. The first effects of global warming are already visible. As a consequence of the climate change in Germany a rise of sea level in coastal areas is expected, less summer precipitation and a larger number of extreme weather events in many regions. Political action is required to restrict the negative consequences for society, the environment and subsequent generations. In recent years climate change has become a top agenda item in Germany and the EU. Different groups of society start asking increasingly specific questions about consequences, probabilities and uncertainties to assess cost and benefits, risks and chances.

In addition to climate protection, adaptation on climate change becomes increasingly important. At EU and national levels, processes to produce adaptation strategies have already begun. Also the German government has compiled its national German adaptation strategy, intended to define the structure for the step-by-step development of adaptation measures. This strategy creates a framework for national adaptation to the impacts of climate change and establishes a transparent and structured medium-term process which, in conjunction with the relevant actors, will progressively ascertain action needs, define appropriate objectives, identify and resolve conflicts of objectives, as well as develop and implement potential adaptation measures. With this strategy, the Federal Government is for the first time adopting an overall position on adaptation to the consequences of climate change and integrating the work already in progress in various ministries in a common strategic framework.

Managing the consequences of climate change for people and the environment, for affluence and lifestyle and for economic and social development is one of the main goals for political decision. This kind of management depends equally on an improved understanding and assessment of the risks and on a definition of the social and economic potential as well as conditions for adaptation. Furthermore, results from climate research must be included in all decision-making processes and there must be awareness about the uncertainties in climate predictions. For example, it remains unclear under which circumstances more and stronger extreme weather events will occur due to global warming. It is also unclear whether future extreme events will affect the same regions as today. Whether we can

retain the competitiveness, affluence and lifestyle to which we are accustomed will depend in part on our ability to predict the climatic conditions of the future and to adapt in due time. Also in adaptation research as well as in deciding on adaptation measures, decision makers and stakeholders in the economy, politics and civil society as well as a new group of highly trained scientists using the data for applied research are in need of tailor made information of climate knowledge for decision making in various contexts or to meet specific demand defined by concerns of applied research on issues related to climate impacts and adaptation. For this task, the Climate Service Center (CSC) has been implemented just recently in Germany (more information see below).

A major framework for activities on climate protection and adaptation is formed by the German High-Tech Strategy for Climate Protection. Within this framework, the federal Ministry of Education and Research has launched a couple of major funding measures which have the climate adaptation topic as their main task. More measures are under preparation and will be launched shortly, for example on the topic of climate change and the financial world as well as selected sectoral topics. Major emphasis is spent on the link between climate science and the development of measures on how to deal with climate change (mitigation and adaptation).

klimazwei – Research for Climate Protection and Protection from Climate Impacts
Under "klimazwei – Research for climate protection and protection from climate impacts", BMBF was funding more than forty research projects. The core of all these projects is the development and use of new technologies, processes and strategies, as a contribution to a future-oriented and integrated climate protection and protection from climate impacts. Both aspects of dealing with climate change, mitigation and adaptation, are addressed. The topic science-policy interaction has been addressed explicitly in klimazwei. Moreover, it was recognized that the interface between basic and applied climate research on impacts and adaptation is itself an important research topic. Supporting this, the so-called "Service Group Adaptation" (SGA) has been established. SGA is specifically responsible to fill the gap between the community of climate knowledge researchers and stakeholders, as economy, society, (applied) research.

KLIMZUG - Managing climate change in the regions for the future
The objective of KLIMZUG is to integrate anticipated changes in the climate and the resulting extreme weather phenomena in processes of regional planning and development. This is intended to increase the future competitiveness of regions, on the one hand, and to advance the development and use of new technologies, procedures and strategies for adapting to climate change in the regions, on the other. The funding activity particularly stresses the regional aspect since global problems such as climate change must be tackled by measures at regional and local level. Regional authorities have the necessary infrastructure, supervise planning procedures and decide on environmental regulations or are at least responsible for the implementation of such regulations at local level. Seven regions are being funded under this funding measure from 2008 to 2014.
For the integration of current climate knowledge, a service-interface between climate system research and questions of dealing with climate change is established also for KLIMZUG. Currently this task is performed by the already mentioned Service Group Adaptation. In the near future, the task will be taken over by the Climate Service Center.

Climate Service Center (CSC)
As a highlight of the BMBF research funding to enhance the science-policy interface in terms of climate change and adaptation the Climate Service Center (CSC) was established. The setup of the center is financed by the German Ministry of Education and Research over the next 5 years. CSC is dedicated to providing climate knowledge to all kinds of stakeholders and users, including applied climate scientists and industry as well as politicians and society. Providing climate knowledge by CSC

is not restricted to data only. Information about uncertainties will be communicated; pros and contras of the sources of climate information like the models as well as processed information for an optimal use in applied climate problems. Through intensive communication with users and scientists and clear orientation to demand, the CSC will prepare climate data in the form of required products and offer advice in its use.

In Germany many different departments work together to answer the problems caused by climate change. But climate change research and policy are probably the best example that one can hardly afford to act in national isolation. Framework conditions will no longer be created in a national context alone and both research topics and policy agendas are set in an international process. In a number of European countries, the scientific community and the research funding organisations started to discuss consequences of this development. We now find various promising approaches to try and facilitate communication on the interface between scientific modelling and scenario development communities and the users of such scientific knowledge. A group of funding agencies meeting in the ERA-Net CIRCLE (www.circle-era.net) have started to share these experiences and explore whether or how advancement of this interface would benefit from trans-national collaboration. This task will be developed further in a second phase of CIRCLE, expected to start from beginning 2010. But also the involvement of developing and emerging countries and a continuous dialogue about the opportunities offered by science and technology are very important. It is time for alliances with those countries whose development will be of a far greater relevance for the future global emission pathway. Such alliances must be at eye level, acknowledging the role of the industrial nations in the past, just as it does acknowledge the requirements for action in climate policies by all governments in the present and future. Approaches and further concepts are expected in the context of the World Climate Conference in Geneva (September 2009).

Discussion

The Service Group Adaptation is an interesting, innovative and important initiative within the research programmes. The projects need and depend on the information that this group produces. The functioning of this Service Group provides some useful lessons for the setting up of the Climate Service Centre. Sometimes the group has difficulty delivering the results needed. Consequently, a joint definition of what is needed is required. This is co-production of science and practice and one important lesson learnt. Concerning the Climate Service Centre a certain amount of overlap with other initiatives is possible and the CSC will make use of synergies wherever possible. Klimzug is linked with other research programmes, such as those funded by the federal ministry of transport. Different from the hotspots selected for Knowledge for Climate, the regional projects in Klimzug came about after an open call.

1.7 Science-policy interactions for climate change adaptation in the United Kingdom

Kathryn Humphrey (DEFRA, UK)

Abstract

Since 2006 there has been a sustained growth in the UK Government's national adaptation programme. Before this time there was no national policy to speak of. Now, adaptation is integral to the UK's first long-term legally binding framework to tackle the dangers of climate change, the Climate Change Act 2008. Requirements under that Act include the requirement for a National Climate Change Risk Assessment, a statutory Adaptation Programme, and a new power to require key organisations to report on how they are taking into account the risks from climate change. The Government's Treasury has included consideration of adaptation to climate change in its guidance on spending and investment for the first time, and departments across Government are set to report on how they are taking the risks from climate change into account by spring 2010. The national

programme includes forty staff working in central Government (having grown from four officials in 2006), and includes a dedicated evidence team (see http://www.defra.gov.uk/adaptation).

There are two aspects to how science has been used to inform adaptation policy through this time; the first has been proving that there is a need to adapt to climate change (and that the Government should play a role), and subsequently to provide evidence as to how the country should adapt.

Is there a need to adapt?
For a number of years the international climate science community has reported scientific findings on observed and projected climate change, and its impacts, through the IPCC Assessment Reports and UNFCCC annual Conference of the Parties. However, much of the attention here has been paid to impacts in other regions than the UK; for example the Small Island Developing States, and Africa, given that these are where it is thought the impacts of climate change will be felt most strongly, and where there is least capacity to adapt. One major influence of the growing recognition that the UK will also be affected in a significant way was that occurrence of a variety of extreme weather events between 2000-2007; including heatwaves in 2003 and 2006, flooding in the village of Boscastle in 2004; (small in geographical scale but high in visual impact), and further serious floods across numerous regions in 2007. These events have sensitised policy makers to the need to protect people, the natural environment and economy to extreme weather events. At the same time, a number of studies came out that showed categorically that the climate is changing now; that these sorts of extreme events will increase in frequency in the future; and that it makes sense to plan for them:

- The UK Climate Impacts Programme 2002 scenarios gave clear messages about the likely future climate for the UK; hotter drier summers, and warmer wetter winters, with an increase in extreme weather events.
- The Stern Review of the economics of climate change (2006) indicated that adapting to climate change is cost-effective, both for developed and developing countries.
- The Climate of the United Kingdom and Recent Trends (2007) stated that temperatures for central England have risen by about a degree C since the 1970s, and importantly that this is very likely due to human activity.
- The IPCC's Fourth Assessment Report (2007) showed that global temperatures have increased; that this was very likely (over 90%) to be due to human activities, and that the lag in the climate system meant that despite future mitigation efforts, global temperatures will keep rising for at least the next 30 years.

Although political changes also had a big influence on the strengthening of UK climate change policy (notably the joint presidencies of the G8 and EU in 2005 which resulted in a much enlarged central Government team on climate change), the evidence provided around this time did have a big impact on the formation of a national adaptation policy because the top line messages were clear, easily explainable to a lay audience, and difficult to dispute. Thus, the need for a better policy on adapting to climate change across all sectors (planning, transport, biodiversity, agriculture, business, water, tourism, insurance etc) could be explained to anyone in a few brief sentences:

- The climate of the UK is changing now.
- Climate change is inevitable for the next 30 years, regardless of mitigation efforts.
- The sorts of events we expect to see an increase in will have a major impact on the UK.
- It is cost-effective to plan adaptation to climate change into existing policies.

As a result of this increased perception of the need to act, not only did adaptation get a mention in the draft Climate Change Bill (now the Climate Change Act 2008) presented to Parliament in 2007, but the relevant sections were strengthened significantly as they passed through Parliament, resulting in a need for a stronger team within Government to implement the various clauses.

How should we adapt?
Using evidence to communicate the need for adaptation has been relatively straightforward. The next big challenge for the national Adaptation Programme is to use the evidence available to point policy makers in the right direction in terms of how they should adapt successfully (in terms of what measures to take, how to implement them, and by when). This is a much more difficult issue given that it deals with localised decision making, within the context of an uncertain future, and necessitates making decisions with economic impacts far before they can be shown to be successful. Providing the evidence to support this goal has brought up a number of evidence gaps a deficiencies that the evidence programme is trying to tackle at present. Some of these unanswered research questions include the following:

- How best can we analyse the costs and benefits of climate change adaptation?
- What is the best methodology for assessing risk?
- What will be the future movement of people (migration) and how will this affect the sorts of impacts from climate change they are subjected to?
- Should we aim to have a policy that considers "mitigate for 2 degrees, adapt for 4 degrees", or base one on individual assessments of own levels of risk?
- Do current climate change projections give a good enough depiction of future climate risk given that there are some tipping points (for example, methane release) and extreme events (wind storms for example) that aren't included?
- How certain are we of the sign of change in future climate projections?
- What will the post-Copenhagen emissions scenarios look like and how should we factor these in to adaptation policy?
- What information can we obtain about seasonal to decadal climate forecasts?
- How can we show that adaptation policy is successful, given that this won't be proven in timescales that are meaningful to the current Government?
- How can we show that adaptation policy is sustainable and enhances the ability to meet wider policy objectives (such as sustainable consumption and production, climate change mitigation, environmental protection).

The Programme's evidence team is seeking to tackle these evidence gaps in a variety of ways.

A cross-disciplinary team. It is apparent that scientific evidence alone is not enough to answer the question of how to adapt successfully; which is why the Programme's evidence team consists of not only scientists but economists, operational researchers and social scientists. This team sits within the wider policy group, and so has direct access to colleagues making policy decisions; a model that has worked well across the Department.

Targeted research aimed at policy makers. An example where this has been implemented is in the UKCP09 programme. A major scientific problem is dealing with uncertainty in climate prediction. Climate is heavily dependent on future emissions, but there are also uncertainties in our ability to model the climate accurately, and what role natural variability will play. The launch of new, probabilistic, projections of climate change for the UK in June 2009 gave a measure, for the first time, of the confidence in different degrees of future change based on an assessment of the uncertainties in these three components. Although the Projections give a much more honest picture of the science, they are very difficult to communicate effectively given that they do not produce one simple answer to the question "how is the UK's climate going to change?". The UK Climate Impacts Programme's role in the Projections has been to look at the science (developed by the UK's Met Office and others) and provide guidance and explanation on their use in policy making- the Projections are available alongside an extensive set of user guidance at http://ukclimateprojections.defra.gov.uk. A review is currently underway to ascertain how the Projections have been received in the first three months

since the launch, which will tell us something about how well this communication has been put across and what improvements are needed.

Independent scrutiny. The UK Climate Projections, and other research findings, will form the basis for the UK's first national Climate Change Risk Assessment due out in January 2012. Because of the complexity involved, and the large range of possible methodologies available, in determining risks to the whole country, one method being employed to add confidence in the project will be to create panels of expert advisers on the science and methodology, and have an ongoing review of the methods and findings by an independent Parliamentary Committee- again made up of scientists, economists and experts across different sectors. See http://www.theccc.org.uk/about-the-ccc/adaptation-sub-committee .

Making use of best practice. The UK Climate Impacts Programme has pulled together case studies of adaptation in practice from around the country (http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=286&Itemid=423) , and is currently seeking a new set of case studies of practitioners making use of the UKCP09 projections (http://ukclimateprojections.defra.gov.uk/content/view/684/511/). The Thames Estuary 2100 project is another example of a new approach that is being championed. It is a "flexible pathways" approach which being showcased to other sectors with big infrastructure needs such as the nuclear build sector, where decisions to commit to expensive developments need to be taken a long time before the necessary work is completed, and the impacts of mal-adaptation are great. The approach plots different decision pipelines against degrees of climate change. (http://www.environment-agency.gov.uk/homeandleisure/floods/104695.aspx)

Evaluating Success. A subsequent major challenge, given that we succeed in providing the best available evidence on which to base policies, will be measuring and evaluating their success. This faces a whole new set of challenges given that whether policies are appropriate or otherwise will not be known in timescales of interest to the current Government. Therefore, other ways of measuring success have to be found that are meaningful now. Work is being taken forward on indicators of adaptation to meet this requirement.

Discussion

For an effective adaptation policy, good communication is of the utmost importance. There is practical evidence needed to stimulate stakeholders to take action (not just scientific evidence) and the relevance must be communicated clearly. Good communication entails clear messages, prerably with good graphics (the IPCC graph with possible impacts is a good example). Sciences other than climate science should be mixed in as well, when adaptation strategies are devised, such as economics.

An issue that surfaced many times during the workshop was the perceived unwillingness of policymakers to listen. Several scientists had negative experiences when trying to contact or inform policymakers on climate issues and climate adaptation. The UK approach was successful in involving most policymakers: due to good communication of the climate change issue and wide media attention, climate change actually became a hook for policy makers to get more funding: climate change was 'hot'. This was not the case for the policy makers in the planning section of government: they had to be chased to get them involved. Climate scenarios were useful tools to raise awareness amongst top level policy makers. These top policy makers then brought climate change to the attention of their employees.

Although climate scenarios are very useful, a recurring critique on this tool is the fact that they often do not take into account mitigation efforts, which could significantly reduce CO_2 in the atmosphere in the future. E.g., the researchers that developed the new UK-scenarios did not include mitigation scenarios either, due to a dispute among scientists about stabilization scenarios. Obviously it is necessary to communicate what the UK may look like under different stabilization scenarios, so this work will be done in the future. In the IPCC scenarios, socio-economic scenarios are taken into account already and the UK scientists didn't want to redo that effort.

What can be noticed is a trend to move away from global scenarios towards more regional or sector specific scenarios.

1.8 The science-policy interactions for adaptation to climate change in Denmark.

Svend Binnerup, Coordination Unit for Research in Climate Change Adaptation (KFT), National Environmental Research Institute, Aarhus University, Denmark[6]

Abstract

The organisation behind the Danish strategy for adapting to a Changing Climate includes the establishment of a Knowledge Center under the ministry of Climate and Energy, and a Cross-ministerial Coordination Forum with representation from the vulnerable sectors, local government, and Danish regions. Furthermore, the independent research coordination board, Coordination Unit for Research in Climate Change Adaptation (KFT) was established to strengthen the transfer of data and knowledge from the research community to the society via the national web-based portal: www.Klimatilpasning.dk. This web-portal is hosted and managed by the Knowledge Center. Another aim of KFT is to strengthen the research agenda within the frame of the national adaptation strategy (NAS) and furthermore strengthen the international collaboration both with respect to research activities and sharing of already existing data and other scientific information.

KFT consists of a steering committee with high-level representation from the Danish universities and research institutes of relevance, a secretariat with staff members from the participating research institutions, and a scientific advisory panel of 23 experts covering the various scientific areas, from traditional technical, environmental disciplines to cross-cutting themes of health, law, socio-economy, design, communication, and climate modelling.

In 2008, KFT identified and mapped the Danish climate and climate adaptation competencies and projects in collaboration with the ministry of Science, Technology and Innovation. The information collected via a questionnaire was categorised according to the five IPCC climate topics (The physical science basis; Mitigation of greenhouse gases; Impact of climate change; Climate adaptation and Vulnerability), the vulnerable sectors described in the NAS, and finally according to the major research disciplines, following the OECD FOS-classification. The questionnaire allowed the researchers to give other types of information, e.g. about data or scientific work of potential relevance for the adaptation web-portal. A summary report of the mapping exercise is available from http://klima.au.dk/fileadmin/filer/KFT/Kortlaegningsrapport_uk.pdf. A key conclusion was that the climate research portfolio in Denmark is a relatively small but very competitive research area. Of the five IPCC research categories, climate adaptation constitutes a small area of the overall climate research. However, it represents a strong capacity across the academic research disciplines to and a large potential to further strengthen this research field.

[6] With contributions from the following KFT staff-members: Karen G. Villholth, Geological Survey of Denmark and Greenland; Iben Frøkjær Strand & Malene Kauffmann Hansen, Technical University, Denmark; Martin Drews & Niels Larsen, DMI, Denmark; Vibeke Nellemann & Berit Kaae, Copenhagen University, Denmark; Lilian van der Bijl, Bent Andersen & Lars Moseholm, Aarhus University, Denmark

In a consultative process, KFT identified important gabs of knowledge and summarised the most important research needs for future research programmes. The analysis was done by members of the KFT scientific advisory panel (representing the trouble-shooters) and members of the sector-ministries and representation from Danish regions and local government (representing the problem owners). A resulting draft report was consolidated by a public consultation before publication and presentation for dialogue with relevant financing ministries. The most important research topics addressed the following major areas: Modeling - feedback mechanisms, sector integration, tools for earths system-modeling, better assimilation of data into existing models; Society – socioeconomic model integration, better tools for decision-making under uncertainties, multilevel governance, social, cultural and ethical aspects of adaptation; Construction – extreme weather consequences, upgradation of major infrastructure, like sewers, indoor health, new architectural design; Landscape –flexible landscapes, integrated water management, sustainable production, maintenance of biodiversity, esthetic values, new pests and weeds, bio-energy crops; Coastal zone - hydrographic processes affected, coastal zone management, acidification and eutrophication of coastal waters, social/cultural aspects of settlement in the coastal zone area.

To enhance coordination of current climate research of relevance for adaptation, KFT recently established a series of "dialogue-meetings" on the Danish universities and research institutions. The aim of the meetings is to enhance the dialogue with the Danish research community, strengthen the research agenda related to climate change adaptation, enhance the information-flow, and promote collaboration between various research environments. Another aim is to raise the profile of KFT among the researchers and get feedback on ways to better provide information services to the research community. Output from the meetings will be reported back to the research community and to the end users via the web-portal

1.9 Science-policy interactions for climate change adaptation in France

Bertrand Reysset (ONERC, France)

Abstract

Climate issues and their impacts on society are a matter of growing concern for both science and policy. Climate change is a complex phenomenon and uncertainty is high: these two factors have enhanced a cooperative approach between policymakers and scientists, and even beyond these two groups. The "Grenelle de l'Environnement" process in 2007, is an illustration of an explicit consultation between policy, science and stakeholders in the area of environment, including climate change. This process of round tables and sharing views has fuelled a set of legal environmental and climate-friendly proposals named "Grenelle Laws". In the specific area of adaptation, the climate change national adaptation strategy (NAS) adopted in 2006 (and published in 2007) has been developed through an extended consultation between climate and natural risks scientists, civil society and the administration. The NAS is a consensus document identifying climate change patterns and related vulnerabilities and giving recommendations on how to consider climate change in policy decision processes.

The National Observatory on the Effects of Climate Change (ONERC), in charge of the NAS and of the forthcoming National Action Plan, is also acting as a moderator of a scientists and specialists network on climate change. The network can be consulted about specific issues and contributes to an online database of climate change indicators in France. A cross-ministerial working group on the quantitative impacts of climate change is also mobilizing several scientists and specialists in order to produce the first broad estimation of climate change impacts in France. This kind of consultation will

be reinforced soon with the national action plan (NAP) development process. A broad consultation on adaptation is to take place next year in France. The consultation will gather stakeholders including administration, elected members, scientists and climate specialists. This consultation will contribute to the design of the French NAP to be issued in 2011.

Science Policy collaboration for climate change research
The science policy nexus in climate change issues goes beyond governmental and administrative consultation. Public expenditures allocate several specific resources for research in the area of climate change and adaptation. We will focus on the two main French specific funding programs: GICC (including the era net CIRCLE) and ANR.

1. The climate change impact and management programme (GICC, 1-3M€/year)
The programme is monitored by the Ministry of Environment and focus on climate change impact, its management and adaptation. It aims at mobilizing the French research community, in an interdisciplinary manner, around practical and policy-oriented research programmes. Outputs from the GICC research projects include tools and methodologies that could be used to design public strategy and investments patterns to adapt climate change. The programme is still running. It has mainly focused on impact planning and knowledge improvement. Significant French forecasted data for future river flows, hurricane modelling in ultra peripheral regions and heat waves in France have been the main GICC outputs. Research on adaptation is under development under the GICC. For example, the DRIAS project is currently working on designing tools to enable a free access to climate projections in France, so as to contribute to the building of national and local adaptation planning. The last call has fostered the development of partnerships between scientists and practitioners.

2. The national research agency (ANR) programmes on climate change (1-5M€/year)
The ANR has mainly funded research on vulnerability to climate change. This year, a scientific consultation is undertaken in a participative way to refine research priority for climate change adaptation. Thus, if the science-policy interaction appears in public research funding, one can notice that research on climate did not focus so much on adaptation yet. To fill the existing knowledge gaps, most of the research was focused on vulnerability and impacts.

The way forward
As we explained above, there are growing interactions between science and policy-makers . The dynamics have mainly focused on climate change as a broad issue, but interest for specific knowledge for adaptation measures is growing and is believed to enhance this dialogue. For example, local governments are currently undertaking a local climate planning exercise that has to include adaptation to climate change. These exercises have to mobilize scientific skills in order to design local climate information and adaptation scenarios. The scientific data is thus at the beginning of the local policy planning (climate scenarios) and at the end (adaptation scenarios and options). Nevertheless, notwithstanding what is currently done at the local level and in the consultation to come for the NAP, the science-policy nexus on adaptation could be enhanced through:

- Stronger orientation of public finding research programmes on adaptation to climate change ;
- Better coordination of research and research funds related to climate change adaptation ;
- Reinforced science-policy dialogue to produce tools to facilitate adaptation planning and political choices from the local to the national level.

Discussion

The French National adaptation strategy came into being only after a broad consultative process among scientists using a method known in the nation as the 'Grenelle process'. Efforts have been made to involve other stakeholder in the adaptation strategy development and implementation as well through extensive communication:

- Each elected local member in France receives the quarterly newsletter 'A gissons!', which covers climate and adaptation issues;
- The organization ONERC, which moderates a scientist network, organizes workshops between scientists and local elected members;

In the future the focus will be on downscaling and developing local adaptation measures. Special attention is also reserved for the overseas regions of France.

One of the problems in developing adaptation strategies is that there is limited communication between those working on a national (or transnational) level and those working on regional adaptation measures. There are very few people (scientists or policy makers) that have knowledge of the state of the art on both the national and regional levels.

Parallel session 2: Science-policy interactions at the national level

How science-policy interactions are structured and designed is unique for each country. To effectively support policy development, countries are developing specific ways for effective coordination of the interactions between science and policy to maximize the usefulness of the scientific results for adaptation policy development. Hence the aim of this session is to discuss the experiences of the various countries within the European Union focusing on the topics which have been discussed in the morning presentations. The parallel sessions addressed the following 4 questions:

1. What are the requirements for scientific research programs to effectively support policy making?
2. How can adaptation policy development best be organized to gather and use information more effectively?
3. How can boundary organisations contribute to 'better' and more 'effective' policy making?
4. Which role could the European Union play to support science-policy interactions at the national level?

Facilitators – *Timothy Carter* (Finland) (A/1) and *Gregor Laumann* (Germany) (B/2)
Reporters – *Marjolein Pijnappels* (the Netherlands), *Kirsten Hollaender* (Germany)

2.1 What are the requirements for scientific research programmes to effectively support policy making?

- *Size of research budget (or hidden budget).* Finland had a budget of only 0.5 million euros, whereas the Netherlands has budget of 100 million euros. Still, Finland is perceived as a leading country with respect to climate research and adaptation. One could interpret this as an indication that more money does not lead to better research. However, it can also be argued that Finland was a leader in climate research and adaptation because they started early, but is losing that frontrunners role due to limited funding. Hidden budgets must also be taken into account. Looking at the Netherlands, much of what is done with respect to adaptation is not labelled as such, such as the Netherland's already extensive flood risk management.
- *Policy-relevant/core research.* One of the most important things when communicating with policy makers about climate change is to make the urgency of the problem very clear. It helps policy makers prioritise. The first question policy makers ask themselves is: is it urgent? Quickly followed by: is it my responsibility to deal with this? Only if the answers to both these questions is 'yes', policy makers can and will act. In the Netherlands, a good argument for the urgency of the problem is the fact that the Netherlands is still behind schedule with respect to the advise of the first Delta Committee (installed after the disastrous flood of 1953).
- *Prioritising issues*. In the Netherlands, the Knowledge for Climate programme facilitates projects in so-called hotspots: the hotspots represent the practise and the stakeholders. Because the money given by the government to fund the programme has to be matched by at least 50 percent funding by stakeholders, the stakeholders play a key role in prioritising. However, in Austria the government owns the funding budget and decided to put most of the money in energy programmes, only a little to climate research of which only a little is designated for adaptation research. Taken all this into account, it is hard to come to an objective prioritising list: all lists are inherently subjective, because it is based on experiences of the past. Goverment and funding institutes can also prioritise in a more subtle way: by framing open calls in such a way that consortia will try to write their proposal so, that it fits within this framing and as such fits the government or funding institutes priorities.
- *Tailoring information to needs*. When communicating with policy makers, it is also important to keep in mind that different levels of government need different types of information. Thus it is

not only necessary for policy makers to know about science, scientists should put an effort into familiarising themselves with how policy works.

- *Economic assessment*. It might help to link (physical) research to policy by introducing economic assessments in each research programme.
- *Continuity of research/monitoring*. How can one make sure that research is continued when responsible government officials or policy makers get new jobs or are re-elected?
- *Interface facility between science and policy*. How can communicating be organized in a smart way? Some propose scientists should be more actively involved in the policy making process, to make sure that the knowledge circulates freely and is not just a one-way process. Others argue that scientists do not have time or a responsibility to take on this interface role, and that a specific (in)formal institution should be designed as an interfacing facility.
- *Co-development of research programmes.* Policy makers must be involved in the formulation of research and in its delivery
- *Perceived risks.* When communicating about climate change, scientists must not just take into account the real risks, but also think about perceived risks.
- *Selection of relevant information*. Researchers must deliver policy-relevant information. In this time in which time is a scarce resource, scientists can simply not afford to deliver research results to policy-makers that are not relevant to them. This raises the issue who determines what is relevant to them? Policy makers need at least to be made aware of the main characteristics of the issue.
- *Harmonization or standardization of methods and tools.* Harmonization of climate models and scenarios sometimes appears desirable, however might be too ambitious. It might be more realistic to aim at compatibility or consistency, allowing for diversity. The call for standardization of climate models in a way reflects the thinking of "more science equals more certainty". However, thinking in the new "assess, hedge and learn" paradigm is important.
- *Specifying user needs.* The question of what hinders decision making should be studied from a social learning perspective. Sometimes information is not so essential as such. User needs have to feature more importantly. Users also need guidance on how to use scenarios.

2.2 How can adaptation policy development best be organized to gather and use information more effectively?

- *Formalising interaction between policy makers and research community.* Good communication between government agencies is essential. It is not really that important who takes on what roles (scientists, policy makers of different levels), as long as it is clear what the responsibilities are and there is communication. Inter-ministerial groups at the highest possible level are important for broad support.
- *Common understanding of definitions*. It is very important that some sort of common language (maybe even using visualisations) is developed, so different groups (scientists, community, policy makers) can communicate. For this some sort of consensus on common definitions and methodologies is necessary.
- *Accessibility of data*. Results of research should be transparent and accessible to all who might benefit from it. In the future, private companies may play a big role in climate adaptation and they need to be involved, but the overall knowledge base should ideally be publicly accessible. E.g., in the UK government, agencies are required to make money from their data, which doesn't necessary benefit the nation. Private companies should be brought in for that, however, they do not have access to data at this moment. A new system is occasionally discussed in the UK, but until now hasn't led to anything changing. Norway, Canada and the US have opened up all their data, which is a good thing on the one hand (everyone has access to data), but also has a downside. When data is freely available, researchers can no longer control

what happens to them. Sometimes it might be wiser if some data is not yet made public until proper user guidance is available.

- *Responsibilities of government bodies* (e.g. federal/regional; sectoral). There has to be good communication about the responsibilities of each government body. Who is responsible for what, and what does each body expect as results? Ministries in the Netherlands have appointed 'Chief Scientists': they are employed by the ministries (until now only the Ministry of environment, VROM) and have a role to play in the policy-science interface.

2.3 How can boundary organisations contribute to 'better' and more 'effective' policy making?

- *Training interfacers.* The US has university training for policy-science interface experts. This will lead to a generation of people who understand both science, community and policy processes. These people should be trained by experts who have been working on the interface and trained themselves to be interfacers (as there is no formal training for this kind of work up until now). It is important that these interfacers exist, but this does not take away the responsibility of the scientists themselves. A golden rule in Sweden is: if you cannot explain your research to your grandmother, you are not a good scientist.
- *Specific roles of boundary organizations*. Four roles that might be imposed on (future) boundary organisations:
    - Communicating between policy, science, community (recognise common elements on both sides)
    - Influencing policy – honest broker role
    - Providing tools
    - Learning and dissemination of experiences (storage of knowledge and analysis)

  Boundary organisations may furthermore function as the "Memory" of the system. It might be the only way to contain this knowledge, as civil servants move on periodically.
- *No monopoly of boundary organizations.* The interface between science and policy should not be monopolized by some specially founded organization, but generally a broad education of scientists is needed. It would be good to have more capacity building for this. Science then not only creates new knowledge, but also communicates to practice. However, this is originally, "not in the nature of the business" and therefore, in addition boundary organizations make sense. They can have a wider perspective, with an consulting attitude, and fed by large international networks. It might be useful to use personnel through secondments from both academia and policy institutions.
- *International exchanges.* Amidst all differences, there are great similarities in the problems countries face and the questions they have, so international exchanges are useful, too.

2.4 Which role could the European Union play to support science-policy interactions at the national level?

- *EU adaptation policy.* The EU is already doing something, although this is not yet widely known amongst national policy makers (White Paper, knowledge clearing house, CIRCLE research network, 7th Framework Programme impacts and adaptation projects). An important component of the White Paper addresses mainstreaming of adaptation into EU policies. The 7th Framework Programme is already addressing much adaptation-related research. See section 3 for more detail.
- *Transnational collaboration.* Better appreciation is needed of national efforts in the member states, but also trans-national research is important for many issues. Comparative work on different governance structures in Europe would be an interesting topic. Joint national programming is promising but as yet needs better co-ordination. The Commission has

compiled a compendium of climate change research, however misses the activities on national level. Linking CIRCLE and initiatives of the meteorological institutes would be interesting.

- *Indicators of good adaptation.* The EU should develop indicators of good governance for climate adaptation, which might be tested first in EU-countries and than taken up worldwide.
- *Common approaches to scenario development and vulnerability assessment.* Comparability of research results would allow for more consistent EU-wide assessments. This should not be a mandatory approach, but a broad one that includes scenario development and vulnerability assessment.
- *Intersectoral communication*. The EU would benefit from improved internal communication. The EU should set an example for national policy makers. It would be good if the EU viewed adaptation as broader than just something for the environmental department.
- *Adaptation as a social process.* Viewing adaptation primarily as a social process can be very informative. This shows that changes in behaviour are needed, to take advantage of knowledge on risk governance, communication on uncertainty etc. Awareness is an important issue. To date there has been little social science on climate adaptation, apart from the Adam project and the work done by the Tyndall institute. The possible contributions of social science are difficult to map and little understood. The social sciences should be taken on board the development of adaptation strategies, but not as 'backing' of the adaptation approaches, but to do research on adaptation.

Plenary session 3: European research and action on adaptation

The aim of this session is to present relevant European initiatives to develop and apply policy-relevant adaptation research, and to discuss potential links between European and national research programs. The European Union is potentially a major player in the field of adaptation by enabling or constraining national adaptation practices in Member States, not only by funding research projects on climate change, but also by developing adaptation policy and supporting Member States to adapt to the impacts of climate change. This section illustrates the past and current activities of the European Union in both policy making and research. Special emphasis will be on the EU White Paper on adaptation, the impacts for national and regional adaptation practices and the research strategies of the European Union on climate change adaptation.

3.1 European Union adaptation to climate change: White paper"

Jacques Delsalle (DG Environment) and *Wolfram Schrimpf (*DG Research/DG environment)

Abstract

In April 2009 the European Commission presented a White Paper on Adapting to Climate Change[7], with the objective to develop further the discussion at European level of the effects of climate change and to take steps to ensure that the EU and Member States are fully able to respond at the levels of both policy definition and practical implementation of solutions, bearing in mind that most adaptation initiatives need to be taken at national, regional or local level. The White Paper was based on an Impact Assessment Report[8], which benefited from the EEA/JRC/WHO report on the impacts of CC in Europe[9] and from a long list of reports and research projects on climate change impacts and adaptation produced by the IPCC, EU research programmes, EEA, international organisations, national and regional authorities, the private sector and NGOs. The specific objective of the White Paper is to identify policy instruments at EU level and establish a work plan for the short and medium term, by:

- Improving the knowledge base on CC vulnerability (impacts and adaptive capacity) and on the costs and benefits of adaptation options;
- Ensuring early implementation of no-regret and win-win measures and avoid mal-adaptation, by mainstreaming adaptation into EU policies;
- Putting in place a process to better co-ordinate adaptation policies and assess next steps, including launching a debate on future funding.

Assessing Vulnerability

Decisions on how best to adapt to climate change must be based on solid scientific and economic analysis. It is therefore important to increase the understanding of climate change and the impacts it will have. Furthermore, pro-active adaptation policies should not be restricted to the analysis of the impact of Climate Change across different sectors, regions or social groups, but should encompass the assessment of their uneven adaptive capacity. The analysis of the Impact Assessment is based on a holistic evaluation framework which goes beyond the direct impacts and economic repercussions of climate change, and takes on board the role of ecosystem services and the social dimension of climate change. Work is ongoing at the European Commission to assess the feasibility and provide options for the design of a set of vulnerability indicators, at sectoral and regional levels, that could be used to assess further EU-wide adaptation policy packages. It requires bringing together indicators at

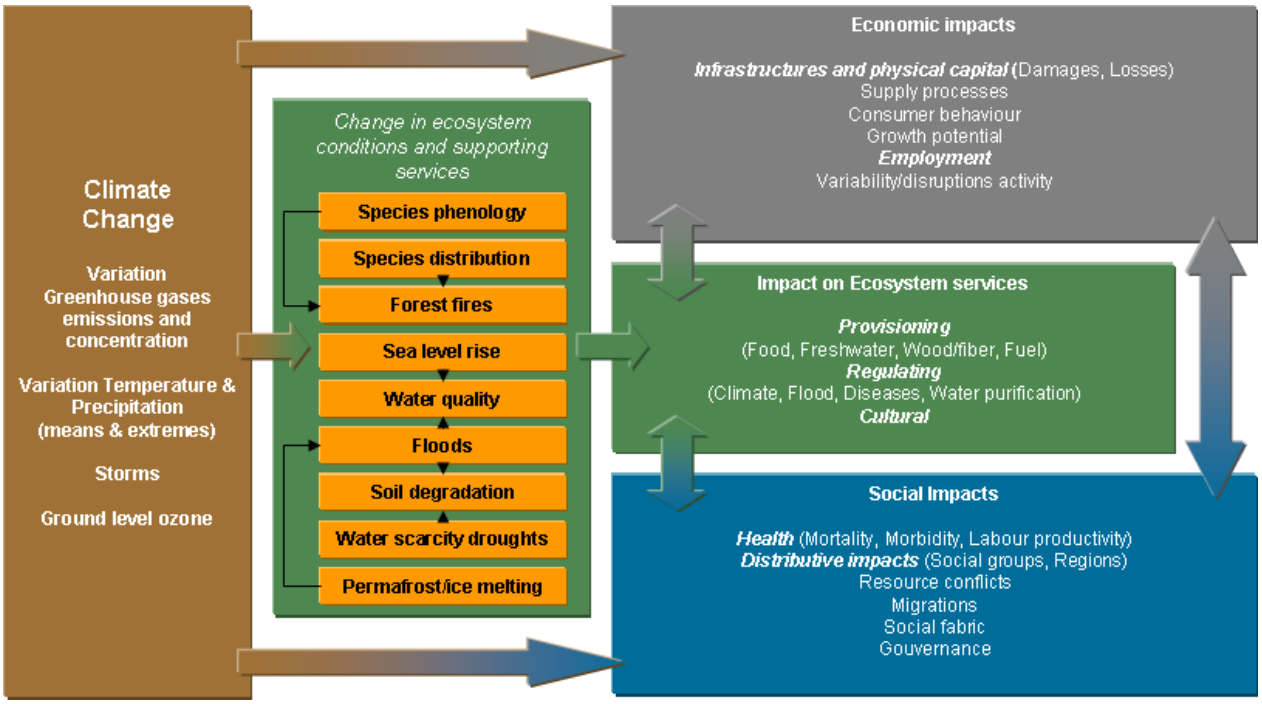
[7] http://ec.europa.eu/environment/climat/adaptation/index_en.htm

[8] Ibid.

[9] Impacts of Europe's changing climate - 2008 indicator-based assessment, EEA Report No 4/2008, http://reports.eea.europa.eu/eea_report_2008_4/en/

economic, social and environmental levels for different climate scenarios, to represent the levels of risks that different sectors and regions are facing.

Chain of Potential Impacts from Climate Change. Source: DG Environment. Potential impacts are all impacts that may occur given a projected change in climate, without considering adaptation.



Broad approaches to adaptation

There is a plethora of public adaptation strategies, plans and projects, each one requiring an assessment of vulnerability and an evaluation of the costs and benefits. The White Paper, however, classified adaptation options into three broad categories:

- *"Grey" infrastructure approaches*, which are physical intervention or construction measures using engineering services to make buildings and infrastructure that are essential for the social and economic well-being of society more capable of withstanding extreme events;
- *"Green" structural approaches*, which contribute to increasing ecosystems' resilience and, while aiming to halt biodiversity loss and the degradation of ecosystem and restore water cycles, at the same time use the functions and services provided by the ecosystems to achieve a more cost-effective and sometimes more feasible adaptation solution than relying solely on grey infrastructure.
- *"Soft" non-structural approaches* are designing and applying policies and procedures, land-use controls, information dissemination, and economic incentives to reduce or prevent disaster vulnerability. They require more careful management of the underlying human systems.

An assessment of the ***cost and benefit of adaptation*** policies requires considering the full picture of EU and national measures (CAP and cohesion policy funds, environmental, health and enterprise policies, etc.) and should consider how re-focusing or reformulating a broad range of policies can help to make adaptation action more cost-effective, quicker and flexible. Autonomous and planned adaptation options may trigger **environmental costs**. This confirms the importance of integrated land and water assessment to ensure the optimal allocation of scarce natural resources (land, water). Other environmental impacts must also be explored as soon as possible to design a sustainable

adaptation policy and avoid “mal-adaptation”. Regarding the **social impact**, a strategy for adapting to climate change has to be socially fair, especially regarding the consequences on employment, equity and distribution. Adaptation strategies must facilitate structural changes when required and harness new opportunities for economic development and the creation of "green jobs", while acting in solidarity with vulnerable groups. At EU level, the modelling effort is focused on identifying no-regret and win-win adaptation actions, focusing on increasing the resilience of ecosystems and socio-economic systems. This means focusing on the further development of land-use and hydrological models, bringing together ecosystem services modelling (green infrastructure, water, etc.) at small scale detail with a strong socio-economic component providing regional and sectoral details.

Action at EU level (2009-2012)

In the White Paper, priority is given to tapping the potential of on-going initiatives, in particular at national level, or co-ordination and awareness raising schemes and to screen in detail the whole range of EU policies and instruments, while putting in place the “governance” of the EU adaptation policy as a way to monitor progress and lay the ground for future action. This corresponds to a **Short term strategy** (up to 2012), starting with the current state of implementation of EU *acquis* (including ongoing initiatives that have not yet achieved their objectives) and the development of adaptation strategies and corresponding schemes by EU Member States driven from their obligation under the UNFCCC. The most relevant actions implying a strong science-policy interaction are the following:

- Development of consistent, comprehensive and regularly updated climate change and socio-economic scenarios (projection data) for analysis across Europe. It requires improving the link between atmospheric, land use and socio-economic models, at global, EU and regional scale; developing options for adaptation strategies and measures at sectoral and cross-sectoral level and the assessment of their ecological, social and economic potential, benefits and costs and identify options for initial no regret measures as starting point for adaptation avoiding costly mal-adaptation. This requires ensuring interdisciplinary cooperation to link the different research approaches to sustainable development.
- Build a structured information dataset to better understand the territorial and sectoral distribution of vulnerability to climate change impacts (vulnerability being defined as a function of 1) the exposure to CC impacts, 2) the sensitivity and 3) the adaptive capacity of a system or a territory.
- Setting up a European wide Clearing House Mechanism (CHM) as a data repository and a platform for knowledge transfer on impacts, adaptation measures in place and best practices, contributing to the Shared Environmental Information System10 (SEIS). Its purpose would be to promote understanding of climate change impacts across Europe and to equip stakeholders to adapt and it could include: communication and dissemination of scientific research on impacts to enable planned proactive adaptation action; exchange of adaptation best practice in or between sectors or regions; tools and guidance for adaptation strategies.
- Work upon a number of additional knowledge gaps: 1) further improvement of the quality and coverage of the analysis of climate change impacts for major sectors at scales relevant to adaptation measures; 2) identification of the limits to resilience beyond which human systems and ecosystems are no longer capable to maintain the required functions and providing the needed services to society and 3) investigation of how to use the ecosystem approach can be used for adaptation efforts as alternative to infrastructure projects.
- Mainstreaming adaptation into key EU policy areas. Developing guidelines and further adaptation strategies outlining the action required requires a step by step approach - based on solid scientific and economic analysis, benefiting from the actions described above:
    - What are the actual and potential impacts of climate change in the sector?

[10] COM(2008)46final

  - What are the costs of action/inaction?
  - How can adaptation objectives be embedded into current EU instruments? Which additional measures should be proposed for action at EU level?
  - How do proposed measures impact upon and interact with policies at other levels and in other sectors?
- Employ a combination of policy instruments. In the short term, action will focus on identification of "No Regrets" measures to be promoted under current legislation and existing EU and National funding schemes. In the medium term, a better understanding of the cost of adaptation measures and investments should be achieved, the potential of insurance, financial services products and market based instruments should be explored, and concrete proposals can be designed in the context of the debate on future multi-annual financial framework.
- The steering committee for the establishment of the EU Clearinghouse will consist of persons nominated by the member states. There will be probably no preconditions, so nominees could be policy makers/civil servants or scientists, as selected by the member states.

3.2 FP7 Research on Adaptation to Climate Change

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Abstract
Research plays a key role in quantifying not only global but also local impacts of climate change in the most sensitive regions in Europe and worldwide, and in underpinning further policy actions. Research into climate change impact helps to build knowledge and adaptive capacity through improving understanding of key drivers, risks and uncertainties. Climate change is a subject of enormous complexity and magnitude. Thanks to focused research efforts, there is continuous improvement of our understanding of the drivers and the options available to reduce its impact. In the European Union, the Framework Programmes for Research have supported actions on climate change since long. The great need and importance of research for developing efficient and broadly accepted predictions, impacts, mitigation and adaptation measures and supporting the implementing of EU policies has already been recognized by the Commission through funding of a number of projects related in this area in FP5 and FP6. The Seventh Research Framework Programme / FP7 (1) comes at an important time for climate change research. Climate change research remains a key element of FP7. The emphasis will be on integrated research addressing the functioning of the climate and earth system in order to better understand its causes and future evolution, determine current and future impacts, and develop effective adaptation and mitigation measures

Results from FP7 projects and actions (2) will help to implement international commitments, contribute to the IPCC assessment reports and address the research needs of existing and emerging EU policies. Policies and actions to combat climate change need to be based on robust scientific knowledge. There is a clear link between European research and the IPCC process. European research teams and projects have played a major role both in providing the scientific knowledge and also in the analysis within the IPCC framework. More than 620 renowned worldwide scientists have participated in the production of the Fourth Assessment Report, amongst them 275 lead authors. Of the 275 lead authors, 110 lead authors come from European countries. Most of these scientists are involved in EU-funded research projects covering a wide spectrum of issues varying from developing large-scale climate models to assessment of costs and effectiveness of impact mitigation and

[*] The views expressed in this article are purely of the author and may not in any circumstances be regarded as stating an official position of the European Commission.

adaptation policies. Conversely, the IPCC process has helped to identify major areas of scientific uncertainty and of particular social and political sensitivity in every corner of the planet, and this has been assisting to direct research efforts under the Framework Programme. Given the global dimension of the problem, special emphasis is given in FP7 to international cooperation actions with third countries. In the last 6 years 177 non – European research institutions from 58 countries have participated in the 139 projects for improving the understanding of climate change.

The European Commission Adaptation White Paper (3) highlights the need to further strengthen the efforts to develop the knowledge base enabling decisions from local to international level on how best to adapt. Better knowledge and reliable data on vulnerability, the likely impact of climate change, the associated socio-economic aspects and the costs and benefits of different adaptation options are needed to develop appropriate policy responses and adaptation measures. The Paper highlights the need to further advance methods, models, data sets and prediction tools, which can be enabled by information and communication technologies, to assist in understanding and forecasting climate change, in identifying vulnerabilities and developing appropriate adaptation measures. In cooperation with the Member States, vulnerability should be assessed against a wide range of climate scenarios and on different geographical scales to facilitate the definition of adaptation measures.

A pro-active research policy is necessary to better promote the understanding of climate change impacts and the development of methods and technologies to cope with the consequences of climate change. Detailed information on research needs is provided in a recent Commission Staff Working Paper (4) including the impacts of climate change and adaptation. Research on adaptation needs to assess the regional variability and severity of climate impacts and the fact that adaptation measures will be taken at national, regional or local level. However, these measures can be supported and strengthened by an integrated and coordinated approach at EU level.

The Commission Paper emphasizes the need to improve Europe-wide risk, impact and cost/benefit assessment for adaptation responses, as compared with no action. These activities should be complemented by a comprehensive analysis of presently developed / adopted adaptation strategies of EU Member States, including a systematic analysis / evaluation of existing EU policies, directives, funding mechanisms and their implementation with regard to constraints for adaptation at European, national and regional level. Additionally, identification of further adaptation policies and measures that could be implemented, sector by sector, region by region, with an assessment of the costs involved should be addressed. This should include the assessment and analysis of barriers and constraints that are specific of local and sectoral contexts, and the means to overcome them.

In order to ensure the delivery of the results needed, at institutional level, a better coordination between the various FP7 activities and other EC actions and initiatives as well as closer collaboration between major national research programmes in Europe and Framework Programme activities will be necessary, in order to make best use of human resources, modelling capacities, field activities, and infrastructures. Thus the impact of scientific results will be maximised and the European Research Area for climate change reinforced. The 7th Framework Programme will strive to continue the implementation of a strong, interdisciplinary and balanced climate change research programme, built on firm foundations of past experience and achievements and incorporating new elements of research. This will improve our basic understanding of the earth-climate system as well as key elements related to impacts, vulnerabilities, and responses measures empowering Europe with the necessary science-based knowledge in order to better manage the risks and opportunities of climate change.

References

(1) Seventh Framework Programme (FP7) http://cordis.europa.eu/fp7/home_en.html
(2) European Research Framework Programme: Research on Climate Change, European Commission, 2009, EUR 23609, ISBN 978-92-79-10280-6, http://ec.europa.eu/research/environment/pdf/cop-15.pdf
(3) Adaptation to climate change: Towards a European framework for action, COM (2009) 147 final
(4) Commission Staff Working Document *Integrated climate change research following the release of the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and most recent research developments,* SEC(2008) 3104.

3.3 ERA Networks on impacts, vulnerabilities and adaptation (CIRCLE-2 ERA-Net)

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Abstract

Collaboration between research funding and managing organisations and their respective national and regional programmes is central to the establishment of a European Research Area (ERA) across a wide range of research fields. The promotion of consistency between R&D activities across levels and countries is expected to give Europe a desired leadership in addressing global challenges - such as climate change - and attaining its sustainable development goals. Coordination between research programmes is essential to share, teach, value and use knowledge effectively for social, business and policy purposes. This means that the need for collaboration under the ERA is a challenge not only for the European researchers but also for science funders and managers. Since the ERA concept was endorsed at the Lisbon European Council of 2000, some progress has been made to build a common key reference for research policy and to help overcome the fragmentation of activities and programmes across Europe.

As of 2003, the European Commission (EC) has been providing support to the coordination of national and regional programmes trough a "bottom-up" scheme named ERA-Net(work).

Bearing in mind the Article 169 of the European Treaty – the article making possible for the European Union to participate as an equal partner in research and development programmes conducted in member states – one of the goals is to step beyond the mere coordination of national programmes and to combine them (or parts of them) into a single joint programme.

As a precursor scheme, the ERA-net facilitates the possibility for national programmes to test their capacity to further integrate within a given research field and, in some cases, to develop into an Article 169 initiative.

The 2007 EC Green Paper "*The European Research Area: New Perspectives*" is clear in its vision and objectives. It points out a group of features that should be included in the ERA, including: (i) an adequate flow of researchers; (ii) world-class infrastructures; (iii) excellent research institutions; (iv) effective knowledge-sharing and; (v) well coordinated research programmes and priorities.

Nevertheless, the same document issues a "warning" about potential difficulties by pointing out that some of these features will take longer to be established than others and that the envisioned ERA may not be fully achieved before some 10 to 15 years.

The multi-scale climate (research-policy) challenge

Over the past decades, European and international climate change research (and policy) has changed and is currently looking into new sets of interactions that go beyond the "classical" climate system and impact assessment research. Gathering knowledge on how to deal with the uncertainties surrounding impact and vulnerability scenarios is becoming an increase source of concern amidst stakeholders and policy developers. Communicating available scientific Information on adaptation options or the necessity to have common assessment "yard-sticks" across borders are just some of the driving questions now faced by European climate science and policy. Adaptation to climate

change has attracted a great deal of attention and is now placed high in global, European and National agendas. Understanding how much does it (potentially) costs to adapt to a changing climate is ranking high in many European countries. Information regarding the economics and financial flows relevant for an effective international response to Climate Change – including both adaptation and mitigation - has been assessed, for example, in the 2007 Stern Review and the same year's UNFCCC technical paper. Just last month, a new review on the costs of adaptation was published by Parry *et al* and more are expected to follow. At the European level, the 2009 EC White Paper on Adaptation is setting the discussion on a common framework to reduce vulnerabilities. And at the national and regional levels, policy -developers and -makers are integrating, with more or less difficulty, all this available information into their adaptation strategies. All this activities are pointing out to the fact that - independently of the addressed scale – current and future knowledge delivered by research on climate change impacts and adaptation options must be policy-responsive, not just to lower the uncertainties surrounding decision-making but especially to support effective adaptation policies.

The ERA-Net on climate impacts and adaptation research

Addressing these common needs by funding policy-responsive climate research while avoiding duplication of efforts and maximising budget expenditure sounds like a logical objective - but this is not a straightforward task. If the ERA-Net scheme could be described as a mechanism to optimise standard research funding processes at the national and regional levels and to align them with transnational needs, climate change research would seem as fertile ground to test the ERA principles. But while the ERA "asks" for countries to align research agendas around common needs and themes and to pull resources into transnational joint initiatives, research funding agencies across Europe are asked by their governments to assure that those initiatives are also of added value at the national and regional scales. So can the ERA principles and in this particular case, can the ERA-Net serve as a platform where these climate knowledge needs are also meet by a coordinated response from European research funders and managers?

CIRCLE-2 *(Climate Impact Research and Response Coordination for a Larger Europe)* will establish a second generation ERA-Net that will try to positively answer that question. This new ERA-Net will be a follow-up of a previous initiative, CIRCLE CA, established in 2005 and that is coming to its end in September 2009. During the past 4-years, CIRCLE has provided to a considerable number of European organisations, responsible for funding and managing national climate change research, a networking opportunity where they could exchange information and give a first step towards the mentioned ERA on climate change research and knowledge. Leaving mitigation research out of its scope, CIRCLE has gathered valuable information about national climate change research programmes and their projects. It has proven that it is possible to jointly fund climate change research by successfully launching 3 joint calls for collaborative projects. Using a "variable geometry" regional approach – Mediterranean, Nordic and Mountain areas - these joint calls involved a total of 14 different funding organisations pulling together around 4.7 Million Euros of national contribution.
Now the challenge is even higher. CIRCLE-2 has to spotlighting on the needs of Europe's response to the climate change challenges and, first and foremost, has to aim at making R&D on climate change more consistently usable by European social, business and policy stakeholders.
In order to do so, the CIRCLE-2 consortium has agreed on a streamlined 4-year work programme based on 3 major pillars of collaborative action:

- Design and develop a common research agenda that can create the backbone of a future joint European research programme on climate change adaptation;
- Fund and enhance the European knowledge production on adaptation by pulling national resources into this programme and tailoring them into joint initiatives, including joint calls for research projects;

- Share its outcomes with all interested stakeholders and engage them to participate in the construction of the ERA on climate change by means of knowledge transfer mechanisms.

The products and outcomes of this collaboration are expected to be not only rooted in the ERA values but to contribute significantly to both European, national and regional adaptation policy efforts. The present communication will address in more detail the goals and objectives of CIRCLE-2 ERA-Net as well as some of its key features designed to address the complex science-policy interactions that surround climate change adaptation.

References:

European Commission (2007) Green Paper "The European Research Area: New Perspectives", COM(2007) 161, European Commission, DG Research, Brussels.

European Commission (2009) White Paper "Adapting to climate change: Towards a European framework for action", COM(2009) 147/4, European Commission, DG Environment, Brussels.

Stern N. (2007) The Economics of Climate Change: The Stern Review, Cambridge University Press, Cambridge.

UNFCCC secretariat (2007) Investment and Financial Flows to Address Climate Change, United Nations Framework Convention on Climate Change.

Martin Parry, Nigel Arnell, Pam Berry, David Dodman, Samuel Fankhauser, Chris Hope, Sari Kovats, Robert Nicholls, David Satterthwaite, Richard Tiffin, Tim Wheeler (2009) Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and Other Recent Estimates, International Institute for Environment and Development and Grantham Institute for Climate Cha

Discussion

For climate policy to be successfully implemented, it is necessary to increasingly 'Europeanise' climate policy. CIRCLE may play a role in that process as a unifier of different geographical areas, as a funder of research, which fuels competition between consortia and countries, and as a facilitator of transfer of knowledge. One of the difficulties of a 'Europeanised' climate policy is dealing with the different rules and laws regarding funding of research in the different European countries. The interest in transnational research is high, but national rules still prove a barrier. It is not easy to find a common ground for research. For this it would be beneficial if common funding was available and common peer reviews were carried out. If EU-countries would put a common effort into it, research on all issues covered during the workshop could be funded.

International calls such as organized by CIRCLE are valuable, not only from a result-oriented point of view, but also from the perspective of boosting international networks of researchers and practitioners. The national expert pools on vulnerability for example are as yet very small: international calls connect these experts, thus increasing the pool of experts available. It has been suggested to develop a CIRCLE database with results/experts, etc. However, these databases are costly and only cost-efficient if they are continuously updated and have a life beyond CIRCLE, which only lasts four years. The Clearinghouse may play a future role here.

Another issue that needs to be addressed for more effective EU adaptation strategies, is the better involvement of socio-economic sciences and humanities. There are some links between the physical sciences and these sciences already, but resources for fully integrated research are limited, not withstanding some good examples of coordinated actions (i.e. marine adaptation).

It is difficult to say something about the effectiveness of these joint actions: some projects (about social impacts) are carried out within socio-economic programmes, others (environmental impacts) within environmental programmes.

Plenary session 4: Participatory approaches in climate adaptation

The central question in this session is how participatory approaches can contribute to more effective adaptation practices. Adapting to climate change has been characterised as a multi-level governance problem: Ideally both public and private actors should be included in decision making for robust adaptation practices. Not by informing them at the final stages of decision making, but by involving them from the very start of framing the adaptation problem and searching for possible solutions. Experiences with these approaches are discussed during this session.

4.1 Perceptions and attitudes towards climate change and adaptation – evidence and policy

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Abstract

It remains a curious, if often un-remarked fact, that despite the very obvious *human, social and cultural* drivers of climate change (use of energy for heating and cooking; increases in mass transportation; unsustainable food, manufacturing and consumption patterns; population growth) its proposed solutions in both mitigation and adaptation policy are, by and large, dominated by technology, the physical sciences, and economics. Although new sustainable technologies, and fiscal instruments for curbing emissions at a community or individual level will clearly be important, it is uncertain whether they *alone* can deliver either the degree or pace of change that as a global society we require to avoid dangerous climate change. The recommendations of the Copenhagen Climate Science Summit held in March of this year stress that societies themselves must undergo major transformations if we are to have any hope of avoiding dangerous climate change, as well as adapting to the degree of warming already inevitable, something more in the domain of the human and social rather than the physical sciences.

A recent report from the *American Psychological Association* argues that a great deal of theoretical understanding and transferable knowledge already exists regarding factors which can be adapted for encouraging sustainable behavior, as well as coping with issues of adaptation. However, human behavior, by its very nature, remains a complex thing; communities and individuals are both adaptable and resilient, but also governed by subtle aspects of the situation or context in which they are embedded. Psychologists and other social scientists have therefore been wary in the past of addressing some of the more normative concerns raised by environmental policy choices. The relationship between human perceptions and behaviour and climate change, at all of its levels, nevertheless requires further investigation in order to understand their full implications, while much of what we know already will require careful interpretation and adaptation in order to be useful for informing policy.

In this paper we first review evidence regarding public understanding and perceptions of climate change in Europe currently. A growing body of research evidence shows us that public awareness of climate change has grown over the past 20 years, and is currently amongst the most significant environmental concerns for most ordinary people. However, when framed against other life concerns such as financial worries climate change tends to be less salient to people. There are also important cultural differences in concerns about climate change, for example people in the Southern European countries have traditionally been the most concerned. Climate change as an issue also has many characteristics that make it unique. It is psychologically distant, both in time and space, involves multiple uncertainties (which can be difficult for people to comprehend), and tackling it will require extensive cooperation at inter-personal and national/global levels. Finally, in terms of responsibility for action there currently exists a potential 'governance trap' in that, when asked,

people typically suggest that it is governments and the international community that are primarily responsible for taking action on climate change, reasoning quite sensibly that climate change is too large a problem for them to influence alone. Equally, governments draw away from the necessary tough action on climate change targets because of fears of the electoral cycle, and in turn seek to motivate individual citizens to action through communication efforts and encouraging behavioral change. Other barriers both to individual and collective action on climate change have also been identified.

Whereas efforts at motivating citizens to undertake climate mitigation activities are now widely embedded in policy and research, we have much less data on the response of individuals to the emerging adaptation agenda. One critical issue is the very recent emergence of risk and uncertainty discourses in climate adaptation policy. While climate science and modelling has always acknowledged and incorporated complex uncertainties and gaps in its understanding, policy documents of the past have preferred to avoid risk. However, the 4th IPCC report in 2007 did adopt explicit (defined) likelihoods in describing scenarios and impacts, while the 2009 scenarios for the UK Climate Impacts Programme incorporate likelihood-based regional impacts predictions to aid adaptation decision-making for the very first time. Risk and uncertainty are therefore set to become part of the common currency underpinning debates about climate change decision-making. In turn, engaging the lay public about climate change will need to draw upon the very best guidance already developed within the field of communicating risk. These include such things as: avoid overly technical or patronizing language: choose risk terms with care, to contextualize numbers where appropriate; contextualize risks in everyday terms, but without raising spurious comparisons; recognize inhomogeneous audiences; avoid distrusted communication channels or parties; treat communication as dialogue (so as to learn as well as inform); combine information about harmful outcomes with actions which can help people to avoid the risk; and (always) evaluate communication impacts.

The talk concludes with brief discussion of findings from recent qualitative research with members of the public who had been subject to the flooding events of 2007 in the UK. Although it is impossible to state whether any particular flooding event is due to climate change, the predictions for the UK are that such events will become more likely and more severe in the future. Focus groups were convened with members of the public in Oxford, Gloucester and Sheffield in the autumn of 2007 following the major flooding there in the summer. Analysis of the data indicated, in line with other studies, that people did perceived a potential link between the flooding events and climate change but that this did not force a reappraisal of their own actions in creating climate change (unsustainable behaviours, energy use etc.). However, participants *did* conclude the need for greater action on adapting their immediate environment to future flooding and climate impacts. This finding suggests that it may be easier to engage individuals and communities around the adaptation agenda than has been the case so far with respect to mitigation. It also implies the need for adaptation and mitigation policy to be linked when efforts are made to engage communities and individuals.

The Copenhagen climate talks in December will need to address the rapid social transformations required to meet existing and future climate change targets as well as adaptation. Transformation will not be attained without also facing up squarely to the question of human behavior. Failing to do this will bring at best the potential for unintended consequences when deploying available technologies and fiscal policies, but at worst a complete failure to move towards a more sustainable world. Evidence from psychology and the wider social sciences all provide important insights into issues thrown up in mitigating and adapting to climate change. In turn, the lesson of our analysis for the policy community is that those who seek to encourage behavior change, should themselves be wary of simplistic or popular characterizations of people, their motivations and subsequent actions.

We all have our own folk theories of human motivations and behavior but many are not borne out by the evidence. Failing to ground instruments and interventions in systematic evidence about human behavior and its drivers, whether in communication and engagement programs, economic interventions, community initiatives, or deployment of new technologies, would seem an omission that environmental policy-making cannot afford. One practical suggestion arising from this analysis is that European and other governments must consider these issues when drawing up their planned future low carbon scenarios for technology deployment and lifestyle change. In line with this, the 5th Assessment Report from the IPCC, currently being outlined, should also take up and address behavioral and social aspects of potential future scenarios. By reviewing in detail scientific and other evidence on the role that can be played by behavior change and its drivers within the societal and technological transformations that are deemed necessary for a carbon-limited future, approaches to both climate change mitigation and adaptation can more fully recognize that the world is also a *social* as well as a physical and economic system.

4.2 Adaptation lab Zuidplaspolder: development of an adaptation strategy for the lowest part of The Netherlands

Hasse Goossen (Alterra, Wageningen UR, the Netherlands)[11]

Abstract

The changing climate increases the vulnerability of societies around the world (Adger 2006, Smit and Wandel 2006, Parry et al. 2007, Swart and Raes 2007) Implementation of adaptation measures reduces the vulnerability of societies to the effects of climate change. Adaptation is defined as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Parry et al. 2007). At the local government level spatial planning has a key role to play in anticipatory adaptation (Bulkeley 2006, Wilson 2006). This paper examines a case study of climate change adaptation in the Netherlands to explore how adaptation measures can best be incorporated into spatial planning .

Problem definition

Plans for intensive large scale urban development are currently being developed for the Zuidplaspolder, one of the lowest lying parts of the Netherlands, and even Europe. This raises the issue of how to adapt the planned development in the face of expected climate change and how such adaptations can best be incorporated in the planning process. The problem is a multi-disciplinary one that includes aspects of climatology, hydrology, economics and spatial planning. In order to succeed in adaptation there is a need for scientists from various disciplines, policy makers and planners to work together.

Approach

In the Zuidplaspolder project various researchers and stakeholders jointly developed and analyzed adaptation strategies using up-to-date climate data and scenarios. The research was performed in a 'laboratory' setting enabling an exchange of ideas and knowledge about a) impacts of climate change scenarios b) possible designs of adaptation options; and c) insights in costs and benefits of adaptation options. Quantifying climate change impacts at the local scale involves coupling of models, translating scenarios to impacts on hydrology, soil characteristics and eventually to impacts on socio-economic functions (biodiversity, agriculture, urban areas, infrastructure, etc). Designing possible

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adaptation strategies was done in interactive workshops. Evaluation and monitoring of alternative options was based on a societal cost benefit analysis. In the Netherlands, the Zuidplaspolder project is one of the first major attempts to develop and implement an integral adaptation strategy in spatial plans.

a) Impacts of climate change

Based on the national climate chance scenarios for the Netherlands (van den Hurk 2006), experts analysed the impact of future climate on flooding, inundation due to heavy rainfall, water shortage, salinisation, and heat waves. With respect to flooding, climate change potentially leads to increasing water levels in the rivers because of increased water discharge in the Rhine river and sea level rise. However, the upstream inlet of the stream (Hollandsche IJssel) that passes the Zuidplaspolder is fully controlled and two storm surge barriers close when the water from the sea reaches a certain level (2.70 m above mean sea level). Assuming these surge barriers function, water levels outside the Zuidplaspolder will not change due to climate change but only the frequency that the barriers close increases. Flood simulations for the Zuidplaspolder were performed using a detailed digital elevation information and a hydrological model (Sobek) to simulate water flows. The study showed that in case of flooding due to a dike breach only the south eastern part of the polder would become flooded with a maximum water depth of 1m30 (see figure 1). This is a result from the disconnection of the Hollandsche IJssel river from the main Rhine branch and the sea. A collapse of the dike would cause the water in the Hollandsche IJssel to flood the Zuidplaspolder, but the volume of water in the river is too small to flood the entire Zuidplaspolder.

24 hours after breach *36 hours after breach*

Figure 1: Illustration of inundation simulation after a breach in the dike of the Hollandsche IJssel near Moordrecht (Deltares)

Based on the flood simulations, damage calculations were performed using a model that estimates economic damage and casualties based on detailed land use statistics and population density (Jonkman et al. 2008). This information was important for the cost benefit analysis for evaluation of adaptation options that aim at reducing flood risks.

The effect of extreme rainfall on local water levels in the polder has been studied using a hydrodynamic model of the polder. It was found that, when implemented properly, the creation of extra open water (i.e. increasing the water storage capacity through ditches, small lakes and canals) compensates for the negative effect of urban development (faster runoff) and climate change (as an increase in extreme precipitation is expected) and that in three out of four scenarios almost the entire polder will comply with the Dutch inundation standards (NBW norms) in 2100 (Figure 2). The current plans are thus climate proof for most projected situations. However, if global temperatures rise by 4 degrees towards 2100 and the atmospheric circulation above North Western Europe does not change (the KNMI W scenario), additional measures will still be necessary.

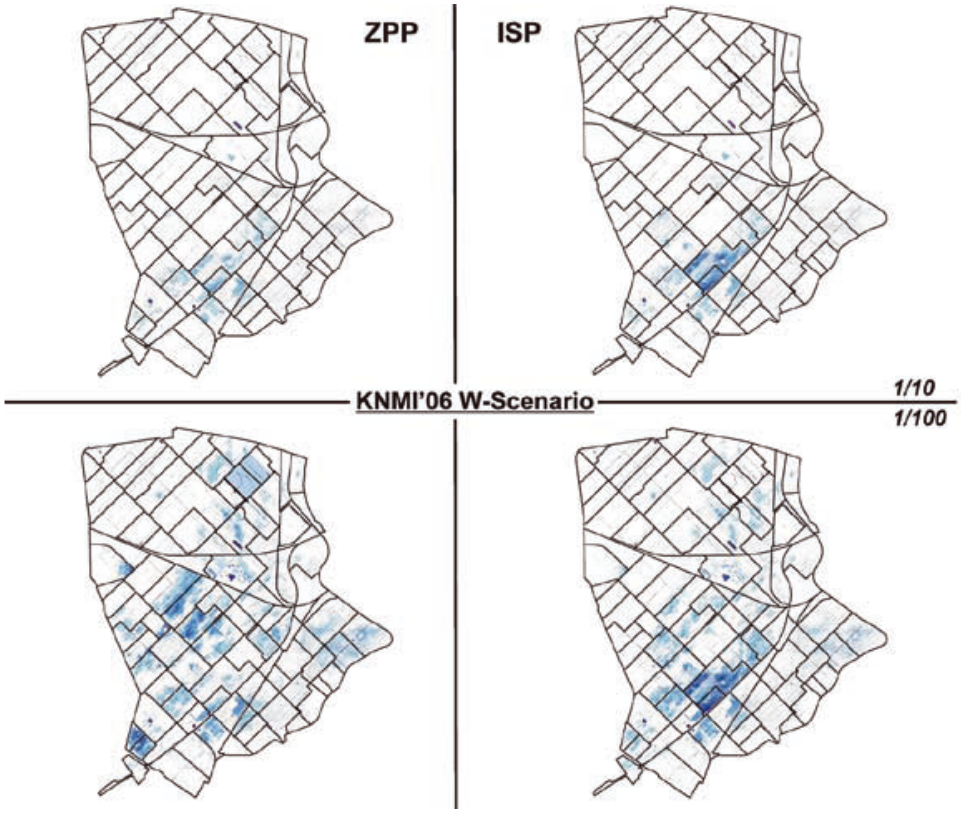

Figure 2: Differences between the existing situation in the Zuidplaspolder (ZPP, left) and the planned situation (ISP, right) for the 1/10 (top) and 1/100 (bottom) year water inundation levels as a result of rainwater, under the KNMI'06 W-scenario. Note that he southern central part of the polder will become a wet nature area, hence the high inundation levels there in the planned situation (ISP) do not pose a problem.

The climate scenarios show that while average precipitation will increase (in various degrees) during winter, it can decrease substantially during summer. This will happen when the atmospheric circulation changes to increased easterly winds and can result in 38% less precipitation on average during summer in 2100. Coupled to this reduction of average precipitation, evaporation will increase up to 30%, resulting in a drastic reduction in water resources. Coupled to the problem of water shortage is the problem of salinisation. Salt water located deep below the Zuidplaspolder (old sea water) is stopped by a relative thin layer of clay. When this layer is penetrated salt water can seep up into the polder. During dry periods water is let into the polder from the Hollandsche IJssel. As sea water will advance further during dry periods, the water let into the polder will thus be more salty.

b) Design of possible adaptation options

Based on the identified impacts of climate change, adaptation options were identified through workshops, consultation of stakeholders and design sessions with various experts. The options relate to water safety, inundation due to extreme rainfall, water shortage and heat stress caused by climate change. The workshops and design sessions yielded a large number of adaptation options (over 50 plans were identified). The long-list of options was used to develop an adaptation strategy, being a coherent set of combined measures aimed to 'climate proof' the Zuidplaspolder area. The strategy was developed in interactive sessions with stakeholders, in which the outcomes of the various impact studies were used. This led to the reduction of the long-list of 50 options to one integral adaptation strategy. This strategy consists of five concrete adaptation projects for climate proofing in specific areas of the Zuidplaspolder.

c) Estimation of costs and benefits

The costs and benefits of direct effects include the direct investment cost, related to direct costs of flood protection measures (sand suppletions, creation of raised infrastructure) and the purchase of land to create additional water storage or nature areas. Avoided damages were estimated by taking the discounted sum of the expected annually avoided damage costs over a period of 100 years. A stated-preference valuation study was conducted to elicit values from residents living in or close to the Zuidplaspolder for selected landscape characteristics in the Zuidplaspolder. The main objective of this valuation study was to estimate monetary values for landscape characteristics that represent important differences between development options but for which value information is currently unavailable. When considering the total area of the Zuidplaspolder, the main factors in the CBA results proved to be the avoided damage costs, avoided costs of for example sand suppletion to elevate the area. Also the benefits from creating additional nature and water areas were considerable. Overall, the adaptation strategy had a positive net present value. Therefore the Hotspot project recommended the development of adaptation projects as one integrated adaptation strategy.

Results

The project resulted in an integral adaptation strategy for the area, consisting of five coherent adaptation projects. Together, these five adaptation projects have shown to be desirable from a socio-economic perspective, based on the outcome of a societal cost-benefit analysis. The project demonstrated that the approach is successful in facilitating close collaboration between scientists and planners. The approach to adaptation proved effective and the proposed adaptation measures have been adopted by the project organisation responsible for the Zuidplaspolder development. Based on the results of the project, the Dutch minister for Housing, Spatial Planning and the Environment granted an additional 24 mln Euro for climate proofing of the Zuidplaspolder area.

References

Adger, W. N. 2006. Vulnerability. Global Environmental Change 16:268-281.

Bulkeley, H. 2006. A changing climate for spatial planning. Planning Theory and Practice 7:203-214.

Jonkman, S. N., M. BoÄkarjova, M. Kok, and P. Bernardini. 2008. Integrated hydrodynamic and economic modelling of flood damage in the Netherlands. Ecological Economics 66:77-90.

Parry, M. L., O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson. 2007. Climate change 2007: Impacts, Adaptation and Vulnerability., Cambridge University Press, Cambridge UK.

Smit, B., and J. Wandel. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change 16:282-292.

Swart, R., and F. Raes. 2007. Making integration of adaptation and mitigation work: Mainstreaming into sustainable development policies? Climate Policy 7:288-303.

van den Hurk, B. 2006. KNMI climate change scenarios 2006 for the Netherlands. KNMI, De Bilt.

Wilson, E. 2006. Adapting to climate change at the local level: The spatial planning response. Local Environment 11:609-625.

4.3 Science-policy interactions in local and regional adaptation practices

Susie Ohlenschlager, Oxfordshire County Council

Abstract

Floods are not new to Oxfordshire, but the impacts of the floods in 2006 and 2007 on local communities sent powerful messages to the public authorities, at a time when awareness about climate change was increasing. Moreover, in the 2007 floods there was significantly more pluvial flooding from localised rainfall, as well as fluvial flooding. Political leaders started to accept the need to develop a longer term response to climate change that crosses political boundaries, and which includes planning to adapt to a changing climate, both within our own organisations and in the county of Oxfordshire. Oxfordshire County Council has worked in collaboration with the UK Climate Impacts Programme (UKCIP) since 2006, when it was the first council in the UK to produce a Local Climate Impacts Profile (LCLIP). The report identified over 260 weather related incidents which had affected council services over the previous 10 years, at an estimated cost of at least £16 million. The working model developed with UKCIP has since been used to develop national guidance.

In this paper I have taken "science policy interaction" to mean the practical application of information and guidance emanating from, or developed with, UKCIP - in particular the use of a risk-based approach to climate change adaptation planning. I will present:

- the context and governance structure within which climate change adaptation work in Oxfordshire takes place
- working with Oxfordshire County Council services
- working in partnership with other organisations and agencies in the county
- issues for further discussion

The Oxfordshire context

Oxfordshire has over 626,000 inhabitants and an increasing population. It is a relatively prosperous county; the value of its economy measured by Gross Value Added (GVA) per head is 15% higher than the South East region overall, and 25% higher than the UK average. Though landlocked, the county has been significantly affected by floods; the city of Oxford itself has a large flood plain area and recent Environment Agency projections have significantly increased the boundaries of Oxford's flood plain area.

Local government

Unlike many areas of the UK which have unitary councils responsible for all services, Oxfordshire retains a two tier local governance system. Oxfordshire County Council is responsible for 80% of local authority services including social and education services, transport, waste disposal, strategic planning, and the fire service. With 22,000 staff, the council plays a key role in the local economy. The five local district councils organise local planning, environmental health, waste collection, and leisure services. In rural areas there are over 300 Parish Councils, some of which take on some local responsibilities such as clearing vegetation. In 2008 all six local authorities in Oxfordshire signed a joint target for adapting to climate change set by national government12. This, following the floods, has been an influential driver for all local authorities to work collaboratively across the county, both to develop adaptation responses within their organisations and in partnership with other agencies.

[12] National Indicator NI188, Adapting to Climate Change, Local Area Agreement 2 (LAA2): http://www.defra.gov.uk/ENVIRONMENT/localgovindicators/documents/ni188-guidance-2008.pdf

Working with Oxfordshire County Council services

This year the Chief Executives of Oxfordshire County Council and UKCIP signed an agreement which engages UKCIP for a further two years in providing advice and consultancy support to the council. A project steering group which brings together UKCIP, the council's risk adviser and other key services, reviews how to most effectively use the expertise and scientific knowledge of UKCIP in the context of the council's structure and activities. The key aims of the two year programme are to:

- ensure all services have assessed the risks of climate impacts and put in place strategies to address them;
- prepare Oxfordshire County Council to reach the Local Area Agreement target level 3 - a comprehensive adaptation action plan, by March 2011.

The four project areas are:

- *Business planning*. This project aims to include climate risk assessments in business planning processes. Workshops facilitated by UKCIP with key service staff have generated a long list of risks from which the services now need to decide the level of risk and assign responsibilities. In view of the uncertainties surrounding future climate change, a risk based approach is a useful way to help take decisions. However, winning corporate support for this approach, which is still new for most local authority staff, is not easy.
- *Developing adaptation responses within individual service areas*. Some service areas have started to incorporate adaptation responses into key plans or working practices, for example the Social and Community Services plan for adapting to high temperatures, or use of sustainable drainage systems in highways work. The authoritative advice and working relationship with UKCIP has helped to provide the rationale, and evidence where needed, to support change. Other services such as the Fire Service have adjusted their working practices by introducing the use of cool packs for use by staff in hot weather as a direct response to their experience of previous heat waves, but are now using the support and provided by UKCIP and the council's risk adviser to help them develop a risk based approach to plan for the future.
- *Taking forward the Local Climate Impacts Profile*. Currently the data from the 2006 LCLIP is being updated, based on interviews with key service staff about the consequences for their services of recent weather events, their responses, and how these have affected their future plans. This review will help to improve our knowledge base and monitoring processes, and to improve information about the costs to the organisation, thus strengthening the business case for implementing adaptation measures in the future.
- *NI188 indicator "Planning to adapt to climate change"1*. The intention is to plot 'adaptation pathways' and aspirations for the council over the next four years, in the context of this indicator. This is a challenge, as organisational strategies are rapidly fluctuating in response to current political and financial pressures. Regular changes to processes such as performance management can be poorly communicated across the organisation, and it is difficult to embed new approaches against other competing priorities. Climate change is a corporate priority, but the concept of adaptation is not well understood. Insofar as senior managers and councillors recognise the need to act on climate change, the carbon reduction agenda still predominates. Both mitigation and adaptation efforts are co-ordinated by staff in the Environment and Climate Change team, who still tend to be viewed as an environmental "special interest".

Both UKCIP and the council value this collaboration. The council benefits from advice and expert knowledge from UKCIP, which is respected by council staff. UKCIP is learning about the difficulties of working within such a large and complex organisation - Oxfordshire County Council has around 1,000 sites and spends over £900 million a year. There is now wider acceptance within the council that climate change *is* happening and action is needed. This means that using scientific evidence such as

UKCP09, the UK climate projections[13], should help to plan rather than to persuade. The challenge now is for people within the organisation to learn for themselves what information is needed to help plan for the future, if and how to use the science - and its limitations.

Working in partnership

All county and district authorities run Local Strategic Partnerships which include organisations such as the police and health services; their purpose is to increase effectiveness by working together strategically for the benefit of the local area - particularly important in a two-tier system which can create tensions and confusion about responsibilities. All Partnerships produce strategies with long term targets for the local area, with adapting to climate change one of the key priorities.
Longer term planning is still relatively undeveloped for many areas of partnership activity (including climate change) which have been driven by short-term political time-frames. The Local Area Agreement target for climate change adaptation , which is an objective in the Oxfordshire strategy, Oxfordshire 203014, has been an important driver for a working group of Oxfordshire councils set up to deliver the target and develop longer-term plans, using an online discussion forum to share experience. The experimental nature of the target is a challenge: guidance is being developed by UKCIP for the government as the process develops. Thus the presence of UKCIP on this group, and at times the Regional Government Office for the SE provides support as well as feedback to the government. Starting from relatively little activity in 2008, all six local councils in Oxfordshire have completed Local Climate Impact Profiles and reached this year's target level, which includes undertaking, and communicating "a local risk-based assessment of significant vulnerabilities and opportunities to weather and climate", as well as planning for the next stage. The group will be working with all the partnerships this year, including organisations such as the health services, using a risk based approach both to develop their awareness to determine the level of responses to weather events by different organisations across the county.

Issues for further discussion

Arguably staff introducing adaptation to local authorities and other organisations need to understand as much about how to influence and persuade within their organisations as they do about climate change. John Cotter[15] lists various obstacles that block successful change in business including: "paralysing bureaucracy, lack of teamwork, fear of the unknown, lack of leadership in middle management"; these are just as true for public services. A better understanding about the decision making process, how policies are developed and implemented, and how to bring about change will improve effectiveness in guiding an organisation's approach to climate change adaptation. However, working with climate change adaptation is still relatively new – with evidence, projections and targets developing rapidly; staff leading this work also need to be able to make use of the constantly evolving science, and tools they can use, in their own organisations. To do this they need sufficient, and authoritative, knowledge and understanding – of climate change as well as organisational change – to help anticipate and plan for the future without getting submerged in the complexities of the science. This requires significantly more guidance and learning.

Using a risk based approach to predict possible future impacts on the organisation is a useful way of dealing with uncertainty; but is also a new subject area for many, and is only one of a range of possible approaches. The risk management process is likely to be more useful in organisations where the process is already reasonably well developed and supported. It can be difficult for people to visualise the possible local impacts of future climate change. Experience within Oxfordshire local

[13] UKCP09, www.ukcip.org.uk

[14] Oxfordshire 2030 strategy and delivery plan, www.oxfordshirepartnership.org.uk
[15] Leading Change, John P.Cotter, Harvard Business School Press, 1996

authorities shows that reviewing recent experiences of floods and heatwaves, for example, is an effective way to engage people at an emotional level, and that learning from the consequences of these events has helped services to prepare and plan for the future. The challenge is to find how ton link increasingly complex science to local experience in a way that is meaningful and useful for practitioners.

Plenary session 5: Uncertainties in climate change adaptation

The aim of this session is to illustrate how uncertainties could be addressed both by policy makers and scientists. The 'wicked problem' of adapting to climate change is a formidable challenge to both scientists and policy makers. Scientific uncertainties are large and of very different kinds. Dependent on the kind of uncertainty and the risk philosophy of the policy makers, different types of adaptation policy may be preferred. Both scientists and policy makers need to find ways to communicate about, and manage the omnipresent uncertainties. This session provides some theoretical insights on uncertainty management as well as practical examples.

5.1 General principles and different approaches to uncertainties in climate change adaptation

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Abstract

It is increasingly recognized that adaptation to climate change has become unavoidable. It is the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect. Societies, organisations and individuals have been adapting to changing conditions for centuries but the advent of climate change brings new challenges. Some of the challenges are brought about by issues related to the rate (and magnitude) of change of climate, the potential for non-linear changes and the long time horizons. All these issues are plagued with substantial uncertainties, which makes anticipatory adaptation difficult. The fact that we have partial knowledge of future climate is in itself a new challenge.

Effective communication between science and policy - necessary for well informed adaptation policy making - is often hampered by misunderstandings about the phenomenon of uncertainty in the science. The focus on statistical and quantitative methods of uncertainty assessment leads to a tendency to ignore policy relevant uncertainty information about the deeper dimensions of uncertainty that in principle cannot be quantified. Lack of systematic attention for unquantifiable uncertainties in the science makes the perceived scientific foundation basis of climate policies prone to controversies, can undermine public support for climate policies, and increases the risk that society is surprised by unanticipated climate changes.

This presentation reviews general principles and different approaches to uncertainty management in climate change adaptation. We focus on the assessment of climate change uncertainties, but we also review existing frameworks for decision making under uncertainty for adaptation to climate change. The presentation explores how different ways of including uncertainty in decision making match with uncertainty information provided by the various uncertainty assessment methods. It reviews a broad range of areas of climate change impacts and impacted sectors of society and economy that may require a response of planned adaptation.

The questions addressed in this presentation focus on three interrelated areas: (1) To what climate changes do we need to adapt where, and what parties are involved in adaptation decision making? (2) What decision making frameworks for adaptation and strategies for accounting for uncertainty in adaptation are proposed in the literature and or used in other countries?, and (3) What methods are available to assess climate change impact uncertainties to inform adaptation decisions? The existence of different attitudes to risk and uncertainty leads to different decision making frameworks existing in various adaptation contexts. The various decision making frameworks call for different decisions analysis frameworks and different tools for uncertainty analysis.

Decision frameworks and analysis tools can roughly be grouped into two schools of thought: the predictive top-down approach and the resilience bottom-up approach. Some mixed approaches were also discussed. The difference between top down and bottom up is in the direction in which the causal chain is followed in the reasoning: Top down starts from the top by exploring the accumulation of uncertainty from each step going from emission scenarios, to carbon cycle response, to global climate response, to regional climate scenarios to produce a range of possible local impacts in order to quantify what needs to be anticipated. Bottom up starts at the bottom: the impacted system and explores how resilient or robust this system is to changes and variations in climate variables and how adaptation can make the system less prone to uncertain and largely unpredictable variations and trends in the climate.

Given that much more attention has been given to the prediction oriented (top-down) approach we reviewed various tools, techniques and methods used in the various steps of climate change impact and adaptation assessments and how these are currently being applied in the fields of climate risk assessment and climate adaptation decision making. We identified a range of strategies to account for uncertainty in decision making and frameworks for decision making under uncertainty of relevance for adaptation decisions. Further, we identified a collection of tools for uncertainty analysis of relevance for informing adaptation decision making processes and discourses. Both for the frameworks for decision making under uncertainty, and for the tools for uncertainty assessment, we mapped how well each of them can cope with three levels of uncertainty distinguished in this report: statistical uncertainty, scenario uncertainty and recognized ignorance.

Roughly, the top down - prediction oriented approaches are strong in statistical uncertainty and the resilience and robustness type of bottom up approaches are strong in coping with recognized ignorance and surprises. An essential first step in the selection of an appropriate decision making framework and appropriate methods for uncertainty analysis for a given climate adaptation decision making problem will thus be a well argued judgment on the policy-relevance of each of the three levels of uncertainty - along with a judgment of their relative importance - to the particular decision making problem at hand.

We also mapped the various uncertainty assessment tools to the various frameworks for decision making under uncertainty, indicating methods that are key for a given decision making framework, methods that are complementary to a given framework and methods that do not match a given framework. Our tentative recommendation is that a plurality of approaches (using both top down and bottom up) need to be tried in different contexts in order to learn what works and what doesn't. We recommend to further explore a few niches in the field of uncertainty and climate change adaptation, amongst others: robust decision making methods, development of indicators for measuring resilience, development of a catalogue of wild cards and imaginable surprises. Further we argue that differences in predicted uncertainty range by different methods (as the one identified in our case study) need to be further explored and discussed in the climate adaptation community.

5.2 New scenario development ahead of the IPCC AR5

Timothy R. Carter, Finnish Environment Institute (SYKE), tim.carter@ymparisto.fi [16]

In January 2009, around 35 international researchers met in Boulder, Colorado to discuss strategies for improving global co-ordination within the research community studying climate change impacts,

[16] Prepared for the workshop: "Europe adapts to climate change – Science-policy interactions in national adaptation policy", 14-15 September 2009, Utrecht, The Netherlands

adaptation and vulnerability (IAV) [1]. Among the specific issues discussed, the participants identified four overarching questions requiring urgent research:

(1) How much adaptation do we need between now and 2030 to cope with "inevitable" climate change?
(2) What are the likely and unavoidable climate impacts over the 21st century, taking into account adaptation and considering a range of scenarios?
(3) What are the processes and interactions in human and natural systems that result in vulnerability to climate change?
(4) What are the interactions between mitigation and adaptation?

One of the recurring requirements for researchers analysing such questions is a need to characterise future developments in society and the environment. These are typically hard to predict, often depending on uncertain human decisions and outcomes. The conventional approach to describing future developments is to construct *scenarios*, which are alternative plausible representations of a future world. Scenarios are usually applied in situations where uncertainties are large. They do not have an ascribed likelihood and hence differ from predictions, which indicate the most probable outcomes. There have been a number of past exercises to develop scenarios for use in examining global climate change. These typically considered future socio-economic and technological pathways, emissions and uptake of greenhouse gases, and resulting changes in climate. The last comprehensive exercise was reported in 2000 by the Intergovernmental Panel on Climate Change (IPCC) in the Special Report on Emissions Scenarios (SRES) [2].

The SRES scenarios, like other scenarios before them, were constructed and applied sequentially in a four-step process (Figure 1a) that involved developing projections of greenhouse gas and aerosol emissions (step 1), estimating the radiative effect on the atmosphere of these emissions (step 2), modelling the climate effects of radiative forcing (step 3) and then examining impacts on natural and human systems arising from the projected climate changes (step 4). This was a time consuming exercise, taking some five years after initiation of the SRES process before IAV researchers could start their work using the new scenarios. Since then, the SRES scenarios have been applied widely in IAV research, often involving re-interpretation of the global scenarios for use at spatial scales ranging from continental down to sub-national or over a regular grid, and representing developments across different sectors. For instance, gridded land use scenarios and a range of technological and policy outcomes for Europe were mapped onto the four basic SRES scenarios (A1, A2, B1 and B2) alongside climate projections to consider future developments in ecosystem services for the ATEAM project [3]. However, while many aspects of the SRES scenarios are still valid, they also have limitations. Apart from the obvious need to update some of their quantitative projections (e.g. of future population) as well as growing demand for finer resolution information, one of the fundamental drawbacks of the SRES scenarios is their explicit exclusion of climate change mitigation policies in the specification of future emissions.

To address these new requirements, climate change researchers from a wide range of disciplines have presented a blueprint for developing new scenarios [4]. This plan responds to scientific and policy interest in exploring a broader range of potential climates and uncertainties, but also attempts to accelerate the process of scenario development to serve the needs of the IPCC Fifth Assessment Report (AR5) and other assessments.

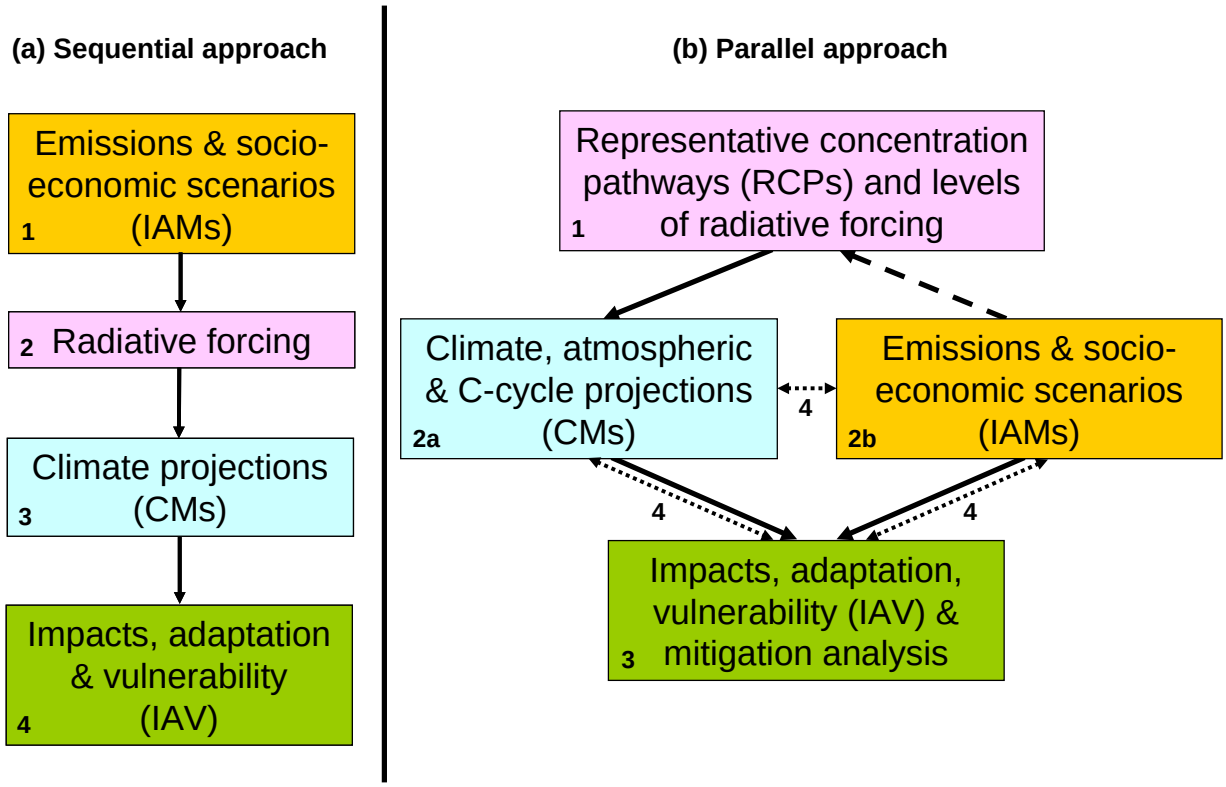


Figure 1. Approaches to the development of global scenarios: (a) sequential approach; (b) new parallel approach. Numbers indicate analytical steps (2a and 2b proceed concurrently). Arrows indicate transfers of information (solid), selection of RCPs (dashed), and integration of information and feedbacks (dotted). IAMs denotes integrated assessment models, CMs climate models and IAV, impacts, adaptation, and vulnerability. [4]

The new process starts with a limited number of (four) scenarios of potential future concentrations of greenhouse gases, short-lived species, and land use and land cover derived from the existing peer-reviewed literature (Figure 1b). These scenarios, known as representative concentration pathways (RCPs) span a large range of potential future climate outcomes and uncertainties, with three out of four explicitly considering climate policies and the fourth representing a "business-as-usual" type scenario. By making these RCPs available at the beginning of the process, climate modellers can begin to undertake new climate model experiments immediately, using the RCP forcing (step 2a). In parallel to this activity, integrated assessment modellers will have an opportunity to develop new socio-economic scenarios that are broadly consistent with the forcing pathways, or alternatively to develop entirely new scenarios with different trajectories that can provide a fresh look at additional futures based on information emerging from new research (step 2b). This parallel phase is anticipated to require about two years after which the socio-economic assumptions and climate model results can be paired and applied in IAV studies (step 3).

Overall, the parallel process presents an opportunity for IAV studies that are based on up-to-date climate and socio-economic scenarios to be undertaken and published more rapidly than was hitherto the case. In this way, new IAV studies can more readily be integrated with the most recent research on the climate system and on mitigation responses (step 4), and all assessed simultaneously by the IPCC and other bodies. The development and interpretation of these new scenarios presents a significant challenge for the scientific community in general. It also raises a set of specific questions for the IAV research community, who are important potential users of such information, such as:

- How can researchers make use of the new RCP-based climate projections in conjunction with new socio-economic and technological scenarios?

- At what temporal and spatial resolutions will new scenarios be made available and how far into the future will the scenarios extend?
- What guidance can be offered for selecting from the large number of projections being produced?
- Will the scenarios be associated with storylines similar to those constructed for SRES?
- What is the time schedule for delivery of new scenarios and how can they be accessed?

These are just some of the issues requiring international deliberation and co-ordination during the next months. One opportunity for this will be a special session devoted to these new scenarios at an International Climate Change Adaptation Conference in June 2010 [5], another outcome of the Boulder Workshop. In advance of this, however, it would also seem prudent for European researchers and funding agencies to prepare themselves for the task of documenting and deploying these new scenarios in Europe as they become available.

Notes

1. Palutikof, J. and P. Romero-Lankao, 2009. Adapting to Climate Change: Research Challenges, *Eos Trans. AGU, 90*(25), doi:10.1029/2009EO250009.
2. Nakićenović, N. and 27 others, 2000. *Emissions Scenarios. A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA, 599 pp.
3. Schröter, D. and 34 others, 2005. Ecosystem service supply and vulnerability to global change in Europe. *Science* 310: 1333-1337.
4. Moss, R., and 30 others, 2008. *Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts, and Response Strategies*, IPCC Expert Meeting Report, 19-21 September, 2007, Noordwijkerhout, The Netherlands, Intergovernmental Panel on Climate Change, Geneva, 132 pp.
5. 2010 International Climate Change Adaptation Conference: *Climate Adaptation Futures: preparing for the unavoidable impacts of climate change*, 29 June – 1 July 2010, Gold Coast, Queensland, Australia.

5.3 Dealing with uncertainties in the Netherlands: the Delta Commission

Pavel Kabat (WUR, the Netherlands)

Pavel Kabat summarized the main vulnerabilities of The Netherlands as to water safety and elaborated on the way that the 2nd Delta Commission has addressed scientific uncertainties, particularly in relation to sea level rise. He noted the high-level political support to "make the country climate-proof", which explains that the Commission not only took a very long-term view (investments in coastal protection should have a very long lifetime), but also considered sea level rise scenarios at the high end of the uncertainty range. He noted that plausible high-end scenarios are necessary to judge the sustainability of the Dutch dike-ring concept, that high-end and low-end scenarios are necessary for robust design, but that the most recent research results suggest that plausible high end scenarios could be the most probable ones. Prof. Kabat also stressed the difference between accuracy in projections and precision. Accurate projections with low precision may have an uncomfortable wide uncertainty range, but high-precision projections that may be attractive from a policy-makers perspective could have a low probability of being accurate. He also noted that "building with nature" is a flexible solution regarding changing conditions and societal values, and increased understanding, it is a cost-effective solution, and it provides opportunities for an integrated and multifunctional approach.

Plenary session 6: Tools to disseminate climate change information

The objective of this session is to discuss how several web-based and other tools to disseminate information on climate impacts and adaptation are developed, what the experiences are and how they are designed to match the target groups. Scientific information on the potential impacts of climate change is highly valuable for local and regional, both public and private organisations to develop pro-active adaptation strategies and take appropriate measures. However, this information is often highly specialized, often hidden in voluminous scientific reports and dispersed between different research organisations.

Session chair: *Chris West* (UKCIP, United Kingdom)

6.1 Comparing the set-up of web based instruments within the European Union: an overview of the CCCRP June 2009 workshop

Juha Karhu (Finnish Meteorological Institute, Finland)

Abstract

The Climate Change Community Response Portal (CCCRP) project (LIFE07 INF/FIN/00152), funded partly by EU through LIFE+ financial instrument, organised an international workshop on web tools for communicating climate change information. The objective of the workshop was to assist the CCCRP project in designing a Finnish climate change portal and to facilitate further collaboration between the participants in planning and realization of web tools for communicating climate change information. In the workshop web portals or web based tools from six countries were presented:

- Finland, Denmark, Norway, United Kingdom, the Netherlands and Canada:
- the Netherlands, KNMI Climate Scenarios, http://www.knmi.nl/climatescenarios
- Canada, The Canadian Climate Change Scenarios Network (CCCSN), http://www.cccsn.ca/
- Finland, Climate Change Community Response Portal (CCCRP), http://www.fmi.fi/cccrp
- Norway, Climate Adaptation Norway, http://www.klimatilpasning.no/ and climate data; http://www.met.no, http://www.yr.no, http://www.eklima.no, http://senorge.no, and adaptation
- Denmark, Danish web portal for climate change adaptation, http://www.klimatilpasning.dk
- United Kingdom, UK Climate Impacts Programme, http://www.ukcip.org.uk

Web-based instruments in responding to climate change are applied widely and they are under intensive development. A climate change web portal with a holistic approach should include at least the following contents: climate change explained, climate data provision, impacts description, options of adaptation to and mitigation of climate change. All web instruments covered here have not been built to be holistic, but most cover all aspects to some extent, if not by the web sites themselves, through links to recommended or related sites.

Climate change science is much more than just atmospheric sciences; oceanography, glaciology, biogeochemistry, etc. have to be considered, too. Explaining climate change in depth in an understandable way is challenging. Feedbacks and uncertainties can seem overwhelmingly hard to grasp. Text articles, FAQs, maps and graphs, summaries of new scientific articles, glossaries, timelines, webinars and interactive tools are being used.

Provision of climate observations and projections differ from nation to nation. Common challenges include local high resolution information, seamless transition between observations and projections, communication of uncertainties, guidance and training, management of user expectations. In Norway all climate observations are distributed free of charge through one dedicated web service: eklima.no, which seems unique in Europe. Deterministic climate projections outnumber probabilistic

approaches (UKCIP09). Compared to climate data, information on impacts of climate change to ecosystems, ecosystem services and society are less abundantly offered in the web portals. Impacts are described using both sectoral/thematical and geographical divisions. In CCCRP, Finland, a web based impacts tool for general public is being developed based on an existing tool intended mainly for researchers. Guidance in adaptation to climate change is also given along the lines of sectoral/thematical categories. Adaptation to adverse impacts is given the most emphasis, but also opportunities are pointed out. Risk framework approach is used, but it is still under development

Mitigation
Integration of adaptation and mitigation is generally low, when response strategies are being considered in the guidance material. All slides of the presentations of the workshop are available as pdfs and most presentations as audio/video recordings through the CCCRP project web page: http://www.fmi.fi/cccrp

The portal is in a way a boundary service. It helps to bring in the social science expertise. The service aims at a holistic user-friendly approach.

6.2 The ADAM Digital Compendium

Jochen Hinkel and *Markus Wrobel*[17]

Abstract
There is a wide consensus that Europe and the rest of the world need to adapt to climate change. Not only has the global mean temperature risen by almost 1 degree C since the onset of industrialisation, there has also been an observable increase in floods, droughts and other climate-related extreme events. But who exactly needs to adapt? And what needs to be done?
There is no single answer to these questions. Impacts, experienced or expected, differ for different people, regions or sectors. For example, whilst the Mediterranean tourism sector is likely to face challenges as a result of temperature increases and decreasing water availability, the visitor economy in Northern Europe may benefit from the new opportunities arising from a warmer, more stable, summer season. There is also no single recipe for adapting to these impacts. In fact, the adaptation situations we find in Europe and beyond are diverse and often complex, involving multiple actors at different scales, differing perceptions about what the problem is and a lack of consensus as to what constitutes effective responses. Furthermore, the information we currently have about impacts and adaptation is still uncertain, incomplete and fragmented. While we have some idea of what level of impacts to expect for some regions and sectors, we know little about what might happen in others. Being a relatively new field of research, practical evidence of the extent, feasibility, efficiency, and cost effectiveness of potential adaptation options remains largely lacking. Hence, adaptation is rarely a simple decision based on certainty about impacts and effective adaptation options, rather adaptation is a continuous process of learning between actors and institutions at all levels of decision making.

The ADAM Digital Compendium contributes to emerging knowledge on adaptation by acting as a portal for the dissemination of adaptation relevant results of the ADAM Project (Adaptation and Mitigation Strategies: Supporting European climate policy). The Digital Compendium aims at complementing the traditional, report- and paper-based communication of scientific results by

[17] H. Asbjørn Aaheim, Ilona Banaszak, Marco Bindi, Adam Chorynski, Tom E. Downing, Mareen E. Hofmann, Richard J.T. Klein, Zbigniew Kundzewicz, Kate Lonsdale, Nicola Lugeri, Piotr Matczak, Darryn McEvoy, Reinhard Mechler, Marco Moriondo, Giacomo Trombi and Taoyuan Wei

making results produced within ADAM available to a wider audience in form of an interactive and user-friendly web-interface. Results from the following five types of analysis are considered:

- Workshops and interviews were conducted and synthesised into key messages about what supports and what hinders adaptation and a set of learning examples that describe the experiences that decision makers and organisations have gained in the adaptation learning processes.
- A meta-analysis of climate change impact, vulnerability and adaptation case studies was performed in order to give a systematic account of what is known in the literature.
- A macro-economic analysis was conducted to estimate the monetary effects of climate change and adaptation for different European countries.
- An adaptation catalogue was developed to collate information on possible adaptation measures including the extent, feasibility, efficiency, and cost effectiveness of these options.
- Finally, an analysis of risk of climate-related extremes such as floods and droughts was performed in order to produce risk / damage maps for Europe.

One particular challenge that needed to be faced in the development of the Digital Compendium was designing it in parallel to the ongoing research of those scientist that provide its content. Hence, it was mandatory to keep a high degree of flexibility with respect to integrating and presenting subsets of content in ways that emerged during the research. Furthermore, it was required to accommodate the multitude of distinct types of contents to be made available, as well as a variety of preferences of the content providers and potential end-users.

Consequently, the Digital Compendium was designed to allow for different levels of structure. Instead of striving for a 'one-size-fits-all' approach, an architecture was designed to manage divers content (e.g., textual descriptions, structured descriptions, model output) in suited substructures, and to fill and refine the Compendium iteratively as new results became available. This was achieved through an information technological architecture that includes the following components:

- content management system to manage text-based parts of the overall content;
- database for the structured descriptions generated in the meta-analysis;
- database for the adaptation catalogue, including a web-based application for submitting the information on the options;
- database to manage GRACE model output;
- set of Java-based routines to extract the content managed in each of the above components, and to transform and integrate it into the Digital Compendium's web-enabled presentation layer.

Despite the variety of the content to be made available, a homogeneous appearance is ensured by applying a consistent overall look and feel. All content is free-text searchable; in addition, a consistent labelling of the content is applied, allowing the user to select content of interest by specifying sector, country, or climate-related hazard. Via hyper-links, the user can jump directly from each page to a list of other compendium pages labelled with the same keyword. Furthermore, additional access functionality for specific content sections is provided, e.g., to search the meta-analysis database by author, title or journal, or to filter the adaptation catalogue by type of option or landscape type.

The Digital Compendium is accessible using any standard web-browser under http://www.digital-compendium.adamproject.eu/.

Discussion

The demand for knowledge is diverse and under-researched. We know little about it. Additionally, research based knowledge however is only one source of information amongst others in decision making processes. In many cases, general headline messages are sufficient. It is very important to

support learning from practical experience and exchange information on best practices. The social learning perspective is very useful for this and should feature more prominently in policies. This implies to start from an analysis of the demand and to strive for knowledge synthesis (however, with greater specificity and not aiming at one fits all-concepts).

6.3 European Climate Impact Indicators

Andre Jol (European Environment Agency (EEA), Copenhagen, Denmark)

Abstract

The EEA, JRC and WHO Europe published a joint indicator-based report on climate change impacts in Europe in September 2008. The objectives of the report were to present new information on past and projected climate change and its impacts through indicators, to identify the sectors and regions most vulnerable to climate change with a need for adaptation, and to highlight the need to enhance monitoring and reduce uncertainties in climate and impact modelling.

Global science and policy background

The IPCC (2007) strengthened earlier scientific findings about key aspects of climate change impacts and vulnerability while several reports were published after the IPCC 4th assessment report (UNEP, 2007; WHO, 2008; IARU, 2009; WWF, 2009). The IARU scientific conference report (IARU, 2009) concluded that: ""recent observations show that many aspects of the climate are changing near the upper boundary of the IPCC range of projections. Many key climate indicators are already moving beyond the patterns of natural variability within which contemporary society and economy have developed and thrived. Recent observations show that societies and ecosystems are highly vulnerable to even modest levels of climate change, with poor nations and communities, ecosystem services and biodiversity particularly at risk"".

Within the UNFCCC, the EU has proposed a target of a maximum global temperature increase of 2°C above the pre- industrial level. However, even with temperature rises less than 2 °C, impacts can be significant, although some societies could cope with some of these impacts through adaptation strategies. Beyond 2°C, the possibilities for adaptation of society and ecosystems rapidly decline with an increasing risk of social disruption through health impacts, water shortages and food insecurity. Furthermore with increasing global temperature large and rapid changes in the behaviour of natural or societal systems may occur, some of which are non-linear related to positive feedbacks in the climate system that can accelerate climate change (IARU, 2009; WWF, 2009).

At the global level there has been progress in implementing the UNFCCC Nairobi work programme on impacts, vulnerability and adaptation to climate change which aims to help all countries, in particular the least developed countries and small island developing States, to make informed decisions on adaptation actions. A post-2012 global climate change agreement that would include both adaptation and mitigation should be agreed by end of 2009 at COP15 in Copenhagen. Many least-developed countries, particularly vulnerable to climate change and with limited possibilities to adapt, regard adaptation as vital. Many developing countries request a substantial increase in the level of funding for adaptation in their countries, within a post-2012 agreement. In Sep 2009 the third World Climate Conference (WCC3, 2009) approved a Global Framework for Climate Services (WMO, 2009) which should strengthen production, availability, delivery and application of science-based climate prediction and services.

European policy developments

Also Europe should reduce its vulnerability to the impacts of climate change. The Commission published a White Paper on Adaptation to Climate Change and an impact assessment (April 2009) in which results were used from the EEA 2008 report.

Phase 1 (2009-2011) supports the preparation of a comprehensive adaptation strategy by:

- Development/improvement of the knowledge base on impacts, vulnerabilities, costs and benefits of adaptation measures.
- Integration of adaptation into EU policies of different sectors considering potential impacts and costs as well as interaction of activities with other policies.
- Employment of a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation.
- Strengthening international co-operation on adaptation by mainstreaming adaptation into all EU's external policies.

Improving existing knowledge management could be done by establishing an EU Clearing House on climate change impact, vulnerability and adaptation, which would include information, e.g. at sector level or national level, also from GMES (Global Monitoring for Environment and Security). EEA will be involved in the development and management of the clearinghouse. Within the Water Framework Directive the River Basin Management Plans due in 2009 should take into account climate change, based on initial guidance recently prepared (with EEA contribution) and the plans due in 2015 should be fully climate-proofed. Climate change should also be integrated in the implementation of the Floods Directive and within the Water Scarcity and Droughts strategy. For agriculture adaptation – e.g. with respect to requirements for more efficient water consumption - should become part of the forthcoming CAP reform and the new rural development policy plan. Climate adaptation should also become part the EU health strategy, e.g. through guidelines on how to deal with climate change. Climate change should be factored into the management of Natura 2000 to ensure the diversity of and connectivity between natural areas and to allow for species migration and survival when climate conditions change. A discussion has started on future post-2010 biodiversity policies and targets, which also will include climate change adaptation considerations.

National adaptation strategies

So far eleven EU member states have adopted national adaptation plans. The priority sectors differ widely due to national circumstances. Planning and implementing adaptation policies and measures are often postponed to a later stage. Mechanisms and criteria for evaluation and monitoring systems are often lacking. Participation by stakeholders at different governmental levels and from different backgrounds has been limited so far. Some countries have recognized advantages of climate change. Some regional (sub-national) and local/city adaptation strategies have been developed, with often similar issues as for the national strategies

Climate change indicators

The 2008 report includes about 40 indicators divided in the following categories:

- Atmosphere and climate
- Cryosphere (glaciers, snow and ice)
- Marine biodiversity and ecosystems
- Water quantity
- Freshwater quality and biodiversity
- Terrestrial ecosystems and biodiversity
- Soil
- Agriculture and forestry
- Human health

The indicators were selected based on measurability, causal link to climate change, policy relevance, availability of historic time series (in most cases at least about 20 years), data availability over a large part of Europe, and their transparency. For the assessment of future trends the results of a variety of existing scenarios and models were used. Potential future vulnerabilities and economic effects were also presented, including weather related disasters; coastal flooding; public water supply; agriculture and forestry; biodiversity and ecosystem goods and services; energy; tourism and human health. The report shows that the most vulnerable areas in Europe are Southern Europe and the Mediterranean Basin, mountain areas, in particular the Alps, coastal zones, densely populated floodplains and the Arctic region. The report concluded that better monitoring and reporting of observations of climate change and high resolution climate change scenarios are needed as appropriate adaptation measures are best taken at regional and local level. Better understanding of costs and benefits, good practices in synergy with mitigation actions and how to avoid mal-adaptation are also needed.

Further development of climate change indicators

All 2008 climate change indicators are available on the EEA web which will allow updating of indicators for which regular new data becomes available and trends are changing significantly. The European Commission has commissioned a project on climate change vulnerability indicators and a report from the consultants is expected in autumn 2009. EEA organised an expert meeting on vulnerability indicators and disaster risk mapping in July 2009 and also expert meetings on adaptation indicators (Sep 2008, July 2009). Vulnerability is defined as a function of 1) the exposure to CC impacts, 2) the sensitivity and 3) the adaptive capacity of a system or territory.

The EEA vulnerability expert meeting concluded the following. Disaster risk and climate change vulnerability assessment and mapping expert communities should share experiences more, e.g. definitions and concepts could be further clarified. It is important to always define the objective of indicators with involvement of stakeholders, and clarifying where in the policy cycle these are needed (e.g. policy development or implementation). Climate change vulnerability maps are one tool next to others to assess adaptation options. Cost benefit analyses could be useful, at different levels (national, local), but its limits should be clarified and understood. Innovation and opportunities due to climate change should be taken more into account. Probabilistic climate change vulnerability assessments are important and useful (provided uncertainties are transparent), but not for all policy questions. Assessments of ecosystem vulnerability (to climate change) should be performed more. Land use change should also be included in the assessments since it is an important pressure.

Data and methodological issues to address include:

- The limits of aggregated/integrated indices (the scientific methods and the communication of the results)
- Work with stakeholders at the right level (e.g. when defining weighting factors for aggregated/integrated indices)
- Consistency and comparability across EU, national, local (case studies)
- How to be transparent and pragmatic
- The adaptive capacity (socio economic data) is the most difficult to estimate (quantitatively), especially for the future (using scenarios), but it could also be done qualitatively
- Communicate uncertainties transparently

Adaptation indicators could be developed for monitoring the implementation of adaptation policies and measures (process based) and for measuring the effectiveness of adaptation actions (outcome based). The EEA expert meetings concluded that process-based indicators are likely to be of greater significance in the short term, with outcome-based indicators assuming a greater prominence in the

longer-term. For example regarding biodiversity from published adaptation principles and initial policies it should be possible to develop adaptation indicators which should be integrated in existing indicator frameworks, in particular SEBI 2010 (Streamlining European 2010 Biodiversity Indicators). A first indicator based assessment report on Europe's progress towards the 2010 target was recently published (EEA, 2009) which included climate change to a limited extent. Within the process of discussions on post-2010 biodiversity policies and targets adaptation indicators related to biodiversity may be developed.

The Commission will arrange an Impact and Adaptation Steering Group that could further discuss how to develop and use vulnerability and adaptation indicators in the coming years and EEA will support this process.

References

EC, 2008. White Paper from the Commission - Adapting to climate change: Towards a European framework for action, COM(2009) 147 final, Brussels, 1.4.2009.

EEA, 2008. Impacts of Europe's changing climate, 2008 indicator-based assessment. EEA report No 4/2008.

EEA, 2009. Progress towards the European 2010 biodiversity target. EEA Report No 4/2009

IARU, 2009. Synthesis report Conference 'Climate change Global Risks, Challenges & Decisions, Copenhagen, 10-12 March 2009.

IPCC, 2007. Climate Change 2007: Synthesis report Contribution of Working Groups I, II and III to the Fourth Assessment Report of the IPCC. Cambridge University Press, UK.

UNEP, 2007. Global Outlook for Ice and Snow. UNEP.

WCC3, 2009. Third World Climate Change Conference, Geneva, 31 August – 4 September 2009

WHO Europe, 2008. Protecting health in Europe from climate change.

WWF International Arctic Programme, 2009. Arctic Climate Feedbacks: global Implications.

6.4 German climate service centre

Lutz Cleemann (Sustainable Business Institute, Germany)

Abstract

Latest with IPCC report 4 it became clear, that adapting to climate change has to be considered to be as urgent as mitigation. It is no longer the question if climate change is anthropogenic. We are now faced with the question: What will be the impact of climate change on our human and natural systems and how should we respond, how do we have to respond to avoid catastrophes, injuries and costs? The challenge:

- Climate variability and change are considerably important for a wide range of human activities and natural ecosystems.
- Climate science has made major advances during the last two decades, yet climate information is neither routinely useful for nor used in planning.
- Climate science has to be connected to decision-relevant questions and to support building capacity to anticipate, plan for, and adapt to climate fluctuations.
- This means in practice, that we have to integrate climate model data into end-user knowledge systems, we have to transform weather and climate data into reliable information for decision makers.

The requirements

- *Improve understanding*: climate research based on societal needs, not on their own agenda, scientists must focus on societal questions

- *Detailed regional information* on the basis of global models that can represent high resolution processes such as convection, hurricanes, surface hydrology.
- *Communicate actionable information* to society through a dialogue between scientists, decision-makers and the public.

The vision of the German Climate Service Center (CSC) (headed by Guy Brasseur, funded by the German Ministry of Education and Research, BMBF). As a national initiative and as a partnership with different German institutions, the CSC will produce and deliver useful, authoritative, and timely science-based knowledge, using Earth system observations, model predictions/projections, and analysis to help (1) mitigate the causes of environmental changes and (2) manage climate-related risks, opportunities and impacts. The Climate Service Center will build bridges between

- Observation & Monitoring
- Research, Modelling & Assessments
- Resource Risk Management
- Adaption & Mitigation
- and provide integrated Climate Services

The mission of the German Climate Center:

- Provide balanced, credible, cutting edge scientific and technical information
- Engage a diversity of users in meaningful ways to ensure their needs are being met
- Provide and contribute to science-based products and services to minimize climate-related risks
- Strengthen observations, standards, and data stewardship
- Improve regional and local projections of climate change
- Inform policy options

The German Climate Service Center will provide these demanding services on the basis and in close cooperation with the already well established German institutional network on weather, climate and climate research. Many sectors will benefit from the German Climate Service Center:

- Energy
- Agriculture
- Forestry and land management
- Water management
- Coastal management
- Fisheries
- Transport
- Tourism
- Trade and Commerce
- Human health
- Financial services and insurances
- Construction and urban development
- Civil protection and environmental security

Particularly the Financial Sector expressed the need for improved climate informations:
(Study of the Sustainability Business Institute as part of the German Ministry of Education and Research (BMBF) sponsored project „CFI – Climate Change, Financial Markets and Innovation, www.cfi21.org). The majority of financial service providers indicate that they are ”poorly informed“ and/or ”would like to be better informed“ regarding the following industries affected:

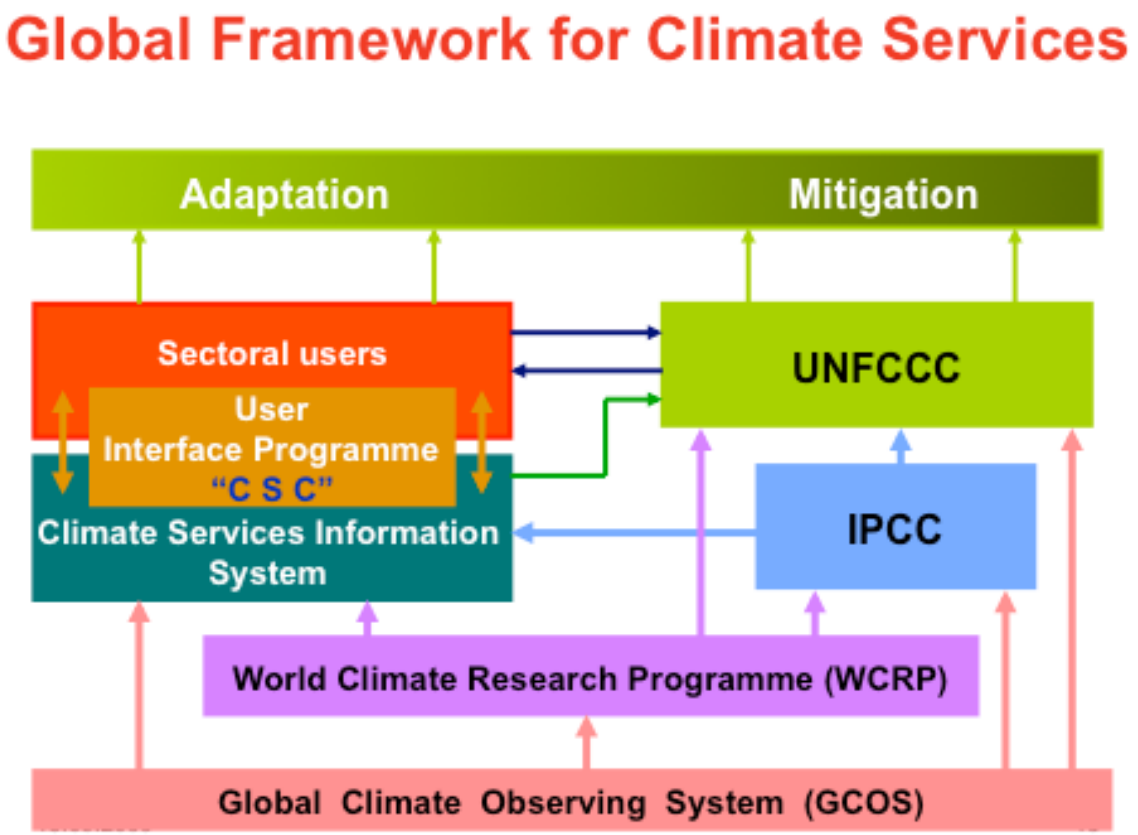
- Construction and real estate industry (16 out of 17)
- Infrastructure and transport (14 out of 16)
- Tourism (12 out of 15)
- Water sector (11 out of 15)
- Financial sector (11 out of 15)

The needs of the financial sector

- Concrete data on expected changes for a specific location and a specific time horizon for the next 5-10 years (14 out of 19)
- Concrete data on expected changes for a specific location and a specific time horizon for the next 10-30 years (15 out of 19)
- Interpretation and assessment of the quality of the data and/or forecasts in terms of probabilities and/or uncertainties (17 out of 19)
- ... and more

Implementation of regional financial studies in addition to the regional scenario models that already have been developed in many industry/research projects (especially in cooperation with local banks) Studies on market potentials and market exploitation levels, especially for new business models Research on insurance issues regarding new technologies. Studies on (international) economic and regulatory issues of climate change, climate protection and ”climate policy“. Studies on the potential for the prevention of losses and catastrophes. Research on the ”carbon impact“ or ”carbon footprint“ of technologies and businesses. Market forecasts on electricity and CO2 certificate prices. Research on the awareness of citizens and their climate-friendly behaviour

The German Climate Service Center is ahead of the Global Vision of WCC-3:
An international framework for climate services that links science-based climate predictions and information with the management of climate-related risks and opportunities in support of adaptation to climate variability and change in both developed and developing countries.



High level declaration

DO 1 We, Heads of State and Government, Ministers and Heads of Delegationpresent at the High-level Segment of the World Climate Conference-3 (WCC-3) in Geneva, noting the findings of the Expert Segment of the Conference;

OP 1 ***Decide*** **to establish a Global Framework for Climate Services** (hereafter referred to as "the Framework") to strengthen production, availability, delivery and application of science-based climate prediction and services;

OP 2 ***Request*** the Secretary-General of WMO to convene within four months of the adoption of the Declaration an intergovernmental meeting of member states of the WMO to approve the terms of reference and to endorse the composition of a **task force of high-level**, independent advisors to be appointed by the Secretary-General of the WMO with due consideration to expertise, geographical and gender balance;

OP 3 *Decide* that the task force will, after wide consultation with governments, partner organizations and relevant stakeholders, **prepare a report, including recommendations on proposed elements of the Framework**, to the Secretary-
General of WMO within 12 months of the task force being set up. The report should contain findings and proposed next steps for developing and implementing a Framework. In the development of their report, the taskforce will take into account the concepts outlined in the annexed Brief Note;

OP 4 *Decide* further that the report of the task force shall be circulated by the Secretary-General of WMO to Member States of the WMO for consideration **at the next WMO Congress in 2011, with a view to the adoption of a Framework**
and a plan for its implementation; and

OP 5 *Invite* the Secretary-General of WMO to provide the report to relevant organizations, including the UN Secretary-General.

Discussion

The Climate Service Centre aims at making the available climate information more useful, to connect it to decision-relevant questions and integrate the knowledge into end-user knowledge systems. There is a need to focus on societal needs, regional information, and stakeholder dialogues. The CSC wants to build bridges. It will have approx. 20 person years and starts with funding from the German BMBF for the first five years. It is conceptualized as intermediary organization. In a way, it is ahead of the vision of WCC03 held in Genève Nov. 2008. There are relations with other institutions and networking and linking up will be important. In the future, the Centre might provide services for which it charges money, but a basic funding will probably remain necessary. The Centre will also assist the financial sector e.g. by pointing to information available internationally. The expectation is that climate services will become mainstream and that a market around these services will evolve.

Some conclusions and reflections

The presentations in the workshop provided a broad perspective of the substantive efforts on climate change adaptation in different EU countries. The presenters highlighted various examples of how the science-policy interface was designed and implemented and showed the many similarities and differences between them. Overall, the presentations highlighted the different roles the national overarching frameworks (in most of the participating countries, formal national adaptation strategies) fulfill in European countries, from setting the national adaptation agenda (e.g. Finland), to maintain political momentum on adaptation (Netherlands, UK), or purposefully chosing not to develop a formal national strategy (Sweden). At the same time, many activities at local and regional level show the multi-level governance approach on adaptation. Many initiatives have started well before the national frameworks were even considered.

Many of the planned adaptation strategies are supported by (national) research programmes, addressing topics that are especially relevant for each country. The shift from fundamental, pure research programmes towards applied research programmes has been particularly strong in the last couple of years. Several local and regional initiatives have already started in the absence of targeted climate adaptation research.

In addition, there has been an increasing role for social sciences, including political sciences, public administration, sociology, organization studies, and psychology, to understand the perceptions and attitudes towards climate change. Insights from other disciplines, including the above mentioned, can provide valuable insights to optimize the science-policy interface in its proper context,, the challenges that emerge and the strategies to cope with these. The value of closer links between social science and current natural-science dominated research on climate change adaptation is emphasized by the workshop participants.

In order to facilitate the information exchange between the scientific and political domain, several organizational structures have been proposed within the different countries. E.g., Denmark, The Netherlands and the UK have developed large interministerial committees, taskforces and workgroups all responsible for parts of the adaptation agenda. The examples show that there is no right or wrong in developing the policy architecture to facilitate the interactions between science and policy. This workshop has shown some examples of how different countries organized adaptation at national level.

In addition, some examples of boundary organizations were presented – organizations that operate at the boundary of science and policy, for example the presentation from UKCIP and the German Service Group Adaptation. Several countries noted the importance of boundary workers as facilitators between science and policy and have started programmes to educate intermediaries between science and policy (and perhaps in the future, society).

The workshop concludes that traditional perspectives on science and policy no longer suffice – a very broad set of public and private actors start to play an important role in implementing the adaptation actions. As climate change is to a significant extent a behavioral problem, and many of the adaptation actions require societal change. Informing the lay public and raising awareness about the potential impacts of climate change, and about opportunities for individual contributions in responding to climate change is of particular interest. Both the scientific as well as the policy community invest in awareness raising using a variety of methods, including workshops, websites, tools and wizards. Most progress can be seen in England and Finland where many of these initiatives have already started.

However, in communicating about climate change, as emphasized by Chris West during his introductory presentation, the problem should not be communicated as a complex and hardly solvable problem – this only leads to fatalism and defeatism among the public and politicians. This has been the dominant discourse in the past, and has not proven to be successful. Rather, the emphasis should be on the opportunities climate change offers and the benefits for individuals.

Even in the absence of absolute certainty on the rate and progress of climate change, decisions have to be made. Suraje Dessai explained in his presentation that uncertainty should not be a limit to adaptation, and many alternatives exist that lead to robust adaptation strategies. More knowledge on the impacts and vulnerabilities alone will not lead to more or better adaptation. In the context of CIRCLE, in 2010 a workshop will be held devoted specifically to the problem of handling uncertainties in climate change adaptation.

One of the general conclusions is that countries hardly share experiences on climate change adaptation as yet. Although there are several efforts to facilitate learning within countries, there is little attention to learning between countries. There are substantial lessons learned that could be shared and prove beneficial for other countries. Particularly countries that face similar impacts and vulnerabilities could learn from other countries or practical tools and methods that could be applied in other contexts.

During the final plenary discussions, the role of the European Commission, or the EEA, to facilitate this process was emphasized, particularly against the backdrop of the 2009 EU White Paper on climate change adaptation. In addition, the EU could also play an important role in facilitating the development of impacts and adaptation scenarios, and of indicators to evaluate the effectiveness of adaptation options. The proposed EU Clearing House could fulfill a key role in synthesizing and making accessible knowledge generated by national and international research and monitoring programmes as well as good practice guidance from real-world adaptation practices. The ERA Network CIRCLE can play a role in focusing and aligning national and European research agendas. The constructive contributions from both national and European research and policy representatives in the workshop demonstrates that more exchange of knowledge can be achieved and help increase the climate resilience of Europe and its vulnerable regions and sectors.

List of participants

Number	Name	First Name	Prefix	Company Name	Postal Country
1	Bessembinder	Janette		The Royal Netherlands Meteorological Institute	The Netherlands
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4	Binnerup	Svend		Aarhus University	Denmark
5	Bregman	Bram		The Royal Netherlands Meteorological Institute	The Netherlands
6	Capela Lourenco	Tiago		FFCUL	Portugal
7	Carter	Timothy		Finnish Environment Institute	Finland
8	Cleemann	Lutz		Sustainable Business Institute	Germany
9	Dannevig	Halvor		Centre for International Climatic and Environtal Research Oslo	Norway
10	Deelen	Kees	van	Foundation Knowledge for Climate	The Netherlands
11	Desmond	Margaret		Environmental Protection Agency	Ireland
12	Dessai	Suraje		University of Exeter	United Kingdom
13	Driessen	Peter		Foundation Knowledge for Climate	The Netherlands
14	Feliu	Efrén		Labein-Tecnalia	Spain
15	Frich	Povl		Danish Energy Agency	Denmark
16	Goosen	Hasse		Wageningen University and Reasearch Centre	The Netherlands
17	Heinen	Marit		Programme office Climate changes spatial planning	The Netherlands
18	Hinkel	Jochen		Potsdam Institute for Climate Impact Research (PIK)	Germany
19	Hollaender	Kirsten		Programme office Knowledge for Climate	The Netherlands
20	Humphrey	Kathryn		Department of Environment	United Kingdom
21	Jol	André		European Environment Agency	Denmark
22	Kabat	Pavel		Foundation Knowledge for Climate	The Netherlands
23	Karhu	Juha		Finnish Meteorological Institute	Finland
24	Khovanskaya	Maria		Regional Environmental Center for Central and Eastern Europe HQ	Hungary
25	Laumann	Gregor		German Aerospace Centre	Germany
26	Lavalle	Carlo		Joint Research Centre of the European Commission	Italy
27	Leitner	Markus		Umweltbundesamt	Austria
28	Liempt	Henk		Federal Ministry of Education and Research	Germany
29	Lilliesköld	Marianne		Swedish Environmental Protection Agency	Sweden
30	Mahrenholz	Petra		Umweltbundesamt Dessau, Kompass	Germany

31	Medri	Silvia		Euro-Mediterranean Centre for Climate Change (CMCC)	Italy
32	Minnen	Jelle	van	Netherlands Environmental Assessment Agency (PBL)	The Netherlands
33	Ohlenschlager	Susan		Oxfordshire County Council	United Kingdom
34	Pater	Florrie	de	Foundation Knowledge for Climate	The Netherlands
35	Pidgeon	Nick		Cardiff University, School of Psychology	United Kingdom
36	Reysset	Bertrand		Observatoire national sur les effets du réchauffement climatique (ONERC)	France
37	Ruuhela	Reija		Finnish Meteorological Institute	Finland
38	Schauser	Inke		European Topic Centre of Air and Climate Change	Germany
39	Schoonman	Rob		Ministery of Housing, Spatial Planning and the Environment	The Netherlands
40	Schrimpf	Wolfram		European Commission, DG Research	Belgium
41	Simonsson	Louise		Centre for Climate Science and Policy Research	Sweden
42	Stefania	Munaretto		Wageningen University and Reasearch Centre	The Netherlands
43	Swart	Rob		Wageningen University and Reasearch Centre	The Netherlands
44	Szalai	Sandor		Hungarian Meteorological Service	Hungary
45	Vellinga	Pier		Wageningen University and Research Centre	The Netherlands
46	West	Chris		UK Climate Impacts Programme	United Kingdom
47	Yrjölä	Tiia		Ministry of agriculture and forestry	Finland
48	Pijnappels	Marjolein		Foundation Knowledge for Climate	The Netherlands