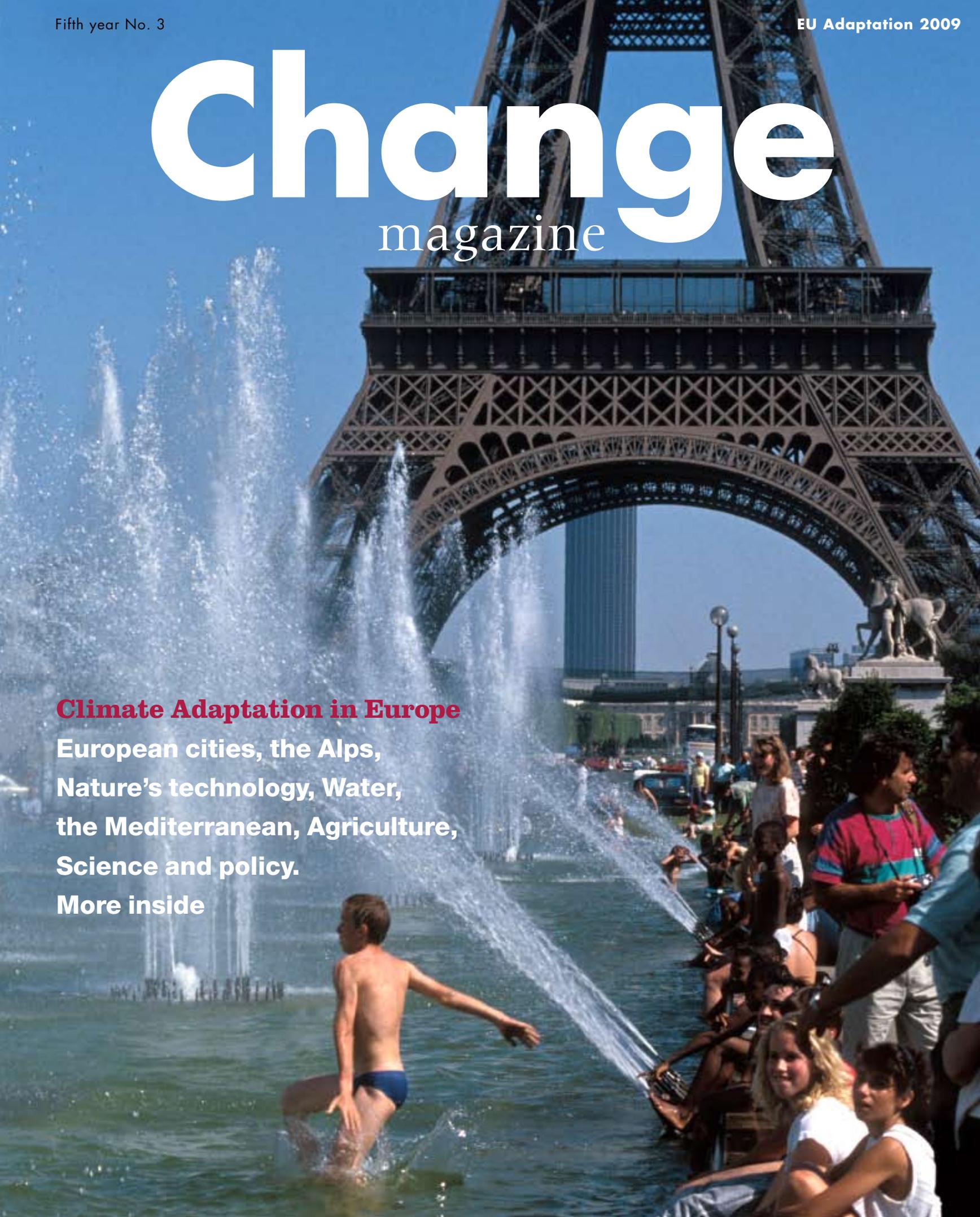


Change

magazine

Climate Adaptation in Europe

European cities, the Alps,
Nature's technology, Water,
the Mediterranean, Agriculture,
Science and policy.
More inside



More than 300 people gathered on the City Hall Square in Copenhagen, Denmark, 24 October 2009 to form the logo of the 350 campaign. Scientists say that 350 parts per million CO₂ in the atmosphere is the safe limit for humanity.





Europe should lay the foundation

The results of research undertaken since the Fourth Assessment of the IPCC have accentuated the threat of sea level rise and intense precipitation. Despite common, ambitious global initiatives to combat greenhouse gas emissions, we still have to adapt to climate change impacts and handle climate variability in a systematic, professional manner. We need more complex models, better tools and more coherent governance to adapt - even to a 2 degree warmer climate scenario. The human dimension in adaptation is pivotal. Throughout the history of humankind, we have always had to adapt; however most of the effort so far has been reactive. Now the time has come for a marked change in our response. The current rate of change in the climate system leaves no alternative. We must face the climate challenge with a concerted proactive effort. Although mitigation needs global solutions, we all know in our heart that adaptation is context specific and starts with local action. Ecological and human systems are vulnerable. Our resilience depends on the way we organize our cities and societies and how we sustainably manage our resources. Using our accumulated knowledge will also contribute to the reduction and management of risk. To this end, modern early warning systems are only part of the solution. Unless we come to terms with perceived hazards, we will never be able to act in due course. Sharing and communicating science-based information provides the necessary platform for adaptation and risk assessment, enabling us to better target our efforts and response.

The landscape is the basis for our livelihood. Through tight planning regulations we may be able to secure sustainable production systems and ecosystem services. Conflicts often arise, however, between our aesthetic values and our use of the landscape for energy production. In earning and maintaining the respect of our citizens, there must be an open dialogue on how to protect and preserve our common goods. Adaptation of our energy systems will put our landscapes under pressure. We - as politicians - have been entrusted to make the right decisions. In order to serve faithfully, we need to devise adaptation measures which are well coordinated, flexible and socio-economically sound. Adaptation to climate change is not only a necessity, but also an opportunity. It is an opportunity to develop sustainable agricultural practices through innovative technological solutions as well as new governance structures that optimize the adaptation efforts across sectors and even across boundaries. When the challenges are common, we should demonstrate pan-European collaboration, in regions such as the Mediterranean, the Alps, the central European river-basins or the Baltic Sea, all of which are at stake. Restoration after natural catastrophes is often a good opportunity for societal learning. An integrated European process for adapting to a changing climate is a strong foundation for a truly global effort.

Connie Hedegaard
Minister for Climate and Energy, Denmark

A handwritten signature in black ink, appearing to read 'Connie Hedegaard', written over the typed name and title.

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Hohe Tauern National
Park, East Tyrol, Austria.
PHOTO: ANP



European Environment Agency



Colophon

Change Magazine is published three to six times a year. Each edition is devoted to a theme, usually in Dutch sometimes in English.

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Coverphoto

People cooling off in the Fountain of Varsovie, in the Place du Trocadero, near the Eiffel Tower (background), Paris, France. Photographed during the heat wave of July 2008. PHOTO: ANP

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Moonwalk

December 2009. The gaze of the world is on Copenhagen. The political horse-trading that we see in the news gives the impression that the impacts of Climate Change are a negotiable reality. But let's not fool ourselves. It is a stark fact. Despite global agreements on cutting CO₂ emissions, the climate changes that are already underway cannot be stopped. We are already past the point of no return. The desperate need for drastic cuts in greenhouse emissions is only becoming more urgent. Not just for today's 30-year-olds, but also for the 40-year-olds in half a century's time and their children. The world's leaders will have to look far beyond the limits of their period in office, starting with the Copenhagen treaty.

At the same time, we shall need all hands on deck to prepare the world to cope with the consequences of climate change. As Ken Livingstone, ex-Mayor of London, put it in Change Magazine last year: '(...) climate change will happen more rapidly. The optimistic scenario is that we're heading towards tens of millions of people dying; the pessimistic scenario would be hundreds of millions'. More than a year later, in this issue, Martin Parry writes that 'our ability to adapt, and thus avoid (...) an additional hundreds of millions at risk of hunger due to climate change, will slip away from us unless richer

countries take a lead. Impacts from climate change cannot be fully avoided by mitigation'. The need to adapt is not just urgent, or even acute. The Maldives government has sent a photo round the world showing the entire cabinet meeting in diving suits under water. A humorous campaign, maybe, but the reality is bitter: on the Maldives, adaptation means leaving or drowning.

This issue of Change Magazine is about adaptation in Europe. Clearly, there is a wide variety of impacts, solutions, research and policy – and Europe is slowly gathering speed. Europe has the money and the knowledge to tackle this challenge. The key is having the political will to transform all the knowledge and means available into co-operation and action. No easy job, that's true. And you can add an even greater challenge: releasing billions of Euros for adaptation measures for the world's most vulnerable regions, which – not coincidentally – are also the world's poorest.

December 2059. Celebration of the 50th anniversary of the Copenhagen Treaty. 'The leaders of that time showed courage and decisiveness', reads the I-headline. 'One small step for man, one giant leap for mankind.' That's how Neil Armstrong put it, 40 years ago. Walking on the Moon – they thought it was impossible

Baud Schoenmaeckers
Editor in Chief Change Magazine





EPA/STR/ANP, ANP



ISSOUF SAHOGO, ANP

Europe must lead on adaptation

Europe's 'know-how' on climate adaptation needs to be made available to other countries. Martin Parry outlines the priority issues.

MARTIN PARRY

The flood situation all over Assam state has been critical since the beginning of July 2009 as the water levels of the main Brahmaputra River and its tributaries are still flowing above the danger level.

Faced with the advancement of the Sahara desert, a result of world climate change, the peasants of Burkina Faso are fighting with little means but certain success to stop the advancement of the dunes by planting shrubs.

Impacts from climate change cannot be fully avoided by mitigation. Some impacts can be observed now as a result of the 0.7°C warming above pre-industrial levels that has already been recorded. Even if emissions stopped altogether this very minute, then a further 0.6°C warming would occur due to past emissions. A depressing conclusion, is that 1.3°C of warming is unavoidable. The challenge, now, is for us to do our utmost not to commit to ourselves to further amounts of warming that might exceed our capacity to adapt. A target now being discussed in the talks leading up to and at the Copenhagen Conference of the Parties to the UNFCCC is to avoid exceeding 2°C of warming. What is often missed in this debate is the enor-

mous challenge that 2°C warming (even if we were to avoid exceeding it) would place on our abilities to adapt.

Poor, children and elderly

We can be clear about those places in the world that are priority candidates for early adaptation. The Intergovernmental Panel on Climate Change (IPCC) concluded that the people most at risk are the poor, children and the elderly.

The most vulnerable systems and sectors are: a) some ecosystems, especially tundra, boreal forest, mountain, Mediterranean-type ecosystems, mangroves and salt marshes, coral reefs and the sea ice biomes; b) low-lying coasts, due to the threat of sea-level rise; c) water resources in low-

latitude regions, due to decreases in rainfall and higher rates of evapo-transpiration; d) agriculture in low-latitude regions, due to reduced water availability; and e) human health, especially in areas with low adaptive capacity

The most vulnerable regions are: a) the Arctic, because of high rates of projected warming on sensitive natural systems; b) Africa, especially the sub-Saharan region,

Heat-waves, storms and droughts are likely to become more frequent, widespread and intense

because of low adaptive capacity and projected changes in rainfall; c) small islands, due to high exposure of population and infrastructure to risk of sea-level rise and increased storm surge; and d) Asian megadeltas, such as the Ganges-Brahmaputra and the Zhujiang, due to large populations and high exposure to sea-level rise, storm surge and river flooding.

Many of the regional differences in impact will stem from changes in water availability (which is essential for human health and food production). Over the past five years we have developed a clearer picture of how water availability may change regionally, with indications of important decreases in southern Europe, and in northern and southern Africa. If these projected changes occur, then impacts in these regions could be severe.

Extreme weather events

Extreme weather events, which can have large impacts as Hurricane Katrina did when it hit New Orleans in August 2005 causing 4,000 fatalities, are projected to increase in their likelihood and magnitude; and we may already be seeing signs of this. For example, the August 2003 heat-wave in western Europe, which led to the deaths of several thousand mainly elderly people, may well be partly ex-

plained by the overall warming of 0.7°C that we have already experienced. If a 4-5°C were to occur (which is projected by the end of this century if we take no mitigating actions to reduce emissions), then this kind of heat-wave could be expected to occur on average once every two years. In other words it would become a normal occurrence.

Major tipping points

Two large-scale events that could affect Europe are substantial sea-level rise and weakening of the Gulf Stream. Faster rates of ice melt and sea-level rise than projected by the IPCC have been reported by post-2007 research. A sea-level rise of over a metre this century seems possible, about double the IPCC projections. Much more substantial 'tipping points' for Europe are less likely: the 2007 IPCC assessment reported that complete melting of the Greenland ice sheet could lead to sea-level rises, over millennia, of 7 m; and for the West Antarctic ice sheet, complete melting could contribute 5 m to sea-level rise.

Weakening of the Gulf Stream, which could lead to cooling in NW Europe, would be very unlikely to occur during this century, the IPCC concluded, but the commitment to it (i.e. which then would occur more than 100 years hence but not be avoidable) could be made this century if there is a continuation of the current trend of thinning of Arctic ice.

A fifty per cent cut

It is now clear that current mitigation targets, even if fully achieved, would not avoid major global impacts. For example, probably the best the UNFCCC can achieve is agreement toward a 50 per cent cut of global current greenhouse gas emissions by 2050. However, this would not avoid exceedance of the 2°C warming target. It allows an even chance of, for example, a billion additional people being short of water due to climate change, as well as many other serious global damages. Additionally, the uncertainty range in Figure 4 indicates a substantial risk of much larger impacts occurring. To reduce serious global damage, we need to adopt much more stringent targets – at least an 80 per cent cut in global emissions, as shown in Figure 1. Even then, the global damage is likely to be severe.

Because there are limits to damage-avoidance by mitigation, the challenge for adaptation will be truly enormous. Figure 1 shows this extent, the area left of the shaded mitigation columns being the field where impacts can only be avoided by adaptation. This 'adaptation field' is, however, almost certainly a substantial under-estimate because Figure 5 assumes global emissions to have peaked by 2015,

Because there are limits to damage-avoidance by mitigation, the challenge for adaptation will be truly enormous

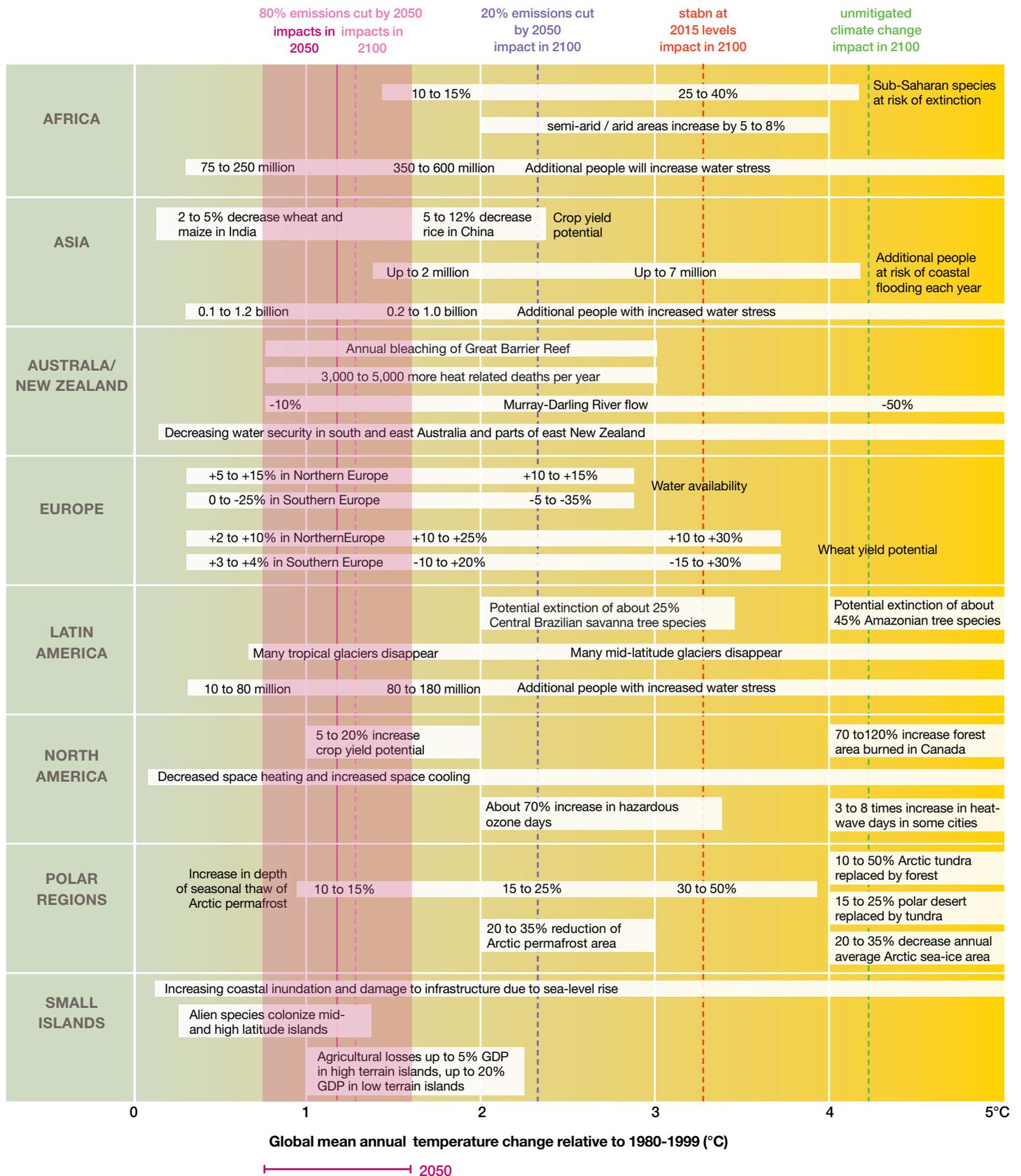
something barely possible even in an ideal world. It is likely that the 'adaptation field' will have to expand right-wards on the figure to allow for mitigation which turns out to be slower and less stringent than the ideal.

Future vulnerability

While current development status may well affect risk of damage from climate change, alternative future development may have an even greater effect. Of course, development experts have guessed this

Figure 1. Selected regional impacts projected for varying amounts of climate change, with shaded column indicating likely impact outcome in 2100 for a rate of greenhouse gas emissions reductions of 80% of current levels by 2050 (continued at constant rate to 2100) (modified from Parry, et al., 2008 and 2009).

Note that the temperature changes in this Figure are scaled against current temperatures, which are c. 0.6°C higher than pre-industrial temperatures. Thus 2°C pre-industrial warming is equivalent to 1.4°C in this figure.



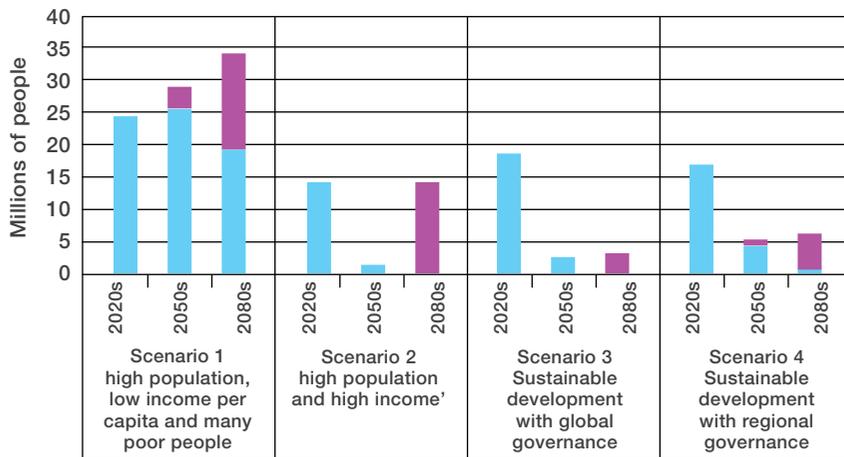


Figure 2. Estimated millions of people per annum at risk globally from coastal flooding. Blue bars: numbers at risk without sea-level rise; purple bars: numbers at risk with sea-level rise (modified from IPCC, 2007, Technical Summary)

for some time. But climate impact assessments now support this assumption. These have used varying social and economic scenarios of the future to examine what the climate change impacts might be under differing development pathways. Their overall conclusion is that *more of the difference in projected impact is due to future development than to climate change*. To illustrate, Figure 2 shows estimates of the number of people globally projected to be at risk from flooding in 2080. The blue bar shows the impact without sea level rise, the purple bar is the premium with sea level rise.

The figure shows that under the scenario with 'high population, low income per capita and many poor people' (scenario 1) these numbers are much higher than under the scenario with 'high population and high income' (scenario 2). Then there are two sustainable development scenarios; one with global governance (scenario 3) and one with regional governance (scenario 4). These scenarios include more robust and adaptive societies and show a much lower number of people at risk of flooding.

Even assuming no climate change and no sea-level rise (the blue bars), there is a striking difference between the impacts of the *scenario-1-future* and the other futures. This is because more poor - and therefore exposed - people are assumed to be living in the future in flood prone areas in East

The challenge for Europe and other rich countries is to transfer technologies and fund development that helps put poorer countries onto a sustainable development track

and Southeast Asia than in the other futures. Unfortunately, the *scenario-1-pathway* is the one we are following at present. The challenge for Europe and other rich countries is to transfer technologies and fund development that helps put poorer countries onto a sustainable development track, making them much less vulnerable to the impacts of climate change.

The previous example indicates that, with the 'right kind' of development, we can develop our way out of the climate change crisis. But that will require a radical change

in type of development. Trying simply to 'add on' to our current development pathway the large mitigation and adaptation tasks that we face would make confronting climate change immensely costly, which may partly explain why we have not yet been successful in agreeing a way forward. For example, protecting billions of poor people against impacts would, when all the costs are added up, be far more costly than raising people from poverty. A change in paradigm of development appears to be necessary; one of sustainable development.

Conclusion

Patching up a 'development-as-usual' pathway will not work and will be immensely costly. Much more likely to be successful is a strategy of sustainable development to ensure high levels of efficiency and equity in resource use, investment and governance. Europe, already providing nearly half the world's current overseas development aid, will need to take the lead in meeting this challenge. It will need to become the 'champion' of adaptation.

Martin Parry is Visiting Professor at the Grantham Institute and Centre for Environmental Policy, Imperial College London. He was Co-Chair of the IPCC's 2007 Impacts and Adaptation Assessment (Working Group II). Formerly he was Professor of Geography at the Universities of Oxford, University College London and Birmingham; and Professor of Environmental Science at the University of East Anglia. His main research interests are on climate change and agriculture. He wrote this article at the request of Change Magazine.



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Financing adaptation

In October this year EU leaders agreed that 100 billion Euros would be needed annually to enable poorer countries to adapt to climate change, and pledged that Europe would pay its 'fair share' of this, though did not decide on a specific figure.

They estimated that about a half of this would need to be public funding with the remainder coming from the private sector. However, developing countries have argued that 3 to 4 times this sum is needed, and this is a key difference which will need to be resolved at the Copenhagen Conference of the Parties to the UN Frame-

work Convention on Climate Change. There is an Adaptation Fund which developing countries can draw from to finance adaptation projects, but it currently owns just a few million dollars.

Several times greater

The difference in these cost estimates seems mainly to stem from different assumptions about what needs to be done to avoid major damage. Most studies of adaptation costs measure only the damage-prone fraction of each human activity, then apply this as a 'climate mark-up' across all sectors in all countries. Studies by the

World bank and the UNFCCC thus arrive at adaptation costs of about \$20 to \$100 billion (annually by 2030) for developing countries. But developing countries often have substantial difficulty adapting to existing climate risks to start with, this so called adaptation deficit is estimated by some to be several times greater than the climate mark-up alone; and without making good this deficit, they argue, poorer countries will always be vulnerable to climate change.

Source: M.L.Parry, and others (2009) 'Assessing the costs of adaptation to climate change', IIED and Grantham Institute, Imperial College London.

World Bank study on global costs of adaptation

The World Bank is working with Bangladesh, Bolivia, Ethiopia, Ghana, Mozambique, Samoa and Vietnam on a new study – *The Economics of Adaptation to Climate Change*. The study will deliver a better understanding of the global costs of adapting to climate change. The study is funded by the United Kingdom, the Netherlands and Switzerland.

The Economics of Adaptation to Climate Change study is a multi-year, multi-country study. It's designed to help decision makers design climate change adaptation strategies through an improved understanding and assessment of the risks posed by climate change and possible adaptation measures that can be taken to reduce the risks.

The report will also help national decision makers to better cost, prioritize, sequence and integrate robust adaptation strategies into their development plans and budgets in a context of high uncertainty, competing needs and limited financial resources. By identifying the climate change adaptation needs of developing countries and their costs, the study also helps inform the international community's efforts to provide access to adequate support and new and additional resources to help the

most vulnerable developing countries meet the costs of adapting to climate change.

Vulnerability of the poor

A primary focus of the study is on government-led (or planned) adaptation at the sector level, encompassing public infrastructure investments, capacity building, implementation of regulations to enable private adaptation, and safety net programs to help the vulnerable cope when adaptation measures are insufficient. Given competing needs for public sector investments in social and economic development, the study will cost, prioritize, sequence, and integrate specific adaptation strategies within the context of development plans and budgets. The study places particular emphasis on improving understanding of the impacts, sensitivity and vulnerability of the poor and most vulnerable social groups, of what adaptation would imply for their livelihoods, and what forms of public support are needed to facilitate such changes.

Additional information can be found at www.worldbank.org/eacc

CIRCLE NETWORK LINKS 34 ORGANIZATIONS IN 24 COUNTRIES

Bridging the gap to adaptation policy



Floating bridge in the Po delta, Italy. Although the bridge will accommodate rising water levels, the low-lying land at either side is vulnerable. Rising sea levels and increasing river discharges could make the bridge obsolete. Europe has many delta areas that share similar adaptation challenges.



Bridging the gap

More specific and coordinated research is required before the seven-headed monster of climate change will allow itself to be tamed by effective political decisions: research that goes beyond national borders and meets questions posed by policy-makers.

MICHEL VERSCHOOR

Europe can't afford to have cross-border climatic influences or comparable natural and social systems analysed separately by each of its countries or regions. Both research and response action must be well coordinated.

Since 2004, such research has been stimulated, financed and made mutually compatible by the European Research Area network CIRCLE. CIRCLE is a bridge between research and adaptation policy. Circle, which stands for 'Climate Impact Research Coordination for a Larger Europe', was initiated in 2004 with partners from 7 countries. As a science funding network, CIRCLE coordinates research on climate change and adaptation throughout Europe by networking and aligning national and regional research programmes. Now at the end of its first phase, 34 organizations from 24 countries

KNOWLEDGE TRANSFER AND ADAPTATION

Connecting laggards to early adopters

Gregor Laumann and Rob Swart both work with CIRCLE partner organizations. In an interview with CHANGE Magazine they reflect on Europe's research network, CIRCLE's initiation and its ambitions for the future. "It's a knowledge market in the specific new area of climate adaptation in Europe."

BAUD SCHOENMAECKERS

CHANGE: What's the status of most research programmes from a European perspective?

Gregor Laumann, who works at the CIRCLE partner German Aerospace Centre: "Research programmes are not organized internationally, or only barely so. They are predominantly national in character. The EU seeks to facilitate exchange across borders and has money available, otherwise there would be much less exchange or none at all. This has to do with the question of where the national Euro is supposed to be most profitably invested – in the national scientific community or in some ingenious EU system. Some critics believe the latter option leaves less for real research."

How can this status quo be improved?

Laumann: "CIRCLE is setting up a structure to widen the availability of adaptation knowledge – which is often gained in national programmes – across national boundaries. Wider in this sense means interdisciplinary, so along less obvious lines of enquiry; like researchers from the social and economic sciences also becoming involved in adaptation research. It means crossing national boundaries, so European countries can learn from each other and exchange their adaptation knowledge.

It also means that this research will have to be useful for policy-makers, both in business and government. Implementing adaptation measures is a matter of policy, so it's important that you link your knowledge

have agreed to continue CIRCLE activities in a second generation network to be launched early 2010. The ultimate goal is to contribute to a climate-proof Europe; a Europe that will be able to overcome the impact of climate change on the whole community.

Reliable foundation

CIRCLE has, with the support of the European Commission, set up an extensive research funding and managing network across Europe. The CIRCLE regional subgroups, Mediterranean, Eastern Europe, Mountain and Nordic, address issues of common interest. CIRCLE-MED with funding agencies from France, Portugal, Spain, Italy and Israel is currently funding projects on Integrated Coastal Zone and Water Management. A recent CIRCLE-MOUNTAIN call is dedicated to Climate

The CIRCLE network is now preparing for maturity in phase 2

Change Impacts and Response Options in Mountainous Areas. CIRCLE-NORDIC, including funding organizations from Finland, Norway and Sweden, chose to fund research on a more generic theme: 'The Consequences of Climate Change for Policy Making in Nordic Countries'.

Research data and analysis from those geographically-based research areas will

create a reliable foundation for regional, national and European adaptation policies.

Listening to policy

Between 2004 and 2009 the CIRCLE Coordination in Vienna has, with its partners, been building the foundations for improved coordinated adaptation research. It has also identified opportunities to give added value to the European collaboration on climate impact research. The network is now preparing for maturity in phase 2. Under a new coordination, based in Portugal, it aims to expand transnational collaboration and create a platform that allows countries to share knowledge and good practices on climate research. It will also bridge the gap between academic science and science-based adaptation policy.

to policy, listen to policy-makers' questions."

Knowledge bazaar

Rob Swart of Wageningen University and Research Centre is to represent the Dutch research programme Knowledge for Climate in CIRCLE 2. He views the network as a 'bazaar', where people not only find what they want – relevant and up-to-date information on adaptation –, but where they can also have contact with people with similar questions and priorities to forge new research alliances. Swart: "It's a knowledge bazaar, the caravanserai where demand and supply meet."

Swart is the leading author of the recent publication Europe Adapts to Climate Change – comparing national adaptation



Rob Swart: It's a knowledge bazaar, the caravanserai where demand and supply meet

strategies (see www.peer.eu). Based on the results of this project, CIRCLE organized a workshop in Budapest. Its goal was to acquaint countries that were lagging in planning for adaptation, such as Belgium, Ireland and parts of Southern Europe, with the experiences of frontrunners, such as the UK and Finland. "This workshop in Budapest was one of the CIRCLE meetings that Ireland used to translate information from the frontrunners to its own situation and to draft an adaptation plan", says Swart. "This illustrates what I mean by 'a bazaar'."

New creative ideas

Swart distinguishes two groups of 'customers': "Scientists and policy-makers. The relevant product for them is the opportunity to gain wider knowledge about what's going on in other countries. Scientists and programme managers should also return from the bazaar with concrete agreements on collaboration. Policy-makers working on national adaptation programmes can supply internationally relevant information to the CIRCLE bazaar, such as practical experience gained in the country's water safety efforts. They should return with new ideas obtained from research in other countries. Moreover, policy-makers from countries that aren't that far ahead with adaptation should return home with new



Gregor Laumann:
CIRCLE will help us to build a bridge between academic climate science and adaptation

information, creative ideas and collaborative partners. This helps them set up or expand adaptation programmes in their own country. This is our ambition. We're not there yet, there's a lot of work still to be done. But the timing is just right and CIRCLE 2 is about to start up."

Laumann acknowledges this, adding, I'm in CIRCLE as an employee of a German re-

search funding organization. There's a lot of useful information for my day-to-day work, a new network, which I use selectively but which I'm certain I couldn't have built up myself. Without CIRCLE I would have done other things, which would have had more of a national character."

CIRCLE has attracted some criticism about lack of effectiveness. Why?

Laumann: "CIRCLE was a start: many lessons were learned but it never fully matured. I expect the second phase to focus more on the value CIRCLE can add to adaptation policy. Partly thanks to CIRCLE it has become clear where all the participants stand and what they need. Now we will have to see which topics and activities CIRCLE can supply to benefit communal added value for policy integration in Europe."

Swart: "CIRCLE was very scientific, with little attention to the relevance to policy-makers. If CIRCLE 2 is to succeed, it is crucial that all the European programmes that are relevant to adaptation are represented, and that they work actively on their relationship with policy makers in Europe."

CIRCLE operates among other 'markets', 'bazaars', and 'networks'. What's the added value?

Swart: "There are a lot of knowledge markets, but not in this specific new area of climate adaptation in Europe. One often



CIRCLE 2 ERA-Net: What does it mean?

CIRCLE 2 (Climate Impact Research and Response Coordination for a Larger Europe) will establish a second generation European Research Area (ERA) Network of 34 science funding and managing organizations across 24 European countries.

The goal:

To create a unified collaboration platform for climate change impacts and adaptation research funding.

The spotlight:

The European need for knowledge about the climate change threats and response options.

The work programme:

Joint foresight and programming activities will help deliver a common vision on climate research funding across a larger Europe.

Shared initiatives such as staff exchange, workshop organizations and joint participation in conferences and meetings will develop this vision into a tangible learning process.

A common agenda will serve as basis to joint funding initiatives allowing countries and organizations to translate their knowledge needs into state-of-the-art transnational research projects.

Active dissemination of results within and outside the network will make the outcomes of those initiatives and projects available to both national and European stakeholders.



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hears ‘I’ll find my colleagues abroad anyway’, but that just doesn’t happen often enough without a structured framework like CIRCLE. If it didn’t exist, it would have to be created.”

A bridge to policy

Laumann: The great challenge remains: how can we make scientific knowledge about climate change and adaptation relevant to decision making? You have to involve the decision makers early on. It’s a stakeholder dialogue. Research in the area of climate change and adaptation is giving us a new kind of information about how we as a society may be able to deal with complex, integrated and long-term socio-ecological issues. CIRCLE will help us to build a bridge between highly academic climate science on the one hand and adaptation on the other. Adaptation needs decisions, planning and investment: a bridge to policy.”

What other challenges do you see for CIRCLE?

Swart: “We seriously need a shift within CIRCLE from ‘impact’ to ‘adaptation’. Some people in CIRCLE haven’t yet taken that step. They represent countries that are mainly carrying out scientific impact studies or atmospheric research: we can see the climate is changing; how is that happening? If CIRCLE 2 is to be relevant to policy, we need people who can take the next step. What are we to do with the information? What can a policy-maker do with it? Impact studies are necessary (or they were, at least) to get the topic on the agenda and indicate its urgency. The next step is more practical. Adaptation cuts into policy, affects society; it is much more a political matter than studying im-

pacts is. We need people who can link the information on physical climate impact to economics, physical planning and social issues. Helping to develop a group of such people across Europe is the great challenge for CIRCLE 2”

Joint funding structures

Laumann: “It’s also a challenge to develop a customer orientation. The decision makers will have to know what sort of information is available, how they should interpret it, how it links up with their own data, despite specific assumptions and uncertainties. To do that you will need some sort of scientific consultancy structure. CIRCLE 2 can be instrumental in creating a strong scientific basis for such a structure.”

And those, says Swart, aren’t the only challenges. “The funding mechanisms in the participant countries are pretty rigid. They make transnational research difficult. National research programmes will not throw money into a common jar just like that: they fund their research in different ways, the timing is different, as are the conditions. There’s not much communality yet. CIRCLE took a very significant step on this road with the funding of a number of transnational projects; this will have to be extended. One of the bazaar’s major products should be a joint funding structure that works.”

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Adaptation needs decisions, planning and investment

CIRCLE Mediterranean Call

The first CIRCLE joint pilot call was dedicated to “Integrated Coastal Zone and Water Management” in the Mediterranean region. Launched in 2007 by the CIRCLE-MED sub-network it was funded by France, Italy, Galicia (Spain), Portugal and Israel. Eight transnational research projects comprising 35 research teams from 9 different Mediterranean countries are currently being funded for a total of €1.65 m.

CIRCLE Nordic call

A second CIRCLE joint pilot call for research projects was launched in 2007 by the CIRCLE-NORDic sub-group. Funding organizations from Finland, Norway and Sweden chose “The Consequences of Climate Change for Policy Making in Nordic Countries” as the research theme for this call. Three collaborative projects with 13 research teams from three countries were selected with a combined funding budget of around € 300,000.

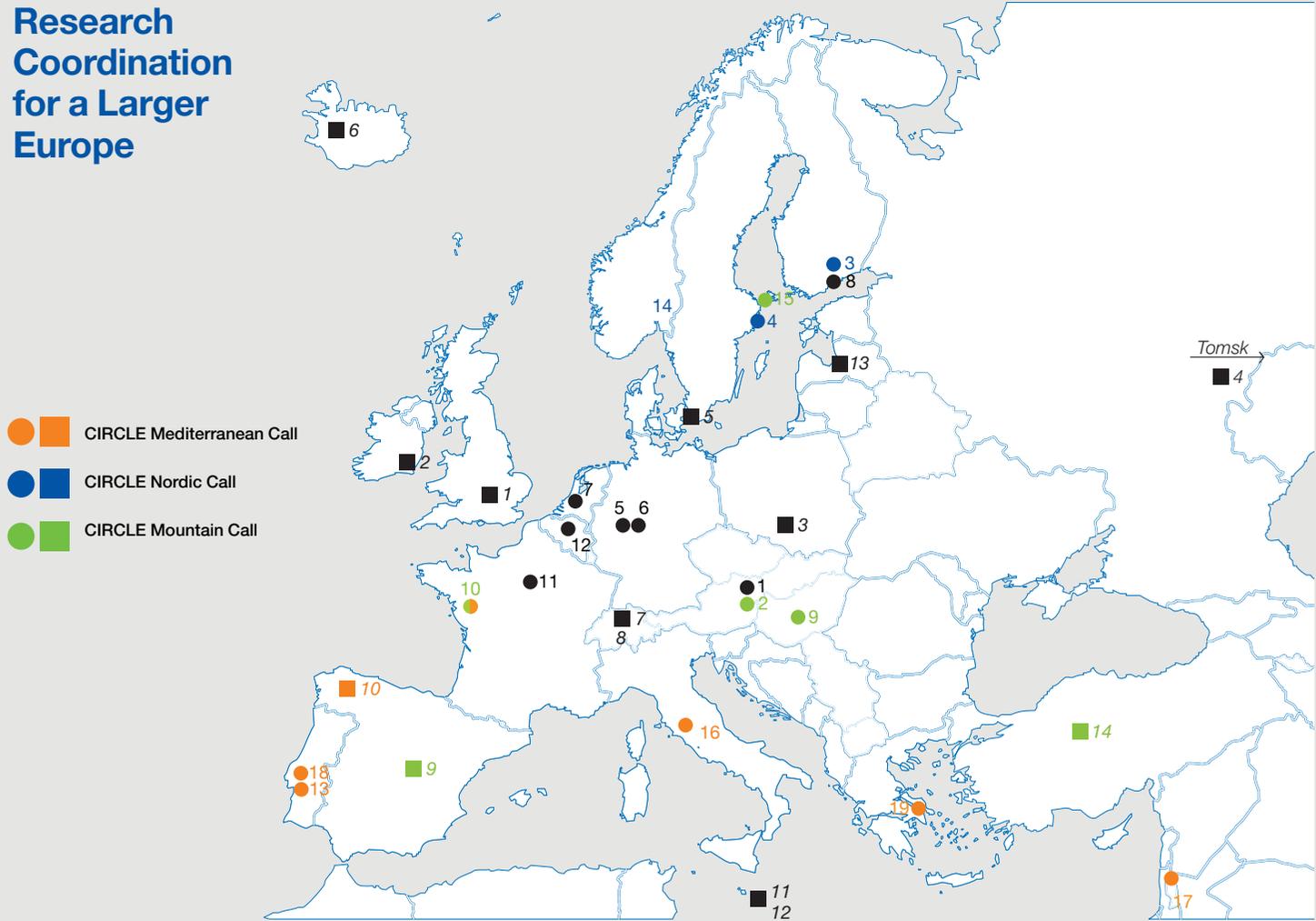
CIRCLE Mountain Call

The first CIRCLE-MOUNTAIN call is dedicated to “Climate Change Impacts and Response Options in Mountainous Areas”. The call is open until January 2010, with a total budget of €2.1 m, made available by research funding organisations from Austria, France, Greece, Hungary, Spain, Sweden and Turkey. Mountains are an important part of the global system, because of their vertical extent. Their climates change with elevation, which generates habitat and species diversity over short horizontal distances.

CIRCLE Eastern Europe

The Central and Central-Eastern European States sub-group (CEES group) was created to meet requirements of the new EU member states. Transnational activities on adaptation research issues, like a workshop on CEES research programmes and projects and a workshop on national adaptation strategies, were successfully held in Budapest.

CIRCLE Climate Impact Research Coordination for a Larger Europe



partners and observers

Partners

- 1 Federal Environment Agency, Austria
- 2 Federal Ministry for Education, Science and Culture, Austria
- 3 The Academy of Finland
- 4 Swedish Environmental Protection Agency,
- 5 German Aerospace Center – Project Management Agency
- 6 Federal Ministry of Education and Research, Germany
- 7 Foundation Climate changes Spatial Planning, The Netherlands
- 8 Finnish Environment Institute
- 9 Ministry of Environment and Water, Hungary
- 10 Agence de l'Environnement et de Maîtrise de l'Energie, France
- 11 French Ministry of Ecology, Energy, Sustainable Development and Sea
- 12 Federal Public Planning Service Science Policy, Belgium
- 13 Foundation for Science and Technology, Portugal
- 14 The Research Council of Norway
- 15 The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
- 16 Italian Ministry for the Environment and Land and Sea
- 17 Ministry of the Environment, Israel
- 18 Foundation of the Faculty of Science/ University of Lisbon, Portugal
- 19 Mariolopoulos-Kanaginis Foundation, Greece

Observers

- 1 UK Climate Impact Programme (UKCIP)
- 2 Environment Protection Agency, Ireland
- 3 The Institute for Ecology of Industrial Areas, Poland

- 4 Center for Environmental Research and Training, Institute of Monitoring of Climatic and Ecological Systems, Siberian Branch of the Russian Academy of Science
- 5 Danish Meteorological Institute
- 6 RANNIS – The Icelandic Centre for Research
- 7 Swiss Federal Office for the Environment
- 8 ProClim – Forum for Climate and Global Change, Switzerland
- 9 Spanish Ministry of Science and Innovation
- 10 Galician Ministry of Innovation and Industry, Spain
- 11 Malta Environment & Planning Authority
- 12 Department of Physics, University of Malta
- 13 Ministry of the Environment of the Republic of Latvia
- 14 The Scientific and Technological Research Council of Turkey (TÜBİTAK),

Adapting to climate change

Professor Jacqueline McGlade is Executive Director of the European Environment Agency (EAA). She foresees real difficulties for those nations and communities that ignore climate change or are unable to adapt quickly enough.

JACQUELINE MCGLADE

Over the past 10,000 years, global temperatures have not strayed further than 1°C from the long-term average. In that time, human civilization developed along with agriculture and the global economy. Today, global warming is increasing at an unprecedented rate, pushing temperatures on Earth up by about 0.7°C over the last century. Alaska and Siberia are heating up even more rapidly – by about 2–3°C within the last fifty years. The impacts are already profound. They cut across normal political and economic boundaries, affecting the poor more than the rich. But eventually everyone will feel the impacts.

Recent observations of key climate indicators are already moving beyond the patterns of natural variability within which our societies and economies have developed and thrived. Unabated emissions are expected to cause many climate trends to accelerate, leading to a growing risk of abrupt or irreversible climatic shifts and related changes in major natural systems.

Troublingly, the risk of such large scale discontinuities is now considered to be even higher than estimated in the 2007 report by the Intergovernmental Panel on Climate Change. Some of the changes may have already approached or even surpassed critical thresholds. In the frozen world, in particular, changes such as the melting of glaciers, polar ice caps and sea ice are occurring faster than previously anticipated and the process seems to be accelerating. The loss of Arctic sea ice will transform the pole from a white, reflective expanse to a dark, heat-absorbing surface, leading to further heating. The loss of glaciers threatens livelihoods because communities depend on glacial ice and seasonal snow for their water supplies and local economic activity.

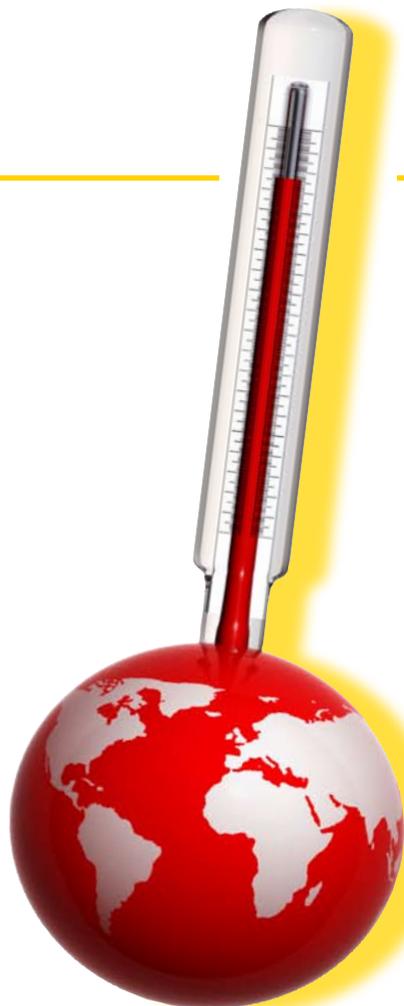
It is in the oceans, however, that we find the greatest threat. Heat from the increasingly warm atmosphere is being absorbed, leading to a gradual expansion of the water itself. The result will be an inexorable rise in sea level, by between 0.8 and 1.4 me-

tres over the next 100 years. This will have major consequences for natural coastal habitats and the many millions of people living in low-lying areas across the world. Another effect of increasing carbon dioxide in the atmosphere is that the oceans are gradually becoming more acidic. Already, scientists have evidence that ocean acidification is jeopardizing the ability of shellfish and corals to develop their exo-skeletons properly.

On land, species of plants and animals will also struggle to cope with the immediate effects of global warming, as their habitats become fragmented and basic resources such as water become more variable or scarce than in the past.

Change will come to all of us. But for today's leaders it brings a responsibility to find the ways and means to mitigate and adapt to climate change. The EU has proposed a target of a maximum temperature increase of 2 °C above pre-industrial levels, which would imply a reduction in global

opinion



Jacqueline McGlade
Executive Director of the
European Environment Agency

gas emissions of at least 50 % by 2050. But even if emissions stop today, climate change will continue for a long time due to the historical build up of greenhouse gases in the atmosphere and the thermal expansion of the oceans. There is thus no question that in Europe we will have to adapt. Southern Europe is expected to become warmer and drier while the north and north-west will most likely become milder and wetter. The risk of coastal and river floods and droughts is projected to increase, with the Arctic, mountain areas, coastal zones, river flood prone areas and the Mediterranean particularly vulnerable. Key economic sectors will need to adapt.

In recent years, it has become clear that adaptation will require changes that cannot be achieved by government action alone. Industry and society will need to become fully engaged and inspired to act. The solutions we will need lie with people: leaders and communities who are already adapting and changing. This is especially evident in some indigenous communi-

ties and in the transition towns and eco-villages emerging across Europe, where the changes are leading to a more sustainable and better quality of life. The real difficulties will lie with those communities and nations that ignore the warnings or do not take opportunities to adapt early on, and who will find themselves increasingly vulnerable and unable to change quickly enough.

The number of EU Member States with national adaptation strategies is increasing but knowledge about vulnerability and the most cost-effective adaptation actions is still scarce. In the coming years, Europe will also need to support developing countries to develop appropriate adaptation plans. The EEA is ready to support this process by using its expertise to develop and regularly update indicators on climate change impacts, as well as producing critical analyses on relevant issues such as water scarcity and droughts, adaptation options and biodiversity.

**Industry
and society
will need
to become
fully
engaged
and
inspired
to act**

STAKEHOLDERS DEMAND REGIONAL RESEARCH DATA

Climate Hot Spot investigation

Wherever spatial planning or investment decisions are made, localized climate change research is becoming increasingly relevant.

Co-creation and tailor-made science is the new trend from Lisbon to Göteborg, from London to Budapest.

MICHEL VERSCHOOR



With the right data we can deliver state-of-the-art services

What would you decide as a board member of a Swiss or Swedish energy provider, planning to build a hydroelectric dam in a mountainous area? Without science-based data on regional precipitation and long-term temperature models, you may be risking your company's future.

To take another example: imagine you are looking for a site on which to build your family house: how would you know that it will not be a flood prone location in twenty years time, damaging your financial position in retirement?

Wherever spatial planning or investment decisions are made, questions related to climate change are becoming increasingly relevant. "Changing water levels, temperatures and flow will affect food supply, health, industry and transport and ecosystem integrity", states April 2009's EU White Paper 'Adapting to Climate Change: Towards a European Framework for Action'. According to the EU, climate change will lead to significant economic and social impact. Due to the regional variability and severity of climate impact, most adaptation, it says, will be taken at national, regional

Adapting to climate change will become part of everyday policy making

and local level. "To be able to take decisions on how to adapt, it's essential to have access to reliable data."

World Heritage Site

In England and the Netherlands, national climate knowledge centres are initiating research and adaptation programmes at national, regional and local levels. In Portugal, regional and local stakeholders are taking the lead themselves. Municipalities like Cascais or the mountainous UNESCO World Heritage Site Sintra – both popular tourist destinations – have commissioned research on the local effects of climate change on coastal erosion, water resources and projected heat-waves. Ski resorts in Austria want to know whether or not investments in certain ski areas at certain altitudes are still profitable under changing climate conditions. If not, they might convert their tourism from winter to summer options.

Decision makers all over Europe fear that safety,

health, the regional economy, or business profits might suffer from climate change. And they all demand the same thing: specific data telling them how to respond.

Climate Service Center

Henk van Liempt works as desk officer with the German Federal Ministry of Education and Research. He is one of the initiators of the national Climate Service Center (CSC), in Hamburg. "We find ourselves increasingly exposed to various groups of stakeholders asking very specific questions about consequences, probabilities and uncertainties of climate change. They aim to assess cost and benefits or risks and chances. The new clients are decision makers and stakeholders on all levels and also highly trained scientists using the data for applied research."

Van Liempt continues: "We are trying to structure climate science in such a way that it becomes more practical in terms of contributing to solutions. Besides improving e.g. climate models and forecasts we stimulate the transfer between knowing and acting. This is a stream of information going both ways. And we would like to see all the different German research institutions work closely together to this end."

The German Government started the Climate Service Centre this summer as a facilitator of exchange between science and the users of such scientific knowledge.

According to director Guy Brasseur, CSC bridges the gap between science and society. "CSC will cooperate with knowledge centres, policy-makers and stakeholders with specific needs for climate data. We are in a unique position. Certain sectors of society need answers, and scientists have to adapt. At CSC we are right in the middle of that process."

Mainstreaming

In Hamburg, Brandenburg, North Hessen and four other regions the CSC is going to work with scientists, municipal officials and the industry sector on regional strategy planning. Van Liempt: "Our aim with integrated planning is to achieve so-called climate mainstreaming. We must acknowledge that planning adaptation implies influencing many decisions that are not primarily taken with climate change in mind. We explore new arrangements where adaptation will have to be integrated into a framework of already existing policy, planning and management tools. This year, however, the Climate Service Center is focusing on the development of a strategic plan and its network



Adaptation and knowledge transfer is a two-way system

development as well as on cooperation with the financial sector. We seek cooperation with banks and insurance companies who face unknown financial risks as a result of climate change.”

On high alert

“Our main interest is not in the results of global climate change models, but in specific, regional data for the near future”, says Peter Höpfe, Chair of the German Climate Change Finance Forum and Head of Geo Risks Research of Munich Reinsurance Company. “Banks and insurance companies, as well as entrepreneurs, want to know what to expect in the next five to ten years within their field of interest, on specific locations. A bank has to incorporate climate change data into its risk analyses. Likewise, insurance companies have to calculate the consequences of extreme weather events.”

Höpfe’s insurance branch is on high alert since the number of devastating weather events has doubled worldwide between 1980 and 2009. “There is evidence showing that at least part of this is due to climate change.”

Within the Climate Change Financial Forum, business representatives discuss climate change knowledge gaps in the German financial sector. Höpfe says: “We meet several times a year and spend a day discussing and addressing our needs and questions.” If our needs are better represented in research programs”, Höpfe goes on, “the German economy as well as individual companies will benefit. With the right data we can deliver state-of-the-art services.”

Co-creation

“It’s of major importance that climate science becomes more closely connected to everyday life”, says Florrie de Pater, Knowledge Transfer Manager of two Dutch research programmes: Climate Changes Spatial

Planning and Knowledge for Climate. “Scientists operate in their own scientific domain, but with the emerging need for climate adaptation and the huge knowledge gaps in this field, it’s time for scientists to work closely together with practice.” Adapting to climate change, de Pater argues, is only possible if government organizations, both national and regional, businesses and other stakeholders actively participate in research programming. For co-creation of knowledge, it is even better if stakeholders participate in the research itself. In the Netherlands scientists are asked to do their research in close cooperation with the eight so-called hotspots: focus projects in areas of particular sensitivity to climate change. Water boards, provinces, local authorities, farmers and nature conservation organisations will also be approached to join. The Dutch programmes have already gained considerable experience in co-creation. One example is the climate effect atlases, in which national climate scenarios are translated into regional ones and the effects of climate change are mapped out. The climate atlases support the process of planning adaptation strategies and measures.”

We must acknowledge that planning adaptation implies influencing many decisions that are not primarily taken with climate change in mind



Guy Brasseur



Florrie de Pater



Peter Höpfe



Chris West



Henk van Liempt

Emerging legislation

In England the UK Climate Impacts Programme (UK-CIP) helps organisations to adapt to climate change. Recently UKCIP announced a North East England study on the economic impacts of climate change, which has been commissioned. 'The Economic Implications of Climate Change North East Study' will include a cost-benefit analysis of the adaptation responses required, the move towards a low carbon economy, and the impact of new and emerging legislation, policy and regulation. The study is supported by organisations from across the region. Chris West of UKCIP says: "UKCIP collects climate information and questions from stakeholders. But we also have a high level role in passing on research data to local authorities. In 1997 we started with adaptation to climate change in the UK. Back then, most climate research available was not being used at all. Organisation of stakeholders and integration of their needs was non-existent. Nowadays most people involved in climate related issues understand that adaptation and knowledge transfer is a two way system."

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Adaptation
research & results:
the CIRCLE
Nordic Call
**Stakeholders
demand data
tailored to
their needs**

There is a widespread need among European member states for more specific climate research that incorporates the needs and questions of (local) stakeholders. Within the ERA-net CIRCLE, applied research projects have started on international collaboration. Preliminary results are being presented or will be published soon. An update on CIRCLE NORDIC.

Research centres in Sweden, Norway and Finland are carrying out three transnational research projects, funded by CIRCLE partners. The CARAVAN-project addresses a Regional Assessment of Vulnerability and Adaptive capacity for the Nordic countries. The Nordic

area's second project asked the question 'Do research, policy and practice meet?' An investigation was also carried out under the project name 'Climate Change, community response and multi-level governance'. One of the main preliminary conclusions on the third project is that placing adaptation on local agendas requires networks that cut across governance levels. The study also made clear that vulnerability to climate change opened the eyes of policy-makers and made them get started with adaptation.

Substantial differences

The question as to whether research, policy and practice already meet has met some negative response. Inquiries

have proved that stakeholders demand more detailed data, especially concerning spatial planning. Stakeholders also want their needs and questions better addressed to increase the relevance of research data. The regional CARAVAN assessment is compiling a set of indices of extreme weather conditions alongside demographic and socio-economic statistics with the aim of developing vulnerability measures. It concludes that even in relatively wealthy and similar countries, there can be substantial differences in the adaptation abilities between social groups, regions and sectors.

for more information on CIRCLE
see p. 14



The European Alps adapt to changing water resources

The Alps play a crucial role in capturing and supplying water to Europe. Hosting the headwaters of the rivers Danube, Rhine, Po and Rhone, they deliver vital ecosystem services within and beyond the region, underpinning social and economic wellbeing in vast lowland areas. The Alpine climate has changed significantly in the past century, however, posing challenges for decision makers.

STÉPHANE ISOARD

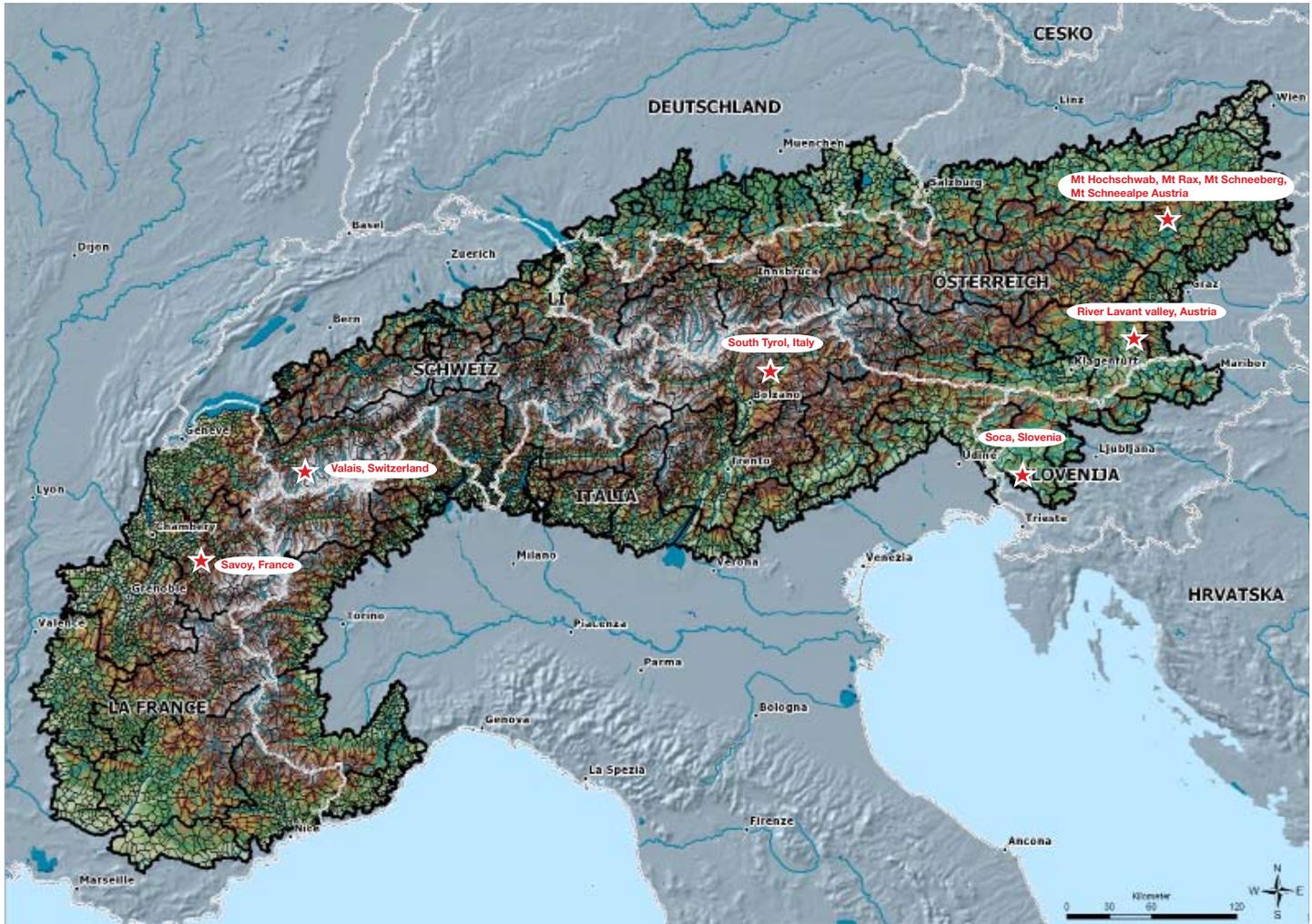
The Alpine climate has changed significantly during the past century. As a recent study by the European Environment Agency (EEA, 2008) notes, temperatures increased by more than twice the global average in that period and are projected to increase by 2.6–3.9 °C above the 1990 level by 2100. Projections show a decrease in summer precipitation and, in most regions, an increase in spring and winter. Precipitation in winter will increasingly fall as rain rather than snow, leading to fewer days with snow cover.

This warming and associated reductions in snow and glacier cover could have grave impacts. The hydrological cycle in the Alps will change, leading to more droughts in summer, floods and landslides in winter and higher inter-annual variability. Economic sectors, including households, agriculture, energy production, forestry, tourism and river navigation, are already vulnerable to water shortages that are projected to increase.

Soil cleans water

Dr Gerhard Kuschnig is working at the City of Vienna Waterworks. As a water expert he is concerned. He states: “The water serving Vienna travels at least 100 kilometres from the springs in the mountains. Our biggest threat at the moment from climate change is increased erosion as it threatens the forests. Without trees and proper foliage the soil will be washed away and it’s the soil that cleans the water. Managing climate change means managing uncertainty and we want to make sure we are asking the right questions.”

Projected water shortages and more frequent extreme events, combined with increasing water demand (for irrigating agriculture or meeting tourist influxes, for example), are likely to have severe adverse effects on ecosystem services, such as the provision of drinking water. Climate change also causes many European plant species to shift northward and uphill. Mountain ecosystems are changing and cold-adapted species are



Six regional case studies

Success factors and barriers to adaptation in the Alps

Regional case studies reviewed in the EEA's report illustrate adaptation to the water resource problems that have resulted from Alpine climate change. They provide valuable insights into the factors that promote or obstruct adaptation.

As the case studies make clear, political support is a key catalyst for initiating, driving and coordinating adaptation to climate change. Such policies are themselves generally responses to extreme events

or natural hazards that motivate public demand for action by authorities.

In addition to political backing, successful adaptation measures were found to exhibit one or more of the following characteristics:

- also promoting other goals, including economic gains;
- a sound legal framework to complement the political support;
- technological adaptation measures, such as improved irrigation techniques, new reservoirs, rainwater harvesting,

wastewater and greywater re-use;

- complementary 'soft' actions on demand management, for example reducing water consumption by households through behavioural change;
- market-based economic incentives and financial support to encourage proactive and innovative adaptation measures;
- stakeholder awareness about the need for anticipatory adaptation actions, especially in sectors with long lead times (e.g. forestry and

power generation);

- making use of local practices and social networks.
- The case studies also identified barriers to adaptation. These included a lack of scientific knowledge and uncertainty about future water availability, quality and demand, the absence of long-term planning strategies, and a failure to use appropriate management tools. Failing to consider climate change explicitly in water supply or demand management plans also created problems.



Because of the fast rate of projected climate change many mountain species will not be able to migrate

Natural alpine grasslands in the Stelvio National Park

being driven out of their ranges. European plant species may shift hundreds of kilometres to the north by the late 21st century and many mountain plant species may face extinction by 2100 if unable to adapt.

High-mountain species are extremely vulnerable to climate change

Dr Franz Essl is working at the Environment Agency Austria, Biodiversity & Nature Conservation Department:

“A recent study has estimated that almost 50% of the unique mountain plant species of the European Alps are at risk of extinction due to projected climate change. This would be a major loss of biodiversity. The risk is even much higher for range restricted species for which total loss of suitable habitats is expected. Because of the fast rate of projected climate change many mountain species will not be able to migrate.”

Observed and projected reductions in permafrost are also expected to increase natural hazards and dam-

age high altitude infrastructure. In addition, climate change can adversely affect winter tourism by reducing skiing areas. To lessen vulnerability to climate change, adaptation will be needed in virtually all economic sectors. For example, the skiing industry will need to plan alternative activities for when there is little or no snow (e.g. economic diversification), and the seasonal workers will need additional training and skills to be able to continue working and provide these new services.

Sebastian Montaz lives in a village in the Chamonix region of France. A mountain guide and ski instructor, he grew up in the French Alps but guides climbers and skiers across the Alpine region. He reports: “Mountains normally change slowly. But here in the Alps we see the changes almost as each season changes. It has changed dramatically since I was a boy and who knows what the Alps will be when my daughter is grown up. For the past five years, from June to July, it has not

been possible to carry out mixed climbing where you climb on snow and ice. Now it's not safe from June until the end of September. Last winter we had the best snow in 9 years but winters like that are now the exception."

Marco Onida is Secretary General of the Alpine Convention. He states: "Within the Alpine Convention, an Action Plan on Climate Change was adopted in March 2009. It aims to make the Alps an exemplary region in preventing and adapting to climate change. Regula Imhoff, Vice Secretary General of the Alpine Convention, reports that "Within this context, for example guidance on sustainable use of hydropower will be given, ensuring good ecological status of water bodies and including measures so dams do not form impassable barriers for migratory fish, while taking into account changing precipitation and river flows due to climate change."

About the author

Stéphane Isoard is project manager at the European Environment Agency for climate change impacts, vulnerability and adaptation issues, and takes part in international climate change negotiations. Since joining the EEA in 2002, Isoard has been responsible for developing outlooks across sectoral and environmental themes, and integrated assessments on climate change impacts and adaptation. He wrote this article at the request of Change Magazine



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Adaptation research & results: the CIRCLE Mountain Call € 2.1 million for transnational mountain research

There is a widespread need among European member states for more specific climate research that incorporates the needs and questions of stakeholders. Within the ERA-Net CIRCLE, a call for applied transnational and interdisciplinary research projects has been launched. An update on CIRCLE MOUNTAIN.

In several European mountainous regions, research centres will be closely looking at 'Climate change impacts (natural

and anthropogenic factors) and response options in mountainous areas'. Project proposals will focus on the effects on water resources, infrastructure, slope stability, agriculture, tourism, public health and biodiversity. The aim of this call is to increase knowledge of options, premises and barriers for climate change impacts and adaptation, including the relationship between adaptation and mitigation in mountainous areas. Special emphasis will be laid on the involvement of deci-

sion makers, developers and relevant stakeholders. This Mountain call is funded by Austrian, French, Greek, Hungarian, Spanish, Swedish and Turkish funding organizations. They have made funding pledges of up to € 2.12 Million. Proposed projects should not exceed € 300,000. Closing date for the Mountain call is 29 January 2010. For more information see: www.circle-era.net

for more information on CIRCLE see p. 14

EU policy options

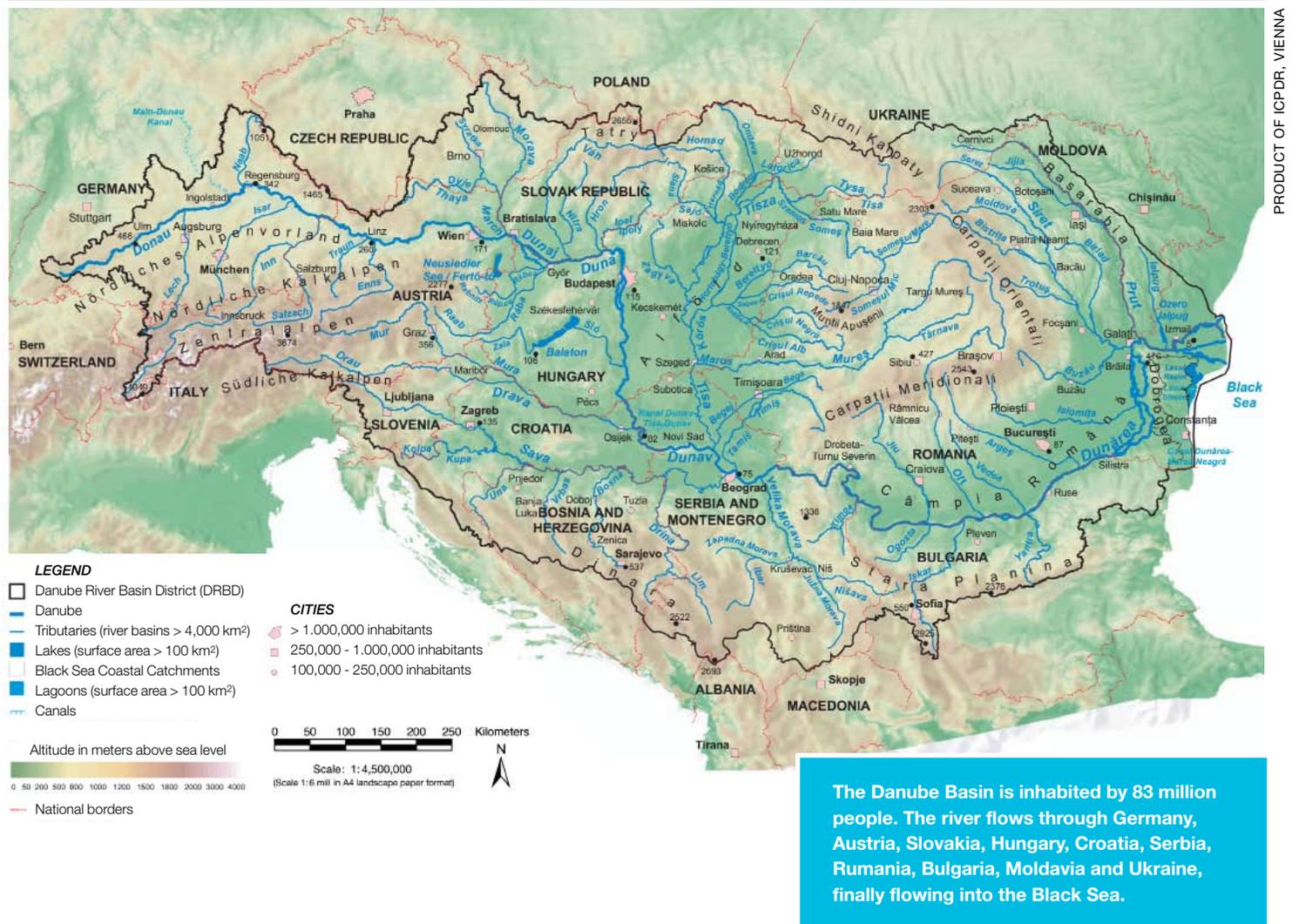
The role of the European Union is important in providing the overall policy framework on adaptation, particularly through the European Commission's Adaptation White Paper (adopted in April 2009) and the Water Framework Directive (WFD).

The Adaptation White Paper sets out a two-phase strategy that complements actions taken by Member States through an integrated and coordinated approach. The first phase will focus on improving the knowledge base on climate change and adaptation measures and means of embedding adaptation in existing EU policies, then a comprehensive EU adaptation strategy will be prepared from 2013 onwards. To support this, an EU clearinghouse on climate change impacts, vulnerability and adaptation is proposed for 2011.

The EU can facilitate the implementation of the first phase by:

- Supporting monitoring and data collection networks to expand time series of key data. More accurate data would better inform policy-makers.
- Developing analytical tools and assessments of adaptive capacity and the vulnerability of natural and human systems. This will help to enhance connectivity between protected areas.
- Developing information platforms on climate change impacts, risks and adaptation options to facilitate information sharing.
- Encouraging countries and regions that have not yet prepared adaptation strategies to do so, and improving transboundary cooperation in managing water shortages along river basins.
- Fostering stakeholder participation in research projects to bridge the gap between scientists, policymakers, civil society and others.

Danube River Basin District: Relief and Topography



PRODUCT OF ICPDR, VIENNA

2010: Total plan for the Danube

The River Danube traces a route of over 1800 miles as it winds through ten European countries. Climate change became bitter reality in the Danube Basin during the dramatic floods of August 2002, August 2005 and Spring 2006.

The Danube is a major shipping artery, agriculture draws irrigation water from the river, and hydropower stations generate electricity. According to the Austrian Danube expert, Helmut Habersack of the University of Vienna, the diverse interests of all the interested parties and nations have hindered the river's sustainable development for decades. At the same time,

the space the river needs is being squeezed as living and working on the waterfront is regarded as increasingly attractive. Perhaps the best-known example of this is 'Donaucity', the business district on the river's banks in Vienna.

Experts from 14 nations are collaborating in the International Commission for Protection of the Danube River (ICPDR) to draft a management plan for the entire Danube Basin, with a planned timetable extending to 2015. The scientists are looking at every aspect: pollution, biodiversity, infrastructure and flood hazard. The plan is due to be discussed by the national mi-

nisters involved in February 2010. ICPDR Chair, the Slovakian Olga Srsnova, says: "It's one thing to draw up a plan. Now we have to ensure that funds are made available. Given the importance Europeans attach to clean, safe surface water, it seems to me nothing other than logical that taxpayers' money should be spent on a clean, healthy Danube." A recent EU Water Barometer found that 68 % of the respondents were worried about the availability and quality of the water in their own country.

MAARTJE SMEETS

Quality of water is the bottleneck for agriculture



The consequences of climate change for town and country planning and the environment are now attracting a great deal of attention from politicians and scientists. But what about the effects of climate change on European agriculture? What is striking here is the direct relationship between climate change and water management.

KARIN ANEMA

Professor Simone Orlandini, a research scientist at the University of Florence, has been looking closely at the impact of climate change on agriculture as part of the COST 734 science network. He concentrates on Europe's most important crops, such as maize, grazing land, wheat, potatoes, sugar beet, apples and citrus fruit, examining the effects of drought, intense rainstorms, frost, heat and disease. The team looked at past, present and future climate trends and their effects.

Orlandini explains: "These trends will be used to develop suggestions and warning systems. It is clear that higher temperatures, intense rainstorms and drought have relevant consequences. It is estimated that, depending on the crop, production will decline by an average of ten per cent."



Compared to 2002, EU grain production fell by 23 million tons.

He recalls the hot summer of 2003, which had major effects on ground water levels and both the quantity and quality of the harvest, especially in Central and Southern Europe. The high temperatures and solar radiation caused the crops to take up far more water than usual. "The arable farmers, the cattle feed industry, dairy farmers and forestry were especially badly hit. The potato growers and winemakers suffered too. Compared to 2002, EU grain production fell by 23 million tons. Side effects, such as soil erosion and flooding, came to light in 2004."

Climate and the market

Tia Hermans (researcher at Alterra, part of the Wageningen University and Research Centre) looked at the effects of climate change on the European arable sector and the dairy industry, using average climate scenarios. In contrast to Orlandini, she sees the effects of climate change on European agriculture in quite relative terms. "In general, the future of agriculture de-

pends far more on changes in the market than climate change." In her view, the Burgundy winemakers are exaggerating when they seek to blame climate change for poorer quality grapes; it's much more a market issue. According to Tia Hermans, if you want an estimate of agriculture's future, research and policy must concentrate on both climate change and the market.

She finds the effects on agriculture in north western Europe acceptable and believes that farmers will not have to adapt any more or differently than they normally do in any case. "The consequences may certainly be somewhat worse in parts of Portugal, Spain and Italy. The only real bottleneck associated with climate change in the next half-century is good quality water. A lot of the water will soon start to contain too much salt." A lack of fresh water, coupled with extreme temperatures, means that farmers in southerly areas will



KARIN ANEMA

have to adapt, perhaps by switching to a salt-resistant crop. Or maybe a cultivar from an earlier time. Another option is water desalination, which is being done in Southern Spain.

Turkey's precarious water balance

Turkey is a country that will experience water shortages around 2030. The largest area of the country lies in a semi-arid region: heavy rainfall in the winter months with long, dry summers. So Turkey will have to store water in the brief rainy season.

In 2007, the European Commission set up the twinning project for capacity building support in the Turkish water sector which they initiated to support Turkey in its implementation of the European Water Framework Directive. The goal is to have water management in Turkey accord with the European water and environmental directives in order to advance the process of admission to the EU. The project is being conducted



The strawberry growers' story clearly shows that climate change has economic consequences

by the Dutch Countryside Commission, in close association with others including the UK Environment Agency, the Slovakian Hydro-meteorological Institute, and Alterra.

Alterra's research, which concentrates on monitoring and climate adaptation, is based on existing climate scenarios. Hydrologist Dr Jochen Froebrich tells us: "It's clear that extreme events will increase throughout the entire Mediterranean region; there will be more intense, shorter periods of rainfall. But it is virtually impossible to make any specific, local forecasts."

What is clear is that climate change will lead to a dramatic decline in the availability of water during the growing season. Moreover, if we are to safeguard our future supply of good-quality water, his colleague Dr Joop Harmsen tells us we shall need to devote great efforts to the treatment of 'used' water. River flows will drop by about 20 per cent in 2050. Higher temperatures will increase evaporation by as much as 30-50 per cent. Productivity will increase, more biomass will be created. Salt will become a serious problem.

William Oliemans, at the Dutch Countryside Commission, says: "Less water, which is simultaneously more saline, coupled with unreliable precipitation, will have major, system-wide effects throughout the entire water system."

A full river basin plan

A management plan has been drafted – Turkey's first – for the 600 km long Büyük Menderes river basin in south-western Turkey. The area is inhabited by 2.5 million people, who depend on agriculture and industries such as olive oil, cotton and leather. With irrigation, the rich clay soil will allow many crops to be raised,

from strawberries to cotton, from vegetables to olive trees, figs, lemons, wheat and maize.

As Henk Sterk, project leader and Twinning Adviser in Turkey puts it: "The decreased water flow, coupled with increased evaporation, will have serious effects on agriculture, which uses 75 per cent of all the river flow for irrigation. Right now, the farmers are experiencing major water shortage problems. The strawberry growers are having difficulty marketing the products in Europe because the berries are too polluted. The river pollution has stayed the same, but it has been concentrated thanks to the lower flow rate. These problems have become increasingly serious in recent years."

Due to the water shortage, drainage water and polluted river water are being re-used with increasing frequency, says William Oliemans: "Among other things, it contains coliform bacteria and pollution from the tanneries." The result? Further pollution of the groundwater and surface waters.

And that, says Froebrich, is where another problem rears its head: the demand for water is increasing, not just from agriculture, but from the towns too. "Water consumption has increased by tens of percentage points, while the supply has decreased."

Saving water on the farm and in the home

The project is scheduled for completion in 2010. The basin management plan is now ready. The advice on adaptation takes account of future water shortages. It includes drip-feed irrigation, phased improvements to water quality, an approach to untreated or inadequately treated water, or switching to other crops that depend less on water. In Turkey, for instance, the cultivation of cotton, tobacco and rice is very water



Climate change and winemaking

Agronomists, vegetation experts and economists in the European COST Action 734 looked at the effect of climate change on wine and olive oil production in Italy. It is expected that, even before 2050, the grape growing season will be about three weeks longer, the period of snow and frost will be noticeably shorter, there will be more water shortages, with more suitable days for planting and harvesting. The grapes will be heavier. Winemaking will shift a long way to the north and to the south. The winemakers in Burgundy are complaining that all this is leading to a loss of quality: their wine will lose its elegance they say.



Attempts to encourage greater consumption of local food produce (zero kilometre chain) are very interesting

intensive. Rice consumes 15,000 to 20,000 cubic metres of water per hectare per annum. As Sterk puts it: "It's all about making the farmers aware that they just can't grow rice any more." One alternative might be vegetable growing. Or relatively salt-resistant citrus and cotton. Oliemans adds: "The water shortage may also mean that herders will have to switch to another lifestyle."

The advice is not just concerned with agriculture, though; it is also directed at households. In Sterk's words: "At the moment, water consumption is often paid for with a lump sum. But by just paying for actual water consumption, our hope is that people will become much more aware of their water usage."

Adaptation at the local level

Translating general advice to the local level is a challenging task, says Sterk: "The measures are pretty abstract as they relate to the entire basin. A series of steps will have to be taken to delve deeper into the techniques needed to cut water consumption. The details will have to go into production methods and crop selection, for instance." One major benefit, in his view, is that the effects of climate change on agriculture are now on the agenda; it's now possible to discuss the topic. "A few years ago it was all denied, or else invisible. By way of illustration, Turkey only signed up to the Kyoto Protocol six months ago.

The strawberry growers' story clearly shows that climate change has economic consequences. The downstream growers blame their upstream colleagues, saying they extract too much water from the river. This hasn't led to conflicts yet, because government has taken the responsibility for spreading the water shortages around, but I expect tensions to rise if the levels drop any further."

The EU is working on ways to improve forecasts so they can also apply to the local level. Jochen Froebrich sees yet another missing link. "Hydrological research still concentrates too much on visible, major rivers. The European Framework Directive doesn't pay enough attention to tributaries and dry river beds, but it's exactly those that illustrate the weather dynamics and the situation in Southern Europe. Extreme situations make it difficult to gain any insight into real evaporation, real flow rates, and water consumption. It's an exciting challenge to get a picture of the Mediterranean area using system analyses, getting a complete picture of an entire basin, as we've done in Turkey. But it's essential if we're to secure improvements in water quality and improve the water shortage situation.' His department has submitted a proposal for follow-up research into improving the quality of the water balance in the Mediterranean, using Turkey as a model project. 'Countries like Italy and Greece in particular need permanent support if they are to fulfil the Water Framework Directive."

The key question, according to Tia Hermans, is how to ensure sufficient water for agriculture in the future. "How will policy be used to allocate a scarce water resource? If agriculture is the last function in the Netherlands to receive a water allocation, then we're in real trouble."

According to Orlandini, the consequences of climate change can only be ameliorated by cutting energy consumption while increasing sustainable energy generation. "What we must do is cut transport. Attempts to encourage greater consumption of local food produce (zero kilometer chain) are very interesting. But agriculture must also play a major role in cutting greenhouse gas emissions and in absorbing them."

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Thames Barrier, London

European cities show ambition on climate adaptation

There is a lot at stake for cities in the event of radical climate change in the decades ahead. London, Rotterdam and Copenhagen are trying to anticipate the changes by means of innovative concepts such as ‘pocket parks’, floating houses and water plazas.

JACO BOER



Bridge over the river Meuse, Rotterdam

These days in Copenhagen there are comings and goings of ministers and heads of state from more than 190 countries. During the United Nations World Climate Change Conference, and subject to the critical gaze of journalists and environmental pressure groups, they will try to reach concrete agreement on how to slow down global warming. Copenhagen is proud to be acting as host to such an important event. Last year the city itself set up an ambitious climate change programme, with the aim of becoming the first 'carbon neutral' capital in the World in 2025. Before then, carbon dioxide emissions must be more than halved. The switch-over to energy extraction from wind and biomass will play an important role in this respect. Inhabitants and companies will also have to use less energy. The city aims to compensate for the eventual remainder of greenhouse gases by constructing extra windmills and by afforestation.

Safe and attractive

Apart from limiting greenhouse gas emission, the city intends to anticipate the

climate changes which, according to scientists, will inevitably descend upon us. These changes will increase the likelihood of floods, heat-waves and periods of extreme dryness. Economies will come under pressure and some places will lose their attractiveness to inhabitants and companies. The Danish capital does not want to let it come to this.

"Copenhagen should continue to be a safe and attractive city to live in", says municipal strategic manager for the environment Lykke Leonardsen.

At this moment the city is putting the final touch to a concrete climate adaptation plan which should be decreed by the summer of 2010. In the programme, attention will be focused on measures to combat the increasing risk of flooding. Towards the end of this century, rainfall will have increased by 30 to 40 per cent, not only in the winters but also as a result of summer downpours. Because the sea level near Copenhagen will rise by an average of 50 cm, the city will also have to find a long-term solution to the danger of flooding. Furthermore, the quality of ground



Public bicycles in Copenhagen.

water and drinking water is under threat as a result of salinization and pollution.

New canals and 'pocket parks'

"Fortunately, a lot of measures that have to be taken also have a positive effect on the quality of the city", according to Leonard-



The water plaza - a Rotterdam invention - discharges water in times of heavy rain showers, preventing water from collecting in the streets and effectively flooding them. In dry weather, the plaza doubles as a playground for children.

sen. "Take, for instance, the disposal of the increasing amount of rainwater, a spearhead in our climate adaptation plans. You can let it run off down the sewage drains as much as possible. But by collecting it in ponds and new canals you can make areas much more attractive." In the years ahead, Copenhagen will also lay out many 'pocket parks'. These not only retain rainwater longer, thus preventing overloading of drains, but they also provide an oasis of coolness and peace on hot summer days. To further improve the city climate, Copenhagen intends to lay cycle paths and stimulate the use of cars running on electricity or hydrogen. The city council itself is setting the right example. By 2015, 85 per cent of its car fleet must be made up of green cars.

As yet Leonardsen doesn't know how much it will cost to make Copenhagen 'climate proof'. "First we have to consider what we need to achieve this. Besides, we have to weigh up the various options from a financial point of view. In some cases it could be cheaper to move people out of an area rather than to protect it from flooding." She expects that it will not be easy to convince residents of the need to invest substantially in climate protection. "We will have to point out to them that, due to the increasing water threat and the risk of flooding, their own homes will also be in danger. Insurance companies will certainly increase their premiums in respect of storm and water damage. Just look at what happened in the U.S. after Hurricane Katrina."

Rotterdam aspires to a pioneering role

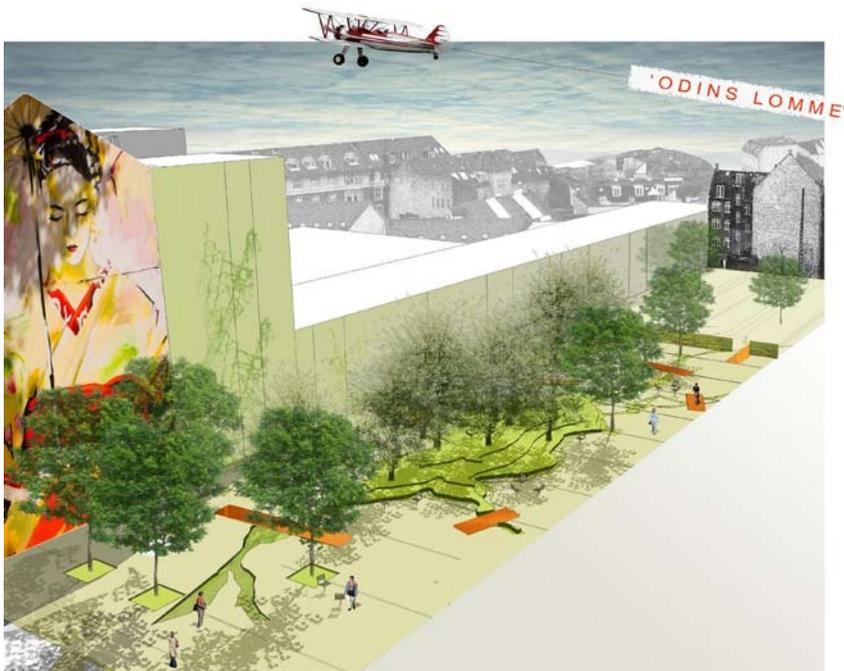
The Dutch port of Rotterdam has also begun to protect itself against the consequences of climate change. Last year the city council drew up an ambitious climate adaptation plan, in which it indicates that the city intends to be fully climate proof by 2025. Rotterdam is assuming a pioneering role where this subject is concerned. Ports all over the world are struggling with the problem of the rising sea level. If we succeed in keeping our feet dry, we will be able to help them with our knowledge and experience and also gain economic advantage from our climate programme", says municipal programme manager of Rotterdam Climate Proof, Arnoud Molenaar. Just like Copenhagen, Rotterdam is for the moment laying the emphasis on col-

All over the world, port cities are struggling with the problem of the rising sea level

lecting the increasing amount of rainwater. As it is, the city renews about 40 kilometres of sewage pipes per year. Also, more ponds and canals will be dug in public spaces. For example, 14 hectares of new waterways were dug at Zuiderpark. "The residents think it's great and at the same time the quality of the water has improved", says Molenaar. The city also wants to introduce so-called 'water plazas', which will be dry most of the year but will, in the event of heavy rainstorms, be allowed to fill up and retain superfluous rainwater for a longer period. For the same purpose, underground reservoirs are being integrated into some new housing projects. The new car park under Museumpark, for instance, will house a collection reservoir with a capacity of 10,000 cubic metres. However, the relatively cheapest solutions for the collection of water remain in laying out small parks and constructing green roofs. Meanwhile, 20,000 square metres of roofs have been made green, and a similar area is expected to be covered in 2010. To add to this, in the district of Delfshaven the largest green roof in Europe will be constructed on top of a new business centre.

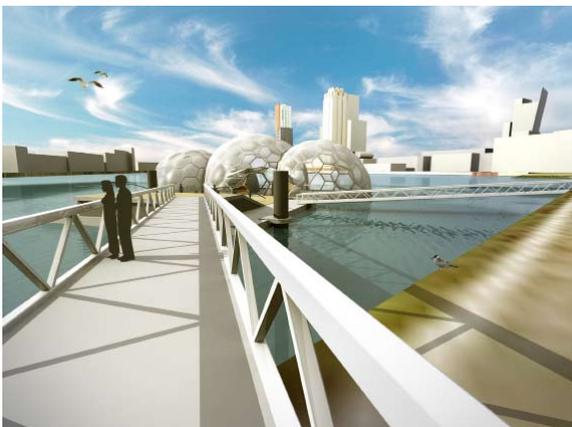
Danger strikes from the hinterland

For the long term, Rotterdam must protect itself against the greater likelihood of flooding from the sea and from its hinterland. For the present, the city has little to fear from the rising sea level, thanks to a modern storm surge barrier in the Nieuwe Waterweg, the sea entrance of Rotterdam. The danger is more likely to come from the rivers, which are of vital importance, due to the transport of goods. Consequently, Rotterdam is currently, in conjunction with the national government, studying a recent report advising the construction of four new movable weirs. "A major investment, but possibly essential for the future of the region", according to Molenaar.



The pocket of Odin

At one time a row of old houses stood on the elongated patch of land. Recently residents of the Copenhagen district of Odinsgade have been able to enjoy the sight of blossoming trees and meandering streams filled with rainwater. "The pocket of Odin", which was opened mid-November, is the first 'pocket park' in Copenhagen. The fact that the mayor in person cut the tape shows the importance the Danish capital attaches to these mini-parks in its struggle against the effects of climate change. Not only do they provide cooling on hot days and retain water from rain showers; they also provide residents with new opportunities for play and recreation. The council intends to lay out fifteen 'pocket parks' in the next ten years. Meanwhile, money has been reserved for the realization of two parks in 2011 and at least one more in the following year. The planning for the other parks depends on the future budget.



Climate-proof pilot project Stadshavens

Rotterdam has ambitious plans for a part of its port area located outside the dikes. In the next twenty years, the phased re-development of 1600 hectares of quays and harbour basins into a climate-neutral and energy-neutral area with 13,000 houses must be carried out. This area, known as Stadshavens, should become a pilot project for innovative concepts in the field of energy production and climate adaptation. The Rotterdam Climate Campus will play an important role in this. Within this centre, companies, knowledge institutions and local authorities will work together on the development and application of knowledge about the subjects of energy and climate. Also, 1200 houses will be built on the water, either on piles or floating. In order to make the various parts of the area accessible, the council intends to put as many water taxis and ferries as possible into service. The absolute eye-catcher of Stadshavens will be a spherical floating exhibition hall, which will open its doors to the public as early as the spring of 2010. In this pavilion, Rotterdam wants to exhibit its knowledge in the field of water management and climate adaptation. In addition, there are plans for the construction of a National Water Centre.

The focus on water does not imply that Rotterdam is otherwise ignoring the problem of rising temperatures. For example, the green roofs and 'pocket parks' help to keep the city cool. "Also, together with the housing associations, we are investigating how they can cool their houses and prevent an explosion in the use of air-conditioning equipment. However, right now we still don't know enough about the subject to take all the right measures", says Molenaar.

Urban heat island effect

London is one step ahead in this field. As a result of the enormous surface area of buildings, the British capital suffers strongly from the 'urban heat island effect', which drives the temperature up. Buildings and asphalt roads cause the city to heat up quickly during the day and then retain the heat, so that it barely cools down in the evenings. In order to combat overheating of the capital, the city council intends to plant two million trees and lay out 'pocket parks' in the inner city. This will result in an increase in the total amount of green area by 5 per cent in the next twenty years. "We are actually aiming for an increase of one third before 2050", says the strategic manager for Climate Change Adaptation & Water, Alex Nickson.

London expects not only hotter but also dryer summers. At this moment, the amount of water available per inhabitant is much smaller than in many Mediterranean countries. In the years ahead, the city will have to be even more sparing with its water reserves. To start with, it would help if the privatized water companies would renew their water pipes more quickly. "One third of the pipes is over a hundred years old. Every day, hundreds of millions of litres of fresh purified water leak away", says Nickson. Moreover, only one in five households is fitted with a water consumption meter. That will have to change in the coming years. "We must help people manage their water consumption more carefully. This is particularly important for poor families from a financial point of view", according to Nickson. The city also wants to make new houses water-efficient to such an extent that the total consumption in the city will not rise any further and will even fall in the future, despite an increasing population.

Concrete river

Apart from heat-waves and longer periods of drought, London must also arm itself against an increasing likelihood of flooding. Just like Rotterdam, the city is, for the time being, well protected against the consequences of the rising sea level, thanks to the Thames Barrier, a sturdy storm surge barrier. However, the risk of getting wet feet remains, due to the tributaries of the Thames. "Seventy per cent of our rivers flow over concrete riverbeds and, as a result, superfluous water cannot be absorbed in a natural way." That's why the city intends to try making arrangements for the collection of water at a number of locations in the case of heavy downpours. "It is preferable to allow the flooding of a park or football pitch once in a decade than to have a whole district flooded."

Hefty price tag

Many of these measures bear a hefty price tag. However, there are also provisions which can be incorporated into planned renovations at little additional cost. Furthermore, part of the costs can perhaps be met by parties who will benefit from the measures. "If we do lay on green roofs, the



London Mayor Boris Johnson plants a tree as part of his 10,000 street trees project

It is preferable to allow the flooding of a park or football pitch once in a decade than to have a whole district flooded

water companies will save on the investment involved in extending their sewage system", says Nickson. The remaining essential investments will have to be paid out of national tax revenues. "You should bear in mind that a large part of the gross domestic product of England is made in London."

Nevertheless, it will require a great deal of exertion to convince citizens and administrators about the need for billions of investments. Measures which visibly improve the quality of life, such as the planting of trees, speak for themselves. But, according to Nickson, it will be quite a task to make people really aware of the problems facing them. "We can make the infrastructure climate proof all right, but it's just as important that the inhabitants of London familiarize themselves with the threats faced. In San Francisco, everyone is aware of the fact that a large earthquake may occur. Buildings are adapted in this respect and inhabitants know what to do when they feel tremor. The city is prepared for the problems. In our case, that cultural shift has yet to be made."

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Food from your city garden

Growing your own food is nice, cheap and better for the climate, because vegetables and fruit no longer need to be flown in from distant destinations. What's more, stony canal banks, roofs and balconies are transformed into green oases. Last year, this was sufficient reason for the British capital to start encouraging people to grow their own food. With the Capital Growth Programme, the mayor has concrete plans to add 2,012 new food gardens by 2012. Meanwhile, inhabitants and neighbourhood committees have taken the first hundred of these into use. Local volunteers and schoolchildren have also set up their own food garden in Potter's Fields Park, next to the City Hall. Vegetable and fruit waste from the City Hall is re-used as compost. Actually, the mayor is not the first politician to have home-grown vegetables and fruit products in his back garden. Obama, the American president, led the way with a food corner in the garden of the White House.

Southern Europe hit even harder: Barcelona takes action

London is right now preparing itself for dryer and hotter summers, but the consequences of climate change hit even harder in southern European cities. Due to its particular geographic location, a city like Barcelona directly experiences all the problems caused by higher temperatures and growing water shortages. It is predominantly ringed by mountains which prevent the prevailing westerly winds from providing natural cooling. This mountain massif also prevents a part of the rainfall from reaching the city.

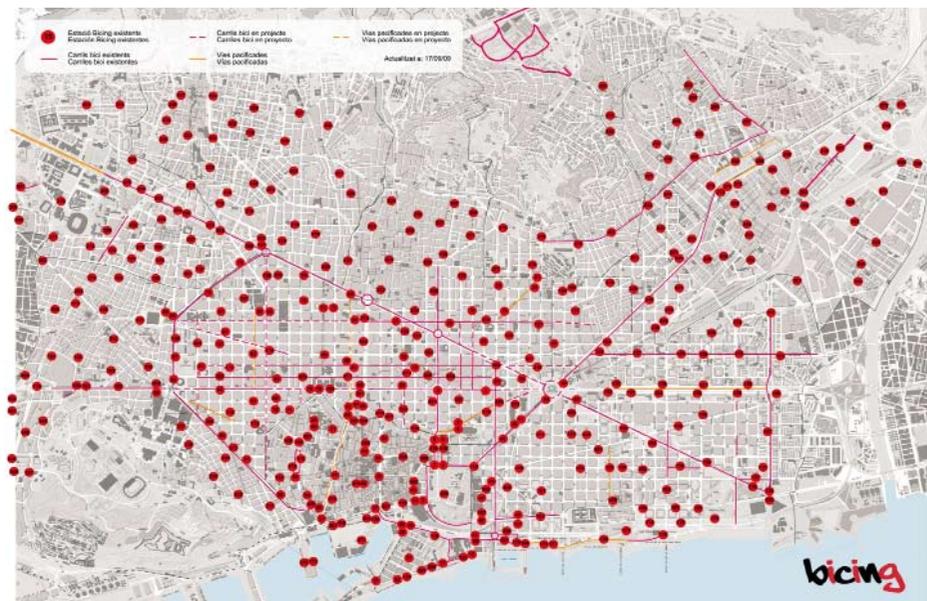
The Mediterranean metropolis isn't letting it rest at that. Under the leadership of Imma Mayol, the alderman for environmental affairs, Barcelona is trying to reduce the heat and drought problems by measures such as restricting automobile traffic. One or more lanes on a number of wide thoroughfares are being removed, parking fees are being increased and trees providing much needed shade are being planted on the wider pavements. Also, more and more streets are being closed to car traffic. Public transport has also been hugely improved in recent years, with new environmentally friendly vehicles, greater frequency, more service hours and a substantial expansion of the network. Furthermore, the council is stimulating bicycle use and has laid on a 100-km network of cycle paths, to be doubled in the coming years. And, as early as 2007, in line with other European cities, the municipal bicycle plan 'Bicing' was launched, which

gives city residents the opportunity to borrow bicycles for a small annual fee.

An extra stimulus for temperature control was provided last year by the intensive campaign to set the air-conditioning in offices and homes and in theatres, cinemas and government buildings at 'just' 24 °C. This led to a substantial reduction in heat emission in neighbouring streets. The municipal vehicle fleet also had to face up to it. In the autumn, for example, the city commissioned a large number of electric company vehicles. More-

over, charging stations for electric cars for personal and company use will be established in the near future.

With a view to safeguarding its drinking water supply for the future, the city has been collecting rainwater in a growing number of underwater basins for some years. This water is subsequently used for the parks, fountains and for hosing down the streets. One extra climate change complication is the fact that the rain these days falls less regularly and in greater quantities.



Take care of the elderly

LESSONS OF THE 2003 HEAT-WAVE

According to the Spanish climatologist Ricardo García-Herrera, the main answer to adapt to more extreme temperatures is a social answer. “Take care of the elderly.”

MICHEL VERSCHOOR

With other scientists, you have done research on extreme temperatures and Iberian mortality; what is your main conclusion?

“During heat-waves like the one in 2003, people who are accustomed to high temperatures suffer less than people who aren't. So, those who are used to high sum-

mer temperature averages will also adapt more easily to extreme temperatures as a result of climate change. This is clearly illustrated if we look at the relation between high temperatures and death mortality. In Madrid daily mortality starts to increase when temperature rises above 36.5°, in Seville we see an effect at 41°, but in Lisbon daily mortality is already on the rise at 34°. In Lisbon more people died than in Madrid.

What else influences heat related mortality figures in Spain and Portugal?

“Demographics and different socio-economic factors. If a country has a relatively high number of retired elderly, more people suffer from extreme temperatures; inhabitants of more prosperous regions can afford domestic air-conditioning, which reduces mortality rates.”

What has Europe learned from the 2003 heat-wave?

“Nowadays, most countries have an early warning system. If meteorological institutions foresee a heat-wave, the general public is informed, while regional governments and hospitals take precautions. We have also learned that taking care of the elderly is the most effective measure to re-

duce mortality. If there is a clear picture of where and under what conditions elderly live, health services can take care of isolated elderly who are easily at risk during a heat-wave.”

And the general public, what can they do?

“Take care of the elderly. Countries or cultures with strong family ties face less temperature mortality that individualized societies. The Latino community in Chicago suffered less during the 1995 heat-wave, because they very well looked after each other. One would think that Spain and Portugal are still quite family oriented, but at least in large Spanish cities, more and more people live on their own. As people do in most North European countries.”

What about technical solutions?

“The obvious answer is that everyone should have a system of domestic air-conditioning. But from a climatologically point of view that's a response in the wrong direction. More air conditioning units use more energy, producing even more CO₂-emissions. Different construction methods could perhaps be an option, but nowadays we use the same brick everywhere. Rural communities in central and southern Spain used to build strong, thick walls of at least 25 cm to keep both the heat and the cold out. I don't think it's realistic to propose to restart building in the old fashioned manner. No, just pay attention to the elderly. City and regional governments have to identify where and how they live, and social and health services have to give specific support under extreme weather conditions. That's quite a mission for most European countries since demographic scenarios show that the proportion of elderly will increase for a number of decades.”

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ANP

Heat-wave: a silent killer

At least 35,000 Europeans died as a result of the record heat-wave in August 2003. That month was the hottest August on record in the northern hemisphere. France suffered the worst losses, with almost 15,000 casualties. Heat-waves are a silent killer, affecting the elderly, the very young and the chronically ill.

With more extreme weather events lying ahead, the annual temperature mortality is likely to increase. Projections by the Intergovernmental Panel on Climate Change (IPCC) predict more extreme weather. By the end of this century, the average world temperature might climb by 1.4 to 5.8°C. Regional scenarios for the Mediterranean region indicate a non-constant increase of temperatures throughout the year. In the report 'Extreme summer temperatures in Iberia: health impacts an associated synoptic conditions', published by Ricardo Garcia-Herrera and Ricardo Trigo, a large increase in summer temperatures is predicted for the Iberian peninsula. In Lisbon the average summertemperature may rise from 28° to as high as 34°, with the frequency of hot days (>35°) increasing from the current figure of 5 to roughly 50 per year. All other European countries will have to deal with more heat as well. "It is expected that under all scenarios temperature mortality might increase, though acclimatization will reduce the burden".

ANP

A hot year in Iberia

Extensive forest fires hit Portugal in August 2003. Five per cent of the countryside and ten per cent of the forests (215,000 hectares) were destroyed, an estimated 4,000 square kilometres. Eighteen people died in the fires and there were around 2000 heat related deaths. Temperatures reached as high as 48 °C (118 °F) in Amareleja. The first of August was the hottest day in centuries, with night temperatures well above 30 °C. In Spain several thousands died and temperature records were broken in various cities, including 45.1 °C in Jerez, with the heat-wave being more felt in typically cooler northern Spain. Thus (record) temperatures were reached in Gerona 38.8 °, in San Sebastian 36 °C and in Sevilla 45.2 °C. SOURCE: WIKIPEDIA, AMONG OTHERS.





EUROPEAN APPROACHES TO ADAPTATION STRATEGY

Controlling the elements

The climate crisis demands damage prevention and control. But how do EU member states approach and tackle the challenges?

MICHEL VERSCHÖOR

Maria Luisa Beach,
Portugal, immediately
after the landslide.
PHOTO: ANP



In October 2009, The London Climate Change Partnership launched a detailed report on the climate change-effects on London's biodiversity. In 'Adapting to climate change: creating natural resilience' the report explores how the role of protecting, managing, designing and creating biodiverse landscapes will help the city adapt to droughts and expected heat-waves. In neighbouring Ireland the country's Heritage Council launched a study into the impact of climate change on the Irish coast and inland waterways. Its recommendations include a discussion of adaptation options and the challenges they bring.

Further to the south, the Portuguese have similar concerns. With 832 km of coastline, many settlements are under the direct influences of a capricious Atlantic Ocean. At Maria Luisa beach in Portugal's Algarve, five people died this August in a coastal landslide, which, according to Environment minister Nunes Correia, was the result of heavy waves hitting the coastline. Some coastal municipalities are already studying on adaptation strategies or have been strengthening their coastal defence systems.

The PEER report

In a growing number of European countries the impacts of climate change are at the top of the agenda at local, regional and national government levels. Although vulnerabilities and impact scenarios differ between sectors and countries, leading policy-makers are on high alert.

Earlier this year, a 280-page study, conducted by six large European environmental research centres, presented a comparison of national adaptation strategies. In the PEER report 'Europe Adapts to Climate Change: Comparing National Adaptation Strategies', scientists describe how European countries undertake the development of adaptation strategies. They also signal a need for continuing climate adaptation research to connect innovative science with local, regional and sectoral policy needs.

Rob Swart of Alterra, PEER partner at Wageningen University and Research Centre, states: "The PEER report provides information on lessons learnt in frontrunner countries and identifies areas where additional efforts are urgently needed. It also helps to broaden the available menu of options for individual countries, since it makes clear that different countries choose very different approaches to adapt to climate change."

Adaptation

According to the Intergovernmental Panel on Climate Change (IPCC) adaptation means: "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."

Different countries choose very different approaches to adapt to climate change.

EU member states are at different stages in preparing, developing and implementing national adaptation strategies. In May, when the PEER report was published, only Finland, Spain, France, the United Kingdom, the Netherlands, Denmark, Germany and Hungary had adopted an adaptation strategy. The recent and rapid pace of development across Europe, however, implies that policies in this area are developing extremely fast, and the information about national activities in the report will soon be outdated.

The Finnish approach

Finland was the first European country to have a national adaptation strategy. A wide range of sectors are covered in the strategy: agriculture and food production, forestry, fisheries, reindeer and game, water resources, biodiversity, industry, energy, transport, land use and communities, building, health, tourism and insurance. The objective of Finland's National Strategy for Adaptation is to reduce the adverse consequences of climate change as well as take advantage of its potential opportunities. Apart from serious risks, Finland also foresees some positive impacts on its national economy. It expects better conditions for agriculture, increased forestry growth and a reduced need for heating.

The Dutch approach

The Dutch approach to adaptation is relatively specific compared to adaptation strategies in most countries. The Dutch national adaptation strategy 'Make Space for Climate!' focuses primarily on physical planning measures, a direct consequence of the country's geography. Almost one-third of the country is located below mean sea level, while a further third has to be protected from flooding by rivers in periods of high river discharge. A national research programme has recently been approved to climate-proof the country. 'Knowledge for Climate' aims to develop applied knowledge



Turfzak, the Netherlands.
Former polder the Turfzak has
been included in the Biesbosch
Nature Reserve. It will serve as
a conservation area and will also
increase the waterstorage ca-
pacity of the Biesbosch. In the
background the River Meuse.



through cooperation between the Dutch government, the business community and scientific research institutes. Among other goals, the research programme aims to develop regional adaptation strategies in eight case study areas (hotspots) that are particularly vulnerable to climate change. Like Finland, the Netherlands also expects some improvement in sectors like agri-

The conclusions of the PEER report can help to broaden the adaptation agenda

culture and tourism, besides the export of knowledge related to water and coastal engineering.

The Spanish approach

In Spain, the 'Plan Nacional de Adaptación al Cambio Climático' (PNACC) was started in 2006. Among its main priorities are impacts on the water sector, coastal zones, mountainous regions and biodiversity. Spain's geographic situation and socio-economic circumstances make it very vulnerable to climate change. Spain therefore signed the Kyoto protocol in 2001 and subsequently developed its National Adaptation Strategy. The plan provides the framework for action on adaptation for the several autonomous communities taking part, as well as for governmental and non-governmental organizations. The PNACC argues

Lake Paijanne, Finland. The irregular shoreline around Päijänne is heavily forested and supports important timber operations that use the lake as a means of transport.



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EEA report on water adaptation

“The impact of climate change on Europe’s water resources is a critical issue for people’s lives and the economy”, according to a study by the European Environment Agency (EEA). “Even if emissions of greenhouse gases were stabilized today, increases in temperatures and the associated impacts will continue for

many decades to come.” With periodic floods, droughts and heat-waves, Europe has a serious water problem. “Analyses from climate change models project show an exacerbation in the frequency and intensity of the events. Changes in precipitation, combined with rising temperatures and reduced snow cover, will have

impacts on water quality and quantity, requiring water managers to incorporate climate change in their planning and investment decisions.” Economic sectors which are projected to be most affected are agriculture, energy, health, tourism and recreation, fisheries and biodiversity. “Strategies for adaptation

need to be embedded within existing national policy and institutional frameworks”, the EEA advises. Top priorities for adaptation should be to reduce the vulnerabilities of people and societies, to protect and restore ecosystems that provide critical land and water resources and services, and water saving initiatives.

that climate change adaptation is inextricably linked to mitigation policies. Mitigation policies determine and influence greenhouse gas concentration levels, and planning a strategy for a two-degree increase in temperature is very different from planning for a four-degree increase. An adaptation strategy therefore requires a significant degree of coordination in respect of mitigation measures.

CIRCLE Extended Country Report

The ‘Extended Country Report’, a study of the CIRCLE ERA-NET, a network of European research institutes, concludes that the key vulnerable sectors in Europe are: “water resources (especially in South and South-Eastern Europe), agriculture (especially in Southern and Central Europe), ecosystems (especially marine ecosystems and wetlands) and tourism (especially summer tourism on the South-East Mediterranean coasts) and the winter sports industry, (especially in the Alps). Key vulnerable areas in Europe are: the Mountains, the Coastal areas and the Arctic environment.

Throughout Europe, public health, water resources management and management of ecosystems are among the sectors that urgently need to develop adaptation measures.

Existing adaptation measures focus mainly on flood defence and health-related issues, spurred by the significant losses incurred from extreme weather events in recent years (e.g., the 2002 floods and 2003 heat-wave). As a result, many countries started or intensified studies of the potential impacts of climate change and adaptation measures in vulnerable sectors. Extreme weather events have already motivated countries to reconsider their health care services and flood risk management plans. Other existing adaptation measures focus on natural hazard prevention, environmental protection and sustainable resource management.

Studies such as the PEER report, CIRCLE’s Extended Country Report, but also the Climate Change and Water Adaption report from the European Environment Agency (see box), as well as the various National Adaptation Strategies, have put adaptation issues on the European political climate change agenda, which was dominated until recently by mitigation. But much remains to be done. “Even if the PEER report doesn’t include any value judgments as to good or bad, the overview presented may lead some countries to feel they are lagging and must step up their efforts”, states PEER project leader Rob Swart. “The report’s conclusions can help to put particular adaptation issues on the agenda in some countries, or reinforce developments that are going on anyway.”

Follow-up steps

Among researchers, policy-makers and stakeholders there is a growing awareness that jointly produced knowledge is needed at all levels of government to assist policy makers in developing and implementing adaptation strategies. European countries have started to design specific science-policy processes, targeted research programmes, policy instruments, and digital information tools, to provide scientific and technical information in support of policy development for adaptation. Only eight countries have adopted a National Adaptation strategy till date, so many more will have to follow to develop their own strategies or address their vulnerability in another way. All have, as Swart puts it, to recognize that a strategy alone is not enough. “Successful adaptation requires careful and urgent preparation of follow-up steps, including the identification of policy instruments, allocation of sufficient resources and evaluation procedures.”

The PEER report
www.peer.eu

The EEA’s Climate Change and water adaptation issues
www.eea.europa.eu/publications

CIRCLE’s Extended Country Report
www.circle-era.net

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Working with nature

We all know that technology is a vital weapon in our efforts to tackle climate change, but as Caro Cowan argues, we are forgetting about a key technology that is cost effective, readily available and tested over hundreds of years: nature's technology.

CARO COWAN





Climate change is the greatest long-term threat to global biodiversity. Against a background of degraded habitats, increasing species loss and growing levels of habitat loss, climate change will only serve to make these problems worse. It's a stark message. And it gets worse – climate change is already affecting biodiversity. The IPCC found that 89 per cent of observed biological changes in Europe were consistent with global warming. In the UK we have seen the leafing date of oak trees advance by three weeks. In Costa Rica the golden toad is being held up as the first climate change extinction. As conservationists we know that we need urgent action to prevent the worst damage if we are to retain the richness and variety of biodiversity that currently exists.

But it is not just the conservationists who should be acting on this stark warning. Without healthy and resilient ecosystems society will fail in its efforts to adapt to the consequences of climate change. Increasing the ability of ecosystems to cope with climate change in turn increases the resilience of society in the face of climate change.

Economics of ecosystems

Our knowledge of the role ecosystem services play in supporting human wellbeing

has increased immeasurably over the past few years, in large part due to the work of the 'Millennium Ecosystem Assessment' and more recently 'The Economics of Ecosystems and Biodiversity'. These studies have demonstrated the huge value, culturally, socially and economically, that biodiversity provides to society. And this value is increasing as society starts to experience the effects of climate change. Drier summers and changing rainfall patterns means more droughts. More intense precipitation is causing increased flooding. Warmer temperatures will reduce water quality. Soil erosion and greater run-off will affect water and agriculture. Changes to ecosystems caused by climate change will have impacts on people's everyday lives.

Nature's technology

In the climate change debates we continually hear calls for new technologies to 'save' us from climate change. Technology is one of the fundamental pillars of the new UNFCCC agreement. There is clearly a role for technology in adaptation – we wouldn't want to see London or the Netherlands without their flood defences or nuclear power stations left to fall into the sea. But in many cases the technology is expensive, inaccessible to the poorest

or doesn't even exist yet. But there is one technology that is cheap, readily available to all and has been shown to do the job over hundreds, if not thousands of years. Nature's technology (known as ecosystem-based adaptation) provides us with a simple way to tackle the commonest consequences of climate change. By managing ecosystems effectively and sustainably we can reduce flooding, increase water supply and quality, cool our cities (see page 40) and at the same time contribute to the reduction of greenhouse gases. And these aren't the only benefits. A healthy natural environment also reduces air pollution, provides habitat for plants and animals, improves health and wellbeing and provides places for recreation and tourism. Over the past year there has been a growing awareness and development of this concept of 'ecosystem-based adaptation'. Twelve months ago it was a virtually unheard of term, although many conservation organisations have been talking about the role the environment can play in helping us adapt for some time. Work by IUCN, The Nature Conservancy and individual country organisations such as Natural England has ensured that discussions of adaptation, and in particular adaptation strategies, include ecosystem based options.



It is widely recognized that working with nature to protect, enhance and restore ecosystems can increase societal resilience to the effects of climate change. This concept was given high level support through the CBD's Ad Hoc Technical Expert Group (AHTEG) on biodiversity and climate change held in late 2008/early 2009. The group's report highlighted the role that managing biodiversity and ecosystem services can play in supporting societal adaptation. They stated that "maintaining natural ecosystems (including their genetic and species diversity) is essential to meet the ultimate objective of the UNFCCC because of their role in the global carbon cycle and because of the wide range of ecosystem services they provide that are essential for human well-being". There are now efforts underway to ensure that ecosystem-based adaptation is recognized in any new agreement that emerges from the UNFCCC meeting at Copenhagen, allowing access to funding in particular for the most vulnerable countries.

Ecosystem-based approaches in Europe

But nature's technology is not just a solution for developing countries. A recent



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workshop of European Nature Conservation Agencies identified a number of examples of ecosystem-based approaches which are already taking place across Europe – even if they haven't been labelled as such. Working with nature can bring similar multiple benefits for European countries and citizens, potentially reducing adaptation costs as well as enhancing mitigation efforts.

For example, as we worry about increased coastal erosion and sea-level rise it may seem sensible to build bigger concrete defences. But these are expensive, they damage habitats and they can in some cases make the problem worse by stopping natural processes which both dissipate tidal energy and allow coastal recharge down the line. Although we recognize that some places must be defended by concrete walls, it is not a sustainable national response in all locations. An alternative is to (re)create more salt-marsh and restore coastal floodplain habitats, which provides cost-effective protection against flooding, improves water quality and provides wetland habitats for everything from birds to commercially valuable fish nurseries and, of course, high quality landscapes for people to enjoy.

This is a sustainable adaptive response centred around a healthy natural environment. There have been over twenty realignment projects in the UK designed either for habitat conservation or flood risk management or both, the largest of which, at Alkborough on the Humber estuary, protects 90,000 hectares of land and 300,000 people from sea-level rise. The financial benefit of this flood protection is estimated to be more than £400,000 a year. In addition, it has produced new recreation opportunities to benefit the local community both directly through increased tourism, as well as significant conservation benefits.

Lower Danube Green Corridor

In Central and Eastern Europe, WWF have been working along the length of the Danube to restore natural floodplains. They found that since the start of the twentieth century over 80 per cent of the original

Over two-thirds of the Finland's mires had been drained by the 1990s and much of the forestry cover was homogenous young stands in isolated patches

floodplain area had been lost due to agriculture, power production and building of canals for navigation. As well as the adverse effects on biodiversity with loss of important habitat for breeding birds, there have been serious socio-economic impacts as villages flood more frequently, ground water recharge is reduced and water quality suffers. Working with local partners, WWF have instigated a programme of wetland restoration which is helping to regain and retain this vital adaptive functions – reducing the risk of floods and droughts to the local communities, allowing the recovery of fish nurseries which provide commercially, as well as ecologically important species and contributing to improving the state of biodiversity. Restoration of the 37 sites that make up the Lower Danube Green Corridor is estimated to cost €183 (\$299) million, but will likely lead to additional earnings of €85.6 (\$120) million per year. Before the restoration, the 2005 flood cost €396 million in damages. This value will only increase as climate change impacts increase – leading to rising flood damage costs.

Filling ditches with tree trunks

In Finland the state Natural Heritage Service, working with Regional Environmental Centres, has begun a programme to un-ditch and restore mires and restore native forest. These areas had been badly affected by drainage and cutting for forestry and road construction from the 1950s. Over





RAULI PERKIO

two thirds of the country's mires had been drained by the 1990s and much of the forestry cover was homogenous young stands in isolated patches. By filling in the ditches with tree trunks, vegetation and peat from the same mire and prioritizing restoration of selected forest sites to allow natural succession a number of climate adaptation benefits have been realized. Flood management is improved as restored mires are better able to hold water during intense rainfall. At the same time ground water levels are stabilized and water quality improved. Air quality has improved and management of the forests using more traditional techniques reduces the threat of invasive species taking a hold. There are also carbon benefits as well as improvement in rural livelihoods as local management is re-introduced. Not to mention the benefits for biodiversity as habitats are restored and enlarged.

With climate change already having an impact on biodiversity and human society, and with those impacts predicted to increase –perhaps faster than we expect–many will argue that biodiversity conservation is a luxury we can ill afford as we struggle to provide food, clean water and housing for a rapidly growing population. But, as these three examples demonstrate, we can't afford NOT to protect biodiversity and ecosystem services. Conserving and restoring ecosystems is a cost-effective and accessible way to adapt to climate change and can also have multiple economic, social and environmental benefits. We cannot tackle biodiversity loss without addressing climate change, nor can we address climate change without tackling biodiversity loss. We must take urgent action to improve our degraded wildlife and ecosystems - not only so that we can retain the inherent character and quality of our landscape, but because we cannot afford not to if we are to ensure that society can retain a high quality of life as our climate changes.

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Water scarcity and drought in the Mediterranean

The balance between water demand and availability has reached a critical level in many southern areas of Europe, the result of over-abstraction and prolonged periods of low rainfall or drought. Reduced river flows, lowered lake and ground water levels, and the drying up of wetlands are widely reported, alongside detrimental impacts on freshwater ecosystems, including fish and bird life.

ROBERT COLLINS



Olive groves in Córdoba province, Andalusia, Spain

In Turkey's Konya Basin, a combination of drought and excessive abstraction of water for agriculture has led to the drying up of a number of lakes and wetlands. Lake Tuz, for example, formerly the country's second largest body of water and visited by thousands of flamingos each summer, has been severely reduced in size. Sinkholes and land collapse are also reported in the Konya Basin, triggered by a severe depletion of the ground water resource.

Where water resources have diminished, a worsening of water quality has often followed because less water has been available to dilute pollutants. In addition, salt water increasingly intrudes into 'over-pumped' coastal aquifers throughout Europe. On Greece's Argolid Plain, for example, boreholes have had to be abandoned due to excessive levels of salinity found in the ground water as a result of such salt water intrusion.

Farmers have seldom had to pay the full resource and environmental cost for water

The Mediterranean region is particularly susceptible to the detrimental impacts of water scarcity and drought. Not only does the region experience relatively low 'effective' rainfall (i.e. the amount once evapotranspiration is accounted for) but both agriculture and tourism exert a significant pressure on available water resources.

Water and agriculture

Across Europe as a whole, agriculture accounts for about 24 per cent of total water use. In parts of the Mediterranean, however, this share can reach up to 80 per cent due to the widespread irrigation of crops, a practice that enhances their yield and quality. Most irrigation water is abstracted during the summer months when crop water demand peaks but water is least available. Moreover, most of the water abstracted by agriculture is 'consumed' through plant growth and evapotranspiration, with often no more than a third being returned to a water body after use. Excessive abstraction for irrigation has been driven, at least in part, by the fact that farmers have seldom had to pay the full resource and environmental cost for water. And until recently, EU subsidies often incentivized water-intensive cultivation.

Summer tourism

International tourist numbers have increased markedly in the Mediterranean region over recent decades and much of the coastline is now



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built on. Not only do tourists enhance pressure on the public water supply through using water for food, drink and personal hygiene; leisure facilities such as swimming pools, water parks and golf courses all exacerbate the problem. Moreover, most tourists visit the region during the summer months when water resources are already subject to considerable stress.

An ever expanding supply

To satiate the demands from agriculture, tourism and other sectors, water supply in the Mediterranean has steadily expanded over recent decades through the building of reservoirs, inter-basin transfers and, increasingly, energy hungry desalination plants. Problematically, this disproportionate emphasis on supply has provided no incentive to limit water use by any sector. Instead, it has promoted the excessive abstraction observed in many Mediterranean regions today that, in combination with periods of drought, have often led to water resources falling to a critical level.

Shipping water

In Cyprus, for example, water use for irrigation and domestic purposes has grown steadily over the last 20 years. In 2008, however, Cyprus suffered its fourth consecutive year of low rainfall, and water availability reached a critical level in the summer months. To ease the island's crisis,

water was shipped in from Greece using tankers and the Cypriot Government was forced to apply emergency measures, including the cutting of domestic supplies. Similarly, in Catalonia, during the spring of 2008, water levels in the reservoirs supplying 5.8 million inhabitants were only at 20 per cent of capacity. The situation was so bad that plans were made to ship fresh water in, at an estimated cost of €35 million. Luckily, May was wet and, in the end, only a few shiploads were transported to Barcelona.

Management of water resources

Continued expansion of water supply is clearly not a viable option for water resource management in the Mediterranean either now or in the future, particularly given the climatic changes anticipated for the region. Climate models predict hotter, drier summers for southern Europe with a progressive increase in the frequency and severity of droughts during the 21st century.

The Mediterranean region needs to implement a sustainable approach to the management of its water resources, focused on conserving water and using it more efficiently. Integral to this is a more equitable approach to water abstraction that addresses not only the requirements of competing economic sectors but also the need for healthy freshwater ecosystems. Successfully im-

Liberian-flagged 'Westama' anchored off Cyprus's southern coast on 2 July 2008. The vessel is carrying 40,000 cubic metres of drinking water from Greece, imported by Cyprus to alleviate the effects of a crippling drought. The island plans to bring in an estimated 8.0 million cubic metres of water in shipping tankers by November.

Cyprus is taking action

While the current situation with respect to water scarcity and drought in the Mediterranean is worrying, positive developments are apparent. In Cyprus, for example, an integrated approach to water management implements measures to ensure water security both now and in the future, accounting for the impact of climate change. As Mr Sofoclis Aletraris, Director of the Water Development Depart-

ment in Cyprus, points out, “A range of measures address the management of demand including metering of water consumption, water pricing that not only reflects its growing scarcity but includes the provision of subsidies for saving potable water, programs to reduce distribution losses, improvement of on-farm management irrigation systems and, the promotion of a water-saving culture”.

Catalonia addresses demand

In Catalonia too, the Catalan Water Agency has taken positive steps to implement more sustainable water management, addressing demand, rather than only focusing on supply. Various conservation practices and measures to improve efficiency have been established, including more recycling and reuse of water. During the 2007–2008 drought, rapid implementation of these measures led to a 17 per cent drop in urban water use. However, as Lorenzo Galbiati of the Catalan Water Agency

explains, “the aim was not only to address the drought crisis but to implement these measures for the longer term, thereby also adapting to the drier climate predicted for this region in future years”. The approach appears successful and as Galbiati points out “whilst some time has now past since the drought ended, the measures implemented remain effective. Per capita water use in Barcelona has now fallen to less than 120 litres per day, one of the lowest levels in Europe”.

The Mediterranean region needs to implement a sustainable approach to the management of its water resources, focused on conserving water and using it more efficiently

Adaptation research & results: the CIRCLE Mediterranean Call **Saltwater intrusion is a major threat to freshwater**

There is a widespread need among European member states for more specific climate research that incorporates the needs and questions of stakeholders. Within the ERA-net CIRCLE, applied research projects have started in an international collaboration; (preliminary) results are being presented or will be published soon. An update on CIRCLE MED.

“Within the CIRCLE MED call, eight projects have been selected”, says Marie Mojaisky, the French coordinator of this geographical research group. “We only expect results at the end of 2010 at the earliest.” According to Mojaisky, countries involved in the research projects range from France, Portugal, Israel and Italy to Croatia, Morocco,

Albania and Tunisia. All these and other partner-countries have one thing in common: they are closely connected to the Mediterranean sea. Its surrounding ecosystems may be among the most impacted by global change drivers. They will at least suffer a decrease in water resources. Therefore within the CIRCLE MED call, research projects on ‘Integrated coastal zone and water management issues’, were funded. Case studies in France, Portugal and Morocco collect data on salt water intrusion problems and groundwater management. “Farmers’ perceptions, needs and questions will be addressed in the study”, Mojaisky explains.

Other MED call studies will focus on the effect of climate

change on freshwater resource availability in other Mediterranean and Atlantic Ocean regions (e.g. the Azores). Preliminary results of interviews in the Italian basin point out that the stakeholders identify saltwater intrusion as one of the major threats to coastal zone freshwater resources. The INTERMED project carried out by Italian, Israeli, and Croatian research institutes are working together on exploring intertidal ecosystems, in order to gain knowledge on whether climate change impacts will cause habitat loss and loss of ecosystem goods like shellfish for human consumption, and the economy.

for more information on CIRCLE see p. 14



plementing such an approach will also address the need to adapt to climate change and contribute to lower energy consumption, because water and energy use are closely linked.

New approaches to irrigation

Irrigated agriculture is central to the economy in many parts of the Mediterranean and in some areas ceasing irrigation could lead to severe economic hardship. Adopting a more sustainable and efficient approach to agricultural water use is critical, therefore, not only to protect the environment but to ensure that agriculture remains profitable. Fundamental change is especially important given the predictions for some regions of the Mediterranean that future lack of water will seriously affect agriculture.

Various practices can be implemented to ensure that agriculture uses water more efficiently. These include the timing of irrigation so that it closely follows – on a daily basis – crop water requirements; adopting more efficient techniques such as sprinkler and drip irrigation systems; and using pressurized pipe networks rather than gravity-fed open channels.

Deficit irrigation also has great potential. This is a technique that reduces the amount of water applied to below the ‘theoretical irrigation need’

of the crop on the basis that the financial savings from reduced water use outweigh the modest reduction in crop yield. To incentivize implementation of these and other measures, however, it is necessary that farmers pay a price for water that reflects its true cost. Additionally, illegal water abstraction must be rigorously addressed. Funds disbursed under the Common Agricultural Policy can also play an important role with respect to subsidizing costs of implementing measures to reduce agricultural water use.

Consumer awareness

Much can also be done to implement a more efficient use of the public water supply. Leakage of water from supply systems can be substantial and efforts need to be made to improve detection, quantify leakage more accurately and upgrade and maintain networks. Achieving more sustainable use of public water supplies will also depend strongly upon raising public awareness of water conservation, including measures such as rainwater harvesting and the use of ‘grey’ water. Various means are available to inform domestic, business and tourist water consumers. Eco-certification of hotels, for example, can help tourists make informed choices. As with the agricultural sector, however, appropriate water pricing structures need to be implemented in order to incentivize water savings.



About the author

Robert Collins is a water specialist at the EEA, focusing on the pressures that impact upon the quality and quantity of freshwater across Europe, and measures to achieve a sustainable use of water resources. He has written this article at the request of *Change Magazine*.

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Climate adaptation in the IJsseldelta: the Overijssel approach

The river IJssel in the Netherlands is a major branch of the river Rhine, the third largest river of Europe. It discharges its flows to the IJsselmeer Lake. The IJsseldelta is a low-lying area that is threatened by floods from both the river IJssel and the IJsselmeer Lake.

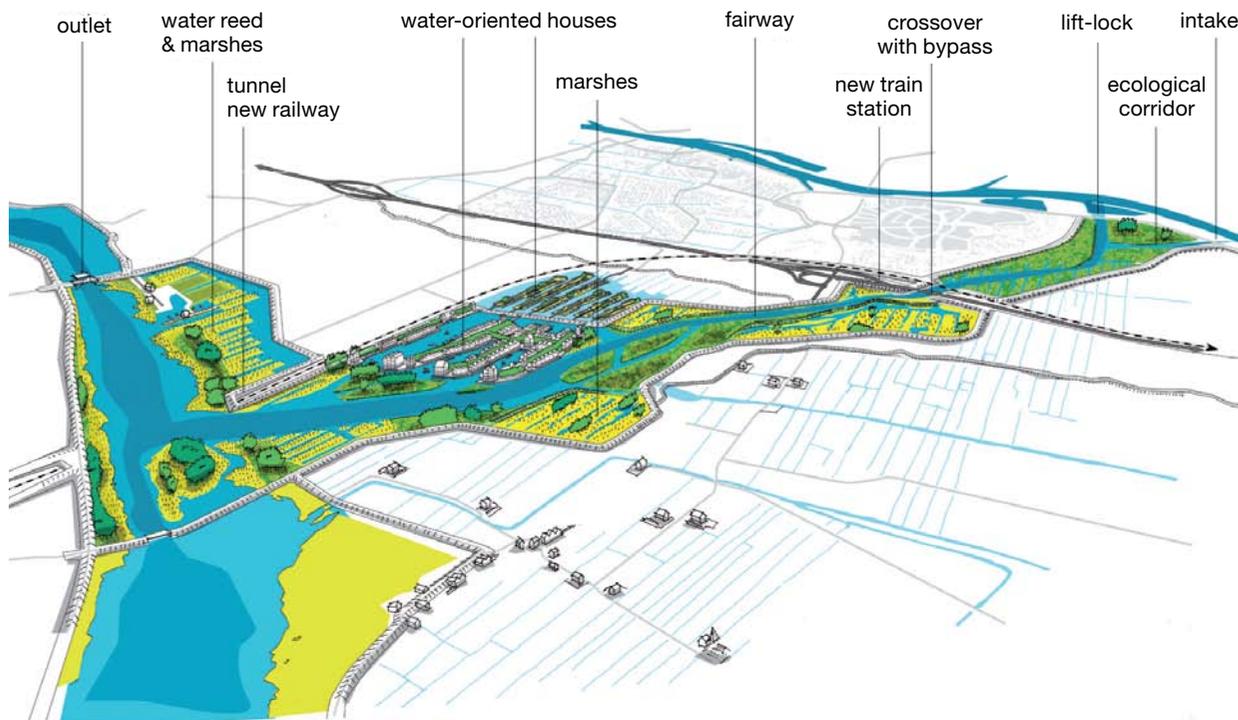
In 2005 the Province of Overijssel initiated the process of drawing a sustainable development plan for the IJsseldelta area with a strong focus on climate adaptation. The challenge was to combine and integrate several spatial developments (housing, infrastructure, leisure, nature, agriculture),

with the construction of a so-called bypass of the river IJssel.

The result is an integral plan that is supported by more than 20 governmental and non-governmental organizations. With the construction of the bypass some 350 hectares will be added to the floodplains of the delta of the river IJssel. The effect of the restoration of the floodplains is that the water levels of the river IJssel will decrease substantially during situations of high river discharges. This contributes to the safety and resilience of the area.

One of the most recent ideas is to develop a climate proof dike – a kind of super dike along the river bypass – that at the same time can act as an embankment for housing development. In September 2009 an agreement was reached to finance the project, which will cost about €325 million in total. If everything goes according to plan and without delay, the implementation of the project will start in 2013.

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Impression of the integral plan of project IJsseldelta (2008)

The green agricultural revolution

For too long, agriculture and countryside development have been viewed as part of the climate problem, rather than as part of its solution. Therefore Gerda Verburg, Chair of the 17th session of the UN Commission for Sustainable Development, decided to put the agricultural industry right at the top of the CSD climate agenda.



MAARTJE SMEETS

Chaired by Verburg, 180 nations gathered this year during the 17th meeting of the UN Commission for Sustainable Development (CSD) in support of a call to place the development of agriculture at the centre of sustainability and the fight against climate change. UN Secretary General Ban Ki-moon expressed the hope that the meeting would contribute to the climate discussions to be held during COP 15 in Copenhagen. In Verburg's words: "Agriculture must no longer be seen as a problem, but a solution. We have to combine all the knowledge we have and use our powers of reasoning, locally and internationally, to ensure we shall be able to feed the world's population sustainably in three decades' time, with respect for humankind, animals and the environment."

One significant outcome of the UN meeting is the need to invest in sustainable agricultural development in Africa: the green agricultural revolution. According to Verburg, for decades, discussions of agriculture and food production throughout the world centred mainly on redistribution. "But you can only start with a satisfactory redistribution of food if agriculture is sufficiently developed: if the farmers don't just produce enough, but also have the facilities to process their products and market them. Production in developing countries can increase by 40 to 60 per cent per hectare – sustainably – if you use selective breeding and specialist biotechnology." To do that, Verburg believes we need a satisfactory agricultural policy and good infrastructure, besides new technology. "What use are ten cows to a farmer if the milk spoils because the nearest market is a three days' walk away? Making food production sustainable is also about upgrading products so valuable animal protein isn't wasted, for example. If you can make cheese from your milk your product is easier to transport and store."

Meat consumption doubles

Ecosystem pressure has led Verburg to push for a cut in animal protein in our diet. After buildings, the agricultural industry is the biggest emitter of CO₂. Research indicates that cattle ranching and meat production alone release 12 to 18 per cent of global CO₂ emissions (depending on whether or not one counts

The UN Commission for Sustainable Development

The Commission meets annually to discuss progress on Agenda-21, adopted in 1992, on The Environment and Development. The 17th session took place this year under the Chairmanship of Gerda Verburg, the Netherlands Minister for Agriculture, Nature and Food Quality.

Under her leadership, proposals were accepted to view agriculture as part of the solution to the climate problem and not just an aggravating factor. A clear signal was sent on agriculture's importance as part of the solution to a number of crises, the need for further investment in sus-

tainable agriculture, and a sustainable green revolution in Africa. The CSD occupies a special place in the UN system thanks to the involvement of NGOs, representing peasants and farmers, youth, trades unions, native populations and women.





On the fertile lands around Kenya's longest river a battle rages between conservationists, pastoralists and investors keen to turn the rich soils into swathes of commercial farmlands and which will displace 22,000 people and dry up the soil.

Keeping cattle and producing animal protein is valuable in every way

the production of animal feed). One kilogram of meat costs 16 times as much water (16,000 litres) as the production of a kilogram of grain. Besides that, meat production takes up 80 per cent of agricultural land, while it contributes 15 per cent to total food consumption. The UN's agricultural organization, FAO, expects meat consumption to double by 2050 to 450 billion kilograms per annum.

According to Verburg, it is mainly the people in the developed countries who increasingly want to see such values as animal welfare and social conditions reflected in the food they eat. "There's a public demand for it, so we have to offer people the choice. That's why I set up the Platform for Sustainable Food, so that suppliers like supermarkets and mass caterers can commit to making their wares more sustainable. They can do that, for example, by offering more meat replacements, products based on algae, insects, possibly even artificial meat." Verburg wants to see a European top group set up, composed of countries that share similar ambitions for a sustainable global food supply. If the Chair of the UN Commission for Sustainable Development gets her way, countries like Germany, the United Kingdom and the Scandinavian nations could combine to take up the global challenge of food production and consumption.

Complete ban

A complete ban on the consumption of meat and animal products isn't the answer, in Verburg's view. She emphasises the role cattle herding plays in the utilization of otherwise useless agricultural land, landscape management, and such animal products as high-grade sources of protein. In Verburg's view, a sustainable system of agriculture comprises both an animal and a vegetable component. "Keeping cattle and producing animal protein is valuable in every way. So we have to investigate how we can make animal protein production sustainable. For example, we have to close the feedback cycles: process manure to give biogas, or extract valuable minerals like phosphate. That's the way to create a win-win situation."

New technologies, like biological crop protection and production, precision sowing using a GPS, and re-use of animal manure allow farmers to increase production while reducing the adverse effects on the climate.

Sharing knowledge is vital, here. Verburg is ambitious here, too: "There's a vast amount of knowledge available right now, but what we for example haven't succeeded in is linking new technologies to local, on-the-spot knowledge in Africa. We have to make our knowledge available by offering training in our leading institutions to people from developing countries, or send our own experts into the field to arrive at the best solutions in cooperation with the local population."

Sustainable food supply

Verburg says the key word is synergy if agriculture is genuinely to contribute to resolving the climate problem. "That's my mission: creating synergy between knowledge centres, market parties and the farmer or market gardener. I want to stress that in a big way in Copenhagen too. In recent years we've been working too much along monorails; none of us knew what the others were doing about innovation and adaptation to changing conditions. We shall have to stop that if we want to innovate towards a sustainable food supply. Let's not sell ourselves short: we need to deploy all the means at our disposal and combine them as needed."

Verburg is not worried that she's marching too far ahead of the band. According to the Minister, the agricultural and the meat industries – neither of them particularly renowned for their idealism in the past – are now ready to accept their share of the responsibility for the climate problem. "What a lot of people don't know is that the arable farmers and the market gardeners have already done a lot. Many of the greenhouses in Holland are now energy neutral, for instance; some of them even generate energy. They use biological crop protection and some new housing estates are being heated with energy released by composting manure. So my motto is: If you do what you did, you get what you got. We can't just carry on talking about a sustainable food supply; we have to take concrete steps, practical and scientific ones, to realise our ambitions."

The PCCC

1. *Improves the quality, efficiency and effectiveness of communication of Dutch climate research.*
2. *Provides a surplus value in communicating with policy makers, non governmental organizations, professional users and society.*
3. *Strengthens the scientific information in an objective, businesslike and transparent way.*
4. *Is political neutral.*
5. *Facilitates the search for (scientific) information on climate change.*
6. *Publishes yearly the latest information on Dutch climate in 'De Staat van het Klimaat' (The State of the Climate).*
7. *Facilitates the Dutch website www.klimaatportaal.nl, containing for example current research insights and FAQs about climate change issues.*
8. *Is supported by the Ministry of Housing, Spatial Planning and the Environment (VROM) and fits in the communication strategy of the Knowledge for Climate programme.*

DeltaDialogues:

Joining forces to adapt deltas to climate change



Credit: Bottom Left, Essex Estuary Massachusetts by Dennis Hubbard, Oberlin Top Right, Jacques Desclotres, MODIS Rapid Response Team, NASA/GSFC

We believe that sharing knowledge and joint learning are essential factors in delivering appropriate solutions for densely-populated delta areas.

With the DeltaDialogues Royal Haskoning offers a process innovation to achieve sustainable solutions for climate adaptation.

The Royal Haskoning DeltaDialogues: interactive sessions with experts and decision makers from delta cities working together for the sustainable development of delta areas around the world.

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