UFZ Special

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ DECEMBER 2009

ON THE CASE OF CLIMATE CHANGE

Where humans have attempted to cultivate deserts, they are now struggling against soil salinisation and desiccation. Climate change will make this situation in many regions of the world worse and is already leaving its mark today. The answer to climate change has to be: Adaptation – and at the same time climate change mitigation. The UFZ is using its expertise to contribute to research on the impacts of climate change and the development of adaptation strategies.

HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

CONTENTS

p. 3 Preamble by the Scientific Managing Director of the UFZ

p. 4 – 5 Research on integrated climate change politics

p. 6 – 7 Interview: Achim Steiner; UNEP
We need to come to an agreement about the climate

Chapter 1: Climate change and Water

p. 8 – 9 The future of water

p. 10 Water from the Amudarya

p. 11 Vulnerability to extreme events

p. 12 Learning from the Kalahari

p. 13 Improving regional climate models

Chapter 2: Climate change and Biodiversity

p. 14 – 15 ALARM: Climate change is tearing holes in the web of life

p. 16 Perspectives for extremists

p. 17 Viruses on tour

p. 18 Poisonous prospects

p. 19 Point of view: Bioenergy – Hope for climate protection from bioenergy?

p. 20 – 21 Climate change and sustainable forestry

Chapter 3: Climate change and Socio-economics

p. 22 – 23 Interview: Pavan Sukhdev; TEEB
Vital ecosystems provide greater protection from the impacts of climate change

p. 24 Point of view: The costs of adaptation to climate change remain uncertain

p. 25 Avoiding conflicts – using synergies

p. 26 Point of view: We can't get around coal!

p. 27 Can we dispose of CO_2 underground?

p. 28 On the road to a European adaptation policy

p. 29 Environmental law and adaptation pressure

p. 30 – 31 Information pages

p. 32 Research for the Environment – An Introduction to the UFZ

CLIMATE CHANGE – A CHALLENGE FOR THE WHOLE OF SOCIETY

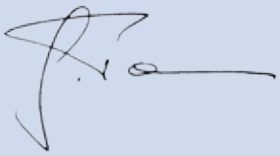
Scientists now agree that the climate is changing – to a large degree also as a result of human actions. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change confirms that an increase in global temperatures between 2 and 4 degrees Celsius over the next 50 to 100 years is unequivocal. Even if the Convention on Climate Change in Copenhagen was to be a success, global warming is here to stay. We are indeed aware that it is not the first time for global warming to occur in the Earth's history but the first time that it is happening at such a pace and with a population of 6.7 billion and an estimated 9 billion by 2050. Experts also agree that climate change will have far-reaching impacts on both humans and the environment that will affect us all either directly or indirectly. Precipitation patterns will change, heavy rainfall, drought and storms will become more frequent and gradual changes will alter our environment permanently. Flowering seasons will be delayed, plant and animal species forced to migrate, streams and river courses will alter, the glaciers will continue to melt and pathogens will spread particularly well at high temperatures finding their way into today's temperate climate zones.

In December 2009, more than 10,000 participants will meet at the Convention on Climate Change in Copenhagen. In addition to climate mitigation, climate adaptation needs to move up on the agenda of the negotiations. Indeed, effective climate change politics must be based on both of these pillars and one will not suffice without the other. As was the case for climate mitigation, climate adaptation will also be a task for the whole of society, calling for action from stakeholders in politics and economics, and from individuals. The former Director of the World Bank, Sir Nicholas Stern worked out that if the rate of climate change does not slow down, then it could cost up to 20 percent of gross global product. According to a preliminary review by Pavan Sukhdev, Head of the TEEB project (The Economics of Ecosystems and Biodiversity), the loss of biodiversity alone could already amount to 6.3 percent of gross global product by 2050. Such figures clearly show that a broad system perspective is imperative.

In Germany the response of the government has been in the form of various research programs as well as the Climate Service Center (CSC) as a central consultation and information interface between science and society. The Helmholtz Association is contributing to the issue by focusing primarily on the regional scale. The Helmholtz Climate Initiative that was established by eight Helmholtz centres, is collating and coordinating first-hand research on processes, collecting and processing data at various levels as well as analysing the effects of climate change e.g. on hydrology, biodiversity and land use.

As Helmholtz-Centre for Environmental Research, the UFZ shows particular competence and experience in analysing complex environmental systems and therefore demonstrates a considerable commitment to the issue of climate change with its broad range of research in the natural and social sciences.

I hope that you will enjoy reading in this magazine about some of the research work that is currently being conducted on climate change at the UFZ.



Prof. Dr. Georg Teutsch
Scientific Managing Director,
Helmholtz-Centre for Environmental Research – UFZ

Thousands of air conditioners for cooling down in offices and apartments – this could be part of adaptation to climate change when the summers get longer and hotter. As true power guzzlers however, air conditioners are at the same time 'climate offenders' helping to drive climate change.
Photo: www.fotolia.de

RESEARCH ON INTEGRATED CLIMATE CHANGE POLITICS

Limiting global warming in the long-term to two degrees will require a worldwide effort. Worldwide carbon emissions would have to start to decrease from next year (2010) – instead of constantly rising as they have done in the past. Even if this change of trend was achieved however, we would still have to count on temperature rises of up to 4 degrees Celsius as a worldwide average on the long road to climate stabilization. Adaptation to climate change is therefore a global necessity.

Adaptation to climate change means that we can reduce our vulnerability to the impacts of global warming. While in Germany we need to be better prepared for heat waves and heavy rain events, in other countries pending dangers will primarily be from a rise in the sea level, extreme water shortages and the loss of sensitive ecosystems such as coral reefs. The countries in the southern hemisphere will carry the brunt of the impacts from global warming, while countries in the northern hemisphere may even temporarily benefit. With increasing global warming however these advantages will turn into disadvantages so that in the long term we will have to deal with worldwide negative impacts from climate change.

Global change – regional impacts

The effects of climate change are showing up at the regional level. Take Germany for example: On a "Business As Usual" path of carbon dioxide emissions a temperature rise between 2 and 3.5 degrees Celsius by 2100 will have to be expected, depending on the emissions scenario and the type of climate model. This warming will mainly affect the variability of precipitation, increasing rainfall in winter and decreasing it during summer. Furthermore, it would cause extreme weather events to increase such as flooding and storms. However there is a high degree of uncertainty for the forecasts of these climate impacts. Therefore considerable modelling and monitoring efforts are to be made, so that more founded forecasts can be made at the regional level. This also applies to the ecological and economic impacts of climate change especially in the most vulnerable regions of this world such as Central Asia, the Middle East or many mega-cities, in which basic economic and social conditions such as income inequality or the level of literacy need to be taken into consideration to assess the impacts of climate change.

Adaptation – the right answer to climate change

There are still large research gaps on how to adapt to climate change and a great deal of uncertainty because many different natural and social factors have to be considered. The UFZ sees this as one of its challenges: to systematically study regional climate change impacts in Germany and in particularly vulnerable regions of this world, to come up with concepts, with which the impacts of climate change can be mastered. It should be the goal of all adaptation measures to minimise the risks to ecosystems, human health and infrastructure. But which adaptation options are available and which are the right ones? How can synergies and conflicts be assessed in order to avoid any direct or indirect negative impacts of allegedly meaningful measures of adaptation? For example, the extensive use of bio-energy as a strategy for reducing greenhouse gas emissions makes us more susceptible to climate fluctuations, and thereby increases social vulnerability. The creation of urban green corridors by comparison helps with carbon sequestration and improves the urban climate. In this respect, climate adaptation and mitigation are not opposed to each other. One without the other would be insufficient. What we need is therefore integrated climate change politics.

Adaptation policies are already taking place at different levels. Since the Earth Summit in Rio (1992) the United Nations has been debating about how to improve adaptation through international measures particularly in the most vulnerable regions of the world. Two per cent of the turnover from the so-called Clean Development Mechanism (CDM) flows into a fund for adaptation

measures for particularly vulnerable countries of the world. This is merely a drop in the ocean. Based on the worldwide need of between 9 and 41 billion US dollars per year (data from the World Bank) the funds from the CDM tax (ca. 180 million US dollars in 2009) are not sufficient by far even with optimistic forecasts for the CDM. Additional funds were promised by the G8 for the countries of Africa, but it is questionable as to whether these funds will actually flow in addition to official development aid or only replace the aid pledges that have been made. Even transferring funds for Africa is turning out to be tough. That is why at the Climate Conference COP 15 in Copenhagen new, effective instruments must be found, in order to cover the enormous future financial needs in the countries of the South.

Thinking globally

The global financial crisis has demonstrated what enormous means can be mobilized internationally within a very short period of time, when there are inherent risks to the world economy. Climate change like the financial crisis is a systemic risk for the world economy – even when this is only in the long run. It would be an act of political wisdom and fairness to future generations to take the financial precautions now that will prepare us for future climate change on a global scale. Here particular responsibility goes to the financial sector following the rescue actions of last year. A Tobin tax (as suggested by US American economist James Tobin in 1972 who proposed a very low tax on all international foreign exchange transactions to restrict short term speculation on currency fluctuations) of only 0.01 percent on all foreign financial transactions alone could raise worldwide funds of 125 billion dollars per year. With that we could reach the order of magnitude of financial means that are actually required for a global adaptation to climate change. This kind of "new green deal" would be more sustainable and currently seems more feasible from a political point of view than an international auctioning of CO_2 emission rights under UN sovereignty. Otherwise we can only hope for corporate philantrophy. Reinsurers and other international enterprises that have accepted global responsibility, can be systematically motivated to additional corporate spending through new forms of "fundraising" e.g. a rating of adaptation projects in developing countries according to their potential for climate change mitigation synergies.

Acting regionally

With its adaptation strategy of 2009, the European Union provided the impetus for a process to work out suitable adaptation strategies at the regional level in different sectors and regions as well as at different levels of forming political will, e.g. the federal, state or municipal level. A preliminary evaluation (see contribution on page 28) shows that effective monitoring and indicator systems are still lacking to control the success of adaptation measures and to effectively coordinate the adaptation policies between the European Community, national governments, regions and municipalities. Looking for synergies and avoiding conflicts will be the key. We will only find effective adaptation policies and measures within the multi-level and multi-sector system of the European Community, if legal, political and economic synergies are sought in line with the objectives of the sectors (e.g. public health policy, transport, agriculture) and if conflicts are avoided. Otherwise the acclaimed EU framework for action on adapting to climate change will remain a declaration of intent. The EU can also show global leadership qualities on this issue.

UFZ contact person:

Prof. Dr. Reimund Schwarze
Dept. of Economics

phone: +49 (0) 341/235-1607
e-mail: **reimund.schwarze@ufz.de**

Further information:
www.ufz.de/index.php?en=15992

Achim Steiner; UNEP
Photo: Klaus-Dieter Sonntag
(www.fotoplusdesign.de)

WE NEED TO COME TO AN AGREEMENT ABOUT THE CLIMATE

Mr Steiner, in December the COP 15 Climate Change Conference will take place in Copenhagen. What are your expectations for the conference?
With only a few months to go, it still remains unclear as to whether the United Nations climate change convention meeting will match the scientific urgency for action. Science is telling us that unless deep and sustained emission reductions on behalf of the developed economies takes place in less than a decade, then greenhouse gas emissions are likely to cause global temperatures that will be beyond the critical threshold of around two degrees Celsius by the end of the century.

In Copenhagen governments must 'Seal the Deal' on an agreement that also puts serious funds on the table that can assist vulnerable developing countries and communities to adapt to the climate change that is already underway while at the same time increasing the technology transfer of low-carbon, resource-efficient technologies.

An agreement that also starts to fund developing economies to conserve rather than clear forests is also needed – if Reduced Emissions from Deforestation and forest Degradation (REDD) can be part of a global climate partnership, it can assist in not only stabilizing climate change but in reversing the rate of loss of biodiversity; improving water supplies; stabilizing soils and perhaps even generating jobs in natural resource management and eco-tourism. REDD underlines the multiple, 'Green Economy' benefits of acting on climate change.

Many experts say that it is above all those countries that contribute the least to climate change, that suffer the most from its effects. What is it that makes it so difficult to implement the goals of climate protection in day-to-day politics? Do we still have the feeling that we are not affected?
You are right in saying that it is continents

UNEP – UNITED NATIONS ENVIRONMENT PROGRAMME

The headquarters of the United Nations Environment Programme are in Nairobi in Kenya. It is the first institution of the United Nations with its headquarters in a less developed country. The director of UNEP from 1998 until the end of March 2006 was the former German Environment Minister Klaus Töpfer until Achim Steiner took the chair in June 2006. The Environment Programme was set up in 1972 as the United Nations „Voice for the Environment". UNEP acts as the catalyst, lawyer, teacher and mediator for environmental conservation and sustainable development. Its tasks range from collecting and evaluating global, regional und national data on the environment, developing political instruments for environmental protection to facilitating know-how and technologies. Some of the main issues that are dealt with include climate change, drinking water shortages, loss of biodiversity, poor soil quality, desertification, damage to coastal zones and oceans, toxic waste and chemicals and atmospheric pollution. The United Nations Environment Programme works closely together with other United Nations Programmes, international organisations, governments, Non Governmental Organisations, industry and civil society.

such as Africa that are responsible for such a small amount of the global greenhouse gas emissions – both in the past and at present – that are set to suffer the most. Africa is naturally a continent with an extreme climate that is in any case prone to extreme weather events such as floods and droughts – and climate change will intensify these patterns.

Meanwhile, Africa and parts of Asia such as Bangladesh, small island-developing states and economies across many parts of the developing world simply lack the financial and institutional capacity to respond at the scale and pace required if climate change is not monitored.

I do believe that an increasing number of people and businesses in the developed and developing world, are increasingly beginning to understand that climate change will affect them and in many cases in quite profound ways. It is perhaps in the area of politics where a blockade is still stalling a transformational change, with some political leaders concerned that action might harm their economies, rather than recognizing that delayed action will become increasingly more costly everywhere.

Treetops of tropical rainforest in Kuranda, Queensland, Australia. Rainforests play an important role in maintaining biological diversity, improving water supplies, stabilizing soils and climate change, and perhaps even in generating jobs in natural resource management and eco-tourism. (Photo: Klaus Henle/UFZ)

In a preparatory meeting for COP 15 there was a warning that climate change will lead to millions of refugees. Where will these people come from, where will they head for and is the global community prepared to deal with this problem at all?
If, as science indicates, the glaciers in mountain regions continue to melt away – in some forecasts many Himalayan glaciers could be gone in the 2030s –then this will reduce many mighty rivers to mere seasonal flows.

Whole economies and ways of life have evolved around these river systems so that many people will simply have no other option than to move away to other regions. Similarly, many people in low-lying areas and on small islands will be overwhelmed by flash storms, which are then followed by a rise in the sea level. In India the situation has become so dramatic that they are already putting up a fence to fence-off Bangladesh. In the Darfur region of Sudan, an assessment led by the United Nations Environment Programme linked the conflict there partly to a reduction in precipitation leading to communities moving into the terrain of others that is already experiencing the problem of scarce natural resources. Is the international community ready for this – they might be aware of this problem, but are they actually ready for it? I believe that the honest answer is no.

How can science contribute to finding the balance between a healthy economic development and climate protection?
Actually, it is science that has really been the key. The consensus-led, peer-reviewed process of the Intergovernmental Panel on Climate Change (IPCC), co-hosted by the United Nations Environment Programme and the World Meteorological Organisation has been the catalyst that has brought more than 190 nations together through the United Nations Framework on Climate Change and its Kyoto Protocol.

It is the fourth assessment report from the IPCC that was published in 2007 that put a final stop to the debate as to whether it is human activity that is causing climate change and its likely and sobering impacts. The IPCC also underlined the fact that the costs of combating the climate will not cost the Earth, but just a small percentage of World Economic Product annually over the next twenty to thirty years.

In this respect we can say that it is science that will bring governments to Copenhagen and therefore science that should be guiding the political decisions that will be made.

Over the course of your career you have lived and worked on different continents. With the problem of climate change in mind, what can people learn from each other?
No one nation has a monopoly on transformative ideas and actions – indeed, we can all learn from each other. A small country such as Costa Rica has underlined the links between deforestation and climate change and established innovative payment schemes between communities and the private sector in order to address this issue. Look at Iceland for example with its determination in the 1980s to harness hydro- and geothermal energy to reduce its dependence on fossil fuels or the energy efficiency of the automobiles developed by Japan over many years or the incredible reforestation projects of China. Or take Germany for example, with its feed-in tariff that transformed its economy in terms of renewable energy, green jobs and clean energy exports: there is a wealth of experience and lessons on how to move to a low-carbon, resource-efficient 'Green Economy' – we simply need to take into consideration and also implement the rich number of experiences and lessons that have been learnt so far.

ACHIM STEINER

Achim Steiner was born in Brazil in 1961 where he grew up and later studied philosophy, politics and economics at the University of Oxford in the United Kingdom. He was awarded his Masters Degree in Economics and Regional Planning by the University of London. During his studies he gained work experience with the German Development Institute (DIE) in Berlin and at the Harvard Business School, after which he worked for environmental organisations at the local level. His commitment to international environmental protection started with his position with the world's largest nature conservation organisation, the IUCN in Washington (D.C.) and Asia. In 1998 he became the Secretary-General of the World Commission on Dams (WCD) in Cape Town. In 2001 he returned to the IUCN as General Director of the World Conservation Union (IUCN) with its headquarters in Switzerland. In March 2006 Achim Steiner was nominated by the United Nations General Secretary Kofi Annan as Klaus Töpfer's succesor for the Office of the Executive Director of the United Nations Environment Programme in Nairobi and assumed office in June 2006.

UFZ scientists take water samples from different depths of the Dead Sea to understand the stratification of the water body and learn about ground water influences. The water level of the Dead Sea goes down every year by about one meter.

THE FUTURE OF WATER

For thousands of years it was the source of prosperity, nourished people and enabled ancient civilisations to prosper. Even today Egypt is almost entirely dependent on water from the Nile. However, in times of climate change and population explosion, the future of water remains uncertain: looking at the statistics, while in the 90‘s 1,000 cubic meters of water per year was available for every Egyptian, in 2030 it will probably only be 400 cubic meters. The catchment area of the Nile extends over ten countries with over a quarter of a billion people. For a decade now neighbouring states have been trying to negotiate a multilateral contract to use water from the Nile as part of a Nile Basin Initiative. This summer the countries postponed the final decision again by 6 months because several issues remained unsolved. The example shows just what potential water has for political conflicts.

Just as in the Nile basin, humans all over the world depend on rivers being effectively managed as important resources for drinking water and irrigation. In industrial regions an unsatisfactory water quality is the main problem, whereas in semiarid and arid regions, water scarceness is regarded as the greatest barrier to development. Climate change and land use, rising population pressure in many parts of the world and an increasing number of extreme weather events will intensify these problems on a global scale. A sustainable management of water resources presupposes that suitable strategies, concepts and measures will be implemented. Water use technologies and management methods must also be adapted to locations. Therefore methods are being developed, which are supposed to help manage such complex systems because adaptation to climate change can only succeed at a regional level.

Water dilemma in the Jordan area

Striking evidence of what happens when a region lives beyond its means can be seen at the edge of the Dead Sea. The river Jordan, from which water is largely being taken for irrigation purposes, feeds this inland sea. The impact is formidable: every year the water level of the Dead Sea goes down by about one meter. Because the water from Jordan can basically not be used any more for drinking water on the grounds of its quality, people have to be supplied additionally with water from deep wells. The ground-water level therefore goes down again and fossil water reserves are drilled that took millions of years to form. “These fossil water reserves will be depleted however in several decades”, Dr. Roland Mueller from the UFZ explains the dilemma. “Therefore there is no way around re-using waste water. If the population is to double over the next few decades, then the management of scarce water resources in this region must change dramatically.” Together with Israeli, Palestinian and Jordanian colleagues, the Helmholtz researchers are therefore looking for ways to stabilize the water supply in the Middle East. As one solution, this autumn a pilot plant was put into operation for waste water purification in Al-Fuhays in Jordan. “If agriculture as the largest consumer of water resources was to use recycled waste water in the future, then that would noticeably take the pressure off scarce fossil resources”, hopes Dr. Tino Roediger, who is investigating methods on the artificial regeneration of aquifers.

Political will is necessary

The fact that German scientists are involved in finding solutions to water problems in the most diverse regions around the world is no coincidence for Professor Dietrich Borchardt from the UFZ, who is coordinating a joint project on Integrated Water Resource Management (IWRM). From all the countries in the world, a mandatory IWRM only exists in Europe, and from those EU countries where it applies, Germany in particular can boast of its success. It is internationally considered to be a country that has succeeded

in setting a high standard. A prime example is the remediation of the Rhine, whose river ecosystem had almost collapsed due to unrestrained economic growth in the 60's and 70's and whose neighbouring states of France, Germany and the Netherlands could not decide on a common effort for protection for decades. "Actually a situation could also have developed here like it is in the Middle East or in the Aral Sea catchment area today. Luckily, this was averted however due to a process of political will. This achievement can not be given enough merit", believes Borchardt.

Critical developments in Mongolia

This political credibility is also a help to researchers in Mongolia. Just as in the Middle East, the urban population there is growing overproportionately. However limits to growth have been set, because the water supply and water disposal of the cities are already insufficient – with dramatic consequences for the spreading of diseases. The quicker that these developments accelerate, the more critical the condition becomes. In addition to that, Mongolia and the Central Asian region belong to some of the last intact expanses of pristine nature. "The Kharaa basin drains into the Baikal Sea, the deepest and oldest lake on earth. Everything that happens in our research area therefore has a direct effect on this unique world natural heritage", describes Dietrich Borchardt. Besides the Baikal Sea there are still a number of other lakes in the region, which are all under nature protection. It is feared that some of these will have the same fate as the Aral Sea and either be altered chemically or shrink away. Indeed, some of the smaller lakes have now already disappeared. By comparison, the water supply will increase in other areas. Nevertheless, that could still mean that life circumstances become harder – for example damp and snow-rich winters that impair the traditional nomadic way of life. Climate change will therefore entail a fundamental change to the living conditions in these rural areas.

Together with his colleagues, Borchardt is developing methods that will enable sustainable development in Mongolia. "In spite of a comparatively low standard of living, the water consumption in urban regions is exorbitantly high. The waste is very distressing. The infrastructures are dilapidated and the means are missing to implement the appropriate technologies to conserve water." The recycling of wastewater would be economical and a part of the adaptation strategy to confront climate change. In this way, groundwater supplies could be enriched or forests supplied with water.

Modern technology alone however will not be able to solve the problem. Concepts are also missing for particularly important source regions. 30 percent of the catchment area produces 90 percent of the water. These "water towers" are areas that would have to be protected on a large scale against forestry, mining, and excessive grazing. Since the end of the planned economy, livestock has increased by around a third for instance. Cashmere goats, sheep and cattle are exported. "The Chinese market takes everything that is produced. Along the floodplains the cattle density is reaching a level, which is not sustainable in the long run. Mongolia has less than three million inhabitants on a surface area that is four times the size of Germany, but probably with about 40 million productive livestock, which are concentrated to such an extent at certain times in the productive floodplains that in the meantime the condition has become critical – with all the associated problems such as overgrazing, erosion, water pollution etc.", waterbody ecologist Borchardt criticizes. "Voices are being raised again for limiting the freedom of private water use again. Upper limits need to be set – even in a free market." This is just one problem, which must be solved on a political level. In this respect, the cultural signs are favourable: Water in this region is a much more pressing topic than in Europe, because water has always traditionally and spiritually been a valuable commodity in Mongolia and each surface water is still used by nomads today as drinking water for humans and cattle. Nevertheless, even here humans need to understand what climate change will mean for them: With more modern environmental monitoring better prognoses will be possible and with these political decisions can be better justified and problems better communicated. Nobody will be helped through pure speculation.

Serenity on the Eroo in the Khentii Mountains of Mongolia. Uncontrolled depletion of forests, forest fires, mining, increased pressure from grazing and climate change will also leave their mark here when not sustainably managed, resulting in over-grazing, soil erosion, water pollution, floodwater and water shortages. (Photo: Dietrich Borchardt)

INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)

A sustainable water resource management should contribute to promoting social and economic development without impairing vital ecosystems and with fair conditions concerning the use of resources. The concept of an Integrated Water Resource Management was already internationally adopted as a mission statement in 1992 with the Dublin Principles and Agenda 21. At present about 800 million humans around the world suffer from a shortage of drinking water and 3.2 billion humans live in conditions without safe wastewater disposal. Until 2015 the United Nations wants to have halved the number of those affected. Therefore the German Federal Ministry for Education and Research has promoted a funding priority, in which IWRM concepts are being developed for 16 selected model regions around the world. The UFZ is involved in the model regions of Jordan and Mongolia and is responsible for coordinating the 16 projects.
www.wasserressourcen-management.de

UFZ contact persons:

Dr. Roland-Arno Müller
Environmental and Biotechnology Centre (UBZ)
phone: +49 (0) 341/235-1275
e-mail: **roland.mueller@ufz.de**
Further information:
www.iwrm-smart.org

Prof. Dr. Dietrich Borchardt
Dept. of Aquatic Ecosystem Analysis (and River Ecology)
phone: +49 (0) 391/810-9757
e-mail: **dietrich.borchardt@ufz.de**
Further information:
www.iwrm-momo.de

Before the Aral Sea collapsed in 1982 the fishing industry used to produce up to 300,000 tonnes of fish annually. In the foreground the Delta of the Amudarya clearly stands out from the Steppe landscape. The Syrdarya and Amudarya tributaries used to feed into the Aral Sea. (Source: The German Remote Sensing Data Centre of the DLR)

WATER FROM THE AMUDARYA

Since Sultanbay Umuratov can remember, water always came from the mountains in the spring bringing life with it into the delta. The river water washed millions of larvae and young fish into the lakes and the catch from fishing always provided Umuratov's ancestors with a modest income on the lower reaches of the Amudarya. Now, when the old man looks out from his bench on the tributary, there is only dry, brown, mud. Until the 60's the delta of the Amudarya was the second largest in the Soviet Union, but then came the decision to expand cotton production. There is hardly any rain on the semiarid plains of Turkmenistan and Uzbekistan – ten centimetres per year at the most. More than ten times that amount evaporates however under hot temperatures and with strong winds in the summer. The snowmelt that the Amudarya carries for several thousand kilometres from the high mountains of Pamir, Tienschan and Hindukusch is the only significant source for irrigating the fields and this was exploited carelessly. Within a few decades cotton production grew tenfold and today over four million hectares have to be irrigated. No wonder that this industry is given top priority in Uzbekistan where it constitutes a third of the national budget.

All of that depends on water from the Amudarya. Not even a tenth of the water is left for the delta and less than a fifth of the once 2,600 lakes still remain – in wetter years. Over one quarter of a million hectares of floodplain forest disappeared in a similar way and no more water has made the 2,500 kilometres to the southern part of the Aral Sea for a long time. It is not only an ecological disaster but also a social one: after the collapse of the fishing industry on the Aral Sea many inhabitants tried their luck upstream. In the remaining lakes commercial fish farms emerged, whose products could become exports again. The Ministry of Agriculture, who shows very little interests for the needs of the fishermen however, now decides just how much water is allowed to flow into the delta. In dry years such as in 2000 and 2001 the water is not even sufficient for the cotton fields. Hence, the lakes dry out. Even in normal years the water level can vary more than one meter. If the water level goes down by half a meter it can dry out the shallow areas of the lake and threaten fish stocks. "The wetlands of the Amudarya Delta however fulfil functions that are vitally important to life", explains Dr. Maja Schlüter from the UFZ. "Fish is both food and a source of income at the same time. Reeds are used as building material and fodder for cattle, wood as a building material and as fuel. The delta is protection against wind and salt storms and apart from that it acts as a buffer to take the edge off dry years." These are sufficient reasons from the scientist's point of view to allow the delta its water. An inflow of water in the critical weeks could support fish production crucially and would cost agriculture very little. At the end of the day however, the interests of irrigated agriculture at the upper reaches conflict with water users at the lower reaches. This kind of case is not unusual as found by the research project NeWater, where Amudarya was one of seven case studies. Climate scenarios for large river catchment areas were compared in Europe, Central Asia and Africa and adaptation measures investigated. For dealing with droughts like for example in the European Tisza and the Central Asian Amudarya that are occurring more frequently, there have been very few solutions so far. It is often ad-hoc strategies that dominate as the development of long-term adaptation measures is promoted very little.

Climate change will intensify such conflicts, because the water from the Amudarya originates to a large extent from glaciers for which forecasts look everything but rosy: In 2050 the average temperature could have risen by three degrees and the shrinking of the glaciers could lead to a 15 percent decrease in river water. An equally enormous amount also seeps out unused from dilapidated canals, or is lost through bad planning or illegal extraction.

"If the interests of different users are better integrated and more flexible management strategies are developed together with a successful increase in the effectiveness of water use in agriculture, then more water could be available to regularly flood the delta", hopes Uzbekian scientist Dr. Gulchekhra Khasankhanova from the Uzbek State Uzgipromeliovodkhoz Institute. This would revive life again in the delta but also provide new options to cope with the potential impacts of climate change.

UFZ contact person:

Dr. Maja Schlüter
Dept. of Ecological Modelling

phone: +49 (0) 341/235-1279
e-mail: **maja.schlueter@ufz.de**

Further information:
www.newater.info/index.php?pid=1010

Flood of the river Mulde in August 2002 in Grimma, Germany (Photo: AP/Eckehard Schulz)

VULNERABILITY TO EXTREME EVENTS

Extreme events surprise us time after time revealing just how vulnerable we are. After the floods of the Elbe, Rhine or Danube and the heat wave in the summer of 2003 this awareness has also become very widespread among the public. "We have found out that the awareness about extreme events is increasing – both among the population as well as the authorities", reports Dr. Dagmar Haase out of experience from several large-scale projects. Why do such events always catch affected individuals, municipalities and organizations "off guard" and how can one reduce or avoid the partially devastating impacts? It is questions such as these that concern a group of scientists at the UFZ.

Some of these questions have been answered through the international research projects Floodmed, FLOODsite, FLOOD-ERA and NeWater. Whether the questions are concerned with research on "their own doorstep" (e.g. Mulde) or in other European river basins (e.g. Theiß), they all come to a similar conclusion: Technical solutions dominate the current protection and adaptation strategies. In flood protection for example there are dykes, concrete dams and flood control basins, which enjoy a high level of acceptance among the population. The social science research that was conducted in the context of the EU project FLOODsite by UFZ scientists Annett Steinführer and Christian Kuhlicke together with colleagues from Italy and Great Britain, also shows the consequences that such technical adaptations can be associated with: Behind the dykes in the protected areas an alleged feeling of safety develops making people complacent to develop their own private flood prevention measures. Shock and vulnerability can therefore go hand in hand again with the next extreme flood. This finding should be given greater significance in risk communication because there is still an enormous gap between the assignment of responsibilities from the legislator and the knowledge of the inhabitants in the endangered areas about what can be done at all.

What will be decisive is how adaptations can be organised in spite of fundamental uncertainties regarding future changes to the climate, the population and the economy. The challenges will be on the one hand to weigh up changes to the risks that are associated with a high level of uncertainty and on the other hand to develop adaptation strategies, to be prepared for these uncertain developments: "Our methods are supposed to help people to adapt more flexibly so that they can become more resistant against frequent changes", states Volker Meyer from the UFZ. Therefore different UFZ scientists are continuing their research in international projects such as CapHaz-Net about drought in Spain, land slide and torrents in the Alps and floods in the Elbe river basin. RISK MAP is investigating how flood risk maps can be improved. Both projects are coordinated by the UFZ.

FLOODCALC

The new EU Floods Directive requires the compilation of risk maps for all larger rivers in Europe. "FloodCalc" was developed at the UFZ enabling a spatially explicit integrated evaluation of all economic, social and ecological flood risks on the basis of data available to the public. It can be used on all PCs without any difficulty. On the basis of flood data and maps showing potential impacts, which display the spatial distribution of criteria over their risk elements in the investigation area, FloodCalc calculates damage maps for different probabilities of flood occurrence. Following that, the economic, social and ecological risk maps are combined. A standardisation of the risks takes place by means of multi-criteria decision rules. The procedure can be transferred to other river basins in Europe (*see Meyer et al. 2008 in Natural Hazards, www.springerlink.com/content/5u76v2381t05771h/*).

UFZ contact person:

Dr. Volker Meyer
Dept. of Economics

phone: +49 (0) 341/235-1641
e-mail: **volker.meyer@ufz.de**

Further information:
FLOODsite: www.floodsite.net
RISK MAP: www.ufz.de/index.php?en=18469

To find out where nitrate in the ground water of the Kalahari comes from, UFZ technician Martina Neuber tests groundwater samples by combining isotope hydrological and chemical methods in the laboratory.

LEARNING FROM THE KALAHARI

How climate change causes nitrate values in the groundwater to increase

The long journey to the Kalahari was worth it for Dr. Susanne Stadler: In a case study on Botswana she was able to demonstrate that there is a relationship between the more frequently occurring change over the last millennium from a predominantly wet to a dry climate and nitrate content in the groundwater. This is not only a problem in Botswana, but also for existing or future semi-arid and arid regions around the world. For her PhD thesis Susanne Stadler from the Leibniz Institute for Applied Geophysics in Hanover cooperated closely with scientists from the UFZ. "We are investigating water resources and the carbon cycle, sulphur cycle and nitrogen cycle that are associated with them" explains Dr. Karsten Osenbrück from the UFZ, who was involved in the research. An integrative approach was used in this study, combining methods from hydrogeology, groundwater chemistry and isotope hydrology to identify the sources of nitrate in the Ntane sandstone aquifer in Botswana.

Investigations in densely-populated areas like the Gaza Strip had shown that fertilizers and waste water can cause the nitrate values in the groundwater to rise in such a way that they pose health risks to the population. But just how does the nitrate content in groundwater change in areas where the influence from human activity is absolutely minimal? This is the case in the unpopulated Kalahari Desert, most of which covers Botswana. The Kalahari is classified as a dry savannah. Its characteristic extensive dune system was stabilized by the growth of vegetation during a wetter climate phase in the recent geological history of the Earth (approximately 10,000 to 20,000 years ago). Grasses, thorny shrubs and acacia trees dominate the landscape and can also survive with extremely low levels of precipitation. The small population of humans living in the Kalahari keep herds of cattle, which graze on the areas where vegetation and the water requirements for both humans and animals have to be met exclusively from the groundwater.

Natural causes

In their investigations Susanne Stadler and her fellow researchers found out that the groundwater in some places exhibited very high concentrations of nitrate that were clearly above the limit of 50 milligrams per litre set by the World Health Organization. "This is down to natural causes", ascertains Stadler. There are e.g. termites that in some cases may burrow right down to the groundwater level. These insects encourage a fungi to grow and feed on its secretions. In order to feed this fungi they bring plant remains containing nitrogen into their nests. This behaviour on its own does not pose any significant danger. It is climate change however that negatively affects the water quality: Hydrochemical and isotope-hydrological investigations of groundwater samples showed a relationship between nitrate concentrations and groundwater age. Over long, dry periods the groundwater is hardly replenished, hence the system "is not flushed" as well. The water quality is reduced because the same amount of nitrate is diluted with less water. "The drier it gets, the higher the concentration of nitrate will be that we will find locally", summarizes Karsten Osenbrück. In this respect the Kalahari and some regions of Europe are no longer so far apart: Through a further decrease in the amount of precipitation, the anthropogenically-caused problems that already exist could be intensified even further by increased nitrate values. In the ecological report 2008 for the Canton of Zurich in Switzerland for example, it was pointed out that particularly dry years led to a temporary mobilization of nitrate and thus higher concentrations of nitrate in the groundwater in agricultural areas. According to the report it is the deregulation of greening of fields in winter that are to blame.

"If we want to be able to make better forecasts for the development of the groundwater quality then we will have to consider the natural and man-made components", says Osenbrück. A task which is worth the trouble and labour of undertaking research in the hot and dry Kalahari Desert.

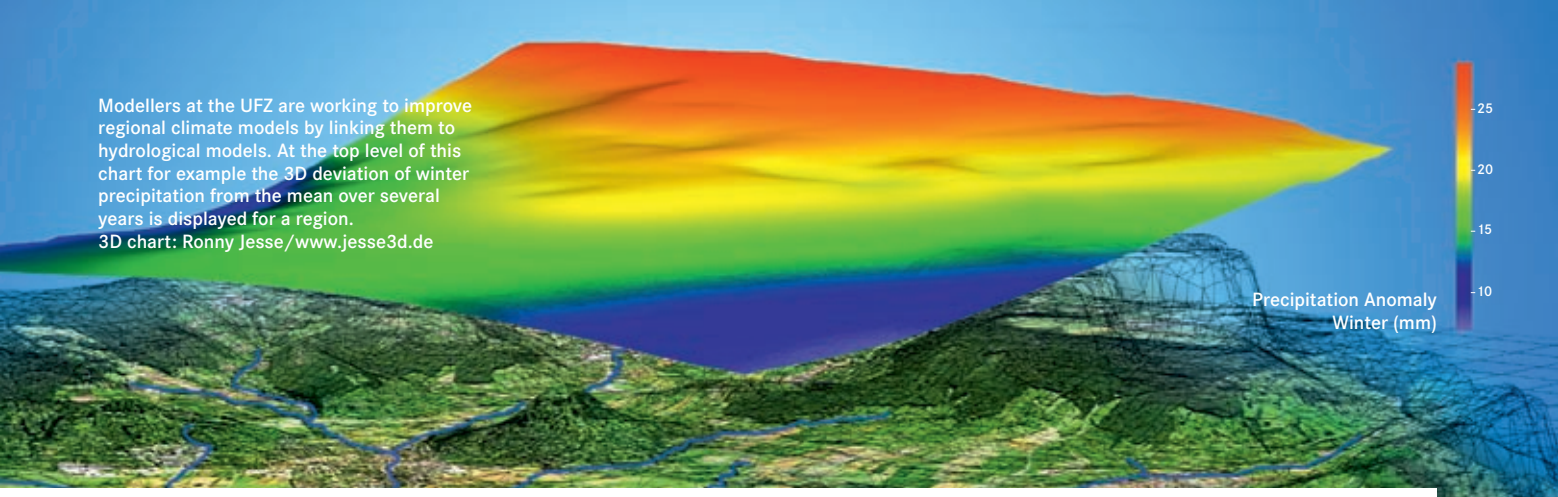
UFZ contact persons:

Dr. Karsten Osenbrück
Dept. of Isotope Hydrology

phone: +49 (0) 345/558-5207
e-mail: **karsten.osenbrueck@ufz.de**
Further information:
www.ufz.de/index.php?en=703

Dr. Susanne Stadler
Leibniz Institute for Applied Geophysics (LIAG), Geozentrum Hannover

phone: +49 (0) 511/643-3545
e-mail:
susanne.stadler@liag-hannover.de



Modellers at the UFZ are working to improve regional climate models by linking them to hydrological models. At the top level of this chart for example the 3D deviation of winter precipitation from the mean over several years is displayed for a region.
3D chart: Ronny Jesse/www.jesse3d.de

IMPROVING REGIONAL CLIMATE MODELS

"Even with the best climate model we won't be able to predict the amount of precipitation or the hours of sunshine for July 2027 on Sylt or in the Alps. A reliable weather forecast with weather models is currently possible for a period of 7 to 10 days and even then it still has a large degree of uncertainty", explains Dr. Matthias Cuntz from the UFZ. Climate models have their limits just as any model does. Their results are not reliable forecasts, but pure calculations, which are only as good as the data and assumptions they are based on. They should help to detect possible trends in climate change and give a weighting to individual climate factors. "That is why we speak of climate projections and not of climate forecasts", the physicist adds.

Climate models belong to the most complicated models with the most elaborate calculations to simulate the Earth and its physical properties. They attempt to take into account as many relevant components and reciprocal effects as possible from the atmosphere, the oceans and the Earth's surface and to couple these with one another depending upon the hypothesis at hand. In spite of high performance computers and a simplified image of the climate-relevant processes, the computer performance required is so high that the spatial resolution of global climate models lies between 50 and 250 kilometres. "This is not high enough to estimate the impacts of climate change for countries or regions and to develop appropriate adaptation concepts. Small-scale processes or extreme weather events fall through such a coarse grid", explains Professor Dr. Sabine Attinger, UFZ expert for modelling hydrological systems. If for example, we want to estimate how future water resources will be distributed on land both spatially and temporally, then both hydrological as well as regional climate models must be implemented, improved and coupled with one another. "We are still at the very beginning. It is only very recently that regional climate models have been able to work at all with small grids of around 10 km. For a long time they were around 50 km, which is simply too coarse for hydrologic models", states physicist Sabine Attinger. On the contrary, it is only in recent years that UFZ scientists have developed numerically efficient schemes for hydrologic models that are able to regionalise vertical processes to larger scales, which are important for climate models, such as the dynamics of soil moisture or plant transpiration. With this it is now possible in principle to link climate and hydrologic models with one another and also to project hydrological as well as climate scenarios.

Forecasts for regional and local hydrology are only accurate, however, if local and regional precipitation data is correct. This input should not be statistical but actually occur at the right place at the right time. This is where there is often a problem in producing hydrological forecasts: climate scenarios supply statistical statements about future weather conditions such as the amount and frequency of extreme precipitation, but unfortunately not the time and place of their occurrence. In order to understand this, one must clarify how climate models are fitted: Climate models as well as hydrological models are firstly compiled using data from the last 50 to 80 years and then measured as to how well they reproduce the past. Regional climate models only calculate one particular region and are embedded into global climate models (dynamic downscaling). Alternatively one can also impose the large-scale processes such as high/low pressure areas in regional climate models (nudging). In both cases the models are influenced from outside and should reproduce observations. Subsequently, scientists allow the model to calculate 100 years into the future – without the parameters of observed temperatures, wind or pressure so that the model is free to calculate and generate its "own" weather. Since the weather behaves erratically, no exact forecasts can be made, but only statistical statements. For this reason scientists are not able to provide exact hydrological forecasts. They are only able to compute hydrological scenarios and their probabilities.

In spite of these many restrictions, scientists hope of course to reduce uncertainties in model projections by linking hydrological and regional climate models. In turn, the results and methods from regional climate modelling will flow into the calculations of global climate models. In this way such calculations will become more precise in the future.

UFZ contact persons:

Prof. Dr. Sabine Attinger
Dept. of Computational Hydrosystems
phone: +49 (0) 341/235-1250
e-mail: **sabine.attinger@ufz.de**

Dr. Matthias Cuntz
Dept. of Computational Hydrosystems
phone: +49 (0) 341/235-1071
e-mail: **matthias.cuntz@ufz.de**

Further information:
www.ufz.de/index.php?en=4658

Nobody can estimate what bees, or other pollinating insects such as bumble bees, hover flies and butterflies are worth. Scientists have worked out however, just how much they provide us with: fruits, nuts and spices that depend on pollinators costed the global economy around 153 billion Euros in 2005.
Photo: www.istockphoto.com

ALARM: CLIMATE CHANGE IS TEARING HOLES IN THE WEB OF LIFE

In the EU project ALARM scientists from 35 countries have for the first time, developed methods to systematically document the biodiversity in European landscapes and to identify decisive factors in the observed loss of species. As it turns out regional climate change is driving the dynamics, although land use and chemicals in the environment also have important effects. The impacts from species loss are complex and difficult to estimate. In the case of pollinating insects the loss leads to poor harvests, which can also be valuated in monetary terms.

"Biodiversity is just as important as the climate, when food supply for mankind is at stake. The thing is that we are still lacking data with a high enough spatial and temporal resolution for so many animal and plant species to be able to project more precisely just how ecosystems will develop", explains Josef Settele from the Helmholtz Centre for Environmental Research – UFZ. The EU project ALARM has succeeded in creating a preliminary overview of important habitats throughout Europe along with their specific problems. ALARM stands for "Assessing LArge scale environmental Risks for biodiversity with tested Methods". Settele coordinated the EU project in close co-operation with six colleagues, and it was funded by the European Union between 2004 and 2009 with approximately 14 million Euros (total budget ca. 24 million Euros); altogether scientists from 35 countries and 68 partner organizations (including seven small and medium-sized enterprises) worked within the project. Core results will be published in early 2010 in an extensive atlas.

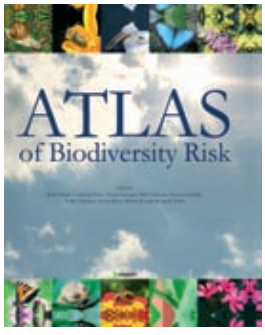
Winners and losers

Within ALARM scientists developed uniform methods that for the first time quantitatively assess large-scale environmental risks to biodiversity for various landscapes across Europe. One driving force is regional climate change, which forces flora and fauna to adapt to new conditions extremely rapidly. In addition to that climate change favours the invasions of alien plant and animal species, which can displace native species and cause considerable expenses as pests in forests and fields. Furthermore, there is the increase in soil sealing, road networks that are becoming increasingly denser and the intensification of agriculture. Environmental chemicals from agriculture and industry also very subtly influence the reproduction rates of insects and invertebrates, which are then eaten by vertebrates such as birds. However, it is the interaction of all of these factors that will make the real difference and bring about species loss at the end of the day.
"The question as to whether climate change is actually good or bad for species, cannot be answered that simply as there will be winners just as there will be losers. For example from approximately 300 butterfly species in Europe around 70 species will benefit whereas the other 230 most likely won't", says Settele.

Insect diligence

Pollinating insects such as bees, bumble bees, hover flies and butterflies play a

ATLAS OF BIODIVERSITY RISK



Initiated and produced in the context of ALARM the "Atlas of Biodiversity Risk" will be published in early 2010. Within eleven chapters core topics of contemporary biodiversity research will be presented: climate change, land use, environmental chemicals, biological invasions, loss of pollinators, the impact of socio-economic factors and combined effects of these and further pressures. Finally an outlook on potential future biodiversity research priorities will be presented. *Pensoft Publishers (Sofia, Bulgaria) ISBN: 978-954-642-446-4 / ISBN e-book: 978-954-642-447-1*

particularly crucial role in ecosystems. The fact that pollination has decreased in many landscapes throughout Europe has already been observed for some time. In the case of crops this leads to harvest losses, whereas for wild plants it can mean a lower reproduction rate and possibly even risk of extinction. Indeed the main carbohydrate suppliers such as rice, rye and wheat use wind for pollination, but approximately seventy percent of crops, among them fruit trees, hazel nut bushes and other vitamin suppliers depend on insects to develop fruits. "We cannot say what the value of bees is, but we can say what value they provides us with" Josef Settele believes and adds: "For example, in 2005 the global purchase value of fruits, nuts and spices that depend on pollinators was 153 billion Euros." This simple calculation even underestimates impacts, as usually when harvests are poor prices increase. In a worst-case scenario workers with brushes would have to take over the work of the pollinators, as it is already standard practice on cocoa plantations. It is results such as these from ALARM that flow into the TEEB report (The Economics of Ecosystems and Biodiversity), headed by the British economics expert Pavan Sukhdev and to a large extent coordinated by a working group at the UFZ (see also pages 22/23)

It is through ALARM that the current distributions of many pollinating insects have been documented accurately for the first time ever. The problems of bee colonies that are endangered by viruses and parasites have been known for a long time, but now there are new insights into wild bees, bumble bees, hover flies and butterflies. "The problem is that we didn't have very good data for a long time, in particular for common species such as the peacock and the tortoiseshell butterfly, which are not that interesting to specialist researchers", explains Settele. Therefore a UFZ team together with the German society for butterfly conservation (GfS) is coordinating a network of approximately 600 volunteers, who regularly walk line transects to count butterflies. "When the TV channel ZDF talked about our project on German TV people even started registering online during the programme through www.tagfalter-monitoring.de", Settele recalls. Together the voluntary conservationists can supply very valuable information, also on migration patterns for example, which can be quite accurately documented. The first analyses point to the fact that 2009 was a relatively good year for butterflies – but some normally very common species such as the tortoiseshell or the small heath were not recorded as often as in previous years. "We still need to collect and analyse this data over several years however to come to any scientifically sound conclusions", stresses Settele.

Maps on biodiversity

In the Atlas of biodiversity risks ALARM researchers have now also combined for example the distribution ranges of certain plants with IPCC climate scenarios and maps of land use, to document where certain butterflies have good chances of survival both at present and in the future. There are some butterfly species, for example the Blues, which can only survive in a unique symbiosis with ants which is only possible with certain kinds of grazing or certain mowing regimes. "With these maps it is clear to see which areas need to be managed with particular attention and we can also see where conservation management could be transferred from the south to the north, if climate change progresses." That sounds plausible, but it is a new idea, which is being systematically pursued through the research project CLIMIT (see page 16). "Climate researchers in the meantime have developed a closely-knit network of gauging stations, which deliver data every hour and minute. We still do not have anything of that kind for biodiversity and it does not just work automatically. That is why the conservation volunteers are so important, who collect data so that we can get some kind of idea of what is happening and which factors are driving the development" says Settele.

UFZ contact person:

PD Dr. Josef Settele
Dept. of Community Ecology

e-mail: **josef.settele@ufz.de**

Further information:
www.alarmproject.net

Specimens of the British *Maculinea arion* from the archives of the butterfly collection at Oxford University's Museum of Natural History, England.

PERSPECTIVES FOR EXTREMISTS

Clever landscape management could improve the chances of survival for many plant and animal species that are threatened by climate change. The creation of small oasis-like habitats that buffer temperature changes might then counteract a moderate climate change and give threatened species the opportunity to have more time to adapt and/or – if corridors between habitats are available – to migrate to cooler areas. This conclusion was drawn by UFZ-scientists from a British investigation on the conservation of the Large Blue *(Maculinea arion).* This butterfly species became extinct in the UK in 1979 and was reintroduced there 25 years ago. Since then this species serves as a prime example for the conservation of threatened insects.

The Large Blue belongs to a butterfly family with around 6,000 species worldwide. In 75 percent of these the caterpillars associate with ants. Compared to the behaviour of the blue butterfly, the insidious subtlety of the Trojan horse was nothing: the blue butterflies of the *Maculinea* genus ensure that their larvae are recognised by particular ant species as members of their own nest. They are carried off by these ants into their nests where they are "adopted" as their own larvae and either fed or allowed to feed insatiably. Semi-natural meadows are the setting for this spectacle of nature, where particular ant species build their nests underground. "The Blues are genuine extremists among the butterflies", asserts Josef Settele. Over the course of evolution, what was once a symbiotic relationship has evolved into an almost purely parasitic one with the *Maculinea* butterflies. All in all a perfect survival strategy.

However they seem to be doomed as a result of this very specialisation: Climate change and altered land use patterns are destabilizing the sensitive association between the species. In the European project CLIMIT (CLimate change impacts on Insects and their MITigation) that is coordinated by the UFZ, scientists are investigating these habitats and mapping out management scenarios for the future. "In this way we can allow the knowledge from previous projects such as ALARM to flow into this project", says Settele (see pages 14/15). "Butterflies are good indicators – they react directly to environmental changes and enable us to draw conclusions about overall developments", explains the agroecologist. Researchers from the UFZ, the UK, France, Italy and Sweden will make further use of this information: They are investigating the effects of climate changes and changes to other influential factors such as land use for some of the most threatened insect species in Europe that have an "association" with ants. Which conditions are necessary for the survival of species? To what extent can they adapt within their habitats and how much time will be required for this? Will there be a shift in migration patterns? Where will the acute threats be?

In the next step, model scenarios are being mapped out for the decades to come and recommendations for conservation action plans and policies are being formulated. The goal is at least not to allow the conditions of the populations to get worse. "Climate change can be outsmarted through targeted management by – for example – allowing meadows or dry grasslands to grow higher than average and therefore resulting in a less serious change to the micro-climatic conditions for the ants than is otherwise to be expected due to the macroclimatic changes", according to the project coordinator Elisabeth Kühn. "That might sound trivial, but it is the best example of how it is possible to buffer climate change through a change in management to give many species the time they need to adapt or to migrate." Should this succeed, then even the most extremist of butterflies will have good perspectives – ideally before they become extinct in the wild and have to be reintroduced.

UFZ contact persons:

PD Dr. Josef Settele
Dept. of Community Ecology
e-mail: **josef.settele@ufz.de**

Elisabeth Kühn
Dept. of Community Ecology
phone: +49 (0) 345/558-5263
e-mail: **elisabeth.kuehn@ufz.de**

The Bluetongue virus is particularly life-threatening for sheep. Humans cannot become infected. Meat and dairy products can be consumed without any danger to health.

VIRUSES ON TOUR

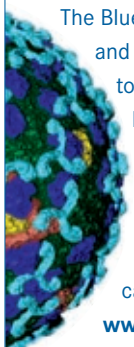
Due to climate change, international trade and tourist traffic, new epizootic diseases could soon be introduced to Germany. In an era of globalization it is not only goods and people that travel around the world, but also viruses, bacteria and vector insects. These are easily able to overcome the distances between the continents in tourist suitcases or in containerised freight with the transportation of livestock and plant deliveries. Fortunately, the "stowaways" are not able to spread everywhere. Experts do fear however that climate change will pave the way for some notorious diseases in new areas, as many pathogens and their vectors can spread particularly well in warmer temperatures.

"In Germany too, there are a couple of very dangerous diseases lurking just around the corner", says Dr. Hans-Hermann Thulke from the UFZ. What would happen if they managed to to cross the border? How will they spread? What can we do about it? UFZ researchers are using computer models to answer these questions but so far emerging diseases have often behaved very unpredictably. This has also been the case with the Bluetongue virus, which is life-threatening for sheep in particular. The ruminant epidemic has its origins in regions south of the Sahara, but in recent decades it has spread north reaching the south of Europe. Epidemiologists from the Friedrich-Loeffler Institute (the Federal Research Institute for Animal Health) had also counted on it arriving in Germany at some point. Nevertheless it still came as a great surprise when in the summer of 2006 some sheep actually contracted the virus in Aachen in the west of Germany. From at least 24 different strains of the Bluetongue virus, these animals contracted the serotype 8, which does not occur at all in the south of Europe. Therefore the epidemic could not have simply spread further north from the Mediterranean in the course of climate change. "How the virus was really introduced into Europe is still unknown to us today", says Elke Reinking from the FLI.

The climate is just a small part of the puzzle in the complicated picture of pathogen migrations. In any case, the pathogens require a favourable means of transport as well as suitable vectors and victims at their destination. If these factors are available then increasing temperatures could help them to advance. "All of these very complex associations are extremely difficult to see through", says Hans-Hermann Thulke. "That is why we want to re-enact the spread of the Bluetongue virus in Central Europe on the computer, in order to examine how diseases conquer new areas". Perhaps regularities will become visible that could be useful in implementing counter-measures as effectively as possible.

Perhaps worst-case outbreak situations could then be prevented if other diseases such as the African horse sickness came to Germany. The effects of an outbreak of this disease were already experienced by Spanish horse owners at the end of the 1980s. On the famous breeding farms in Andalusia at that time, numerous animals were lost due to infection with that pathogen. In the meantime it is well-known how the epidemic came to Spain: a single infected zebra was imported for the zoo in Barcelona.

BLUETONGUE VIRUS



The Bluetongue virus is an insect-borne viral disease of ruminants such as sheep and cattle, which is transmitted by biting midges. The pathogen is the Bluetongue virus (abbreviated as BTV). So far at least 24 different serotypes are known. It owes its name to its most distinctive symptom: the tongue of the animals takes on a blue discolouration when the virus is first contracted. Further symptoms are fever, oedema, breathing difficulties and ulcers. The most susceptible and worst infected ruminants are sheep and above all lambs. In Germany a vaccination has been obligatory for sheep, goats and cattle since 2008.

www.ufz.de/index.php?en=18943 (FLI Oct. 7th 2009: New Risk analysis for Germany on continuation of mandatory vaccination against BTV-8)

UFZ contact person:

Dr. Hans-Hermann Thulke
Dept. of Ecological Modelling

phone: +49 (0) 341/235-1712
e-mail: **hans.thulke@ufz.de**

Further information:
www.ufz.de/index.php?en=14377

A warmer climate will lead to growing populations of pests and an increased use of insecticides. This will have impacts on the environment, not only on waterbodies, ground water and soil but also on the organisms, which they contain.

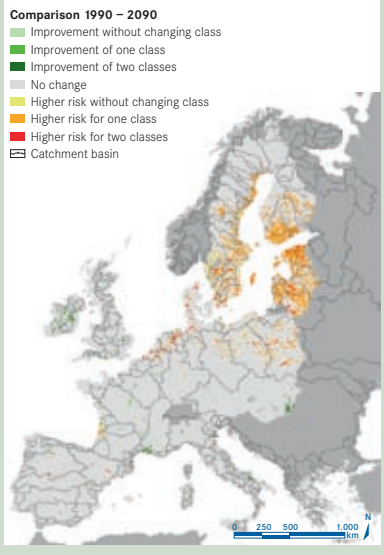
POISONOUS PROSPECTS

How climate change causes the use of pesticides in agriculture to increase.

First the good news: with rising temperatures increasingly more land in higher latitudes around the world will be able to be used for agriculture. Regions that were previously considered to be too cold will come into consideration again for the cultivation of cereals or vegetables. However, a warmer climate also makes it easier for populations of pests to flourish, therefore leading to an increased use of pesticides in this respect. The rise in average temperatures will have particularly serious consequences in the North of Europe: in countries such as Sweden, Denmark or Finland the increase in insect pests due to a rise in the temperature is likely. "This is because in countries of the northern hemisphere the temperature is a limiting factor for many insect species", explains Dr. Matthias Liess from the UFZ. This does not only apply to insect pests. At the beginning of August 2009 there were numerous media reports about anomalous plagues of mosquitoes in Sweden, which had assumed threatening proportions.

For agriculture the answer is simple: the higher the average temperature, the greater the impact from the pests and consequently the higher the need to use pesticides. "If for example the annual average temperature in Finland is the same as here in Germany, then approximately the same amount of pesticide would be required there as in this country today", concludes Liess. Pesticides however do not only fight pests, but can also kill other, sometimes useful, insects. Because it is only the extremely insensitive insects that survive, the natural equilibrium can soon become disrupted from the use of pesticides and not just in those areas that are used for agriculture. Beyond that, insecticides build up in the environment, damage other organisms and cause elevated concentrations of poisonous substances, particularly in watercourses. For the flora and fauna inhabiting these areas, multiple impacts result from larger quantities of pollutants and rising water temperatures. Matthias Liess and his colleagues at the UFZ are investigating these associations and projecting future scenarios of the effects on ecosystems from pesticides used in agriculture. "The goal of the research project is to predict the future impacts and ecological risks to the fauna of watercourses in Europe", says Liess. Based on current climate scenarios, the exposure and the ecological risks from pesticides on the ecosystem are being modelled and represented as a risk map for the North of Europe and Central Europe. From this it is apparent how the use of insecticides and fungicides will increase because of rising temperatures and thus rising pressure from pests. Surface water run-off through heavier precipitation events will furthermore facilitate the influx of pesticides into streams. Agriculture has to face up to these altered climate conditions. Alternative ways are required in order to keep the ecological and health impacts low while bringing economic interests in tune with sustainable agricultural practices. In order to reach the goal that was formulated among other places in the EU Water Framework Directive as achieving a "good" chemical and ecological water quality, prudent management measures not only have to be implemented in water management, but also in agriculture.

The risk map for Central and Northern Europe shows a change in ecological risk due to insecticides from 1990 to 2090. It can be clearly seen that above all in the northern part of Europe – in Scandinavia and in the Baltic States – a decrease in environmental quality due to a growing implementation of insecticides in agriculture is to be expected.



UFZ contact person:

Dr. Matthias Liess
Dept. of System Ecology

phone: +49 (0) 341/235-1578
e-mail: **matthias.liess@ufz.de**

POINT OF VIEW: HOPE OF CLIMATE PROTECTION FROM BIOENERGY?

Professor Dr. Erik Gawel is the Deputy Head of the Department of Economics and Director of the Institute for Infrastructure and Resource Management at the University of Leipzig. His main fields of research are Environmental and Institutional Economics as well as Public Economics. Current research issues are the conception of sustainable bioenergy strategies and the economics of climate adaptation.

phone: +49 (0) 341/235-1940
e-mail: erik.gawel@ufz.de

Renewable energy from biomass is still considered to be a beacon of hope. On the one hand, in terms of climate change policy, it promises a significant reduction in greenhouse gases. At the same time it taps into additional energy sources, which are urgently needed to satisfy the insatiable worldwide demand for energy. Unlike energy that is generated from solar and wind power, biomass is constantly available and can be applied very diversely – not only for the generation of both heat and electricity but also as a fuel. Moreover, biomass reduces the dependency on fossil fuel resources that are becoming increasingly more scarce and their immanent price escalations. Traditional agriculture and forestry economies are hoping for a new increase in demand from bioenergy markets and the national economic policy has sensed a profitable business from exporting biomass technologies and additional value added for rural areas that are economically underdeveloped. With this background in mind it is hardly surprising that over recent years politics have put a greater onus on the extensive development of bioenergy.

Problems arising from land use change

The sparkling image of the miracle solution for climate and energy policies has been bruised however: Bioenergy is suddenly being criticised for putting the ensured food supply of an increasing world population at risk due to the redesignation of agricultural production factors for the production of energy. Beyond that, with an uncontrolled production of bioenergy, global land use changes could arise that could encroach upon important ecological subjects of protection such as biodiversity, the water supply and soil integrity or the socio-economic living conditions of those people living in bioenergy regions or even the desired climate neutrality itself, as long as the conversion of land for biomass and the processing of biomass release more, rather than reduce the amount of CO_2 that would be released from using fossil fuels over the same period of time. Indonesian palm oil grown on land converted from rainforests and used in this country as "Bio-diesel", which also further delays the urgently needed change to electric mobility, has become the epitome of a bioenergy policy that went dramatically wrong.

Uncertainty has arisen: What can bioenergy really achieve for climate protection? Are the side effects uncontrollable? Which forms of use and application can really be considered as being sustainable? International research must quickly provide the knowledge that is required so that switches can be made to a sustainable use of bioenergy and erroneous developments avoided. The search for synergistic options thus becomes the key to success for the climate protection strategy "bioenergy": We need options for the production of bioenergy that are both environmentally and ecologically sound, that avoid utilisation conflicts and prove to be sustainable in the face of climate change.

Research goals: Comprehensive solutions

To achieve this, scientists from different research fields at the UFZ are pursuing an extended research approach: They are investigating the reciprocal effects of energy production from biomass with the ecological, technological and socio-economic aspects of land use, looking for sustainable bioenergy options and devising suitable governance instruments for each case. Thus existing and new bioenergy systems are being systematically analysed in terms of their energy efficiency and climate balance, but also for their effects on biodiversity, water and soil – taking into account climate change in each case. With the help of experiments and modelling, the understanding of the complex associations between ecosystems, climate effects and energy output can be improved on a regional scale. Simultaneously, researchers are investigating the effect of political incentives for the promotion of bioenergy in connection with global markets on land use decisions and their consequences for nature and the environment. This enables conclusions to be drawn on the sufficient creation of governance instruments and avoids providing the wrong incentives. Finally, biotechnologists are working on increasing energy and land-use efficiency for different forms of sustainable bioenergy. One example of this is the production of bio-methane from perennial cellulosic energy plants (e.g. Miscanthus sp., poplars) to feed into the natural gas power network. The research work is being conducted in close co-operation with the German Biomass Research Centre (DBFZ), which has many years of technological and system-analytical expertise in this field.

Bioenergy as a component of a new climate protection strategy

This research work contributes to developing strategies for the integration of climate protection in complex global land use decisions. In particular the climate-sensitive disposal of the resource "land" must consider climate effects in the future. On the other hand it requires the improved integration of the climate driver "land use" into international climate policy. Here a sustainable bioenergy production can contribute to both the mitigation of CO_2 emissions as well as adaptation to climate change.

CLIMATE CHANGE AND SUSTAINABLE FORESTRY

From oak chains, lineages and welcome rain.

Our forests need to change: If they are to cope with the effects of climate change such as a rise in temperature and changes in precipitation levels as well as the impacts from pollutants, then new concepts will be needed for Germany's forests of tomorrow. "The challenge will be in developing and implementing suitable strategies and regulations that minimize risk and protect ecosystems and biodiversity", sums up Andreas Werntze from the UFZ. In the context of the funding priority "Sustainable Forestry" of the German Federal Ministry of Education and Research (BMBF) that ends in 2010, several joint research projects are concerned with this very problem. Andreas Werntze is a specialist for the forest-timber chain and is actively involved in the scientific moderation of the BMBF programme. He is particularly pleased with the many realistic and very concrete approaches to solutions that the large-scale research programme has achieved over the five years that it has been running. Take for example the joint research project *Oakchain*, in which fundamental experiences were gained from restructuring a forest by planting Sessile oaks in northeast German lowlands.

Oak chain makes Scots pine forests stronger

In the northeast of Germany it is beech and beech-oak forests that dominate the landscape. In regions with less precipitation there used to only be monoculture pine forests that were ecologically restructured after 1990 and primarily interspersed with Sessile oaks. The goal of restructuring these forests was to create mixed forest stands that were less susceptible to risk but more ecologically valuable. However it is not that simple: with a dry climate, worse nutrient absorption and poorer water retention ability of the soils, the Sessile oaks cannot grow optimally. Until now there has hardly been any practical experience or scientific research like this on the restructuring of forests. The BMBF joint research project Oakchain now treats the key parameters in the context of changing climate conditions in an interdisciplinary manner: the ability of trees to adapt genetically, carbon sequestration, phenology and vitality, reaction of the stands to stress from increased droughts as well as threats from biotic pathogens are all considered. In doing so it is possible to make some predictions about the adaptability of mixed oak-pine woodlands under changing climate conditions in the future. However, it is not only about finding the best mixed tree stand combination for the climate conditions of the future but it is also about convincing forest estate owners: Pine woods can be harvested for the first time after approximately 30 to 40 years, whereas with oaks one has to wait approximately 100 years. Therefore a fundamental reorientation is also required for forest users. "With respect to site conditions, theoretically the impacts from disasters after bad weather, i.e. devastating storms such as Kyrill with vast areas of destruction could be used as an opportunity for sustainable reforestation", stresses Andreas Werntze. That much, researchers already know – mixed woodlands with oak-pine stands are better suited to outsmart climate changes and apart from that to stabilize the ecological balance. In the context of Oakchain management, recommendations for mixed woodlands with oak-pine stands are being compiled, which should ensure sustainable forestry practices. The basis of these are investigations on biodiversity, site conditions, nutrient supply from soils and trees, upper and underground growth of the tree stands, compe-

On so-called plantations with a quick turnover, investigations are taking place on the success of quick-growing tree species such as poplars and willows in terms of cultivation, harvest and biomass utilisation on agricultural sites. Scientists are therefore accompanying the practitioners from suitable saplings to harvesting machines, from site selection to economic and ecological audits.

tition between the two tree species as well as the quantity and quality of the resulting wood. This information is then integrated into a decision support system (DSS) that provides recommendations for the sustainable management of mixed tree stands. Not lastly, innovations are being developed within the transdisciplinary project in the fields of wood use and wood logistics, which will substantially improve the future capacity of the timber industry: this will range from new applications for oak small-dimensioned wood, via the production of oak thermowood, and innovative marketing instruments to improved forestry operations, which are supposed to significantly reduce the costs of this sector.

Diversity as an answer to uncertain conditions

Similarly, in the northeast of Germany scientists are actively involved in BMBF's joint research project *NEWAL-NET* (the sustainable development of forest landscapes in the northeast German lowlands). "How can forests be prepared for climate change? Which tree species should we plant now so that our grandchildren and great-grandchildren can still experience intact forests?" are central issues of this research. Unfortunately, climate models today can only make forecasts for the next 50 years, but trees live substantially longer. In order to cover many future climate eventualities, it would therefore seem advisable to draw on a large degree of biodiversity from the forests. But this is easier said than done: it has to be the right species in the right combinations to ensure high ecosystem stability. Which of these it will be exactly is being narrowed down through investigations in the context of NEWAL-NET. Even though in the context of this project research is primarily concerned with consequences for the water regime and the atmosphere, nevertheless a whole range of other requirements need to be taken into account: the demand for renewable resources and energies, technical as well as societal developments are constantly increasing the standards for forest management. At the same time there is a continual necessity for the sustainable management of forests, particularly those in sensitive ecosystems. One possible way out is a mixed deciduous forest that can adapt to the climate and keeps open a number of development paths for future developments, so-called "degrees of freedom". The adaptation of forests to changing basic conditions in nature and society through the ability to self-organise, to adapt to the location and the functional diversity of forests is described in detail in the NEWAL-NET project. Apart from that assessments are being conducted on the changes to forest use and its complex effects on the landscape under variable environmental, site and general conditions.

The forests of tomorrow from the best origin

In order to achieve the greatest possible adaptability to changing environmental conditions, it is extremely important that the seed and seed stock genes are of supreme quality. Beyond that a suitable origin determines the production potential of forest stock. The BMBF's joint research project *origin control* has been concerned with how the authenticity of forest reproduction stock can be systematically examined to secure the quality of our future forests. Due to the climate changes that are prognosticated, a substantial percentage of the tree stocks in Germany that currently cover an approximate eleven million hectares will be classified as having a poor or risky location: the restructuring of forests to resistant mixed woodlands is necessary and will bring about a change of tree species. Insufficient controls would favour the use of poorly adapted origins and could bring about long-term damage to forest development, cause timber companies to lose profit and have high subsequent costs – not to mention the associated environmental damage. The choice of a suitable origin is therefore imperative, also for ecological reasons.

UFZ contact person:

Andreas Werntze, MSc.
Dept. of Conservation Biology

phone: +49 (0) 341/235-1816
e-mail: **andreas.werntze@ufz.de**

Further information:
www.nachhaltige-waldwirtschaft.de

Pavan Sukhdev talking to journalists at the German Press Conference on 2nd September 2009 in Berlin.
Photo: Klaus-Dieter Sonntag (www.fotoplusdesign.de)

VITAL ECOSYSTEMS PROVIDE GREATER PROTECTION FROM THE IMPACTS OF CLIMATE CHANGE

You are leading the international TEEB study (The Economics of Ecosystems and Biodiversity – TEEB). What has biodiversity actually got to do with climate change?
The loss of biodiversity and climate change are very much associated: on the one hand global warming contributes significantly to the progressive loss of species and the destruction of ecosystems. According to calculations that have been made by the Intergovernmental Panel on Climate Change (www.IPCC.ch) climate change is considered to be the second largest driving force for the projected loss of biodiversity until 2050.

On the other hand, causality also exists the other way around. The destruction of ecosystems and in particular the continuous clearing of tropical rainforests leads to additional CO_2 emissions. Almost a quarter of terrestrial CO_2 is stored in these forests, which would be released if they were cleared. At the same time a significant CO_2 sink is lost through deforestation. According to calculations, these forests can sequester up to 4.8 gigatonnes of atmospheric CO_2 – annually!

Finally, vital ecosystems often have a better resilience and greater capacity for adaptation to the climate change phenomenon and provide humans with greater protection from its impacts. For example intact coral reefs and mangroves reduce the vulnerability of humans when faced with climate-related extreme events such as storms or floods.

With this in mind TEEB is attempting to record and describe the importance of ecosystem services for human well-being from an economics point of view.

Could you elaborate on that by providing us with some examples?
The TEEB report serves the purpose of providing economic arguments that increase awareness about the loss of biodiversity and ecosystem services. This can refer to entire industries as well as to the sources of livelihoods of individuals. For example: More than one billion people depend on fish as their major source of protein. The livelihoods of about 500 million people depend on intact coral reefs – which may be worth up to USD 172 billion annually. There is also a rising concern at the global level over the loss of bees and their natural pollination capacity. In the United States alone, the value of increased yield and the quality of crops due to pollination from bees were estimated at USD 14.6 billion in the year 2000. The pharmaceutical industry depends on biodiversity – up to 50% of the total value of the market (circa USD 650 billion per year) is derived from genetic resources.

PAVAN SUKHDEV

Pavan Sukhdev, a senior banker at Deutsche Bank, is currently on secondment to the United Nations Environment Programme to lead the agency's Green Economy Initiative, which includes The Economics of Ecosystems and Biodiversity study (TEEB), the Green Economy Report, and the Green Jobs report. As a career banker, he founded and went on to chair Deutsche Bank's Global Markets Centre in Mumbai. TEEB is compiling, building and making a compelling economics case for the conservation of ecosystems and biodiversity. The study is drawing on expertise from around the world to evaluate the costs of the loss of biodiversity and the associated decline in ecosystem services worldwide, and to compare them with the costs of effective conservation and sustainable use. The scientific co-ordination of TEEB is conducted at the Helmholtz Centre for Environmental Research (UFZ).

At the same time, the determination of monetary values for individual ecosystem services can substantially contribute to these being given greater consideration in national accounts for example and consequently the degradation of such vital ecosystems. Both, instruments to reward the so far unrecognised benefits of biodiversity protection, e.g. payments for ecosystem services as well as measures to make the polluter pay for ecosystem degradation, for example in the form of fees or taxes rely heavily on economic information being effectively designed.

In the run-up to the United Nations Climate Convention meeting in Copenhagen an update of TEEBs interim report was presented, which centred on coral reefs and the clearing of rainforests. What is the association between forests and coral reefs?
Global warming is a principal cause for the dying off of coral reefs. Recent investigations have concluded that even CO_2 levels of approximately 320 ppm in the atmosphere can substantially impair the regeneration ability of corals. With the current atmospheric CO_2 concentrations of around 387 ppm it is therefore very probable that large areas of corals will die off. This means that at the Climate Convention, even if there is an agreement on stabilizing atmospheric CO_2 levels at 450 ppm, then this would strongly endanger the existence of coral reefs – and thus the world's species-richest marine ecosystem that provides habitat for more than one quarter of all marine fish species.

In order to counteract a further increase in CO_2 concentrations in the atmosphere, a whole spectrum of avoidance and sequestration options must be explored. The reduction of emissions through technical reduction possibilities, higher resource efficiency and the conversion to renewables will all play an important role in this respect. However, beyond that the carbon sink function of forests should also be taken into consideration, as these can sequester enormous amounts of CO_2 and actively work against a further increase in greenhouse gas concentrations. Both a reduction in deforestation and an active reforestation program could make a substantial contribution to slowing down global warming and concomitantly conserving valuable coral reefs.

Why are you calling for an urgent reform for national accounts?
The achievement of sustainable social development is still nothing more than a noble declaration of intent. The causes for this can partially be explained by the fact that we are still using insufficient indicators, when it comes to determining social progress. In particular the growth of the gross national product – the standard yardstick of societal wealth – tends to ignore the condition of natural resources and livelihoods. As a result this indicator distorts the basis of decision-making in favour of man-made values and consequently against the conservation of ecosystems and biodiversity.

Conscious decisions can only be made however when sufficient relevant information is available. That is why TEEB is specifically supporting the development of indicator systems for recording and measuring services that are specifically provided by nature. This does not only apply to measuring societal wealth but also to measuring the balances of private enterprises, whose net product also depends on nature. In short, responsible management can only be achieved when it is based on sufficient information.

Does an economic view of our resources help, in order to be able to value them and protect them better? What do you think? Can the TEEB study help?
For me the power of TEEB is to recognise that there is a tremendous amount of value that is locked up in nature, and to emphasise that we have been missing the potential for using the value of nature to solve economic problems, to solve climate problems and of course to solve nature's problems as well. In actual fact, any form of capital can generate returns. We are aware that physical capital does and we are aware that human capital does. It is time for us to realise that natural capital can also generate returns.

But when we actually plan policies at a national level we typically do not take the value of nature into account. We keep saying that nature is an externality. Why? Is it because it is simply too big for our calculations? We need to internalise it! The message is that we should internalise it because if we don't then the foundations of our very own existence are at risk of collapsing.

It took many years for climate change to become a big topic. Will it take just as long before we recognise the loss of biodiversity?
I believe that two things are happening. One of these is that thanks to climate change, people have started to understand that nature is irreplaceable. It is not something that is only to be enjoyed on holiday, but part of one's existence. I think that the next round of understanding will be on ecosystems and biodiversity, which can be seen as one aspect of training that climate change has provided people with.

The second aspect is that we are beginning to see more and more extreme weather events as a result of climate change than ever before. Therefore, if for example politicians at the Climate Change Conference in Copenhagen agree to a goal of stabilising CO_2 levels at 450 ppm, we will still see a major loss of coral reefs. This will generate resistance because people want and need coral reefs. Hence we might see a different attitude prevailing and political action will be different. Therefore, I am optimistic that through the TEEB study the right messages are being sent not only to decision makers and economists but also to mankind. If substantial policy changes are to be made, then we need to take these messages to the people, for the conservation of biodiversity is not just a question that concerns scientists but the whole of humanity.

TEEB INVITES FURTHER CONTRIBUTIONS

At a German press conference in early September 2009 the TEEB Climate Issues Update was presented. The final TEEB study will be published by mid-2010. TEEB invites scientists and experts to contribute to TEEB, either by submitting responses to the TEEB D2 Call for Evidence, open until end of 2009, or by commenting on draft chapters of the various TEEB reports. Please consult **www.teebweb.org** or contact TEEB Scientific Coordination at **teeb@ufz.de**

UFZ contact person:
Dr. Heidi Wittmer
Department of Economics
phone: +49 (0) 341/235-1629
e-mail: heidi.wittmer@ufz.de

POINT OF VIEW: THE COSTS OF ADAPTATION TO CLIMATE CHANGE REMAIN UNCERTAIN

Prof. Reimund Schwarze lectures in International Environmental Economics at the University of Frankfurt/Oder. Since Oct. 2007 he has been working at the Helmholtz Centre for Environmental Research in the field of "Economics of Climate Change". He is a speaker on this topic within the Climate Initiative of the Helmholtz Association. In December 2009 he will be a participant at the COP 15 in Copenhagen as a member of ClimateNet.

phone: +49 (0) 341/235-1607
e-mail: reimund.schwarze@ufz.de

Economics has been dealing intensively with issues on climate protection for the last 30 years. By comparison, the issue of adapting to climate change has hardly been dealt with or only in isolated case studies. Striking evidence of this is shown by a current survey with Cost-Benefit Analysis on the adaptation to climate change conducted by the OECD. The estimates reflected there for the worldwide costs of adapting to climate change are based on a handful of analyses that are strongly shaped by the assumed costs for climate proofing global cash flows with the climate changes that are expected until 2030. All in all they disclose very low costs for an adaptation to climate change – less than 0.02 percent of world economic product – but there is a high degree of uncertainty, up to a factor of ten with the same methodological background. In fact, for an economic estimation of the worldwide costs of adaptation to climate change these studies still do not offer a reliable basis.

The costs of adaptation are difficult to determine

Why do we need an estimation of the costs of adaptation at all? Won't the affected regions and sectors adapt autonomously and at minimal cost to the climate conditions that they will encounter? This simplified view, which is the basis for many integrated assessment models on the economics of climate change, is wrong in my opinion. I would like to demonstrate this using two examples of international co-ordination problems: Dramatic climate changes will result in migration („a climate exodus"). The costs of the climate exodus however have not been taken into account in any current economic model of climate change. Another example is the global redistribution of wealth. The consequences of climate change will affect economies around the world very differently. The worldwide economic impact could however be minimised by arranging a redistribution of the expenses incurred. If however, countries already anticipate this in the run-up to the negotiations on climate protection, there is a danger that countries who protect themselves prematurely from climate change will pay more into the fund for the redistribution of expenses than those countries that wait to see how climate change will affect them. The costs of adaptation would then increase for all.

Win-win strategies can lower adaptation costs

There are numerous synergies and conflicts between individual measures of adaptation. The use of bioenergy to reduce greenhouse gas emissions makes countries more susceptible to fluctuations in the climate. The creation of urban green corridors however acts as a carbon sink and improves the urban climate. By exploiting synergies and avoiding conflicts over adaptation measures, the economic picture of the costs of climate change can be altered dramatically. Win-win strategies are indeed the best way to keep adaptation costs low.

A change of more than 2°C will be costly

The search for synergies between climate adaptation and climate protection will, however, only be a sufficient answer to the challenges of climate change when global warming can be limited to a moderate level of around 2 degrees Celsius. Beyond this level it will become extremely costly and elaborate worldwide adaptation strategies e.g. coastal and flood protection or large-scale land use changes will be required.

Study	Costs in billions of USD (% GDP)	Time Reference	Relevant Region	Relevant Sector(s)	Remark
World Bank (2006)	9 – 41 *(< 0,1 %)**	Present	Developing countries	National economy	Global cash flows affected by climate change
Stern Review (2006)	4 – 37	Present	Developing countries	National economy	World Bank study (slightly modified)
Oxfam (2007)	> 50	Present	Developing countries	National economy	World Bank study + adjustment projects of NGOs
UNDP (2007)	86 – 109	2015	Developing countries	National economy	World Bank study + disaster prevention costs
UNFCCC (2007)	28 – 67	2030	Developing countries	Agriculture, water supply, health, coastal protection, infrastructure	Contains double counts
UNFCCC (2007)	44 – 166 *(0,6 – 0,21 %)*	2030	The World	Agriculture, water supply, health, coastal protection, infrastructure	Contains double counts

*) The World Bank Study has estimated the percentage of world cash flows affected by climate change. Compare with OECD (Shardul Agrawala/Samuel Fankhauser), Economic Aspects of Adaptation to Climate Change, Paris. Percentages for the gross world product are based on our own calculations.

Environmental zones are to ensure cleaner air in cities.
Photo: Klaus-Dieter Sonntag (www.fotoplusdesign.de)

AVOIDING CONFLICTS AND USING SYNERGIES

As long as climate policies remain lip service we are all for them. But regardless of whether policies are made to mitigate or to adapt to climate change, they can only be successful when the objectives of climate policies are effectively integrated into those sectors that are either responsible for causing climate change or affected by its impacts. This applies to vital sectors of our modern industrial society such as the transport, energy, land use and food supply sectors. Together with European colleagues from the PEER network social scientist Dr. Silke Beck, political scientist Prof. Dr. Christoph Görg and geographer Dr. Christian Kuhlicke have been investigated the extent to which the requirements of climate protection and climate adaptation are integrated into six European countries.

The project team has come to the conclusion that since 2007 climate change gained political importance in all countries and was considered to be a "top-priority". When compared with other European countries, Germany is still regarded as a pioneer, since ambitious climate policy goals are integrated into sector policies and are sealed with extensive measures (like for example in the fields of energy production, energy supply and the modernisation of buildings etc.). However, even here important measures and initiatives, for the transport sector in particular, could not be implemented or are still very vague. Hence, it is still often a consistent realisation that is lacking in many fields. Beyond that it is often only selected sectors such as the transport or energy sectors that are taken into consideration, "while for example issues concerning spatial planning and land use are still neglected as they always have been", says Görg. One is warned in particular about placing too much hope on technical innovations to solve all the problems surrounding climate policies. Technical innovations are indeed important, but they have to be questioned with regards to potentially negative side effects. "We have to face up to the critical discussion about the potentially negative effects from decisions that only appear to have positive consequences at first glance", states Görg.

However this is often easier said than done, because stakes are high for target groups and political measures would require fundamental changes of daily life routines and transition of major institutional frameworks and arrangements. Anywhere, where favourite habits in terms of modes of transport or eating habits for example are concerned and at stake, one must reckon with a high degree of resistance, like for example from the automobile industry. In all of those countries that were investigated however it was demonstrated that climate protection must not necessarily be a burden for the national economy, but can also open up opportunities for improving the national energy security and creating new jobs, as is currently being discussed at the moment under "Green New Deal". To realize this, it is not only the implementation of European or national programs that is required, but also a commitment from individual municipalities, companies and even consumers. "The readiness of the latter to change one's behaviour is often there, but not always sufficiently taken up and promoted from the political side", in Beck's opinion. In order to enhance synergies and to avoid trade offs, these measures have to be scientifically monitored and adjusted better. In this respect it is not about reinventing the wheel but about systematically using and linking existing knowledge and instruments in the field of environmental research and bringing them into the political decision-making process. The order of the day, which is gaining more and more importance with adaptation, is to reduce conflicts and exploit synergies.

UFZ contact persons:

Prof. Dr. Christoph Görg
Dept. of Urban & Environmental Sociology
phone: +49 (0) 341/235-1628
e-mail: **christoph.goerg@ufz.de**

Dr. Silke Beck
Dept. of Economics
phone: +49 (0) 341/235-1733
e-mail: **silke.beck@ufz.de**

Further information:
www.peer.eu/publications/climate_policy_integration_coherence_and_governance

POINT OF VIEW: WE CAN'T GET AROUND COAL!


Photo: Norma Neuheiser

Professor Bernd Hansjürgens has been teaching Environmental Economics at the Martin-Luther-University Halle-Wittenberg. He is programme spokesman of the Helmholtz Programme "Terrestrial Environment" and head of the Department of Economics at the UFZ. His research interests are among others in emissions trading and architectures for climate policy.

phone: +49 (0) 341/235-1233 or -1259
e-mail: bernd.hansjuergens@ufz.de
www.ufz.de/index.php?de=1643

We all know that the central problem in climate and energy policies are the fossil fuels coal, oil and natural gas, which when burnt release greenhouse gases that endanger the climate. What is more, our energy system largely depends on fossil fuels, which are used in diverse ways: for heating and cooling systems, transport and mobility, as well as a number of services that depend on electricity. A reduction in the use of fossil fuels is therefore the central goal of climate policies with the emissions from industrialized countries to be lowered by up to 80 percent by 2050. Meanwhile, significant emerging nations have also accepted the goal of limiting global warming. Coal is of particular focus, as its associated CO_2-emissions are even higher than those from oil or natural gas.

Nevertheless, whether we like it or not: in the foreseeable future there will be no way around coal! For many years it will remain a crucial source of energy. The remaining coal reserves are concentrated in the USA, Canada, Russia, India, China, South Africa and some European countries where the "coal belt" extends from Germany through the Czech Republic, Poland and the Balkan states as far as Greece and Turkey. It is thought that these reserves will still last for more than a century and they will guarantee the security and an economical supply of energy. The next few years will set the course for the development of the next 40 to 50 years. In particular, replacements and modernisations of power stations all over the world will be pending in the period from 2015 to 2030. It can already be seen that new power stations are largely focussing on coal and according to forecasts from the International Energy Agency, the demand for energy will increase by 45 percent until 2030 – 85 percent of which will be covered by fossil fuels. At present, coal accounts for 39 percent of the worldwide production of energy and accounts for a third of the increase.

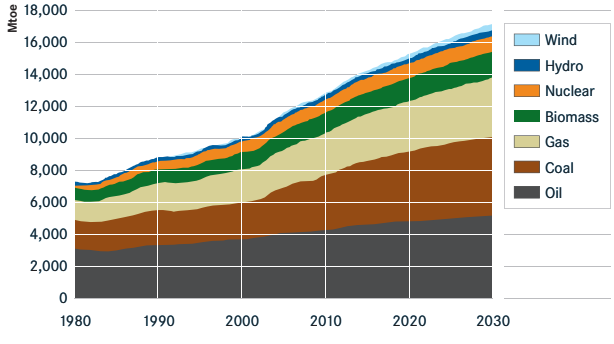
We cannot turn a blind eye to this predictable development and act as if we could get away with no longer using fossil fuels including coal without any great difficulty. But what would this mean in terms of policy and research?

Firstly, in terms of policy there will be a tough battle for years to come centering on mitigation measures, their costs and distribution. I am not expecting a major break-through at the climate conference in Copenhagen, as the capital from long-term investments is too high and any deviation from the track that we are on would be rather expensive. Besides, every country always expects measures to be adopted by other countries, but is not willing to bear the costs themselves.

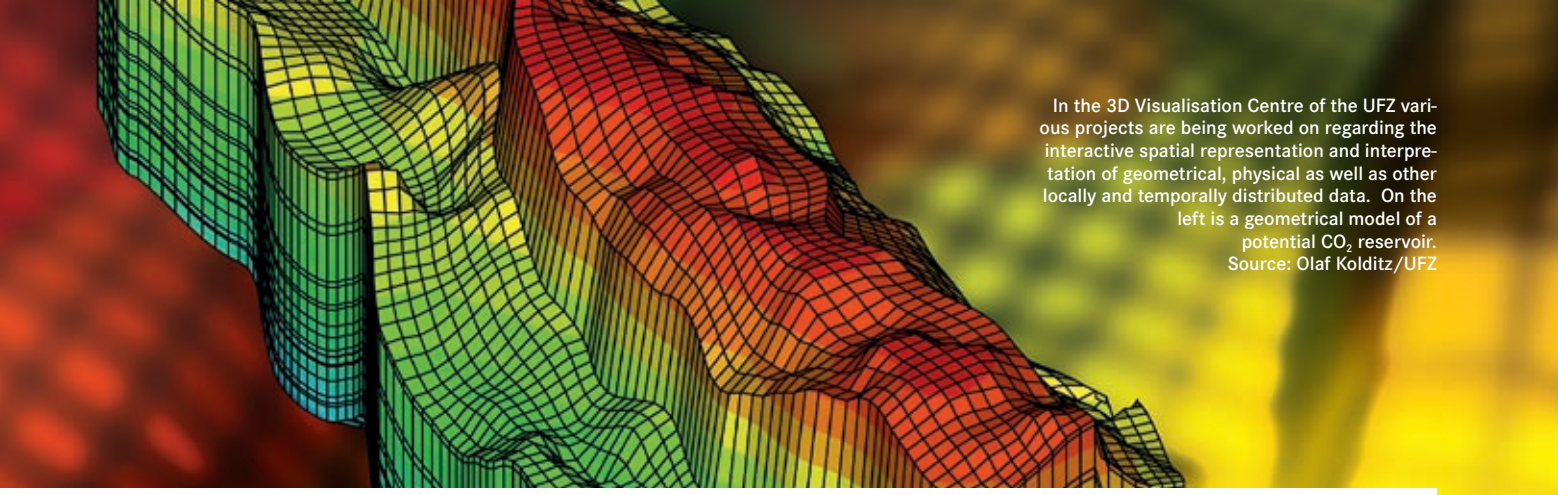
All efforts regarding coal, whether these are to increase the degree of efficiency of coal-fired power stations, or new developments to capture and store carbon dioxide, must play a major role. Because the worldwide energy systems are so strongly geared towards coal, there will be no other option. This means that the effectiveness of power stations, which amounts to a worldwide average of only 29 percent, must be increased to 50 percent or more, which would correspond to the Best Available Control Technology. That means that carbon capture and storage (CCS), at least as a transition technology, must be intensively considered and researched. This is difficult because the estimated abatement costs for this are as much as 70 Euros per ton of CO_2. It also means that in the context of international negotiations, technology transfer will play a crucial role.

For research and policies it results from this that there will not be a simple solution to a CO_2-free future that quickly. This will depend on the research efforts made in different fields. On the one hand in the field of coal itself, but also on other ways of decreasing CO_2. Land use will play a major role here, which is after all, responsible for 30 per cent of the CO_2 released into the atmosphere. Finally it will be inevitable to have to deal with the consequences of climate change and to develop strategies for adaptation. It is in these areas mentioned where the UFZ is attempting to make a substantial contribution.

ENERGY DEMAND WORLDWIDE UNTIL 2030



(Source: IEA, 2008)



In the 3D Visualisation Centre of the UFZ various projects are being worked on regarding the interactive spatial representation and interpretation of geometrical, physical as well as other locally and temporally distributed data. On the left is a geometrical model of a potential CO_2 reservoir.
Source: Olaf Kolditz/UFZ

CAN WE DISPOSE OF CO_2 UNDERGROUND?

Even if in many industrial nations such as Germany renewable energies are booming and their percentage of the total energy mix is increasing, they still only make up a small percentage of our total energy. Indeed, it appears that conventional power stations that run on coal or natural gas will still be needed for quite some time and should therefore not be excluded from the negotiations on climate change in Copenhagen. Coal is a fossil fuel, which when burnt releases the CO_2 that was once fixed by its biologically active original form in geological antiquity. That is why new concepts are constantly being developed to reduce the amount of CO_2-emissions. The often rather emotional instead of objective discussions that are led in favour or against these concepts are becoming just as heated as the climate itself. This can be clearly seen in the current debate over a new technology, which has the potential to make power stations cleaner: Carbon Dioxide Capture and Storage – or CCS for short.

CCS entails the capture of carbon dioxide from flue gases and its long-lasting sequestration in deep geological layers. For this CO_2 is transformed into a so-called supercritical state and injected into porous rock. "Supercritical" refers to a fluid aggregate state, which is neither a gas nor a liquid but has the advantages of both, namely high density but low viscosity. By injecting it into exhausted natural gas or oil deposits there is a very high chance that CO_2 can be stored in open pores while at the same time enabling remaining oil or natural gas to be extracted. Further possibilities for sequestration are the injection of CO_2 into deep sediment layers filled with brine, so-called saline aquifers or into marine sediments.

Nowadays the use of technical processes to capture carbon dioxide can be controlled and even its transportation via tank trucks or pipelines has been tried and tested. The borehole technologies for disposing of it underground are also well developed due to natural gas and oil extraction, except that in the case of CO_2 it is not about extraction but about sequestration. Experience is growing on this issue through worldwide pilot projects in both industry and research. Nevertheless some questions are still open: How large are storage capacities and how long will they last? Will seismic micro-activities be released from the CO_2 injected under pressure and which effects could these have? Will the deep injected carbon dioxide escape again over the course of time?

To systematically provide facts and answers on these and other similar questions, the Federal Ministry for Education and Research is promoting several joint projects on CCS. The UFZ is also involved in this work. One of these tasks is the numerical simulation of the short and long-term behaviour of the injected carbon dioxide into geological formations. "It is extremely difficult to look underground. Therefore we require the assistance of such simulations to get a feel for what is going on down there", explains Dr. Uwe-Jens Görke from the Department of Environmental Informatics. "We have the advantage of many years of experience in the field of numerical simulation of geotechnical procedures with our own software package (GeoSys)."

From injecting and leaving CO_2 to spread into the reservoir, complex hydraulic, mechanical, thermal and chemical processes will occur that affect each other. A coupled simulation of these is being planned and realised together with working groups from the Christian Albrechts University in Kiel, the Helmholtz Centre Potsdam, the German Research Centre for Geosciences (GFZ), the University of Stuttgart as well as other institutions. The complexity of the calculations requires very high efficiency from the algorithms and high performance computational technology. With the help of the 3D-Visualisation Centre (TESSIN) at the UFZ, the simulation results can be analysed and interpreted very realistically. With the numerical investigations on CO_2 sequestration in deep geological structures, the UFZ is carrying out an objective contribution to the founded analysis of the sequestration process in the CCS concept. "Our scientific work should provide results of numerical experiments and scenarios, that lead to indications about the organization of the injection process and long-term trends in geo-reservoirs" says Görke.

The ambitious goals for climate protection of the government can hardly be achieved without CCS as a transition technology. For the realisation of these in the near future it is not only a question of the technological controllability of CO_2 sequestration on a scientifically founded basis that needs to be sorted out but also the questions of acceptance, legal framework conditions and integration into future energy supply structures that are just as important.

UFZ contact person:

Dr. Uwe-Jens Görke
Dept. of Environmental Informatics

phone: +49 (0) 341/235-1804
e-mail: **uwe-jens.goerke@ufz.de**

The storm-surge barrier Maeslantkering should provide flood protection for about one million people in the District of Rotterdam. On flooding it prevents floodwater from the North Sea from surging into the river Maas. Normally, the flood gates are open enabling access into the port of Rotterdam. It turned out that the construction of the storm-surge barrier was more effective than making the Maas dam higher. The gates of the barrier are 22 meters high and each one is 210 meters long.
Photo: Rijkswaterstaat (Hydraulic Engineering Office, the Netherlands)

ON THE ROAD TO A EUROPEAN ADAPTATION POLICY

Europe has recognized that future adaptation to climate change will be just as important and necessary as containing further global warming. However: "adaptation policy is in many ways still in its initial phase and is particularly lacking an effective coordination between the levels of action and its participants". This is a main finding of the study "Europe Adapts to Climate Change – Comparing National Adaptation Strategies", which was compiled by the research group PEER (Partnership for European Environmental Research) with the participation of the UFZ as a PEER centre. "The goal of the project was to get an overview of the actions towards adaptation strategies in EU countries", describes Dr. Moritz Reese, who was involved in the study from the UFZ. For this, the adaptation strategies of Denmark, Germany, Finland, France, the Netherlands, Spain and the United Kingdom that have been available until now were analysed and compared.

In all countries the first priority is to establish the regional climate impacts and the actions that are required to put these over to political and private participants and to get a political process underway to ensure that one is in time with any necessary national and private measures. To achieve this an effective study and practice-oriented procurement of the regional adaptation requirements are necessary, sufficient political and administrative capacities must be created and a continuous monitoring and development of the adaptation policies must be ensured. The study reveals that national strategies are still predominantly in the initial state regarding all of these challenges.

For the challenge of further scientific clarification a considerable lack of planning, finance and above all lack of coordination has been determined: "there is no consistent inter-regionally coordinated agenda for the research on climate impacts", reports Reese. We must avoid conducting parallel research at the national and regional levels without any coordination. "In this respect institutions with wide networks such as PEER and the UFZ could make important contributions", says Reese. Here the social sciences are also required: For example, Economic Cost-Benefit Analyses, which could provide a rational basis for determining the action required, are currently missing to a large extent.

Convincing concepts are also missing that would effectively coordinate adaptation policies between the European community, national governments, regions and municipalities. Indeed national adaptation strategies emphasize throughout that climate adaptation presupposes an efficient cooperation at all levels of official action. Until now however it is a range of local and regional activities, which can already be observed throughout Europe, that have been considered individually. Furthermore there are large gaps in the monitoring and development of political planning and regulations. Concrete planning to develop monitoring and indicator systems and regular progress checks can hardly be found. In this respect the German adaptation strategy can at least comparatively be regarded as exemplary: "It allows for follow-up planning, sets concrete time horizons, focuses on strategy revision and implementation and envisages the creation of a meaningful monitoring plan", explains Reese. However, even in Germany there is still a long road ahead to the development and implementation of an effective indicator and monitoring concept.

UFZ contact person:

Dr. Moritz Reese
Dept. of Environmental and Planning Law

phone: +49 (0) 341/235-1987
e-mail: **moritz.reese@ufz.de**

Further information:
www.peer.eu/publications/europe_adapts_to_climate_change

The Alpine Emerald dragonfly (*Somatochlora alpestris)* is together with the Azure Hawker dragonfly *(Aeshna caerulea)* the only dragonfly species to inhabit the High Alps. One protected area where the Alpine Emerald dragonfly can be found is the Upper Harz Mountains in Sachsen-Anhalt, where it can be found at altitudes above 800 meters. Global warming could however restrict its ideal habitat to even higher altitudes. Photo: www.rotholl.at

ENVIRONMENTAL LAW AND ADAPTATION PRESSURE

Climate change is forcing adaptation, also in central areas of environmental protection, like nature conservation and water management. How can one ensure that the task of adaptation will be taken up by individual sectors? Is this task of adaptation being observed? It is questions such as these that a group of researchers at the UFZ is investigating on behalf of the Federal Office for Environmental Protection (UBA).

"Environmental regulations and their implementation are important means to guide behaviour", describes Professor Dr. Wolfgang Köck. Environmental planning is one of the central control instruments of environmental law, in order to make state decisions, or for the preventative control and authorisation of projects with environmental impacts. UFZ researchers are of the opinion that both instruments require improved efficiency. This means adjusting planning and authorisation systems to the task of adaptation, to consider results and continually monitor decisions that were made, improving them if necessary with new insights. "An environment law, which is to be able to cope with the requirements of adaptation, must be understood as risk legislation", claims Köck. It can thereby learn from other areas of legislation such as the chemicals law or the genetic engineering law that have institutionalised the handling of uncertainty.

It will not be sufficient to master the task of adaptation alone through instruments of environmental law. Adaptation is also becoming a challenge for the legally fixed goals of environmental policy. One example of a mandatory stipulation in nature conservation is to establish a network of priority areas for nature conservation (NATURA 2000). Based on the expertise from ecologists and conservationists more than 4600 areas in Germany alone have been selected in the meantime for the NATURA 2000 network, which are to be protected at a national level by focusing on certain habitat types and species. Can this goal still be achieved under the conditions of climate change? Will the laboriously compiled system of priority sites have to be abandoned and worked out over again? Or will all areas have to be made so robust that they are able to fulfil their functions in the long term? "Neither one strategy nor the other is correct", Köck is convinced. It is important to make the Natura 2000 sites more sustainable by investing in nature conservation so that stressed systems can last longer. But this only functions within limits. Under some circumstances the goal itself will have to be changed. The current Natura 2000 conservation law however forces management measures to be adopted in order to conserve those habitat types and species that were the reason for including the site in the network. This could be like fighting against the forces of nature. The crucial question is: At which point is the threshold, where it no longer makes economic sense to conserve such sites because of a certain species? Therefore criteria must be established, which are based on expert assessments in the field of economics and nature conservation. It should be more important to protect existing priority sites than each individual species that might disappear from valuable habitat due to climate change. To achieve this, corridors must be created between these sites that favour the migration patterns of these species.

Another example that the task of adaptation will affect the goals of environmental protection is water protection in the form of the European Water Directive (WRRL). One goal of the WRRL is to maintain or re-establish a good chemical and ecological water quality for surface waters by the end of 2015. "What is determined as good quality, depends on the reference condition," explains Dr. Moritz Reese. "This is determined on the basis of the reference conditions of semi-natural waters." At present the requirements have been determined by the good condition based on the reference analysis from the year 2004. "Climate change", according to Reese, "will force us to redefine the reference conditions every 10 to 15 years and hence what we understand to be a 'good condition'". According to Reese, the rectifications of shortcomings will also concern quantity planning to guarantee the availability of water. At present, the "good quantity condition" is still not one of the goals of the European water protection for surface waters. Climate change and adaptation pressure will force us to devote more time to this problem in the future.

UFZ contact person:

Prof. Dr. Wolfgang Köck
Dept. of Environmental and Planning Law

phone: +49 (0) 341/235-1232
e-mail: **wolfgang.koeck@ufz.de**

INFORMATION PAGES

COMPETENCE CENTER FOR CLIMATE CHANGE IMPACTS AND ADAPTATION (KOMPASS)

The Competence Center for Climate Change Impacts and Adaptation at the Federal Office for the Environment (UBA) abbreviated to KomPass is official contact partner for climate change adaptation activities in Germany. As an interface between climate impact research, society and politics, it detects vulnerable areas and regions, evaluates the impacts of climate change and highlights both the opportunities and hurdles of adaptation measures. KomPass works in close co-operation with science, ministries and authorities as well as institutes and enterprises and functions as an office for the development of DAS.
www.anpassung.net

GERMAN STRATEGY FOR ADAPTATION TO CLIMATE CHANGE

In December 2008 the German Federal Cabinet adopted the German Strategy for Adaptation to Climate Change. In doing so, a framework for adaptation to the impacts of climate change in Germany was established. The strategy contains the current state of knowledge on anticipated climate change and the impacts that are associated with it Management options have been identified for fifteen different fields and for those regions that are particularly vulnerable. An implementation of the strategy will help participants from science, politics and society to reduce their vulnerability to climate change. KomPass supports the implementation of DAS both from a technical as well as an organizational point of view. Until Spring 2011 an action plan for adaptation will be worked out in cooperation with the actors and countries involved. The foundations for the development of DAS were laid down at the scientific preparatory conference in August 2009 at the UFZ in Leipzig. At this Symposium research needs for the adaptation to the impacts of climate change over coming years were prioritised and the interfaces that are required between the fields of action were identified.
www.bmu.de/english/climate/downloads/doc/42841.php

HELMHOLTZ CLIMATE INITIATIVE (REKLIM)

The Helmholtz Association is extending its work in the field of climate research by providing 16 million Euros for the next 4 years for the Helmholtz Climate Initiative “Regional Climate Change: From Observations and Modelling to Decision Support for Mitigation and Adaptation (REKLIM)”. A strong emphasis will be on the development of an earth system model and the study of regional impacts from global climate change. The participating centres, including the UFZ will all contribute the same amount of money so that the climate initiative will have a total sum of 32 million Euros. With the new climate initiative the competences of different Helmholtz working groups will complement each other to investigate climate change and in particular the impacts associated with climate change at a regional level. Here, socio-economic aspects will also be considered, to provide specific recommendations to ensure the sustainable management of forests and agricultural areas as well as efficient water management. The Head of the Climate Initiative is Professor Dr. Peter Lemke from the Alfred Wegener Institute for Polar and Marine Research. A close co-operation is planned with universities and non-university working groups. Outreach will be done by the Regional Climate Offices of the Helmholtz Association, the Climate Service Center and the German Climate Consortium to support the policymakers and the other regional stakeholders in assessing risks and opportunities and in designing mitigation and adaptation strategies.

REGIONAL HELMHOLTZ OFFICES FOR CLIMATE CHANGE

Climate change will have different effects in different regions. Farmers, coastal engineers, town planners, but also decision makers in both politics and industry will require first-hand information to be prepared for climate change in their region. The Helmholtz Association will cover this need for information through a nationwide network of regional climate offices. In addition to the collation and mediation of research results on regional climate change, the knowledge gaps of regional stakeholders will be detected and then integrated into the research programs of the Helmholtz Association.

The **Climate Office for Polar Regions and Sea Level Rise** with its headquarters at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven covers climate change issues with particular attention to reciprocal effects between ice, the atmosphere and the oceans.

The **South German Climate Office** at the Karlsruhe Institute of Technology (KIT) offers expertise on regional climate modelling and extreme weather events such as heavy precipitation and flooding.

The **North German Climate Office** at the GKSS Research Center in Geesthacht focuses on the following research issues: storms, storm surges, ocean waves, and energy and water cycles in the North of Germany.

MITTELDEUTSCHES Klimabüro

The **Climate Office for Central Germany** at the Helmholtz Center for Environmental Research (UFZ) in Leipzig provides information on environmental and socio-economic aspects of regional climate impacts and on the design of adaptation strategies. Special emphasis is given to feedback mechanisms between climate change and land use.
http://climate-office.com

UFZ contact person: Dr. Andreas Marx
phone: +49 (0) 341/235-1074
e-mail: andreas.marx@ufz.de

CLIMATE SERVICE CENTER (CSC)

A new national service centre was created with the Climate Service Center (CSC) at the GKSS Research Center with its headquarters in Hamburg, which acts as a central information and consultation platform and is closely linked with German research on the climate and climate impacts, climate consulting institutions and the economy. It provides consultation in all areas ranging from economics and society to politics and science. It is the goal of the CSC to collate the results from research on climate systems and to derive a meaningful basis from these for decision makers. It therefore closes the gap between climate system research and the users of climate data. The CSC collates current research results from climate change research adapting these accordingly to better suit the information needs of society.
www.climate-service-center.de


Source: photodisc/getty images

PEER – POOLING EUROPEAN ENVIRONMENTAL RESEARCH

PEER (Partnership for European Environmental Research) comprises of seven European environmental research centres, whose common goal it is to conduct interdisciplinary and program-oriented environmental research. This UFZ initiative was set up in 2001 and with nearly 5,000 co-workers and an annual budget of approximately 360 million Euros, PEER intends to increase its competitive advantage in European environmental research, use infrastructure efficiently and ensure a long-term co-ordination of research programs – among others on climate change impacts and adaptation.
www.peer.eu


Photo: Klaus-Dieter Sonntag

TERENO – OBSERVING THE ENVIRONMENT

Several Helmholtz research centers have collaborated to form a new earth observation network: TERENO (Terrestrial Environmental Observatories). On a long-term basis four regions of Germany will be observed and explored in terms of how climate change and land use change will regionally affect the water cycle, regional climate and weather, biodiversity, soil and air quality and the resulting socio-economic impacts, so that changes can be intervened with and adaptation strategies developed accordingly. At the centre of the TERENO concept is the connection between measurements, modelling and experiments as well as a multi-disciplinary approach. The observatories are equipped with weather stations, ultra-light aircraft with special optical sensors, geophysical measuring technology, radar systems, soil sensors and groundwater measuring systems. In TERENO new model concepts and scaling methods are being developed to close the scale discrepancy between measurements, models and management. **www.tereno.net**

UFZ contact person: Dr. Steffen Zacharias, Department of Monitoring and Exploration Technologies, phone: +49 (0) 341/235-1381, e-mail: steffen.zacharias@ufz.de

UFZ CLIMATE EXPLORATION

The UFZ is setting up a full-scale experiment on climate change over an area of twelve hectares in Bad Lauchstädt. With controllable rainy and dry periods and CO_2-concentrations, the scientists want to investigate for example the medium-term and long-term climate change impacts on soil and plants to provide important results for agriculture and politics, also in terms of adaptation measures. The Helmholtz Association is funding the experimental platform with four million Euros. The full-scale experiment will have a runtime of 15 years and will also be available to other research institutes.

UFZ contact persons: Prof. Dr. Francois Buscot, Department of Soil Ecology, phone: +49 (0)345/558-5221, e-mail: francois.buscot@ufz.de · Dr. Stefan Klotz, Department of Community Ecology, phone: +49 (0) 345/558-5301, e-mail: stefan.klotz@ufz.de

NEW BOOK PUBLISHED

Silke Beck: Das Klimaexperiment und der IPCC (Schnittstellen zwischen Wissenschaft und Politik in internationalen Beziehungen) The book describes from a social-science perspective, how the IPCC succeeded in maintaining its expertise in scientific integrity as well as political relevance and credibility.
Metropolis Publisher for Economics, Society and Politics, ca. 200 pages, 22,80 Euro, ISBN 978-3-89518-771-1

Imprint

Publisher:
Helmholtz-Zentrum für Umweltforschung GmbH – UFZ
Permoserstraße 15 · 04318 Leipzig/Germany
phone: +49 (0) 341/235-1269
e-mail: info@ufz.de · web: www.ufz.de

Editorial office:
Doris Böhme (chief editor; p. 13, 27, 29, 30/31)
Gundula Lasch (p. 12, 16, 18, 20/21), Antonia Rötger (p. 14/15), Kerstin Viering (p. 17), Jörg Aberger (p. 6/7, 24, 25, 26, 28), Tilo Arnhold (p. 8/9, 10, 11, 22/23), Reimund Schwarze (p. 4/5, 24), Christoph Schröter-Schlaack and Augustin Berghöfer (p. 22/23)

Picture Editing:
Doris Böhme, André Künzelmann, Tilo Arnhold

Photography:
André Künzelmann

Translation:
Sarah Gwillym-Margianto
(info@der-fachuebersetzer.com)

Layout:
noonox media GmbH, Leipzig

Printing:
Messedruck Leipzig GmbH/Germany
Printed on 100% recycled paper

HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

ISSN 1868-7512

RESEARCH FOR THE ENVIRONMENT

At the **Helmholtz Centre for Environmental Research – UFZ** scientists are investigating the causes and consequences of far-reaching changes to our environment. Their work is to provide solutions to specific environmental problems. They provide knowledge for politics, the economy and society on complex systems and associations in the environment and recommend instruments and concepts accordingly. This is not always an easy task as the expectations and possibilities of the parties involved can differ greatly.

The Helmholtz researchers are concerned with the management of water resources and the impacts of land use change for biodiversity and ecosystem functions. They develop remediation strategies, monitoring und investigation methods for contaminated ground and surface waters, soils and sediments. They investigate the reactions and effects of chemicals in the environment and on human health and the immune system and work on models to predict environmental changes, while also considering issues in social science and the economy. In this way the environmental research at the UFZ with its natural science orientation is also closely linked to human, social science and legal perspectives.

Research on the impacts of climate change plays a major role at the UFZ. Particular emphasis here is on the impacts of climate change for the environment and for human health as well as the development of adaptation strategies and political measures for climate change. Based on the wide-ranging expertise of UFZ-scientists, effects in the areas of water resource management, terrestrial ecosystems and biodiversity are paramount. The analysis of climate change processes and policy is therefore carried out with an integrative approach, including relevant disciplines and stakeholders.

Helmholtz Centre for Environmental Research GmbH – UFZ
Permoserstraße 15 · 04318 Leipzig/Germany
Public Relations: phone: +49 (0) 341/235-1269 · e-mail: info@ufz.de · www.ufz.de

UFZ offices in Leipzig,
Permoserstrasse 15

UFZ offices in Halle,
Theodor-Lieser-Strasse 4

UFZ offices in Magdeburg,
Brueckstrasse 3a

HELMHOLTZ-ASSOCIATION OF GERMAN RESEARCH CENTRES

The Helmholtz Association contributes to finding solutions for large and pressing issues in society, science and the economy through excellence in the following 6 areas of research: earth and the environment, energy, health, key technologies, structure of matter, transport and aerospace. With its 28,000 employees at 16 research centres and an annual budget of approx. 2.8 billion Euros, it is the largest scientific organisation in Germany. Work is conducted in the tradition of the great biologist Hermann von Helmholtz (1821–1894). **www.helmholtz.de/en**