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Climate Change in Regions

Adaptation strategies for seven regions

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Adaptation strategies for seven regions

Welcome

The impact of climate change in Germany is likely to be relatively small compared to the global phenomenon. Nevertheless, news of such extreme weather events as heavy rains and the floods they bring with them remind us of the fact that the climate is also changing here. A changeable climate will have impacts on Germany's highly developed and complex infrastructure, which may be very severely affected by future extreme weather conditions. At the same time, long-term climate change also opens up new opportunities in such areas as agriculture and tourism. For this reason, it is about time for us as a society to start preparing for future changes in our climate. Adapting to climate change is thus the focus of the funding initiative "KLIMZUG – Managing climate change in the regions for the future". The initiative aims to raise awareness of the fact that we need to adapt to the changing

climate within our society and to equip the regions to live and deal effectively with new climate conditions. These aims are to be developed within the KLIMZUG programme on a pilot basis in seven German regions. To ensure that these adaptive solutions can be implemented successfully, durable networks will be established in the KLIMZUG regions between political decision-makers, public administration, economy, scientists and the public. Only if all social powers are harnessed together will we be able to overcome the future challenges of climate change on a regional, national and, ultimately, on an international level. The German Ministry of Education and Research (BMBF) supports the formation of such networks by providing resources for research funding, as part of a process to become a model for other regions within Germany, but also in other countries.

To be in a position to decide on the adaptive actions to be made and to make the required investments, politicians, private enterprises and individual citizens will need to know how the climate is expected to develop in the future. For this reason, communicating existing and continuously growing scientific knowledge to society represents a key challenge for the future, as does the communication in the opposite direction of wider society's questions to the scientific community. This task is taken on by the Climate Service Center (CSC), established in 2009 as an interface between science and society – and not just for KLIMZUG.

We would like to invite you to join us in tracking these KLIMZUG networks in their efforts to make the regions fit for the future in the face of climate change! At this point I wish you an enjoyable and informative read.



Frankfurt am Main
Image: Fotolia

Introduction

KLIMZUG – Climate change in the regions

The climate is changing worldwide. This climate change also calls for regional thinking and action. How are we to approach the problem in Germany? Even if the impacts of climate change here are still relatively minor compared to other parts of the world, they still affect us to some extent – in ways that vary from region to region. Our ability to adapt to these changes will be fundamental to protecting our environment and to maintaining our standard of living. The KLIMZUG funding initiative is aimed at increasing Germany's adaptive capacity: we need to anchor an awareness of the necessity of adaptation firmly within society. In this way will we ensure its fitness for living with and managing changes in climatic conditions.

KLIMZUG Facts

The seven KLIMZUG joint projects, each of them involving a large number of cooperating regional partners coming from the areas of research, the economy, politics, public administration and society, are being supported by the BMBF's research funds for a five-year period. Each joint project is being provided with funds of up to 15 million Euros. In total, KLIMZUG's funding amounts to approximately 83 million Euros.

Regional adaptation to climate change

The aim is to implement the KLIMZUG programme on a pilot basis in seven German regions. Adaptive measures in the face of climate change must be developed and implemented in region specific manner: coastal areas are not like uplands, rural areas differ from cities.

For this reason, KLIMZUG has a regionalised structure. New adaptive measures are tailor-made for each region and tested there. It is intended that this approach becomes a model for other regions within Germany, but also in other countries.

Increasing regional acceptance via networking

Within these KLIMZUG regions, durable cooperation networks are being developed between politics, public administration, economy, science and society. This helps to convert the concept of adaptation to climate change into practicable solutions and to ensure a high level of acceptance amongst the various interested parties.

The seven networks work in an interdisciplinary fashion with the involvement of local decision-makers. Thus the scientific, planning-related, technical and entrepreneurial strengths of the various actors can be combi-

Managing climate change in the regions for the future

ned. And it also ensures that the structures developed can deal with climate change in a timely manner. These networks are to be embedded in the regions' culture so that a self-sustaining structure, which can implement need-oriented and innovative adaptive measures vis-à-vis climate change, will be in place by 2014, when the funding stops.

Only by combining all social forces will we be able to meet the challenges posed by climate change on a regional, national and international level in future. The Federal Ministry of Education and Research (BMBF) supports and funds the creation of these networks.

Innovation to ensure continued capability

This future-oriented approach equips the seven KLIMZUG regions with a competitive advantage, as well as boosting the competitiveness of companies, thus securing jobs. In addition, it will help Germany to maintain its innovation potential and to strengthen its pioneering role in responding to climate change internationally. By promoting research in this field, Germany can set the pace in the development of adaptive strategies.

Involving international partners

The KLIMZUG-regions not only act as a role model nationally but also contribute to international knowledge transfer. The KLIMZUG funding initiative therefore provides support for cooperation with regions outside Germany. If a partner region is affected by similar problems caused by climate change, then ideas and solutions can be drawn up together. In this way suitable adaptation measures can be exchanged. Also to be tapped as part of this process are both the traditional and newly acquired knowledge possessed by partners already living with the climatic conditions predicted for Germany in the future.

The KLIMZUG funding initiative is also supported by an advisory board of international experts. This board provides practical recommendations for all KLIMZUG projects. It provides mentors for the networks, who monitor the process continually and are available to offer advice regarding the research and implementation processes. The information gathered is discussed at the advisory board and the outcomes of these discussions are then communicated back to the networks. The Federal Ministry of Education and Research is investing today to ensure that our society is well positioned tomorrow.



Urftalsperre dam; image: Fotolia



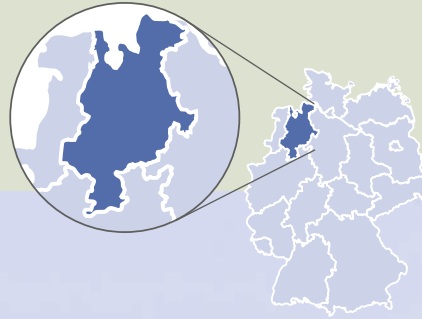
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northwest2050

The economy in the Metropolitan Region Bremen-Oldenburg in the Northwest

The coastal and port region of Bremen-Oldenburg, with its almost three million residents, is exposed to the consequences of climate change in a variety of ways. These consequences do not include only directly perceptible changes such as wetter and warmer winters or drier and warmer summers. Climate change also has far-reaching consequences for the economic value creation chains specific to the region and for its competitiveness. Potential interference with global transport routes and the international flow of goods could, for example, give rise to uncertainties in the supply with raw materials to the region's industry.

In this context, the joint project northwest2050 ("Prospects for Climate-Adapted Innovation Processes in the Metropolitan Region of Bremen-Oldenburg in North-Western Germany") analyses the region's institutional structures and its central economic areas of activity (referred to as "clusters") strongly affected by climate change whilst at the same time being of decisive regional importance. These areas include the energy and food industry as well as the port and logistics industry. The project area covers the entire catchment area of the Bremen-Oldenburg Metropolitan Region in the Northwest.



Climate adaptation through innovation in the Northwest

Objective: a “Roadmap of Change” for the Northwest

Under the northwest2050 umbrella, approximately 50 partners from the economy, science, politics and public administration are now developing technical and institutional innovations for dealing with the consequences of climate change. This process of analysis and development is to culminate in 2014 in a long-term schedule for climate adaptation: a “Roadmap of Change”, designed to show how risks facing the region can be reduced and how to benefit from new opportunities in the period up to 2050. The group is not only focussed on adapting to the predicted consequences of climate change. It also works on the assumption that a more turbulent climate will spring surprises – for which reason northwest2050 aims to render the society, politics and economy of the region more robust overall, and less vulnerable to disruptive events.

Of central importance is the topic of innovation: it is intended to develop and execute climate adaptation pilot projects in cooperation with economic actors, based on extensive research into the theoretical foundations, vulnerabilities and innovation potential of the relevant topics. Partners from companies, relevant institutions and regional networks are being involved right from the outset in the joint development of feasible solutions.

The Energy cluster

The Bremen-Oldenburg metropolitan region numbers amongst Germany’s most important areas for the energy sector, with approximately 23,000 jobs in the industry. Thanks to its particular geographical characteristics, the project area serves as a hub for many energy carriers. A particular driving force within the region is the wind energy industry, which develops and manufactures systems locally for a global market. But the oil, gas, coal and biomass-based energy industry also has an important part to play.

On the one hand, the energy industry in the northwest is faced with a number of direct challenges resulting from climate change to overcome. These include the limited supply of cooling water for thermal power plants – for example owing to more frequent and longer heat waves – or the growing risk of disruptions to the supply of commodities. And on the other hand, the energy sector is faced with a rising demand for energy to run air conditioning systems and a dwindling demand for heat.

To ensure that the energy industry can prepare for changes in climate and maintain its productivity, pilot projects are exploring options for rendering the energy supply more robust and for benefiting from newly emerging opportunities. Such projects involve a search for any



Biogas facility
Image: ecolo



potential to make better use of the existing ambient and residual energy – for example for the generation of cooling energy and for air conditioning.

Also being examined is the question of how the space requirements for renewable energy can be optimised, thus preventing utilisation conflicts. One of the general aims of these projects is to provide a sustainable energy supply

that can also provide adequate services under adverse conditions.

The Food cluster

The metropolitan region's food industry employs approximately 140,000 people in the cultivation of fruit and vegetables, in animal husbandry and in fishing. The various sectors and operations of the industry are closely interwoven, from production to processing and on to distribution. They have established a great number of common systems. The sector has thus become one of the most competitive economic clusters in Europe.

Climate changes affect these food industry systems in a wide variety of ways. The food cluster is therefore cooperating with partners with experience in the development of climate adaptation strategies for the meat and fish industry, as well as for vegetable and grain cultivation. Besides innovative cooling and ventilation methods used in animal husbandry and processing, climate-adapted varieties and races are also being tired out. In the food area, product ranges are being extended to adapt to climate change. And in the convenience food industry, new technologies are intended to reduce the need for cooling – without having to make sacrifices in terms of shelf life.

Climate adaptation in vegetable and grain cultivation

Climate change makes outdoor cultivation more difficult. Vegetables in particular suffer from such extreme weather conditions as heat waves or heavy rain falls. The Freese Bioland farm in East Frisian Rhaderfehn is currently testing a film in its greenhouses previously used for the outer skin of Munich's football stadium. Its unique translucence provides for light conditions which resemble open land conditions and allow protected cultivation without significantly detracting from quality. At the same time, the farm is on the lookout for resistant, climate-adapted vege-

table and grain varieties, whose specific attributes are being tested both outdoors and under the new film.

In grain cultivation, the farm is engaged in an attempt to cultivate an old variety of German rye – 'Urroggen' or ancient rye. This deep-rooting plant is very robust, grows rapidly and generates a good soil structure, so that large amounts of water can be absorbed by the ground like a sponge. This means that the plant can help prevent waterlogging. The ancient rye is then further processed by baker, and a marketing concept is being developed for bread based on it. The findings are being passed on to the Bioland association.

northwest2050

The cluster is also developing a dialogue-based approach to finding solutions for competing land use demands to ensure a plentiful food supply into the future.

The Port and Logistics cluster

The maritime, logistics and port industries make the Bremen-Oldenburg region one of central Europe's most important logistical hubs. The sector provides 150,000 jobs. An important role in this is played by the eleven seaports in the cities of various sizes in Northwest Germany. Major new infrastructural projects of European significance are currently either in planning or under construction. Climate change presents an important challenge to the port and logistics industry.

Regional episodes of extreme weather can seriously affect workflows in ports. Hence this needs significant investments to protect existing infrastructures. The usability of shipping routes or connections with the hinterland may also be put at risk of restriction. On top of this, the consequences of climate change might also force changes in global transport chains elsewhere in the world and thus affect the regional flow of goods, affecting the significance of individual ports in the process. In this respect the port and logistics cluster is developing a regional adaptation strategy for the industry in cooperation with sector's main actors.

The Region cluster

The Region cluster deals with a wide spectrum of issues. These questions concern the vulnerability of the area's natural environment to climate change, as well as changes in the behaviour of private consumers. Under the heading of "Governance", business strategies for climate adaptation are examined, as are decision-making processes in politics and public administration. Thus it is important under this heading to know what national and international political standards apply, and also where there is room for manoeuvre in the region for adaptation to climate change.

The Region cluster combines the findings from the Energy, Food, Ports and Logistics clusters and other fields of action into a single whole. It promotes and provides support for dialogue between the various actors from politics, the economy and society. The central focus is on promoting the wider use of findings – be it by public authorities and administrations, by commercial companies or by general public. For example, the various network partners are currently investigating if a set of guiding principles could play a decisive part in this process.



Tomato cultivation under special film; image: Heiko Freese



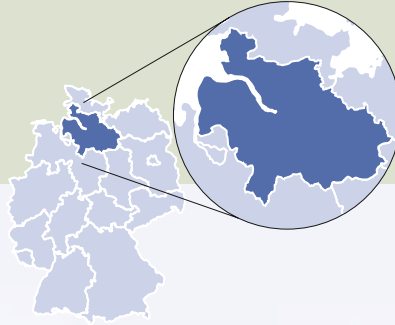
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KLIMZUG-NORD

Varied region – diverse challenges

Urban metropolitan flair and rural idyll; the North Sea coast and the Elbe estuary: the surroundings of Hamburg are characterised by contrasts. Climate change affects the region in various ways: the marine ecosystems along the North Sea coast and in the Elbe estuary will certainly change, as will the region's forest ecosystems, heathlands, moors and water meadows.

The average temperature in Hamburg has risen by one degree Celsius over the last century. In the coming 30 years the average temperature in Hamburg could rise by another degree. The orchards in the Altes Land region now blossom two to three weeks earlier than 30 years ago. Agriculture has to prepare for longer vegetation periods and insect plagues, which are sometimes able to reproduce twice a year.

The competition for water will also intensify, as summer rains can be expected to decline in parts of the region. In cities the question is being raised whether their open areas will be capable of absorbing the water volumes resulting from heavy precipitations and floods. The amount of land use disputes will soon increase because of the continuing densification of urban areas. And last but not least, faced with the rising sea level, cities, towns and rural regions will need to organise protection against storm surges. Such tides could rise by 0.3 to 1.1 meter by the end of the century, as compared to today's levels.



Climate change in Hamburg and its surrounding areas

Recommended actions for dealing with the consequences of climate change

To meet these challenges, a “Roadmap for Climate Adaptation” including a time frame up to 2050 is now being drawn up, pointing out potential actions to those in charge. This is the objective that KLIMZUG-NORD – a network of universities, research facilities, authorities and businesses – has set for itself. Further support is coming from the regions of Lower Saxony and Schleswig-Holstein, which jointly surround Hamburg, as well as the Hanseatic city itself.

The partners of the KLIMZUG-NORD project carry out research into the consequences of climate change for cities, rural zones and the Elbe estuary area. They analyse climate data, create simulations, plan nature conservation measures, perform field and laboratory experiments and develop concepts for urban and spatial development, as well as preparing new economic models and measures to help the region adjust to climate change. KLIMZUG-NORD puts an emphasis on close cooperation amongst science, economic actors, public administration and professional associations, as well as a dialogue with the population.

The network intends to create a broad awareness of adaptive strategies amongst the population of the Hamburg region. Furthermore, involving a wide range of partners ensures a high level of innovation. This is why a variety of specialists at

KLIMZUG-NORD are now working on solutions: these experts include urban and landscape planners, engineers, biologists, agronomists, meteorologists, architects and climatologists. Strategies are to be tested and implemented in cooperation with local authorities and economic actors. New materials, products and methods are to be exposed to real conditions. Local interests and the private sector are involved early on to ensure acceptance.

“Estuary Management” along the river Elbe

The Elbe estuary is already seriously affected by climate change. The river section from the Elbe estuary to the weir near Geesthacht is affected by the tides of the North Sea. Higher water levels, stronger storm surges or spring tides and a higher tidal range threaten the Elbe marshes, as well as low-lying settlements, and industrial and agricultural areas. Siltation and sedimentation of the tributaries and harbours will also increase.

Experts are examining the ecological consequences from changes in the volumes of sediments or pollutants, as well as changes to the fish fauna. They are analysing the effects of new flood protection measures, or the decreased quality of the soil and ground water systems and any possible change to the brackish water zone.

The container terminal at Altenwerder
Image: www.mediaserver.hamburg.de/N. Keller





KLIMZUG-NORD

Strategic Approaches to Climate
Change Adaption in the Metropolitan Hamburg

Urban and spatial development adapted to climate change

The residential and urban areas in and around Hamburg will also be affected by the changes, as well as the Elbe marshlands. Here the focus is on two central questions: how should urban and spatial development look like considering a changing climate? What adaptations are required to maintain a

good standard of living quality in the various urban areas? Various strategies are being considered by a number of projects, including an analysis of new approaches to rainwater management due to heavy precipitations and inland flood protection. For example, mobile barrier walls are being tested.

With rising temperatures it is obvious that innovations in construction and a re-evaluation of inner-city open spaces will also be required. How, for instance, can development patterns be improved to provide residential areas with corridors of cool air? This question is currently being tested by experts with the help of scale models in wind tunnels. They are also examining climate-adapted construction methods and ideas for providing air conditioning in administrative and industrial buildings. And last but not least, the biotopes and nature conservation areas within the city are also being identified.

Adaptations needed in coastal protection

The climate change, with its potential for extreme storms and a rising sea level, also requires better coast protection in the long term. The Institute of River and Coastal Engineering at the Hamburg University of Technology is currently studying strategies permitting a more effective and a more flexible protection for foreshore areas. At the Lower Elbe, scientists are examining protection measures against high tide levels and floods. Models and field experiments are taking place to study the effects of dyke relocation, cascading polder systems, overflowable dyke sections, and new revetments – compared to conven-

tional methods such as increasing the height of dykes or installing flood barriers. These approaches are intended for use in combination with inland flood protection measures such as decentralised rainwater management, and they are being integrated into a comprehensive conceptual approach.

In addition, a local test is currently running on the island of Sylt, where the KLIMZUG project is studying how a revetment made from a mixture of polyurethane and gravel can stop and disperse waves. The strong bond of the revetment stones combined with their high porosity can provide strong resistance against sea swell. The material is also durable and easy to repair.

Agricultural and cultural landscapes fit for the future

The vicinity of Hamburg features a variety of landscapes – from heathlands to wet grasslands to agricultural areas. Seven sub-project groups are studying three particularly characteristic areas: the Biosphere Reserve in the Lower Saxony Elbe valley, the heathland region of north-eastern Lower Saxony, and the Altes Land near Hamburg.

KLIMZUG-NORD

Several field experiments were initiated here to further assist developing soil use – involving new methods of irrigation and fertilisation, soil management and tillage, as well as the cultivation of new varieties. Insect plagues new to Northern Germany are meanwhile being diagnosed and combated in the fruit cultivation area of the “Altes Land”. Here associations of fruit growers, farmers and scientists are working hand-in-hand. Black fruit rot is one fungal disease which was studied – defence measures have already been applied.

Other projects look into water supply issues examining changes in the groundwater and the consequences for the region’s supply. Meanwhile, another test examines the suitability of treated waste water for field irrigation.

Climate change and nature conservation

High temperatures and reduced summer precipitations are also affecting the vegetation of heathlands and upland moors in nature conservation areas. Which adaptations are required here? Researchers are analysing the consequences of climate change and continually rising nitrogen levels due to agriculture in a variety of outdoor experiments involving soil, vegetation and wildlife – in the Lüneburg Heath nature conservation area, the Nemitzer Heide heathland, in the Himmelmoor in Schleswig-Holstein and the Schweimker Moor in the Uelzen area. Focus points for these studies include the vitality of

common heather (*Calluna vulgaris*) and how conservation measures can be planned and implemented faster. The intention is to create a dynamic model to help orient nature conservation efforts to consider climate changes and to draw up priorities for future nature conservation work.

Feedback from the economic actors, politicians and the public

If KLIMZUG-NORD is to be successful, all relevant partners will need to be integrated. Therefore, it is an important task to improve the acceptance of the approach amongst politicians, economic actors and the public. For example, discussions with representatives of economic interests centre around the question of which measures should best be prioritised given limited resources. Also currently under study are such questions as to how specific markets for land and real estate are likely to develop under the influence of climate change.

An awareness of these issues also needs to be fostered amongst politicians. The “Governance” section deals with this task by implementing projects which regularly pass ideas for actions on to the authorities. The focus here is on a continuous dialogue to identify suitable new regulations and measures at a political level. Parallel to these processes, the public is always being informed, as adaptive strategies will also need to be integrated in the citizens’ everyday lives.



An irrigation system; image: Dräger

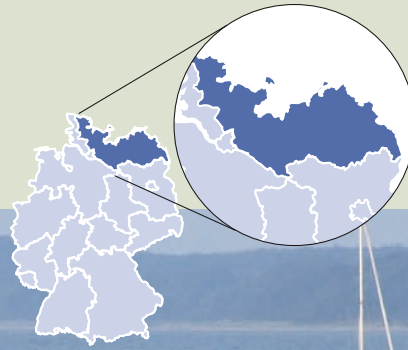


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RADOST

Potential for future sea level rise and more frequent storms

The German Baltic coast is 2,247 kilometres long. Every year, around five million people spend their holidays here. The average temperature could rise by approximately two to five degrees Celsius by the year 2100 and the sea level will also continue rising during that period. The extent of this rise is still uncertain, though the average worldwide figure of 20 to 80 centimetres currently expected by the Intergovernmental Panel on Climate Change also appears possible for the German coast of the Baltic Sea. There is a need, however, to also take into account local particularities such as the ongoing upward and downward isostatic adjustments which began during the last ice age. There is a need for further research in this area, as well as into the impacts of climate change on the strength and frequency of storm surges.

Warming is also already felt in the coastal region between Flensburg and Usedom. Naturally occurring changes in the coastline – most importantly coastal retreat – could intensify in the future while storms and floods may impact on the coast more frequently. At the same time, altered ocean currents and sea conditions may lead to sand displacements – while some sections of the coast retreat, others threaten to silt up. Effects on water quality can also

The Baltic coast facing enormous challenges

be expected. Reasons for such concerns include rising temperatures, altered nutrient contributions from rivers, and the modified behaviour of water inflows.

But what will this mean for the people and the environment of the region? What needs to be done to protect the coast and reinforce the basis of life in the area?

Climatic conditions have traditionally played an important role for communities living along the Baltic coast: the climate-dependent industries of tourism, agriculture and fishing are all important employers. The coastal area is also home to rare animal and plant species. The Baltic region therefore needs reliable information on likely climate changes and to improve awareness amongst all parties which will experience the consequences of climate change, as well as a range of adaptive strategies to face the challenges ahead.

Climate strategies for the coast

Scientists have been drawing ideas for strategies since 2009 in collaboration with representatives of business, state authorities, municipalities, professional associations and other organisations within the joint project RADOST ("Regional Adaptation Strategies for the German Baltic Coast"). Besides the core consortium of 17 institutions, RADOST also comprises a looser network currently contain-

ing about 150 partners. The work focuses on six fields: coastal protection; tourism and beach management; water management and agriculture; ports and maritime economy; nature conservation in connection with the uses made of the coastal area and marine environment; and energy, with a focus on renewable energies.

Working groups and networks have already been established for some of these topics. Building on this, RADOST intends to create a platform for public discussion in Schleswig-Holstein and Mecklenburg-Vorpommern with a special focus on the consequences of climate change. Annual regional conferences are held to inform the public on the status of current research and on adaptation options. In addition to these conferences and other regional discussion platforms, experts and users also meet in specific sub-regions: in the Bay of Kiel, the Bay of Lübeck, in Rostock and its vicinity, on the Fischland-Darss-Zingst peninsula, in the Adlergrund/Lubmin area, and in the Oder estuary region.

The Adlergrund/Greifswalder Bodden/Lubmin region, for example, features not only migratory bird stopover sites of European importance, but also major investments in energy infrastructure. The KlimaBündnis Kieler Bucht, or Bay of Kiel Climate Alliance, involves communities, scientists, environmental organisations, representatives of economic inte-

Kühlungsborn
Image: Tiepolt



rests, and public authorities in a search for ways to maintain the region's attractiveness for vacationers in the face of climate change whilst promoting climate-friendly tourism.

Individual research measures

But what is happening in detail? Natural scientists and engineering researchers first explore the climate changes

expected along the Baltic Sea coast. Then, they consider the implications of climate change for the coastline, the water quality, and the flora and fauna.

1. To find out how the coastline is changing, scientists are analysing where and to what extent sand is being eroded or deposited by altered water levels, swell, and flow conditions. This process involves analyzing the results obtained using models to simulate how the situation unfolds, throughout the 21st century, under different scenarios. These will then serve as a basis for recommendations given to authorities and municipalities in relation to the protection of sandy coasts.

2. To assess how the water quality of the Baltic Sea is changing, scientists begin by modelling the consequences of climate change and possible changes in land use for the catchment areas of the rivers flowing into the Baltic Sea. This serves to advise authorities and farmers who may need to reduce water pollution caused by agricultural nutrients.

3. To understand how the fauna and flora of the Baltic Sea waters respond to altered environmental conditions, data from the last 15 years are being analysed in detail and related to calculations modelling future climate changes. This is intended to help planners assess to what extent interventions in the ecosystem need to be re-evaluated against the background of climate change. A field experi-

Investing in the beach – the Kühlungsborn example

When selecting a holiday destination, the attractiveness of the beaches plays a key role for many people. The seaside resort of Kühlungsborn is one of the most attractive holiday destinations along the German coast of the Baltic Sea – not least thanks to the longest beach promenade in Germany. But the sandy beach of Kühlungsborn, which is very narrow in a number of places, is severely overcrowded in the high season. The number of guests is bound to increase given the tendency for warmer summers. The municipality commissioned a study looking into the options available for enlarging the area of the beach. These

options include a combination of various coast protection measures such as the creation of a sediment depot by means of pumping offshore sand onto the beach, the construction or extension of rows of wooden groynes, and the deployment of an offshore breakwater at a section particularly affected by coastal erosion. The approach conforms to the coastal protection strategy of the State of Mecklenburg-Vorpommern. This tourist infrastructure development effort is assisted by the state's ministry of economic affairs. The State Agency for Agriculture and the Environment of Central Mecklenburg, which is involved in RADOST, is advising the municipality on the implementation of the concept.

RADOST

ment is also being carried out at the periphery of the Kiel joint venture power plant, where the water temperature of the surrounding sea is raised by approximately two degrees Celsius by the discharge of cooling water. The researchers are using this phenomenon to study the consequences of higher sea water temperatures for the growth of algae and mussels. From this they can then derive perspectives for the cultivation of marine flora and fauna in a warmer climate.

Climate change and the regional economy

The climate processes will cause serious changes in the ecosystems along the Baltic coast. These changes will also have an impact on the local economy. But will it be a situation where everyone loses, or can there also be winners?

Tourism along the Baltic Sea may well benefit from climate change: higher temperatures will extend the swimming season, while tourists in the Mediterranean will more often tend to find their usual holiday destinations too hot. Higher water temperatures could also open up new market opportunities for farming seaweeds or mussels. Scientists are testing the possible use of such cultures for foodstuffs, or for cosmetics, pharmaceutical and medical products – or even for energy generation.

Also being tested is the possibility of designing dykes and other coast protection systems with geothermal installations incorporated in such a way that heat and cold from the sea or the ground can be used to heat and cool buildings. Using such installations, hotels and boarding houses could reduce their costs and emissions, while regional planning offices and tradespeople could also benefit from the necessary installation work.

Researchers at RADOST are currently collecting data on the way climate change is likely to impact the regional economy. On the basis of this information, they are developing scenarios for assessing its potential effects on income and employment as well as the costs and benefits of adaptation options.

Exchange of experiences with other regions

But RADOST is not simply keeping its results to itself. It is also exchanging its findings and practical options for change with similar projects both at home and abroad. RADOST partners are located in Denmark, Latvia and Finland, on the Polish Baltic coast, on the Slovenian and Moroccan coasts of the Mediterranean, and on the east coast of the USA.



Blue algae; image: Gauss



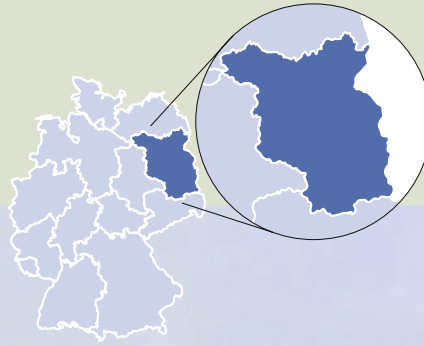
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INKA BB

Heavy rains, drought and tropical nights

The Berlin-Brandenburg region is located in a transition zone between continental to maritime climate. It is therefore particularly vulnerable to changes in climate. The temperature there has already risen by one degree Celsius over the last 100 years. The precipitations, which were always low anyway, are currently already shifting from the summer to the winter months.

The temperature could increase by as much as another two degrees by 2100, while tropical summer nights and severe rains could increase in frequency. But the water storage capacities of the region's sandy soils are limited. This renders the region very vulnerable to drought, particularly during longer periods of heat.

All this will affect not only the agriculture or forestry or even tourism sector. It will also impair water quality in an area containing approximately 3,000 lakes. And during hot periods urban areas will also heat up, generating potential health risks.

Yet the region's people are willing to face up to these changes. The INKA BB (Innovation Network for Climate Change Adaptation, Brandenburg-Berlin) network is elaborating suitable regional adaptation strategies. Involved in this effort are over 100 scientific institutions, agricultural and forestry businesses, energy companies, interest

Significant climate changes affecting Berlin-Brandenburg

groups, municipalities and authorities from Brandenburg and Berlin. They intend to make use of findings and innovations resulting from scientific research and practical applications in order to adapt to climate change in their land and water use, or also in public health management.

Developing regional adaptation strategies

The 24 sub-projects of INKA BB are searching for opportunities for adaptation. They are located in the two planning regions of Uckermark-Barnim and Lausitz-Spreewald, as well as in Berlin. Their key aspects: land use, forestry systems, water resource management, tourism, and healthcare. In each of these areas, local partners from economic actors and public administration collaborate with scientists and public authorities. They are aiming to develop solutions also capable of being implemented in other regions. The region covered by the project therefore covers a wide spectrum of environments: from rural areas to suburban districts and into urban spaces. For the duration of the project up until 2014, the network is tasked on the one hand with providing information on the possible impacts of climate change, and on the other with developing recommendations for action and management guidelines.

Agriculture and forestry

Climate changes are already posing enormous challenges for Berlin-Brandenburg's agriculture and forestry sectors. Extreme weather events such as drought or heavy rains are causing repeated economic losses. The situation calls for quick solutions. But what can be done to adapt the management of already low-yield soils to climate change? A number of projects are dedicated to these agricultural issues. They involve carrying out tests in some farms on the effect of soil management methods suited to drought conditions. The focus here is on making optimal use of the existing moisture in the soil for plant growth, and on preventing the loss of fertile soil particles, as well as the associated formation of dust.

Vegetable and agricultural plant varieties better adapted to the future expected climate are being tested. These may include new varieties of fruit, for example. Despite these efforts, the need for additional irrigation will probably be unavoidable in future. This will apply not only to asparagus growing, but also to other crops such as potatoes. And there will be insurance policies against climate damage, similar to the already existing policies against hail damage, to protect farmers from consequential losses.

Drought-damaged grain
Image: Dalchow, ZALF



Organic farming is facing unique problems of its own. Because it uses no synthetic fertilisers, the optimal nitrogen supply needed under the new conditions will have to be researched.

Climate change similarly affects the usage of pastures. There is a need to develop sustainable systems of management for Brandenburg's groundwater-dependent

grasslands. How would such a system affect grazing cattle and sheep? An adapted pasture management system is now being drawn up for 300,000 hectares of land. In relation to forestry, other projects are testing climate-adapted models of silviculture. Where pines now predominate, mixed oak and beach woodland is required. The scientists are also planning to study the advantages of agro-forestry, using fast-growing timber such as robinia and poplar as examples. Such hedgerows may, for example, offer wind protection and shade for arable crops, as well as providing farmers with additional income.

Catch cropping during dry periods

Climate change also leads to extreme weather situations in summer, with dry phases alternating with heavy rains. This can erode farm land, something to be prevented at all costs in locations with light soils. The Ökodorf Brodowin organic farm is therefore testing a climate change-adapted form of catch crop cultivation. After grain harvest and before straw collection, the moisture near the soil surface frequently evaporates unproductively. Brodowin is therefore studying to what extent this residual water can be used for catch crop

seeds. To this end the stubble fields are tilled as evenly as possible immediately after the threshing so that only a small amount of water from the deeper ground layers can evaporate. Simultaneously with the tilling, a mixture of catch crops amongst the grain stubble is sown. Such crops may include Egyptian clover, narrow-leaf lupine, buckwheat, fodder radish, common vetch, and sunflower. The approach prevents soil erosion and also makes use of the residual moisture and precipitations to create food for earthworms with the help of fast-growing catch crops.

Tourism and nature conservation

Nature and water tourism is becoming increasingly important in the region, particularly in Brandenburg's lakeland areas. The expected warmer summers may give a boost to these areas and open up new fields of activity for local residents. But an increased number of tourism and leisure proposals can also give rise to conflicts with the water resource management and nature conservation needs. INKA BB is trying to minimise these conflicts and to develop an approach adapted to the expected climate and attuned to the waters and their surroundings, because lakes, rivers and wetlands are highly sensitive to climate change and to changes of use.

INKA BB

Water management

Water management will present a key challenge for the region in the future. Water shortages are already being felt in summer, causing serious problems for water quality, given the fact that volumes of pollutant remain unchanged. Falling surface and ground water levels lead to supply bottlenecks and conflicts amongst the various users such as farmers and recreational visitors. At the same time, the increasing frequency of heavy rains and the sudden increases in volumes of water cause serious challenges to drainage systems.

The INKA BB innovation network is therefore currently developing water management systems for the smaller catchment areas of waters as well as the larger wetlands such as the Spreewald region. These systems will be aimed at adapting water management to the changed availability of water and to the attendant water quality problems. One important aspect in this is the creation of water retention and drainage areas, to unburden streams and rivers in heavy rains whilst keeping the water in the region. In addition, the region's lakes are being looked at in order to maintain or improve their water quality. A system for rain water stock management and ground water replenishment is also under discussion to secure Berlin's supply with potable water.

Health-related warning systems

Heat waves and the low air quality that accompanies them are particularly stressful for the sick and the elderly. Dosages of medication – for drugs used to treat chronic pulmonary disorders, for example – may also need to be adjusted. The scientists are developing a heat wave warning system for such people, as well as a telemedical information system for patients with cardiovascular diseases and respiratory disorders.

Strengthening the region for climate change

Adaptation to climate change also needs to be expressed in the regional planning. A review is made to determine where spatial plans lack climate adaptation measures. Scientists and regional planners for Uckermark-Barnim and Lausitz-Spreewald are developing a land use concept oriented towards climate change, mitigating damage and making use of opportunities. The intention is to make the region more robust in the face of climate change. This principally involves promoting the exchange of experiences. INKA BB has established two communication forums in the south and north of Brandenburg – the “Lausitz-Spreewald Regional Dialogue” and the “Water Landscape Workshop” in the Welse region of Uckermark-Barnim.



Water tourism on the Finow canal; image: Schobert, ZALF



Dr. Andrea Knierim

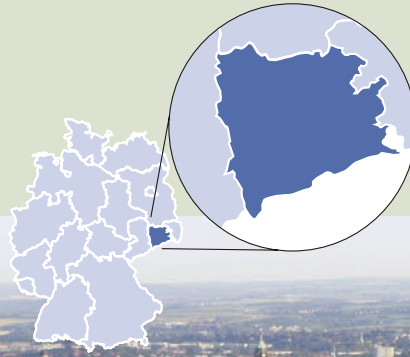
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REGKLAM

Strategy for an area of many facets

Dresden is regarded as the “Florence on the Elbe”. But will the future climate of Dresden and its surroundings be similar to that of central Italy today? Climatologists think that rather unlikely. But one thing is certain: the climate in the model region of Dresden is changing. The consequences are already tangible today: hot and dry periods can reduce the quality of life and give rise to health risks in densely built-up urban areas. The composition of airborne contaminants is changing; taking the form of fine particulates they can harm both people and technical installations. Extreme weather events such as heavy rains and subsequent flooding pose challenges when dealing with sanitation systems, soil protection and building management. Reduced amounts of snow could be damaging for winter tourism in the Erzgebirge region. However climate change could also bring opportunity. The recognition of both challenges and opportunities in conjunction with risk management is a particular challenge of this region.

The REGKLAM joint project, or “Regional Climate Change Adaptation Programme for the Model Region of Dresden” supports the region’s approximately 120 towns and municipalities in facing it. It is developing adaptive strategies for a multi-faceted region, ranging from the peaks of the Erzgebirge in the south to the lowlands on the border with

Climate adaptation in the Dresden model region

Brandenburg in the north, and is almost completely representative for the whole of Saxony in geographical terms. In addition to metropolitan Dresden, the area also includes smaller towns with a variety of economic structures as well as rural areas. The region's many facets make it susceptible to the effects of climate change in a variety of ways.

Fields of action and initial steps

Adaptation strategies for a wide range of fields of action are being developed in 17 sub-projects. The focus areas include urban development, water systems, agriculture and forestry, business and overlaps between them.

The climate adaptation programme created is intended to show what climate changes are likely to occur in the region and who is likely to be affected by them. It will also identify objectives for regional climate adaptation and propose measures, coordinate them, and introduce practical options for action. The first strategy is formulated in 2011. Thus the first steps to implementing the strategy are now being taken.

Networking regional actors

Regional adaptation to climate change can only be successful if local actors work together. One of the key aims thus resides in bringing existing networks together and

reinforcing them. Even now, around 60 project partners are working toward the same goal. Representatives of universities, research institutes, alliances and associations, as well as from public authorities on a Bundesland, regional and municipal level are jointly searching for solutions. The scientists have the support of a business advisory council specifically established for the purpose. Its members – representatives of industrial sectors important to the region – provide advice on the practical implementation of proposed measures.

Regional climate and development scenarios

Anyone who wants to recommend courses of action will first need to know what developments will likely occur in the future. Climate models and projections help to take a scientific look into the future. Thus REGKLAM has built up a database of all metrics and model outcomes for the region. On the basis of this information, climate trends up until 2100 can be taken into account in the climate adaptation programme, together with the uncertainties contained in the individual data sets. Developments affecting society or the economy, such as demographic change or technological progress, are taken into account in the scenarios. Merging all the findings provides comprehensive

Low water levels of the Elbe
Image: Michaela Surke



suppositions needed to predict likely changes in the climate of the model region over the next 20, 50 or 80 years, from which can be derived actions that need to be taken.

Focus area urban development

Climate change poses important challenges to urban and regional planners. Paving over land and a lack of greenery

can cause extensive heat stress in urban areas and reduce quality of life. Bio-meteorological simulations help to pinpoint severely affected areas and to assess the impact of possible alterations to buildings on cold and fresh air corridors. The health of trees at heat-stressed locations is being analysed to select suitable tree species for future planting. How buildings can be protected from such extreme weather as hail, flooding or extreme heat is another subject being studied by REGKLAM (see box). Amongst other things, the research concerns the question of how buildings can be better shaded by plants and built structures, thus keeping them cooler.

Adaptation in building construction

Hot periods and very dry conditions, but also heavy rain, already hint at the consequences of future regional climate change. These conditions sometimes cause enormous damage in buildings and can have a negative impact on the bio-climate. One of REGKLAM's objectives therefore consists in making buildings more resilient to climatic conditions and making them healthier for users.

Scientists and experts from the environmental department of the City of Dresden are thus researching what buildings are characteristic for the region. Decisive factors in this analysis include the year of

construction and the way such buildings are used. As the next step they are studying the damage that may be caused by climate events such as high temperatures, heavy rain, flooding or hail, and how such damage could compromise the usefulness of such buildings.

As a result of this process building measures that might help to avoid climate-related damage can be recommended. The focus here is on improvements in the structural design and building services engineering. The particular solutions identified will promote climate-adapted construction within the region to a much greater extent than heretofore. These solutions apply to new builds as well as to renovation and upgrading work.

Focus area water systems

Projected climate changes involving such conditions as longer dry spells, rising temperatures and changed patterns of precipitation pose new challenges for the management of water resources in the Dresden model region. So what climate-related changes await hydrological system?

What measures are likely to secure the supply of potable and industrial water in the long term, as well as providing the equivalent of today's drainage quality? A key role is played by the river dams of the model region: they not only supply water, but also play a central role in flood

REGKLAM

protection. Their sustainable management (e.g. optimisation of the storage distribution) is thus a central element of the climate adaptation programme.

Water treatment strategies are also in development to enable short-term responses to changes in the quality of raw water. In general, the objective of the urban water management plan in the model region is to develop small-scale, transferable action packages. For this reason, methods are being developed with partners in the field to allow the insights obtained in the project to be appropriated as an integrated whole by the whole model region.

Focus area agriculture and forestry

Where land use is concerned, climate change has contradictory effects: farmers in the Erzgebirge region benefit from greater warmth and longer growth periods, whereas forest owners in eastern Saxony can expect a greater bark beetle risk to their spruce trees and a greater risk of forest fires in their pine forests.

In the model region there is only limited leeway for redistributing agriculture and forestry areas to address such risks as water erosion or drought. Adaptation to climate change therefore needs to be implemented by means of changes in cultivation methods. In agriculture, new rota-

tion systems and better adapted field crops are recommended. In forests, which have a longer life cycle, natural adaptation processes are being supported by introducing drought-resistant maincrop tree species such as Scots pine or oak, by maintaining a variable population structure, as well as by using a broad range of tree species.

Focus area business

Innovative cooling concepts, new products, the efficient deployment of resources and energy – there are many solutions for dealing with the consequences of climate change in business. But what are the impacts to be expected by businesses in and around Dresden? And what meaningful measures can be taken in response to them? Research in this area is focussed on business sectors that are relevant for the region and/or sensitive to climate change, such as the food industry, construction, microelectronics, and tourism. The analysis of these sectors takes the consequences of global economic change into account. One objective of REGKLAM: enabling the region's businesses to determine independently how the air temperature, rainfall or wind, for example, will affect buildings, personnel or value creation business processes, such as procurement and production. The project is developing a software program able to support businesses in achieving this.



Forest, fields, villages; image: Michael Grunert, LfULG



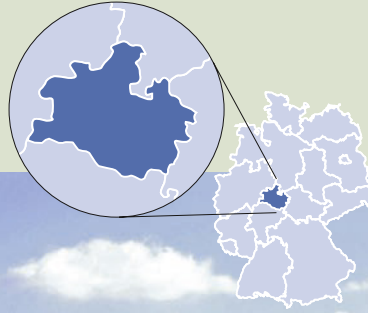
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KLIMZUG- Nordhessen

Extreme weather events in the uplands

Northern Hesse is a typical low mountain region with plenty of forest, dotted with villages and with Kassel being its largest city. This rather rural cultural and natural landscape has a population of approximately two million. In the future, the region is likely to be more strongly affected by extreme weather events such as heat waves and heavy rains as a result of climate change. It is expected that summers will be even hotter and drier, the winters warmer and wetter.

The Northern Hesse region's key industries of energy technology, forwarding and logistics, tourism and agriculture will be just as affected by the consequences of climate change as the health of a population that is ageing at a time of demographic change. Even today, the forestry and tourism industries are suffering from severe storms that uproot trees and can cause extensive damage.

Precipitation in Northern Hesse may also change due to climate change. The large number of rivers appears to guarantee the water supply for agriculture and forestry, yet it is uncertain how altered precipitation patterns will affect local tree species and soils. Therefore the KLIMZUG-Nordhessen joint project ("Regional Network for Climate Change Adaptation - Northern Hesse") intends to design climate scenarios and adaptation measures tailor-made

Northern Hesse in the process of climate change – Germany's centre prepares itself for the future

klimawandel
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gestalten | nordhessen

REGIONAL NETWORK FOR CLIMATE
CHANGE ADAPTATION – NORTHERN HESSE

for the region. The actors involved in this effort include districts, municipalities, research institutes and representatives of various business sectors, as well as such social groups as churches and NGOs.

Realising ideas for climate adaptation at local level

Successful and timely adaptation to climate change requires close cooperation between politicians, public authorities, private companies and citizens. KLIMZUG-Nordhessen aims to sensitise these groups to climate change and to promote cooperation between them. Only forward-looking action can help the region reduce risks to its infrastructure, human health and environment, and to promote business development opportunities.

And that is what the network's 27 different sub-projects are doing. The focus areas of the individual projects include scenarios, resources, energy, transport, society, tourism, and health. Some projects focus on providing scenarios by modelling the small-scale effects of global climate trends. The majority are concerned with researching and developing adaptation measures, or identifying ways of encouraging acceptance and implementation of such measures by society and business sectors. The newly developed concepts for adapting to climate change

are being put into practice even while the project is still running. At the same time the project is also studying the effects of such measures.

The KLIMZUG-Nordhessen network has established three institutions to enable a closer tracking: "Climate adaptation officers", "Climate adaptation managers", and a "Climate adaptation academy". Their task is to mediate between the interested parties from science, public administration, the businesses and society respectively.

Where are these new institutions located? The five climate adaptation officers work on the premises of the five administrative districts of the region, the City of Kassel and the Regional Council in Kassel. Three positions for climate adaptation managers have been created in the Northern Hesse regional management's clusters for mobility, decentralised energy technology, and tourism and health. Meanwhile, the climate adaptation academy, with a staff of three, is an organ of the Kassel region adult education centre.

Relevant fields of action for northern Hesse

But what is actually happening in the 18 research and nine implementation projects? Three projects are currently addressing resources in agriculture, water manage-

Lake Edersee
Image: Frank Roland



ment and forestry, an area of key importance for the region. The altered availability of surface and ground water is decisive in these areas. How and where different tree species will grow best, for example, can be derived by calculating water balances. Tree species such as spruce for example no longer suit local conditions and need to be replaced by beech trees or non-indigenous species

Heat prevention network for the elderly

Of all people, elderly people are most affected by the consequences of climate change. A central problem to lower the effects of heat stress for seniors living alone is to find ways how to reach and address the target group considering their increased isolation in society. To address this problem, the health authority in the region of Kassel initiated the project “Targeted prevention of heat-related health risks for seniors in the community” building on existing networks within residential districts. Relevant people will be integrated in and contacted by these networks.

Initially, a newly founded “Heat prevention network Kassel West” organised a district conference on the subject of “the older generation and climate change”. During this conference the network introduced both itself and the KLIMZUG project to the public, and a number of prevention measures and promising access routes to older people were also presented. The conference served to initiate a district-wide hot weather warning system primarily designed to reach seniors living on their own. In addition, an advisory centre is to be established to provide housing owners with advice on the options available for taking heat stress events into account when refurbishing and in new builds.

such as Douglas fir and grand fir. Moreover, mixed woodlands also need to be promoted.

In agriculture, heavy rains are causing increased erosion, for example in the cultivation of energy plants such as maize and canola. This problem can be prevented using two-crop systems or mixed cultivation – or by the conversion of arable land into grassland. A project explores possible alternatives available.

The projects in the energy field of action are studying the adaptation requirements in various industrial sectors. For example, a new decentralised supply of energy is capable of catering for a demand for heat, cold, pressurised air and electricity calculated for up to three days in advance. Everything is flexibly and efficiently adapted to the companies’ demand by means of an intelligent control system. Further projects within the same field are addressing the question of how indoor comfort can be maintained or increased during heat waves via both technical solutions and changes in behaviour. An agricultural pilot unit is developed to dry damp crops using solar energy. A salt solution absorbs moisture during the drying process and the moisture is then removed from it using heat energy from solar collectors.

The projects in the transport field of action are needed to respond to the increasing air pollution and extreme

KLIMZUG-Nordhessen

weather situations experienced by the region. They are aimed in particular at enforcing local public passenger transport and increasing the efficiency of the goods transport.

Climate change also means that infections spread by insects and arachnids – such as ticks – are becoming an increasing risk as a result of rising temperatures. Against this background, the health field of action is tackling a monitoring system to detect pathogens of Lyme's disease and meningitis. The field also includes projects for providing healthcare to people especially affected by heat, or to situations where the provision of outpatient care services is put at risk by severe weather conditions. This will concern seniors living alone, for example, as well as people with risk factors for such problems as cardiovascular ailments.

Last but not least, the climate-sensitive aspects of tourism in Northern Hesse (winter sports and activity tourism or health spas) are also being examined for possible promising opportunities for adaptation. How can it be ensured that these segments are fit for the future and capable of creating added value? The projects hope to identify important pointers via surveys carried out on tourists, spa residents, hotels, and health spa specialists. One assumes that the health tourism segment will be

less affected by climate change, since Northern Hesse will presumably retain its healthy mild climate, and because many spa-based attractions are not weather-dependent. But where winter sports are concerned, there may be a need to create other attractions.

Transdisciplinary and transnational cooperation

Ultimately, the results are disseminated within the network and a guidance for each action is prepared – i.e. for political panels and public administration, for enterprises and private citizens in the environment they live in. The various results so far obtained are also being discussed for example with partners in the Lower Austrian Waldviertel region. This region, with which Northern Hesse has been exchanging experiences in sustainable regional development for two decades, resembles Northern Hesse both climatically and in structural terms. It is faced with such similar challenges that the benefits of learning from each other's solutions are obvious.



Heat and old age; image: Grewe

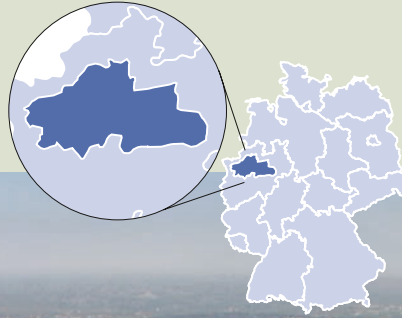


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Weather extremes and water resource management in the Emscher-Lippe region

The conurbation of Dortmund, Bochum, Essen and Duisburg forms the core of the Ruhr region and one of Europe's most densely populated areas of economic activity. 3.8 million people live here within the area drained by the rivers Emscher and Lippe. This region contains strong contrasts: the Emscher area is industrial in character, adjoined by the more rural Lippe region to the north.

The future climate here will be characterised by wet, less cold winters and hotter, dry summers with frequent heavy rains. The average annual temperature will rise by between 2 and 3.5 degrees Celsius in the area drained by the Emscher and Lippe rivers by the year 2100. The annual rainfall will only increase by 5 percent, but will increasingly shift from summer to winter. This change will entail tangible consequences for the regional water balance in western Germany within only a few decades, and hence also for the population's living and economic conditions. The *dynaklim* network ("Dynamic adaptation of regional planning and development processes to the consequences of climate change in the Emscher-Lippe region") therefore primarily concentrates on the future availability and usage of water in the region.

Climate change in the densely populated Ruhr area

The network and the research project

The *dynaklim* group includes more than 50 network partners: companies involved in the regional economy, water boards, municipalities, universities and research facilities, as well as regional and civil society initiatives.

They are currently drawing up a joint regional adaptation strategy by way of 18 sub-projects in five subject areas. The network's thematic platforms "Water balance and infrastructure", "Climate-focussed economic development", "Climate-proof organisation and financing", "Civil society and participation", and "Politics, planning and administration" have been established for this purpose and are used regularly to exchange know-how and experiences. The actors involved in the sub-projects are elaborating measures to be implemented in the Emscher-Lippe region, but also transferable to other regions. To this end the *dynaklim* network ensures a constant exchange of new knowledge and practical experiences between the project partners and with the public. The design of the network and strategy is meant to ensure that by 2014 the adaptation process thus initiated can be continued by the region on a self-sustaining basis once the funding has stopped.

Regional climate adaptation with the Roadmap 2020

The central objective of the *dynaklim* network is the elaboration of a "Roadmap 2020". This requires a coordinated and cross-sectoral adaptation strategy to be provided by the year 2014. This roadmap fleshes out important fields of action such as water resource management, economic development, or urban and regional planning, as well as detailing what adaptation measures are to be provided by what actors from politics, the economy, education or society, and at what point in time, as well as what resources are required to achieve this. *dynaklim* initiates and moderates this regional strategic process, mobilises the relevant local players and makes established know-how available. At the same time, the results and experiences gained from the project work and pilot areas are continually absorbed into the roadmap effort.

New approaches to adaptive water systems

The Emscher-Lippe region is naturally rich in water – which one would think an advantage in a time of climate change. But just like everywhere else in the Ruhr region, in the next 50 to 100 years people here will also need to

Bicycle tourism on the Emscher trail
Image: Emschergenossenschaft



prepare for climate changes that are already noticeable. This particularly applies to water supply and sewage disposal systems, as well as to ground and surface waters.

Essential questions in this regard are: how is the urban infrastructure prepared for the future higher frequency of floods entailed by heavy rains? How are we to deal with dry periods? How will the availability of water be

Forward-looking management of competing water uses

In the central Lippe area between Hamm and Wesel ground and surface water levels can be expected to fall in future hot summers. The hot summer of 2003 has already intimated the consequences to be expected of climate change. Given the higher expected frequency of spells of dry weather, agriculture, for example, will require additional water, which may potentially be unavailable exactly in the periods it is needed, or may have to be shared with other water users. If such users' water requirements increase at the same time, the quantity and quality

of ground and surface waters may suffer as a result. Aside from agricultural consumption, the requirement for potable water and the needs of environment, water users along the Lippe river also include mining operations, the users of waterways and the energy industry. Adopting new approaches to communication and management and ensuring continuous knowledge transfer, *dynaklim* aims to enable the various water users along the Lippe river to exchange information of their requirements more intensively, and thus to formulate joint solutions by balancing the various interests involved.

affected? How will severe rains and heat waves affect the water quality of rivers and lakes, or of ground water? How can competing interests be coordinated when water is scarce? And how can the sensitive ecosystems of the regional green belts and forested areas be adapted to climatic extremes?

In this area, the *dynaklim* projects are elaborating new concepts for a sustainable and adaptive management of the water balance. Technical solutions enabling more precise predictions of, and more flexible responses to, the consequences of climate change for the water balance, water infrastructure and urban climate are being developed. Comprehensive hydro-meteorological data are being gathered and more exact precipitation data extracted from them to provide a basis for this work. Initial draft concepts for sustainable ground water management and ground water use in the cities have already been delivered. Considerations on adaptive rain water management have already been drawn up. In addition to this, new approaches are being elaborated for the future coordination of competing users of ground and surface water in the central Lippe region. This pilot project for the Lippe area is providing an important part of the basis for the entire regional climate adaptation strategy in the Emscher-Lippe region (see box). Solutions to

the problem of securing a reliable supply of drinking water for an adaptive approach to urban water management are also being designed. And the results of an urban quantitative climatological network are set to be included in a guideline to improving the urban climate. But how and when can all this be implemented? To find out, *dynaklim* is cooperating with experts in water management, public administration and the economy of the region in studies to identify the regional costs to be expected in the future for climate adaptation, and what a future climate-proof, cost-efficient organisation and finance model is likely to look like in relation to water management.

Climate-focussed economic development

However, apart from the water management, other areas of the economy of the Emscher-Lippe region are also affected by climate change. For the businesses this will often entail risks. But an adaptive economy will also be able to identify opportunities to develop new products, technologies and services.

The *dynaklim* network intends to recognise such market and innovation potentials early on, and render them usable to the businesses of the region. An in-depth analysis is

planned to expose the strengths and weaknesses of the regional economy, to identify new ideas in adaptation and to find and network pioneers in adaptation in the region. A climate-focussed development strategy is due to be jointly elaborated with actors in the economy, in public administration and in politics.

Close networking and knowledge management

Ideas, strategies and plans are of little help if they are not implemented. The *dynaklim* network is therefore collaborating closely with decision-makers and implementers in the municipalities and in water management bodies, the economic institutions of the region, and with social initiatives and actors. At the same time, improved cooperation methods and more effective approaches to adaptation management are being jointly developed and put into practice. Close networking and an approach to knowledge management focussed on disseminators within the region will foster trust between the protagonists and create efficient working, coordination and decision-making structures. This in turn will pave the way for continued development and the successful implementation of the regional adaptation strategy.



New bridge in the Emscher landscape park; image: EmscherGenossenschaft



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The Support Process

Researching adaptation needs, networking options and public relations

The work of the seven KLIMZUG networks initially relates to the participating regions. But exchange between networks and communication to the outside are also important. The Cologne Institute for Economic Research is addressing this need by setting up a support process. It is focussed on two tasks: firstly, the Institute monitors and supports networking between the KLIMZUG groups and derives conclusions from this to identify synergies, conflict potentials and examples of best practice. It also publishes the central issues and solutions identified in these networks. Secondly, the Institute analyses the adaptation needs of businesses and municipalities nationwide in the face of climate change.

The KLIMZUG-funded regions are intended to serve as an indication of what a successful and practicable adaptation model capable of serving as a prototype for other regions might look like. To give KLIMZUG a nationwide perspective and improve its ability to communicate its experiences with different adaptation strategies, the Cologne researchers plan to find out what solutions lend themselves to being transferred. Connected to this are questions regarding the extent to which solutions to problems can be exported to other

countries, whether they are facing similar or very different climate changes.

Analysis of opportunities and threats in climate change

Economic developments happening under changing conditions are the main object of research at the Cologne Institute for Economic Research. Climate change and climate policies form part of these conditions. And precisely where adaptation to climatic effects is concerned, businesses and politics are increasingly paying attention.

Thus in relation to KLIMZUG the researchers are examining the assessments and options for action of decision-makers in both the economy and in local government. The data required for this analysis were obtained in two large surveys carried out amongst business and municipal government representatives in the spring of 2011. The central points of the surveys included climate-related vulnerabilities, adaptation needs, and the conditions required for adaptation measures.

The surveys show what climatic changes are expected by respondents, to what extent such changes will entail opportunities or risks, and what the information needs they have. Besides the direct, i.e. natural, physical effects of the climate, indirect effects brought about by new legal

regulations and marketplace changes both for suppliers and on the demand side also need to be considered as they affect businesses. The team will also clarify the status of opportunities for adaptation and how they can be enhanced. This area will consider the question as to who is given the task of dealing with the challenges of climate change, and what resources are available to them.

Adaptation needs in the economy

For the great majority of businesses, climate change has thus far only been a topic where climate protection or climate politics is concerned. Future consequences of the climate do not appear relevant to them in many of their decisions. But businesses are increasingly affected even today when international suppliers and customers experience production failures or delayed delivery due to extreme weather events. Here is where businesses need to adapt.

The Cologne Institute for Economic Research takes the value chain into account and analyses such possible critical operations as procurement, production and distribution. The result is a detailed picture of the opportunities and threats facing the various economic sectors, as well as the weaknesses and strengths of the businesses concerned.

Positioning KLIMZUG nationwide

Adaptation needs in the municipalities

In parallel to all this, of decisive importance for KLIMZUG are the adaptation needs of and adaptation options available to municipalities. In this area, a survey has been carried out amongst local directors of environmental affairs and mayors. This is to help the scientists determine to what extent already existing solutions or ones currently in development are required by the municipalities and can be adopted by them.

Municipalities greatly vary in their organisational structure, size, financial resources, and of course also in their location. Storm surges, floods and droughts do not represent a risk to be prepared for everywhere. Heat islands do not pose a problem in all cities. Some municipalities are very dependent on tourism, while others have a strong commercial component. Connections with neighbouring municipalities also differ. They may either mutually support or obstruct one another. The results of the survey show the importance of cooperative solutions for planning and implementing adaptation measures, differentiated into such areas as healthcare, tourism, water and energy supply, or agriculture and forestry. Municipalities are united by the universal aim of maintaining their attractiveness by offering favourable conditions to visitors, residents and businesses.

Networking and public relations

In parallel to this nationwide climate adaptation study, the support process provided by the Cologne Institute for Economic Research also assists joint projects in communication and organisation. In so doing it provides the researchers and practitioners involved with opportunities to exchange experiences in particular cross-sectional topics. The Institute is actively looking for such themes of general relevance for discussion and exploration in workshops.

In addition to this, KLIMZUG and its project activities are also being presented at many events as a component of the Federal Government's High-Tech Strategy for Climate Change. The KLIMZUG networks are deeply involved in these efforts and generally also attend such events in person. Together with representatives of these networks, the Cologne team is elaborating materials and publications designed to provide a uniform presentation of the individual KLIMZUG networks, as well as a presentation of the overall funding programme. It thus provides support for the transfer of results and experiences between interested parties. A quarterly newsletter provides information on the KLIMZUG regions and the overall KLIMZUG network, while a webpage at www.klimzug.de offers the latest news, as well as providing a central portal for accessing the individual websites of each of the KLIMZUG networks.



Flooding in Cologne; image: Florian Lang



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