| CLIMATE CHANGE |

Germany in the midst of climate change

Adaptation is necessary

Umwelt Bundes Amt
Für Mensch und Umwelt

KomPass
Kompetenzzentrum
Klimafolgen u. Anpassung

Imprint

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Climate change and climate impacts

Based on the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) submitted in 2007 concerning the causes and impacts of global warming as well as options for mitigation, the scientific findings are unambiguous. In all likelihood, i.e. with a probability of over 90 percent, the rise in the mean global temperature since the mid-20th century is attributable for the most part to the anthropogenic increase in the concentration of greenhouse gases. [1]

The currently observed impacts of climate change represent the reaction of the climate system to the greenhouse gas emissions of the past two centuries. Because of the inertia of the climate system, the impacts of the now significantly higher greenhouse gas emissions will not become noticeable until the coming decades and consequently the climate of the Earth will presumably continue to heat up for many centuries to come. Therefore, in addition to reducing emissions, which will continue to be essential, it will also be increasingly important to develop and implement strategies for adapting to this inevitable climate change. The Competence Centre on Climate Impacts and Adaptation (KomPass) at the Federal Environment Agency (UBA) makes a contribution to this.

Global climate change

Since the advent of industrialization in the 18th century humankind has influenced the composition of the atmosphere. The global atmospheric concentrations of the gases causing the greenhouse effect have increased considerably as a result of human activities (consumption of fossil fuels, changes in land use, clearing of many forests) since the 18th century.

Changes in the atmospheric concentrations of greenhouse gases and aerosols (small, airborne solid and liquid particles in the atmosphere), insolation and the characteristics of the land surface change the energy balance of the climate system. The observation data of the past 100 years clearly show that the climate is heating up. Between 1906 and 2005 the global mean near-ground temperature rose by 0.74 degrees Celsius (°C). Mountain glaciers and snow cover declined on average in the northern and southern hemisphere. In the 20th century the sea level rose by around 17 centimetres (0.12 to 0.22 metres) on a global average. The reason for this is thermal expansion of seawater as well as melting glaciers, ice caps and ice sheets. [2]

Scientists make forecasts of future climate change by means of climate models. The results are based on a large number of model simulations and a broad selection of climate models. Thus, it is possible to indicate best estimates and probable ranges of uncertainty for the forecast changes. The IPCC conducted climate model simulations for various so-called emission scenarios. This means the researchers use alternative scenarios for greenhouse gas emissions as the basis for their climate models. The projected mean global warming on the Earth's surface for the period 2090–2099 as compared to 1980–1999 is shown in Table 1.

TABLE 1
Projected mean global warming on the Earth's surface for the period from 2090–2099 as compared to 1980–1999

Emissions scenario	Best estimate	Probable range
B1	1,8°C	1,1 2,9°C
A1B	2,8°C	1,7 4,4°C
A1FI	4,0°C	2,4 6,4°C

The warming of approx. 0.5°C that occurred between the preindustrial age and the period from 1980 to 1999 is not included in these figures. If one adds this temperature increase, a warming of 2.3°C results for the low emission scenario, 3.3°C for the medium scenario and 4.5°C for the high emission scenario. These figures exceed a maximum temperature rise of 2°C compared to the preindustrial level. Many experts view this as a threshold above which dramatic damage may result as a consequence of climate change.[2]

» It is high time that we take a closer look at the impact of global warming in Germany. We must adapt today so as not to be overwhelmed by its economic and social consequences tomorrow. To this end we need a joint national strategy, and all the important stakeholders must be on board «

Sigmar Gabriel
(Federal Minister of the Environment)

Climate change and climate impacts for Germany

Global climate change is also becoming noticeable in Germany. The annual mean temperature in Germany over the past 100 years rose by about 0.8°C. This warming trend accelerated substantially in the course of the past decades and has now increased to nearly double that rate at a pace of 0.15°C per decade. Especially the winter months became warmer. The last ten years of the 20th century were the warmest decade of that century. Nine of the years between 1990 and 2000 and also the majority of the years in the 21st century to date were warmer than the long-term average temperature of 8.3°C. In the past 100 years precipitation has increased significantly, primarily in western Germany, the greatest increase taking place in winter. In eastern Germany, by contrast, particularly the summer precipitation declined. Climate changes are also manifesting themselves in the unusual intensity of extreme weather events, such as heat periods and heavy precipitation. They are longer in duration, more frequent or more intense. Because of the great damage potential of such extreme events, they are also exceptionally important from an economic point of view. Various model calculations carried out in climate research come to the conclusion that extreme events will occur more frequently and intensely in future than to date.[3]

The Federal Environment Agency (UBA) has published the results of regional climate models that calculate possible climate changes in Germany up to 2100. The regional climate models are based on global climate models and enable a more extensive forecast of the possible development of the climate in Germany up to the year 2100. In a comparison of the possible climate in the years 2071 to 2100 with the period from 1961 to 1990 the climate models show that[4]

- temperatures in Germany will presumably increase with regional and seasonal differences by 1.5° to 3.7°C,
- there will be fewer frost days, more hot days and more tropical nights, and the number and duration of heat waves will increase,
- summer precipitation will decline by 30 percent on average and at the same time the frequency of heavy precipitation will increase,
- we must expect a shrinkage in glaciers and snow cover in the Alps and
- the sea level could rise significantly by 30 centimetres on average. It has to be kept in mind here that a considerably higher rise in sea level must be expected for part of the coasts in Germany due to land subsidence and enlargement of the tidal range.[5]

Regional impact of climate change

An examination of natural areas in Germany brings to light the regional differences of climate change and its consequences. The regional climate models of the UBA expect a comparably low temperature rise for the coastal regions of the North and Baltic Sea up to the end of the 21st century. The reason for this is the proximity to the sea and the relatively balanced and moderate coastal climate. However, the frequency of so-called key temperature days (ice days, frost days, summer days, tropical nights) will change significantly in some cases. With regard to precipitation, the models predict an above-average rise in winter precipitation for the North Sea coast and the northwest German lowlands and a particularly sharp decrease in summer precipitation for the Baltic Sea coast and the northeastern lowlands. In the northeastern regions of Germany, which are already affected by drought today, this may lead to problems – for example in agriculture or water management – unless suitable adaptation measures are taken. [4]

According to the regional projection, the central low mountain range and the Harz region will retain a cooler climate as compared to other parts of Germany. The number of frost days will not change as much as in lower regions. However, the number of summer days will more than double in some areas. The precipitation level in these regions is already high at present. The projections point to an above-average decline in summer precipitation in the Harz mountains and Harz foothills region while winter precipitation will be characterized by an above-average increase.

The region of the low mountain range on both sides of the Rhine stands out in particular for its projected precipitation behaviour. The models project this region to experience the highest increases in average winter precipitation in all of Germany. Summer precipitation, on the other hand, will decline to a relatively minor extent. As a result, the projected annual precipitation also shows a shift to a generally higher-precipitation climate for the low mountain range on the left bank of the Rhine. Consequences can be expected for agriculture and forestry as well as for flood protection (see Table 2).

For the Upper Rhine Graben climate change will become manifest in particular by a substantial increase in hot days and nights as well as in the number and duration of hot seasons. This increase will be a challenge for the health care sector in particular. Furthermore, the regional climate models project a higher temperature rise for the foothills of the Alps as well as for the natural landscape in the Alps and the northern Bavarian hilly country in southern Germany than for the Bavarian Forest and the coastal regions. The precipitation in southern and southwest Germany could also decline to a very substantial degree. This, in combination with the high summer temperatures, could significantly increase evaporation of the residual precipitation.

» We can very easily forecast what happens with coral reefs when the ocean rises and becomes acidifies. When it comes to tourism in Harz in 2050, it is a much more complicated matter «

Professor Hans Joachim Schellnhuber
(Director of Potsdam Institute for Climate Impact Research and Climate Protection Commissioner of the German Federal Government)

Risks of climate change for Germany

The overwhelming majority of climate experts agree that climate change will also have severe consequences for people and the environment in Germany. The knowledge about imminent risks rose significantly in the past years. Now it is important to identify vulnerabilities and future risks for individual regions and sectors in Germany.

Initial comprehensive analyses indicate that most sections of society as well as many regions are moderately to highly vulnerable to climate change. Climate change also manifests itself in an unusual degree of extreme weather events, such as heat periods and heavy precipitation. They last longer, are more frequent or more intensive. It is not possible to calculate the damage caused by such events in advance with adequate reliability. However, a look at the recent past shows the possible dimension for Germany. The Elbe flood in 2002, for example, caused total economic damage of € 9.4 billion in Germany, the hurricanes "Lothar" and "Martin" in 1999 were responsible for damage amounting to over € 14 billion[6]. As a consequence of the hot summer in 2003, statisticians counted over 7,000 deaths more than in normal summers in Germany[7]. Sectors affected to date include forestry, agriculture and water management, and increasingly the energy and finance sectors, as well as tourism in the low mountain range regions and the Alps. Climate change also poses new challenges for human health, nature conservation and coastal protection. Table 2 presents a selection of possible impacts of climate change in different fields of activity and sectors[8].

UBA studies show that southwest Germany (Upper Rhine Graben), the central sections of eastern Germany (northeast German lowlands, southeast German basins and hills) and the Alps have the highest vulnerability to climate changes. Water resources, human health and tourism are considered to be exceptionally prone to the impacts of climate change. Agriculture, forestry, biodiversity and nature conservation as well as transportation and settlement development have also been identified as susceptible to climate change. The studies additionally show that more or less extensive options for adaptation exist for all regions and fields of activity. If they were implemented, the vulnerability in nearly all fields of activity and regions would be decisively reduced. However, knowledge about possible means of adaptation is still very incomplete in some cases. In some areas where experience has already been gained with suitable protective action, there are substantial deficits in the implementation of such measures[9].

TABLE 2
Selection of possible impacts of climate in selected fields

Field of activity / sector	Examples of possible climate change impacts
Human health	illnesses and injuries caused by heat waves, storms, floods, avalanches or landslides as well as altered areas of spread of vector-borne diseases; in the cities great heat intensity that may lead to more cardiovascular problems all the way to deaths
Agriculture	impairment of yields, particularly in regions that will be more arid in the future, as well as declining crop yield reliability due to increased climate variability; increase in soil erosion (summer: wind erosion, winter: erosion due to water); mounting risk of impeded drainage, flooding or drought stress; altered conditions of leaching of nutrients and contaminants into groundwater and surface water
Forestry	increased vulnerability of forests unsuitable for their location as well as greater risk of forest fires and increasing pressure due to pests and extreme weather conditions
Water management	increased heavy precipitation, greater risk of floods in winter and spring, more frequent low water in summer and altered groundwater tables with possible consequences for drinking water supply; inadequate rainwater drainage in cities
Nature conservation and biodiversity	threat to species diversity, especially in wetlands and mountainous regions, with consequences for nature conservation goals
Transportation	impairment of inland shipping by virtue of more frequent high and low water levels; destruction of infrastructure due to extreme events
Tourism	reduced snow-reliability in mountainous regions as well as improved prospects of economic success for tourist destinations on the coasts; possible negative consequences for tourists because of increased occurrence of jellyfish and toxic algae on the coasts
Flood and coastal protection	more frequent and intensive flood events place demands on flood and coastal protection facilities; failure of the protective facilities means risk of damage
Regional and settlement development	development areas and building structures subject to risk due to increasing flood events, reinforcement of heat island effect in inner cities, aggravation of conflicts between protection of valuable areas and different human use demands

Possible adaptation strategies and measures

Once the climate-related vulnerabilities at the regional and sectoral level as well as the resulting risks, and possibly opportunities have been analyzed, the next step is to identify, plan and implement policies and action for adaptation to climate change for the most vulnerable sectors.

Excursus: What is adaptation?

Climate adaptation measures are taken to cope with the consequences of a changing climate and avoid future risks. Adaptation is aimed at reducing the risks and damage from current and future negative impacts or achieving potential advantages in this way. Adaptation encompasses both national and regional strategies as well as practical measures taken at all political levels or by individuals. It can be preventive or reactive, and it applies to natural as well as to social systems. Ensuring the sustainability of investments over their entire lifetime taking explicit account of the changing climate is often referred to as climate proofing [10].

Example of flooding[9]: Climate change will have an impact on the water balance and frequency of flooding. Building owners, administrations and companies have to prepare themselves for this at an early stage in order to avoid damage. The Flood Protection Act enacted in 2005 provides a good basis. A major element of preventive flood protection is the designation of flood areas. This makes it possible to maintain retention areas where the flood can spread without causing damage and to reduce damage due to floods. Development and construction of infrastructure with a high risk potential must be avoided in areas vulnerable to floods.

In addition, the planning bases for flood protection measures should take into consideration future impacts of climate change. Technical protective structures should be designed flexibly in such a way that they can be expanded relatively easily as required. For example, dikes have to be planned and built such that they can be raised later on by increasing the slope inclinations or reinforcing the dike on the landward side. Reinforcing the dike at a later time means that the areas behind the dike have to remain open and must not be developed. The federal states of Bavaria and Baden-Württemberg already take into account possible future climate changes in the planning of new flood protection measures. They add a climate change factor of 15 percent to the normal design bases for technical protective structures. [11]

Climate change not only necessitates technical and planning adjustments. There is also a need for greater discussion among policy-makers and the public concerning what risk of flooding should be considered tolerable. These discussions are aimed at reaching a consensus on differentiated protection levels, i.e. on assets and uses that should be protected as a matter of priority and on ones that can be neglected. Other possible adaptation action and strategies for selected fields of activity and sectors are shown in Table 3 below.

Decision-makers in business, politics and administration should have a more fundamental awareness of the necessity of adaptation to the consequences of climate change in Germany. For this reason the UBA seeks to improve decision-makers' awareness of associated risks and opportunities through increased public information activities, scientific workshops and fostering dialogue between the parties concerned.

To ensure that the risks of climate change do not lead to displacement responses or even fatalistic reactions, policymakers should always combine communication of the risks with communication of possible adaptation measures. Knowledge holders should develop suitable information campaigns as well as communication strategies and tools for this purpose. In the end climate adaptation is a societal task to which citizens as well as actors in business, politics, administration, the media, environmental organizations, education and research can and should make a contribution.

» We have to know what to expect. Only then can we adapt to climate change in the best possible way at acceptable costs «

Professor Andreas Troge
(President of the Federal Environment Agency, UBA)

TABLE 3
Possible adaptation strategies for selected fields of activity and sectors

Field of activity / sector	Examples of possible strategies of adaptation to climate change
Human health	increasing education among the population and among doctors and nurses, introduction of early warning systems providing warnings and rules of conduct for certain times and areas, boosting medical research and intensifying monitoring of climate-induced illnesses, and expansion of public health care programmes so that suitable vaccinations and measures to curb spread of pathogens can be carried out
Agriculture	changing sowing dates, cultivating more resistant varieties suitable for local conditions with a high climate tolerance and lower vulnerability to pests, selection of appropriate crop rotation, changes in range of cultivation and varieties, use of erosion-reducing and flood-tolerant species for retention areas, soil-protecting and water-saving forms of farming; spatial and temporal adaptation of fertilization; adaptation of irrigation and drainage regime
Forestry	restructuring forests to increase diversity of tree species and introducing suitable species, optimizing forest management practices, improved prevention of forest fires, altering water management concepts, e.g. increasing water retention in waterside forests, and reducing additional stress factors, e.g. by reducing input of substances, preserving soil fertility and avoiding disturbances of sensitive forest ecosystems
Water management	more efficient use of water resources, giving consideration to change in intensity and frequency of extreme events in the planning of water management infrastructure and in the management of resources, inter-sector coordination of adaptation measures, implementing sustainable land use management to improve landscape water balance, adapting infrastructure planning to ensure sufficient water storage in reservoirs and aquifers or to provide drinking water via networks; continuation of water-saving measures in business, agriculture and forestry as well as in private households; improving water quality and ecological status of surface waters in order to reduce vulnerability of aquatic ecosystems and as the basis for reliable drinking water supply
Nature conservation and biodiversity	protection of natural adaptation potential, improving migration opportunities, e.g. by linking-up biotopes; establishing protection areas whose foremost objective is to preserve naturally occurring processes in the ecosystem; revising nature conservation concepts and making protection area boundaries more flexible
Transportation	technical adjustments to transportation infrastructure with new heat-resistant materials; technical measures against extreme events, such as landslide and mudslide protection and relocation of traffic routes in potential flood areas; improved management of water levels in waterways; shifting goods transport e.g. from ship to rail, further development of shallow-draught vessels
Tourism	increasing flexibility and diversity of tourism offers, such as weather-independent, year-round options, enhancing attractiveness by emphasizing special regional features, improving educational and cultural offers, debate on the issue of climate change among players in the tourism sector, monitoring bathing water quality
Flood and coastal protection	reinforcing existing protective facilities, creating retention areas, flood-adapted methods of construction, increasing public awareness of flood risks
Regional and settlement development	keeping areas subject to flood risk open, reconversion of developed areas if applicable; land-saving settlement structures and infrastructure, preventing urban sprawl to avoid reasons for new protective action (e.g. in coastal region); flood-adapted methods of construction; ensuring fresh air corridors and green areas in city centres; soil desealing, protection of water resources in land use

Towards a German adaptation strategy

Apart from a significant reduction of greenhouse gas emissions, contemporary climate policy requires a second pillar: adaptation to consequences of climate change that are no longer avoidable today. Politicians and researchers should establish adaptation to climate change as a permanent issue since it will not be possible to avoid all serious consequences of climate change, even with a substantial reduction in emissions. Therefore, it is urgently necessary to prepare for the expected climate changes and the related effects right away. This is why the responsible policymakers should step up the activities they have already launched to develop and implement national, regional and local adaptation strategies.

Excursus: Climate protection

Climate protection by reducing emissions of climate-changing greenhouse gases is important for two reasons. Firstly, it makes it possible to limit the extent of climate change and, secondly, consistent climate protection slows the pace of climate change. Even if global warming is limited to less than 2°C above the preindustrial level up to the year 2100, significant consequences would result, e.g. an increase in extreme weather phenomena. However, experts see this as generally controllable. By contrast, they predict serious consequences if global warming significantly exceeds 2°C. A slow climate change enables both natural and social systems to adapt to the changes in part. Only if the concentration of greenhouse gases in the atmosphere becomes stable on a long-term basis, is there a realistic chance, according to current knowledge, to comply with the 2°C temperature limit. Higher greenhouse gas concentrations would probably result in higher global warming, which would

be incompatible with the commitment also entered into by Germany to avoid "dangerous climate change" within the meaning of the United Nations Framework Convention on Climate Change (UNFCCC). Analyses of the economic consequences of progressive climate change, such as that by British economist Nicholas Stern, point out that consistent climate protection is also worthwhile in economic terms. Stern drew the conclusion that from an economic point of view it is far less expensive to initiate measures to protect the climate and adapt to the consequences of climate change as quickly as possible than it is to eliminate the effects of climate change later on[12].

The German strategy for adapting to climate change

The need to develop strategies for adaptation arises directly from the expected adverse consequences of climate change, the resulting damages as well as the economic costs. With the ratification of the United Nations Framework Convention on Climate Change, Germany committed itself to implementing action programmes that facilitate systematic adaptation to expected climate change and its consequences.

At the end of June 2007 the European Commission published the Green Paper "Adapting to climate change in Europe – options for EU action". It is based on findings of the European Climate Change Programme and shows how adaptation measures should be integrated into European climate policy. The Green Paper describes possible ways of taking action at the EU level in order to trigger a Europe-wide public debate and participation in future adaptation actions.

At national level the German Federal Government resolved in its 2005 Climate Protection Programme to initiate the necessary steps for development and implementation of a comprehensive national concept on adaptation to climate change in Germany. Allocating responsibilities in the shaping of federal policy and carrying out adaptation measures require close cooperation between the federal government and federal states (Bundesländer). For this reason the Conference of the German Federal and State Environment Ministers decided in spring 2007 to support the federal government in its efforts to identify and implement a German adaptation strategy. The strategy will also incorporate international and EU activities so as to learn from the experience of other countries and pass on Germany's own knowledge.

The objective of the German strategy of adaptation to climate change will be to avoid or mitigate ecological, social and economic damage due to climate change based on a broad consensus in society. Another aim is to strengthen and improve Germany's adaptation capacity so as to reduce the vulnerability to climate change, mitigate damage and take advantage of opportunities that may arise from climate change.

In this context the strategy should

- actively support the process of adaptation to climate change,
- promote natural, social and technical adaptation capacity,
- provide the necessary decision-making basis for this and
- help make adaptation management an integral part of all fields of policy and action.

» The goal of our measures must be to limit the temperature rise worldwide to a maximum of two degrees by 2050 by means of reduced greenhouse gases. This would make the temperature increase due to greenhouse gases and the resulting deterioration of living conditions less drastic «

Professor Andreas Troge
(President of the Federal Environment Agency)

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and UBA organize specialized conferences as well as workshops on climate impact and adaptation and promote networking of relevant actors through special dialogue events. These activities will be complemented by electronic discussion forums and installation of an interdisciplinary body of experts. Furthermore, the responsible federal departments conduct technical meetings on specific topics. All these activities aim to fully integrate the actors and parties concerned into the adaptation strategy at an early stage. To support these and other tasks, the BMU set up the Competence Centre on Climate Impacts and Adaptation (KomPass) at UBA.

The Competence Centre on Climate Impacts and Adaptation (KomPass)

The Competence Centre on Climate Impacts and Adaptation summarizes the results of climate impact research and makes them readily accessible to public. Furthermore, KomPass collects information on possible adaptation options, evaluates them with respect to their risks and opportunities and makes the results available to relevant actors. Key questions in this context are how vulnerable sections of society and possible adaptation action can be identified, what adaptation costs, what its limits are and what political framework must be in place to implement adaptation strategies. UBA wants to simplify the work of all those involved in adaptation to climate change, whether as companies, administration, trade associations or environmental organizations. In particular KomPass gives technical and conceptual advice to the Federal Environment Ministry in the work on the German adaptation strategy and acts as a central office for coordination and implementation of the strategy.

The Competence Centre on Climate Impacts and Adaptation at UBA will offer the following services, staggered over time:

- By providing climate scenario data and scientific information KomPass intensifies regional climate impact research for Germany.
- KomPass helps to evaluate information on regional climate change and climate impacts at the national level. It publishes this evaluation by means of a specialized information system, maps and graphs, brochures, information folders and background papers.
- Publication is carried out via the website www.anpassung.net. There users will also find a searchable catalogue on projects and activities as well as a newsletter that regularly reports on the status of discussions in this field and highlights relevant activities performed by KomPass and cooperating institutions.
- An Internet-based map service will support the evaluation of climate change and climate impacts. The service will be integrated into the Geographical Information System Environment (GISU) at UBA.
- KomPass operates a network with actors from business and administration for the purpose of, firstly, join together sectoral and regional results and, secondly, learning about requirements and concerns of its partners and taking them into account in the centre's work. To this end, KomPass conducts workshops and seminars for participants from business and administration.
- KomPass develops easy-to-use tools that point out to users regionally differentiated climate changes and impacts as well as possible options for action.
- Furthermore, KomPass designs an indicator system to review the effectiveness and success of adaptation action.

KomPass performs its tasks in close cooperation with institutes, universities, federal institutions (such as the Federal Office for Civil Protection and Disaster Assistance, the German Meteorological Service and the Federal Agency for Technical Relief), institutions of the federal states (such as environment offices and agencies of the federal states), European institutions (such as the network of European environment agencies, the European Environment Agency and the European Commission) as well as in cooperation with international bodies (such as the groups of experts of the EU Council Working Group on Climate Change and the Intergovernmental Panel on Climate Change IPCC).

»It is important to avoid the uncontrollable and control the unavoidable«

Professor Hans Joachim Schellnhuber (Director of Potsdam Institute for Climate Impact Research and Climate Protection Commissioner of the German Federal Government)

Footnotes

[1] *4th Assessment Report of the IPCC "Climate Change 2007: Summary for Policymakers" of September 2007 (german version).*
http://www.de-ipcc.de/download/IPCC2007-FullDocument.pdf

[2] *UBA background paper "Klimaänderungen, deren Auswirkungen und was für den Klimaschutz zu tun ist" [Climate change, its impacts and what has to be done for climate protection] of November 2007.*
http://www.umweltbundesamt.de/uba-info-presse/hintergrund/ipccsynthese.pdf

[3] *See among other Schönwiese et al. (2005): Berechnung der Wahrscheinlichkeiten für das Eintreten von Extremereignissen durch Klimaänderungen [Calculation of probabilities for the oc currence of extreme events due to climate change], Climate Change 07/05, (UFOPLAN project No. 201 41 254), Dessau.*
http://www.umweltdaten.de/publikationen/fpdf-l/2946.pdf

[4] *UBA background paper "Neue Ergebnisse zu regionalen Klimaänderungen – Das statistische Regionalisierungsmodell WETTREG" [New results on regional climate change – the statistical regionalization model WETTREG] of January 2007.*
http://www.umweltbundesamt.de/uba-info-presse/hintergrund/Regionale-Klimaaenderungen.pdf

[5] *Research project "Klimawandel und präventives Risiko- und Küstenschutzmanagement an der deutschen Nordseeküste" (KRIM) [Climate change and preventive risk and coastal protection management on the German North Sea coast].* http://www.krim.uni-bremen.de

[6] *Münchner Rück (2003): Annual review of natural disasters in 2002, München.*
http://www.munichre.com/publications/302-03630_de.pdf

[7] *Koppe, C. and Jendritzky, G. (2004): Die Auswirkungen der Hitzewelle 2003 auf die Mortalität in Baden-Württemberg [Impacts of the 2003 heat wave on mortality in Baden-Württemberg], Baden-Württemberg Ministry for Social Affairs, Stuttgart.*
http://www.wind-energie.de/fileadmin/dokumente/Themen_A-Z/Klimafolgen%20und%20Klimaschutz/gesundheit_hitzewelle.pdf

[8] *UBA background paper "Anpassung an Klimaänderungen in Deutschland – Regionale Szenarien und nationale Aufgaben" [Adaptation to climate change in Germany – regional scenarios and national tasks] of October 2006.*
http://www.umweltbundesamt.de/uba-info-presse/hintergrund/Anpassung-Klimaaenderungen.pdf

[9] *UBA research report "Klimawandel in Deutschland – Vulnerabilität und Anpassungsstrategien klimasensitiver Systeme" [Climate change in Germany – vulnerability and adaptation strategies of climate-sensitive systems] of August 2005. English Version available.*
http://www.umweltdaten.de/publikationen/fpdf-l/2974.pdf

[10] *Green Paper of the European Commission "Adapting to climate change in Europe – options for EU action" of June 2007.*
http://ec.europa.eu/environment/climat/adaptation/index_en.htm

[11] *Research project "Klimaänderungen und Konsequenzen für die Wasserwirtschaft" (KLIWA) [Climate change and consequences for water management].* http://www.kliwa.de

[12] *UBA report "Die Zukunft in unseren Händen – 21 Thesen zur Klimaschutzpolitik des 21. Jahrhunderts und ihre Begründungen" [The future in our hands – 21 climate policy statements for the 21st century] of August 2005.*
http://www.umweltdaten.de/publikationen/fpdf-k/k2962.pdf

Further **Information**

You can obtain further information at the following websites:

United Nations Framework Convention on Climate Change: http://unfccc.int/

Intergovernmental Panel on Climate Change – IPCC:
http://www.ipcc.ch

German IPCC Coordination Office: http://www.de-ipcc.de/

Competence Centre on Climate Impacts and Adaptation . (KomPass): http://www.anpassung.net/

Umweltbundesamt (UBA) [Federal Environment Agency], webpage on Climate Protection:
http://www.umweltbundesamt.de/klimaschutz/index.htm

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) [Federal Ministry for the Environment, Nature Conservation and Nuclear Safety], webpage on Climate and Energy:
http://www.bmu.de/ueberblick/klima_und_energie/aktuell/4039.php

Bundesministerium für Bildung und Forschung (BMBF) [Federal Ministry of Education and Research], webpage on Climate Research: http://www.bmbf.de/de/8493.php

Green Paper of the European Commission on adaptation to climate change:
http://ec.europa.eu/environment/climat/adaptation/index_en.htm

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