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## UMID Special Issue

# Climate Change and Health

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# Climate Change and Health

Action Programme Environment and Health Germany

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# CONTENTS

## Introduction



## Individual Aspects

## Information Opportunities

# Health effects due to climate change Information and awareness raising as an essential part of adaptation measures

*Björn Ingendahl, Imke Thieme*

**Abstract:** *Climate change can result in increasing infectious and non-infectious diseases such as cardiovascular disorders and allergies. There is also reason for concern that more injuries will occur if extreme weather events – such as storms and floods – become more frequent. In order to control the risks arising from introduced pathogens, sectoral authorities and research institutions need to work together and take joint precautions. It is important to assess the adverse effects of climate change on human health in order to take effective countermeasures. Relevant data should be obtained and analysed on a target orientated basis and important findings must be communicated to specialists and the general public.*

Climate change is already having numerous direct and indirect effects on human health, which means that adaptation measures are required in the fields of health care and preventive medicine, urban planning and building design, and in individual behaviour.

## Extreme weather and non-infectious diseases

Heavy precipitation, flooding, storms, avalanches and landslides can cause physical injury and in some cases even death. During the summer heat wave in 2003, for example, around 7,000 people in Germany alone died from heart attacks, cardiovascular disorders, kidney failure, respiratory problems and metabolic disorders caused by heat-related stress.

Along the Baltic coast and in Germany's inland lakes, mild temperatures, combined with increases in nutrient content, encourage the growth of toxic blue-green algal blooms. Contact with the algae can cause skin rashes, gastrointestinal disorders, and even serious liver damage in some cases.

Another possible effect of climate change is a further increase in allergic disorders, primarily due to changes in pollen dispersal patterns. The German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) launched an Action Plan against Allergies in 2007 in order to make daily life easier for allergy sufferers. The nationwide Action Programme Ambrosia, coordinated by the Julius Kühn Institute (JKI), should be mentioned first and foremost in this context.

An increased occurrence of respiratory problems can be expected, triggered by ground-level ozone during high-pressure periods in summer. There could also be a greater risk of skin cancer due to an increase in the amount of solar radiation. Not least, negative changes occurring at recreation areas and affecting the urban climate may also impact adversely on physical wellbeing. However, the extent to which atmospheric warming will indeed influence non-infectious diseases in Germany now or in future is still uncertain.

## The spread of infections

A mild climate is not only more conducive to the spread of existing pathogens; it could also result in the introduction of non-native pathogens in Germany. With rising temperatures, foods spoil more quickly as well, leading to more frequent outbreaks of gastrointestinal infections, such those caused by salmonellae.

Pathogens which are already present but which may spread more quickly in a milder climate include the hanta viruses, which are transmitted by rodents. A frequent source of infection in Germany is a species of vole called the Rötelmaus (Myodes glareolus, or bank vole). Infection with the virus, e.g. through contact with the animal's excretions, can cause symptoms ranging from fever to kidney failure. The borreliae or tick-borne encephalitis (TBE) viruses are another example; warmer annual temperatures offer more favourable conditions for ticks to breed.

A warmer climate could also lead to species such as the Asian tiger mosquito (Aedes albopictus) be-

coming established in Germany. This mosquito can transmit various pathogens, including dengue fever. There is also evidence for the presence, in Germany, of the pathogens that cause leishmaniasis, which is transmitted by certain species of sand fly.

## Prevention needs information

In order to control the risks arising from introduced pathogens, sectoral authorities and research institutions need to work together and take joint precautions. This not only involves adaptation of the existing surveillance systems; it is also important to understand how climate-sensitive pathogens or their vectors behave and spread in Germany. From that basis, experts must then look at ways of improving the detection and diagnosis of these infections and providing the best possible treatment for infected persons, and also consider whether there is potential to develop appropriate vaccines.

In the case of the non-infectious diseases, it is important to bear in mind that these conditions cannot be attributed solely to the impacts of climate change. Personal lifestyle and health behaviour – such as eating habits, the amount of exercise taken, and tobacco and alcohol consumption – and factors such as the amount of noise exposure in the residential area all influence individual health. In order to be able to assess the adverse impacts of climate change on human health and take effective countermeasures, it is therefore important to obtain and analyse relevant data on a target orientated basis and communicate important findings to specialists and the general public.

The Federal Government and the federal states (Länder) should also inform the general public and individual risk groups, such as children and the elderly, as well as multipliers such as medical personnel, nursing staff and the emergency services about basic preventive measures relating to the impacts of climate change. For example, more intensive efforts should be made to raise awareness of effective ways of preventing heat injuries. The Robert Koch Institute (RKI) deals with these issues on behalf of the Federal Government. The impacts of climate change are also being addressed within the Action Programme Environment and Health (APUG), a joint programme supported by the three federal ministries responsible for health, environment and consumer protection. Public information and better cooperation between relevant agencies are among the programme's key objectives.

Well-functioning early warning systems mitigate the risks of injury to persons. The German Meteorological Service (DWD) alerts the federal states (Länder) and, where necessary, the rural counties to impending hot spells or heavy rainfall.

## A healthy environment: essential for wellbeing

Architects and urban and landscape planners can do much to influence whether heat accumulates, especially in built-up areas. In order to prevent heat stress, open fresh air corridors are essential, especially in conurbations. Green spaces also act as "cool islands". Local authorities should therefore refrain from "sealing" open spaces through the construction of new roads, car parks and houses.

Hospitals, care homes and residential homes for the elderly should also ensure that their premises are properly insulated against heat and cold and that their cooling systems are climate-neutral, i.e. as passive as possible.

## Joint action to protect the public

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry of Health (BMG) cooperate intensively on health adaptation to climate change in a process which also involves the World Health Organization (WHO).

To this end, we will

- support research and monitoring programmes focussing on vectors and allergenic plants,
- support early warning systems similar to the heat health warning system of the German Meteorological Service (DWD),
- initiate further training for health service personnel, and
- promote awareness of the new conditions among urban and landscape planners.

In addition, we will:

- ensure that in future, citizens have better access to information about the health risks associated with climate change, and

- identify options for individual adaptation.

A parallel aim is to ensure that the impacts of climate change on human health are given appropriate consideration in all national and international adaptation and mitigation programmes.

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# Activities on the subject "Climate Change and Health" by Federal Institutions in Germany

*Jobst Augustin*

**Abstract:** *Climate change has various effects on human health. A survey by the Federal Environment Agency indicated which federal institutions perform activities in the area of "climate change and health". The results show a wide variety of research and other activities that are undertaken by federal agencies and institutes.*

## Introduction

Climate change has various direct and indirect effects on human health. The direct effects include the increased occurrence of cardiovascular disorders due to heat waves or the psychological effects of extreme weather events. Allergies (e.g. allergic rhinitis), vector-borne diseases (e.g. tick-borne encephalitis (TBE), dengue fever) and UV radiation-related diseases (skin cancer, cataract) are among the possible indirect effects. There is a substantial need for research into the diverse and sometimes very complex links between climate change and the associated human health impacts.

## Background

Research activities by federal agencies and institutions make a major contribution to the study of the health impacts of climate change. In order to improve the exchange of information and knowledge between these agencies and institutions and utilise the synergies generated within the framework of the Action Programme Environment and Health (APUG), the German Federal Environment Agency (UBA) carried out a survey in September/October 2009 which brought together and provided an overview of the various activities being undertaken in the field of climate change and health.

## Results

The survey showed that the agencies and institutions selected are engaged in work in the following thematic areas: "non-infectious diseases" (caused by thermal stress, pollen dispersal, UV radiation), "infectious diseases" (tick-, insect- and rodent-borne diseases) and other issues such as food and nutrition, air quality, toxic plants, and adaptation to climate change (for a brief overview, see Table 1).

The *Federal Office of Civil Protection and Disaster Assistance (BBK)* and the *Federal Agency for Nature Conservation (BfN)* are both engaged in activities relating to adaptation to climate change. The BBK, for example, investigates the impacts of climate change on critical infrastructures (health system institutions), while among other things, the BfN is planning a study on biometeorological effects of green spaces in residential areas on human health. The BfN is also supporting the development of an Internet-based information system on nature conservation and health. This is intended to facilitate swift and comprehensive access, for professionals and public alike, to existing factual knowledge about the nature conservation/health nexus. The thematic area "climate change and health" is one of the modules within this information system.

The *Federal Office of Consumer Protection and Food Safety (BVL)* exercises various duties in relation to food and nutrition, with relevant articles by experts being published in the Journal für Verbraucherschutz und Lebensmittelsicherheit / Journal of Consumer Protection and Food Safety.

The *German Meteorological Service (DWD)* focusses primarily on non-infectious diseases, including the development of a heat health warning system in Germany, the establishment of an automatic pollen monitoring network and the planned launch of a service providing ultraviolet (UV) radiation climatology data, in order to detect changes in UV intensity to date. The DWD is already engaged in these

| Institution | Activities relating to | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Non-infectious diseases | | | Infectious diseases | | | Other topics | | | |
| | Thermal stress | Pollen dispersal | UV radiation | Ticks | Insects | Rodents | Nutrition | Air quality | Toxic plants | Adaptation |
| Federal Office of Civil Protection and Disaster Assistance (BBK) | | | | | | | | | | x |
| Federal Agency for Nature Conservation (BfN) | | | | | | | | | | x |
| Federal Office of Consumer Protection and Food Safety (BVL) | | | | | | | x | | | |
| German Meteorological Service (DWD) | x | x | x | | | | | x | | x |
| Julius Kühn Institute (JKI) | | x | | | | | | | x | |
| Robert Koch Institute (RKI) | x | x | | x | x | x | x | | | |
| Federal Environment Agency (UBA) | x | x | | x | x | x | | | x | x |

**Table 1:** Overview of key activities by federal agencies relating to climate change and health.

fields of activity, and there are plans to expand them further.

The *Julius Kühn Institute (JKI)* works on non-infectious diseases relating to pollen dispersal and toxic plants. Among other things, the Institute investigates organisms that damage or adversely affect plants with concomitant negative human health impacts and whose occurrence is affected by climate change (one example being Common Ragweed – Ambrosia artemisiifolia).

The *Robert Koch Institute (RKI)* deals with infectious and non-infectious diseases in the context of climate change, with a particular focus on vector-borne diseases. For example, the Institute studies long-term trends and risk factors relating to tick-borne pathogens (e.g. Lyme borreliosis) in light of climate change. Besides these focal areas, the RKI also works in the thematic area of food and nutrition, one example being its investigation of the link between climatic factors and the incidence of Campylobacter in Germany.

The *Federal Environment Agency (UBA)* focusses mainly on the thematic areas of non-infectious and infectious diseases and adaptation to climate change. Its activities include publications (e.g. the report "Klimawandel und Gesundheit: Informations- und Überwachungssysteme in Deutschland" (Climate Change and Health: Information and Monitoring Systems in Germany), available at: http://www.umweltdaten.de/publikationen/fpdf-l/3816.pdf), organising symposia, and conducting various research projects. One example is the development of a strategy for the establishment of a surveillance system for climate-related health risks. The Competence Centre on Climate Impacts and Adaptation (KomPass) is also based at the UBA.

## Conclusions

The survey showed that the federal agencies and institutions selected are already engaged in various fields of work relating to climate change and health. Their activities range from scientific studies to the organisation of events and publicity work. The results of the survey indicate that there is substantial

potential for cooperative endeavours, which should be utilised in future.

A table providing a comprehensive overview of the activities of the selected federal agencies and institutions in the field of "climate change and health" can be found at the end of this publication.

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# November 2009: "Climate change and health – which problems occur due to thermophile organisms?" Joint symposium of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Environment Agency

*Hans-Guido Mücke and Jobst Augustin*

**Abstract:** *It is possible that climate change could result in an increase in non-infectious diseases, such as allergies and asthma. Mild temperatures favour the presence and distribution of thermophile organisms of plants and insects (species such as Ragweed and the Oak Processionary Moth). Contact with pollen or stinging hairs of such species may not only lead to allergic skin, eye and pulmonary irritations, but may also cause serious asthma attacks. The symposium gave an insight and overview on the current situation and ideas on adaptation measures for public health protection in Germany and selected neighbourhood countries.*

On 9-10 November 2009, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environment Agency (UBA) hosted an international symposium in Berlin on "Climate change and health – which problems occur due to thermophile organisms?".

The background to the symposium is that climatic changes could have various implications for human health: for example, climate change could result in an increase in infectious (e.g. vector-borne) and non-infectious diseases (e.g. allergies and asthma).

The latest findings of scientific research and practice provide evidence that harmful thermophile organisms with increased allergenic potential are expanding in Germany on a massive scale. Both the presence and the distribution of these organisms and their allergens are associated with climatic changes. It would thus appear that the changing climate is already causing a shift in the occurrence and distribution of harmful plant and animal organisms in Germany. This could result in an increase in allergies and asthma and hence a greater public health burden.

A well-known example is Common Ragweed (Ambrosia artemisiifolia), which prolongs the period of suffering for many people with pollen allergies. Thermophile species of fauna are also showing changed occurrence and distribution patterns. For example, thermophile moths that are native to Germany have expanded into new regions in recent years, and neophyte species could become established. Allergens produced by these fauna can trigger a reaction in humans, resulting in sometimes serious health impairments. It is evident, for example, that the stinging hairs (setae) of the caterpillars of the oak processionary moth can pose a risk to health as they can cause not only allergic skin irritations (e.g. caterpillar dermatitis) but also respiratory effects (e.g. asthma-like symptoms). As knowledge about the impacts of harmful thermophile organisms on human health is still limited, more information and research into the type and manifestations of the health effects of these and other harmful organisms are required.

The aim of the symposium was to pool existing knowledge and develop perspectives for future research planning and preventive public health protection. During the first session, the experts therefore considered the presence, distribution and expansion of thermophile native or newly introduced plants and insects whose dispersal in Germany is favoured by a warming climate.

During the second session, initial findings about the impacts of such organisms on human health, e.g. in the form of contact and/or respiratory allergies, were presented. The third session focussed on initial experience with adaptation management by environmental and health authorities, e.g. the development of strategies to control harmful organisms and the identification and analysis of cases of allergy disorders triggered by thermophile organisms.

The international symposium was attended by around 50 experts from the scientific and research community, public authorities and practitioners,

including delegates from Austria, Switzerland and the World Health Organization (WHO). The event focussed on experience and perspectives at the national, regional and local level.

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# Tracing New Aeroallergens as Part of Adaptation to Climate Change in Germany

*Carolin Sperk, Wolfgang Straff*

**Abstract:** *Climate change can influence the health of people in Germany in various ways. Apart from extreme weather conditions like heat waves, storms, heavy rain or flooding, indirect health risks can also play a role for the population. Not only the type, amount and consistency of pollen allergens alters, but also emissions of insects or moulds can play a more important role in the future. The change of factors like temperature and humidity promotes the spread and reproduction of organisms that produce aeroallergens. The article addresses examples like Common Ragweed (Ambrosia artemisiifolia) and Oak Processionary Moth (Thaumetopoea processionea) and discusses the necessity for monitoring measures for health prevention as a part of adaptation to climate change in Germany.*

## Introduction

The effects of climatic changes on human health in Germany are increasing. Direct impacts are caused by extreme weather events such as heat waves, storms, hail, heavy rain, flooding, avalanches or landslides. Indirect health risks and impacts occur as a result of adverse changes in environmental conditions due to climate change, and can include impairment of drinking water quantity and quality or changes in the occurrence of biological allergens. Not only can changes be observed in the amount and composition of pollen in the atmosphere; an increase in health risks is also expected as a result of emissions of insects and other harmful organisms. Pollens, caterpillar hair and spores, known as "biogenic aeroallergens", are dispersed by air currents. Upon contact with the skin, eyes or bronchial tubes, they can cause sometimes severe allergic reactions. Changes in climatic factors such as temperature and humidity are favourable to the propagation and distribution of organisms that produce these aeroallergens.

**Figure 1:** Common Ragweed
(photo: wikipedia public domain).

## Invasive plants as a cause of allergies: the Common Ragweed

The best-known example of an organism which is spreading in Germany due to more favourable climatic conditions is Common Ragweed (Ambrosia artemisiifolia), also known by various other names including Bitterweed, Blackweed, Carrot Weed, Hay Fever Weed, Roman Wormwood, etc. This plant, which originates in North America, causes major health problems; indeed, its allergen is described as the number one cause of seasonal allergies in the US and Canada (Starfinger 2008). Its pollen is highly allergenic and can cause allergic reactions in the respiratory tract even at low atmospheric concentrations. The plant can also cause contact allergies, and its pollen is a trigger in seasonal asthma, which mainly occurs during the period of pollen dispersal and until now has been limited to the spring and summer months. With the spread of Common Ragweed, the pollen dispersal period is extended due to the plant's late flowering period (July until the end of October). On account of Common Ragweed's high allergenic potential, an increase in sensitisation and the incidence of

allergies is expected. Numerous cross-reactions with foods exacerbate the ragweed problem (Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz [Bavarian State Ministry of the Environment, Public Health and Consumer Protection] 2008).

In some of the German federal states (Länder), the situation has worsened over the past three to five years; according to the Federal Agency for Nature Conservation (BfN), the presence of Common Ragweed has been observed in 267 counties across Germany (Otto et al. 2008; for a discussion of the issue of the spread of ragweed and the associated health risks, see the article by Eis and Helm elsewhere in the present publication).

## Thermophile insects: new "airborne" allergens on the advance?

Health impairments such as allergies and asthma triggered by an increased or new occurrence of thermophile insects have grown in significance in recent years. So far, however, little attention has been paid to these risks in the debate about health adaptation to climate change, even though they are now a problem on a local and even a regional scale in some cases. For some years, the caterpillars of the Oak Processionary Moth (Thaumetopoea processionea) (Figure 2), which is native to Germany, have posed major problems for public health. From the third instar (larval stage) onwards, the caterpillars of the Oak Processionary Moth develop stinging hairs, known as setae, which contain a toxic protein (thaumetopoein). The setae are extremely fine and can be dispersed very easily by the wind. Contact with the setae can cause mechanical irritation of the skin and the mucous membranes in the eyes and respiratory tract, as well as toxic-irritative and "genuine" allergic reactions. Known symptoms range from skin reactions (severe itching (pruritis), contact urticaria and dermatitis) and conjunctivitis to allergic respiratory distress and even anaphylactic shock (Gottschling and Meyer 2006, Heudorf 2006). This clinical picture, which can also include general malaise and fever, is known as lepidopterism.

**Figure 2:** Caterpillar of the Oak Processionary Moth (photo: wikipedia public domain).

The Oak Processionary Moth favours trees in open, sunny habitats, often isolated trees in open places. It frequently lays its eggs in urban situations with lone trees or open woodland located near schools, children's nurseries, swimming pools, camping sites or other recreational amenities. The allergenic setae of the caterpillar of the Oak Processionary Moth therefore pose a risk not only to forestry workers and hikers but to everyone in the vicinity of infested trees, especially to employees of municipal open space authorities and to children (Wulf 2008). There are various studies which provide evidence of the health impacts after contact with the caterpillars of the Oak Processionary Moth (Utikal et al. 2009, Gottschling and Meyer 2006, Heudorf 2006, Maier et al. 2003), and it is apparent that the setae can cause a wide range of health complaints (Figure 3). Depending on the amount of contact and the affected person's state of health, the symptoms can occur with varying degrees of intensity. Due to the airborne dispersal of the setae, the health effects could potentially occur on an epidemic scale. The toxin remains active in the setae for some time, which means that the risk of symptoms occurring can continue for several years (Maronna et al. 2008).

## Climate change and the spread of harmful human pathogens in Germany

There has been extensive coverage of the problem in Germany's local and regional press over recent years, and forestry and plant protection authorities are also engaged in numerous activities to detect

**Figure 3:** Caterpillar dermatitis
(photo: D. Ullrich, Wikimedia Commons,
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and control the caterpillars of the Oak Processionary Moth.

An increase in the number and spread of the caterpillars was observed initially in Southern Germany, in Bavaria and Baden-Württemberg, from the mid 1990s onwards, and since 2000/2001, also in North Rhine-Westphalia, Berlin and Brandenburg, and from 2003 in Hessen, Saarland, Rhineland-Palatinate, Saxony-Anhalt and Lower Saxony. In particular, the mild winters and hot dry summers such as occurred in 2003 and 2006 have been highly favourable to the mass propagation and spread of the Oak Processionary Moth (Wulf 2008).

The spread of the Oak Processionary Moth may well only be the start. Other plant and animal organisms are also becoming established in Germany due to the favourable effects of climate change. They include other species of moth, such as the Asian gypsy moth (Lymantria dispar), the small eggar (Eriogaster lanestris), and the Brown-tail (Euproctis chrysorrhoea) as well as other micro-organisms that are known to damage trees. The forestry and plant protection authorities have already drawn attention to the problem (Lehmann 2008).

## Allergies: a factor to be borne in mind in adaptation to climate change

Some of the main health risks associated with climate change are already being monitored. Information and surveillance systems have been established in most sectors and produce information and forecasts about exposure to various climate-related risk factors. They include drinking water, food and infection surveillance, air quality monitoring, the heat health warning system, solar UV monitoring and the pollen forecasts. The Action Programme Ambrosia initiated by the Julius Kühn Institute (JKI) in 2006 is a key element of the Action Plan against Allergies launched by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) in 2007. It includes a notification system, publicity and information activities and targeted control measures that aim to prevent any further spread of the Common Ragweed.

The rapid spread of the Oak Processionary Moth in Germany in recent years and the sometimes serious health impairments with which it is associated highlight the need for systematic monitoring. Particularly in light of its allergenic effects, an expansion of the existing systems to include a surveillance system for the early identification of new health risks posed by thermophile organisms is required. This should not only include surveillance of the various species but also the collection of health data. Only on this basis will it be possible to adopt timely countermeasures, such as effective control of the harmful organisms and appropriate precautionary measures for public health protection. When specific symptoms occur, doctors and medical personnel must be able to identify the causes correctly and initiate appropriate treatment pathways. Collection of case data on the emergence of new clinical symptoms, or symptoms which are known but have rarely manifested themselves until now, will also become increasingly important in relation to non-infectious diseases.

## More research and monitoring to identify new health risks

The examples of the Oak Processionary Moth and Common Ragweed highlight the difficulties in con-

trolling a species once it is spreading unchecked. These two species are also particularly significant because they favour locations within human habitats. The role of urban green spaces will become increasingly importance in the framework of climate-compatible urban planning, and in light of this aspect too, targeted surveillance of the spread of human pathogens is required. In the interests of early identification of new health risks, integration of health data with data on the spread of pathogens is essential.

Further research to identify other human pathogens that trigger non-infectious diseases (especially allergies and asthma) is required. In this context it is also important to take account of dispersal dynamics. This can contribute to the better evaluation of future risks and the timely development of adaptation measures.

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# Climate Change: Expansion of Common Ragweed and the associated risks to health

*Dieter Eis, Dieter Helm*

**Abstract:** *We review medical significance of the Common Ragweed (Ambrosia artemisiifolia) in Germany, especially in regard of climate change. Originally native to North America, this ragweed was introduced to Southern Europe and is now spreading rapidly and invasively in Central Europe due to global warming. Its green tassel-like flowers produce large amounts of pollen, which cause hay fever and other allergic disorders.*

## Introduction

Due to climate change, Common Ragweed (Ambrosia artemisiifolia) is expanding invasively in Europe. Regions formerly free of Common Ragweed, or where Common Ragweed only occurred intermittently, have become notable within just a few years for extensively colonised areas and high pollen concentrations. In Germany, highly colonised areas can now be found in the southwest, in East Bavaria, Lausitz and other regions (Figure 1). Originally native to North America, the plant is highly allergenic and therefore poses considerable public health risks.

## Allergic sensitisation and disorders

In the US, where the plant originates, around one quarter of the population shows a positive skin test response to ragweed (Arbes et al., 2005). Similarly high sensitisation rates are reported from European regions with substantial ragweed occurrence, with the percentage of persons sensitised to ragweed pollen having increased markedly in recent decades (Asero 2004; Corsico et al., 2000; Frei, 2006; Taramarcaz et al., 2005). The extent of pollen dispersal correlates with the sensitisation rate (Jäger, 2000). Figure 2 shows the distribution of ragweed pollen in Europe for the year 2008.

As part of the German Adult Health Survey (DEGS) 2008–2011, testing is currently being carried out on a nationwide representative sample of the adult population (approx. 7,500 subjects), inter alia to determine the presence of ragweed pollen-specific IgE antibodies in blood serum samples. An initial interim evaluation carried out for orientation purposes suggests that around 8 % of the adults are sensitised to the native total pollen extract of Ambrosia artemisiifolia (w1), whereas almost none of them appears to be sensitised to the purified major allergen (n Amb a 1). It is probable that most of the w1 sensitised participants are primarily sensitised to Mugwort (Artemisia vulgaris) (w6) and show cross-reactivity to Ambrosia. As the study will not be completed until the end of 2011, the final results are not expected until early 2012.

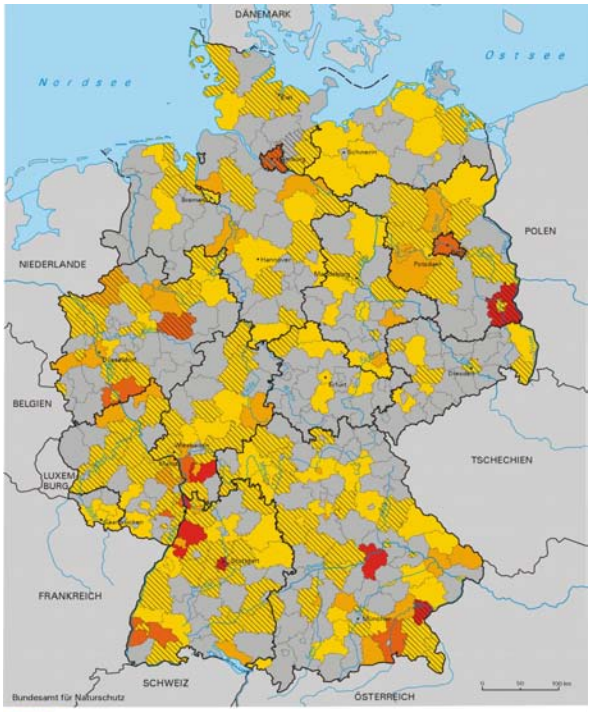


**Figure 1:** Occurrence of Ambrosia artemisiifolia in Germany's counties and urban districts (source: Otto C, Alberternst B, Klingenstein F, Nawrath S (2008): Verbreitung der Beifußblättrigen Ambrosie in Deutschland. Hrsg.: Bundesamt für Naturschutz. BfN-Skripten 235:22.)

In Baden-Württemberg, a total of three surveys were carried out at several sites between 2006/07 and 2008/09 (project implemented by the monitoring health offices). In total, 2,678 children of approximately 10 years of age (fourth grade), as well as 1,134 adults during the last survey, were screened to determine the presence of inhalative allergen-specific IgE in blood serum samples (LGA, 2009). Approximately 15 % of the children and 10 % of the adults were found to be sensitised to Ambrosia (native total pollen extract, w1), whereas sensitisation to the purified major allergen (Amb a 1) was found to be present (i.e. IgE antibodies detected) in just 3 % of the children and in isolated cases among the adults (< 1 %) (LGA, 2009). Often, these were polysensitisations to weed pollen, especially Ragweed-Mugwort, but also cross-allergenicities to grass and tree pollen. Further molecular analysis of the relevant allergens and the increasing availability of tests for recombinant major and minor allergens will gradually improve our understanding of the complex mechanisms underlying the "cross-reactivity" phenomenon (Asero et al., 2006; Frei, 2006; LGA, 2009; Weber, 2003; Wopfner et al., 2005).

In a study conducted at the Clinical Center of the University of Munich, 1,131 patients who were evaluated for a possible diagnosis of inhalative allergic disease underwent skin prick tests with ragweed test solutions to determine the serum concentration of ragweed-specific IgE antibodies (Ruëff et al., 2009). Around 20 % reacted positively to ragweed during skin prick testing, while 23 % demonstrated ragweed-specific IgE antibodies, yielding a total of 27 % of patients who were found to have ragweed sensitisation. About half of these persons reacted positively to ragweed in a conjunctival provocation test (Ruëff et al., 2009). In a similar study conducted at the University Hospital of Munich Technical University, involving 133 patients with allergic rhinoconjunctivitis, 33 % were found to be sensitised to ragweed (Jaeger et al., 2009).

In Italy, the frequency of ragweed sensitisation among allergy patients is 17 % (Alpine region), 29 % (Po Valley) and 2 % (Sardinia, Sicily) respectively (Corsico et al., 2000). The SAPALDIA2 study carried out in Switzerland in 2002 found that of 372 subjects with hayfever, 29 % were sensitised to ragweed, whereas among the 2,500 subjects without hayfever, around 4 % were sensitised to ragweed (Frei, 2006). It is apparent that the percentage of pollen allergy sufferers who become sensitised to ragweed can increase substantially within a relatively short period of time: in France and Italy, for example, an increase from 20 % to 40-60 % was noted within just a few years (Rybnicek and Jäger, 2001).

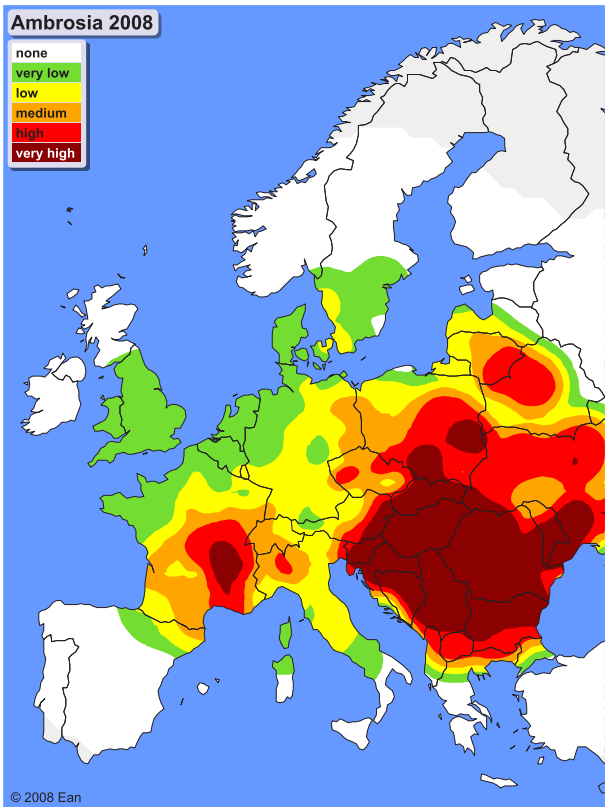


**Figure 2:** Ragweed pollen distribution in Europe, 2008 (source: European Aeroallergen Network (EAN). In: Zwander H, Koll H (2009): Der Pollenflug in Kärnten im Jahr 2008. Klagenfurt – Carinthia II, 199./119. Jahrgang: 169–182.)

As ragweed pollen is very allergenic, a very low concentration such as 5-10 pollen per m³ of air, and in any event from 25-30 pollen/m³, is sufficient to trigger allergic reactions (Taramarcaz et al., 2005, Frei 2006). Correlations between the level of exposure and the frequency of allergic rhinoconjunctivitis and allergic bronchial asthma have been demonstrated in epidemiological studies (Taramarcaz et al., 2005; White and Bernstein, 2003). In highly affected regions (US, Hungary, Northern Italy), more than 50 % of all cases of pollinosis are related to Ambrosia pollen (AAFA, 2005; Taramarcaz et al., 2005; VINCA, 2006).

## Measures

In order to control the health risks associated with ragweed dispersal, a wide range of targeted activities that are as well coordinated as possible and take place at various levels and within various fields of action is required. In Germany, relevant activities can be observed at federal and Land level (national and regional action programmes, information brochures/factsheets, research studies etc.). Of key importance in this context is the nationwide Action Programme Ambrosia launched in 2007 with the involvement of the Julius Kühn Institute (JKI), Federal Agency for Nature Conservation (BfN), German Pollen Information Service Foundation (PID) and other actors (Starfinger, 2007; further information is available at http://www.jki.bund.de). Similar activities exist in Austria, Switzerland and other affected countries.

Monitoring and surveillance are a key element of activities undertaken to date; this means tracking the occurrence of

- ragweed plants,
- ragweed seeds in imported goods (birdseed etc.),
- ragweed pollen (pollen dispersal),
- ragweed sensitisation and allergies.

In this context, besides regional distribution, medium and long-term time trends certainly also play a key role.

The involvement of the Robert Koch Institute (RKI) mainly relates to ragweed sensitisation and allergies. With financial support from the Federal Ministry of Health (BMG) and the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), nationwide allergy and sensitisation monitoring, which includes testing for ragweed sensitisation in adults, is being carried out for the first time as part of the German Adult Health Survey (DEGS) (field phase: 2008-2011), with appropriate IgE screening then being extended to subjects in the KiGGS cohort, i.e. children and adolescents, in the coming years. The RKI's health monitoring programme (Kurth et al., 2009) provides a good basis for continued nationwide allergy monitoring (including sensitisation monitoring) in the German population in future.

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# Emerging vector-borne diseases: climate change may entail health risks in Germany

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**Abstract:** *The risk of introducing new vector-borne diseases or of the geographic expansion of existing ones is one of the main topics in the discussion on the impacts of climate change. The recent outbreaks of bluetongue virus infection in northwestern Europe 2006 and of Chikungunya infection in Italy 2007 displayed the vulnerability of Europe. Aedes albopictus, the tiger mosquito, is just one example of the risks posed by global transport combined with global warming. This potential vector of many arboviruses like West Nile Virus, Dengue Virus or Chikungunya Virus has been spread through the world primarily by the global transport of used tyres, and recently by the transport of lucky bamboo from China to Europe. Some European countries (Switzerland, Italy, France) have already started control programmes against Aedes albopictus. Additionally, public awareness campaigns seem to be supportive of monitoring programmes. Climate change is just one of many factors that can cause the spread of vector-borne diseases and other factors should also be included in the analysis. The Federal Environment Agency (UBA) has started research programmes concerning the influence of climate on the spread of ticks and tick-borne diseases as well as on rodents and rodent-borne diseases in Germany*

The introduction of new pathogens and their animal vectors has been one of the main topics in the debate about the impacts of climate change for some time. However, it was the outbreaks of bluetongue virus infection, which is transmitted by midges, among ruminants in a number of European countries in 2006 and the outbreak of Chikungunya infection in Italy 2007 that have displayed Europe's vulnerability to these threats.

Climate is just one of many key factors whose interaction influences the occurrence and spread of articulates (arthropods). Over the past two decades, for example, the Asian tiger mosquito Aedes albopictus has been spread round the world primarily via the global used tyre trade and in imports of lucky bamboo (Dracaena spp.) containing mosquito eggs as "blind passengers". The tiger mosquito has already become established in some European countries and is continuing to spread.

**Figure 1:** The Asian tiger mosquito (Aedes albopictus) (photo: KABS; Björn Puskota).

## The tiger mosquito: Why is it so dangerous?

*Aedes albopictus* is a vector for numerous diseases in humans. It plays a particularly significant role in the transmission of serious virus infections such as Yellow fever, West Nile Virus, dengue and Chikungunya fever. In the past, these diseases were of only minor significance in Europe, with the majority of reported cases having been imported from tropical or subtropical regions abroad. However, the outbreak of Chikungunya infection in Italy in summer 2007 clearly demonstrated that the threat of local transmissions within Europe itself must now be taken seriously. According to the European Centre for Disease Prevention and Control (ECDC), data and forecasting of the occurrence and spread of the relevant vector – Aedes albopictus – are crucially important in order to assess the risks of future local

transmissions occurring in Europe, with more intensive efforts being required in this regard.

The tiger mosquito was recorded in Europe for the first time in Albania in 1979, where it appears to have been introduced through a shipment of used tyres from China, and initially spread over a small area along the Mediterranean coast. In 1990, it then entered Europe for a second time via the port of Genoa, and this marked the start of large-scale and aggressive dispersal of the species in Italy. It was the widespread presence of the tiger mosquito in Italy that enabled the Chikungunya outbreak to occur, although the outbreak itself originated in a family returning to Italy from India. Over recent years, the mosquito has spread on a massive scale from Italy into all neighbouring countries that offer appropriate climatic conditions for the mosquito's development, mainly the south of France, northern Spain, and Ticino in Switzerland. All types of transport (private cars, heavy goods vehicles, the railways, aircraft and shipping) have been identified as its main means of dispersal. Comprehensive government monitoring and control programmes have been established in countries under strong pressure from the introduction and dispersal of the tiger mosquito, especially Switzerland and France. The costs of these measures are borne by government, regional and municipal authorities.

Since 2005, the German Mosquito Control Association (Kommunale Aktionsgemeinschaft zur Bekämpfung der Stechmückenplagen e.V – KABS) has conducted a monitoring programme to track the occurrence of the tiger mosquito in south-west Germany. Within this programme, a small number of eggs were found on just one occasion to date, in 2007, along the A5 highway in the Upper Rhine valley between the Swiss border and the Karlsruhe area. Although only a few eggs were found, this shows that live mosquitoes are being brought into Germany too via transport routes. A nationwide government programme of vector monitoring does not yet exist in Germany, however.

## What action needs to be taken?

Research projects must investigate in more detail which specific minimum climatic and ecological conditions would allow the tiger mosquito, for example, to become permanently established in a given region. It is already clear that such conditions exist throughout the Upper Rhine valley in Germany. The climatic changes that are expected to occur over the next few years could dramatically expand the potential distribution area. Regional climate projections could serve as valuable tools in identifying at-risk areas in this context.

Besides government monitoring programmes, targeted public awareness campaigns are already under way in other countries (Switzerland, Italy, France, US) to monitor potential areas of expansion. In Italy, for example, this starts in schools, with pupils being taught how to recognise the mosquito and identify potential breeding sites, and how to prevent the mosquitoes from becoming established by covering or emptying these sites. The general public is also encouraged to hand in insects that they have found and which they suspect to be tiger mosquitoes to the relevant agencies for identification. It is hoped that these timely measures will prevent the development of a mass population of the tiger mosquito.

## Current activities by the Federal Environment Agency (UBA)

A research project under way since 2008 is investigating the impacts of climate change on the spread of disease-transmitting ticks in Germany. This programme, which will run for three years with expert support from the UBA, is intended to provide more precise data about ticks, which are an ideal subject for a pilot scheme to forecast potential climate-related areas of expansion of disease-transmitting arthropods. Through the evaluation of climate data, GIS-based biotope analyses and data on the occurrence of relevant species of tick, the aim is to establish correlations between climate events and tick distribution. By incorporating the findings of a research project on regional climate scenarios (UFOPLAN-FKZ 204 41138), the aim is to enable forecasting of regional tick distribution to take place. Adaptation measures for targeted health and environmental protection will then be proposed. As a pilot scheme, the project establishes a basis from which to develop other models for the forecasting of the future distribution of other medically significant groups of arthropods.

Another research project, launched in 2009 and scheduled to run for three years, investigates the impacts of climate on rodents which are the vectors for hanta viruses in Germany. Rodents can transmit a variety of diseases to humans. Hanta viruses

are especially significant as they can cause severe kidney disorders. Direct contact with an infected rodent is not necessary for infection to occur, as the virus is mainly transmitted through the inhalation of dust contaminated with the virus from the excretions (urine and faeces) of wild rodents. The number of notified cases of hanta virus infection has noticeably increased in Germany and neighbouring countries (France, Belgium) in recent years and smaller-scale epidemics frequently occur. The project will study the impact of climate factors on the frequency and distribution of rodents that are vectors of hanta virus (the bank vole (Myodes glareolus), and common vole (Microtus arvalis) and their contamination with hanta viruses. It will also analyse relevant factors and produce projections of future scenarios relating to the problem of hanta virus. This is a particularly important project, for besides ticks (which transmit TBE/borreliosis), hanta virus-transmitting rodents are the most important source of environmentally associated infectious diseases in Germany, with 1,687 cases of infection being reported in 2007 (RKI 2008).

Further information can be found in the documentation of two conferences supported/organised by the UBA in 2007 and 2008. The first, entitled "Vector-borne diseases and their control", is available on the Internet at: http://www.springerlink.com/content/9074t8vl1820hv65/. The second, a volume of abstracts from the "International Symposium on the Asian Tiger Mosquito Aedes albopictus – its distribution in relation to its bionomy and climatic factors", can be obtained from BMU@broschuer-enversand.de or info@kabs-gfs.de

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# Solar UV Radiation and Global Climate Change

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**Abstract:** *Human health is directly affected by solar UV radiation. The main target organs are eyes and skin. Beside acute effects such as sunburn, chronic effects like premature skin ageing and skin cancer are of concern. To monitor the consequences of climate change on solar UV exposure and to inform the public about responsible behaviour in relation to UV, UV radiation near the ground is an important environmental indicator. For more than 15 years, near-ground UV radiation has been monitored by a nationwide network of UV monitoring stations and the data are evaluated by the German Federal Office for Radiation Protection (BfS) with respect to effects on human health. The BfS keeps the public up to date about the UV situation by publishing daily calculated UV indexes and, in addition, provides three-day forecasts of the UV index during the summer.*

## Introduction

Climate change resulting from global atmospheric changes could affect our exposure to natural solar UV radiation over the coming decades. Although the ultraviolet (UV) radiation component accounts for less than 6 % of total optical solar radiation, it is highly significant in terms of its effects on human health and the living environment. Near-ground solar UV radiation has therefore become an important environmental parameter requiring constant monitoring and assessment of its health impacts. Continuous UV monitoring enables the public to estimate their level of current and future UV exposure and also supplies scientists with high-quality data which can be utilised to answer relevant biophysical questions. Against this background, in the interests of public health protection, the German Federal Office for Radiation Protection (BfS) began continuous monitoring of natural solar UV radiation early on within the framework of preventive radiation protection.

## The UV monitoring network

The locations of the measuring stations in the UV monitoring network were selected so as to take account of differences in latitude, altitude, climate and haze across Germany. Figure 1 shows the various sites in the UV monitoring network.

The reference station in Munich is responsible for quality control and storage of the monitoring data. The solar UV spectrum is measured in a wavelength from 290 to 450 nm, i.e. in both the UV-B range (280–320 nm) and the UV-A range (320–400 nm).


**Figure 1:** Solar UV monitoring network in Germany.

## Health impact assessment of UV radiation

Due to the low penetrating properties of UV radiation in human tissues, the direct health-relevant biological effects of exposure to solar UV radiation are limited to the skin and eyes. In terms of the effects on the eyes and skin, a distinction can be made between acute damage, i.e. occurring immediately after a short period of exposure, and chronic damage, i.e. delayed onset after prolonged exposure to radiation.

Due to the anatomical structure of the eye, it is mainly the cornea and conjunctiva which may suffer acute damage and the lens which may suffer chronic damage. A certain amount of protection from excessive UV exposure is provided by the involuntary closing of the eyelids against excessive brightness with a correspondingly high UV component.

High levels of uncontrolled solar UV radiation exposure pose a potentially very significant risk to the skin. However, the skin has developed various long-term protection mechanisms, such as thickening of the top skin layer (hyperkeratosis) and tanning (pigmentation) (Figure 2). The level of protection depends largely on skin type and individual constitution and is adapted to the UV intensity concerned. The extent to which the skin can adapt to UV is limited, however.

The acute and primary effect on the skin caused by the short-wave solar UV component is sunburn (erythema), a visible inflammation and reddening of the skin, which is triggered by photochemical processes associated with the release of cell toxins. The "Minimal Erythemal Dose" (MED) is used to describe the minimum amount of UV radiation that produces redness and is around 250 J/m² for sensitive skin type II. The long-wave solar UV component mainly triggers phototoxic and photoallergic processes which, via endogenous or exogenous substances, can heighten the skin's sensitivity to radiation.

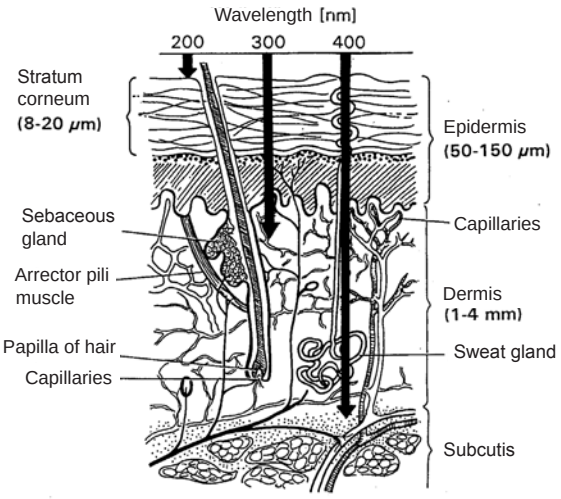


**Figure 2:** Spectral UV penetration of the skin surface. Reproduced from: Bundesgesundheitsblatt, Sonderheft "UV-Strahlung und Gesundheit", vol. 27 (1994).

The short-wave UV component is mainly responsible for chronic effects as well, such as premature skin ageing and the development of skin cancer. In basal cell carcinomas and squamous cell carcinomas, which are relatively common, a direct correlation has been established between solar UV exposure and the incidence of skin cancer. With malignant melanoma, the situation is not so clear-cut. Although melanomas can occur anywhere on the body, not only in areas of skin that are exposed to UV, and there is no direct correlation with cumulative UV dose and the frequency of melanoma, epidemiological data indicate that UV exposure is a significant causal factor for this disease as well. Here, frequency of sunburns, especially during childhood and adolescence, appears to play a role.

UV radiation also affects the human immune system. Doses lower than the MED can cause immune suppression in the skin, while higher doses in the short-wave UV range induce systemic immune suppression. The best clinical example of this is an increase in herpes virus infections after longer periods of sun exposure in summer.

In order to evaluate the health risks in quantitative terms, dose-effect relationships are required for the individual UV-induced biological effects. The effects of UV radiation on biological systems show a strong dependence on wavelength, so a biologically effective exposure has been determined for each wavelength (the "action spectrum"). The action spectra for erythema, premature skin ageing and the development of skin cancer are particularly significant for evaluation purposes. According to current scientific knowledge, all three action curves show a similar progression, with the short-wave range being as much as 1000 times more effective than the long-wave range. Sunburn (erythema) – the minimally delayed biological response to excessive UV radiation – is therefore an appropriate indicator for evaluating the health impacts of UV radiation.

## Monitoring figures and trend

The fraction of solar UV radiation received at ground level depends primarily on sun elevation and the time of day and year, overall ozone content and cloud cover (Figures 3 and 4).

In its annual UV report, the Federal Office for Radiation Protection (BfS) documents in detail the current measured and evaluated UV data from the monitoring stations (http://www.bfs.de) and has done so since 1995. So far, the monitoring data have not revealed a clear trend in changes in UV exposure (Figures 5).

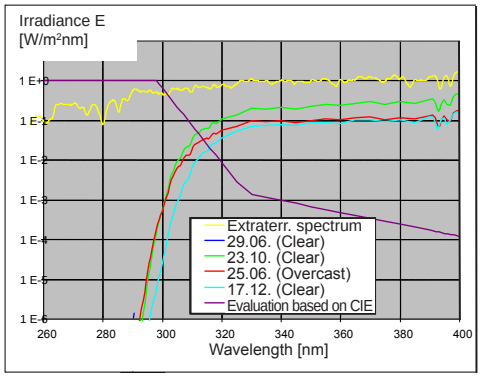


**Figure 3:** Effect of ozone, position of the sun and cloud cover on ground-level UV radiation. The figure shows UV spectra with a clear (29.6.) and heavily overcast sky (25.6.) at annual peak sun elevation, with a clear sky in autumn (23.10.) and close to the lowest annual sun elevation (17.12.). The spectra were each measured in 1995 at 12.00 noon CER in Neuherberg (extraterr. spectrum = solar spectrum outside the Earth's atmosphere). In addition, the erythema action spectrum based on CIE is shown.

## Public relations

The global solar UV index (UVI) is used as a tool to inform the public about UV radiation. This internationally harmonised index is designed to highlight the potential for adverse health effects (sunburn) from UV exposure. "Safe tanning times" are deliberately not used, as people tend to interpret

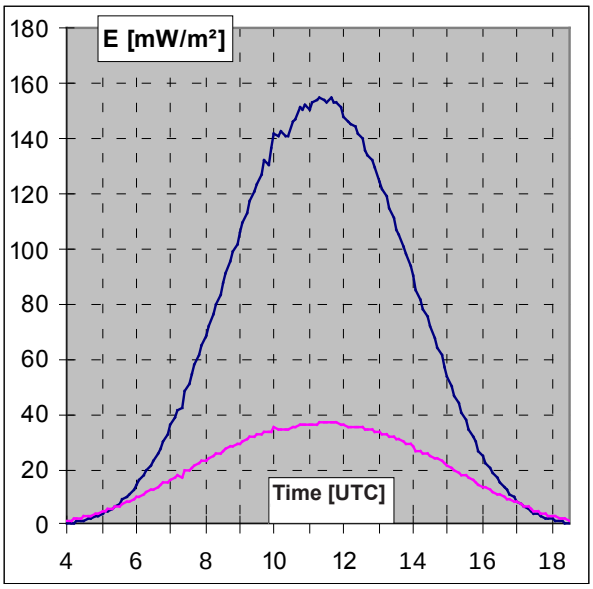


**Figure 4** shows the diurnal courses of erythema-weighted UV radiation in the UV-B range (290-320 nm) and the UV-A range (320-400 nm). Whereas the UV-A component achieves a maximum value of around 40 mW/m², the peak value of the UV-B component is four times higher, at around 160 mW/m².

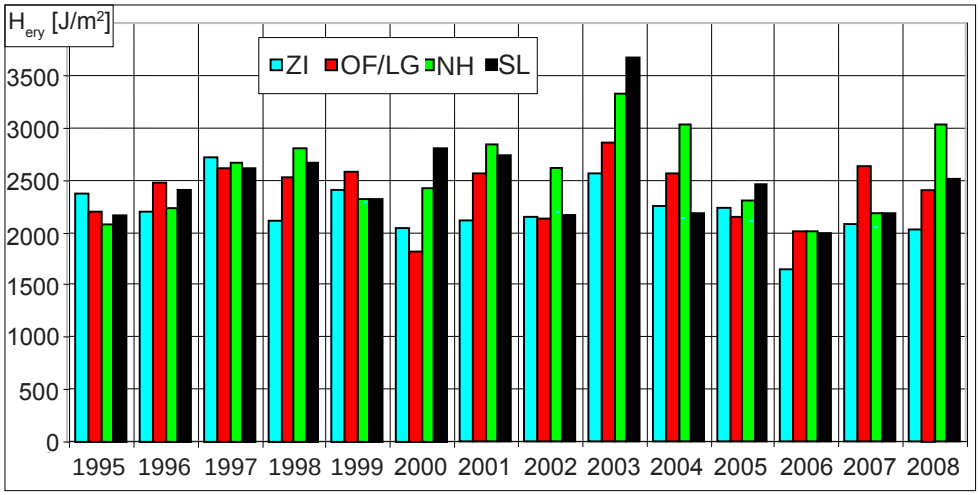


**Figure 5:** Daily means for the month of August at the four core stations of the nationwide UV monitoring network. ZI: Zingst, OF/LG: Offenbach, Langen, NH: Neuherberg, SL: Schauinsland.

them to mean that there is a safe level of unprotected sun exposure. The UVI should not imply that extended sun exposure is acceptable from a health perspective. On the contrary, the aim is to send a clear message that cumulative UV radiation exposure is a major causal factor in the development of skin cancer.

Table 1 shows the UVI sun protection scheme adopted by consensus by the World Health Organization, the World Meteorological Organization (WMO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The scheme recommends clear and simple actions for each exposure category.

The BfS informs the public about the current solar UV situation using the maximum UV index values measured daily at the monitoring stations. It also publishes three-day UV forecasts every day from

| UVI range | Exposure categorys | Burn time | Protection | Action |
|---|---|---|---|---|
| >10 | Extreme | < 15 mins | Extra protection | Avoid being outside during midday hours. Shirt, sunscreen and hat are a must! |
| 8,9,10 | Very high | < 20 mins | Extra protection | Avoid being outside during midday hours. Shirt, sunscreen and hat are a must! |
| 6,7 | High | After 20 mins | Protection reqired | Seek shade during midday hours. Slip on a shirt, slop on sunscreen and slap on a hat! |
| 3,4,5 | Moderate | After 30 mins | Protection required | Seek shade during midday hours. Slip on a shirt, slop on sunscreen and slap on a hat! |
| 1,2 | Low | After 30 mins | No protection required | |

**Table 1:** Recommended sun protection scheme with details of approximate burn times (skin type II).

spring to autumn. The forecasts are generated automatically, and unlike the model-based weather forecasts from the German Meteorological Service (DWD), are based on statistical evaluation of the UV monitoring data collected, combined with the relevant weather data. Based on information about forthcoming weather events, the appropriate UVI value is then determined and utilised for the fore-

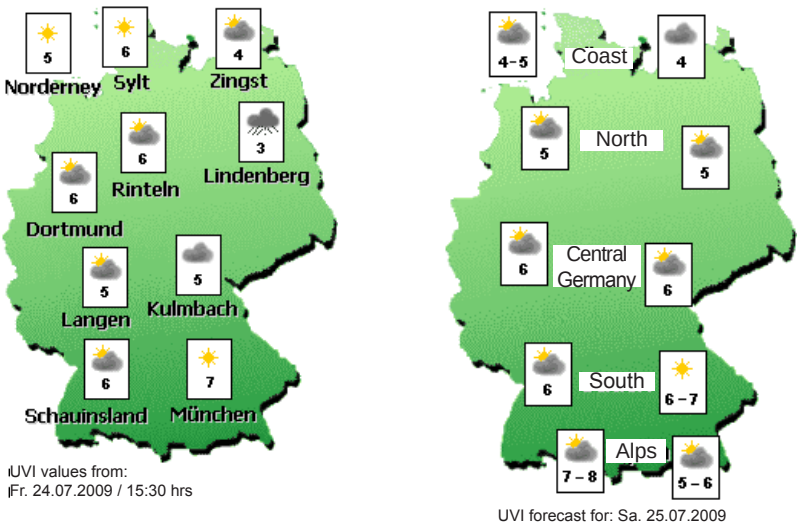


**Figure 6:** Left: graphic depiction of the 3-day UVI forecast; centre: graphic depiction of current UV monitoring figures at the individual stations; above: UVI logo.

cast. The BfS uses weather data provided by the DWD to produce the weather forecast for the UVI forecasting areas.

In cooperation with the Bavarian Environment Agency (LfU) and Bayerischer Rundfunk (Bavarian Broadcasting – BR), the BfS publishes a regional forecast for northern and southern Bavaria on videotext on BR's TV Channel 3 and recommends appropriate protection measures.

Besides the forecasts, the BfS also provides information about skin types and action to avoid sunburn, e.g. the use of sunscreen, appropriate behaviour when swimming, and advice on the protective effect of clothing. As more and more people are holidaying in sunny regions of the world, long-haul travellers can also access maximum potential UVI values for more than 25 regions of the world.

To what extent will climate change affect the prevalence of skin cancer? Which preventive measures may be sensible, and what will be the likely impacts of changing prevalence? These issues are currently being addressed by the Climaderm network; the national Climaderm – Climate Change and Skin Cancer research project aims to provide answers (further information available at: http:// www.uke.de/kliniken/hautklinik/index_44545. php).

Current UVI monitoring figures and further information are available on the BfS website: http:// www.bfs. de/de/uv/uv_messnetz/uvi/messnetz. html.

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# Mercury in Fish
# Project to establish a basis for a long-term study of climate change

*Christine Sommerfeld[1], Reinhard Kruse[2], Svenja Behrens[3], Heike Itter[1], Edda Bartelt[2]*

**Abstract:** *The current global climate change might influence the metabolism of fish directly, possibly causing a higher storage of toxic substances such as methylmercury. In order to start the analysis of the relation between potentially higher mercury storage in fish and climate change, the present study examines typical edible fish from fishing grounds which are highly relevant for European consumers. Analysis of the data yields the following results: not a single sample exceeded the legal upper limit for total mercury concentration. Moreover, the content of methylmercury did not exceed the recommended toxicological benchmarks of the FAO and WHO. Hence, no sample posed a health hazard under the assumption of average fish consumption.*

## Introduction

Fish plays an important role in a healthy, balanced diet. It is a source of high-quality, easily digestible protein, and its oils are rich in essential polyunsaturated fatty acids. Fish also contains vital fat-soluble vitamins and essential trace elements such as iodine and selenium. However, the storage of toxic substances such as methylmercury in fish must be viewed as a limiting factor. The extent to which this storage will be affected by climate change is a topic of current and future research. At present, the main requirement is for long-term data as a starting point from which to analyse the relation between methylmercury concentration/accumulation in fish and climate change. These long-term data are essential to enable valid conclusions to be drawn about the effect of climate change on methylmercury content in fish. The purpose of the research project presented below, which was carried out by the Institute for Fish and Fishery Products (IFF) Cuxhaven on behalf of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Institute for Risk Assessment (BfR), was therefore to determine current methylmercury contamination of fish and shellfish and establish a data basis for estimating exposure in light of climate change.

Climate change-related factors, such as the acidification and the warming of the oceans, are already changing the species spectrum in the marine food chain and the biopassage of toxic substances within it (Huntley et al. 2004). Continuing or worsening climate change might influence fish metabolism directly, possibly causing higher storage of toxic substances such as methylmercury. Mercury occurs naturally throughout the biosphere even without anthropogenic activity, and levels of 0.001 – 0.1 µg/l are regarded as the natural background concentration in seawater. Methylmercury is an organic compound formed in sediments and soils as a result of microbial processes. It is ingested from seawater by marine fauna and accumulates throughout the marine food chain (Castoldi et al. 2008; Chen et al. 2008).

## Materials and methods

742 samples of various fish species (cod, redfish, herring, plaice, flounder, and mackerel) were taken from several fishing grounds in the North Sea and Baltic Sea. Fish from other North Sea/North Atlantic fishing grounds, such as East Faroes, East Peterhead, Pobie Bank, Bressay Ground, Bressay Shoal and Fladen Ground, were also included in the study. Imported deep-frozen fillets of Alaska pollock, labelled as originating in the "North Pacific off Alaska", were tested as well. At IFF Cuxhaven, the fish were measured, weighed and then filleted. Fully homogenised material from the muscles from the entire body of the individual fish, removed representatively, was then used exclusively as samples for

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[2] Institute for Fish and Fishery Products (IFF) Cuxhaven, part of the Lower Saxony State Office for Consumer Protection and Food Safety (LAVES).

[3] German Association of the Flavouring Industry (DVAI) / German Association of the Fragrance Industry (DVRH).

analysis. Due to the selective enrichment process of methylmercury in fish tissues, the concentration of this toxic substance increases continuously throughout the life cycle (age-related accumulation). To take account of intake dynamics, the total lengths and weights of the fish were defined as species-dependent indirect parameters for the age of the fish, using descriptive statistics, and were analysed to establish their correlation with mercury content.

## Results

Figure 1 shows the methylmercury contamination of various species of fish. With the exception of redfish and North Sea cod, the values are lower than 0.3 mg/kg. In the case of redfish and North Sea cod, the samples analysed show greater variability, with maximum values less than 0.5 mg/kg.

Correlations were also noted between the concentrations of methylmercury/anorganic mercury and the length and weight – and hence, indirectly, the age – of the individual fish. In all cases studied, it was shown that the content of both methylmercury and anorganic mercury increases with greater length and weight. A characteristic of all the results is the considerable variability between the concentrations detected. This high variability is shown with reference to Baltic Sea cod in Figure 2, which also depicts the correlation with length and weight.

## Evaluation of the results in terms of food safety regulations and toxicology

There are no legal regulations currently in place on methylmercury content in fish. By way of alternative, reference can be made to Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs, which specifies maximum permissible amounts for total mercury content. By taking the totals of all the samples from each of the individual fish species, it was possible to derive the average total mercury content for the species in question, the number of cases that exceeded the applicable legal upper limit, and the percentage of the limit utilised. Not a single sample exceeded the legal upper limit for total mercury concentration. The utilisation of the legal upper limits ranged between 1.8 % in the case of Alaska pollock and 31.4 % in the case of North Sea cod (Table 1). Hence none of the samples tested in the project currently pose a health hazard.

In terms of the toxicological assessment, reference may be made to the recommendation of the European Food Safety Authority (EFSA); as stated in the opinion of the Federal Institute for Risk Assess-

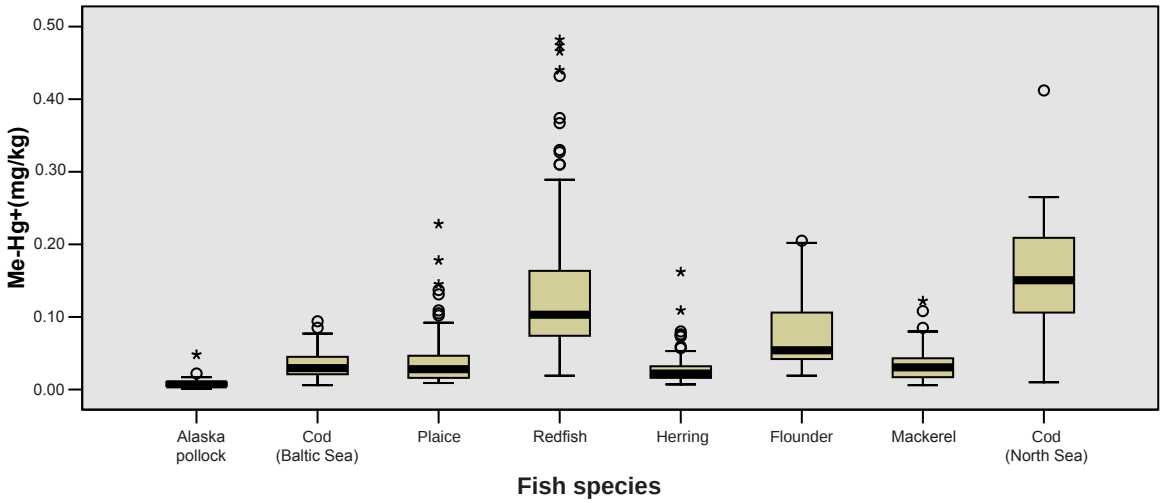


**Figure 1:** Methylmercury concentration in fish fillets from various species of fish (mg/kg).
The boxes represent the values between the 25th and 75th percentile (interquartile distance), with the median represented as a horizontal bar. The vertical lines end at the highest and lowest values within a range of 1.5 times the interquartile distance. Values outside this range, indicated as "○", are designated as outliers (greater than 1.5 times the interquartile distance) or extreme values, indicated as "*" (greater than 3 times the interquartile distance).

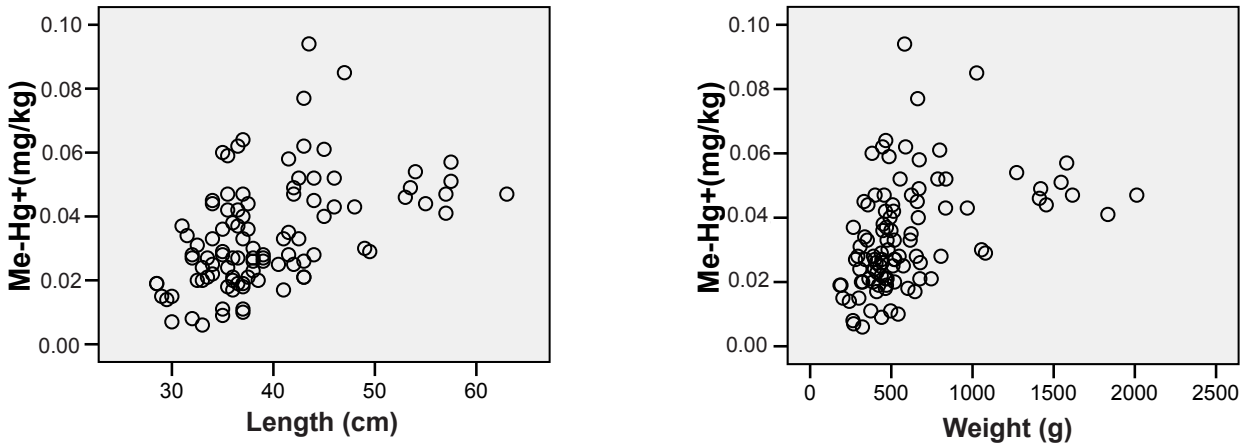


**Figure 2:** Correlation between length (correlation coefficient r= 0.53) and weight (correlation coefficient r= 0.52) and methylmercury concentration with reference to Baltic Sea cod.

ment (BfR) of 29 March 2004, the recommendation defined 1.6 µg methylmercury per kg of body weight (1.6 µg/kg BW) as the "provisional tolerable weekly intake" (PTWI) value. This recommendation is based on an evaluation by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) from 2003. Reference can also be made to the recommendation of the US National Research Council (US-NRC), which has derived an intake limit of 0.7 µg/kg BW per week as a toxicological limit value. The results summarised in Table 2 show that intake exceeding the PTWI value is unlikely to occur at the average methylmercury concentrations detected, assuming normal levels of fish consumption.

Much higher methylmercury levels were detected, however, in species such as shark, swordfish and butterfish in an earlier study (Kruse and Bartelt 2008). Excessive consumption of these species could result in the relevant total tolerable weekly intakes, indicated above, being exceeded by a substantial margin.

## Consumer health protection

The results present the current methylmercury contamination of fish and fish products from the fishing grounds studied and provide a data basis for estimating exposure. Taking account of the current levels of contamination of fish with methylmercury and assuming normal levels of consumption, and also

| | Number of samples | Legal upper limit for total Hg [mg/kg] | Average total Hg content [mg/kg]* | Average utilisation of legal upper limit [%] |
|---|---|---|---|---|
| Alaska pollock | 100 | 0.5 | 0.009 | 1.8 |
| Cod (Baltic Sea) | 100 | 0.5 | 0.037 | 7.4 |
| Plaice | 135 | 0.5 | 0.039 | 7.8 |
| Herring | 126 | 0.5 | 0.029 | 5.8 |
| Redfish | 100 | 1.0 | 0.147 | 14.7 |
| Flounder | 37 | 0.5 | 0.078 | 15.6 |
| Mackerel | 98 | 0.5 | 0.037 | 7.4 |
| Cod (North Sea) | 46 | 0.5 | 0.157 | 31.4 |

**Table 1:** Rate of exceedances of legal upper limits and proportion of limit utilised.
*The total Hg content is derived from the totals of the Hg content from the analysed species (methylmercury and anorganic mercury).

| Fish species | Me-Hg content [µg/g] | Intake amount in 150g of fish | Intake amount per kg BW [µg] (person weighting 70 kg) | Utilisation of JECFA recommendation of 1.6 µg/kg BW per week [%] | Utilisation of NRC recommendation of 0.7 µg/kg BW per week [%] | Market share of consumer basket [%] (data according to FIZ 2007*) |
|---|---|---|---|---|---|---|
| Alaska pollock | 0.008 | 1.2 | 0.017 | 1.1 | 2.4 | 23.6 |
| Cod (Baltic Sea) | 0.034 | 5.1 | 0.073 | 4.5 | 10.4 | < 1.0 |
| Plaice | 0.038 | 5.7 | 0.081 | 5.1 | 11.6 | 0.8 |
| Redfish | 0.191 | 28.7 | 0.409 | 25.6 | 58.5 | 2.7 |
| Herring | 0.027 | 4.1 | 0.058 | 3.6 | 8.3 | 16.1 |
| Flounder | 0.074 | 11.1 | 0.159 | 9.9 | 22.7 | < 1.0 |
| Mackerel | 0.034 | 5.1 | 0.073 | 4.6 | 10.4 | 1.7 |
| Cod (North Sea) | 0.154 | 23.1 | 0.330 | 20.6 | 47.1 | 4.4 |
| Total | | | | | | 49.4 |

**Table 2:** Toxicological evaluation of the results.
*The German Fish Information Centre (FIZ): Daten und Fakten, 2007 edition (available from Fischinformationszentrum (FIZ), Große Elbstraße 133, 22767 Hamburg).

in light of food safety regulations and toxicological criteria, the findings indicate that fish consumption does not pose a general exposure risk. However, a critical level of exposure could arise in individual cases as a result of substantially above-average levels of fish consumption or excessive consumption of species which may contain highly elevated levels of methylmercury. This is particularly relevant in the case of pregnant women and nursing mothers, as the foetus and infants are highly sensitive to methylmercury and could sustain neurological damage as a result of exposure to it. For that reason, it is important to determine the methylmercury content in fish. In order to avoid possible neurological damage from exposure to methylmercury, pregnant women and breast-feeding mothers are advised to limit their consumption of fish with potentially high methylmercury levels (shark, butterfish, swordfish, halibut, tuna and anglerfish) as a precautionary measure to protect their children, and instead to eat species of fish which contain low levels of methylmercury (e.g. pollock, herring, Baltic Sea cod, mackerel, plaice) (Kruse and Bartelt 2008). The results of the research project presented above now serve as a data basis for the methylmercury content in fish, which can be used in future as a frame of reference in studies to determine the possible effect of climate change on the methylmercury content in fish.

The research project "Climate change-related intake of toxic methylmercury via fish consumption" was funded from the environmental research plan of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) (research ref. no. 08 49 745) and ran from 1 March 2008 to 31 December 2008. The final report can be downloaded as a pdf file from the BMU's website: http://www.bmu.de/files/pdfs/allgemein/application/pdf/endbericht_methylquecksilber.pdf.

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# "Climate Change and Health": Educational and information material for primary level

*Judith Meierrose*

**Abstract:** *Almost every day we hear or read in the media about the possible consequences of climate change, e.g. heat-related fatalities, flooding and the spread of animals and plants that can affect our health. Primary school children too pick up the news and worry about what this might mean for them now and in future. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environment Agency (UBA) have published new educational material for primary schools on "Environment and Health", which contains four worksheets that deal with "Climate Change and Health". With this material, children can learn about the diverse health-related consequences of climate change and draw conclusions for their own behaviour. The worksheets and background information for teachers are available in English and German at the educational service of the BMU (http://www.bmu.de/bildungsservice). They are free of charge.*

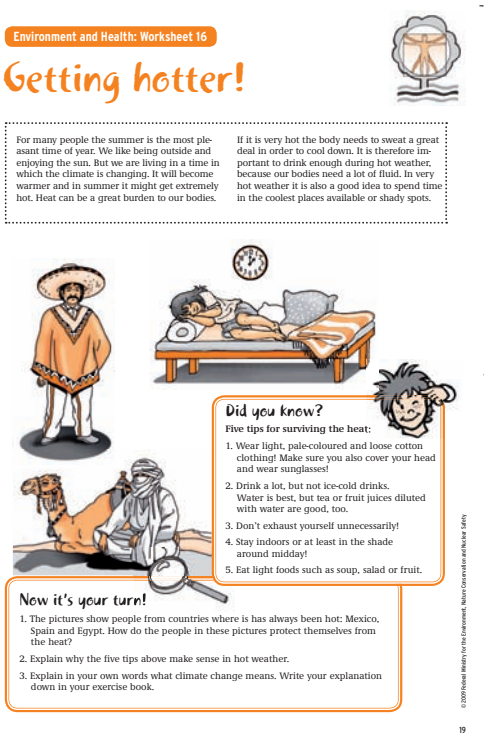
Almost every day we hear or read in the media about the possible consequences of climate change: temperature extremes, heat-related fatalities, rising sea levels, storms, flooding, changes in flora and fauna, and the spread of vectors and pathogens that can affect our health. Primary school children pick up the news as well, and worry about what this might mean for them now and in future.

In May 2009, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environment Agency (UBA) therefore published new educational material for primary schools on "Environment and Health", which contains four worksheets on "Climate Change and Health" as well as relevant background information for teachers. The materials help teachers explore the health-related consequences of climate change with their classes and answer children's questions about this topic.

## Content of the worksheets

Using the "Getting hotter!" worksheet (Figure 1), the children learn about the effects of heat on the body and are given tips on appropriate hot-weather behaviour. The "Thunder and Lightning" worksheet gives them the opportunity to learn about extreme weather conditions. Using the worksheet about ticks, schoolchildren can look at the lifecycle of the tick and learn how it can transmit disease. They find out that climate change is creating conditions that are conducive to the spread of ticks, and discuss what they can do to protect themselves from tick bites during excursions.

The fourth and final worksheet on "Climate Change and Health", entitled "Ragweed Alarm!", explains to children that certain plants are occurring more frequently in Germany as a result of climate change, one of them being Common Ragweed (Ambrosia artemisiifolia) which can cause serious allergic reactions. The children learn what they should and should not do if they come across a ragweed plant,


Environment and Health: Worksheet 16

Getting hotter!

For many people the summer is the most pleasant time of year. We like being outside and enjoying the sun. But we are living in a time in which the climate is changing. It will become warmer and in summer it might get extremely hot. Heat can be a great burden to our bodies.

If it is very hot the body needs to sweat a great deal in order to cool down. It is therefore important to drink enough during hot weather, because our bodies need a lot of fluid. In very hot weather it is also a good idea to spend time in the coolest places available or shady spots.

Did you know?

Five tips for surviving the heat:

1. Wear light, pale-coloured and loose cotton clothing! Make sure you also cover your head and wear sunglasses!
2. Drink a lot, but not ice-cold drinks. Water is best, but tea or fruit juices diluted with water are good, too.
3. Don't exhaust yourself unnecessarily!
4. Stay indoors or at least in the shade around midday!
5. Eat light foods such as soup, salad or fruit.

Now it's your turn!

1. The pictures show people from countries where is has always been hot: Mexico, Spain and Egypt. How do the people in these pictures protect themselves from the heat?
2. Explain why the five tips above make sense in hot weather.
3. Explain in your own words what climate change means. Write your explanation down in your exercise book.



19

**Figure 1**:"Getting hotter!": worksheet on "Climate Change and Health".

and are also encouraged to find out about other plants which can cause allergies.

The worksheets place particular emphasis on what the children can do to protect themselves from the health impacts of climate change, thereby ensuring that lessons about climate change and health are both stimulating and action-oriented. The aim is to raise pupils' awareness of the climate change/health nexus and the topic of environment and health, and in the process, reach parents as well.

In addition to the four worksheets described here, the workbook contains worksheets on other topics: indoor air, noise, swimming in natural waters, radiation and chemicals. The materials can be combined to good effect (the "heat" worksheet ties in with the worksheet on sun protection, for example) and communicate the learning content in a lively manner using experiments, games and observation exercises. Children are thus encouraged to use all their senses to explore the broad topic of environment and health.

## Information for teachers

The worksheets are available individually and as a classroom set. They are supplemented by background information and advice for teachers on appropriate teaching methods. These practically oriented materials have proved their worth in science and technology lessons as well as in interdisciplinary teaching. The materials are available in English and German.

The workbooks and information for teachers can be downloaded free of charge from the Internet at: http://www.bmu.de/publikationen/bildungsservice/bildungsmaterialien_grundschule/lehrer/doc/43971.php.

Educational materials for primary schools on other aspects of climate change have been published recently (in German). The BMU Educational Service also offers teaching and learning materials on a wide range of other topics, suitable for use in lessons at primary and secondary schools (secondary levels I and II); these can be accessed at: http://www.bmu.de/publikationen/bildungsservice/aktuell/6807.php.

UNESCO has recognised the BMU Educational Service as an official project for the UN Decade of Education for Sustainable Development.

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# Competence Centre on Climate Impacts and Adaptation (KomPass) at the Federal Environment Agency (UBA) Information and services

*Petra Mahrenholz, Achim Daschkeit, Clemens Haße*

**Abstract:** *Adaptation to climate change requires user oriented information about climate change, its impacts, possible adaptation options and best practice examples. The Competence Centre on Climate Impacts and Adaptation (KomPass) at the Federal Environment Agency (UBA) summarises the results of climate impact research and makes them readily accessible to the 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. To support this knowledge transfer among research and adaptation actors KomPass operates a network with actors from science, business and administration.*

## Introduction

In order to counter the negative impacts of climate change on the environment, economy and society, it is important to develop and implement a range of adaptation measures. These include, for example, the introduction of monitoring and early warning systems to identify health burdens at an early stage and thus facilitate effective mitigation of the associated risks. Decision-makers must be able to identify threats to health more quickly and take swift action against emerging risks.

The range of climate advisory structures already in place in Germany – such as scientific bodies, federal and Land authorities, independent experts and consulting engineers, and new institutions such as the regional climate offices of the Helmholtz Association of German Research Centres and the Climate Service Center – thus face a major challenge: how to synthesise, evaluate, network and communicate the available climate knowledge on a systematic basis for a variety of applications.

## KomPass at the UBA: Synthesising, evaluating, networking and communicating climate knowledge

The Competence Centre on Climate Impacts and Adaptation (KomPass) at the Federal Environment Agency is a pioneer and contact point for adaptation-related activities in Germany. As the interface between climate impact research, society at large and policy-makers, its task is to identify vulnerable sectors and regions, evaluate climate impacts, and assess possible adaptation options and their associated opportunities and risks. KomPass cooperates with the scientific community, ministries and public authorities, trade associations and companies. The knowledge base is underpinned by the numerous products, services and information provided by KomPass: besides the KomPass newsletter, fact sheets, brochures and flyers, KomPass also operates an Internet-based information and communication platform with continuously expanding content. Its components and services are depicted in Figure 1.

Besides scientific information, access to climate scenario data, information and activities relating to the German Adaptation Strategy, KomPass also provides a searchable catalogue of projects relating to climate impacts and adaptation which is networked with the German Environmental Information Portal (Portal-U), and much more. Interactive elements such as online surveys, a catalogue of measures, expert profiles and an expanded events diary will soon be added to support the participation process. Risk mapping and a decision-making support system for local authorities and companies round off KomPass's portfolio of services.

The success of the policy advice provided on the basis of this climate information can be demonstrated, for example, by the fact that the German Government has recognised the future parameters for climate developments: since 2005, KomPass has facilitated the regular updating and interpretation of regional climate scenarios and no-cost data access, and, in conjunction with the Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Transport, Building and Urban Development (BMVBS) and its higher federal authorities, has driven the process to secure

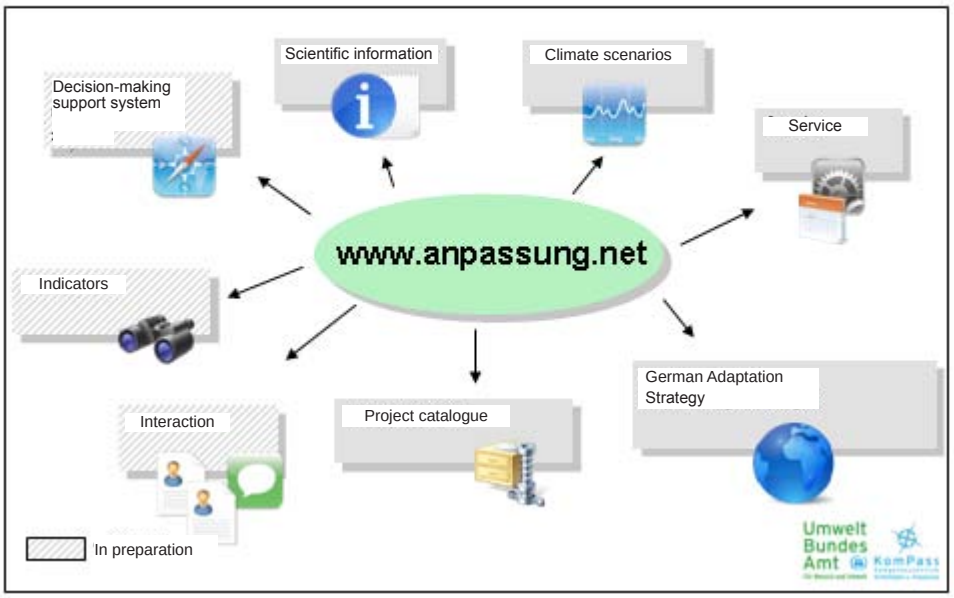


**Figure 1:** KomPass – Communication platform on climate impacts and adaptation.

political acceptance of these scenarios in the federal ministries working on the Adaptation Strategy (now the Inter-Ministerial Working Group on Adaptation). In this context, the discussion with political decision-makers about the uncertainties inherent in the results of modelling, and a joint agreement on principles for decision-making under conditions of uncertainty, have played a particularly important role. KomPass was able to contribute its experience from five years of working with experts from the environmental authorities at Land level to this discussion, as the issues arising at regional and at federal level are often broadly similar.

Together with climate scientists and with support from the German Meteorological Service (DWD), BMBF and its project agency DLR, target-group-appropriate, policy-relevant scientific advice is now being provided successfully, ranging from syntheses and evaluations of the available regional climate scenarios to policy advice for the Federal Cabinet. As one outcome, the Federal Government has undertaken to assess possible opportunities and risks of climate change in future policy planning. However, it will not base its assessments on individual scenarios or models but will consider the uncertainties surrounding future climate developments that are apparent from various emissions scenarios and climate modelling. The Federal Government will face up to the challenge and has decided that it will henceforth base its planning processes and associated adaptation decisions on the available ensembles, taking account of existing uncertainties, and will thus accept probability statements as a basis for planning. This process is no means a given at present and necessitates a rethink of existing practices in a number of sectors.

## Needs arising from the requisite further development of adaptation strategies

Future needs can be subdivided into the following categories: research, synthesis/evaluation, networking and communication. Research into the interactions and feedback between natural and socioeconomic systems should addressed as a particular priority. For example, issues relating to general cross-sectoral integrated analysis and evaluation, and especially economic evaluation, of adaptation measures, and conflicts between different programme objectives, have still not been resolved.

Networking and communication should be promoted not only within the regional and national framework but also at the European and international level. Climate services and information must therefore be adapted accordingly.

The European Commission's White Paper on adaptation to climate change offers entry points for European networking and communication. They include, for example, the establishment of a European Clearing House Mechanism for adaptation, which will build on national (e.g. http://www.anpassung.net) and international (e.g. http://www.euro.who.int) information and communication platforms.

Further information about KomPass is available at: http://www.anpassung.net.

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# The Heat Health Warning System of the German Meteorological Service

*Christina Koppe*

**Abstract:** *Heat waves are an emerging public health problem in many parts of the world. As an example, the 2003 heat wave in Western Europe – which caused over 35,000 fatalities – clearly showed the danger that can arise from a long-lasting heat load. In its Fourth Assessment Report the IPCC has stated that it is very likely that the frequency and intensity of heat waves will increase and that this will lead to an increased risk of heat-related mortality – especially for the elderly, chronically sick, very young and socially isolated people. Heat health warning systems (HHWS) are one possibility to adapt to this change in climate and to reduce heat-related health impacts.*

## Introduction

In summer 2003, heat waves in Europe caused an estimated 35,000–50,000 fatalities. In Germany too, the 2003 summer heat wave led to a significant increase in the number of deaths (Figure 1). These events clearly showed the danger that can arise, also in Central Europe, from a long-lasting heat load. The Intergovernmental Panel on Climate Change (IPCC) expects the frequency and intensity of heat waves to increase in future and that this will lead to a rise in heat-related mortality with the main at-risk, groups being the elderly, chronically sick, very young and socially isolated people (IPCC 2007).

In order to reduce heat-related health impacts as far as possible in future, the German Meteorological Service (DWD), like many other European weather services, has set up a heat health warning system (HHWS). Heat health warning systems utilise current weather forecasting in order to predict periods

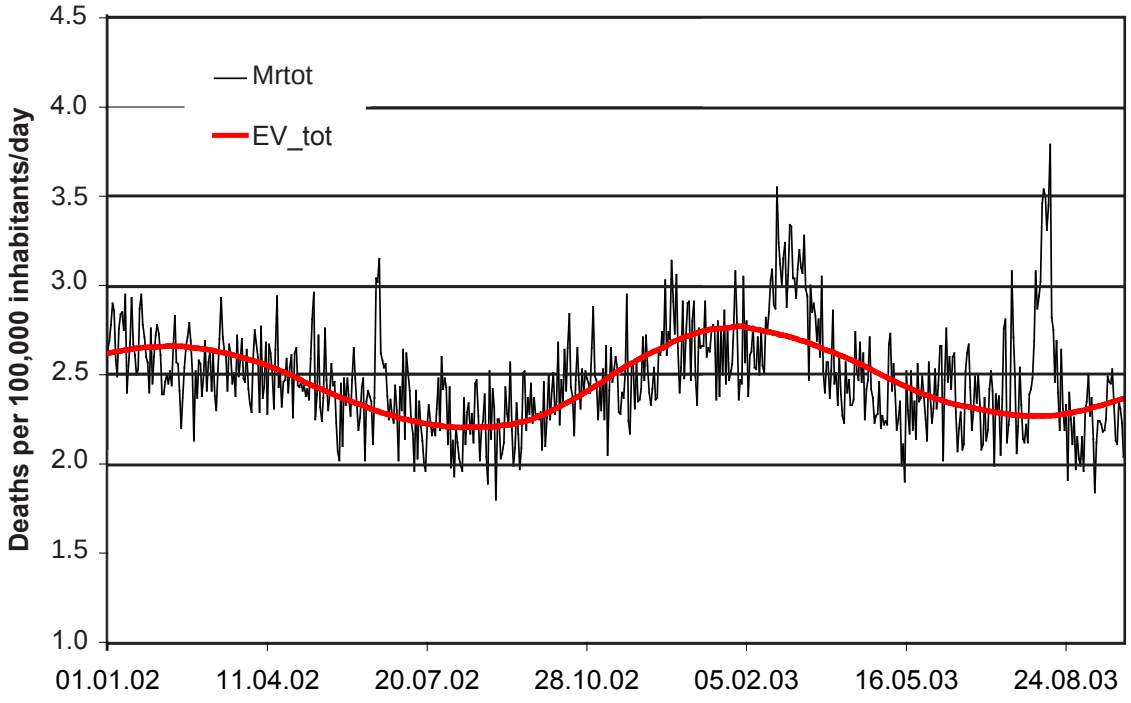


**Figure 1:** Total mortality rate (Mrtot) during the period 01.01.2002 to 30.09.2003 in Baden-Württemberg (SW Germany). The high mortality rates in summer 2003 occurred during the heat wave in the first few days of August in 2003 (EV_tot: expectation value).

of high thermal stress which may have negative impacts on health (increased morbidity or mortality). In addition, mechanisms to trigger intervention measures must be established.

## The heat health warning system of the German Meteorological Service

Energy exchange between the human body and its environment takes place via radiation and the flow of sensible and latent heat. There are four basic environmental variables that affect the human body's response to the thermal environment: air temperature, radiant temperature, humidity, and air movement (wind velocity). Therefore to assess human thermal environments, it is necessary to quantify these four basic parameters (Parsons 2003). Combined with the metabolic rate and the clothing worn by a person, these meteorological elements provide the six fundamental factors which define the conditions for heat exchange between the human body and its environment.

The method used by the German Meteorological Service (DWD) for the health-relevant assessment of the thermal environment is Perceived Temperature (PT) (Jendritzky 1990). This is based on a complete heat budget model of the human body and takes into account all relevant mechanisms of heat exchange with the atmospheric environment. The following meteorological elements – air temperature, humidity, wind velocity, and short-wave and long-wave radiant fluxes – are the parameters used for the computation of the Perceived Temperature. Heat exchange is modelled for a standard male, known as "Klima-Michel". This standard male chooses his clothing in order to remain in thermal comfort as far as possible. The Perceived Temperature PT is recorded in the dimension °C and can be summarised in terms of a scale of physiological stress (Table 1).

| Classification band (K) | Perceived Temperature (PT) in °C | Thermal Perception | Physiological Stress |
|---|---|---|---|
| | < -39 | Very cold | -4: Extreme cold stress |
| 13 -[ | -39 to -26 | Cold | -3: Heavy cold stress |
| 13 -[ | -26 to -13 | Cool | -2: Moderate cold stress |
| 13 -[ | -13 to 0 | Slightly cool | -1: Low cold stress |
| | 0 to 20 | Comfortable | 0: No thermal stress |
| 6 -[ | 20 to 26 | Slightly warm | 1: Low heat load |
| 6 -[ | 26 to 32 | Warm | 2: Moderate heat load |
| 6 -[ | 32 to 38 | Hot | 3: Heavy heat load |
| | ≥ 38 | Very Hot | 4: Extreme heat load |

**Table 1:** Perceived Temperature, thermal perception and physiological stress, following VDI (1998).

Over the course of the summer, the human body becomes more acclimatised to high temperatures. Heat loss becomes more efficient, e.g. through an increase in the sweating rate. In order to account for this acclimatisation, a procedure has been developed which allows the threshold value of the comfort range (Table 1) to be adjusted according to the thermal conditions of the last 30 days (Koppe 2005). The classification bands are maintained, however, and the threshold values for moderate, heavy and extreme stress shift accordingly. An example of this threshold flexibility is shown in Figure 2. The thresholds for the individual stress categories vary, in addition, from region to region: for example, they are generally higher in southwestern than in northern Germany in summer.

In order to determine how the different categories of thermal stress impact on human health and when it is necessary to issue a warning, an analysis of

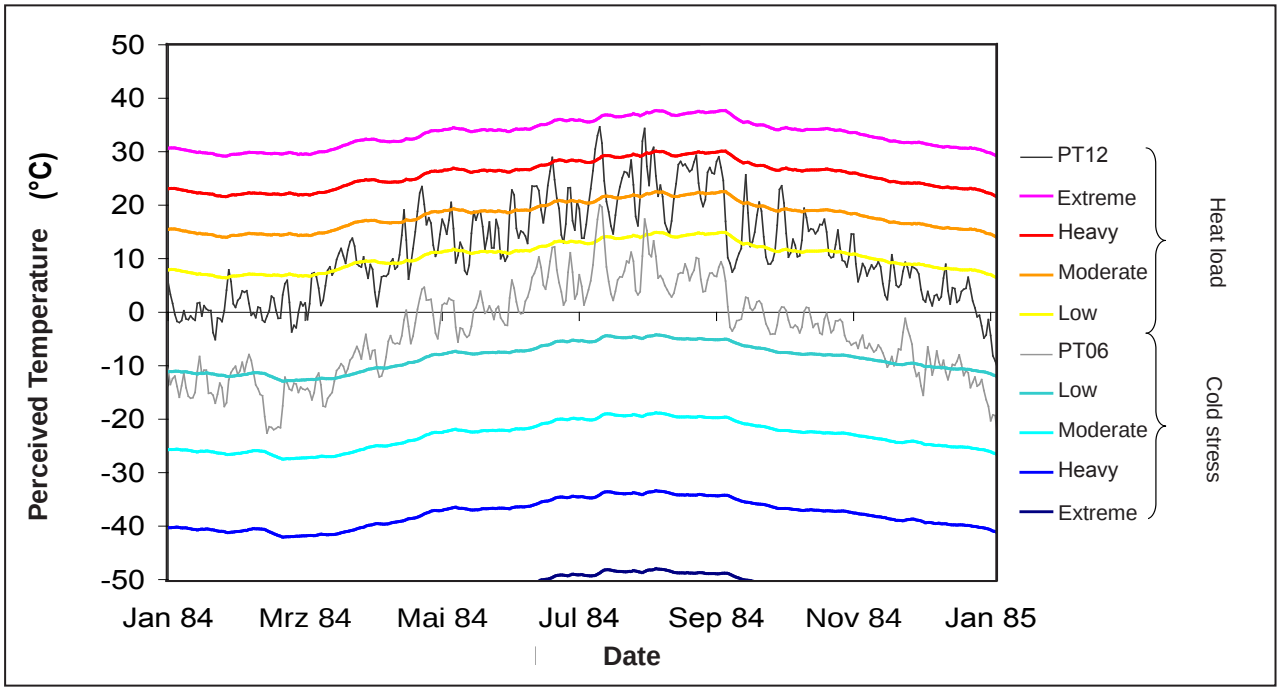


**Figure 2:** Perceived Temperature at 12 (PT12) and 6 (PT06) UTC (Universal Time Coordinated, UTC) and flexible thermal stress categories in Baden-Württemberg in 1984.

mortality data from various European regions was carried out (Koppe 2005). As the morbidity data available are often inadequate, unfortunately, total mortality was selected as the indicator of health impacts. It was found that in all the regions investigated, heat loads classed as "heavy" and above were associated with a clear deviation of actual mortality from the expectation value. Figure 3 shows mean total mortality relative to the expectation value in Baden-Württemberg. On days with a heavy heat load, around 13 % more people die, on average, than expected.

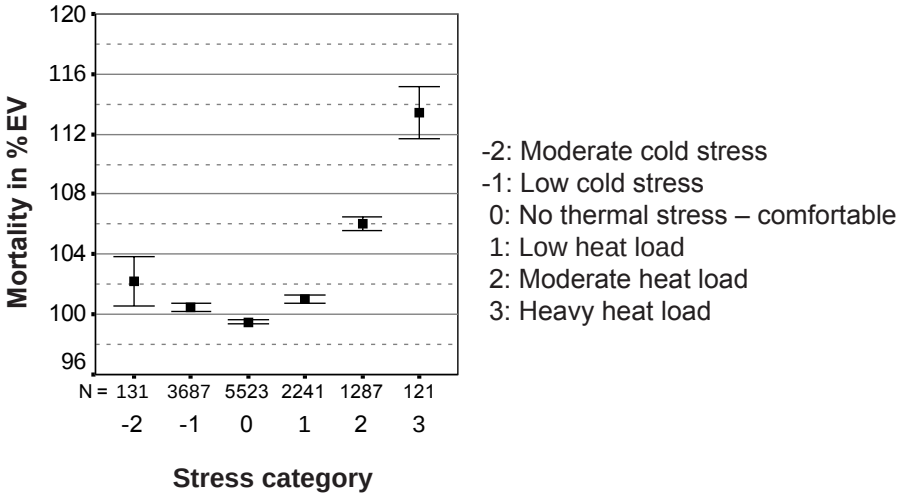


**Figure 3:** Mean relative mortality during the period 1968–2003 in Baden-Württemberg. EV: expection value; N: number of cases; bars: 95 % cofidence interval on the mean (Koppe 2005).

Even a moderate heat load is linked to significantly increased mortality. However, because days with at least a moderate heat load occur relatively frequently – between 30 and 40 times a year – "moderate heat load" is not suitable for use as a warning criterion; excessively frequent warnings may result in "warning fatigue", with people failing to take them seriously. For that reason, in Germany, warnings are only issued on days for which at least a "heavy heat load" is predicted.

## Issuing of warnings by the DWD

On each day that the Perceived Temperature at 12.00 Universal Time Coordinated (UTC) exceeds the warning threshold, a warning is issued by the DWD at around 10 a.m. The warning covers a two-day period. The information pathways that are followed when the "heavy heat load" threshold is exceeded are shown in Figure 4.

Based on numerical weather prediction for the next 48 hours, the model calculates whether the "heavy heat load" warning threshold will be exceeded in the individual counties across Germany, and up to which altitudes. At the same time, it checks whether the minimum temperature is likely to fall below a specific threshold (16–18 °C, depending on the region), as night-time cooling guarantees a recovery period. During long-lasting heat waves, adjustment of the threshold values to weather conditions over recent weeks could well produce a very high threshold value for "heavy heat load". Therefore in order to ensure that warnings continue to be issued during this type of scenario, in which ongoing stress can pose a threat to health, the warning threshold value is fixed at a maximum of 34 °C Perceived Temperature.

This generates a warning recommendation which is then reviewed by biometeorologists. They have the option to accept the recommendation to issue a warning, and they can also add warnings of their own if, in their view, a critical situation could arise. Besides the data provided by the heat stress model, the biometeorologists also obtain information

from a building simulation model that provides data about thermal conditions in the indoor environment; these data are also fed into the decision-making process.

The warnings generated in this way are published on the DWD website (http://www.dwd.de/warnungen)

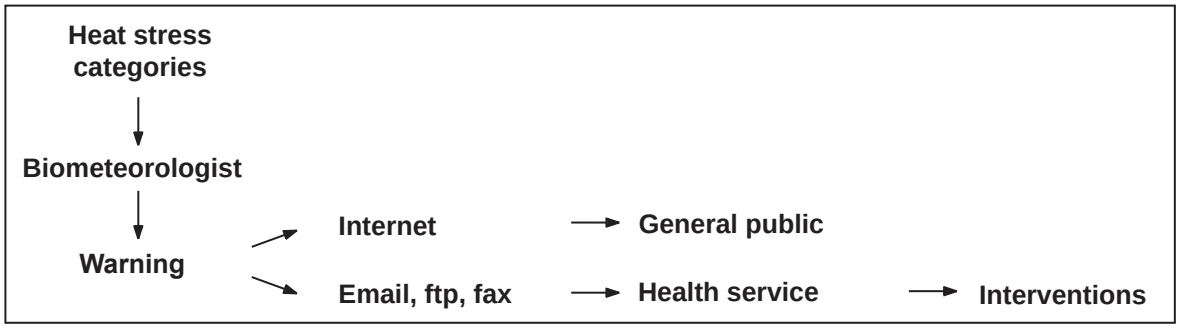


**Figure 4:** Schematic overview of the information pathways followed when heat warnings are issued.

and are sent to elderly care and nursing homes by email, ftp and fax. The relevant health and supervisory authorities are also notified; they are responsible for drawing up a list of intervention measures and monitoring their implementation. There is also the option of broadcasting the warning more widely to the public on radio and television.

In addition to the heat warning for the next 48 hours, the DWD provides heat load information for the next 2–7 days.

## Conclusion

Heat waves can pose serious problems for the health service, as became apparent during the heat wave in summer 2003. Since then, most European countries have established heat health warning systems. Here, it is important not only to issue warnings about high air temperatures but also to take account of other meteorological parameters that influence heat loss from the human body. The DWD uses Perceived

Temperature for this purpose. When issuing heat warnings, the threshold values that must be exceeded in order to trigger a warning are adjusted to local weather conditions over the past 30 days. This adjustment is necessary to take account of the fact that the human body adapts to its thermal environment (acclimatisation). For a southern European, for example, a Perceived Temperature of 30 °C is nothing out of the ordinary, whereas for people in northern Germany, such temperatures may result in considerable physical stress.

Initial evaluations of the heat warning system in Hessen show that the system is working effectively, especially in the area of residential elderly care. Giessen Regional Commissioner's Office undertook a comparative study of hospital admissions among residents of elderly care and nursing homes with heat-related symptoms during heat waves before and after the introduction of the heat health warning system. The study revealed that the number of admissions has fallen significantly (Gussmann 2009). This shows that the measures taken in Hessen in response to heat warnings have successfully reduced the number of heat-related health complaints.

In view of climate change and the prospect of more frequent and intensive heat waves, it is therefore important to develop such intervention measures further and extend them to other areas outside residential care. Although the elderly are classed as particularly vulnerable, other groups of persons can suffer during heat waves as well.

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# The Allergy Internet Portal within the Action Plan against Allergies of the Federal Ministry of Food, Agriculture and Consumer Protection

*Saskia Dombrowski and Johannes Klockenhoff*

**Abstract:** *The allergy internet portal within the Action Plan against Allergies was initiated by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) in March 2007 and was established thereafter by the Federal Office of Consumer Protection and Food Safety (BVL). The properties and aims of this allergy internet portal are described in relation to environment and health.*

## Introduction

It is now accepted that the world's climate is warming up beyond normal variations (Brandt 2009). This means that in future, northward displacement of vegetation zones with more arid conditions can no longer be ruled out, and – associated with this – the spread of non-native "problem" plants (neophytes) into our regions must be regarded as a possibility. As is evident from the current acute problem of the expansion of Common Ragweed (Ambrosia artemisiifolia) and ensuing concerns about an increase in allergic reactions among susceptible persons due to Ambrosia artemisiifolia's long flowering period and heavy pollen load compared with relevant native species, the process of global warming could cause radical changes in the flora found in our latitudes which will impact negatively on allergy sufferers' quality of life. Practical action is needed in response to this problem. In early 2007, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) therefore launched the national Action Plan against Allergies in order to provide practical support for allergy sufferers and their families and enhance their quality of life. Rather than introducing formal regulations, the initiative aims to provide a broad range of information and assist consumers to actively avoid contact with allergens and prevent allergies.

Within the framework of the Action Plan against Allergies, in March 2007 the BMELV contracted the Federal Office of Consumer Protection and Food Safety (BVL) to set up an internet portal to provide allergy information and raise awareness among affected persons and interested consumers. The BVL had submitted its conceptual proposals and applied for the contract alongside other public authorities and private-sector companies.

Just six months later the portal (http://www.aktionsplan-allergien.de) was activated by former Federal Minister Horst Seehofer at the BMELV's Consumer Policy Conference on 13 September 2007.

The BVL has been responsible for the technical and editorial management and development of the website from the start, with expert support from a scientific advisory council. A brief overview of the Action Plan against Allergies and the internet portal is provided below.

## Allergies – the background

The term "allergy" is used to describe a heightened immune response within the body to an environmental substance which is not necessarily harmful in itself. The reaction causes symptoms and disease in a predisposed person. There are many types of allergy, and the range of substances that can trigger allergic reactions is correspondingly diverse.

They range from allergenic food ingredients to medicines, allergenic pollen, animal allergens, and substances – in cosmetics, for example – which can trigger an allergic reaction upon contact with the skin.

There has been a noticeable increase in the number of people with allergies in Europe in recent decades: according to medical experts, more than 30 % of the population of Germany now suffers from an allergy[1], and it is estimated that by 2015, as many

[1] Global Allergy and Asthma European Network.

as one in two Europeans is likely to suffer from at least one form of allergy, such as allergic rhinitis, asthma, eczema and food allergies.[2] 17% of children and adolescents in Germany suffer from at least one allergic disease, and 41% are sensitised to at least one allergen[3] – in other words, they show a predisposition to be allergic. Respiratory allergies are particularly common, at an estimated 30%. Around 15–20% of the population in Germany react to contact allergens[4] and 10% are allergic to medicines. It is estimated that 2–3% of adults and 4–6% of children in Germany react allergically to foods, while 10% of infants develop atopic dermatitis.[5]

So why do allergies develop, and what are the causes of the observed increase in allergies? Neither of these questions has been answered conclusively. However, various factors are known or are assumed to be conducive to allergy. For example, there is a widespread view that the increasing pollution from environmentally harmful industrial production processes is an important trigger of allergies such as allergic respiratory diseases. Another often-cited factor is that global trade and industrial-scale food production are exposing us to an unprecedented variety of exotic foodstuffs and synthetic food ingredients, and that the ensuing changes in eating habits may also increase the risk of contact with new allergens.

Then there is the "hygiene hypothesis" – reported by some sections of the media, somewhat misleadingly, as "too much hygiene encourages allergies" – which claims that an immune system that is "trained" through exposure to pathogens may be less susceptible to allergies. Various studies have found that statistically, children from farming families, for example, suffer from far fewer allergies than their classmates from urban environments. Some animal-experimental and clinical research projects on allergy prevention also include administering bacterial cell wall components.[6] What is certain is that good hygiene – i.e. cleanliness – is essential; however, disinfection of household articles is usually unnecessary, especially as disinfectants themselves can have an allergenic effect and their use may be a risk factor for sensitisation.

Genetic predisposition is a key factor whose role in the development of allergies is undisputed. A child whose parents are both allergy sufferers or who has a sibling with an allergic disorder faces an increased risk of developing an allergy as well. However, there does not appear to be a single "allergy gene". It is more likely that complex interaction between genetic predisposition, antibodies and other (environmental) factors is at play.

The aforementioned factors do not provide a conclusive or definitive explanation of the precise causes of allergy development. Health-related consumer protection therefore focusses primarily on prevention and information provision. The national Action Plan against Allergies was launched by the Federal Ministry of Food, Agriculture and Consumer Protection for this purpose.

## Allergies and consumer protection – the BMELV's Action Plan against Allergies

The main aims of the Action Plan against Allergies, launched in spring 2007, are to mitigate the development of (new) allergies, create more security and quality of life for allergy sufferers, improve the provision of information for consumers in a range of areas, and minimise the avoidable cost burden on the economy.

The Action Plan is structured in eight fields of action with the following objectives:

1. **Food and consumption:** Here, the aim is to protect consumers from allergenic food ingredients through better labelling of packaged and loose goods, provide advice for affected persons, develop strategies for industry on minimising allergenic content, and improve the range of alternative products.

[2] European Centre for Allergy Research Foundation.

[3] National Health Survey for Children and Adolescents (KiGGS) undertaken by the Robert Koch Institute.

[4] BMELV, Action Plan against Allergies.

[5] Professor Ulrich Wahn, Charité Berlin, pers. comm.

[6] The BVL aims to implement the allergy monitoring programme as soon as possible.

2. **Cosmetics, personal care, household:** The aim is to prevent allergic reactions triggered by contact with cosmetics, laundry/cleaning products and tattooing agents through general awareness-raising and reducing the allergenic substance content in these products.

3. **Clothing and toys:** The aim is to cut the rate of sensitisation in the public at large and reduce the frequency of allergic reactions to contact allergens, e.g. from disperse dyes in textiles, allergenic substances in toys, etc.

4. **Outdoors, travel:** Here, the aim is to improve allergy sufferers' security and quality of life while on the move by supporting the provision of allergy sufferer-friendly services in hotels, restaurants, department stores, public transport, etc. and supporting measures to control Common Ragweed (Ambrosia artemisiifolia).

5. **Monitoring:** Systematic allergy monitoring aims to support the early detection of new allergens and establish the bases for evidence-based allergy prevention programmes in Germany.

6. **Communication:** The aim is to design and develop modern and effective forms of communication in order to provide as many consumers as possible with genuine assistance to prevent allergies, enhance the quality of life of allergy sufferers, and add value to existing offers.

7. **Home and interior:** This involves the provision of information about anti-allergenic building materials and furnishings, thus enabling allergy sufferers to make an informed product choice.

8. **Research:** Research funding programmes aim to systematically close knowledge gaps about allergy development and avoidance, and also focus on coping strategies for allergy sufferers.

As part of the "communication" field of action, the BVL is involved in developing and managing the allergy portal. It is also participating in designing and implementing the allergy monitoring scheme to be established within the framework of the Action Plan.[6]

## Allergies and consumer information – the allergy portal

Despite the substantial increase in allergies and allergic diseases, there is still a lack of knowledge among the public at large about allergies, preventive measures to reduce the risk of sensitisation, and information to help allergy sufferers enjoy a high quality of life. A simple Google search on the Internet reveals that although there are numerous institutions, companies and initiatives providing information about allergies and allergy prevention on their websites, many of these offers are neither independent nor impartial, while others are targeted at experts, the medical profession and treatment providers and are incomprehensible to the layperson. In the BMELV's view, there is a substantial need for clear, impartial and scientifically sound information for consumers and persons affected by allergies.

The internet portal http://www.aktionsplan-allergien.de has therefore been established to offer support and advice to as many consumers as possible. It enables users to undertake straightforward online searches for information about the development, prevention and management of allergies, provides clear and objective information about various aspects of allergies, and serves as an impartial and up-to-date guide through the wealth of information available for affected persons and other interested users.

The portal not only provides evidence-based scientific information and practical advice on all aspects of life, including prevention; in addition, a steadily expanding service portfolio is being established online. For example, the portal serves as a platform for self-help groups and a forum where affected persons can share their experiences. It offers a calendar of events and includes useful literature, press releases and an extensive list of links. It provides answers to frequently asked questions and a contact form for users to submit their own enquiries. A search function and a glossary of key allergy-related terms with easy-to-understand definitions complete the portfolio. The allergy portal is constantly being expanded and updated through the inclusion of additional links to further information available on other relevant websites. Its content,

[6] The BVL aims to implement the allergy monitoring programme as soon as possible.

too, is being expanded to cover topical issues and includes regular editorials on a range of subjects.

A solid core of users, whose numbers are steadily increasing, testifies to the portal's success as a guide through the wealth of allergy-related information on the Internet.

The present article is an amended version of an article published in the Journal für Verbraucherschutz und Lebensmittelsicherheit / Journal of Consumer Protection and Food Safety, no. 4 (2009), pp. 31-33.

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# Overview: Activities on the subject "Climate Change and Health" by Federal Institutions in Germany (October 2009)

*Jobst Augustin*

| Institution | Topic: Non-infectious diseases | | |
|---|---|---|---|
| | **Thermal stress** | **Pollen dispersal** | **UV radiation** |
| **Federal Office of Consumer Protection and Food Safety (BVL)** | | • Allergy portal<br>• Allergy monitoring | |
| **German Meteorolo-gical Service (DWD)** | • Development of an operational heat health warning system for Germany<br>• cCASHh: Climate Change and Adaptation Strategies for Human Health in Europe<br>• KLARA: Assessment of climate change impact on heat-related mortality in Baden-Württemberg<br>• EuroHEAT: Development of a Europe-wide heat information system; overview of operational heat health warning systems in Europe<br>• WMO Shanghai I (project coordination): Comparison of various heat health warning methodologies<br>• ZWEK: Includes modelling thermal stress scenarios based on Perceived Temperature | • Joint Ragweed project as part of Land Baden-Württemberg's "Climate Change Challenge" programme: investigation of parameters influencing the expansion of ragweed and ragweed pollen dispersal<br>• Development of an automatic pollen monito-ring network<br>• Pol-DACH: Numerical modelling of pollen dispersal to improve forecasting<br>• Pollen statistics | • PROMOTE: Global UV Index forecasting<br>• UV forecasting and warnings for Germany |

| Institution | Topic: Non-infectious diseases | | |
|---|---|---|---|
| | **Thermal stress** | **Pollen dispersal** | **UV radiation** |
| **German Meteorological Service (DWD)** | Planned<br>• WMO Shanghai II: Study on the impacts of heat stress on visitors to EXPO 2010 (morbidity study)<br>• Computation of thermal stress in 21$^{st}$ century with further climate scenarios<br>• Improving the heat health warning system (spatial differentiation, specific products for further target groups, improved focus on the indoor environment, etc.) | Planned<br>• Use of data from automatic pollen monitoring network to improve forecasting<br>• Investigation of the importance of long-distance transport in ragweed pollen load | Planned<br>• Improving UV warnings and forecasting through inclusion of aerosol forecasting (previously aerosol climatology)<br>• Launch of a service providing UV radiation climatology data in order to detect changes in UV intensity to date<br>• Effect of UV radiation on vitamin D supply |
| **Julius Kühn Institute (JKI)** | | • Action Programme Ambrosia<br>• Investigation of organisms that damage or adversely affect plants with concomitant negative human health impacts and whose occurrence is affected by climate change (e.g. Common Ragweed) | |
| **Robert Koch Institute (RKI)** | • Methodological evaluation of already published studies on excess mortality during heat waves | • Investigation of allergo-epidemiological issues in the context of climate change | |
| **Federal Environment Agency (UBA)** | Publications<br>• UBA/DWD Ratgeber 04/2008: Joint UBA/DWD brochure on "Climate Change and Health – Information on the health impacts of summer heat and heat waves, and tips on preventive health protection" | Publications<br>• BMU magazine "umwelt" 06/2009: "Thermophile plants and insects – new health risks and allergies ahead?"<br><br>Events<br>• Joint BMU/UBA symposium, 11/2009: "Climate change and health – which problems occur due to thermophile organisms?" | |

| Institution | Topic: Infectious diseases | | |
|---|---|---|---|
| | **Ticks** | **Insects** | **Rodents** |
| **Robert Koch Institute (RKI)** | • Status reports, data analysis, studies and reviews on climate change and infectious diseases, e.g. study of long-term trends and risk factors relating to tick-borne pathogens (e.g. Lyme borreliosis and TBE) | • Status reports, data analysis, studies and reviews on climate change and infectious diseases (insects) | • Status reports, data analysis, studies and reviews on climate change and infectious diseases, e.g. study of long-term trends and risk factors relating to rodent-borne pathogens such as hanta viruses |
| **Federal Environment Agency (UBA)** | • "Possible impacts of climate change on distribution of pathogens through animal vectors" (initially focussing on ticks) (UFOPLAN 2008 project; 2008-2011)<br><br>• "Biological control of disease-bearing vector ticks in the open air: further development of existing methodologies to make them fit for practice" (UFOPLAN 2009 project; 2009-2012) | Planned<br>• "Pathophysiological impact mechanisms of new species of climate change-related non-infectious pathogens" (UFOPLAN 2010)<br><br>Publications<br>• BMU magazine "umwelt" 06/2009: "Climate change harbours health risks from new pathogens". Symposium on the spread of the Asian tiger mosquito *Aedes albopictus* in Europe, including Germany<br>• Parasitology Research 12/2008: "Vector-borne Diseases and Climate Change". Supplement to the international conference: "Vector-Borne Diseases: Impact of Climate Change on Vectors and Rodent Reservoirs"<br><br>Events<br>• International Symposium, 11/2008: "The Asian Tiger Mosquito Aedes albopictus – its distribution in relation to its bionomy and climatic factors", organised by BMU/UBA<br>• International conference, 09/2007: "Vector-Borne Diseases: Impact of Climate Change on Vectors and Rodent Reservoirs" | • "Possible impacts of climate change on distribution of rodents that transmit hanta viruses" (UFOPLAN 2009 project; 2009-2012) |

| Institution | Other Topics | | | |
|---|---|---|---|---|
| | **Nutrition** | **Air quality** | **Toxic plants** | **Adaptation** |
| **Federal Office of Civil Protection and Disaster Assistance (BBK)** | | | | • Investigation of climate change impacts on all areas of civil protection and critical infrastructures (including health system institutions)<br>• Development of an alliance of authorities (UBA, DWD, THW, BBK) |
| **Federal Agency for Nature Conservation (BfN)** | | | | • Development of an Internet-based information system on nature conservation and health (integration of climate change and health)<br><br>Planned<br>• Study on biometeorological effects of green spaces in residential areas on human health and quality of life, in order to identify their potentials to support adaptation to climate change |
| **Federal Office of Consumer Protection and Food Safety (BVL)** | • Publication of relevant articles by experts in the Journal für Verbraucherschutz und Lebensmittelsicherheit / Journal of Consumer Protection and Food Safety<br>• Allergy portal<br>• Allergy monitoring | • Allergy portal<br>• Allergy monitoring | • Allergy portal<br>• Allergy monitoring | |
| **German Meteorological Service (DWD)** | | • Investigation of general effect of weather on air quality in healing spas | | • Development/implementation of strategies to increase adaptive capacities to climate change (e.g. heat and UV warning systems) |

| Institution | Other Topics | | | |
|---|---|---|---|---|
| | **Nutrition** | **Air quality** | **Toxic plants** | **Adaptation** |
| **Julius Kühn Institute (JKI)** | | | • Research studies on plants whose toxicity makes them potentially dangerous to human health and whose occurrence may increase as a result of climate change | |
| **Robert Koch Institute (RKI)** | • Investigation of the link between climatic factors and the incidence of Campylobacter in Germany | | | |
| **Federal Environment Agency (UBA)** | | | • Online research on the effects of climate change on Ragwort | • Internal UBA project 10/2008-03/2009, climate change and health: "Information and surveillance systems in Germany – an Internet-based study on adaptation measures relating to health impacts of climate change in Germany"<br>• Internal UBA project 08/2009-02/2011, climate change and health: "Development of a strategy for the establishment of a surveillance system for climate-associated health risks" |

| Institution | Other Topics | | | |
|---|---|---|---|---|
| | **Nutrition** | **Air quality** | **Toxic plants** | **Adaptation** |
| **Federal Environment Agency(UBA)** | | | | Publications<br>• UBA-Ratgeber 4/2009: information brochure on "Health adaptation to climate change"<br>• UBA publication series "Environment and Health", 03/2009: "Climate change and health: Information and surveillance systems in Germany: results of an Internet-based study on adaptation measures relating to the health impacts of climate change"<br>• UBA-telegramm, 03/2009, "Climate change and health: New airborne health risks"<br><br>Events<br>• November 2009: Two-day status conference on UBA-sponsored research on adaptation to climate change, including the UBA projects on vector-borne diseases |