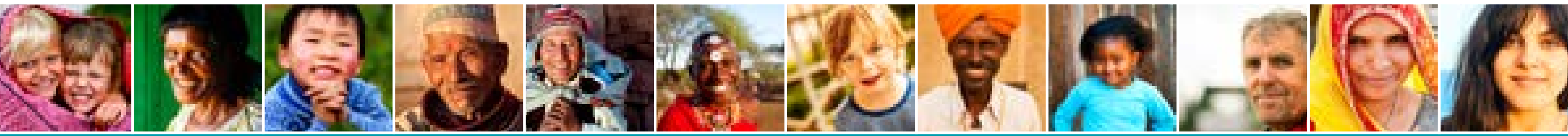
CLIMATE AND HEALTH COUNTRY PROFILE – 2015

GERMANY

World Health Organization

United Nations Framework Convention on Climate Change



OVERVIEW

Germany, with a total area of 357,022 square kilometres (Central Intelligence Agency, 2014), has three distinct climatic zones ranging from a mild maritime climate in the north, a continental climate further inland to a mountain climate in the South. Germany faces significant health impacts attributable to climate change including: a potential increase in risk of mortality and morbidity from extreme weather; expected changes in the range of vector borne diseases; and likely increases in the risk of food- and water-borne infections as well as respiratory diseases and allergies.

Particularly vulnerable to the impacts of climate change on health are populations with low socio-economic status or a lack of social networks, the elderly, children and patients with chronic diseases and disabilities.

SUMMARY OF KEY FINDINGS

- In Germany, under a high emissions scenario, mean annual temperature is projected to rise by about 5°C on average from 1990 to 2100. If global emissions decrease rapidly, the temperature rise is limited to about 1.6°C [page 2].
- In Germany, under a high emissions scenario, and without large investments in adaptation, an annual average of 112,400 people are projected to be affected by flooding due to sea level rise between 2070 and 2100 [page 3].
- In Germany, under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 66 deaths per 100,000 by 2080 compared to the estimated baseline of under 3 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in global emissions could limit heat-related deaths in the elderly to about 10 deaths per 100,000 in 2080 [page 4].
- Germany could face increased risks of vector, food- and water-borne infectious diseases through pathogens that are native to Germany (e.g. hanta virus, TBE virus and borrelia infections, which are transmitted by ticks, salmonella, campylobacter), and emerging infectious diseases (e.g. dengue fever or chikungunya and leishmaniasis).

OPPORTUNITIES FOR ACTION

In Germany, the Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the environmental ministries of the federal states share responsibility for climate change, and coordinate with the Federal Ministry of Health with regard to all climate-related health issues.

Additionally, the German National Adaptation Plan (NAP), adopted by the Federal Government in 2008, integrates recommendations and objectives for the health sector.

Country reported data indicate there are further opportunities for action in the following areas:

1) Adaptation

- Continued activities to reduce vulnerability to the impacts of climate change by maintaining the ability of natural, societal and economic systems to adapt.
- Strengthening of early warning and response for extreme events.
- Continued surveillance and monitoring of existing and new health risks.
- Evaluation of existing national information systems as a factor in reducing vulnerability.

2) Mitigation

- Continued implementation of the Integrated Energy and Climate Programme (2007), consisting of 29 key elements in various sectors, including the energy, housing and transport sectors.

3) National policy implementation

- Continued efforts to raise awareness, training and capacity building within the health sector.
- Continued support of research initiatives such as impact studies.

DEMOGRAPHIC ESTIMATES	
Population (2013)[a]	81 million
Population growth rate (2013)[a]	0.1%
Population living in urban areas (2013)[b]	74.9%
Population under five (2013)[a]	4.2%
Population 65 and over (2013)[a]	21.0%
ECONOMIC AND DEVELOPMENT INDICATORS	
GDP per capita (current US$, 2013)[c]	45,601 USD
Total expenditure on health as % of GDP (2013)[d]	11.3%
Percentage share of income for lowest 20% of population (2010)[c]	8.3%
HDI (2013, +/- 0.01 change from 2005 is indicated with arrow)[e]	0.911 ▲
HEALTH ESTIMATES	
Life expectancy at birth (2013)[f]	81 years
Under-5 mortality per 1000 live births (2013)[g]	3.9

a World Population Prospects: The 2015 Revision, UNDESA (2015)
b World Urbanization Prospects: The 2014 Revision, UNDESA (2014)
c World Development Indicators, World Bank (2015)
d Global Health Expenditure Database, WHO (2014)
e United Nations Development Programme, Human Development Reports (2014)
f Global Health Observatory, WHO; 2014
g Levels & Trends in Child Mortality Report 2015, The UN Inter-agency Group for Child Mortality Estimation (2015)

1 CURRENT AND FUTURE CLIMATE HAZARDS

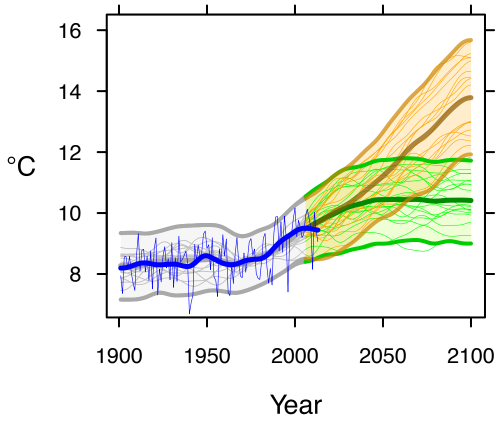
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

Outlined here are country–specific projections up to the year 2100 for climate hazards under a 'business as usual' high emissions scenario compared to projections under a 'two-degree' scenario with rapidly decreasing global emissions. Most hazards caused by climate change will persist for many centuries.

COUNTRY-SPECIFIC CLIMATE HAZARD PROJECTIONS

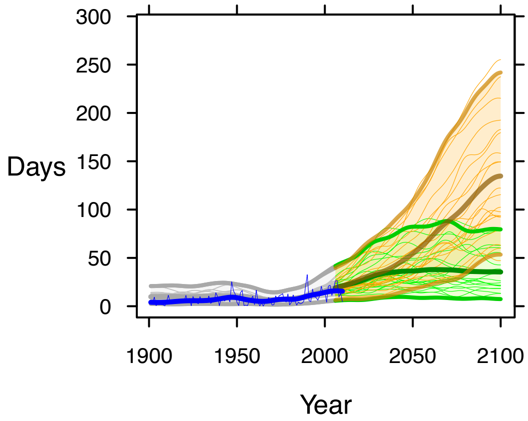
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).[a] The text boxes describe the projected changes averaged across about 20 models (thick line). The figures also show each model individually as well as the 90% model range (shaded) as a measure of uncertainty and, where available, the annual and smoothed observed record (in blue).[b,c]

MEAN ANNUAL TEMPERATURE



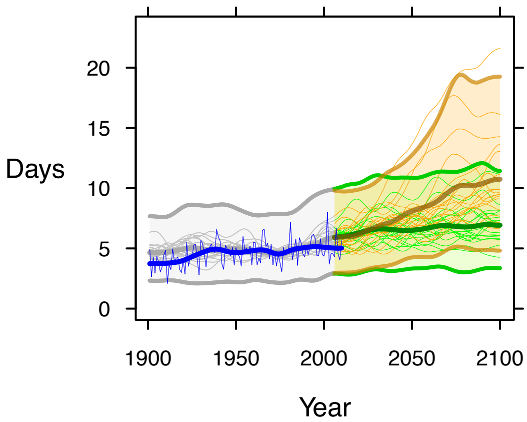
Under a high emissions scenario, mean annual temperature is projected to rise by about 5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

DAYS OF WARM SPELL ('HEAT WAVES')



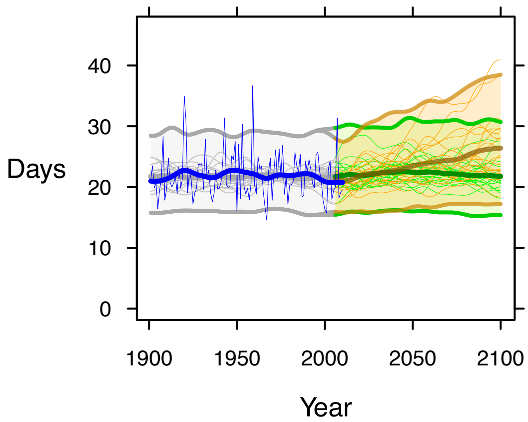
Under a high emissions scenario, the number of days of warm spell[d] is projected to increase from about 10 days in 1990 to about 135 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 35 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under a high emissions scenario, the number of days with very heavy precipitation (20 mm or more) could almost double (an increase of about 6 days on average) from 1990 to 2100, increasing the risk of floods. A few models indicate increases well outside the range of historical variability, implying even greater risk. If emissions decrease rapidly, the increase in risk is much reduced.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell is indicated to increase slightly from an average of about 20 days to about 25 days, with continuing large year-to-year variability. If emissions decrease rapidly, there are no anticipated changes in the length of dry spells.

a Model projections are from CMIP5 for RCP8.5 (high emissions) and RCP2.6 (low emissions). Model anomalies are added to the historical mean and smoothed.
b Observed historical record of mean temperature is from CRU-TSv.3.22; observed historical records of extremes are from HadEX2.
c Analysis by the Climatic Research Unit and Tyndall Centre for Climate Change Research, University of East Anglia, 2015.
d A 'warm spell' day is a day when maximum temperature, together with that of at least the 6 consecutive previous days, exceeds the 90th percentile threshold for that time of the year.

2 CURRENT AND FUTURE HEALTH RISKS DUE TO CLIMATE CHANGE

Human health is profoundly affected by weather and climate. Climate change threatens to exacerbate today's health problems – deaths from extreme weather events, cardiovascular and respiratory diseases, infectious diseases and malnutrition – whilst undermining water and food supplies, infrastructure, health systems and social protection systems.

ANNUAL EXPOSURE TO FLOODING DUE TO SEA LEVEL RISE, GERMANY (2070 –2100)

Severity of climate change scenario	Without Adaptation	With Adaptation
RCP2.6	14,700	300
RCP8.5	112,400	500

* Medium ice melting scenario ** Values rounded to nearest '00

In Germany, under a high emissions scenario, and without large investments in adaptation, an annual average of 112,400 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If global emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/raising of dikes) the annual affected population could be limited to about 300 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Source: Human dynamics of climate change, technical report, Met Office, HM Government, UK, 2014.

KEY IMPLICATIONS FOR HEALTH

Germany also faces inland river flood risk due to climate change. Under a high emissions scenario, it is projected that by 2030, 19,400 additional people may be at risk of river floods annually due to climate change and 14,400 due to socio-economic change above the estimated 79,800 annual affected population in 2010.[a]

In addition to deaths from drowning, flooding causes extensive indirect health effects, including impacts on food production, water provision, ecosystem disruption, infectious disease outbreak and vector distribution. Longer term effects of flooding may include post-traumatic stress and population displacement.

VECTOR-BORNE, FOOD-BORNE AND WATER-BORNE INFECTIOUS DISEASES

According to the German climate change and health assessment report, increased risks are expected for vector-, food- and water-borne infectious diseases through:

- Pathogens that are native to Germany (e.g. hanta virus, TBE virus and borrelia infections, which are transmitted by ticks, salmonella, campylobacter), and
- Emerging infectious diseases (e.g. dengue fever or chikungunya and leishmaniasis).

Lyme Borreliosis, transmitted by ticks, is the most common notifiable vector-borne disease in Germany, with 16,461 cases in the eastern Länder between 2007 and 2009.

Source: Klimawandel und Gesundheit: Ein Sachstandsbericht, Robert Koch Institut, Germany, 2010.

KEY IMPLICATIONS FOR HEALTH

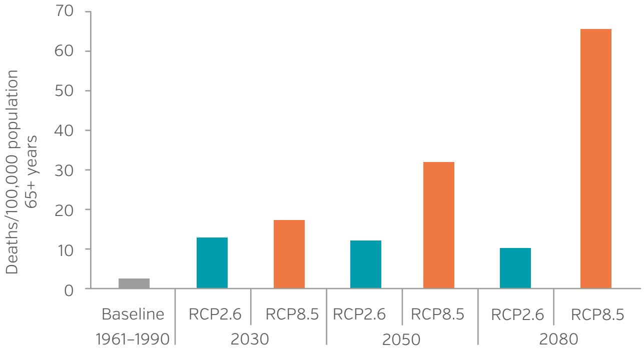
Some of the worlds most virulent infections are also highly sensitive to climate: temperature, precipitation and humidity have a strong influence on the life-cycles of the vectors and the infectious agents they carry and influence the transmission of water and food-borne diseases.[b]

Socioeconomic development and health interventions are driving down burdens of several infectious diseases, and these projections assume that this will continue. However, climate conditions are projected to become significantly more favourable for transmission, slowing progress in reducing burdens, and increasing the populations at risk if control measures are not maintained or strengthened.[c]

a World Resources Institute, http://www.wri.org, Aqueduct Global Flood Analyser. Assumes continued current socio-economic trends (SSP2) and a 100 year flood-protection.
b Atlas of Health and Climate, World Health Organization and World Meteorological Organization, 2012
c Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

HEAT-RELATED MORTALITY

Heat-related mortality in population 65 years or over, Germany (deaths / 100,000 population 65+ yrs)



Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 66 deaths per 100,000 by 2080 compared to the estimated baseline of under 3 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in global emissions could limit heat-related deaths in the elderly to about 10 deaths per 100,000 in 2080.

Source: Honda et al., 2015.[a]

KEY IMPLICATIONS FOR HEALTH

Climate change is expected to increase mean annual temperature and the intensity and frequency of heat waves resulting in a greater number of people at risk of heat-related medical conditions.

The elderly, children, the chronically ill, the socially isolated and at-risk occupational groups are particularly vulnerable to heat-related conditions.

INFLUENCE OF HEAT WAVES ON ISCHEMIC HEART DISEASES IN GERMANY

A study of the German Meteorological Service, supervised/accompanied by the German Environment Agency, funded by the Federal Environment Ministry, analyzed the impact of heat waves on ischemic heart disease (IHD) mortality and morbidity in Germany during 2001–2010. Heat waves were defined as periods of at least three consecutive days with daily mean temperature above the 97.5th percentile of the temperature distribution. The results show that IHD mortality during heat waves was significantly increased (+15.2% more deaths on heat wave days). In contrast, no heat wave influence on hospital admissions due to IHD could be observed. Regional differences in heat wave IHD mortality were present, with the strongest impact in Western Germany and weaker than average effects in the Southeastern and Northwestern regions. The increase in mortality during heat waves is generally stronger for females (+18.7%) than for males (+11.4%), and for chronic ischemic diseases (+18.4%) than for myocardial infarctions (+12.2%). Longer and more intense heat waves feature stronger effects on IHD mortality, while timing in season seems to be less important.

Source: Zacharias S, Koppe C, Mücke HG (2014): Influence of Heat Waves on Ischemic Heart Diseases in Germany. Climate, 133-152; doi: 10.3390/cli2030133

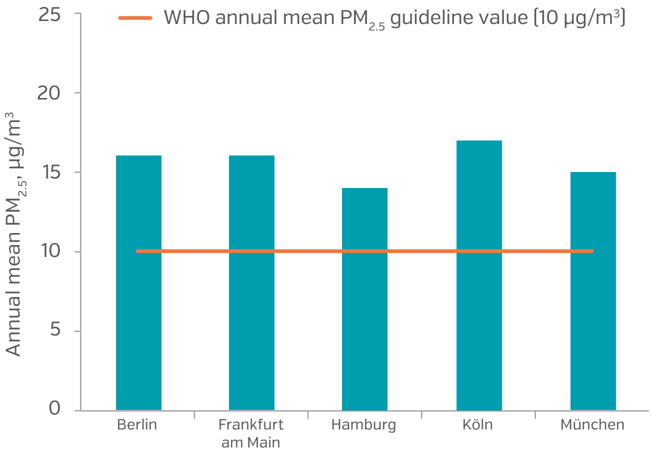
a Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. The mean of impact estimates for three global climate models are presented. Models assume continued socioeconomic trends (SSP2 or comparable).

3 CURRENT EXPOSURES AND HEALTH RISKS DUE TO AIR POLLUTION

Many of the drivers of climate change, such as inefficient and polluting forms of energy and transport systems, also contribute to air pollution. Air pollution is now one of the largest global health risks, causing approximately seven million deaths every year. There is an important opportunity to promote policies that both protect the climate at a global level, and also have large and immediate health benefits at a local level.

OUTDOOR AIR POLLUTION EXPOSURE

Outdoor air pollution in cities in Germany annual mean $PM_{2.5}$ (μg/m³) 2013



The five most populated cities for which there was air pollution data available had annual mean $PM_{2.5}$ levels that were above the WHO guideline value of 10 μg/m³. Source: Ambient Air Pollution Database, WHO, May 2016.

KEY IMPLICATIONS FOR HEALTH

Outdoor air pollution can have direct and sometimes severe consequences for health.

Fine particles which penetrate deep into the respiratory tract subsequently increase mortality from respiratory infections, lung cancer and cardiovascular disease.

SHORT LIVED CLIMATE POLLUTANTS

KEY IMPLICATIONS FOR HEALTH

Short-lived climate pollutants such as black carbon, methane and tropospheric ozone – released through inefficient use and burning of biomass and fossil fuels for transport, housing, power production, industry, waste disposal (municipal and agricultural) and forest fires – are responsible for a substantial fraction of global warming as well as air-pollution related deaths and diseases.

Since short-lived climate pollutants persist in the atmosphere for weeks or months while CO_2 emissions persist for years, significant reductions of SLCP emissions could result in immediate health benefits and health cost savings,[a] and generate very rapid climate benefits – helping to reduce near-term climate change by as much as 0.5°C before 2050.[a]

In Germany, it is estimated that a reduction in SLCPs* could prevent about 3,300 premature deaths attributed to outdoor air pollution per year, from 2030 onwards (Shindell, D., Science, 2012).

* Through implementation of 14 reduction measures: 7 targeting methane emissions and the rest, emissions from incomplete combustion. See source for further detail.

a United Nations Environment Programme. Reducing Climate-related Air Pollution and Improving Health: Countries can act now and reap immediate benefits. http://www.unep.org/ccac/Media/PressReleases/ReducingClimate-relatedAirPollution/tabid/131802/language/en-US/Default.aspx

4 CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION: A GLOBAL PERSPECTIVE

Health co-benefits are local, national and international measures with the potential to simultaneously yield large, immediate public health benefits and reduce the upward trajectory of greenhouse gas emissions. Lower carbon strategies can also be cost-effective investments for individuals and societies.

Presented here are examples, from a global perspective, of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.[a]

Transport

Transport injuries lead to 1.2 million deaths every year, and land use and transport planning contribute to the 2–3 million deaths from physical inactivity. The transport sector is also responsible for some 14% (7.0 $GtCO_2e$) of global carbon emissions. The IPCC has noted significant opportunities to reduce energy demand in the sector, potentially resulting in a 15%–40% reduction in CO_2 emissions, and bringing substantial opportunities for health: A modal shift towards walking and cycling could see reductions in illnesses related to physical inactivity and reduced outdoor air pollution and noise exposure; increased use of public transport is likely to result in reduced GHG emissions; compact urban planning fosters walkable residential neighborhoods, improves accessibility to jobs, schools and services and can encourage physical activity and improve health equity by making urban services more accessible to the elderly and poor.

Electricity Generation

Current patterns of electricity generation in many parts of the world, particularly the reliance on coal combustion in highly polluting power plants, contribute heavily to poor local air quality, causing cancer, cardiovascular and respiratory disease. Outdoor air pollution is responsible for 3.7 million premature deaths annually. High-income countries still have work to do in transitioning to cleaner and healthier energy sources.

The health benefits of transitioning from fuels such as coal to lower carbon sources, including ultimately to renewable energy, are clear: Reduced rates of cardiovascular and respiratory disease such as stroke, lung cancer, coronary artery disease, and COPD; cost-savings for health systems; improved economic productivity from a healthier and more productive workforce.

Food and Agriculture

Agricultural emissions account for some 5.0–5.8 $GtCO_2eq$ annually, with food and nutrition constituting an important determinant of health. Many high-income countries are feeling the burden of poor diet and obesity-related diseases, with some 1.9 billion adults overweight globally.

A wide range of interventions designed to reduce

Healthcare Systems

Health care activities are an important source of greenhouse gas emissions. In the US and in EU countries, for example, health care activities account for between 3–8% of greenhouse gas (CO_2-eq) emissions. Major sources include procurement and inefficient energy consumption. Modern, on-site, low-carbon energy solutions (e.g. solar, wind, or hybrid solutions) and the development of combined heat