G20 climate

climate20 press conference 2017

Climate facts as a basis for policy decisions

Press information on the state of research | Press conference in Hamburg | 6 July 2017

Digital version including images at: http://t1p.de/mhps

To mark the meeting of the heads of state of the world's twenty leading industrial nations, German climate researchers have joined forces to present the facts of observable climate change. In a joint press conference, they present the essential facts relating to global change as a basis for policy decisions and put the scientific evidence in context.

Urgency calls for sober handling of facts

Professor Dr. Mojib Latif,
Chairman German Climate Consortium (DKK):

We are vehemently opposed to public posts that could generate confusion and uncertainty in the population about the facts on climate change. Considering the urgency of global climate action, we wish to highlight the following points.

1. Climate change is a fact and human activities are the dominant cause of it. Observed changes in the climate system cannot be explained without considering human activity, in particular the burning of coal, oil and gas.

2. Natural alternations of glacial and interglacial periods occur over tens of thousands of years. The currently observed warming however, which occurred at a comparatively fast rate over only around 150 years, and its multiple effects are a completely new development. It rules out any comparison with earlier warm periods.

3. Continued greenhouse gas emissions will cause further warming and changes in all components of the climate system and increases the likelihood of severe, pervasive and irreversible impacts for people and ecosystems."

Irreversible changes in climate processes visible in all regions of the world

Dr. Paul Becker,
Vice-President German Meteorological Service (DWD):

"Irreversible changes in global and local climate processes can already be observed in all regions of the world. It is essential that **all states take joint**mitigation **measures at the global level** in order to limit the impacts of anthropogenic climate change on our societies. In case of further greenhouse gas emissions, however, adaptation measures at the local level will additionally play an increasingly important role."

Temperatures in Germany have increased by an average of 1.4 °C since 1881. Thus, Germany lies above the global trend of around 1 °C over the same period. Fact is, that this warming is directly linked to the human-induced increase in global greenhouse gas concentrations. Greenhouse gas emissions have increased steadily since the beginning of the industrialisation leadingto CO_{2-} concentration levels crossing the 400 ppm mark for the first time in 2016, for example.

In addition to the rise in mean temperature, however, other impacts of climate change are already apparent in many other areas. In Germany, these include changes in rainfall patterns featuring an increase in winter precipitation and the distribution of weather patterns. A striking element in this respect is the marked increase of the "Through over Central European Trough" large-scale weather pattern in summer, which is also usually linked to so-called Vb trajectories. In certain areas of Central Europe, this weather pattern is often responsible for heavy rainfall with an increasing flood risk potential. However, owing to the very rare occurrence of such events, it continues to be difficult to provide robust evidence of a change in meteorological extremes. At present, it is only possible to statistically confirm an increase in temperature extremes such as the number of *hot days* (daily maximum ≥ 30 °C). In general, the effects of climate change can already be felt in many sectors of our society, such as in agriculture and human health.

As in Germany, the impacts of climate change can also be observed around the world. The increase in temperature is not as distinct in all parts of the globe as it is in Europe; specifically tropical regions are warming more slowly. And yet it is these regions in particular that are more often at risk of an increase in the number of natural disasters.

We need unconstrained science

M.Sc. Inge Niedek,
President German Meteorological Society (DMG),
Chair International Association of Broadcast Meteorology (IABM):

“In times of well-recognized existence and spreading of fake-news, we need real science as a neutral corrective more than ever before. Science is the key to the past, the fundament for the presence and hope for the future and has no borders. We need science to understand and to learn from the past, enabling us to guide, judge and plan our actions today and hopefully to make the right decisions for the future and future generations.

Political leaders or powerful business representatives have always tried to (mis)use science in order to support their own agenda. The US, an important supporter in research and evaluation of weather and climate data, have announced to leave the 2015 Paris Agreement on climate change . However, measures against climate change have to be implemented globally in order to have a global effect.

Meteorological science has achieved enormous progress until today: Satellites are used for tracking dangerous storms, thus enabling authorities to warn the population in time. Global sea level and changes in polar ice-shields can be monitored with remote sensing technologies. High-resolution climate models yield scenarios of future states of the climate. The now known facts on climate change are based on vast international scientific research and the assessments of the IPCC (the Intergovernmental Panel on Climate Change), a UN-Institution. Thousands of international scientists voluntarily assess the current state of knowledge on climate change and deliver independent, policy-relevant but not policy-prescriptive, results, which have been accepted by all member states.
Let’s put together all our efforts to convince society of the importance of unconstrained science, so that the world can act against climate change upon scientifically agreed consensus.”

Cities have a great responsibility

Jens Kerstan,
Senator for Environment and Energy of the Free and Hanseatic City of Hamburg

“Hamburg is directly affected by climate change. We need to prepare for more heavy rainfall, more frequent storms and wetter winters – and, course, for rising sea levels. We want to reduce our CO_2 emissions by 50 per cent by the year 2030, which is why we are working flat out on the transport transition, massively expanding bicycle traffic and bus and rail connections. Our heating transition involves heating systems in hundreds of thousands of households, with a departure from coal and the maximum use of renewable energy sources. At the same time, adaptation to climate change represents the second pillar of our climate policy: we are raising dykes, making sure that rainwater can seep into the ground properly, and planting climate-resilient trees in parks and at the roadside. Cities have a great responsibility in meeting the two degree target agreed in Paris. Just the day before yesterday, Hamburg signed up to the ‘Covenant of Mayors for Climate and Energy’, a climate network for local and regional authorities and smaller towns.”

Filling the cracks in Earth, our common home, now

Frank Böttcher,
Director Institute for Weather and Climate Communication,
Board Member German Meteorological Society (DMG):

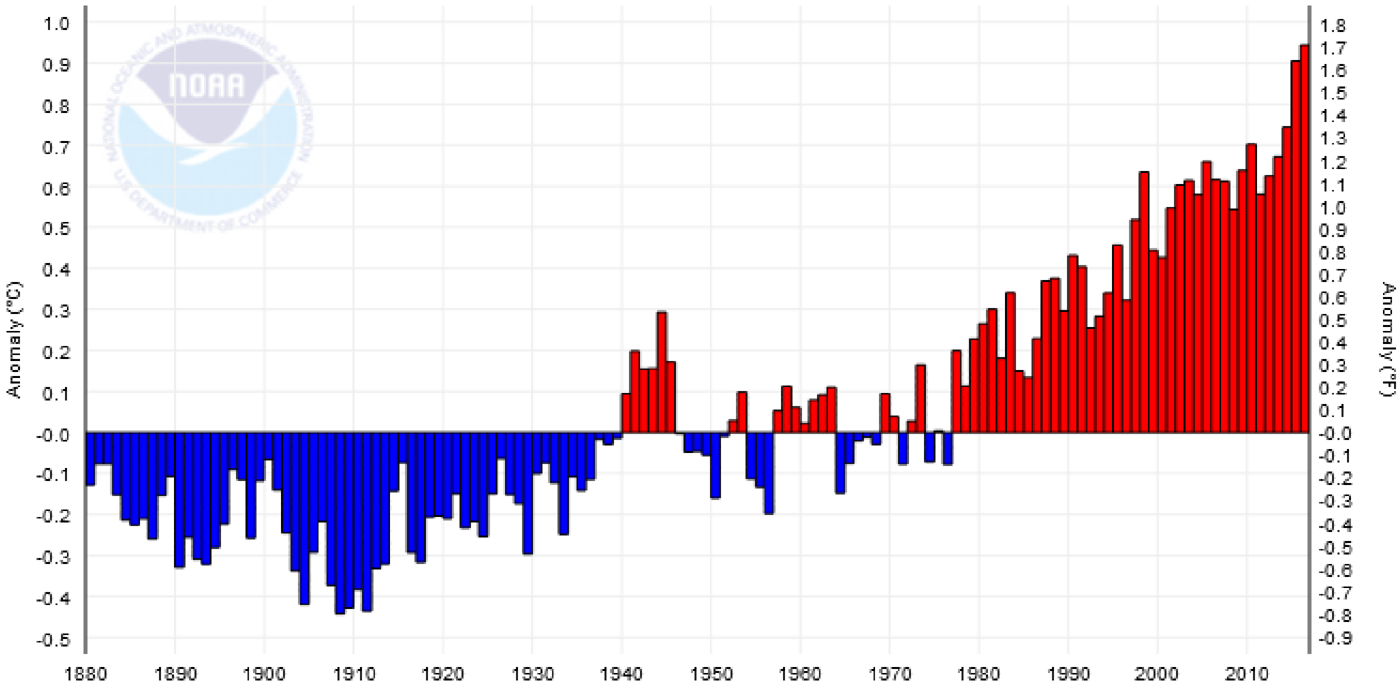
“Imagine a large house where individual walls and supports are gradually being removed. At first, the consequences will not be visible. After a while, cracks start to appear. Finally, the house suddenly collapses. The first cracks are clearly visible in the Earth system, and they are growing. Changes in the atmosphere and our oceans are occurring at such a pace that some ecosystems have already been severely affected. Areas that require stable conditions to ensure their preservation and respond sensitively to even small fluctuations are affected first. These areas include coral reefs, such as the *Great Barrier Reef*. Large parts of this ecosystem have collapsed. As with a home, however, no one room stands alone. Every change has an impact on the static stability of the whole system. It is important to now fill the cracks in Earth, our common home, and to implement the climate objectives agreed upon in Paris. The changes in our environment call for joint action of the G20 members. The basis of common action is peaceful and cooperative interaction among states and cultures. The G20 participants should work towards this goal at all costs.”

Climate change – a list of facts

A list of facts on the state of research | Press conference in Hamburg | 6 July 2017

List of facts | GLOBAL | Temperature

1. Air at the earth's surface has already warmed considerably. In 2016, the global mean near-surface air temperature was around 0.94°C higher than the 20th century average. This fact was reported by the NOAA at the beginning of 2017. Consequently, 2016 was the warmest year since records began, breaking the previous record years of 2015 and 2014 – three record years in a row had not been registered since weather records began.



The graph above shows global air temperature anomalies for the mean of individual years between 1881 and 2016, based on the 20th century mean. Source: NOAA

Warmest 10 years globally since 1880 and deviation compared with average of 20th century

1.	2016 (+0,94°C)
2.	2015 (+0,90°C)
3.	2014 (+0,74°C)
4.	2010 (+0,70°C)
5.	2013 (+0,67°C)
6.	2005 (+0,66°C)
7.	2009 (+0,64°C)
8.	1998 (+0,63°C)
9.	2012 (+0,62°C)
10.	2003 (+0,61°C)
10.	2006 (+0,61°C)
10.	2007 (+0,61°C)

Source: NOAA

2. A clear upward trend has been apparent for decades.

Mean temperature at the earth's surface and mean surface water temperature have steadily increased on average in recent decades. Ever since the 1960s, each decade has been warmer than the previous one. And data for the current decade so far suggest that the decade 2011 to 2020 will also set an all-time high. Data records of the US National Oceanic and Atmospheric Administration (NOAA) for 2011-2016 show that the mean global temperature anomaly for 2011 to 2016 of 0.59°C is considerably higher than the value of 0.42°C determined for the previous decade.

3. The clustering of record temperatures in recent years is highly unusually.

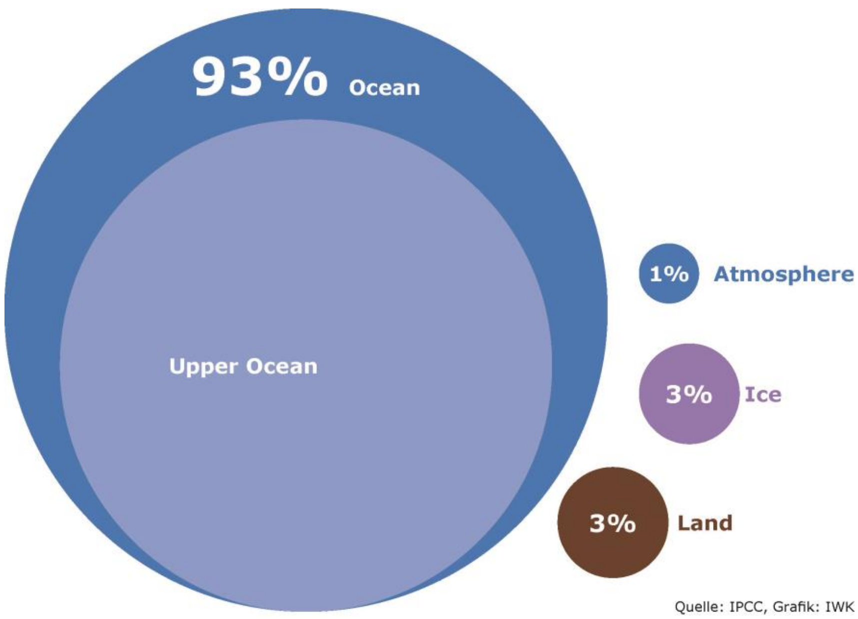
16 of the 17 warmest years since records began occurred after 2000; every one of the five warmest were post-2010. Since 1977 – i. e. for four decades – not a single year has been cooler than the 20th century average.

4. Oceans have warmed considerably.

The temperature of the upper ocean increased by 0.5°C between 1980 and 2015. There are also ocean areas where water temperatures have decreased over the same period (such as the North Atlantic); in others, however, temperatures have increased disproportionately. This is related to a number of reasons.

5. Most of the additional heat caused by global warming is stored in the oceans.

Since the 1970s, the oceans have absorbed around 93 per cent of the total warming of the climate system (the rest is distributed as follows: melting ice: three per cent; warming of the continents: three per cent; warming of the atmosphere: one per cent).



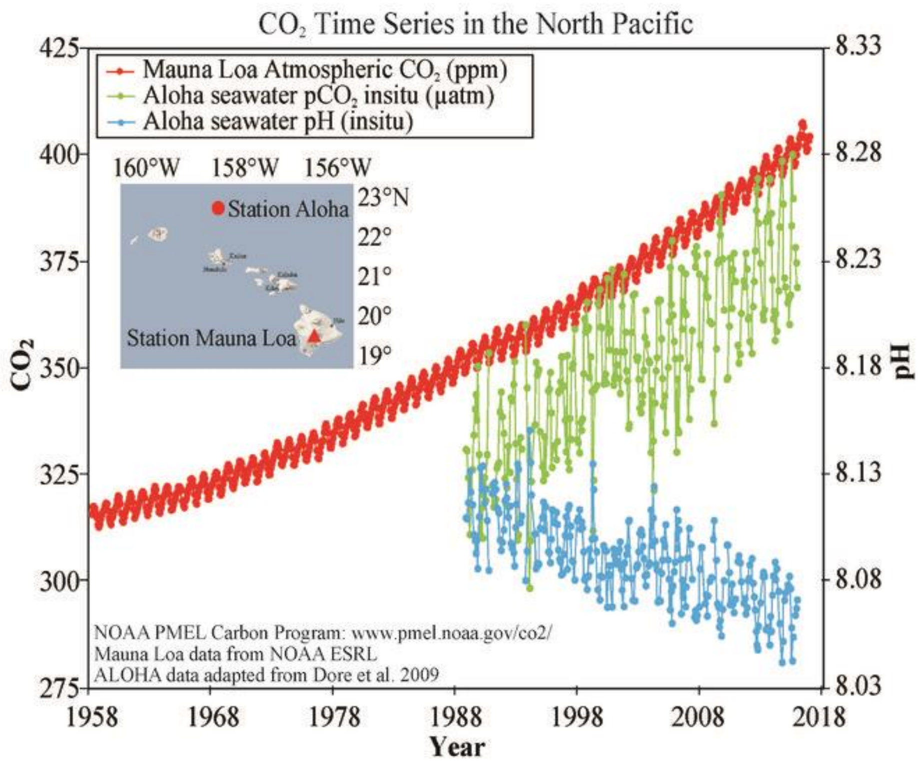
Quelle: IPCC, Grafik: IWK

List of facts | GLOBAL | Oceans / CO_2

6. Sea levels are rising.
NASA satellite measurements show that global average sea levels rose by around 85 millimetres between 1993 and 2017; the rate of increase is currently 3.4 mm per year (± 0.4 mm). Sea levels are rising, but this rise varies geographically – it is more pronounced in some regions than in others. Sea levels in the Western Pacific, for example, have risen by up to 12 mm per year. The single largest effect is thermal expansion of the ocean as a result of warming. This is followed by the melting of ice in Greenland, glaciers and the Antarctic.

7. Levels of carbon dioxide in the atmosphere are steadily increasing.
Observations at the reference station Mauna Loa in Hawaii showed that the mean for past month of 2017 was already around 405 ppm. This concentration of CO_2, around 41 % above the pre-industrial level, is the highest level for at least 800,000 years

The graph on the right shows the development of CO_2 levels at Station Mouna Loa in ppm (red) as well as the carbon dioxide partial pressure (pCO2, carbon dioxide as a percentage of total pressure) of ocean water at Station Aloha (green) and the pH value of the water also at Station Aloha.



Data: Mauna Loa (ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_mm_mlo.txt) ALOHA (http://hahana.soest.hawaii.edu/hot/products/HOT_surface_CO2.txt)
Ref: J.E. Dore et al, 2009. Physical and biogeochemical modulation of ocean acidification in the central North Pacific. *Proc Natl Acad Sci USA* **106**:12235-12240.

8. Oceans are acidifying.
Oceans currently have a global mean pH of 8.1, a decline of around 0.1 compared to pre-industrial times. Acidification is a threat to numerous marine organisms because lower pH values cause calcification problems, affecting shell formation in bivalve and gastropod molluscs. Acidification occurs due to an increase in the level of carbon dioxide in the air, which is absorbed in part by oceans. By the end of the century, continued high CO_2 emissions could cause the pH to fall to levels that have not occurred in our oceans for more than 50 million years.

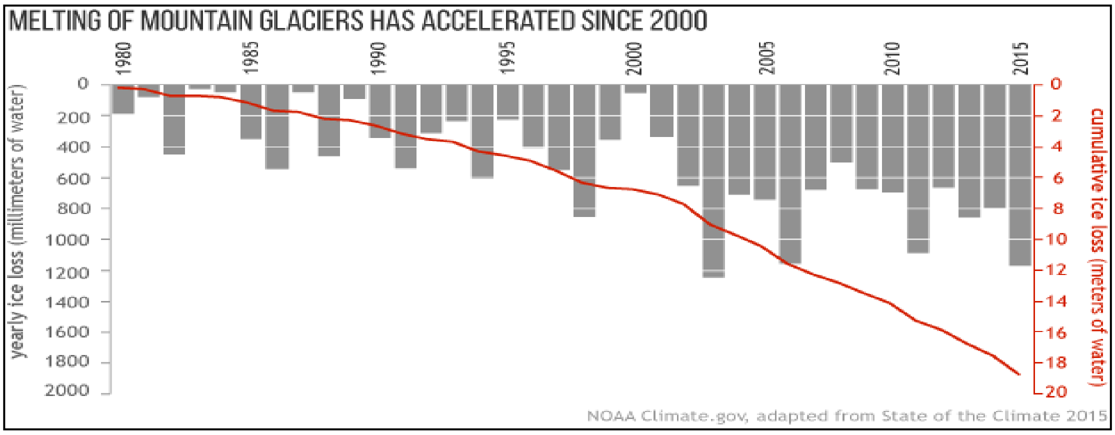
List of facts | GLOBAL | Ice

9. Greenland is losing ice on a massive scale.

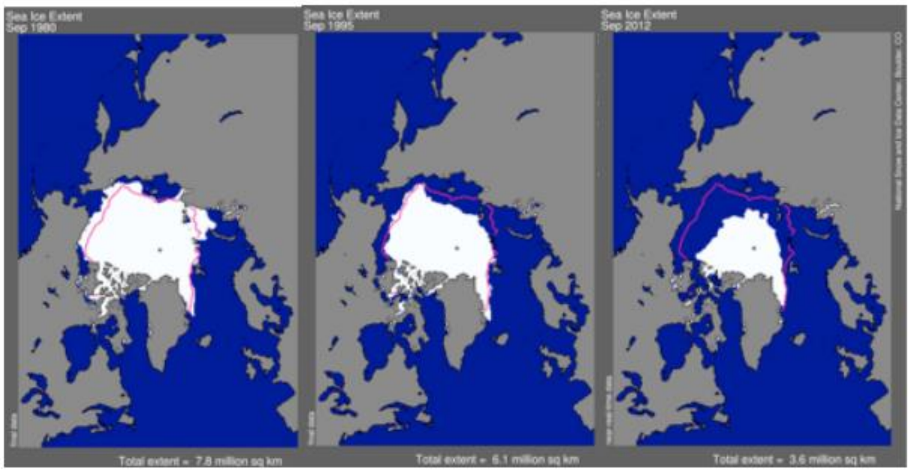
Greenland ice sheets are declining at a rate of 250 to 300 billion tons a year, leading to approximately 0.6 millimetre rise in global sea levels per year. The rate of ice loss has increased in recent years.

10. Glaciers and snow are disappearing.

Four out of five mountain glaciers being observed by researchers around the world are currently losing ice mass. Even if the few glaciers that are growing (due to regional peculiarities) are included, the total mass of glaciers around the world has fallen sharply since 1980 – an ice sheet with a thickness of around 20 metres has disappeared on average. Glaciologists state that no such development has been observed since records began. Although glacial retreat is probably due in part to the after-effect of warming following the "Little Ice Age" in the northern hemisphere between the 15th and 19th century, the main cause of glacial retreat in recent decades has been anthropogenic climate change. Snow cover in the northern hemisphere is also declining. In the Swiss Alps, for example, the snow season has become considerably shorter over the last 45 years – on average, it now begins twelve days later and ends 26 days earlier than in 1970.

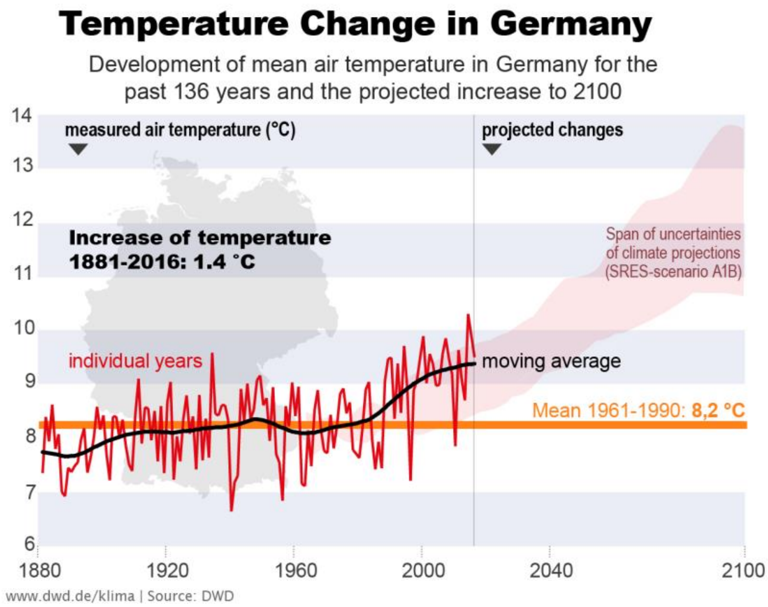


11. Sea ice around the North Pole is continuously decreasing. Both the maximum extent of the Arctic sea ice at the end of winter and the minimum extent at the end of summer have continuously declined since satellite observation began in 1979. The trend is less clear at the South Pole, where the sea ice extent might be slightly increasing ; changed wind patterns causing an inceased sea ice spread are thought to be the cause of this trend. Despite this trend, in winter 2016/17, a record low of global sea ice extent (North Pole and South Pole combined) was recorded.



List of facts | Germany | Temperature

12. Climate change is already considerable in Germany, too.
According to data provided by the German Meteorological Service (DWD), mean air temperature has increased by 1.4 °C since 1881. The temperature rise in Germany is therefore considerably higher than the global average.



13. Marked increase in heat events.
The number of hot days (daily maximum air temperature ≥ 30 °C), averaged over the whole of Germany, has increased from around three days a year in the 1950s to now an average of nine days a year. The average number of ice days (daily maximum air temperature < 0 °C) has decreased from 28 days to 19 days over the same period. The frequency and intensity of heat waves in Germany has also changed. Pre-1994, there were no 14-day hot spells with an average daily maximum air temperature of at least 30 °C in Hamburg, for example. But since then, such events have occurred there four times. If greenhouse gas emissions remain unchanged, a further increase by five to ten hot days are expected for Northern Germany and by ten to 15 hot days in Southern Germany for the 2021-2050 period. According to a number of studies, the European heat wave of 2003, for example, claimed the lives of 50,000 to 70,000 people, including numerous cases in Germany, particularly in Baden-Württemberg.

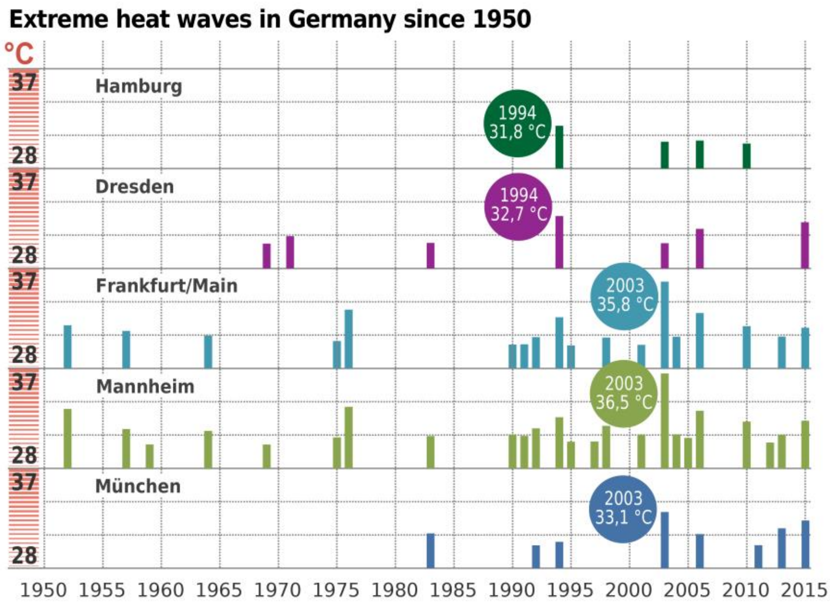
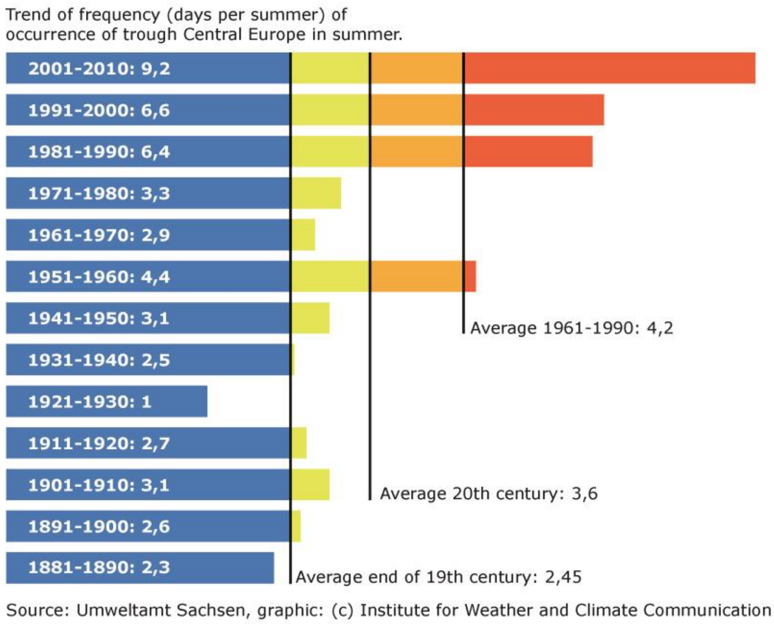


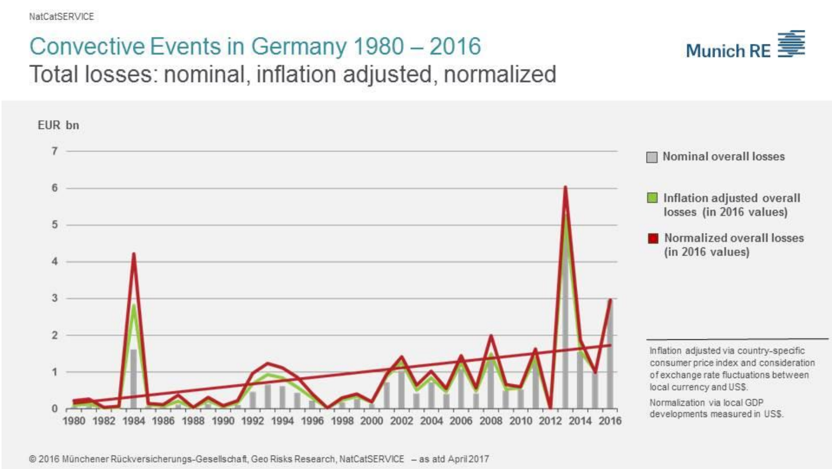
Figure left: 14-day heat periods with an average daily maximum of the air temperature of at least 30 ° C in five German cities between 1950 and 2015.

A joint invitation of:

List of facts | Germany | Precipitation

14. There is an increased risk of flooding. The number of days with large-scale weather patterns (GWL) involving a high flood risk potential (GWL Central European Trough, TRM) in Germany has increased considerably on average since the end of the 19th century. In the last 30 years, it was two to three times higher than at the beginning of the last century.





15. Severe thunderstorms are causing larger losses. According to information provided by Munich Re insurance company, the number of loss relevant events caused by natural perils around the globe has roughly tripled since 1980, in Germany especially the risks caused by intense thunderstorms have increased. Since 1980, the losses incurred have increased significantly (the data have been “normalised”, meaning that they are adjusted for inflation and increasing assets).

List of facts | Germany | Sea levels / Flora / Fauna

16. The sea level on the German coast is rising.
An increase of 10 to 20 centimetres has been measured in the North Sea and the Baltic Sea over the past one hundred years – causing storm surges to reach higher levels. Sea level on the German North Sea coast is rising by 1.6 to 1.8 millimetres per year.

17. Plants and animals react to general warming.
Various plants, such as the monkey orchid, are spreading further north. Migratory birds are returning earlier, and fish have been shown to have an earlier spawning season. Climate change also affects interaction between organisms: for example, the onset of flowering in plants changes, meaning that it no longer corresponds to the flight time of the insects that pollinate them. An analysis of 500 selected native animal species revealed that climate change poses a high risk to 63 of them, with butterflies, molluscs (e. g. snails) and beetles being most severely affected.

18. Agriculture and forestry already clearly feel the impact of climate change.
Today, apple trees come into blossom around 20 days earlier than in the 1970s – but because it can often still get very cold at night so early in the year, fruit growers are affected by severe frost damage more frequently (as was the case in spring 2017, for example). Climate change is altering growing conditions for many tree species at a quicker pace than they are able to shift to new regions. Drought stress due to less summer rainfall, the accelerated development of insect pests and the increasing danger of forest fires pose risks to forestry. Studies show that areas suitable for spruce cultivation in Baden-Württemberg, for example, could decrease by 93 per cent this century.

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List of facts | GLOBAL | Sea level

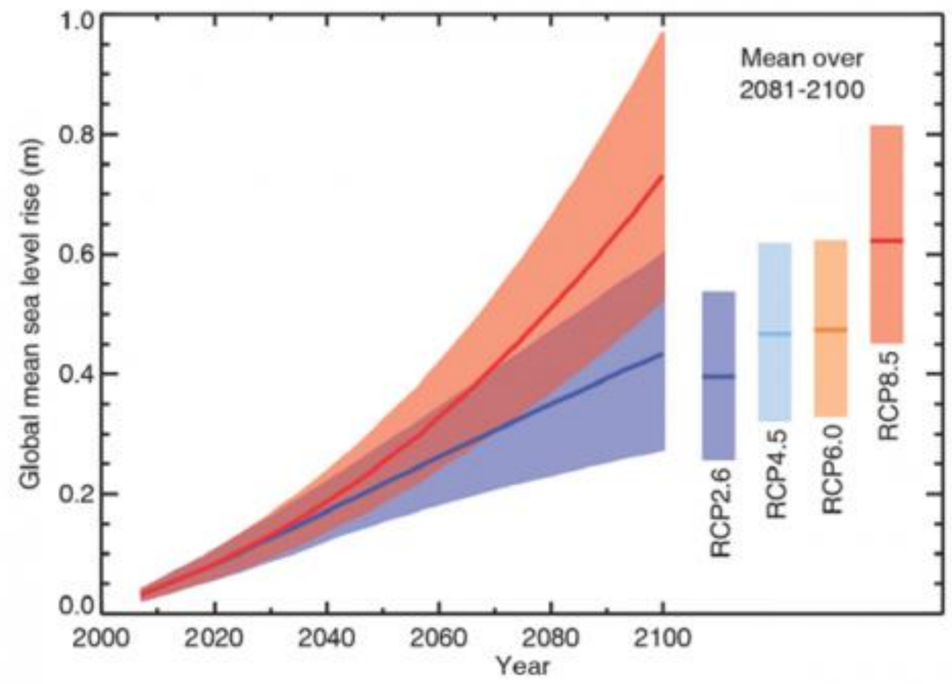
Consequences for coastal cities in G20 states

Coasts and coastal cities are particularly vulnerable to the consequences of anthropogenic climate change – after all, they are directly affected by sea-level rise. All member states of the G20 and many of their most populous and strongest economic regions are already directly affected by rising sea levels. Sea levels have risen by around 20 cm on average worldwide since 1880, but there are major regional differences.

In the decades ahead, sea-level rise combined with local factors (such as erosion or land subsidence due to groundwater extraction) will present major challenges to numerous G20 coastal cities. For example, it is likely that flooding will become more frequent – and more severe.

The amount of expected damage and costs incurred for protective measures depend to a great extent on the future development of greenhouse gas emissions. Ambitious mitigation measures taken at an early stage can limit loss and damage considerably.

It is not possible to predict sea levels exactly. In its last Assessment Report from 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that if emissions continued unchecked, sea levels would rise by 52 to 98 centimetres by the end of the century (red curve in the graph on the right).[i] However, ice mass loss from the Greenland and Antarctica ice sheets was generally not considered in the model calculations, meaning that the actual rise could be higher.[ii] Above all, the Antarctic appears to be more unstable than previously thought[iii] – this region alone could cause a sea-level rise of more than one metre by the year 2100[iv].



Global warming contributes to rising sea levels mainly via two particular mechanisms: ocean water masses expand due to warming, and mountain glaciers and ice sheets in Greenland and the Antarctic are disappearing. Due to the long reaction time of ice masses to a warmer climate, the entire consequences of today's greenhouse gas emissions will only be perceptible in many decades or centuries to come. An international study on sea-level rise conducted in 2016 summarises the situation as follows: “Policy decisions made in the next few years will have profound impacts — not just for this century, but for the next ten millennia and beyond.”[v]

Living space for hundreds of millions of people is at risk

The IPCC estimates that hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss by the year 2100; those most affected are from East, Southeast and South Asia.[vi]

A study conducted in 2013 stated that four million people around the world have been affected by flooding each year since the beginning of the century. If emissions remain unchanged (and no adaptation measures are taken), this number would increase to around 262 million people worldwide by 2100 – 117 million people would still be affected each year even if emissions were reduced considerably.[vii]

Twelve of the 20 coastal cities around the world where the most people will be at risk of severe flooding in the 2070s are located in the member states of this year’s G20 Summit.

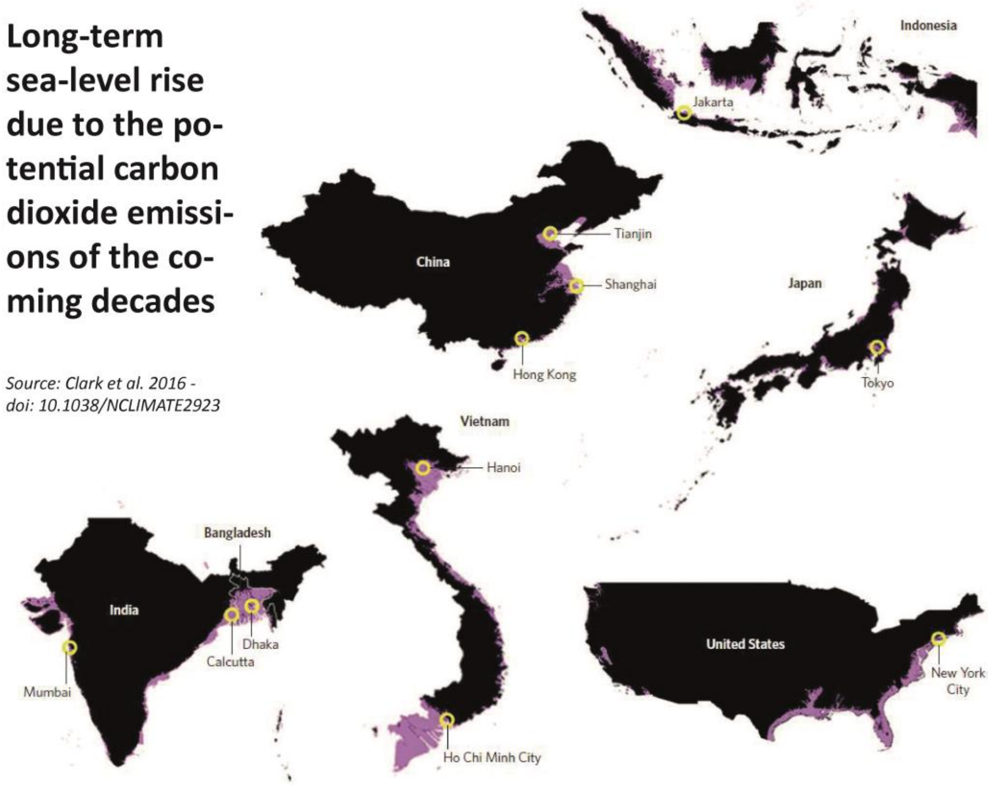
	City	Population currently at risk of flooding (in thousands)	Population at risk of flooding in 2070 (in thousands)
1.	Kolkata (India)	1,929	14,014
2.	Mumbai (India)	2,787	11,418
4.	Guangzhou (China)	2,718	10,333
5.	Ho Chi Minh City (Vietnam)	1,931	9,216
6.	Shanghai (China)	2,353	5,451
9.	Miami (USA)	2	4,795
10.	Hai Phong (Vietnam)	794	4,711
12.	Tianjin (China)	956	3,790
14.	Ningbo (China)	299	3,305
17.	New York/Newark (USA)	1,540	2,931
19.	Tokyo (Japan)	1,110	2,521
20.	Jakarta (Indonesia)	513	2,248

Another study examined the world’s 136 largest port cities: results show that 38.5 million people living in these cities are currently exposed to a one in a hundred year coastal flood event. In 2070, the number of people exposed due to sea-level rise (and other factors such as urban growth) could grow more than threefold to around 150 million people. Coastal cities in Asia are particularly hard hit, but Miami exhibits the highest increase rate (see table).[viii]

In the event of a sea-level rise of 90 centimetres by the end of the century, areas of the USA with a total population of 4.2 million people would be flooded.[ix] If greenhouse gas emissions remain unchanged, sea levels would rise by 4.3 to 9.9 metres in the long term, i.e. over the next few centuries – meaning that around 20 million US citizens alone would be displaced.[x]

Buildings and infrastructures worth trillions of US dollars at risk

Climate-related extreme weather events can cause very costly damage, as Hurricane Katrina demonstrated in 2005: this hurricane caused damage of about 1.7 billion US dollars in the ports of the state of Louisiana alone, some were destroyed completely.[xi]



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The study of the world's 136 largest port cities, mentioned above, revealed that they will become much more vulnerable in future decades: in 2005, assets worth 3,000 billion US dollars were exposed to flood risk, corresponding to around five per cent of global gross domestic product (GDP) – by 2070, assets totalling around nine per cent of global GDP would be exposed in the event of a sea-level rise of 50 centimetres. Potential damage is particularly high in the ports of industrial nations, such as in the USA (Miami, New York/Newark, New Orleans), Japan (Osaka/Kobe and Tokyo) and the Netherlands (Amsterdam, Rotterdam). Many ports where potential damage may increase particularly drastically are located in other G20 states, such as in China (Guangzhou, Shanghai, Tianjin) and India (Kolkata, Mumbai).

Other studies have also revealed a considerable increase in exposure. Flood losses in the 136 largest coastal cities are estimated to be between 60 and 63 billion US dollars in 2050 – almost all of the twenty cities with the highest predicted losses are located in G20 countries, besides the cities already mentioned, these include Guayaquil (Mexico), Shenzhen (China) and Ho Chi Minh City in this year's G20 guest country Vietnam.[xii]

Current emissions will cause long coastlines to be flooded in the long term

The full consequences of anthropogenic CO_2 emissions will only become apparent when we look ahead many centuries. Present-day emissions will drastically change the geography of many countries in the long term: vast areas of land currently housing megacities are likely to be inundated by the sea. The graph on the previous page shows simulations for some of the participant states of the G20 Summit: the purple areas will be covered by sea over the next millennia, cities marked with a yellow circle (currently) have a population of more than ten million.[xiii]

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[i] IPCC, 2013: Zusammenfassung für politische Entscheidungsträger. In: Klimaänderung 2013: Naturwissenschaftliche Grundlagen. Beitrag der Arbeitsgruppe I zum Fünften Sachstandsbericht des Zwischenstaatlichen Ausschusses für Klimaänderungen (IPCC) [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, Great Britain and New York, NY, USA. German translation by the German IPCC Coordination Office, Environment Agency Austria, ProClim, Bonn/Vienna/Bern, 2014, p. 24 – http://www.de-ipcc.de/_media/AR5-WGI_SPM.pdf;
Graph: http://www.realclimate.org/index.php/archives/2013/09/the-new-ipcc-climate-report/
[ii] Jevrejeva et al. 2016 – http://www.pnas.org/content/113/47/13342.full
[iii] see, e.g.: Mengel/Levermann 2014 – http://www.nature.com/nclimate/journal/v4/n6/full/nclimate2226.html
Rignot et al. 2014 – http://onlinelibrary.wiley.com/doi/10.1002/2014GL060140/abstract
Paolo et al. 2015 – http://science.sciencemag.org/content/348/6232/327
Scambos et al. 2017 – http://www.sciencedirect.com/science/article/pii/S092181811630491X
[iv] DeConto/Pollard 2016 – https://www.nature.com/nature/journal/v531/n7596/abs/nature17145.html
[v] Clark et al. 2016 – https://www.nature.com/nclimate/journal/v6/n4/full/nclimate2923.html
[vi] IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp, , Chapter 5: Coastal Systems and Low-Lying Areas, Executive Summary, p. 364 – http://ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap5_FINAL.pdf
[vii] Hinkel et al. 2013 – https://link.springer.com/article/10.1007/s10584-012-0564-8
[viii] Hanson et al. 2011 – https://link.springer.com/article/10.1007%2Fs10584-010-9977-4
[ix] Hauer et al. 2016 – https://www.nature.com/nclimate/journal/v6/n7/full/nclimate2961.html
[x] Strauss et al. 2015 – http://www.pnas.org/content/112/44/13508
[xi] Becker et al. 2012 – https://link.springer.com/article/10.1007%2Fs10584-011-0043-7
[xii] Hallegatte et al. 2013 – https://www.nature.com/nclimate/journal/v3/n9/full/nclimate1979.html
[xiii] Clark et al. 2016 – https://www.nature.com/nclimate/journal/v6/n4/full/nclimate2923.html

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