

# Climate changes

**Prof. RNDr. Milan Viturka, CSc.  
FEPA MU, Brno**



# What is Global Warming and Climate Change?

Global warming refer to an increase in average global temperatures. Natural events and human activities are believed to be contributing to an increase in average global temperatures. This is caused primarily by increases in "greenhouse ,, gases.

A warming planet thus leads to a change in climate which can affect weather in various ways.

What are the main indicators of Climate Change?

As explained by the US agency “National Oceanic and Atmospheric Administration,, there are seven indicators that would be expected to increase in a warming world and three indicators would be expected to decrease:

# The indicators for a global warming



# What is the Greenhouse Effect?

The term greenhouse is used in conjunction with the phenomenon known as the greenhouse effect

- energy from the sun drives the earth's weather and climate, and heats the earth's surface
- in turn, the earth radiates energy back into space
- six main greenhouse gases and water vapour trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse
- the result is the rise in temperature on Earth as certain gases in the atmosphere trap energy.
- six main greenhouse gases are: *carbon dioxide/CO<sub>2</sub>, methane/CH<sub>4</sub> (which is 20 times potent as CO<sub>2</sub>) and nitrous oxide/N<sub>2</sub>O plus three fluorinated industrial gases i. e. hydrofluorocarbons/HFCs, perfluorocarbons/PFCs) and sulphur hexafluoride/SF<sub>6</sub>*

This is a necessary sign that the greenhouse effect is a prerequisite for life on Earth - without their effect, the average temperature at the Earth's surface (determined only by the radiation balance) was -18 ° C.

# Human impact on climate change

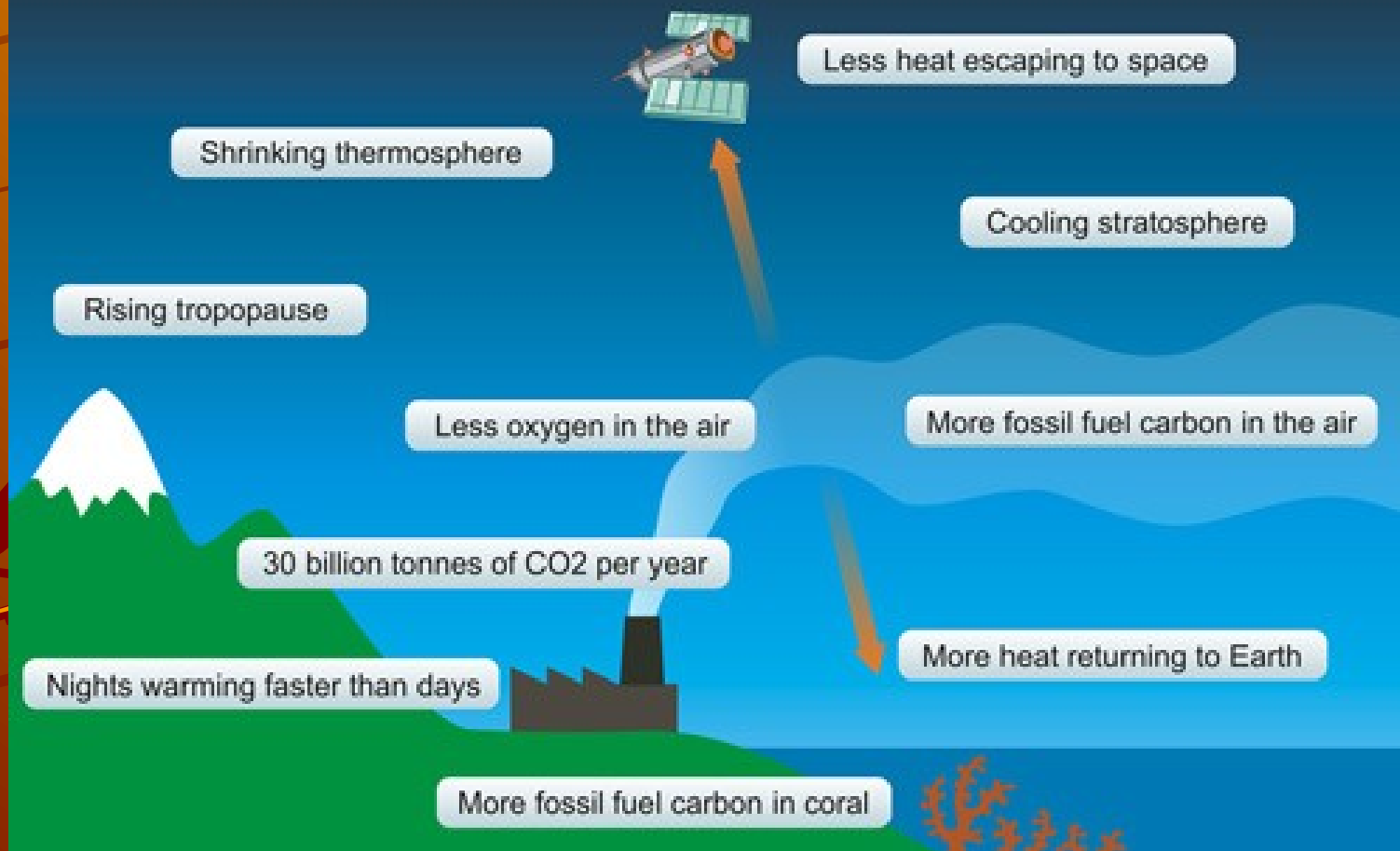
Human activity has caused an imbalance in the natural cycle of the greenhouse effect and related processes.

- when we mine coal and extract oil from the Earth's crust, and then burn these fossil fuels for transportation, heating, cooking, electricity and manufacturing, we are effectively moving carbon into the atmosphere than is being removed naturally through the sedimentation of carbon.
- by clearing forests to support agriculture, we are transferring carbon from living biomass into the atmosphere (dry wood is about 50 percent carbon).
- if the greenhouse effect becomes stronger, then more heat gets trapped than needed, and the Earth might become less habitable for humans, plants and animals.
- the difference between the natural carbon cycle and human-induced climate change is that the latter is rapid and ecosystems have less chance of adapting to the changes.

The result is that humans are adding ever-increasing amounts of extra carbon dioxide into the atmosphere. Because of this, atmospheric carbon dioxide concentrations are higher today than they have been over the last half-million years or longer.

# Main indicators

## 10 Indicators of a Human Fingerprint on Climate Change



# Ecosystem Impacts

Many studies have pointed out that the rates of extinction of animal and plant species, and the temperature changes around the world since the industrial revolution have been significantly different to normal expectations.

Those observations note that global climate changes will lead to the following situations:

- ❖ rapid global warming
- ❖ dramatic increase in greenhouse gas emissions
- ❖ warming of the oceans leads to further increase greenhouse gasses
- ❖ permafrost thawing will aggravate global warming
- ❖ induced massive extinction of species deepens the environmental crisis
- ❖ such vicious circle where each problem exacerbate other problems can lead to a sudden collapse of biological and ecological systems
- ❖ effective measures can decrease global warming and other problems, unfortunately the world community has repeatedly failed to establish cooperation in this .

# OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO<sub>2</sub> absorbed from the atmosphere



carbon dioxide



water



carbonate ion

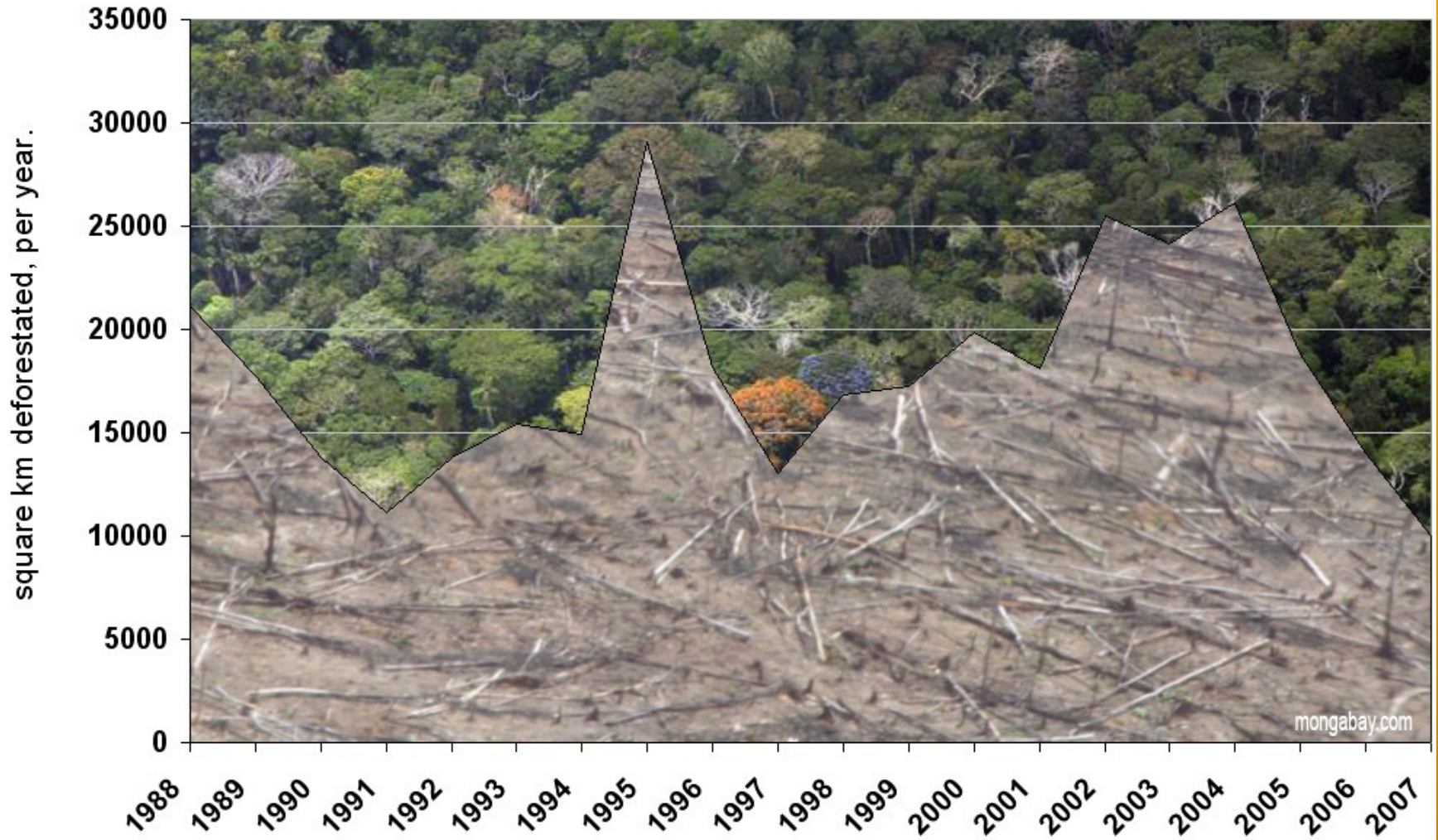


2 bicarbonate ions

consumption of carbonate ions impedes calcification



## Deforestation in the Brazilian Amazon, 1988-2007



## Other impacts

- ✓ **rising sea levels - affecting many small islands and a large mass of humanity lives near the coasts or by major rivers**
- ✓ **increasing ocean acidification - resulting changes in the chemistry of the oceans disrupts the liveability of plants and animals in the sea**
- ✓ **increase in pests and disease - climate changes can increase pathogen development, disease transmission and host susceptibility**
- ✓ **failing agricultural output, increase in world hunger - drought and desertification are starting to spread and, intensify in some parts of the world already**
- ✓ **agriculture and livelihoods are already being affected - most noticeably in the tropics and subtropics**
- ✓ **changing crops - in some cases, improved agricultural techniques may help, such as rainwater harvesting and drip irrigation (some also believe may be essential to deal with changing climate).**

# The climate has always varied in the past. How is this any different?

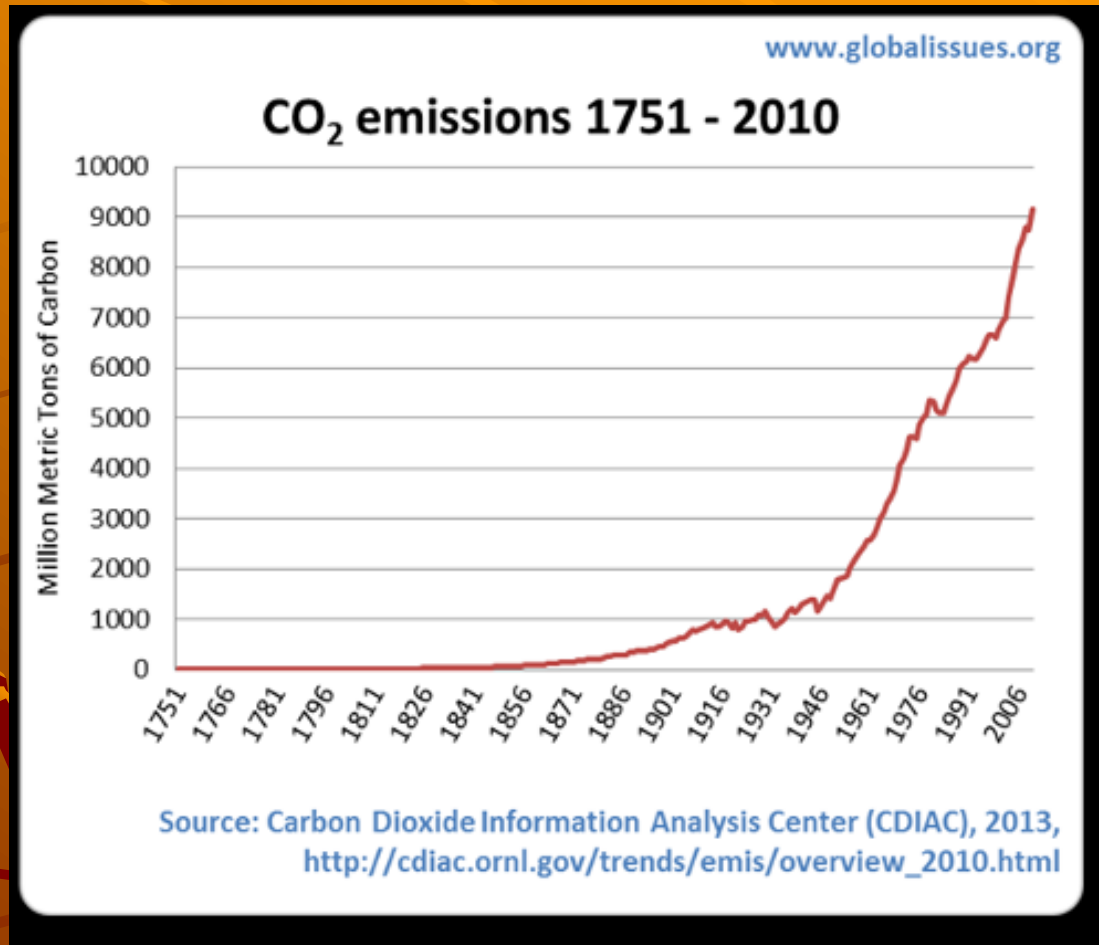
Throughout Earth's history the climate has varied, sometimes considerably. Past warming does not automatically mean that today's warming is therefore also natural. Recent warming has been shown to be due to human industrialization processes.

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture.

There is a huge contrast between developed and developing countries. In terms of historical emissions, industrialized countries account for roughly 80% of the carbon dioxide. Much of the growth in emissions in developing countries results from the provision of basic human needs for growing populations, while emissions in industrialized countries contribute to growth in a standard of living.

This is exemplified by the large contrasts in per capita carbon emissions between industrialized and developing countries (per capita emissions of carbon in the U.S. are over 20 times higher than India); around 2007, China surpassed the US as the world's largest emitter.

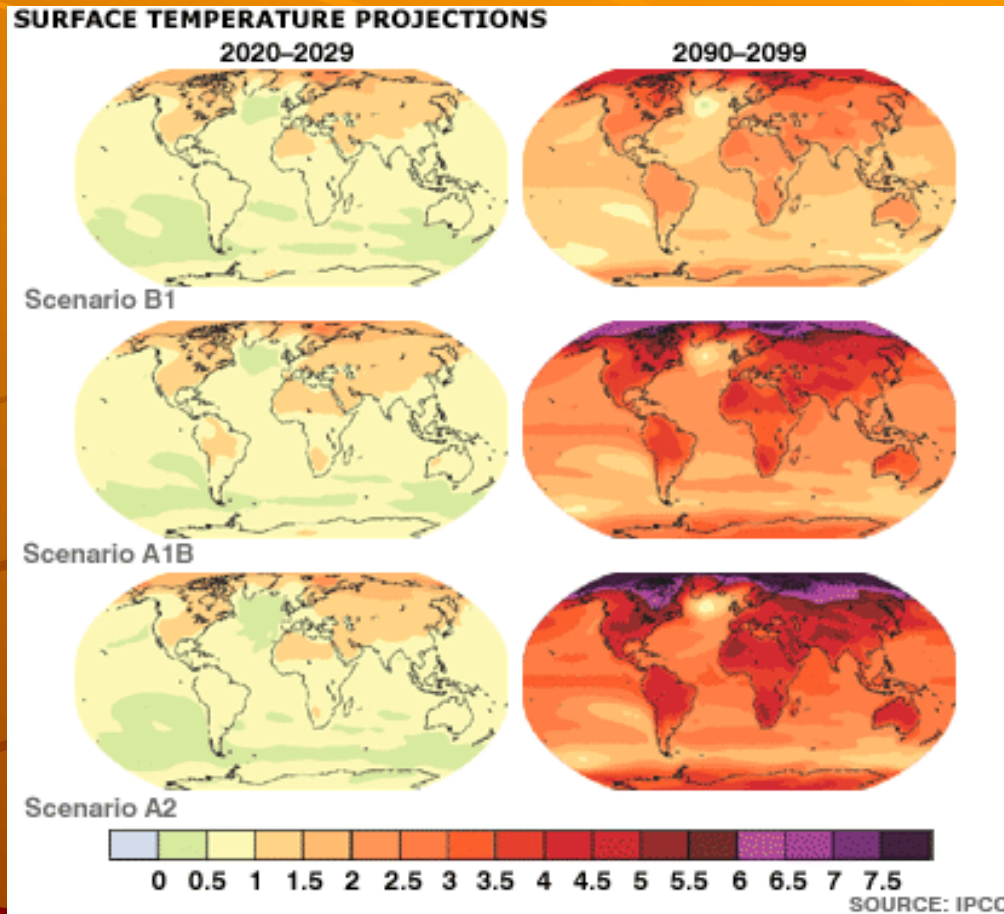
# Development of emission of CO<sub>2</sub>



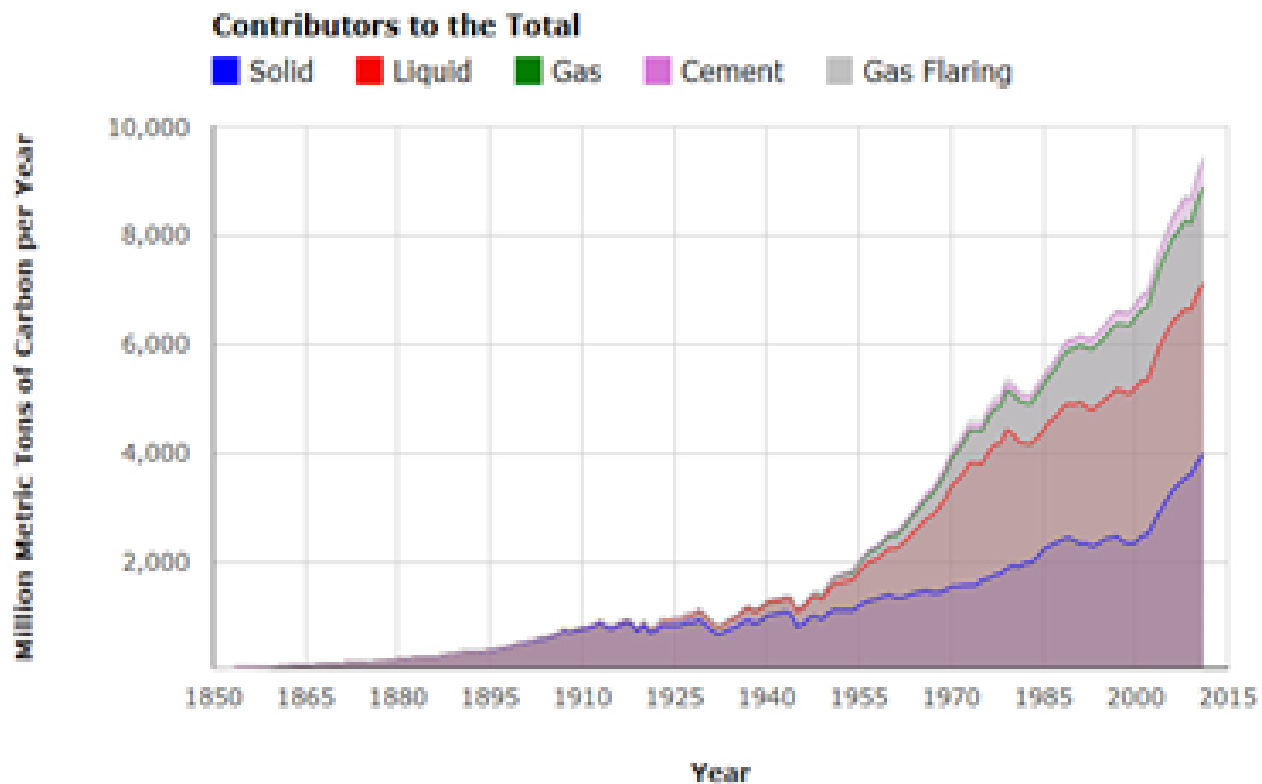
At the 1997 Kyoto Conference, industrialized countries were committed to an overall reduction of emissions of greenhouse gases to 5.2% below 1990 levels for the period 2008—2012. The set targets were not met - overall global GHG emissions increased by 11% over the reference period.

# Prediction of climate change

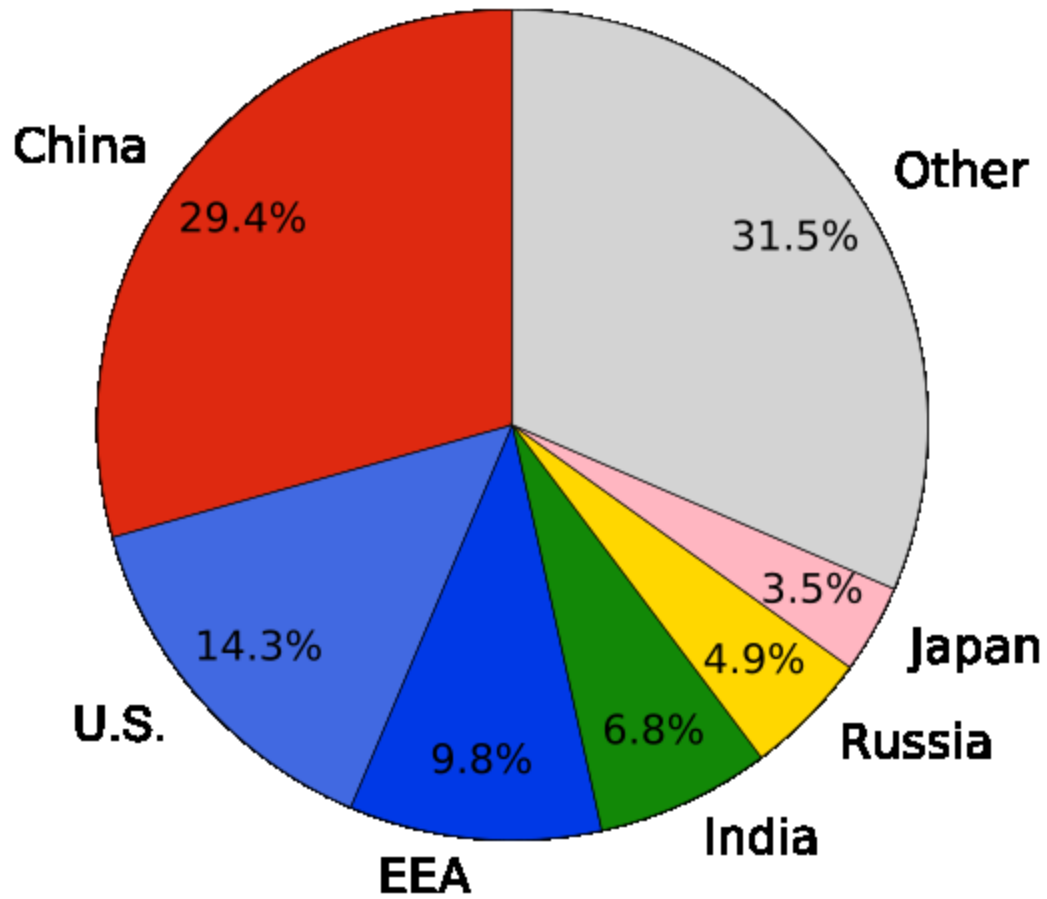
The climate has.



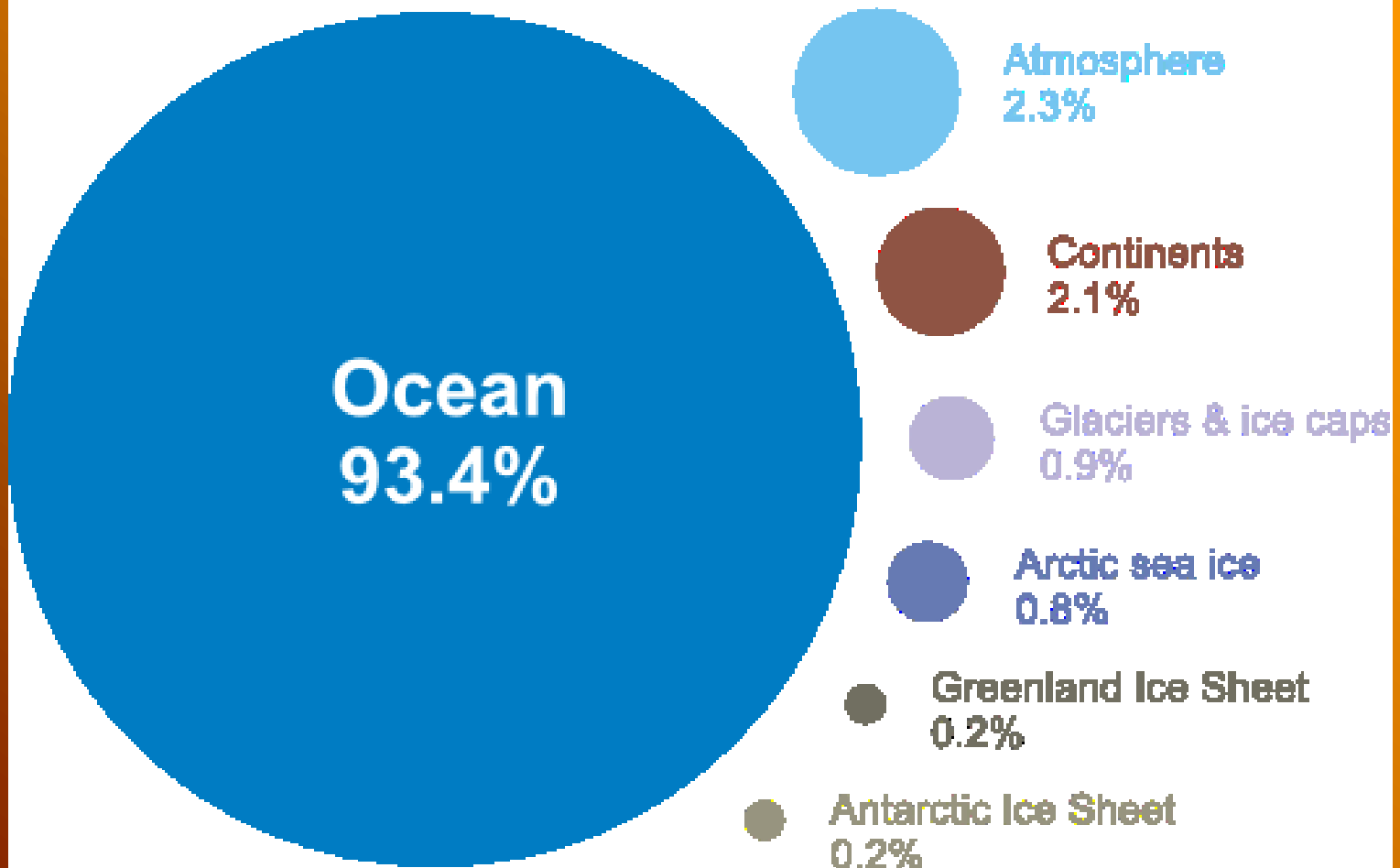
The Intergovernmental Panel on Climate Change predicts that temperatures are most likely to rise by 1,8 ° C – 4 ° C by 2100. But the possible range is much greater; 1,1 ° C – 6,4 ° C. The maps above show how a range of three different scenarios will affect different parts of the planet. The emissions scenarios, A1B, A2, B1, used to create the maps above, are based on a range of detailed economic and technological data. These versions of the future consider different population increases, fossil and alternative fuel use, and consequent CO<sub>2</sub> increases.



Source: Boden, T.A., G. Marland, and R. J. Andres. 2015. Global, Regional, and National Fossil-Fuel CO<sub>2</sub> Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi: 10.3334/CDIAC/00001\_V2015.



# Where is global warming going?



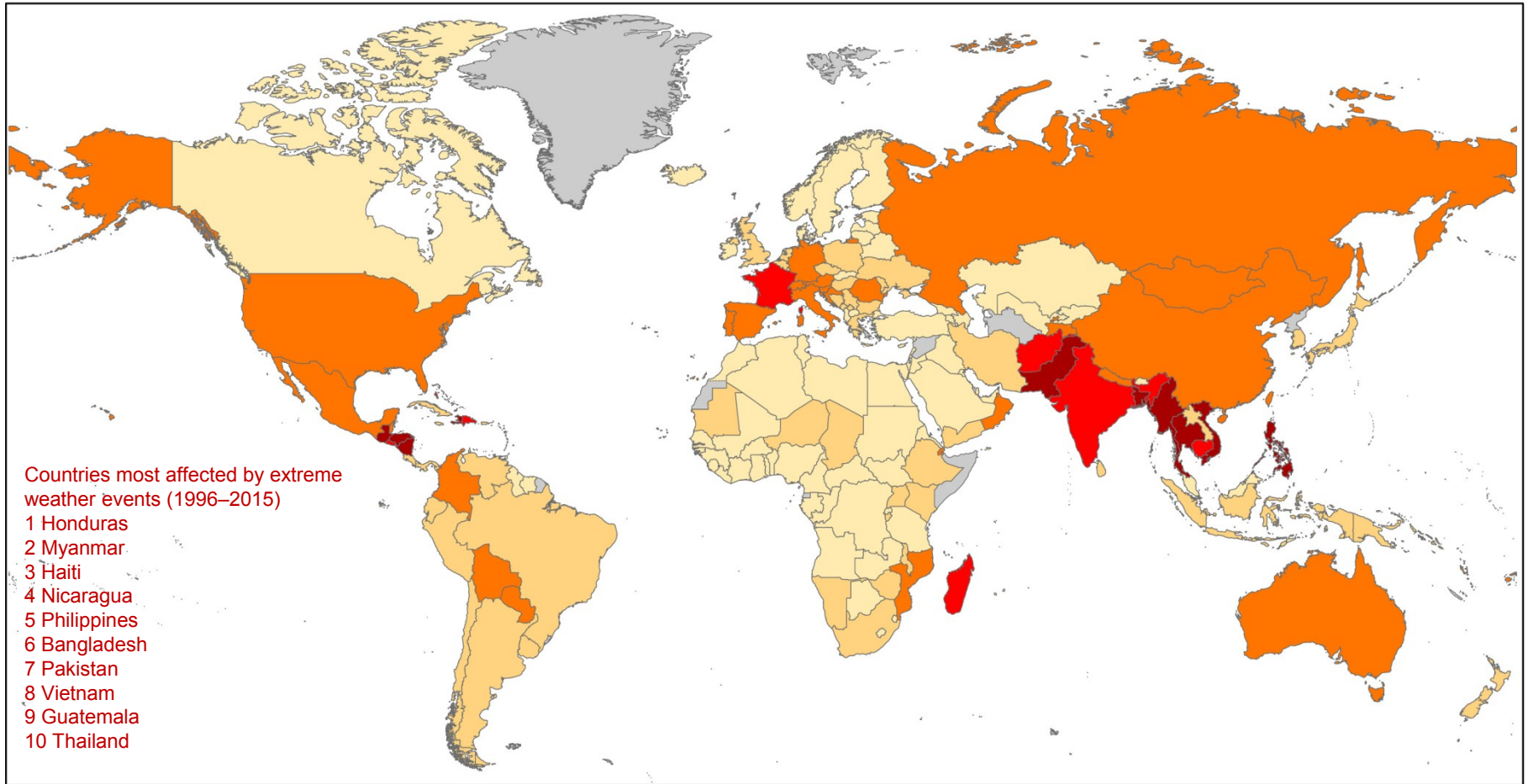


# Ozon depletion and extinction

The ongoing accumulation of greenhouse gasses causes increasing global warming.

- ❖ This causes a more extensive destruction of ozone in the polar regions because of accentuated stratospheric cooling.
- ❖ Increase of ozone destruction increases the UV-radiation that, combined with higher ocean temperature, causes a reduction of the gigantic carbon dioxide trapping mechanism of the oceanic phytoplankton biomass;
- ❖ This accentuates the warming process.
- ❖ This will enhance the global warming, and the polar destruction of ozone, and so on.

# World map of the Global climate risk index 1996–2015



Climate Risk Index: Ranking 1996–2015

1–10

11–20

21–50

51–100

>100

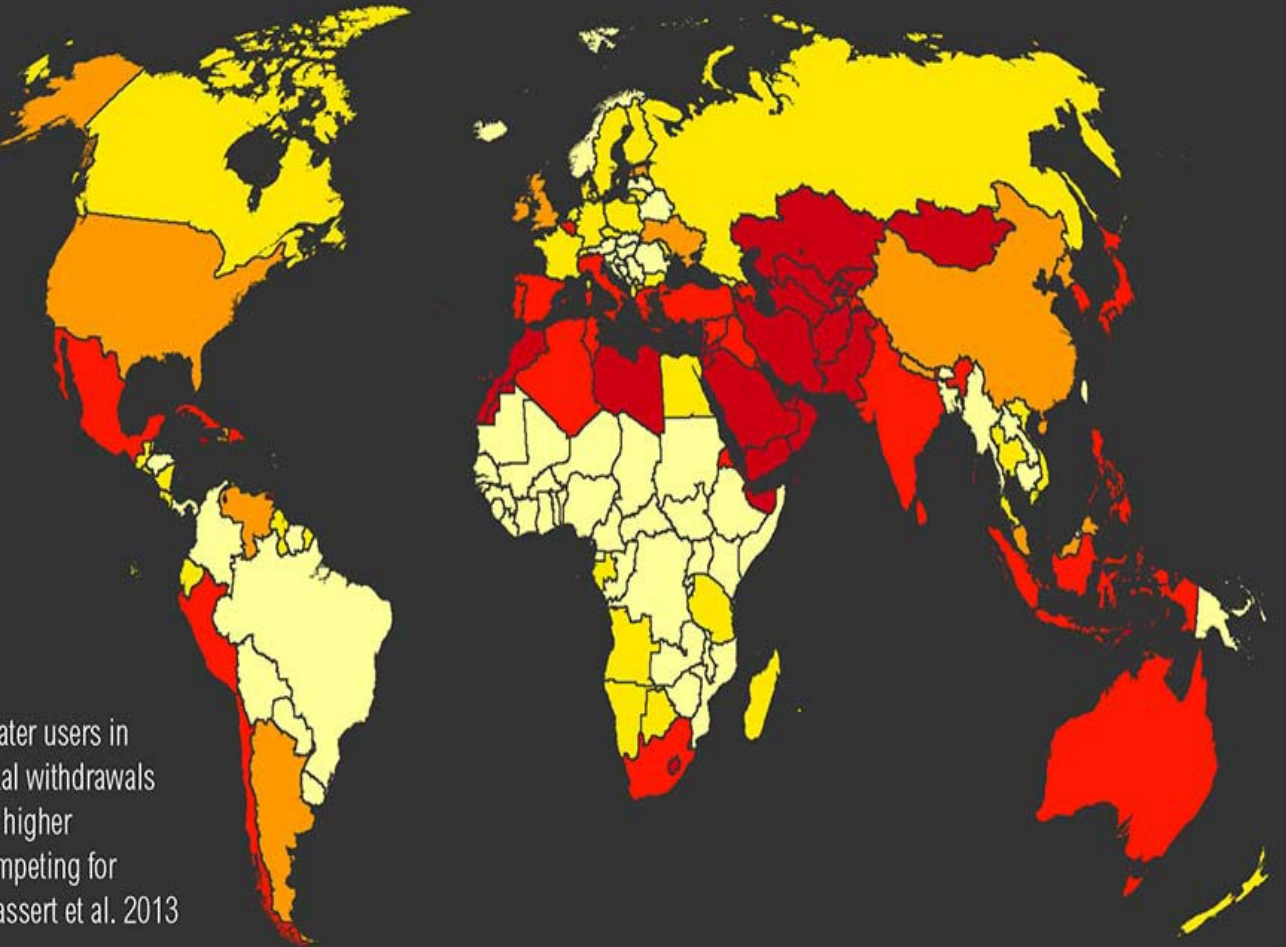
No data

# WATER STRESS BY COUNTRY

## ratio of withdrawals to supply

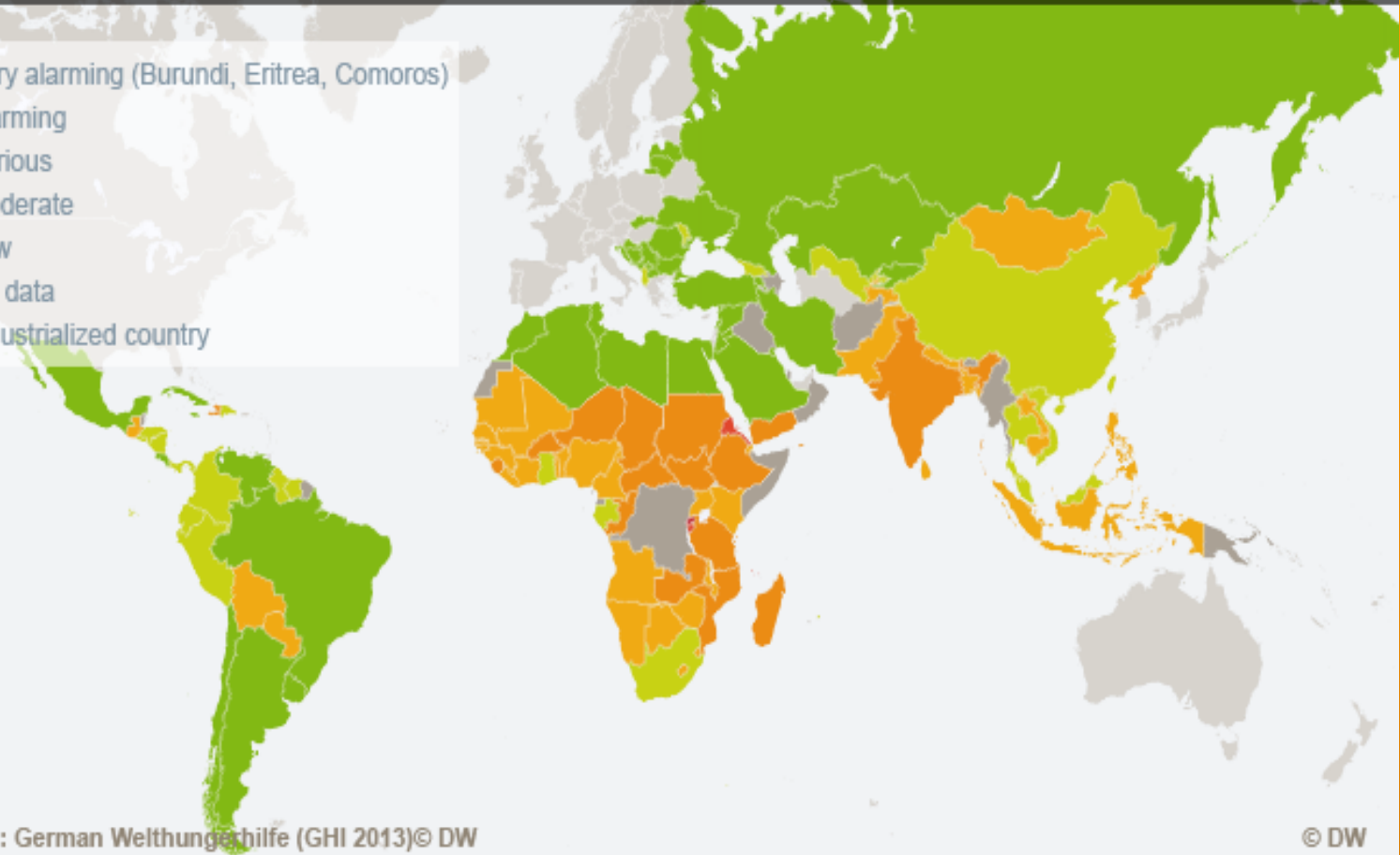
- Low stress (< 10%)
- Low to medium stress (10-20%)
- Medium to high stress (20-40%)
- High stress (40-80%)
- Extremely high stress (> 80%)

This map shows the average exposure of water users in each country to water stress, the ratio of total withdrawals to total renewable supply in a given area. A higher percentage means more water users are competing for limited supplies. Source: WRI Aqueduct, Gassert et al. 2013



## Global Hunger Index scores by severity

- Very alarming (Burundi, Eritrea, Comoros)
- Alarming
- Serious
- Moderate
- Low
- No data
- Industrialized country



Source: German Welthungerhilfe (GHI 2013) © DW

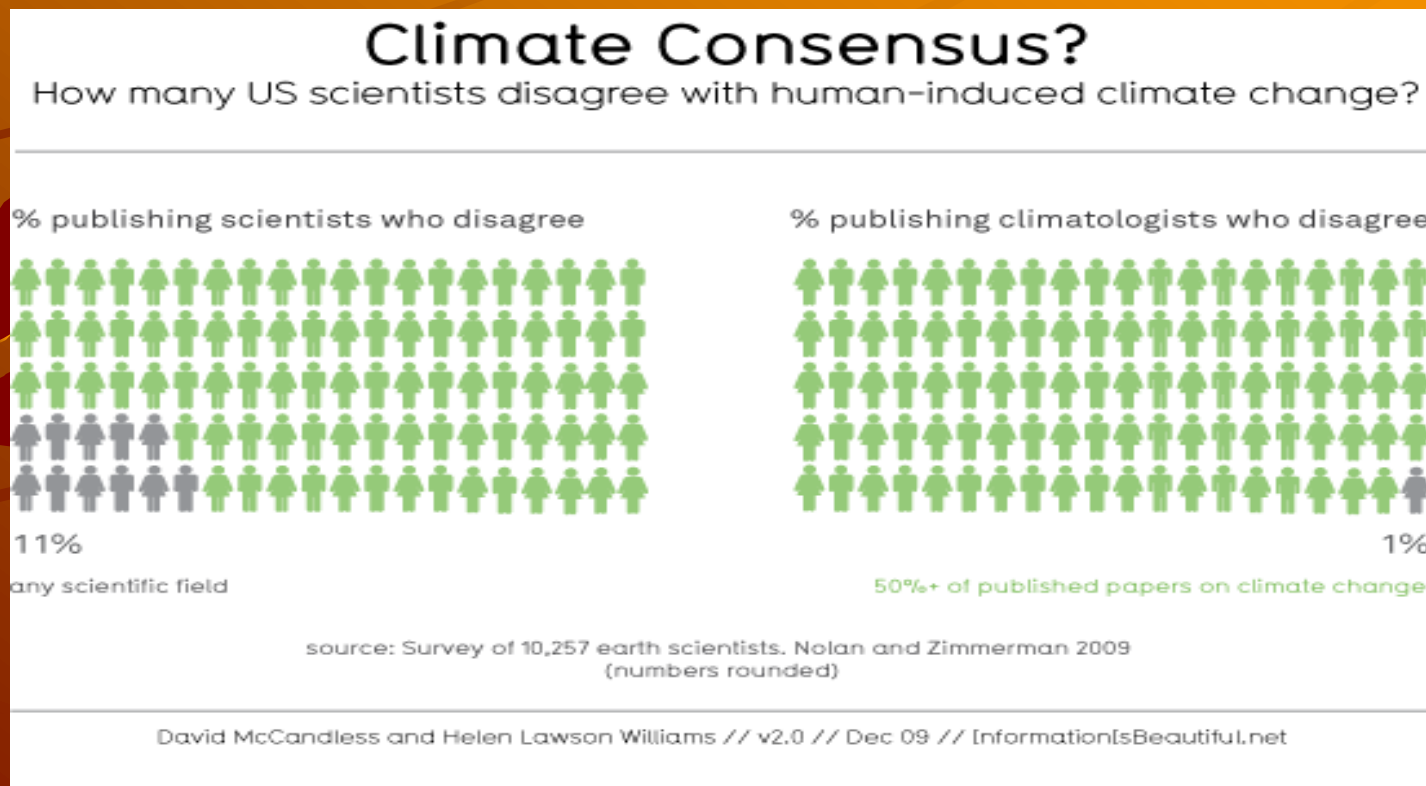
© DW

## Top 10 warmest years (1880–2014).

Rank 1 = warmest period of record	Year	Anomaly °C
1	2014	0.69
2 (tie)	2010	0.65
2 (tie)	2005	0.65
4	1998	0.63
5 (tie)	2013	0.62
5 (tie)	2003	0.62
7	2002	0.61
8	2006	0.60
9 (tie)	2009	0.59
9 (tie)	2007	0.59

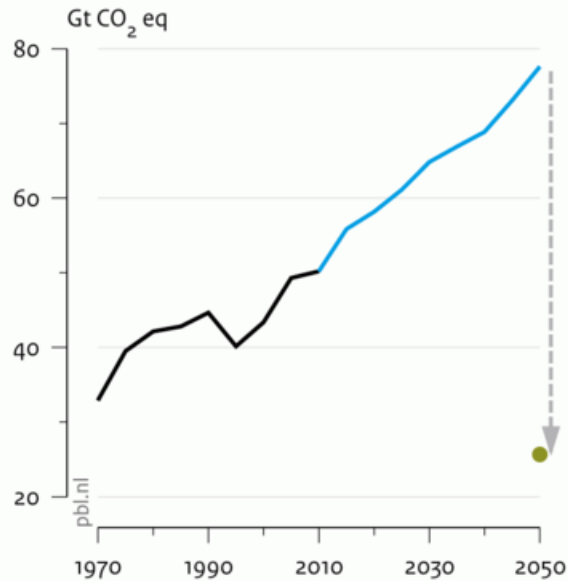
# Scepticism on global warming or that it can be human-induced

For a very long time, something of contention and debate in the U.S. had been whether or not a lot of climate change has in fact been induced by human activities, while many scientists around the world, Europe especially, have been more convinced that this is the case.

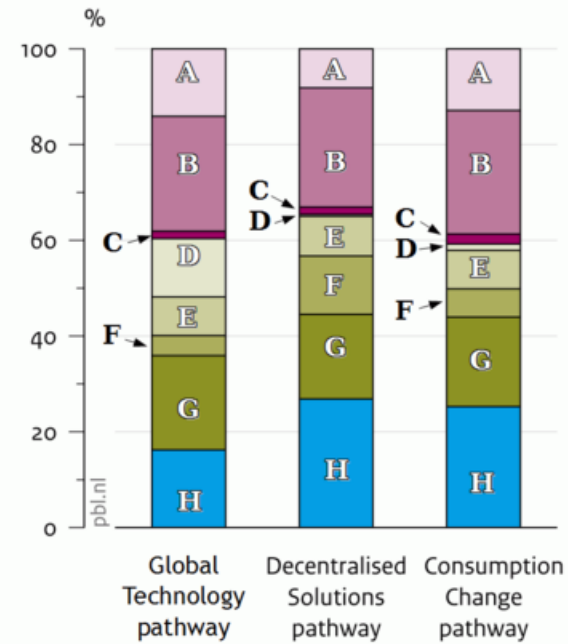


## Global greenhouse gas emissions and options to reduce emissions

Greenhouse gas emissions



Contribution to cumulative emission reduction, 2010 – 2050



— History

— Trend scenario

● Goal

↓ Policy gap

**A** Avoid deforestation

**B** Reduce other greenhouse gases

**C** Reduce other energy-related emissions

**D** Increase nuclear power

**E** Increase bio-energy

**F** Increase solar and wind power

**G** Increase CO<sub>2</sub> capture and storage

**H** Improve energy efficiency

Mark Twain might as well have been talking about global warming when he famously remarked, “**Everybody talks about the weather, but nobody ever does anything about it.**” For years we have heard so much about the causes of climate change, that we’ve missed the fact that there are simple, practical solutions that can slow this growing problem. Technologies exist today that can cut emissions of heat trapping gases and make a real difference in the health of our planet. And these solutions will be good for our economy, reduce our dependence on foreign oil, and enhance our energy security.

**Union of Concerned Scientist.**



## Challenge We Can Meet

Global warming doesn't just mean balmy February days in northern climes. It also means increasingly hot days in the summer, and a host of negative impacts that are already under way and are expected to intensify in the coming decades.

- ❑ More heat waves will likely increase the risk of heat-related illnesses and deaths.
- ❑ Cities and towns along the nation's major rivers will experience more severe and frequent floodings.
- ❑ Some areas will likely experience more extensive and prolonged droughts.
- ❑ Some of our favorite coastal and low-lying vacation areas, such as parts of the Florida Keys, will be much less appealing as sea levels rise, dunes erode, and the areas become more vulnerable to coastal storms.
- ❑ Many families and businesses, who have made their living from fishing, farming, and tourism could lose their livelihoods, and others who love hunting, boating, skiing, birdwatching, and just relaxing near lakes, streams and wetlands will see some of their favorite places irretrievably changed.

# Comprehensive ideas for solving the problem of global warming

## **Reduce fossil fuel use**

Burning fossil fuels increases the levels of greenhouse gases in the atmosphere. There are two ways to reduce fossil fuel use: Use less energy, or use alternative energy sources like solar and wind power.

## **Plant trees**

Plants take in carbon dioxide and release oxygen. They use carbon to build their own tissues and return some of it to the soil in a process called sequestration. Deforestation of rain forests is a large contributor to global warming, but planting new trees, can help to offset this.

## **Reduce waste**

The production of waste contributes to global warming both directly and indirectly. Decomposing waste produces methane and other greenhouse gases. Recycling metal, plastic, glass and paper lowers greenhouse gas emissions, since recycled items take far less energy .

## **Conserve water**

Cities consume significant amounts of energy when purifying and distributing water, which contributes to greenhouse gas emissions. Saving water reduces the amount of energy used.

## How each of us can contribute to this

- saving electricity by using energy-efficient appliances and compact fluorescent light bulbs, as well as reducing gasoline use and buying green power from your electricity provider, if available.
- reducing your consumption patterns and reusing items whenever possible minimizes your carbon footprint, since fewer new items need to be made
- turn off water immediately whenever you're not using it, and repair or replace leaky faucets and toilets. In your yard, landscape with plants and grasses that require less water, and capture rainwater in barrels for irrigating.

The once-world's fourth biggest lake was thought gone forever and a source of decades of environmental disaster (Aral lake in Kazakhstan- situation in 1989 and 2014). But something is changing.

