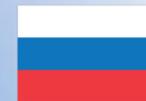


CLIMATE BOX

Module 1. Basic course on climate change.

Topic 1.2.1. The problem of climate change.



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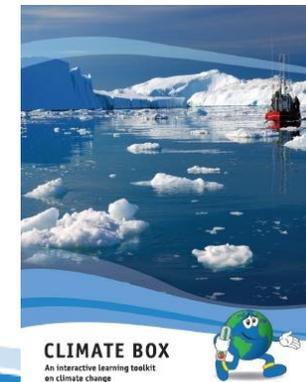
Instead of a preface

Climate leaders

Around the world, youth are leading the climate movement.

'Children and youth are bringing new energy and creative thinking to the fight against climate change. Our role is to engage them more actively and give them more opportunities and knowledge with innovative approaches to education and training on climate change.'

Armen Grigoryan, UNDP Regional Team Leader for Climate Change and Disaster Risk Reduction in Europe and Central Asia.



'Climate Box' helps teachers communicate the most relevant knowledge about climate change to schoolchildren and inspire them to take concrete action on climate change.

Module 1. Basic course on climate change

Objectives of the module

Module 1 is a basic course on the topic of 'climate change' for teachers and educational experts (“methodologists”) based on the materials of the interactive learning toolkit 'Climate Box'.

The objective of the module is to provide basic and at the same time comprehensive knowledge on issues related to climate change. The module will help to better understand this problem, the causes and consequences of climate change, as well as what can be done on a country, city, school, family and individual scale to reduce impact on the climate and adapt to the inevitable consequences.



Module structure

The module consists of three thematic parts, corresponding to the three parts of the textbook ‘Climate box’:

- **Part 1.** The problem of climate change.
- **Part 2.** How climate change affects the natural world and human beings. Can we adapt to the inevitable consequences of climate change?
- **Part 3.** How to mitigate climate change.

Each part provides both general information about the world and examples from different countries, which can be replaced with examples specific to your country or region.

Module duration - 8 hours.

Module 1. Basic course on climate change

Module content

PART 1. The problem of climate change

- 1.1. Climate and weather
- 1.2. Types of climate and climate zones
- 1.3. How and why the climate changed in the past
 - 1.3.1. Causes of climate change: millions of years
 - 1.3.2. Causes of climate change: tens and hundreds of thousands of years
 - 1.3.3. Causes of climate change: centuries
- 1.4. Climate change today

PART 2. How climate change affects the natural world and human beings.

Can we adapt to the inevitable consequences of climate change?

- 2.1. How climate change affects... **the weather**
- 2.2. How climate change affects... **plants and animals**
- 2.3. How climate change affects... **forests**
- 2.4. How climate change affects... **water resources**
- 2.5. How climate change affects... **agriculture**
- 2.6. How climate change affects... **coastal regions**
- 2.7. How climate change affects... **mountain regions**
- 2.8. How climate change affects... **the Arctic region**
- 2.9. How climate change affects... **cities and human health**
- 2.10. How climate change affects... **social problems**

PART 3. How to prevent dangerous climate change?

- 3.1. 'Green' energy sources
 - 3.1.1. What is energy?
 - 3.1.2. The main sources of energy
 - 3.1.3. Fossil fuels
 - 3.1.4. Nuclear energy
 - 3.1.5. Renewable energy sources
 - 3.1.6. Advantages and disadvantages of different energy sources
- 3.2. Energy efficiency and energy saving
 - 3.2.1. Environmentally friendly transport
 - 3.2.2. Household appliances and electrical devices
 - 3.2.3. Green construction. Passive and active buildings
 - 3.2.4. Green cities
- 3.3. Carbon footprint
- 3.4. How can I help the planet? Reducing your carbon footprint
- 3.5. Global cooperation on climate change and sustainable development

Part 1. The problem of climate change

The problem of climate change

1. The problem of climate change

1.1. Climate and weather

1.2. Types of climate and climate zones

1.3. How and why the climate changed in the past

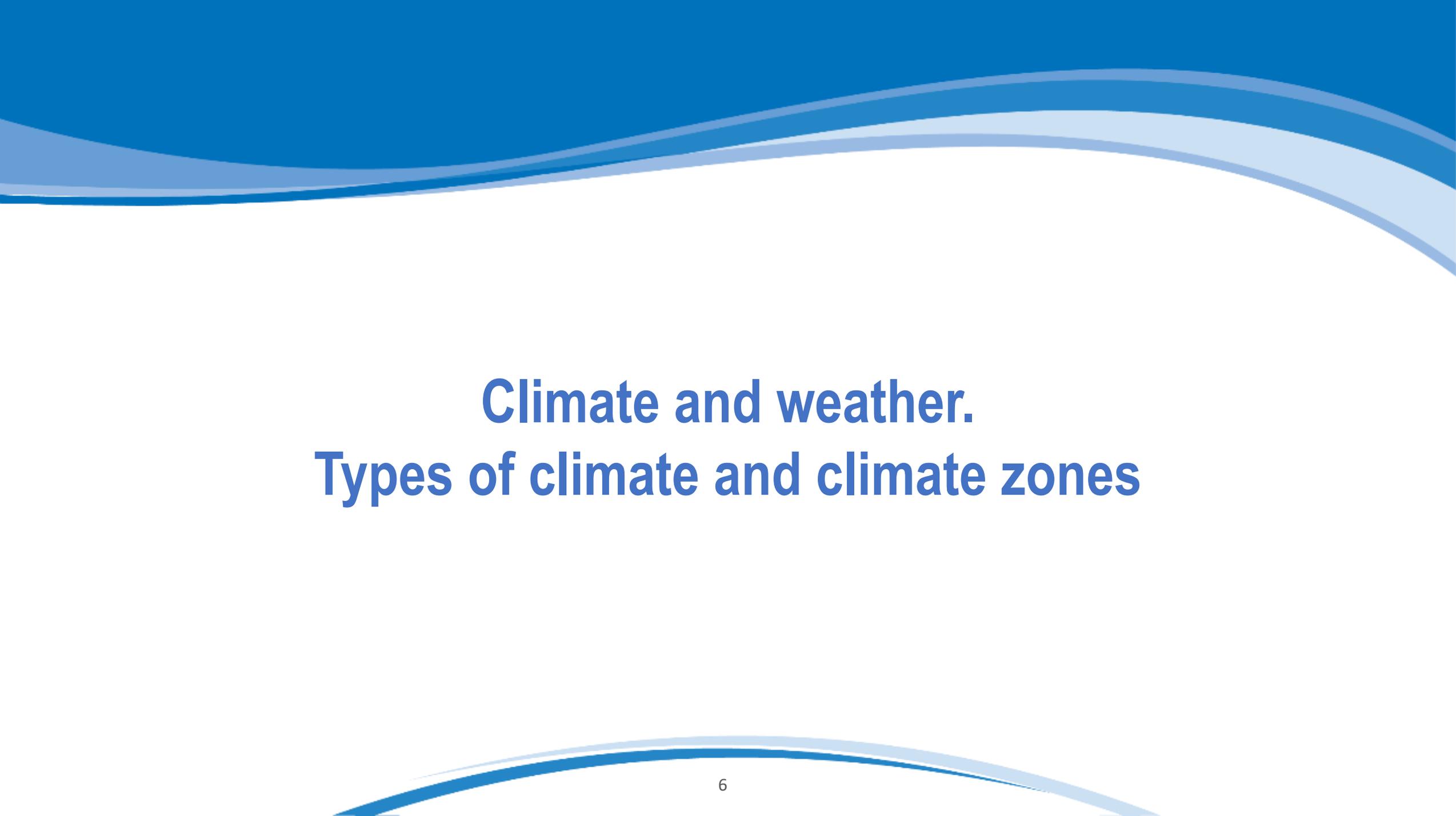
1.3.1. Causes of climate change: millions of years

1.3.2. Causes of climate change:
tens and hundreds of thousands of years

1.3.3. Causes of climate change: centuries

1.4. Climate change today





Climate and weather.

Types of climate and climate zones

Climate and weather



***Weather** is the state of the atmosphere at a particular place at a particular time or for a limited period of time (for example, a day or a month).*



***Climate** is the average state of the weather at a particular place over a long period of time (several decades).*



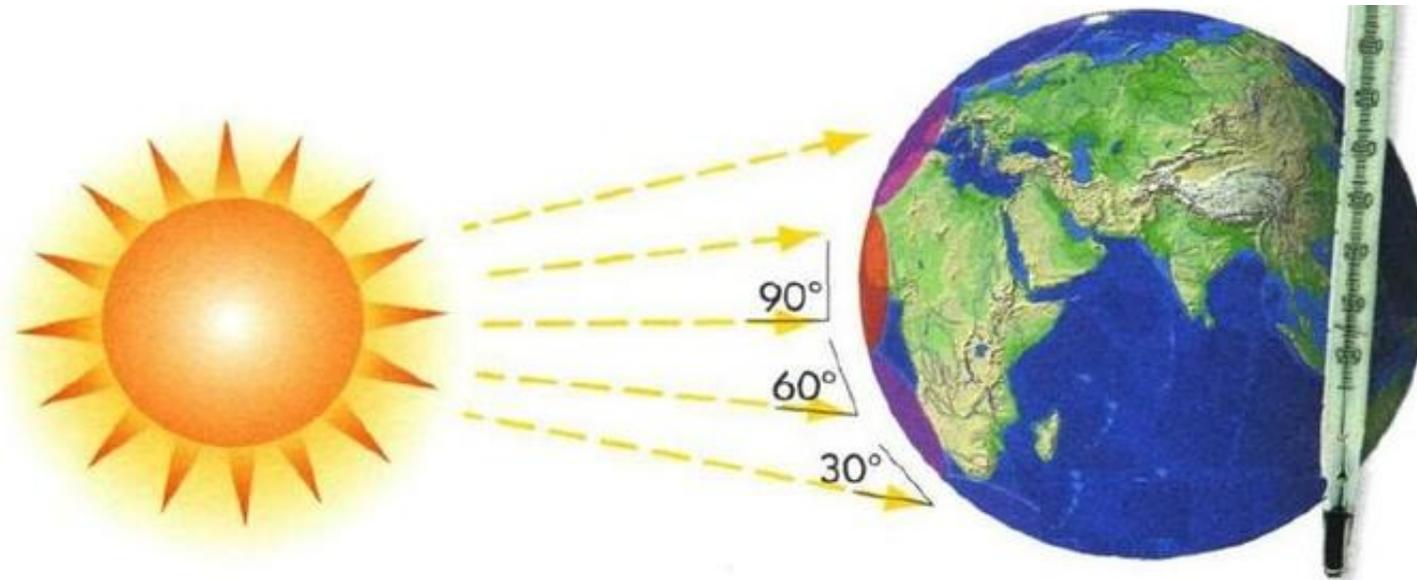
'Climate is what we expect, weather is what we get'

Mark Twain

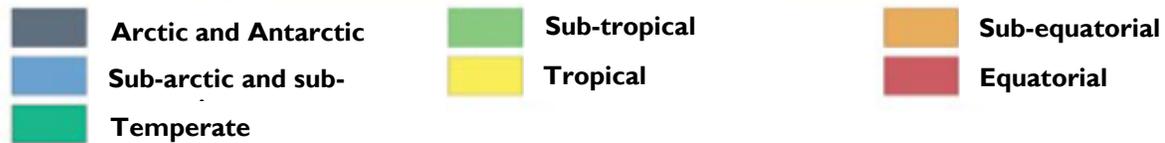
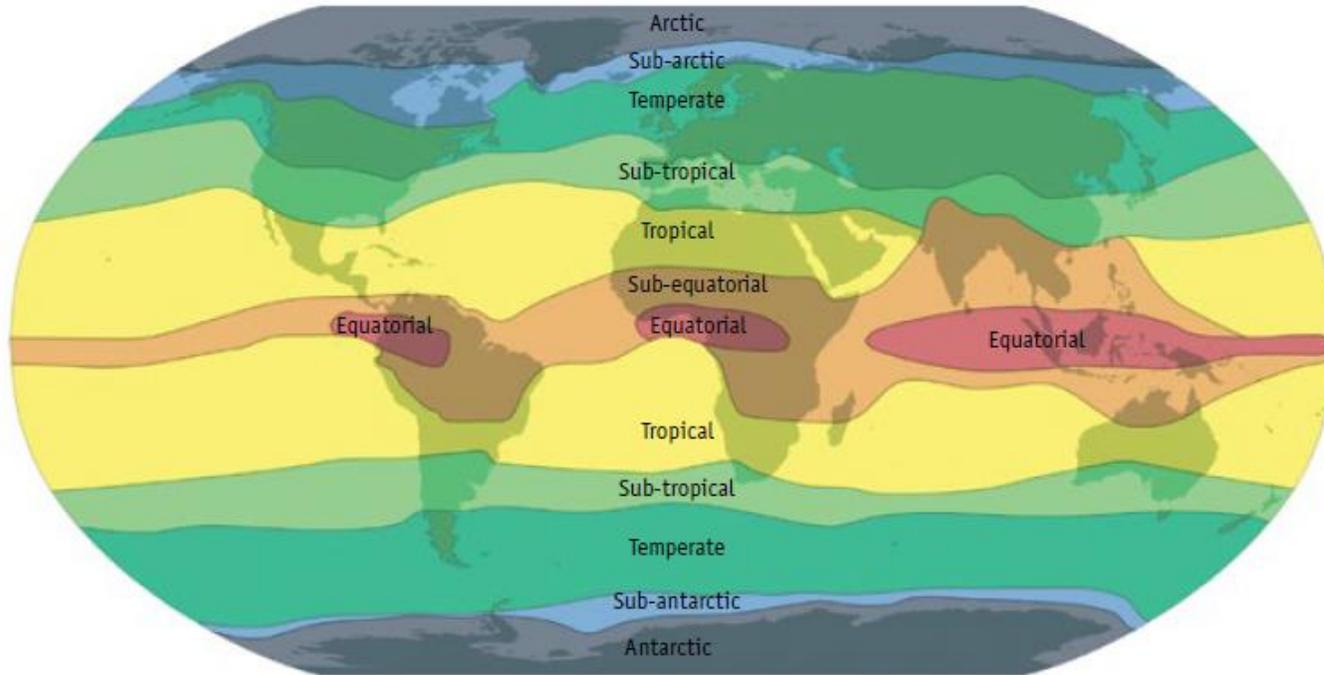
Climate and weather

The word 'climate' comes from the Greek language in which it refers to the angle of inclination of the sun.

Differences in the climate on our planet are primarily due to the fact that the sun's heat is distributed unevenly over the Earth's surface, but not only...



The Earth's climates (by B. Alisov).



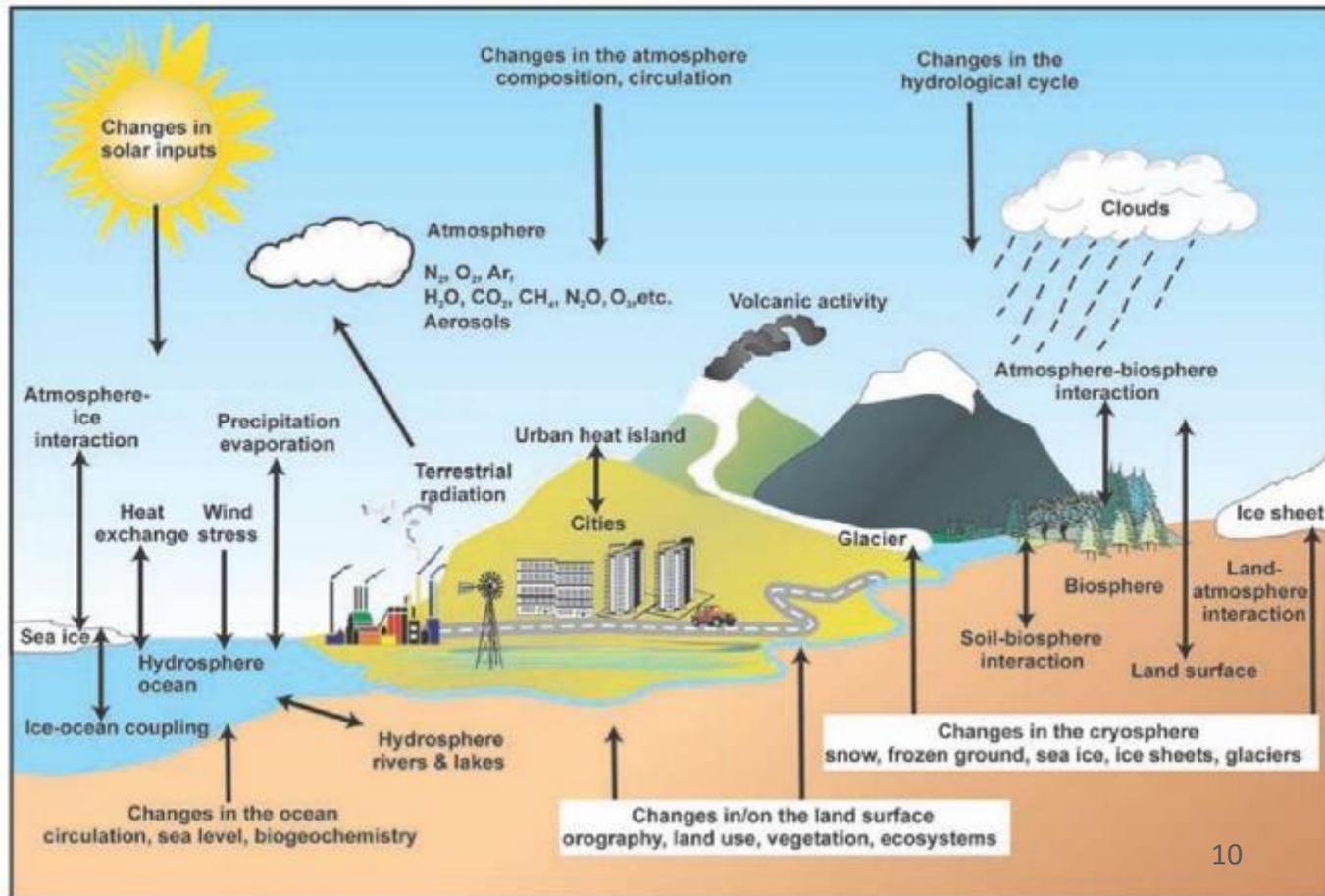
The main features of climate are:

- air temperature and its change depending on the season;
- the amount and the time of precipitation (rain and snow) during the year;
- how air masses move;
- prevailing and other winds.

Some climate zones contain specific climate regions with a **continental, maritime, monsoon climate or the climate of the western coasts.**

Climate system

'Climate' - is the characteristics of the ocean-atmosphere-lithosphere-cryosphere-biosphere system averaged over a time interval of 30 years.



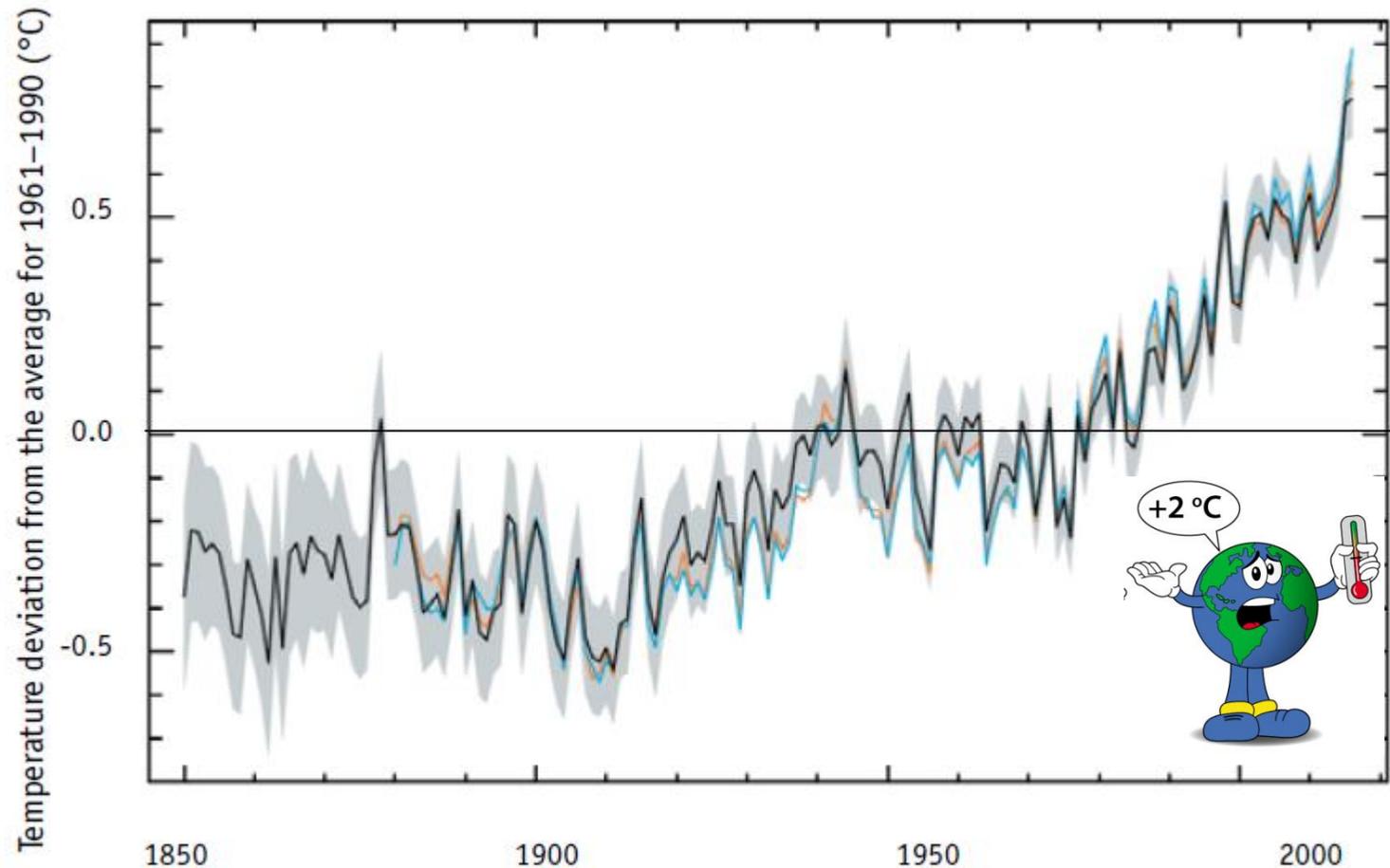
Climate change is not a theory, but a fact

This is evidenced by direct observations: Since 1850, the average temperature on Earth has increased by 1 °C.

Even such a seemingly small increase in temperature on a planetary scale is dangerous for its inhabitants: plants, animals and for you and me.

Therefore, the world community recognizes 1.5-2 °C as a 'relatively safe' maximum temperature rise.

We are already halfway there!

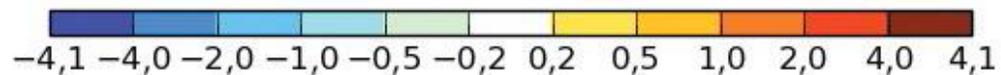
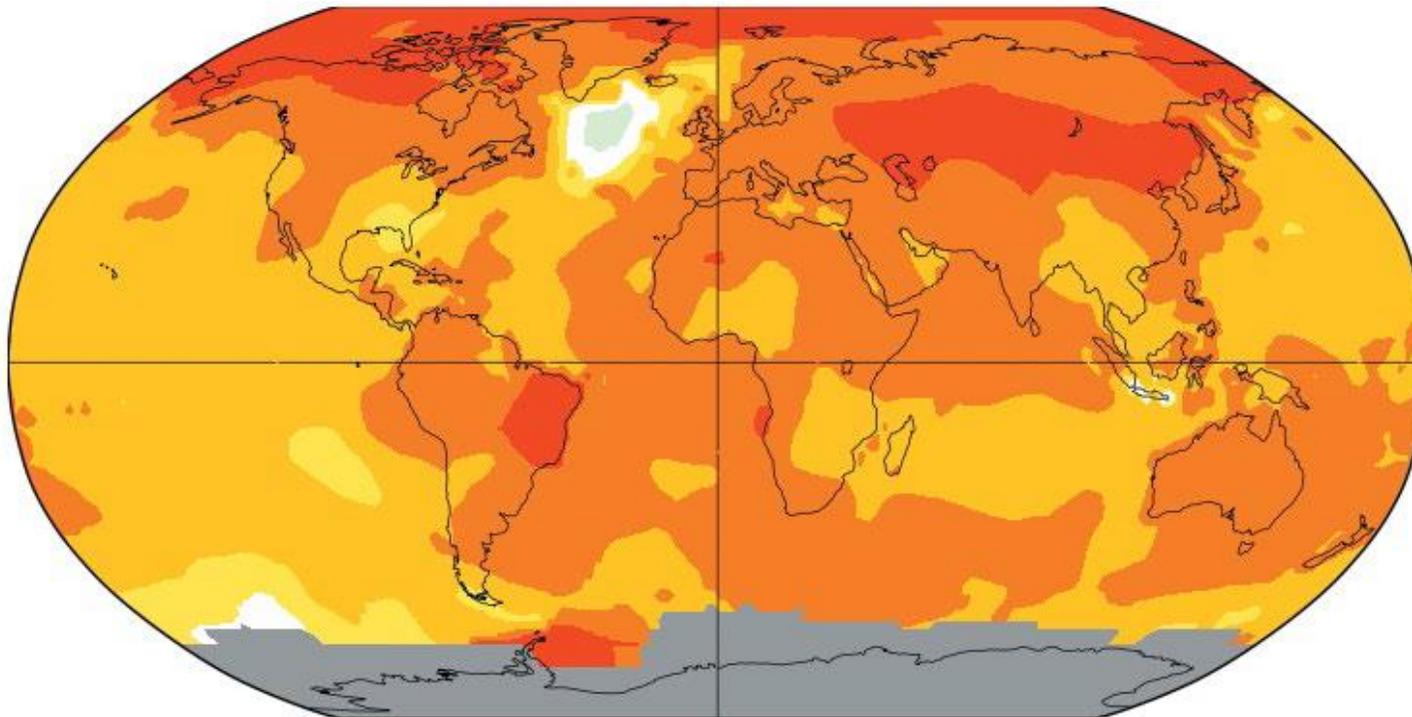


The blue, black and red lines are data from meteorological centres in the US and UK. The gray band represents the range of possible error, as estimated by British scientists.

Source:WMO

Changes are taking place in all regions of the planet

Map of observed changes in surface temperature from 1901 to 2018.



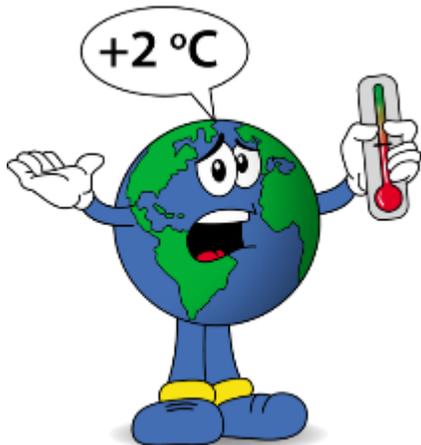
A temperature rise of 1 degree is the world's average.

But in some regions, especially in the Arctic, warming is happening much faster.

Change in temperature (°C from 1901 to 2018)
Areas for which there is insufficient data are marked in gray

Temperature breaks records

- 17 of the 19 years of the new millennium are among the warmest in the history of meteorological observations
- 2015, 2016, 2017, 2018 and 2019 were the hottest years on record (WMO, 2020)
- In the Northern Hemisphere, there has not been such a warm period as from 1983 to 2020 in the last 1400 years

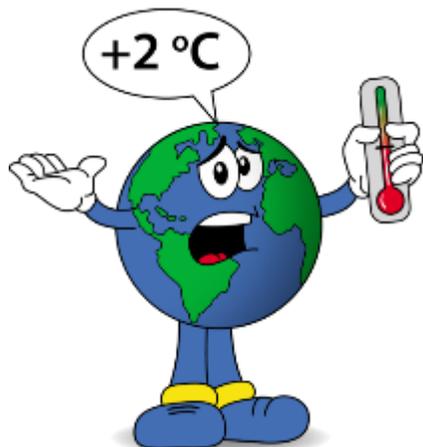
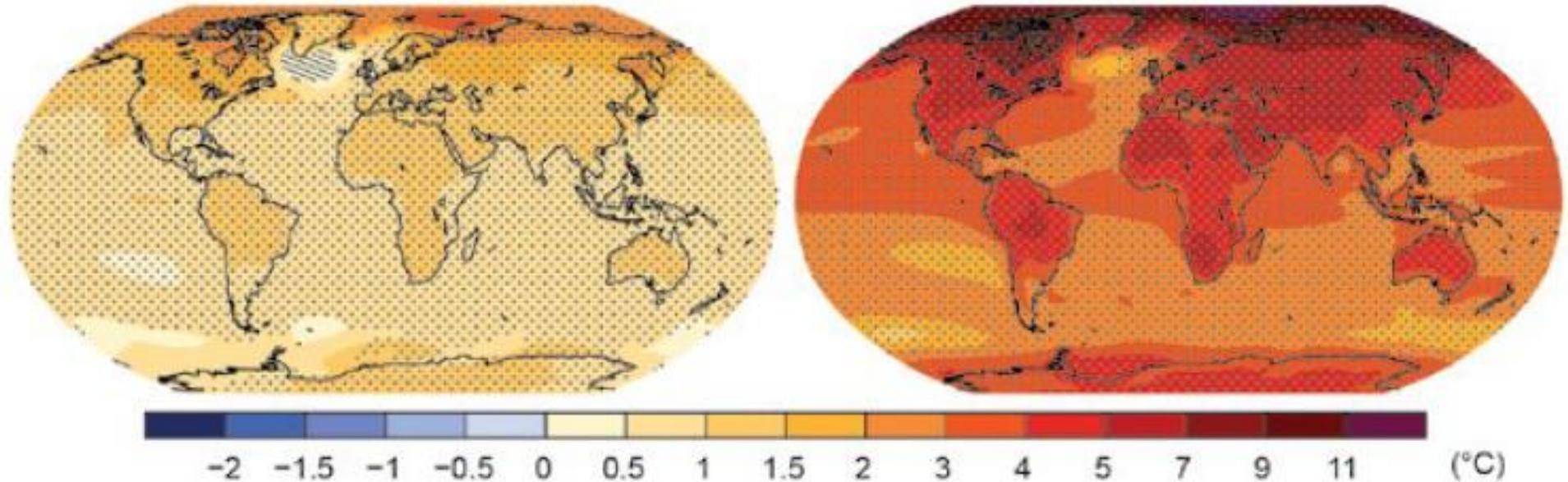


... and forecasts, alas, are disappointing if nothing is done

Change of average surface air temperature in 2081–2100 compared with the average in 1986–2005

the worst case scenario

the best case scenario



Global Warming or Climate Change?

'Climate change' is a more accurate term than 'global warming' because higher temperatures are only a part of what climate change means for Earth. As the temperature rises, we observe other related processes:

- the precipitation regime is changing,
- the level of the oceans rises,
- glaciers and permafrost melt,
- extreme weather events become more frequent and dangerous

These and other manifestations of climate change are dangerous for plants and animals, threaten the economy, health and even human life.

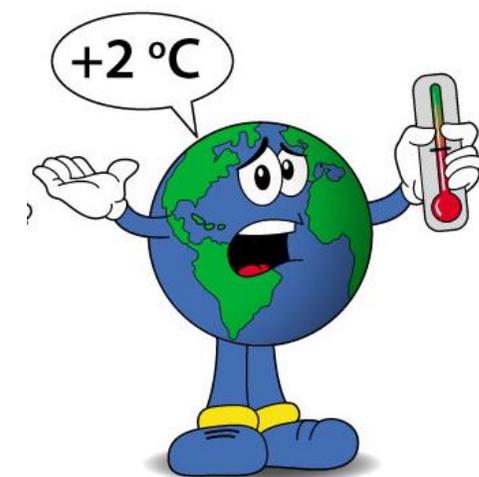
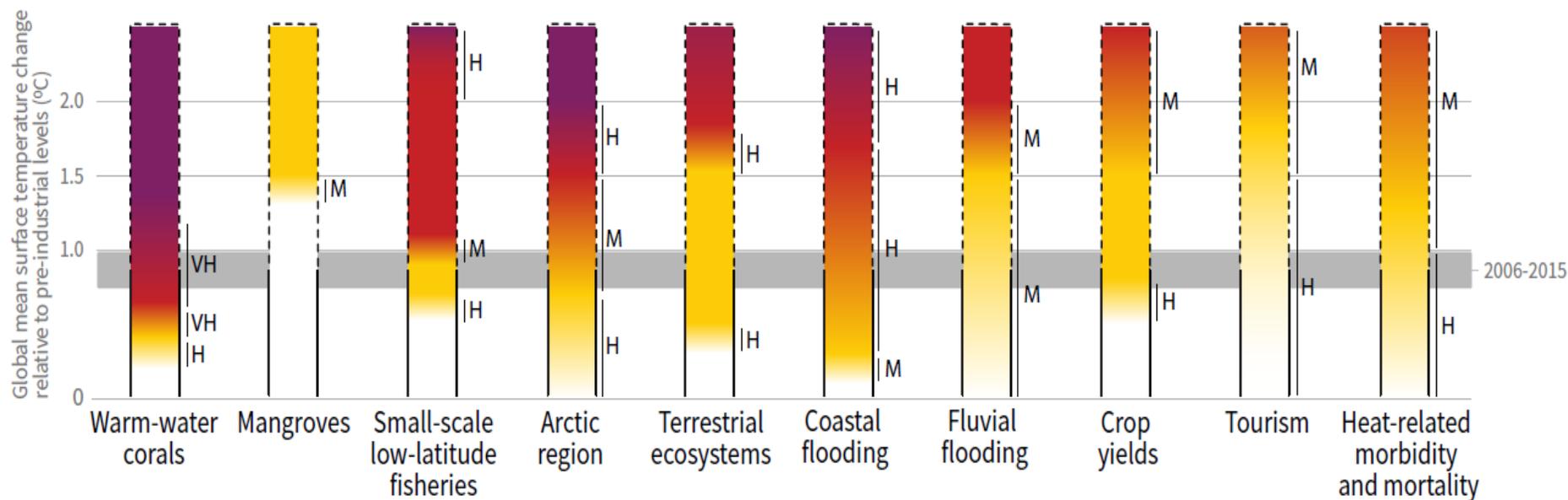
It is important to understand that this is not only a matter of 'warming', but of the general imbalance of the entire system **atmosphere-ocean-lithosphere-cryosphere-biosphere**.

We will talk more about the consequences of climate change for nature and humans in Part 2 of the module.



Impacts and risks for nature and economy

Possible risks for ecosystems and humans with a temperature rise of 1,5-2 °C and more



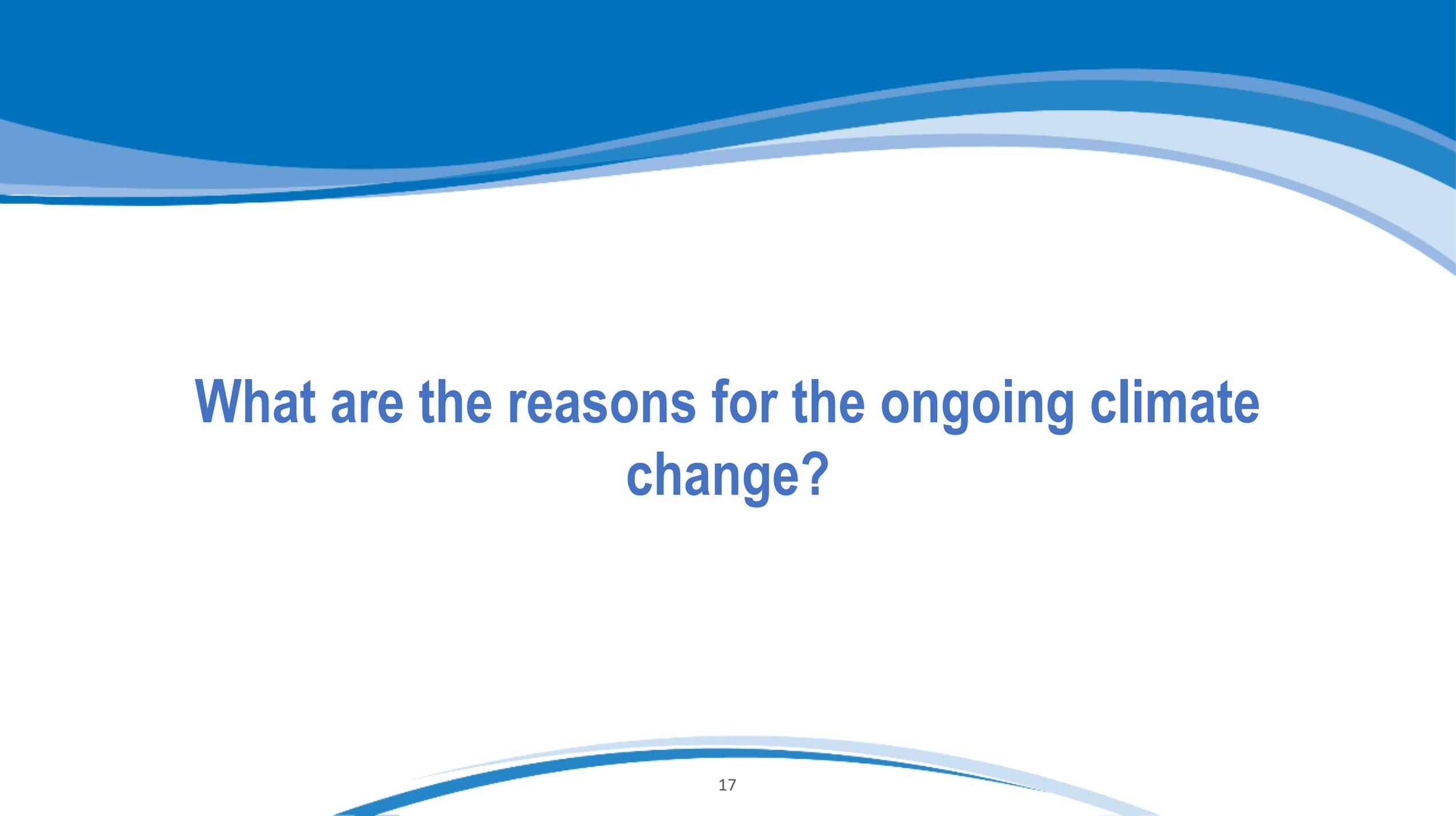
level of additional risk caused by climate change

undetectable

average

high

very high

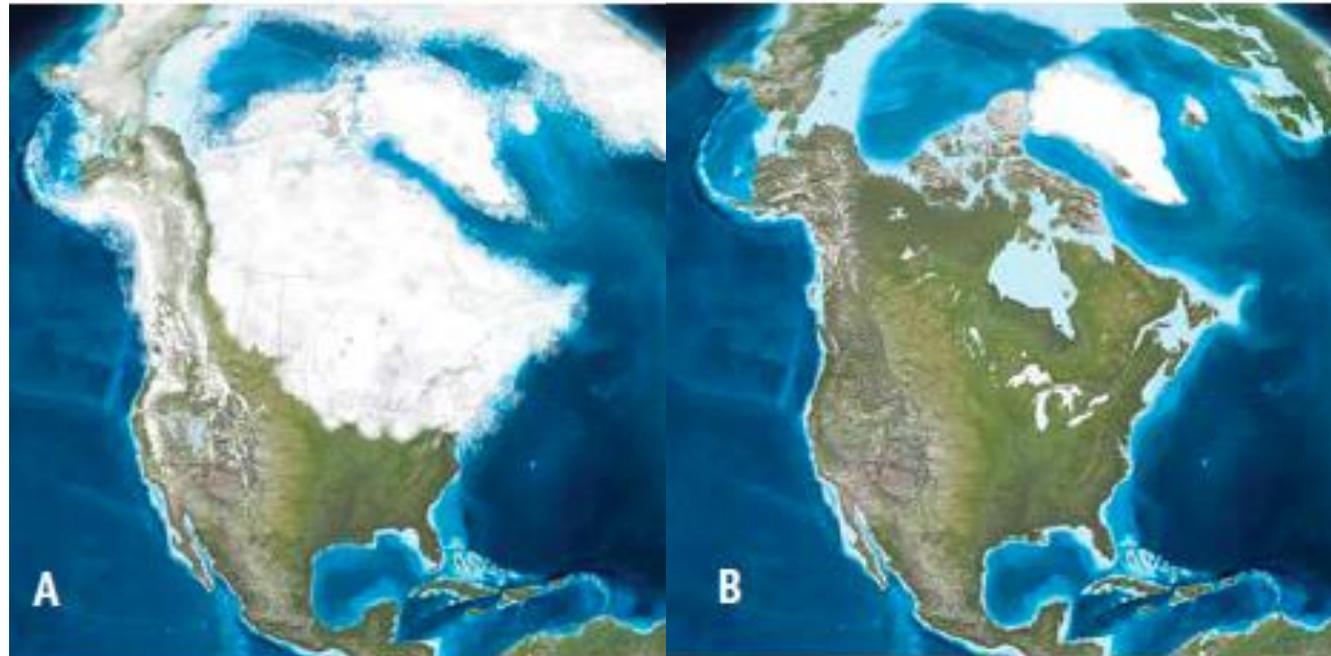


What are the reasons for the ongoing climate change?

Climate change has happened on Earth before

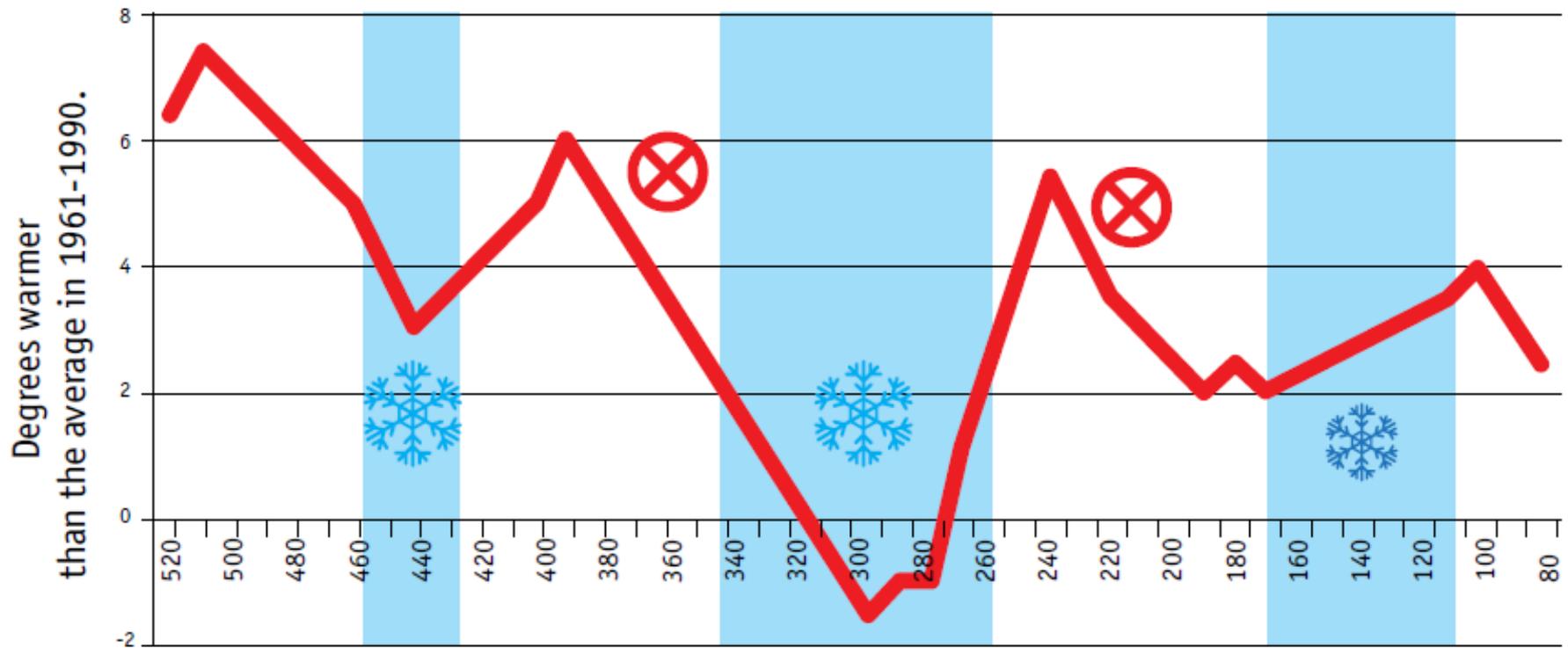
Over hundreds of millions of years of Earth's history, temperatures have changed very much – by about 10 °C!

- A) North America during the glacial period 125,000 years ago;
- B) at present.



Changes in temperature on Earth over the past 500 million years

The temperature on Earth over the past 500 million years



Major ice cover on land

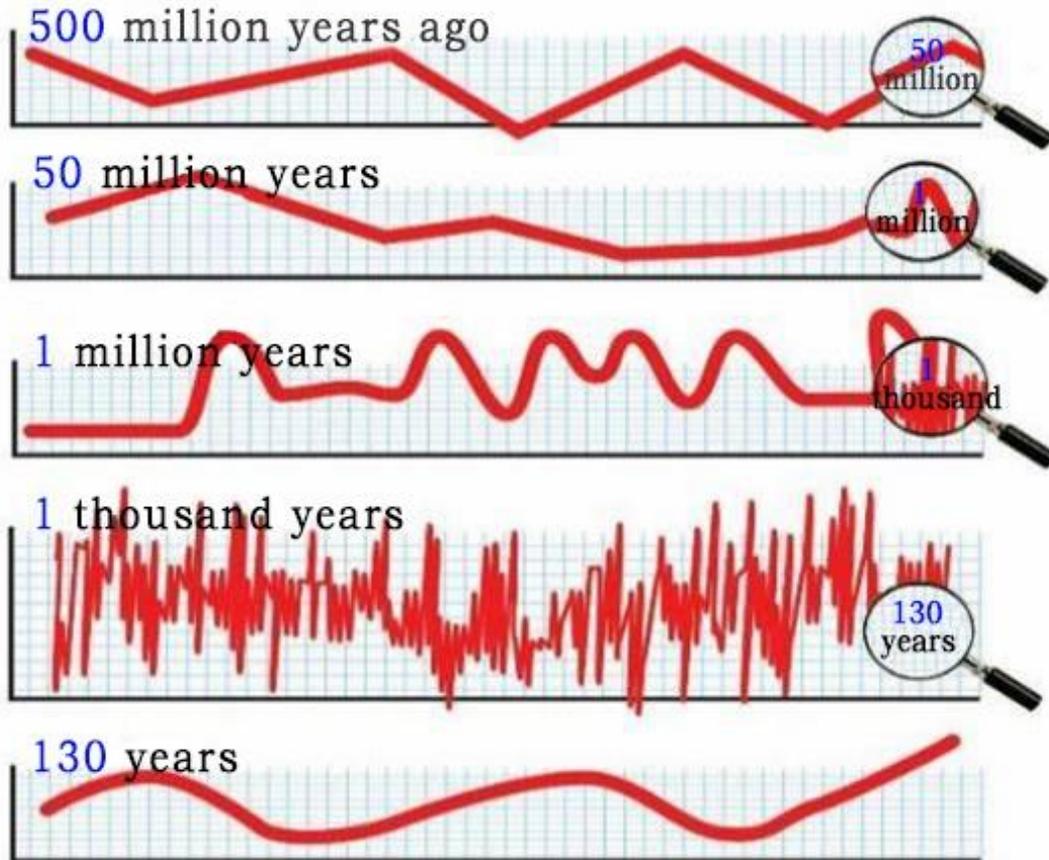


Partial ice cover on land
(between 500 and 100 million years ago the Antarctic continent was free of ice for most of the time)



Mass extinction of plants and animals
(a 'bio-catastrophe') between 370 and 240 million years ago.

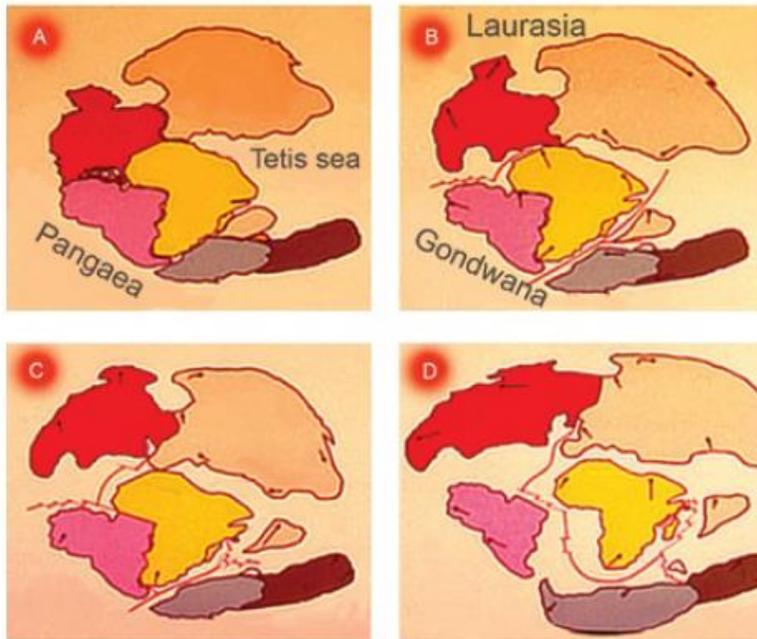
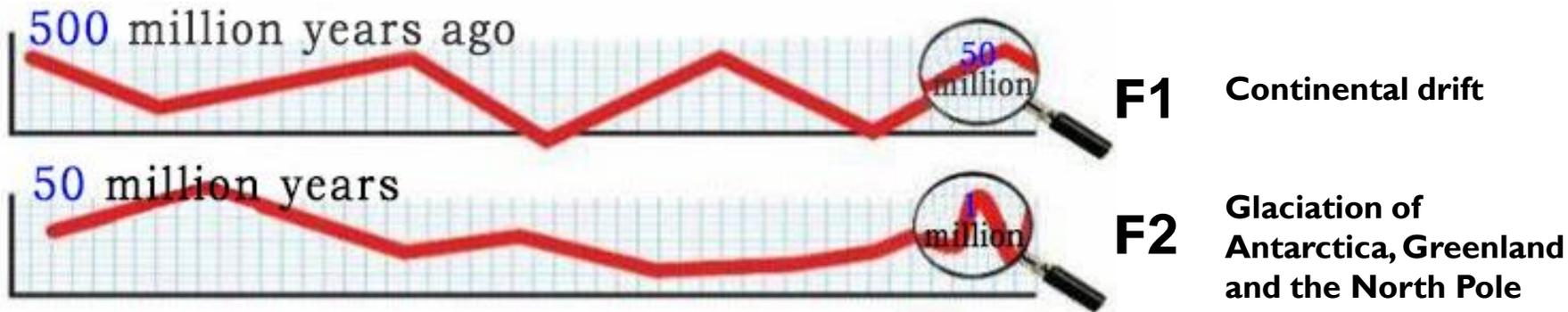
Climate change has happened on Earth before



Factors

- F1** Continental drift
- F2** Glacier caps appearing in Antarctica, Greenland and the North Pole
- F3** Earth orbit
- F4** Ocean fluctuations, Sun, volcanoes
- F5** Anthropogenic influence

Causes of climate change: millions of years

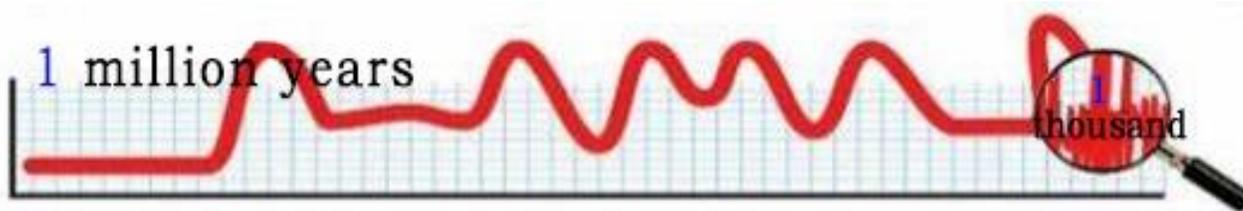


Movement (drift) of continents

- A – the formation of Pangaea;*
- B – the division of Pangaea, formation of Laurasia and Gondwana;*
- C – the splitting of Gondwana, formation of Hindustan, Australia and Antarctica;*
- D – the formation of South America, beginning of the division of Laurasia.*

*100 million years ago, it was much warmer on Earth than today.
30–40 million years ago Antarctica became covered with ice and 10 million years ago the same happened to Greenland, causing temperatures to drop to their current level.*

Causes of climate change: tens and hundreds of thousands



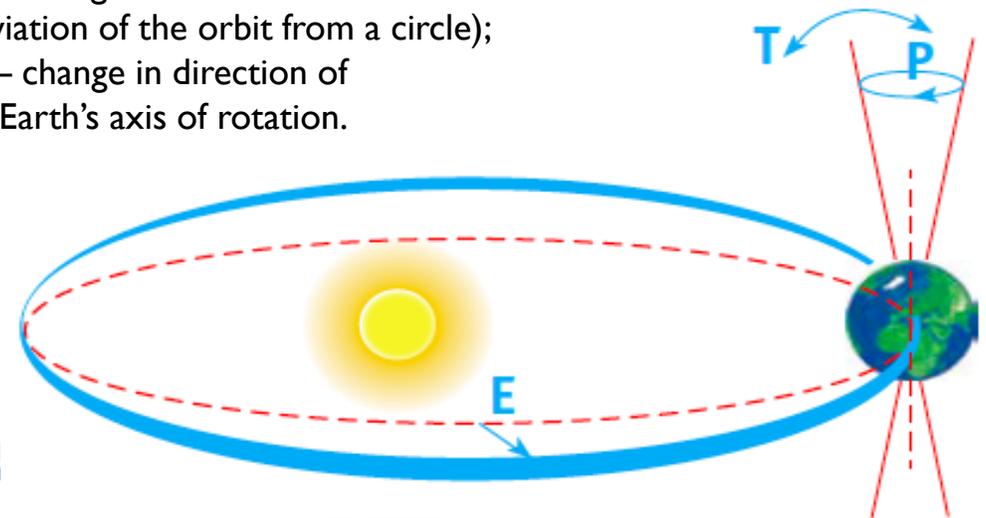
F3 Earth orbit

Changes in the Earth's orbit and its rotation around its own axis, which determine the onset of glacial periods.

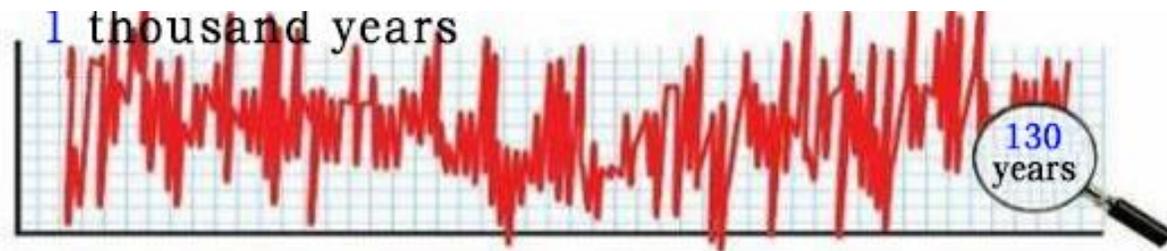
- T** — the tilt of the Earth's axis;
- E** — changes in the Earth's orbit (deviation of the orbit from a circle);
- P** — change in direction of the Earth's axis of rotation.

The Earth's orbit around the Sun changes about every 400,000 and 100,000 years. When the Earth's orbit is close to circular, seasonal changes in the flow of heat from the Sun are less than when the orbit has an elliptic shape.

Every 41,000 years the tilt of the Earth's axis alters in a range between 22 degrees and 24.5 degrees (it is currently at 23.5 degrees). This variation makes the duration of polar nights in polar regions longer in some periods and shorter in others.



Causes of climate change: centuries



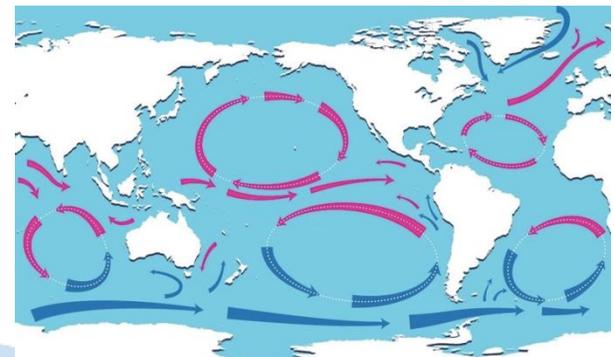
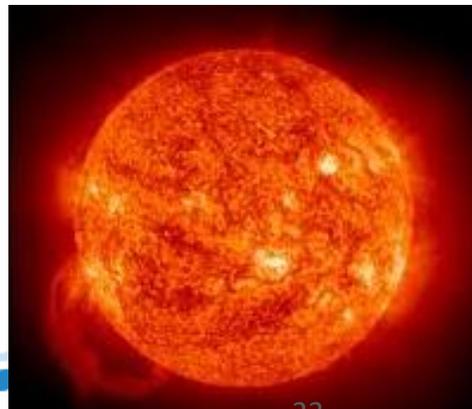
F4 Ocean fluctuations, Sun, volcanoes

Fluctuations in solar activity for 11, 40-45, 60-70, 100 and 200 years

Ocean currents

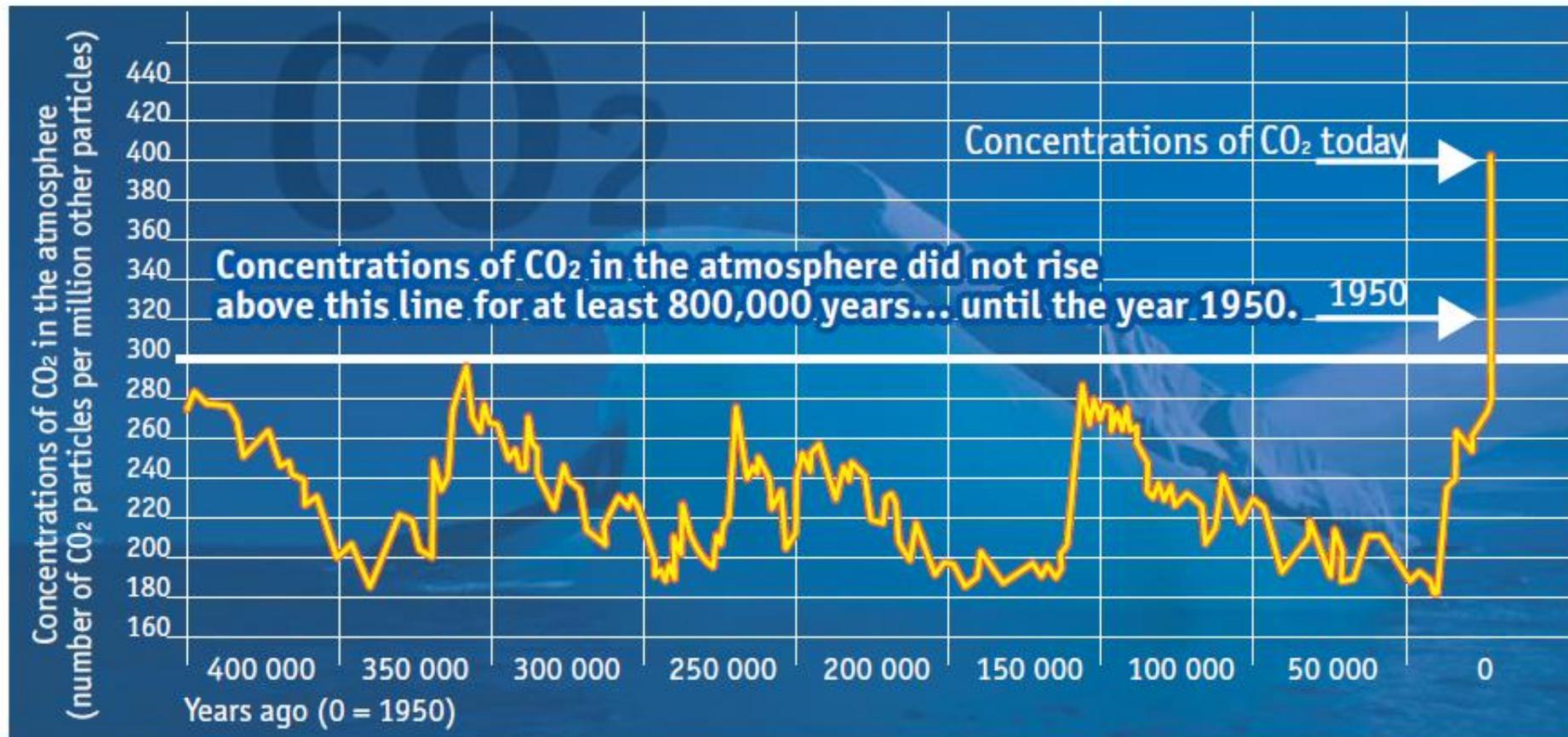
Currents are getting warmer and colder. This is enough to trigger warmer and colder climate periods.

Volcanic eruptions



Climate change has occurred on Earth before, but ...

The concentration of CO₂ in the atmosphere has never been so high



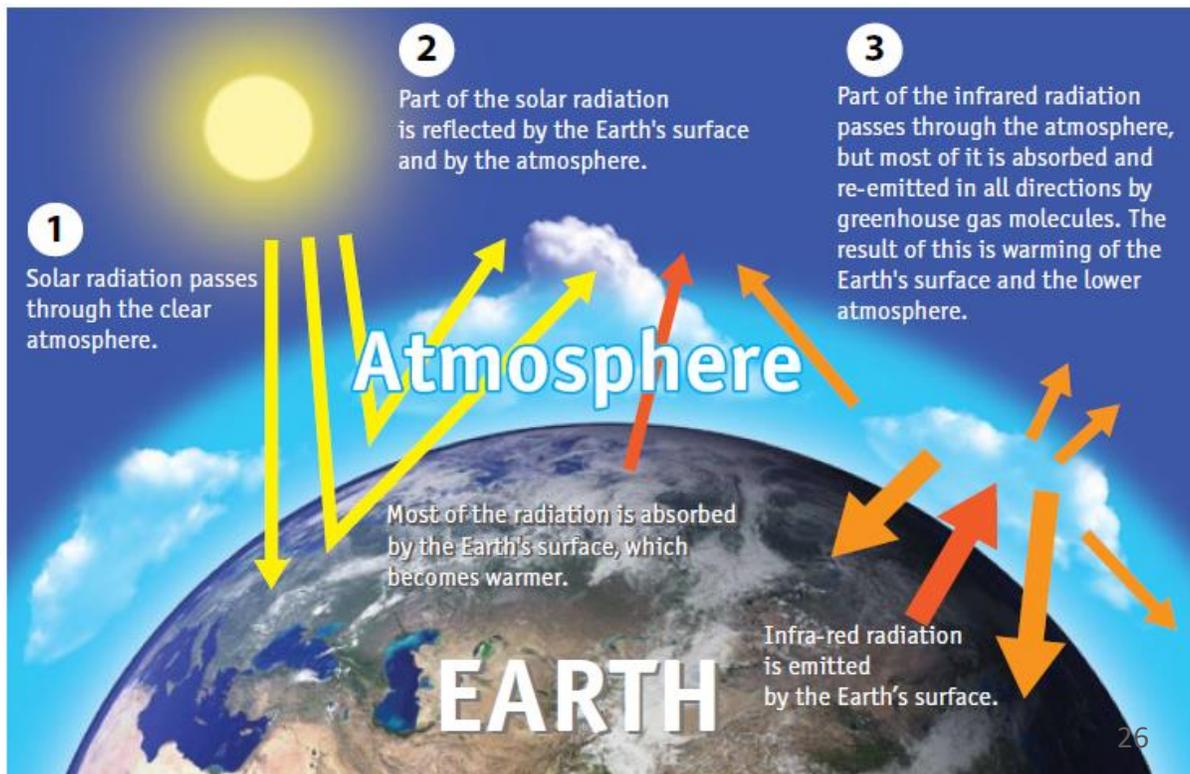
Climate Change Today

The greenhouse effect

Scientists explain the modern warming of the planet by the intensification of the greenhouse effect.

The greenhouse effect is the process by which gases, dust, water vapor in the atmosphere absorb the earth's heat and prevent it from reflecting from the earth's surface - **the effect is similar to a greenhouse for growing vegetables.**

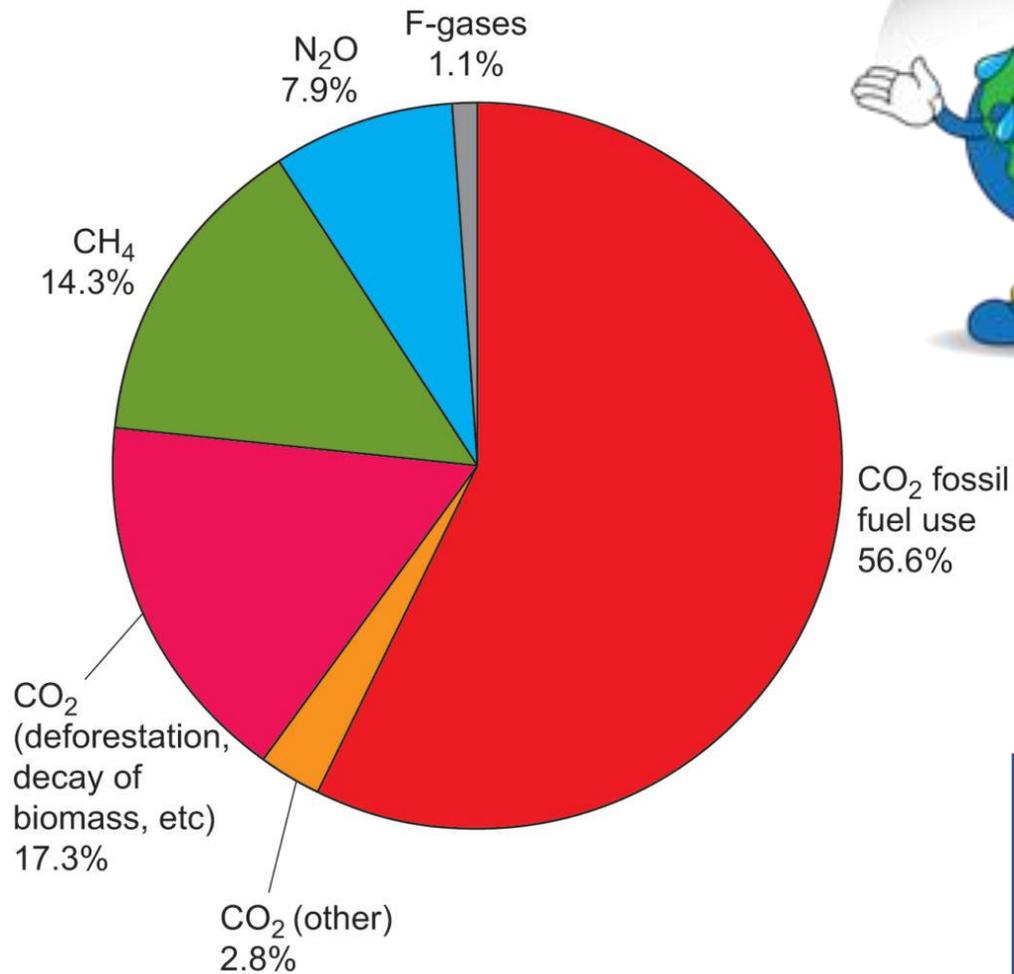
Therefore, the gases responsible for this effect are called '**greenhouse gases**'.



Without the greenhouse effect, the average air temperature on the Earth's surface would not be +14 °C, as now, but -19 °C.



Basic greenhouse gases associated with human activities



Extraction and use of energy from non-renewable hydrocarbon resources (oil, coal and natural gas) emit up to 75% of all greenhouse gases associated with human activities.

How do scientists know about the concentration of greenhouse gases 800 thousand years ago?



How did scientists come to the conclusion about the leading role of humans in the ongoing climate change?

Intergovernmental Panel on Climate Change (IPCC)

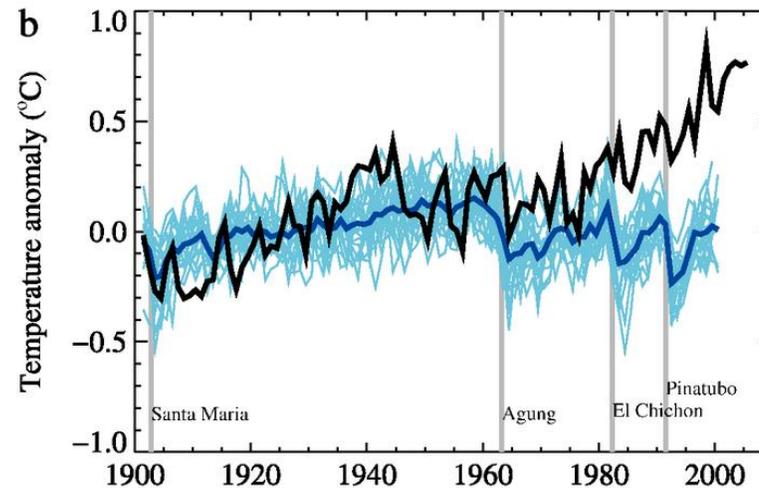
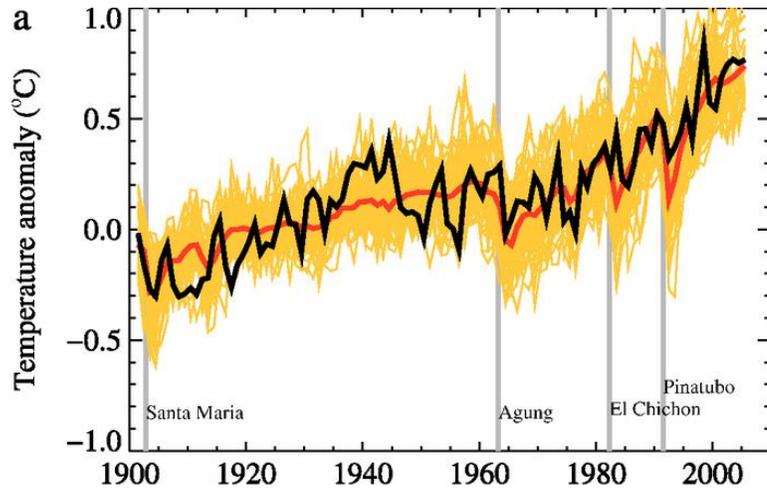


- United Nations organization responsible for assessing and compiling scientific evidence on climate change
- 195 participating countries
- 2,500 scientists and experts and 130 countries
- 30 years of active work
- Periodic detailed reports on the basis of which UN countries make policy decisions
- Awarded the Nobel Peace Prize in 2007 for its contribution to the formation and dissemination of knowledge about the problem of climate change and ways to solve it

How did scientists come to the conclusion about the leading role of humans in the ongoing climate change?

Models versus direct observation (1900-2007):

a) taking into account human contribution and b) without human intervention



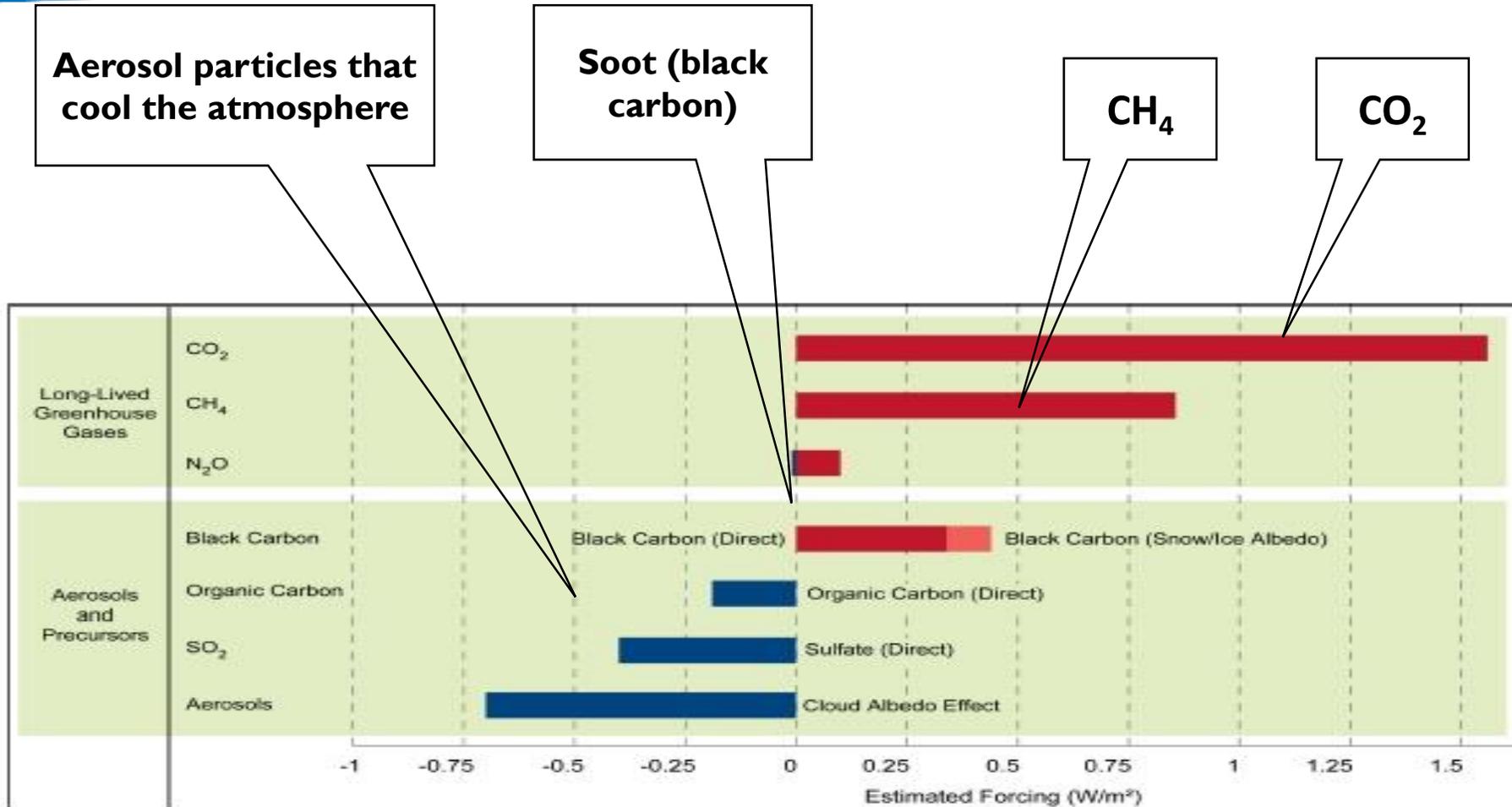
Black line - meteorological data

Orange line - simulation results taking into account human influence

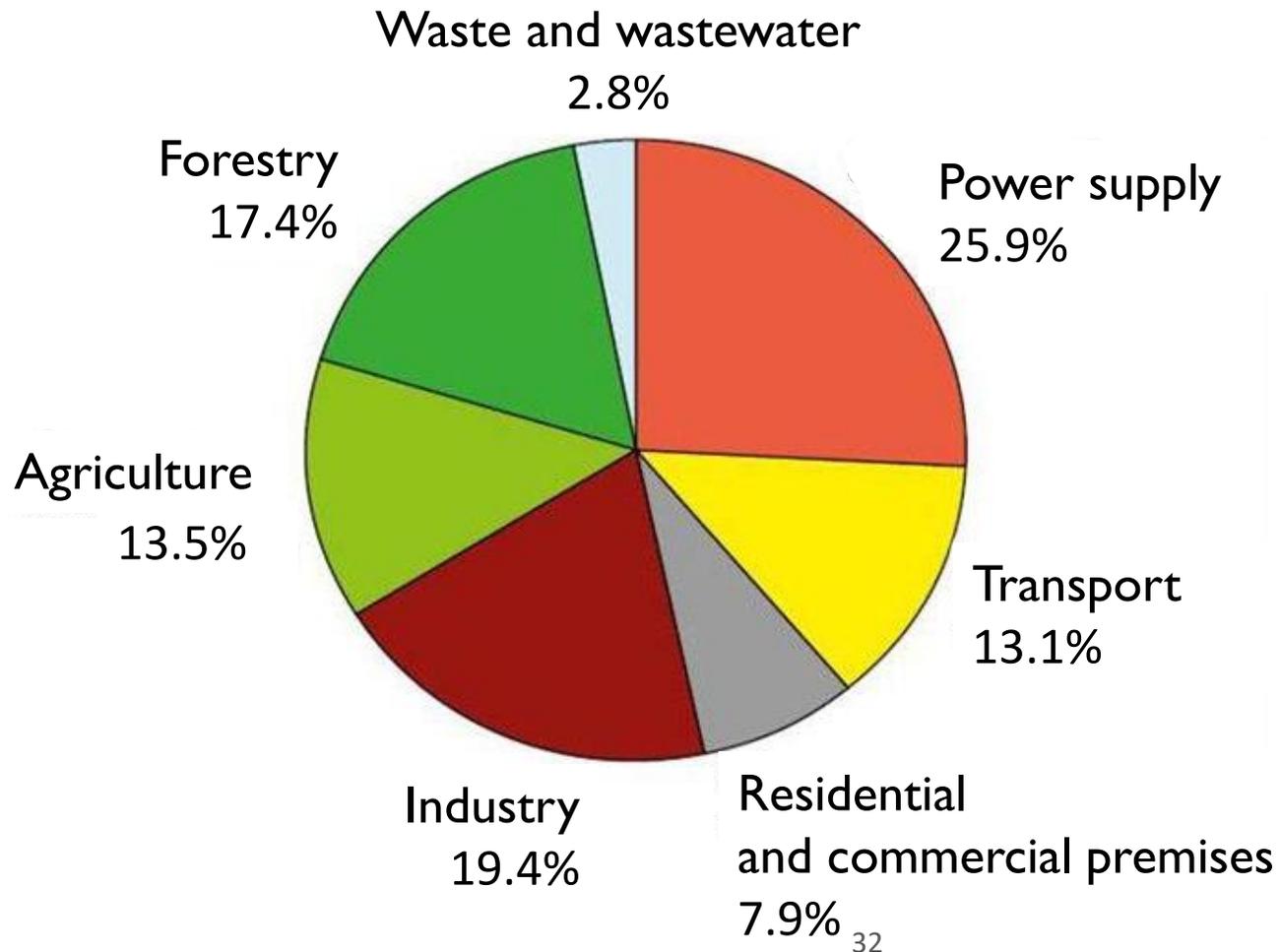
Blue line - simulation results without human influence (natural causes only)

Conclusion: without human influence, the rise in temperature would not be so significant

Human: 'warming' and 'cooling'. Average - warming



Basic sources of greenhouse gases (our carbon footprint)



About 75% of these emissions are directly or indirectly related to the production or consumption of energy from hydrocarbon sources.

Greenhouse gases are not pollutants!

Greenhouse gases ≠ pollutants



Unlike pollutants, CO₂ and other greenhouse gases **do not have direct negative impact** on human health and the ecosystem at the **place of release**.



Accumulating in the atmosphere, they enhance the greenhouse effect, affecting the rise in temperature. Then the increasing temperature impacts other processes in the climate system, which, in turn, impact humans and ecosystems.

Thus, **we are affected by climate change caused by greenhouse gases, but not by the gases themselves.**

Discussion

Why is the problem of climate change not so much of an environmental issue as an energy, economic, social, political issue and one of the fundamental goals of the UN in the field of sustainable development?



Questions to reinforce

1. The weather is :

- A. The state of the atmosphere at a given point at a given moment or for a limited period of time;
- B. Average air temperature typical for a given area;
- C. The relationship between precipitation and air temperature in a particular climatic zone.

2. The climate is :

- A. Weather characteristic indicating the frequency of precipitation;
- B. Long-term weather regime in this area;
- C. A characteristic of the weather indicating the average seasonal (spring, summer, autumn, winter) temperature in a particular climatic zone.

3. Which of these parameters is not used to characterize the climate of a given area?

- A. Precipitation mode;
- B. Prevailing winds;
- C. Longitude.



Questions to reinforce

4. What method do scientists use to find out what the climate was like on earth hundreds of thousands of years ago:

- A. Studying the tree rings;
- B. Study of air bubbles in Antarctic ice;
- C. Study of data of meteorological observations.

5. Volcanoes heat or cool the Earth's atmosphere?

- A. Heated because a large amount of thermal energy is emitted from hot lava;
- B. Cool;
- C. Have no effect.

6. How much has the temperature on Earth increased over the past 150 years?

- A. By 1°C ;
- B. By 5°C ;
- C. By 10°C .



Questions to reinforce

7. Which of the following gases is a greenhouse?

- A. Nitrogen(N);
- B. Methane(CH₄);
- C. Carbon monoxide(CO).

8. The main source of anthropogenic greenhouse gas emissions?

- A. Transport;
- B. Deforestation;
- C. Power supply.

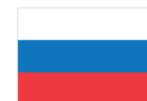
9. Does CO₂ affect the ecosystems condition and public health?

- A. Doesn't affect;
- B. Affects directly within a radius of 100 km from the source of emission;
- C. Affects indirectly, since its concentration in the atmosphere leads to an increase in the temperature on the planet, which, in turn, affects nature and humans.



The photos and illustrations used in the module, where sources are not specified, are either taken from the Climate Box toolkit (see the List of illustrations at the end of the textbook) or provided by the program participants.

THANK YOU FOR YOUR ATTENTION



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Resilient nations.*