What is Climate Change?

What can we do about it?

Pedro Sepúlveda Monteiro

Região Autónoma da Madeira
Governo Regional

Secretaria Regional
de Ambiente, Recursos Naturais
e Alterações Climáticas
Direção Regional do Ambiente
e Alterações Climáticas

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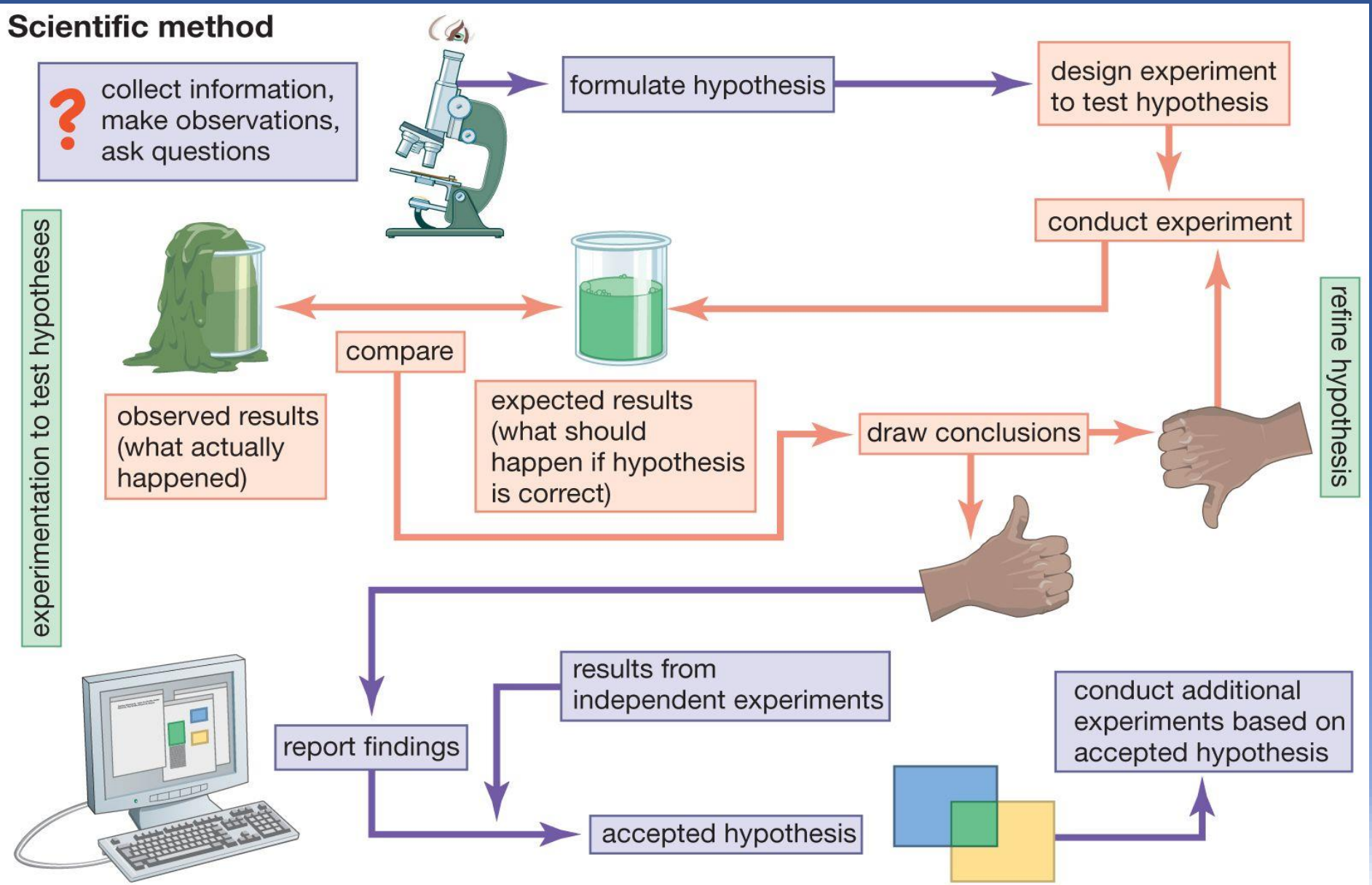
Escola Básica com Pré-Escolar Bartolomeu Perestrelo

23rd January 2023

First, let's speak about science…

- What is science?
  - **the pursuit** and application **of knowledge**
  - **understanding the natural world**
  - following a **systematic methodology**
  - **based on evidence**
  - **Not on belief or guess…**

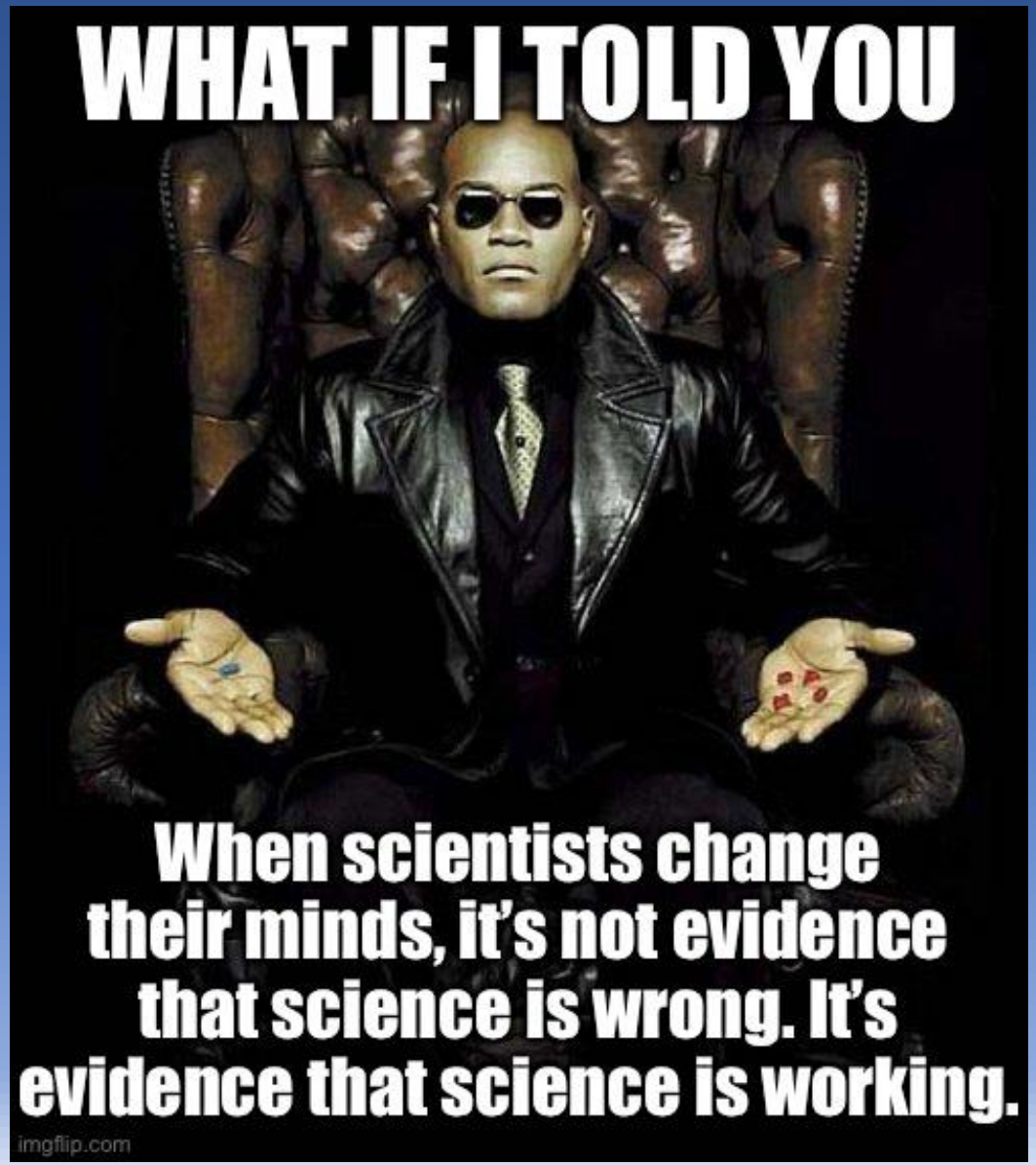
Scientific method



- Observation
- Question
- Hypothesis
- Experiment
- Conclude
- Report
- **Repeat**
- **Refine**

Scientific method

- **Progressive process**
- Based on evidence
- Better experience design or new technologies – different conclusions
- Better explanation to understand what surrounds us
- Only better science refutes science



And now, let's speak about climate change!

Weather *vs* Climate

WEATHER

WHAT YOU GET

CONDITIONS OF THE ATMOSPHERE OVER A SHORT PERIOD OF TIME

CAN CHANGE WITHIN MINUTES OR HOURS

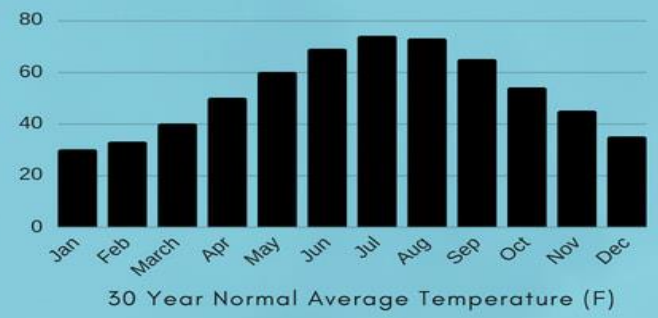
vs

CLIMATE

WHAT YOU EXPECT

HOW THE ATMOSPHERE BEHAVES OVER A LONG PERIOD OF TIME AND SPACE

AVERAGE REGIONAL WEATHER PATTERN OVER DECADES



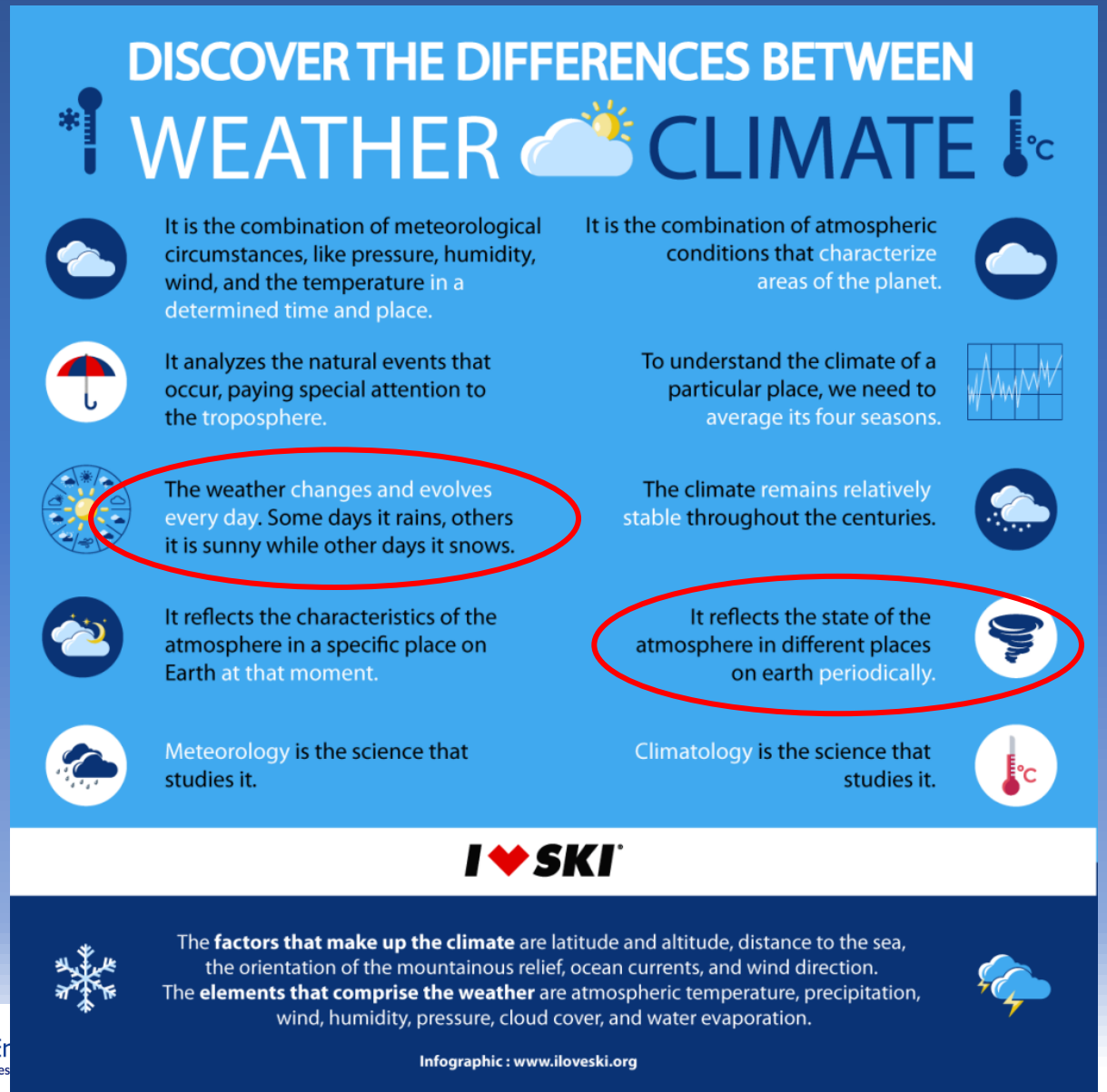
Climate is your playlist.
Weather is the song that's playing *right now*.

Weather *vs* Climate

- Pressure
- Humidity
- Wind
- Temperature

- Variable
- Specific place
- Given moment

- Meteorology



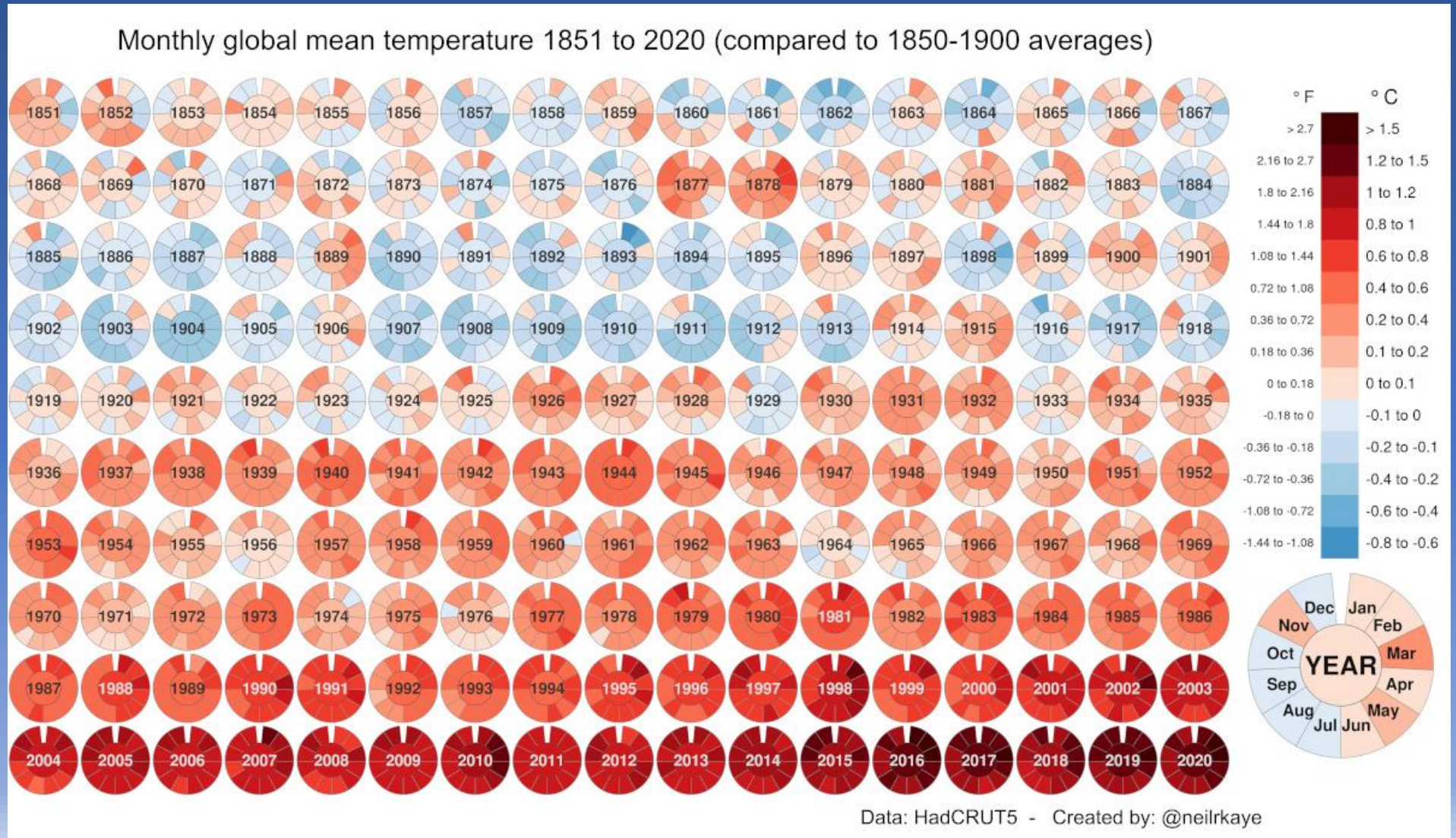
- Polar
- Mediterranean
- Desertic
- Tropical

- Stable
- Average periods
- 30 years

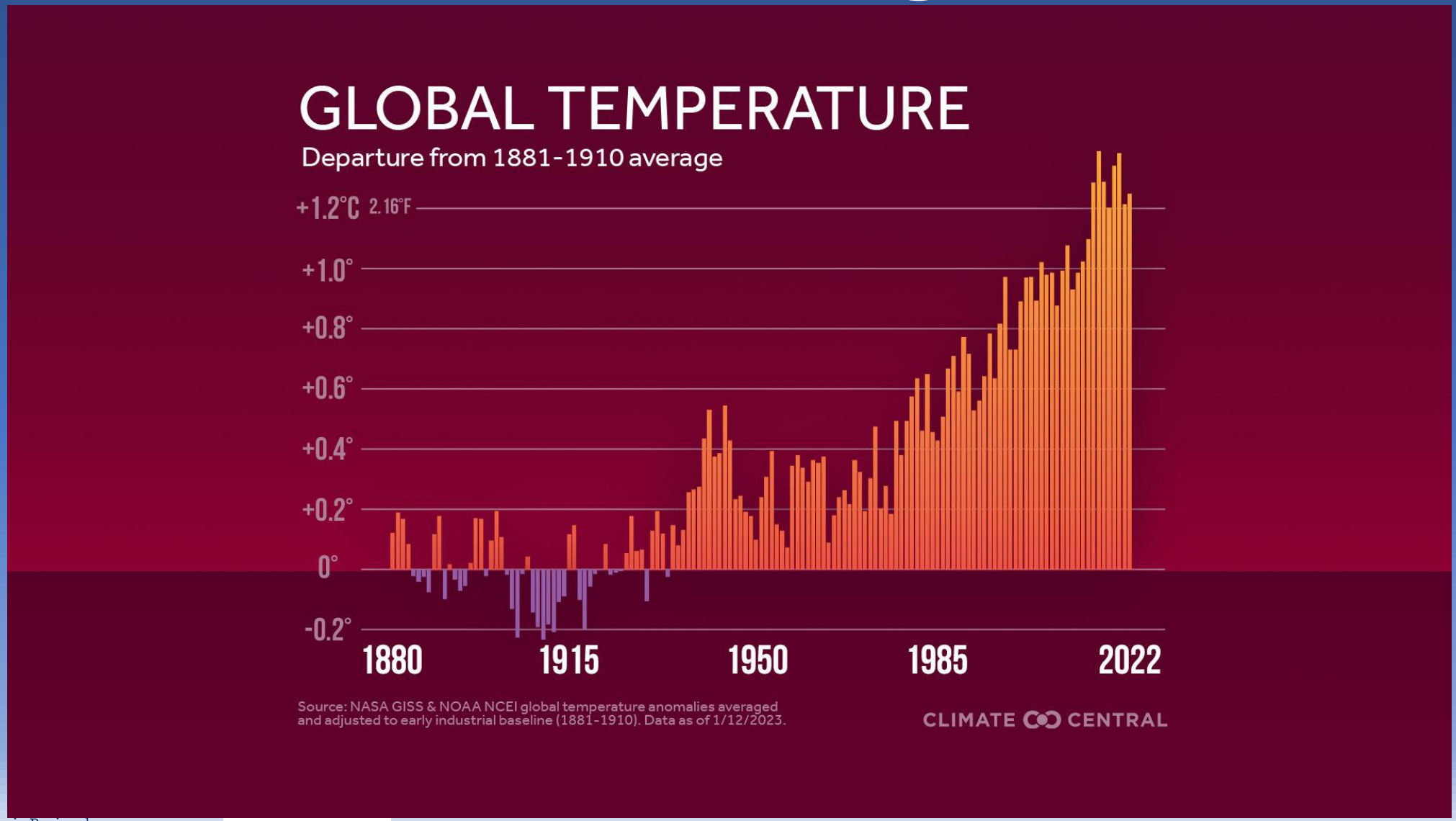
- Climatology

The world is getting hotter…

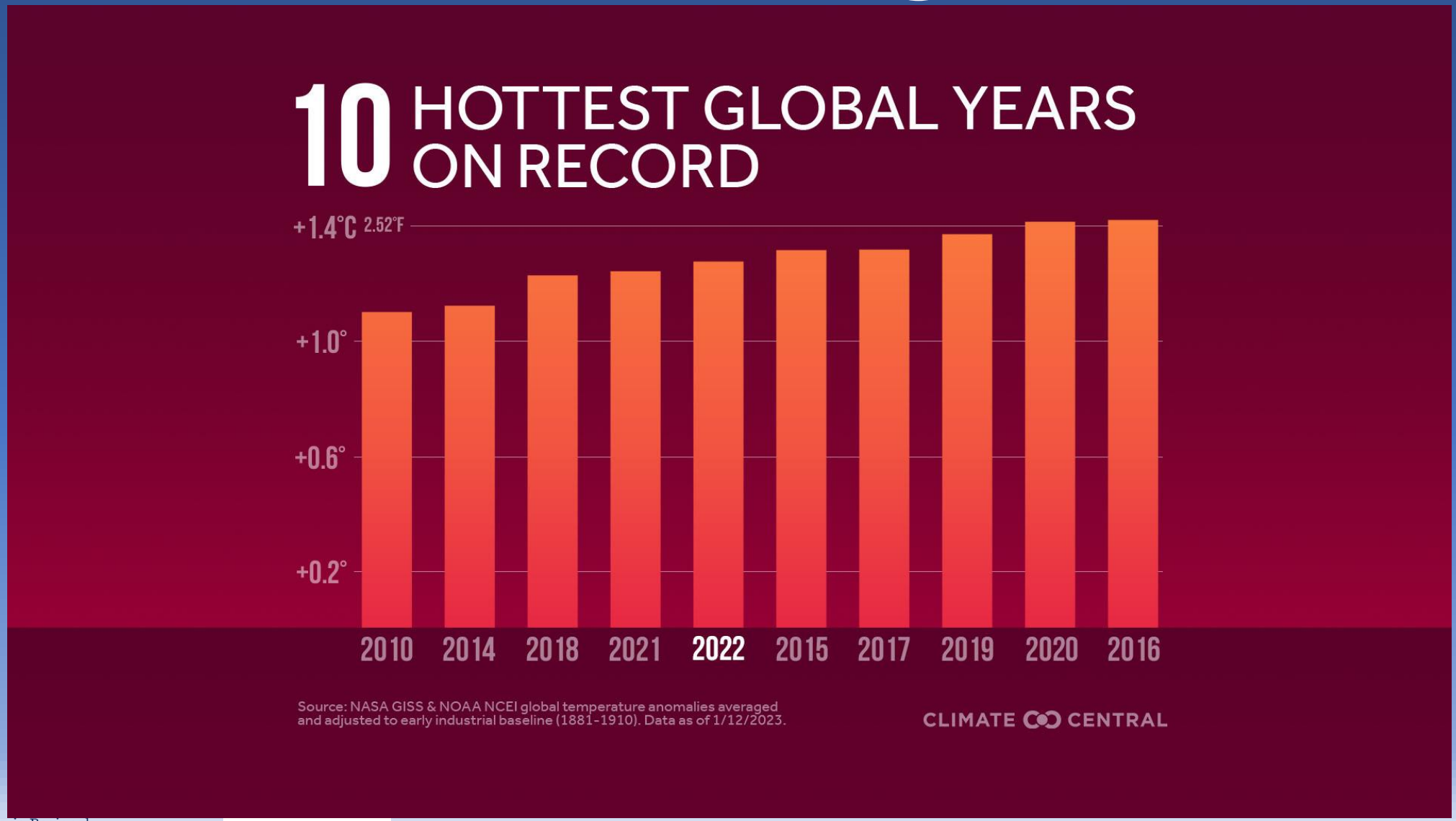
Global warming is real!



Global warming is real!



Global warming is real!



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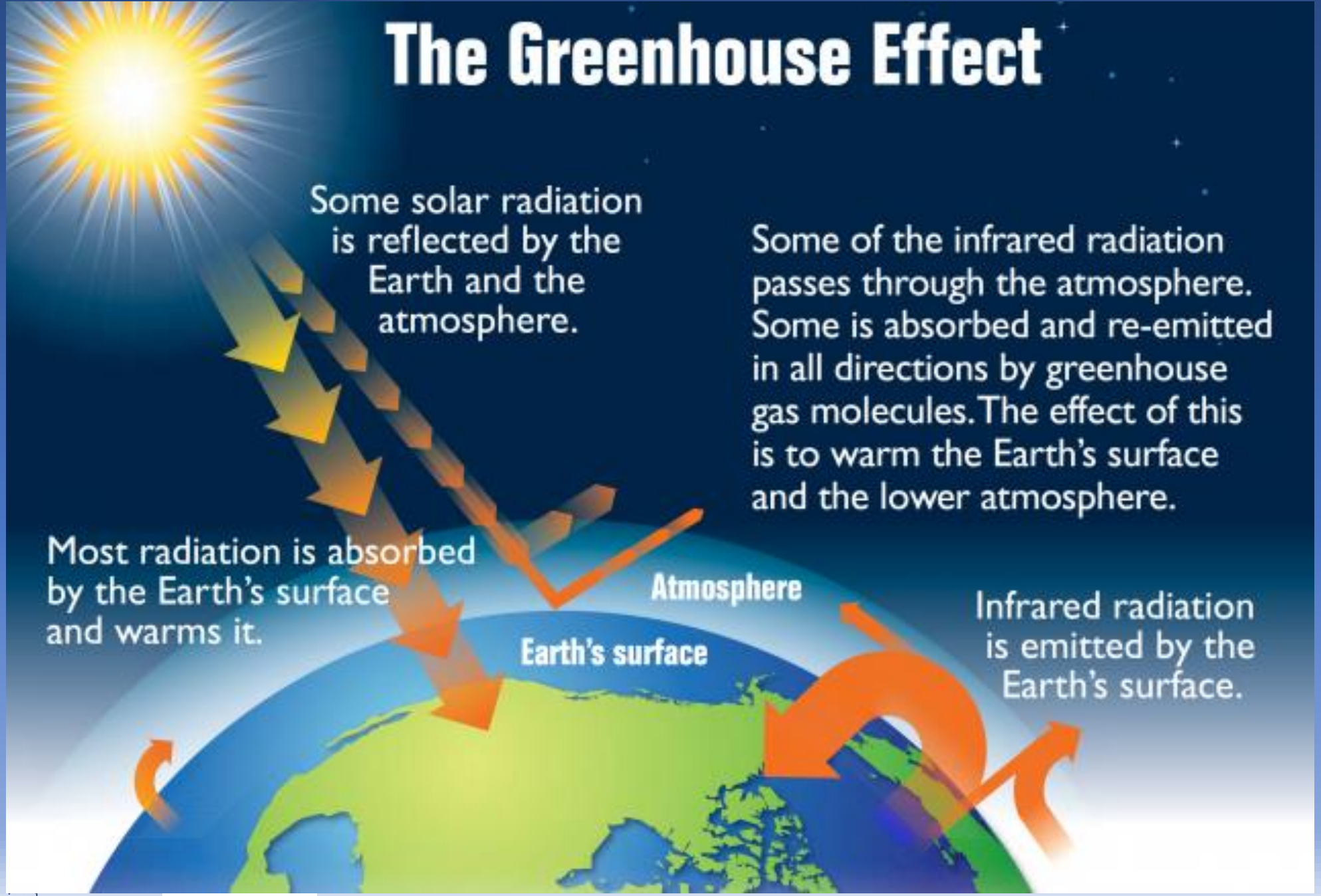
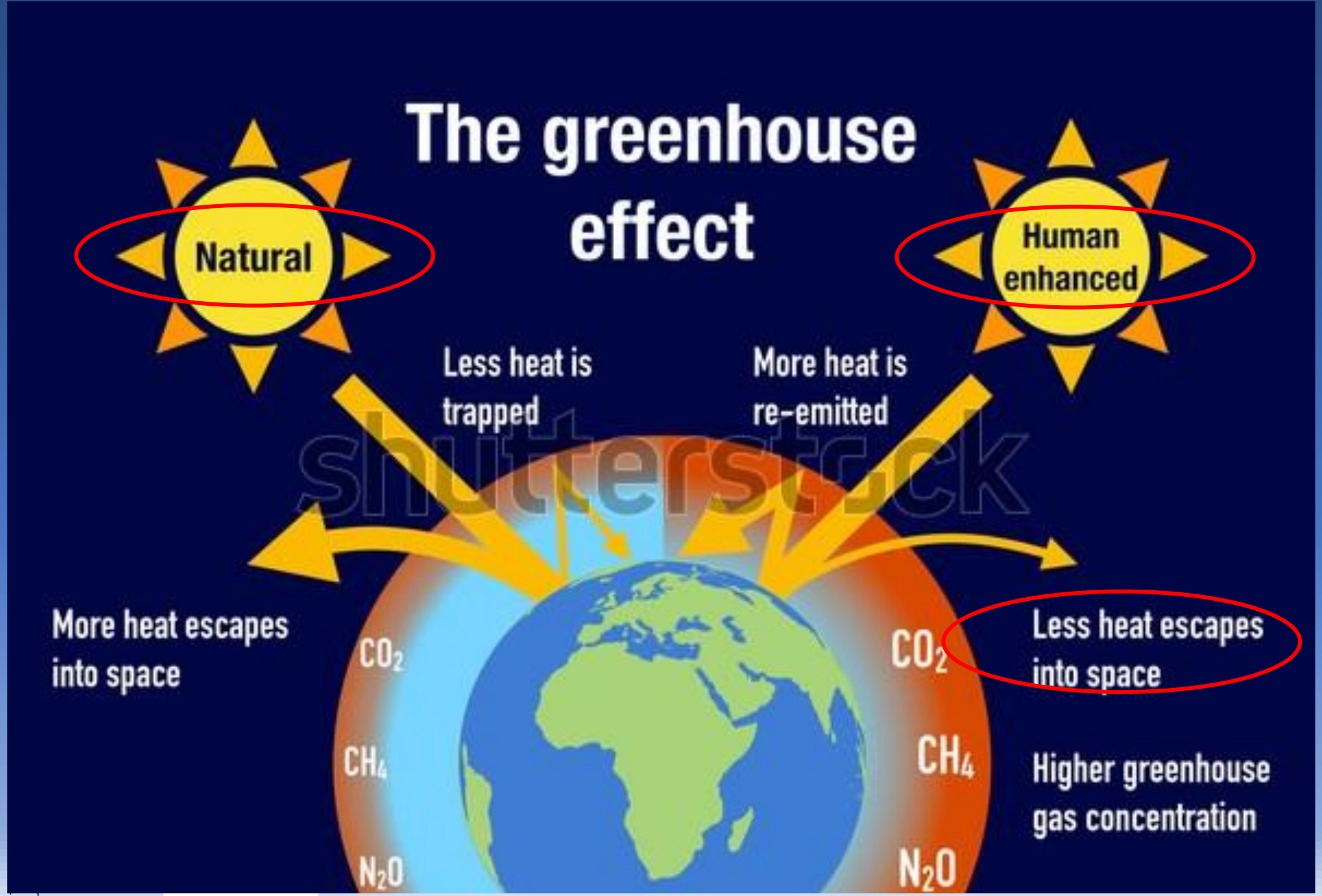
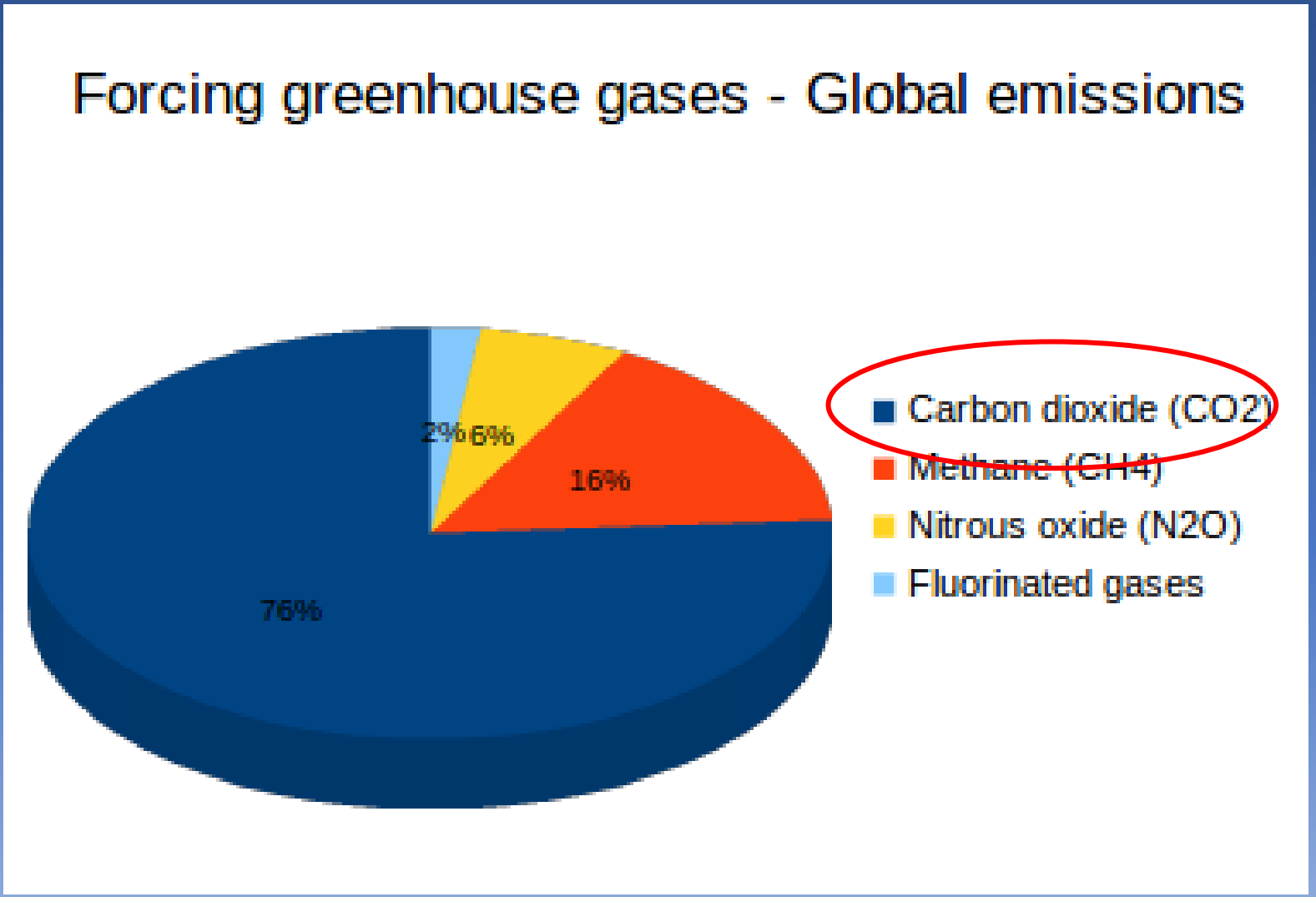
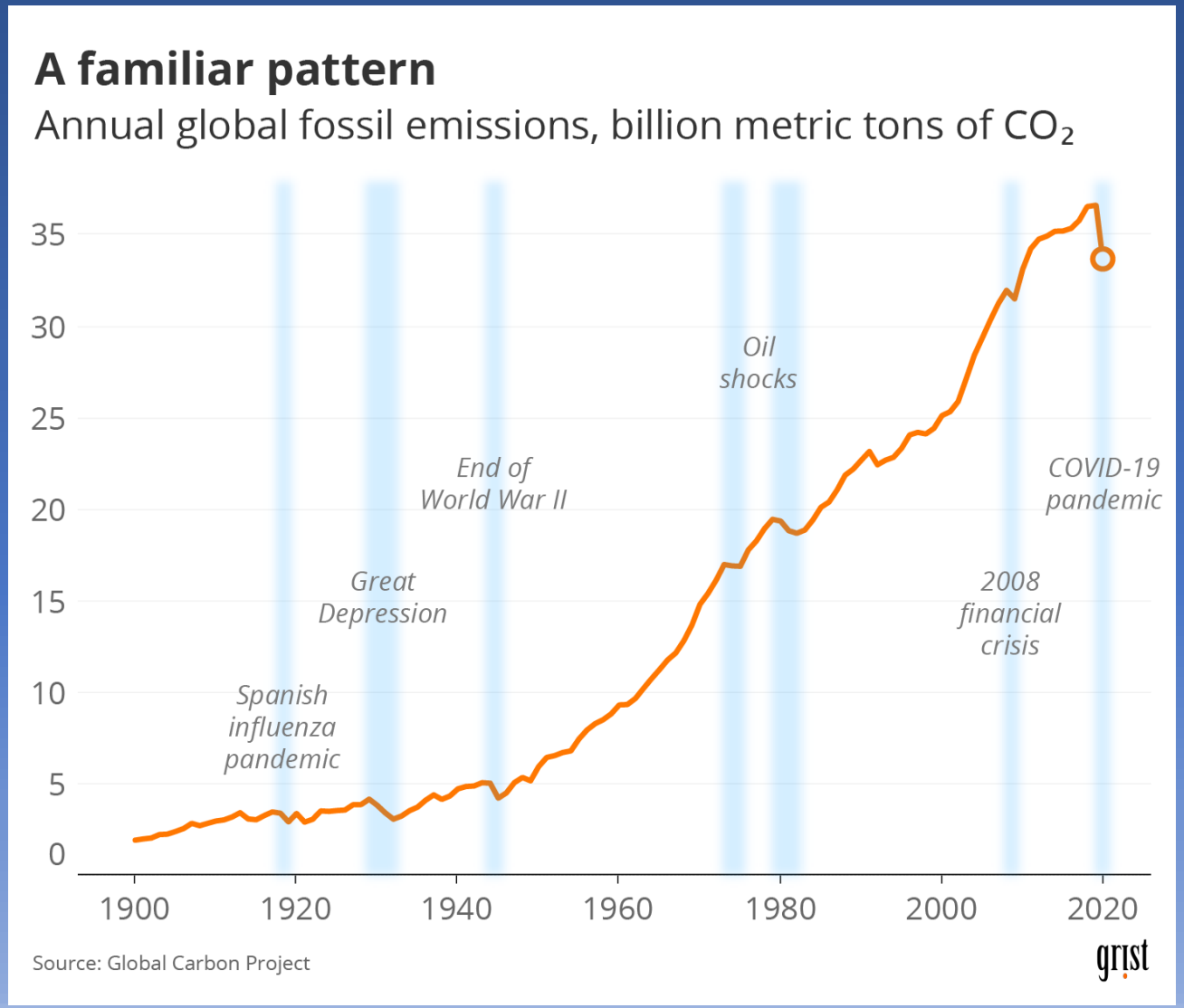

The Greenhouse Effect
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Most radiation is absorbed by the Earth's surface and warms it.
Atmosphere
Earth's surface
Infrared radiation is emitted by the Earth's surface.


The greenhouse effect
Natural
Human enhanced
Less heat is trapped
More heat is re-emitted
More heat escapes into space
Less heat escapes into space
CO_2
CH_4
N_2O
CO_2
CH_4
N_2O
Higher greenhouse gas concentration
shutterstock

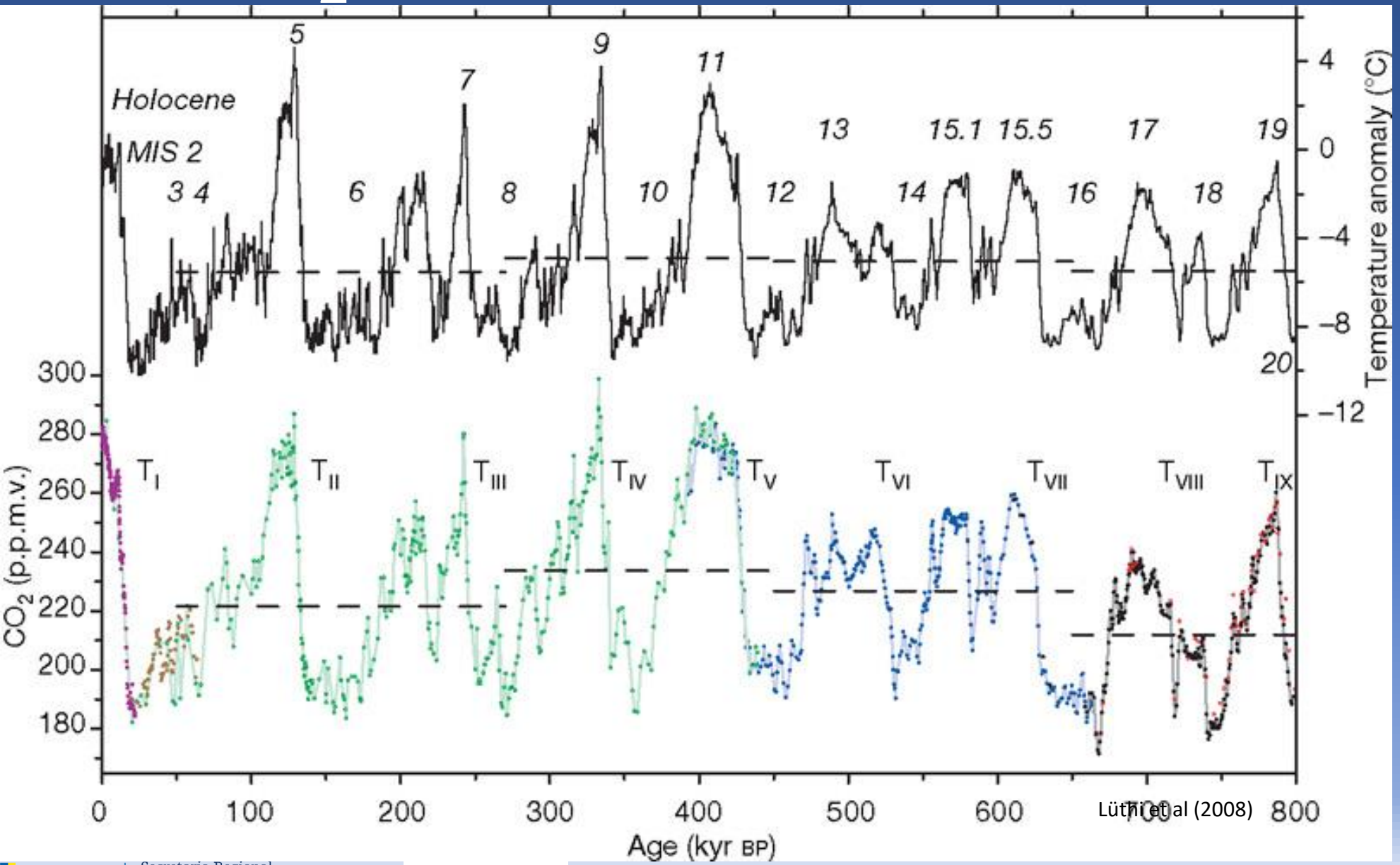
Greenhouse gases



The CO_2 effect on the temperature



The CO_2 effect on the temperature

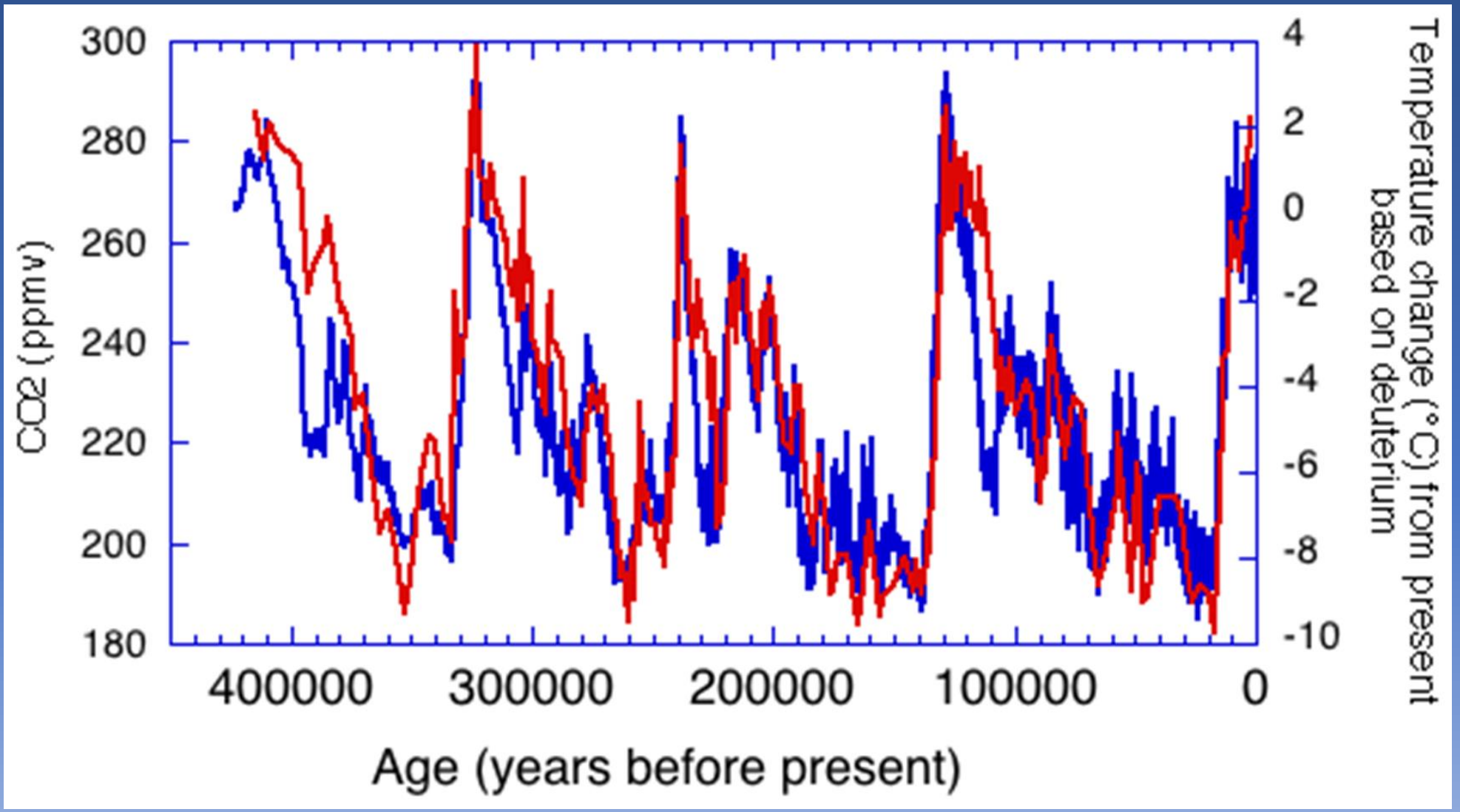


Lüthi et al (2008)

- **Temperature**
- **Atmospheric CO_2**

Reconstruction through air bubbles prisioneed in Antarctica ice cores

The CO_2 effect on the temperature

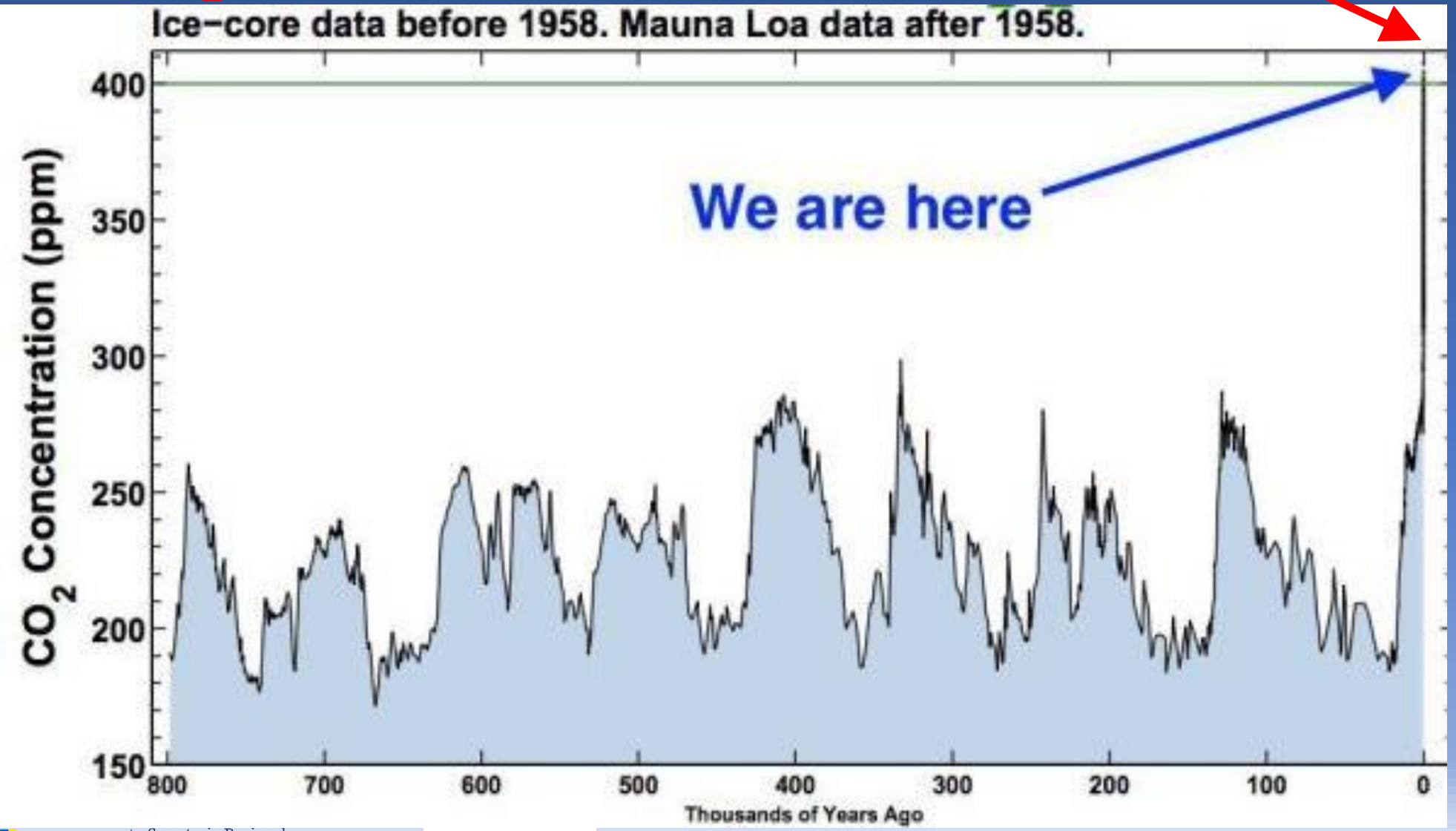


- **Temperature**
- **Atmospheric CO_2**

Almost perfect match

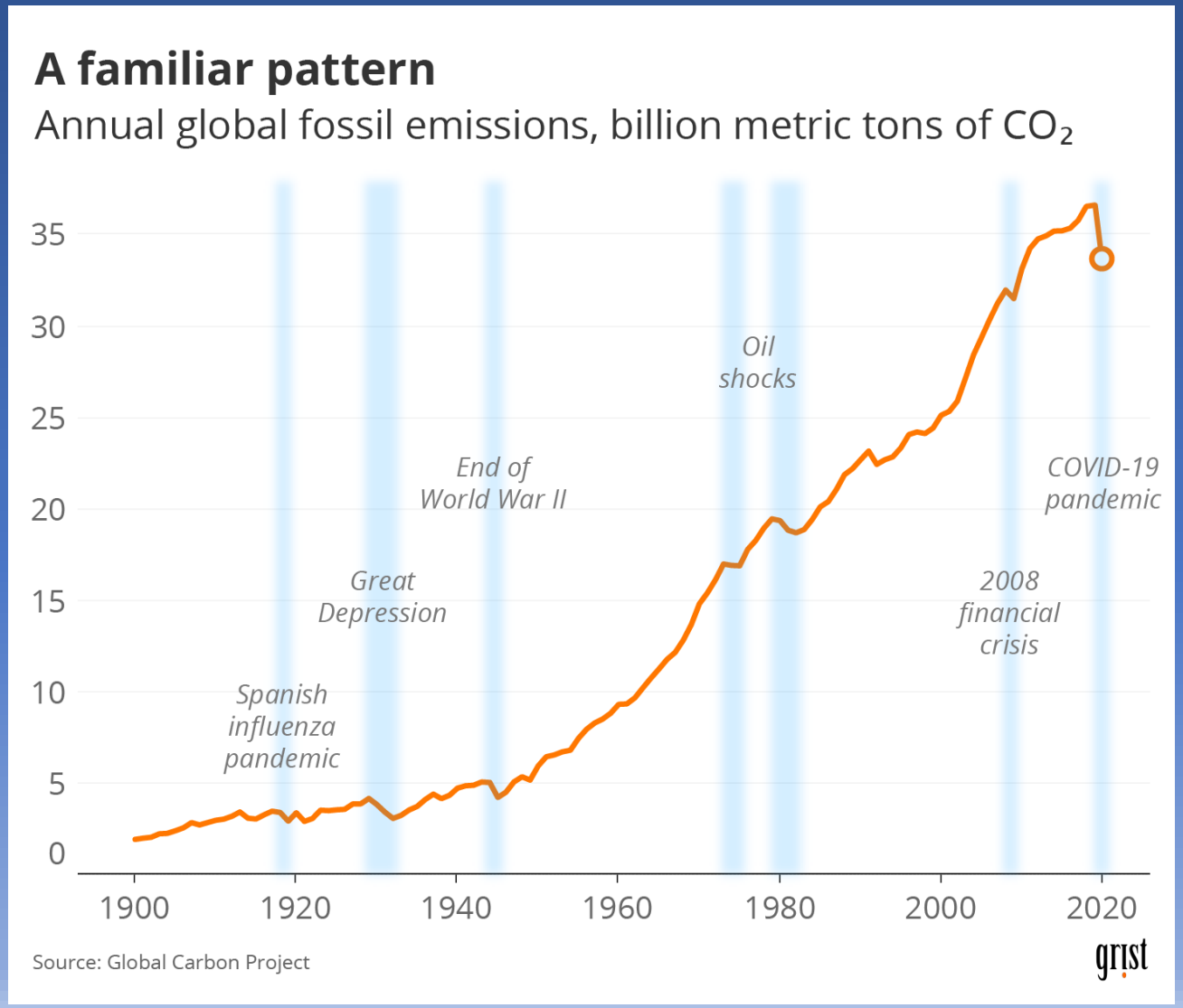
The CO_2 effect on the temperature

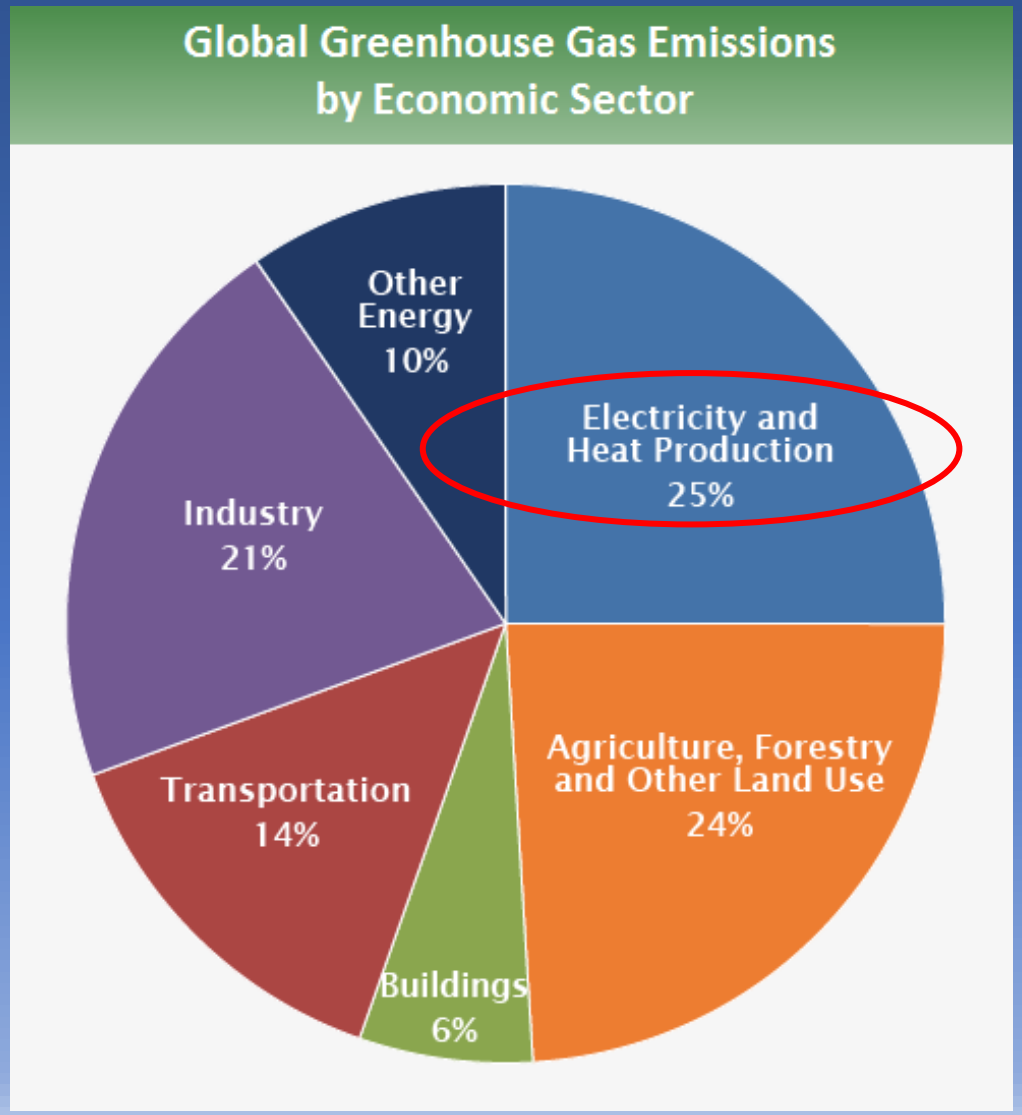
CO_2: 419.57 ppm (january 14th 2023)



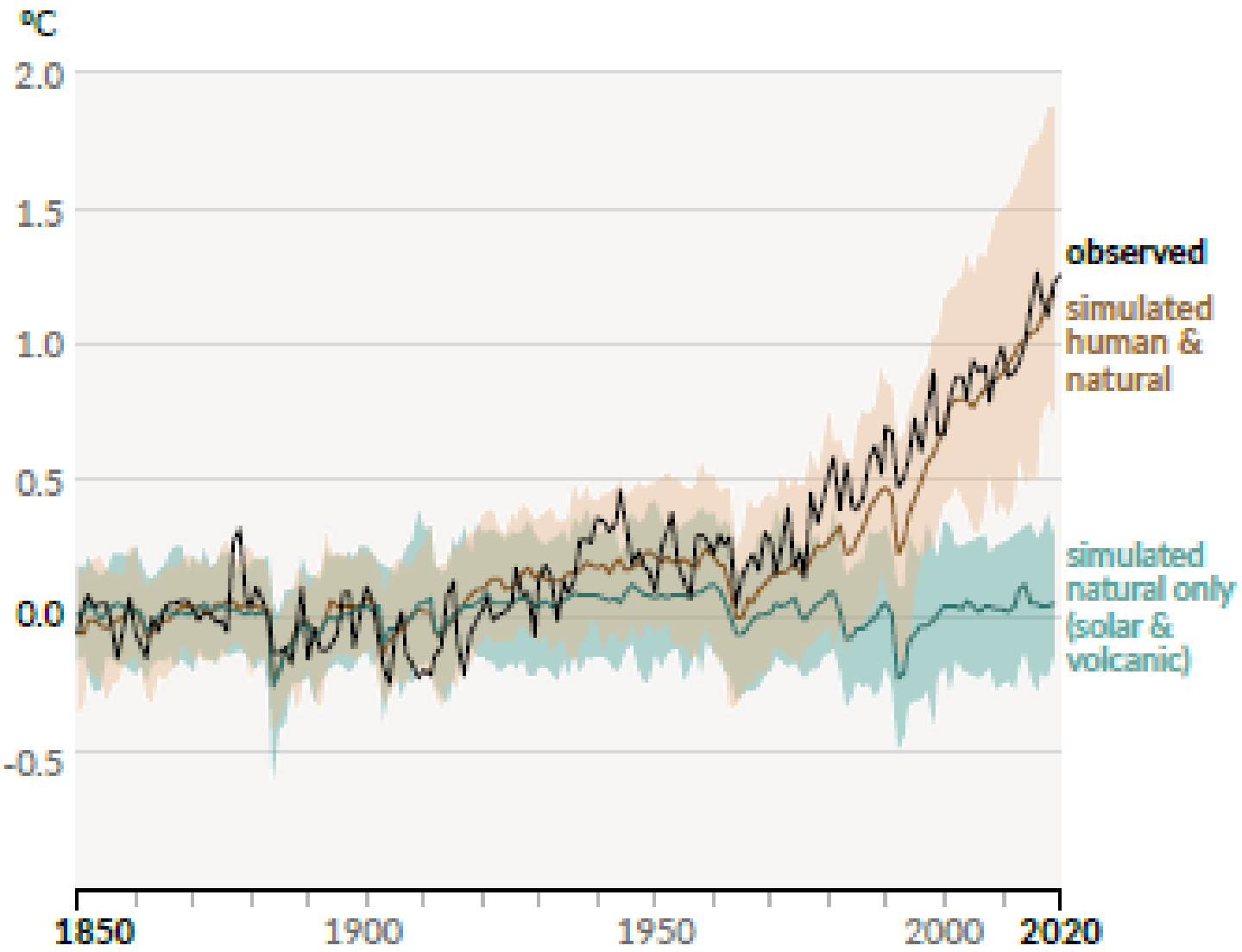
- CO_2 exponencial rise
- Industrialization
- Fossil fuel burning

The CO_2 effect on the temperature





b) Change in global surface temperature (annual average) as observed and simulated using human & natural and only natural factors (both 1850-2020)



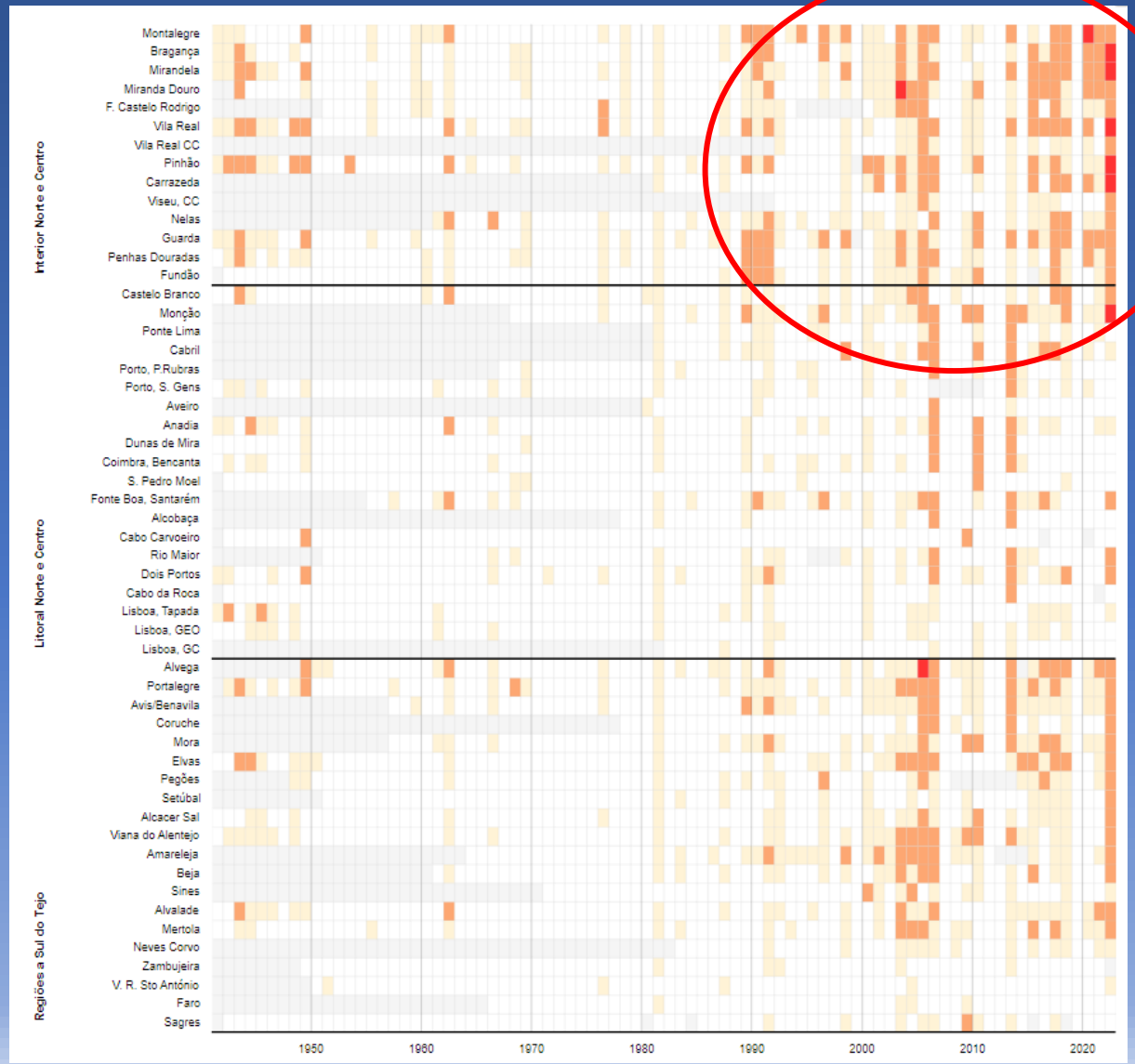
- Can global warming be result of natural causes?
  - Solar activity
  - Volcanic activity
  - Biological processes
- Modeling (physics, math, computacional science)
  - Simulations
  - Match observation
  - Evidence
  - Explains what is around us
  - Humans are causing it!

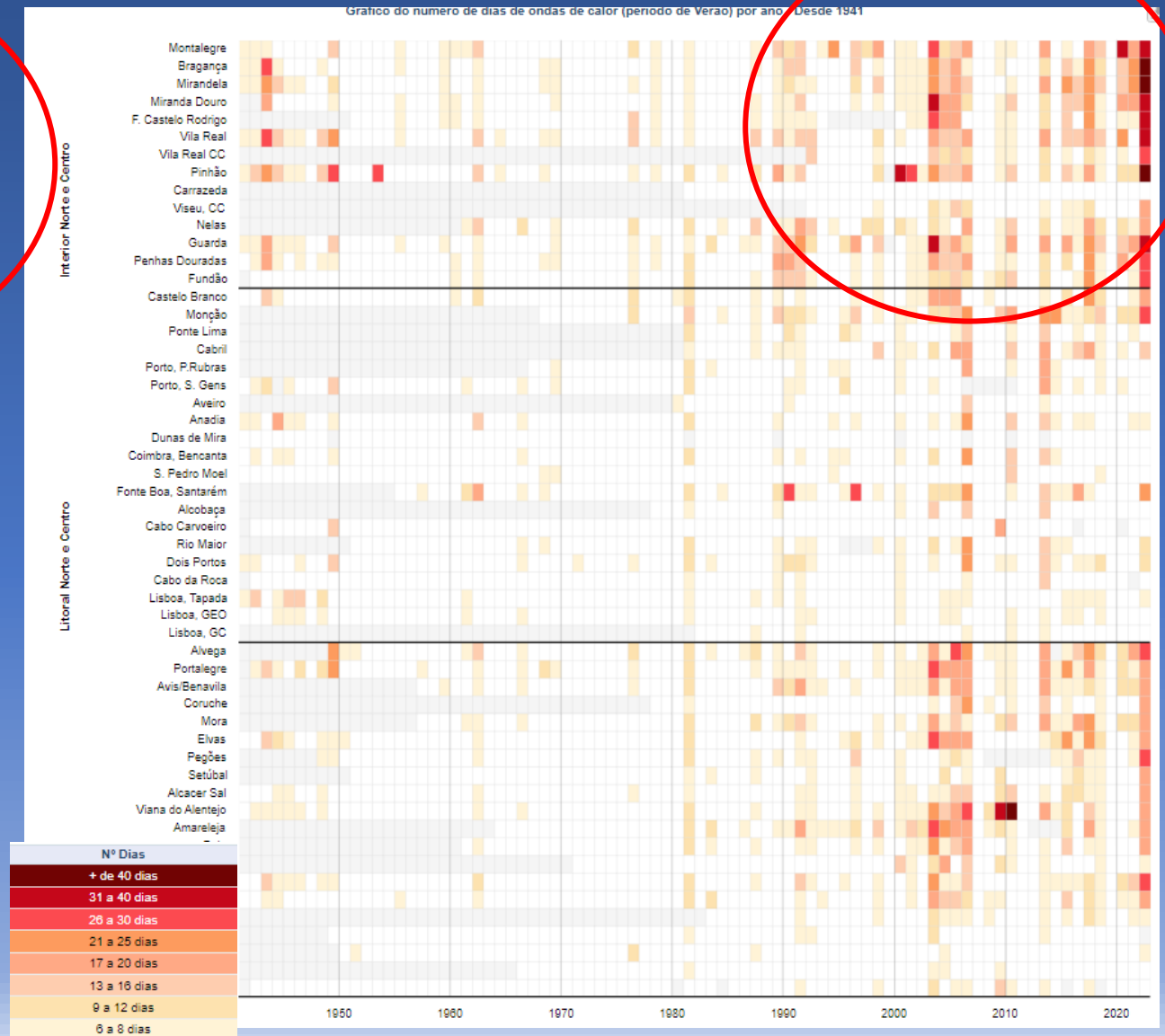

CONSEQUENCES
(today)

Global warming *vs* Climate Change

GLOBAL WARMING	CLIMATE CHANGE
A gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels
Occurs due to the human expansion of greenhouse effect	Emerges due to global warming
Increase of the earth's average temperature	Includes the increasing temperature, changes in the wind and precipitation, lengthening of seasons, increased strength and frequency of extreme weathe
A worldwide phenomenon	Either global or regional

Heatwaves (Portugal)





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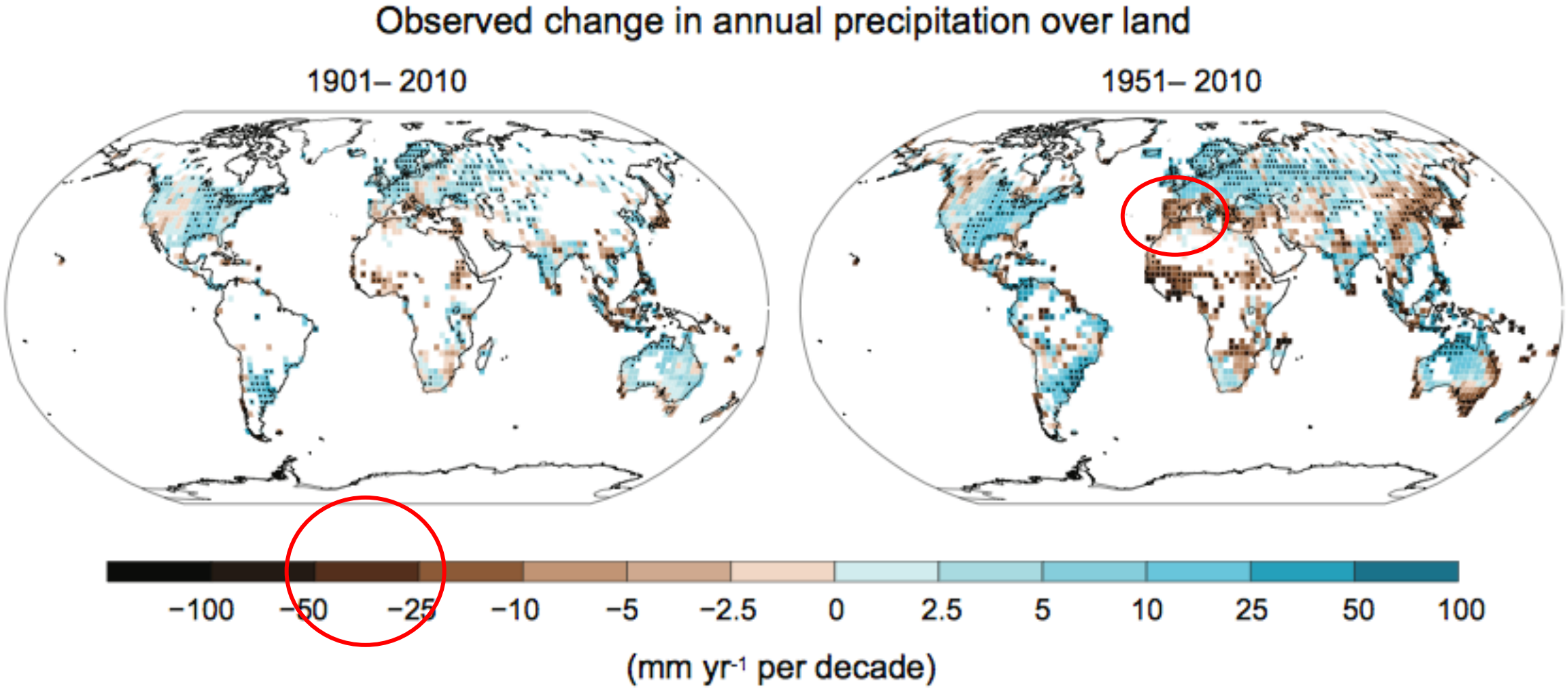
Precipitation

IPCC – 2013
AR5



Wildfires

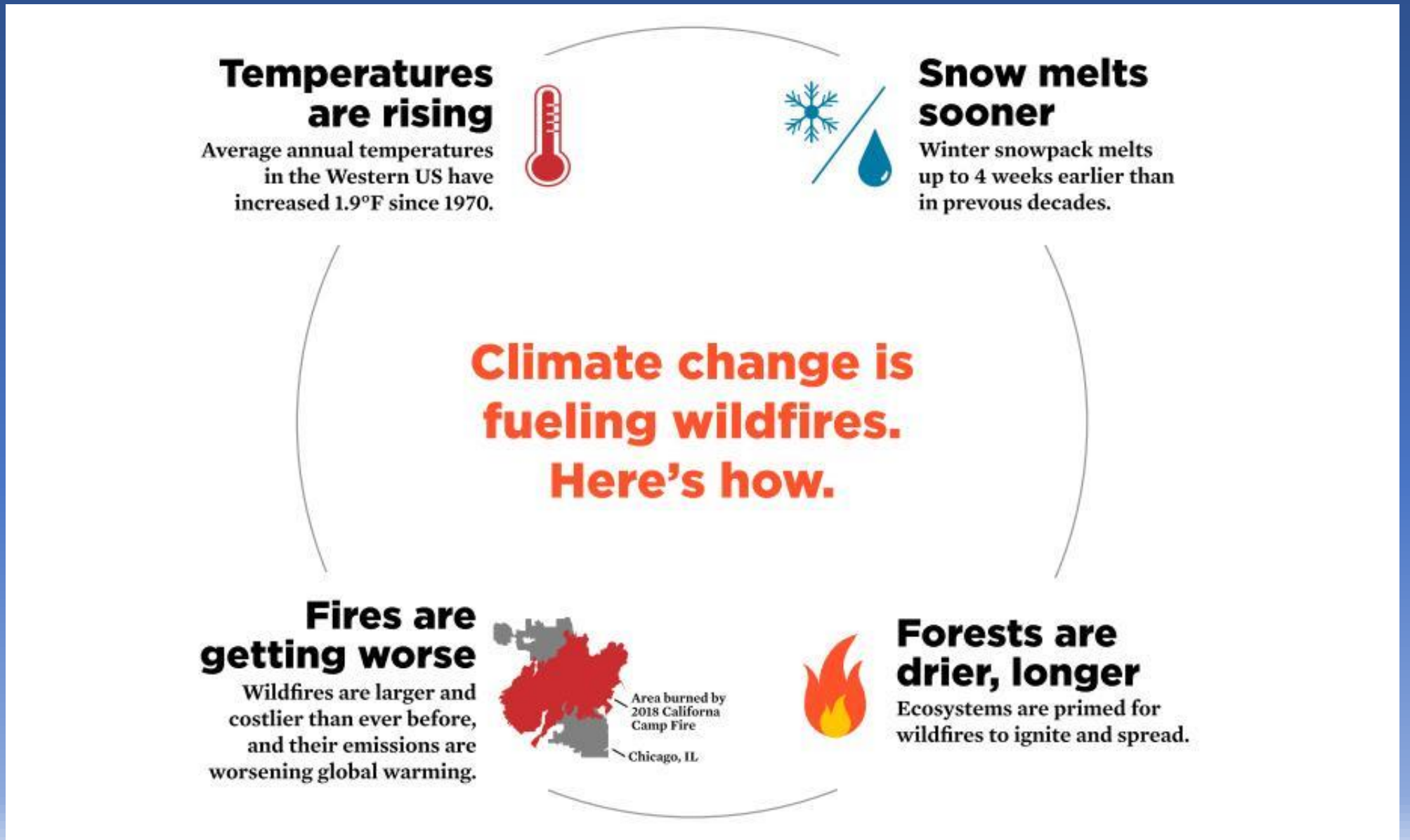
Pedrogão Jun 2017

Marinha Grande Oct 2017

Madeira Island

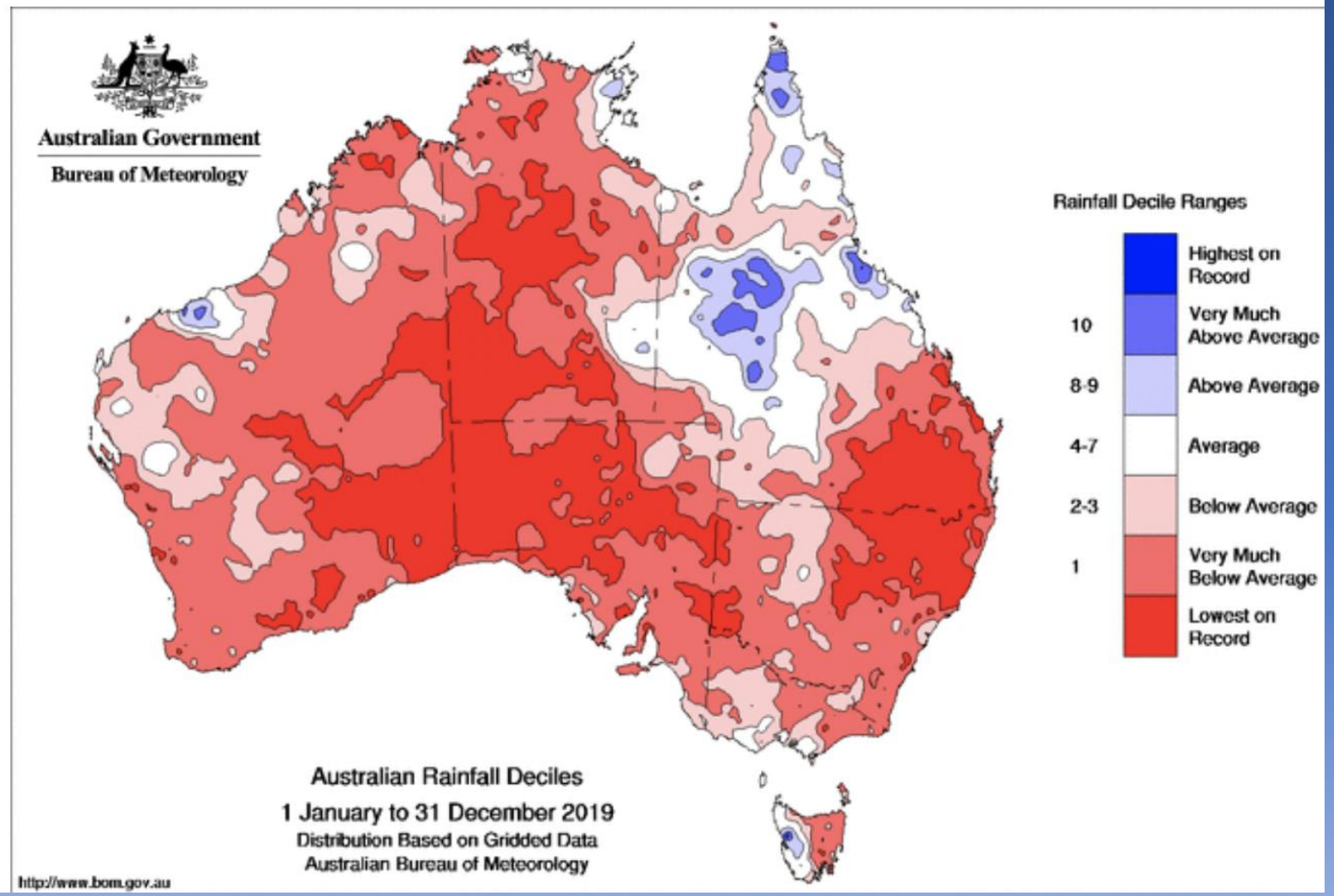
2010, 2012, 2016

Wildfires


Temperatures are rising
Average annual temperatures in the Western US have increased 1.9°F since 1970.
Snow melts sooner
Winter snowpack melts up to 4 weeks earlier than in prevous decades.
Climate change is fueling wildfires. Here's how.
Fires are getting worse
Wildfires are larger and costlier than ever before, and their emissions are worsening global warming.
Area burned by 2018 Californa Camp Fire
Chicago, IL
Forests are drier, longer
Ecosystems are primed for wildfires to ignite and spread.

Wildfires

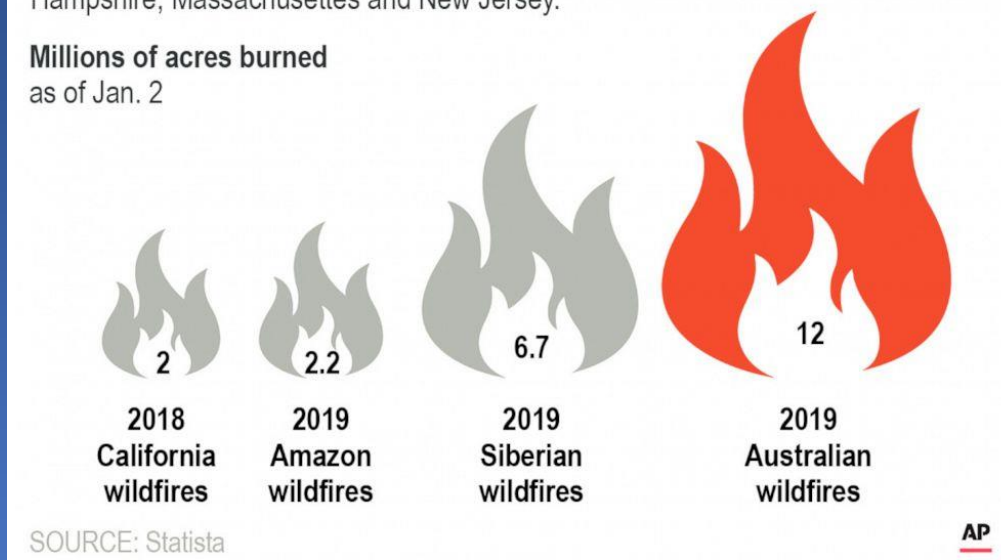
2019 Australian rainfall decile map



Wildfires

Australia fires dwarf other major wildfires

The wildfires burning in Australia, covering roughly 12 million acres, are as large as the state of Maryland and bigger than several other states including Vermont, New Hampshire, Massachusettes and New Jersey.



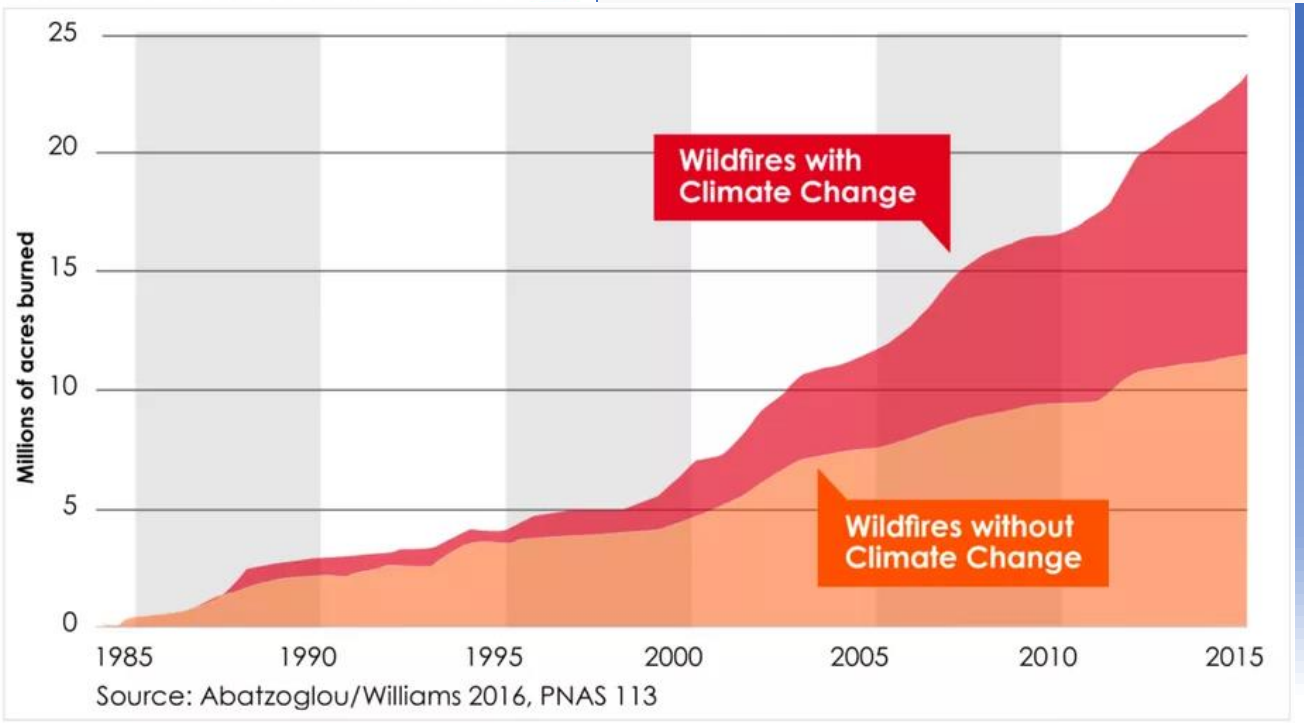
Australia fires compared to other major fire events

FIRE NAME	YEAR	NUMBER OF ACRES BURNED
Australia bushfires*	2019–20	25.5M
Brazilian Amazon fires over 12 months	2019	17.5M
Siberia fires in July	2019	6.4M
Alaska fires over the summer	2019	2.5M
Worst California wildfire season	2018	1.9M
Peshtigo fire: Worst fire in US history	1871	1.2M
Australia's Black Saturday bushfires	2009	1.1M
Latest California wildfire season	2019	260K
California Camp Fire	2018	153K

*As of January 7, 2020

Sources: Reuters; IPNE; NASA; Cal Fire; Weather.gov; National Museum Australia

INSIDER



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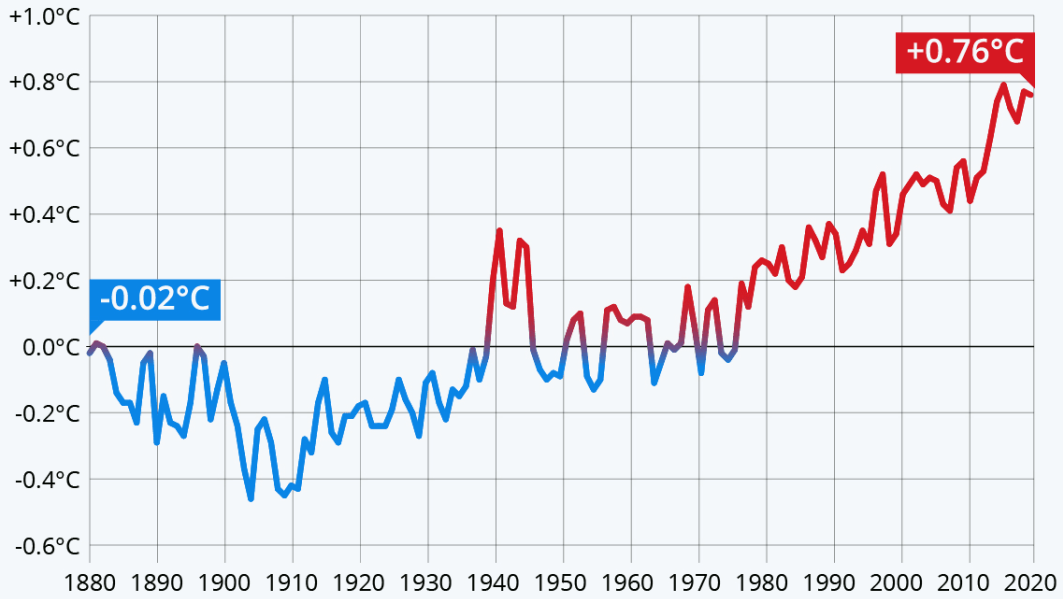
Oceans are also getting warmer

The Oceans Are Getting Warmer

Annual divergence of global ocean temperature from 20th century average (1880-2020)

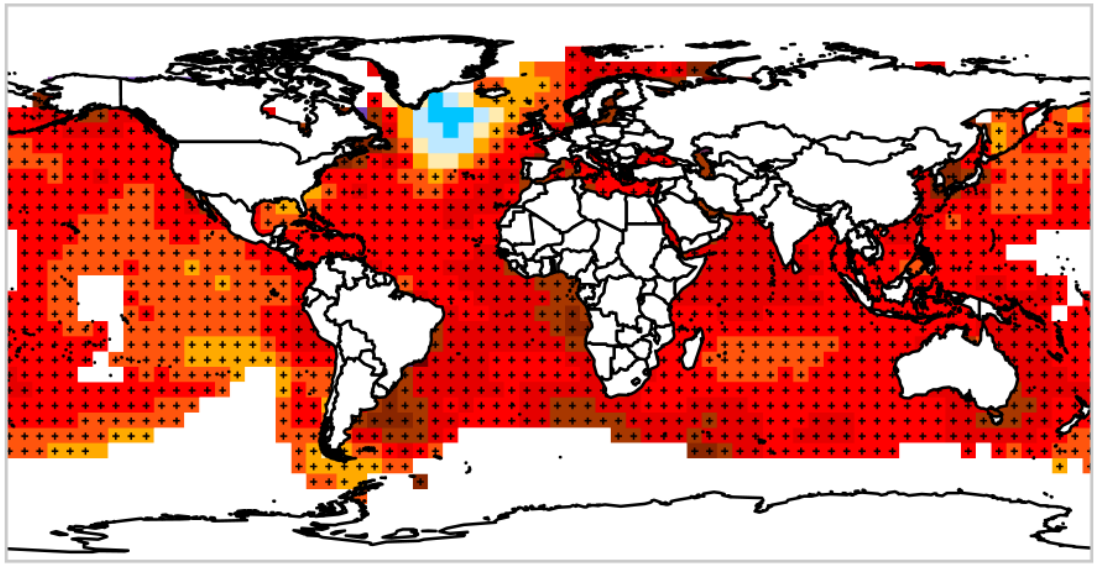


Ocean surface temperatures

Source: NOAA National Centers for Environmental Information (NCEI)

statista

Change in Sea Surface Temperature, 1901–2020



Change in sea surface temperature (°F):

-1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 Insufficient data

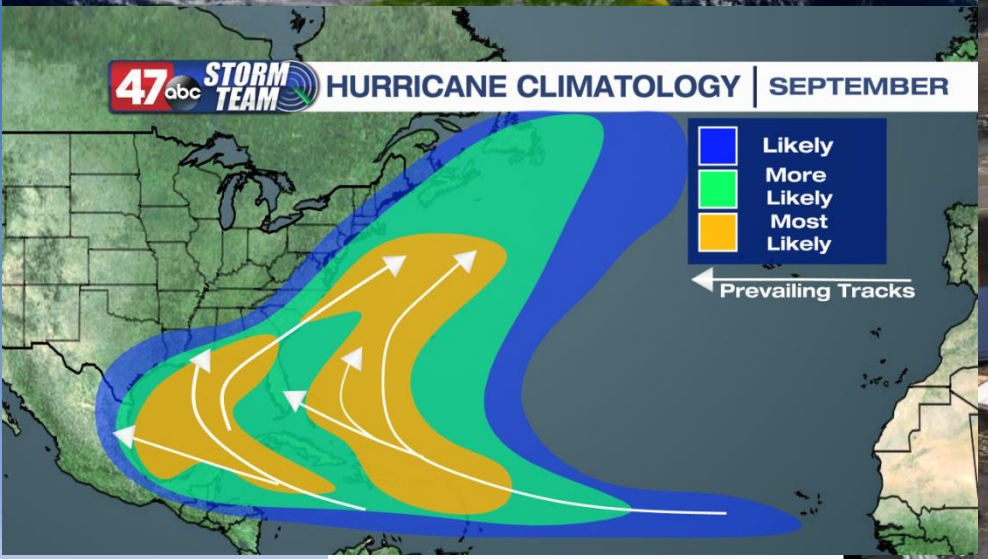
+ = statistically significant trend

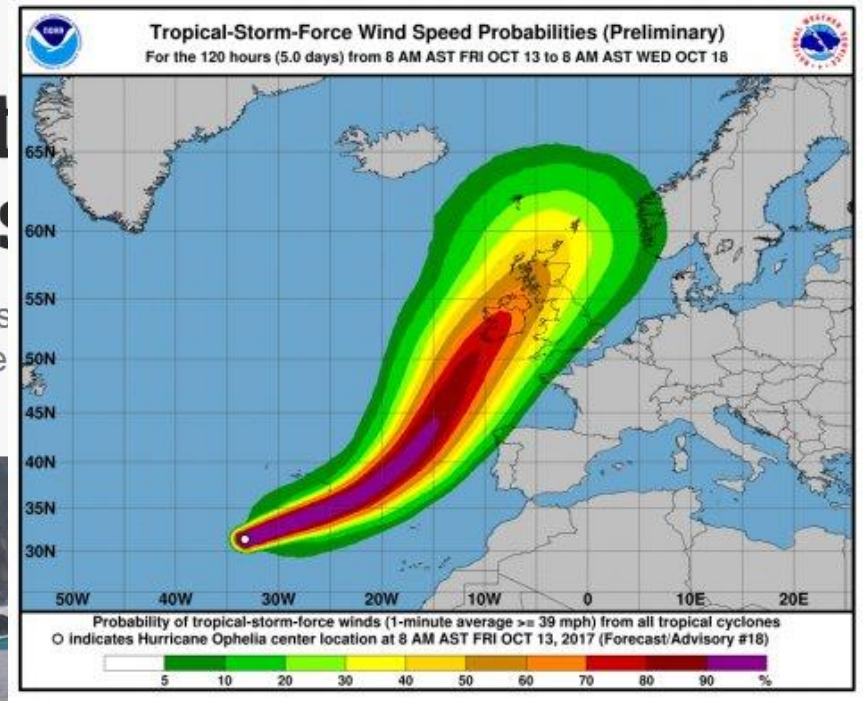
Data sources:

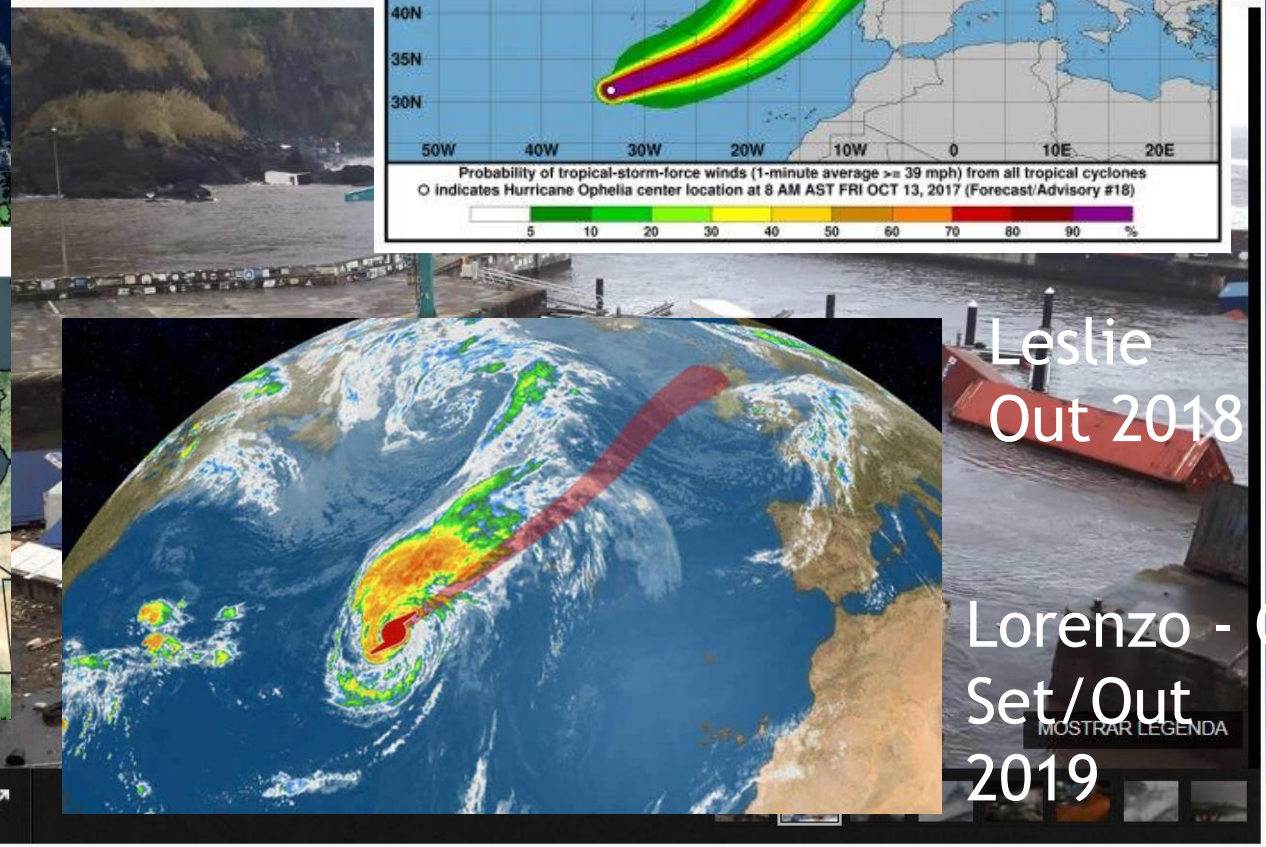
- IPCC (Intergovernmental Panel on Climate Change). 2013. Climate change 2013: The physical science basis. Working Group I contribution to the IPCC Fifth Assessment Report. Cambridge, United Kingdom: Cambridge University Press. www.ipcc.ch/report/ar5/wg1.
- NOAA (National Oceanic and Atmospheric Administration). 2021. NOAA Merged Land Ocean Global Surface Temperature Analysis (NOAAGlobalTemp). Accessed March 2021. www.ncdc.noaa.gov/data-access/marineocean-data/noaa-global-surface-temperature-noaaglobaltemp.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Storms - Hurricanes and Tropical storms







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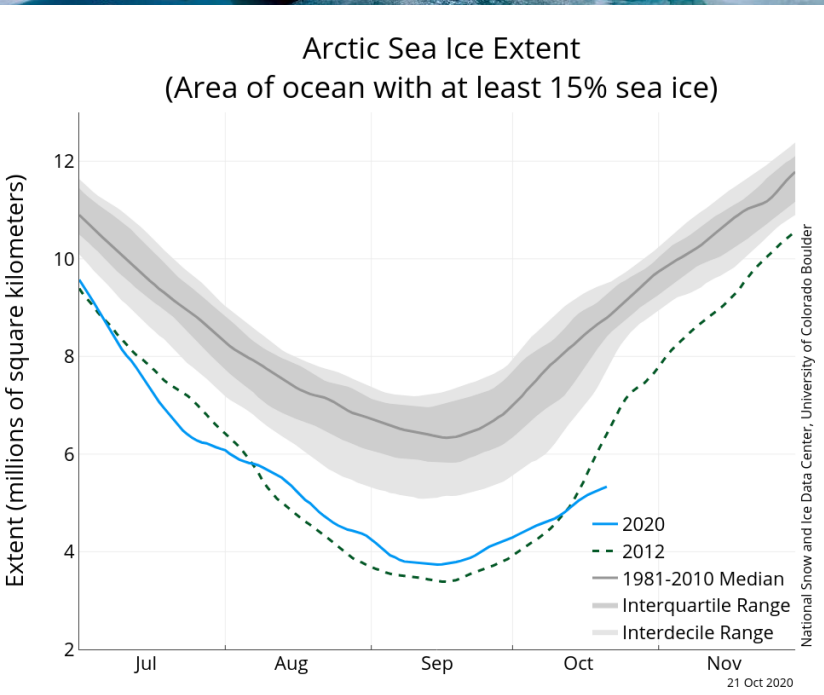
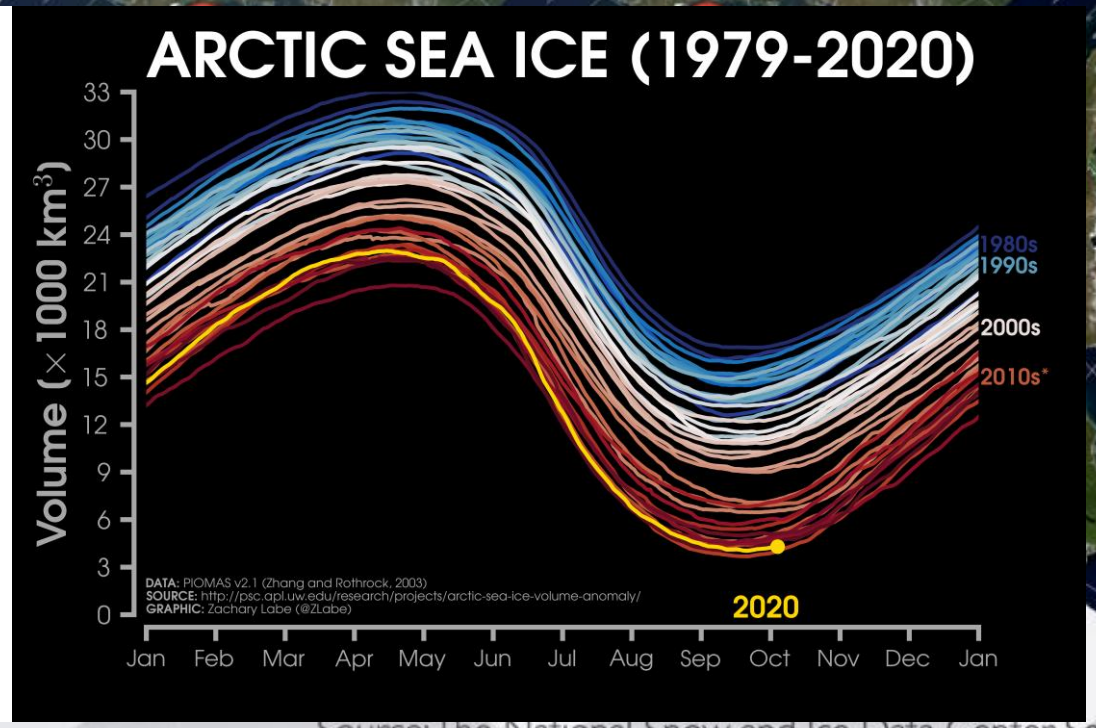
Artic ice melting





Since 1979 the Summer ice volume in the Arctic has diminished by over 80% and the melting is speeding up…

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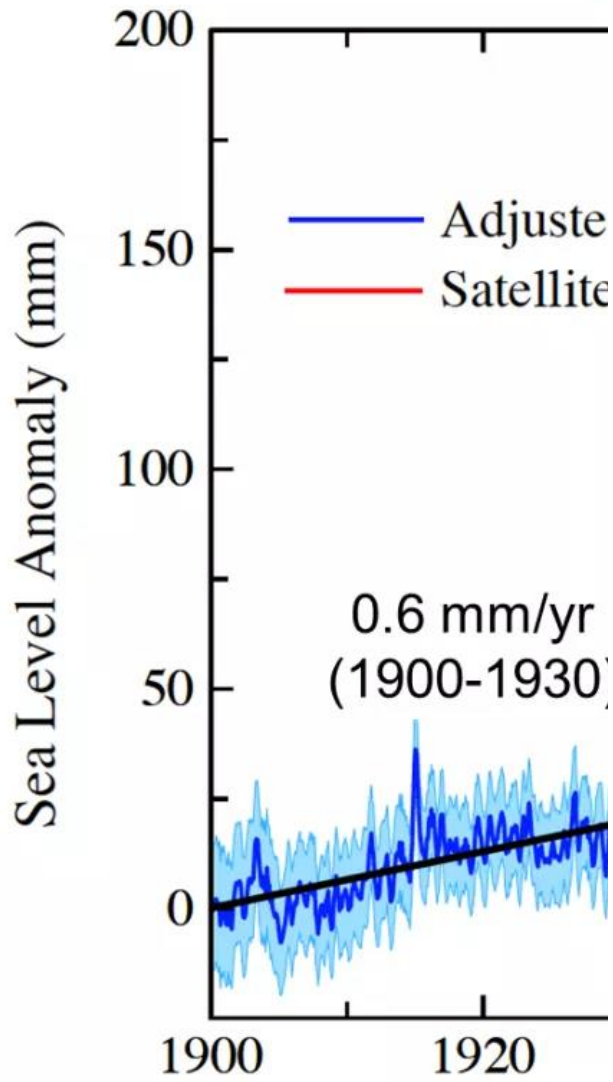
Sea level rise



Expresso 50

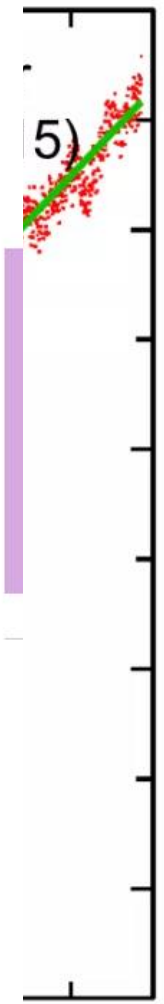
ÚLTIMAS GUERRA NA UCRÂNIA OPINIÃO ECONOMIA PODCASTS TRIBUNA BLITZ JOGOS

SOCIEDADE

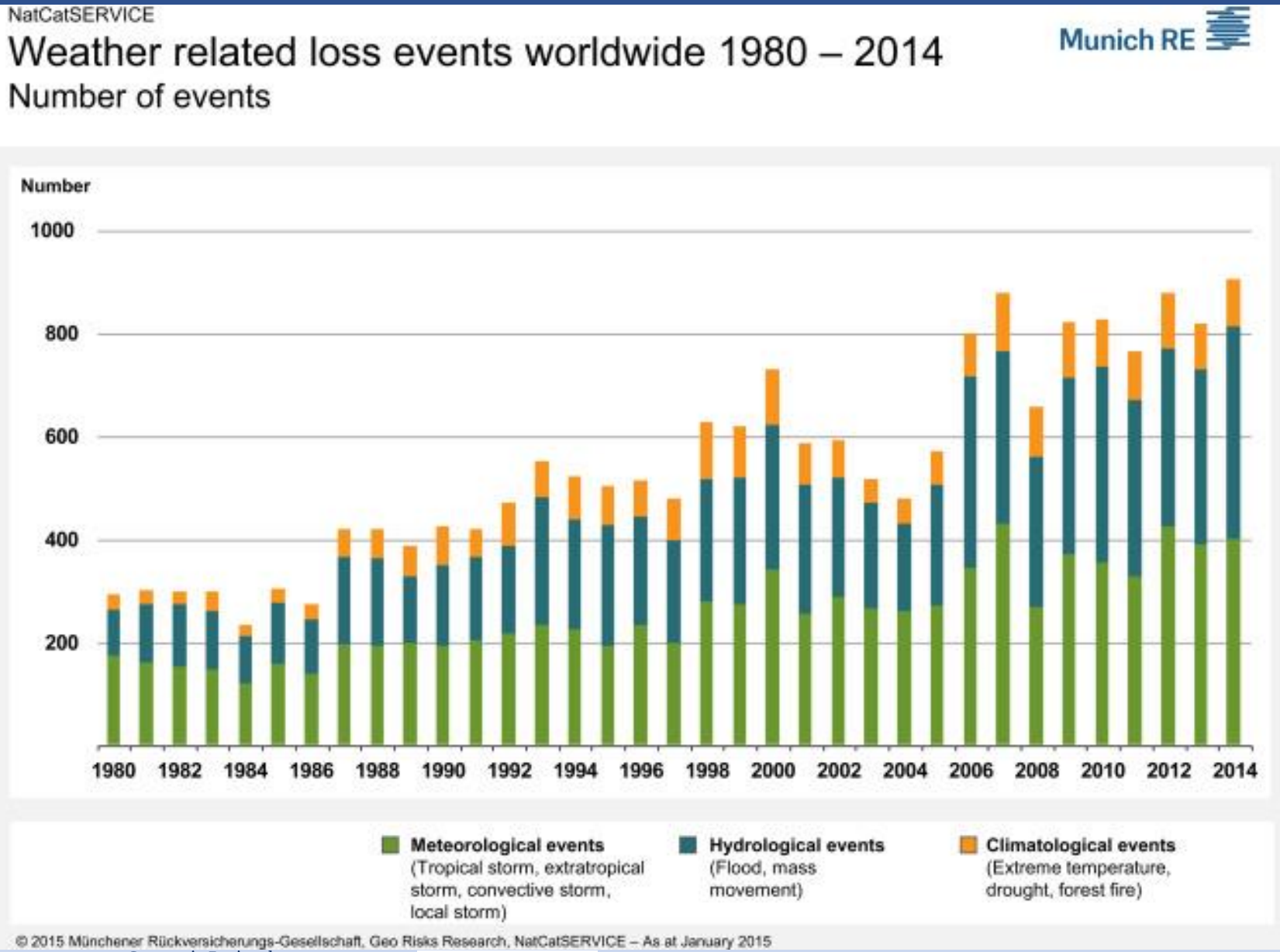
Cheias: nunca tinha havido tanta chuva em apenas uma hora em Lisboa

António Pedro Santos/Lusa

Recorde foi batido na estação da Tapada da Ajuda entre as 22h40 e as 23h40, segundo o IPMA. Máximo anterior tinha sido registado nas cheias de novembro de 1983 que afetaram vários concelhos da região de Lisboa



Extreme events

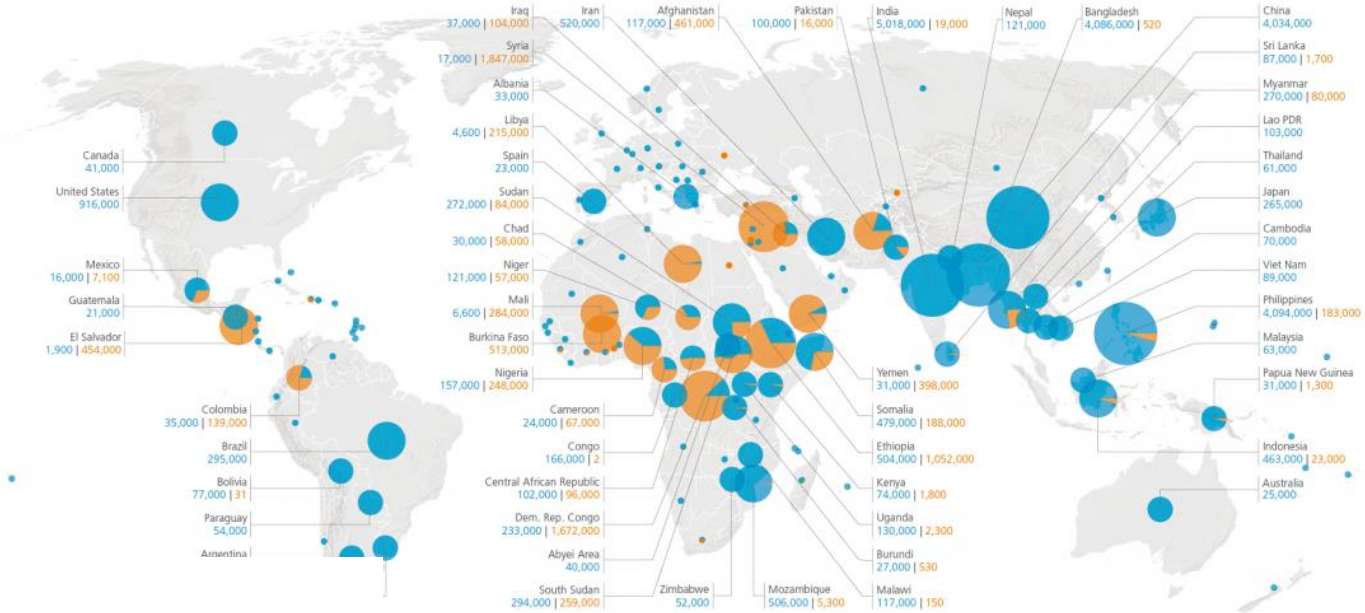


- Meterological:
  - Tropical storms
  - Extratropical storms
  - Convective storms
  - Local storms
- Hydrological:
  - Floods
  - Mass movement
- Climatological
  - Extreme temperatures
  - Drought
  - Forest Fires

Displaced people

Total 33.4 M
Disasters 24.9M
Conflicts 8.5 M

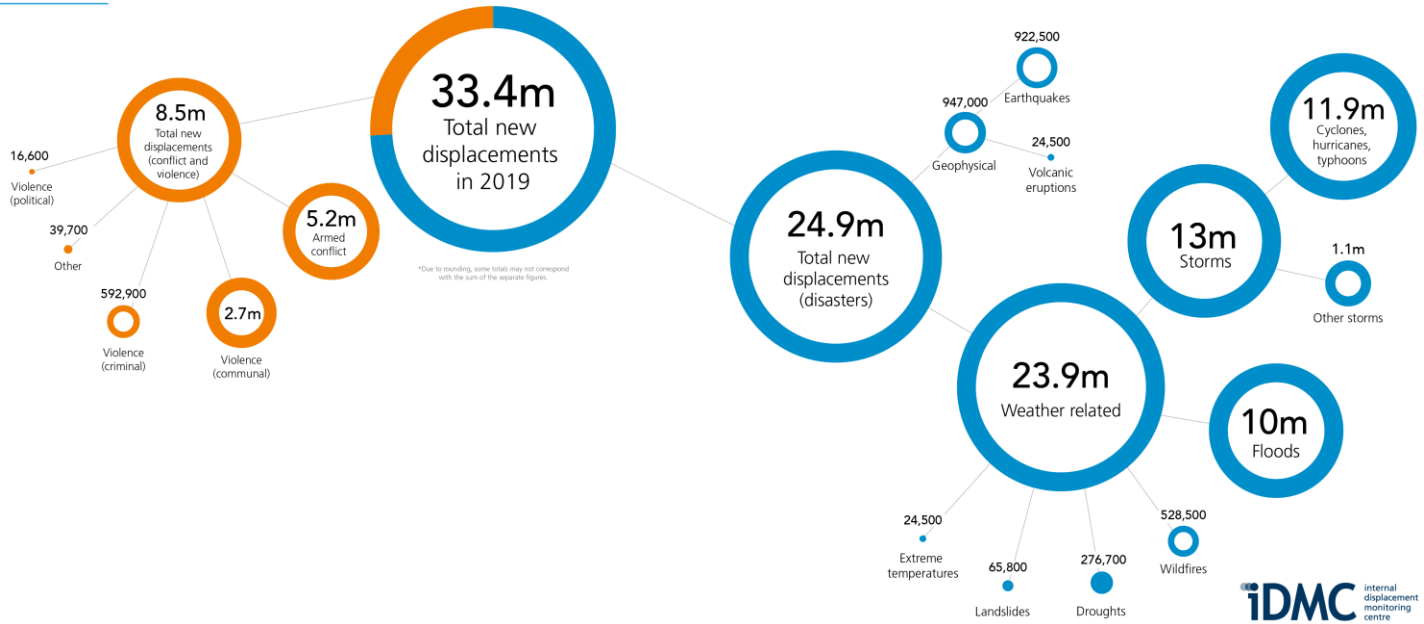
New displacements by conflict and disasters in 2019



e total new displacements value exceeds 20,000. Due to rounding, some totals may not correspond with the sum of the separate figures.
p do not imply official endorsement or acceptance by IDMC.

iDMC internal displacement monitoring centre

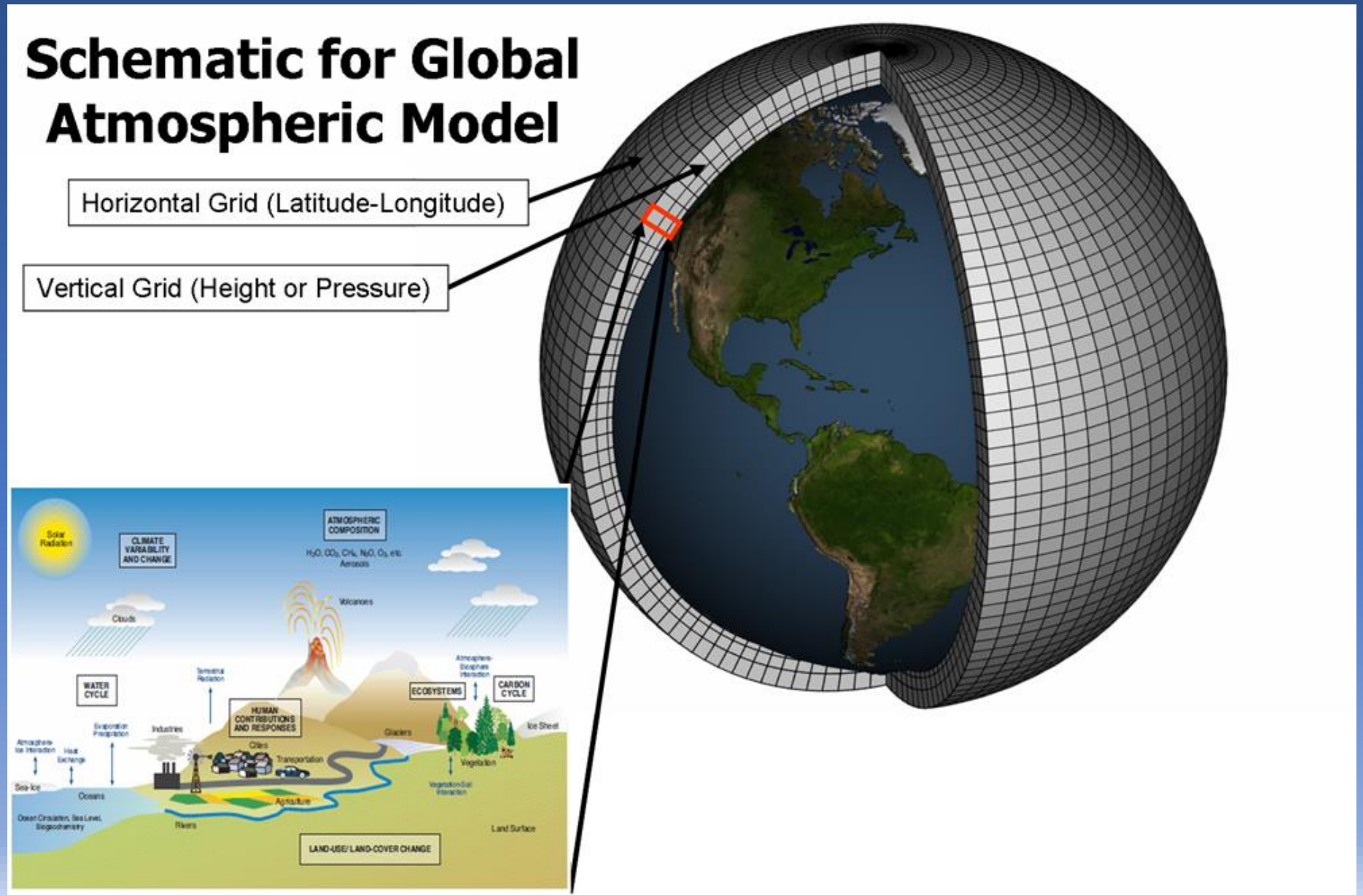
New displacements in 2019: breakdown for conflict and disasters



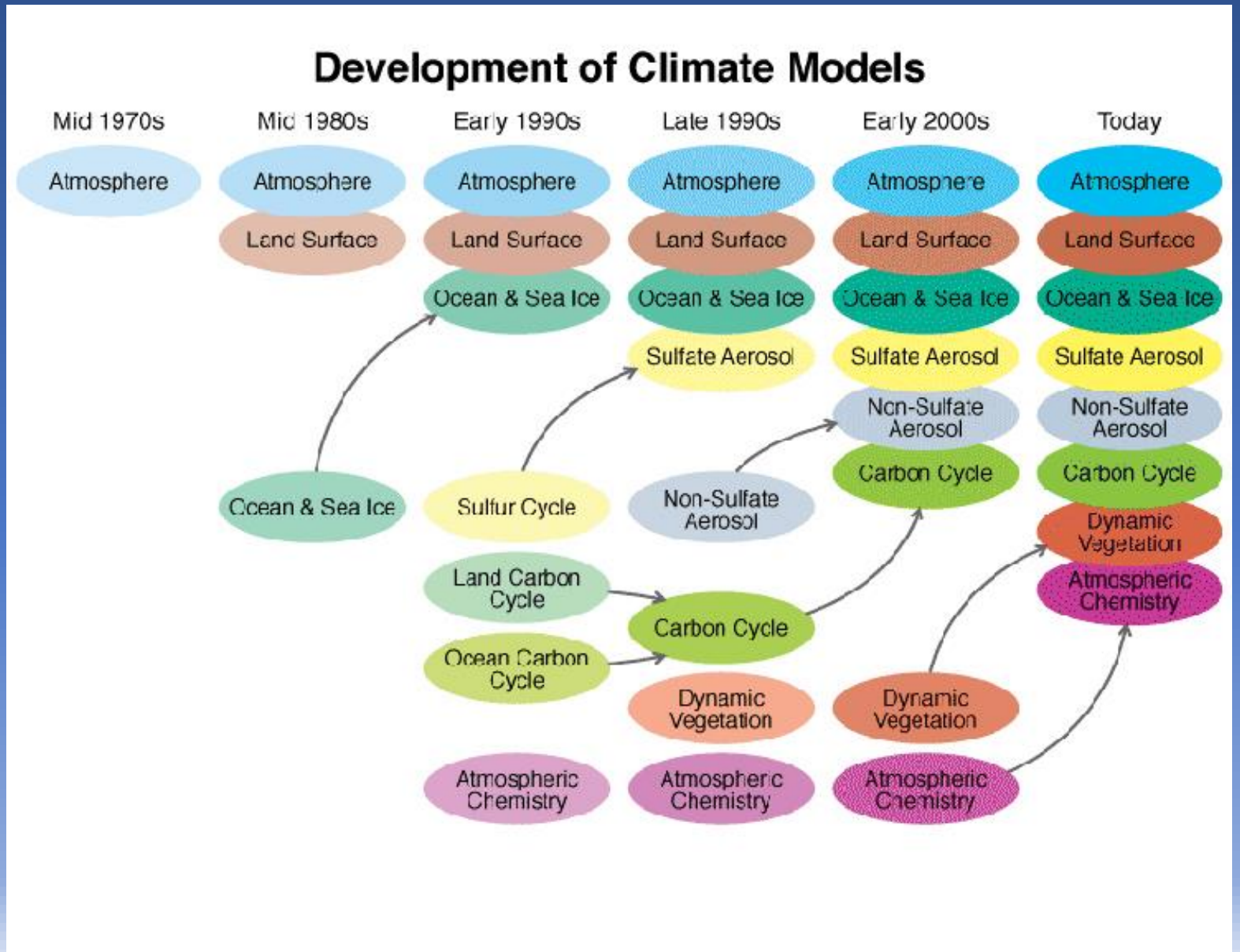
iDMC internal displacement monitoring centre


CONSEQUENCES
(future)

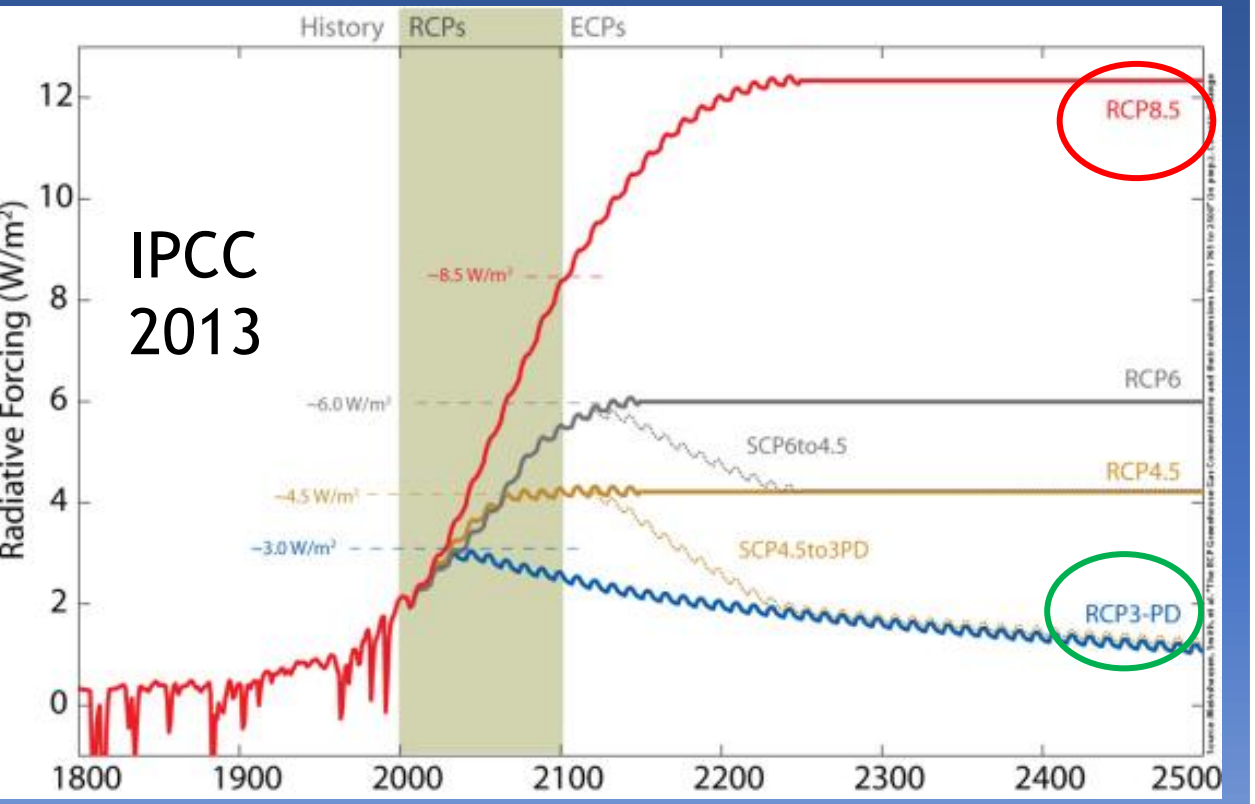
Climate models



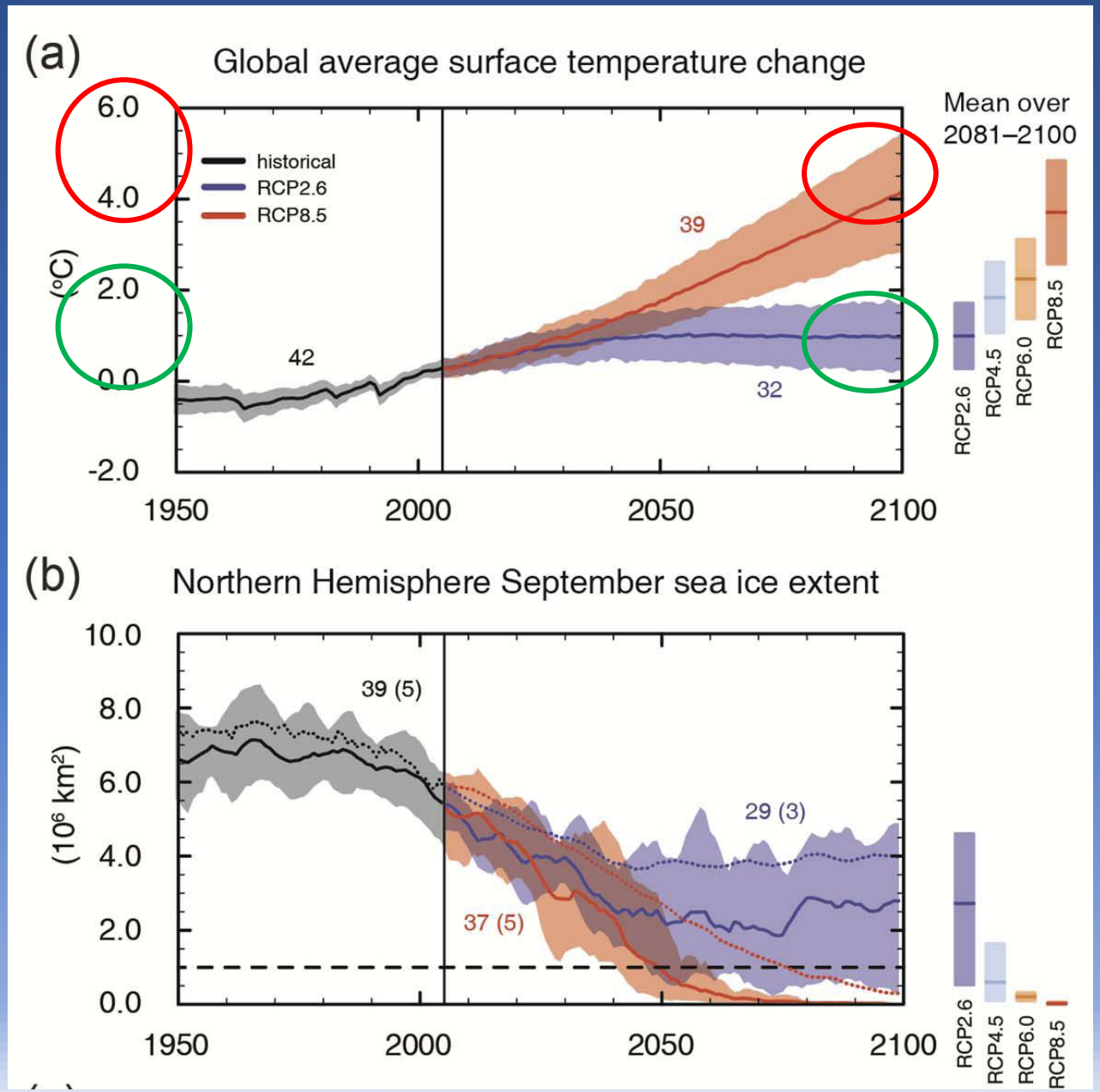
Climate models



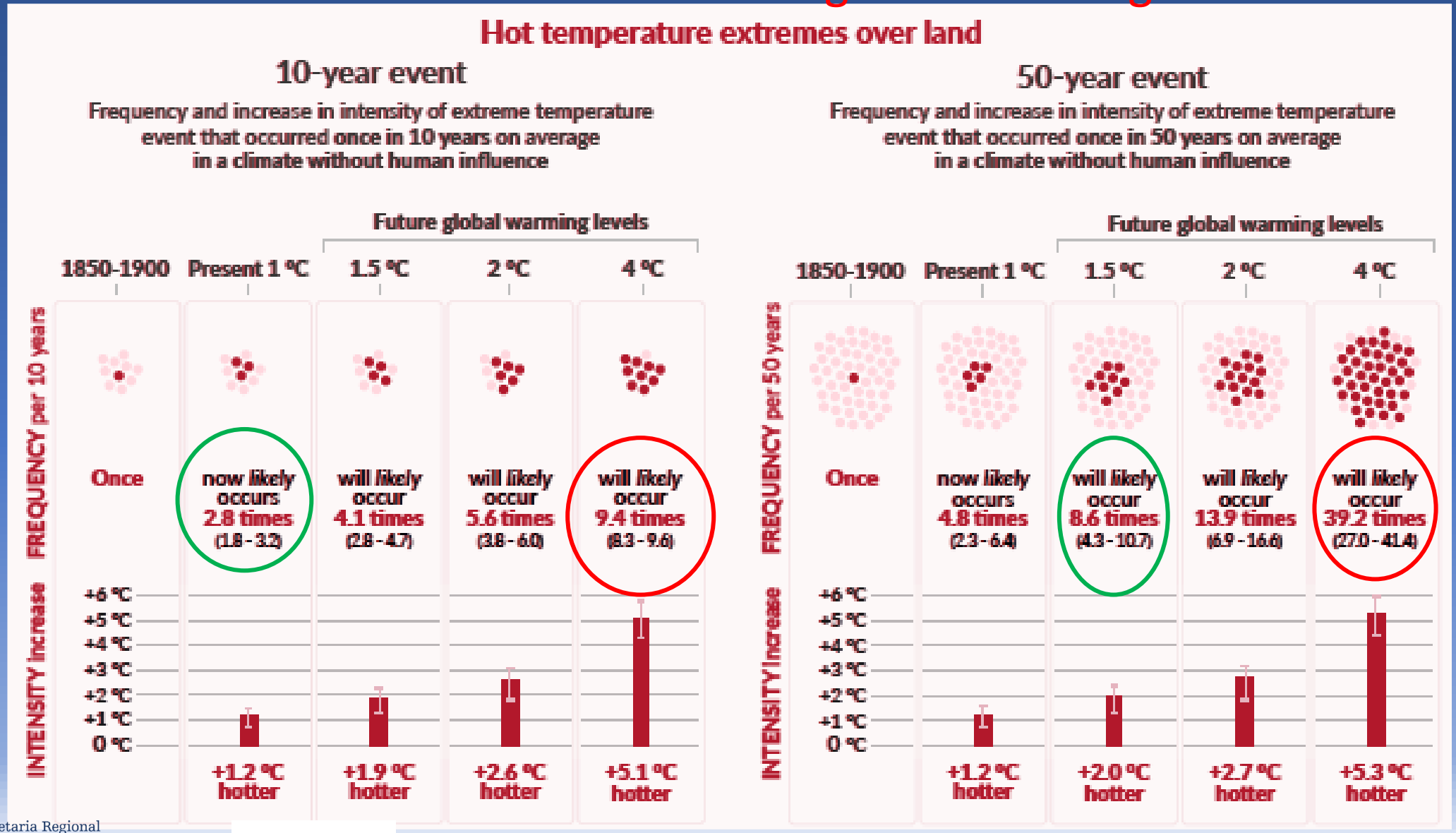
The future of climate



IPCC 2013



Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming



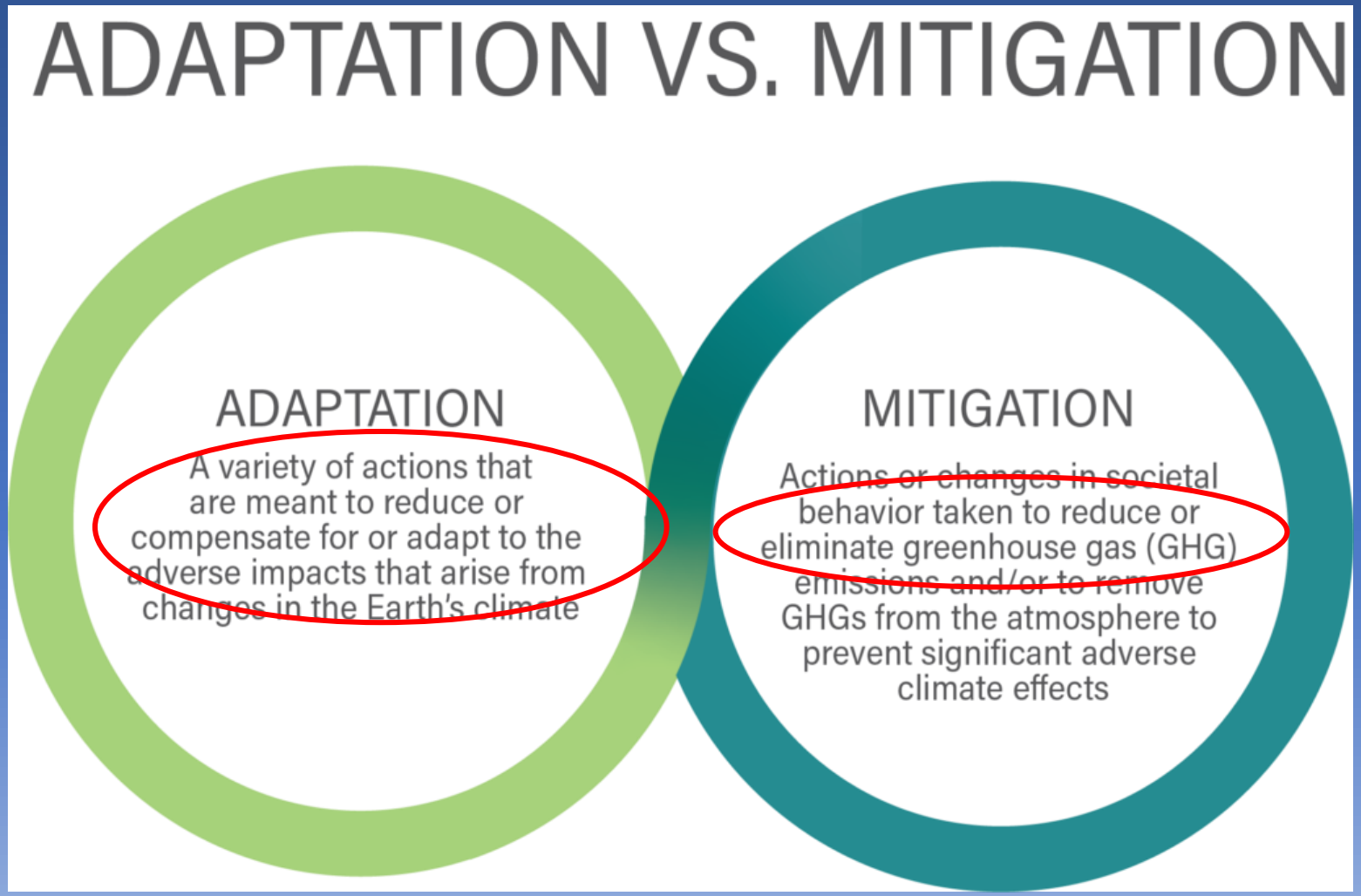
IPCC AR6 WGI, 2021


Mitigation/Adaptation
(What can we do about it?)

Mitigation and Adaptation

- Reduce effect
- Compensate
- Adapt

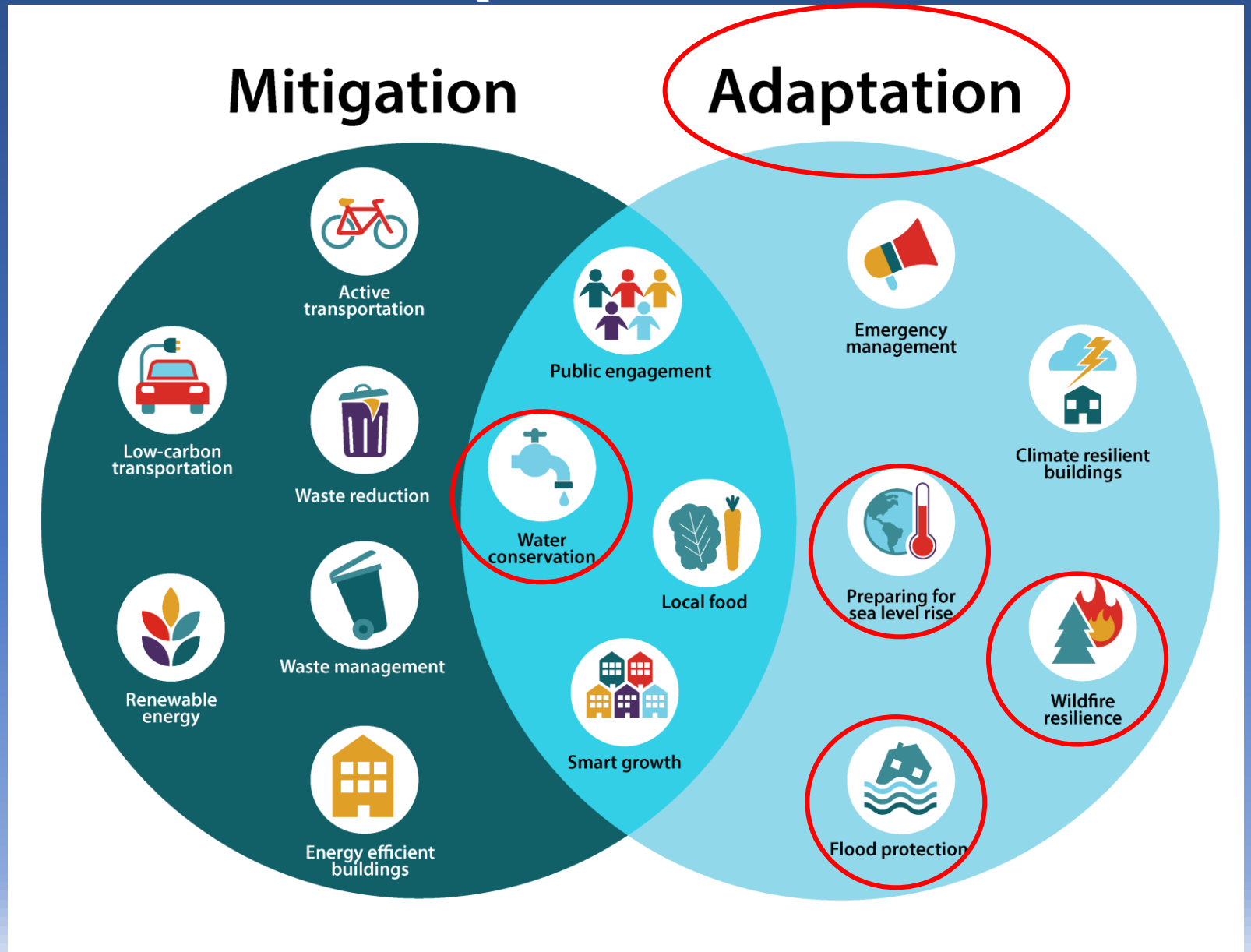
- Local effect



- Halt GHG emission
- Prevent

- Global effect

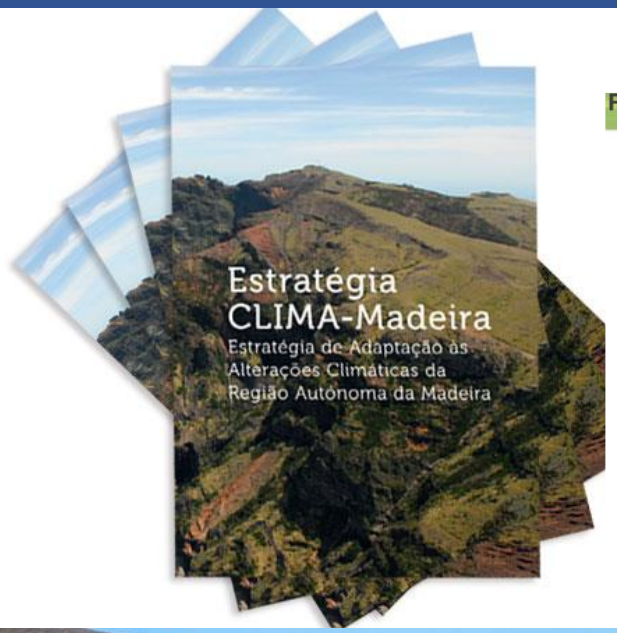
Mitigation and Adaptation



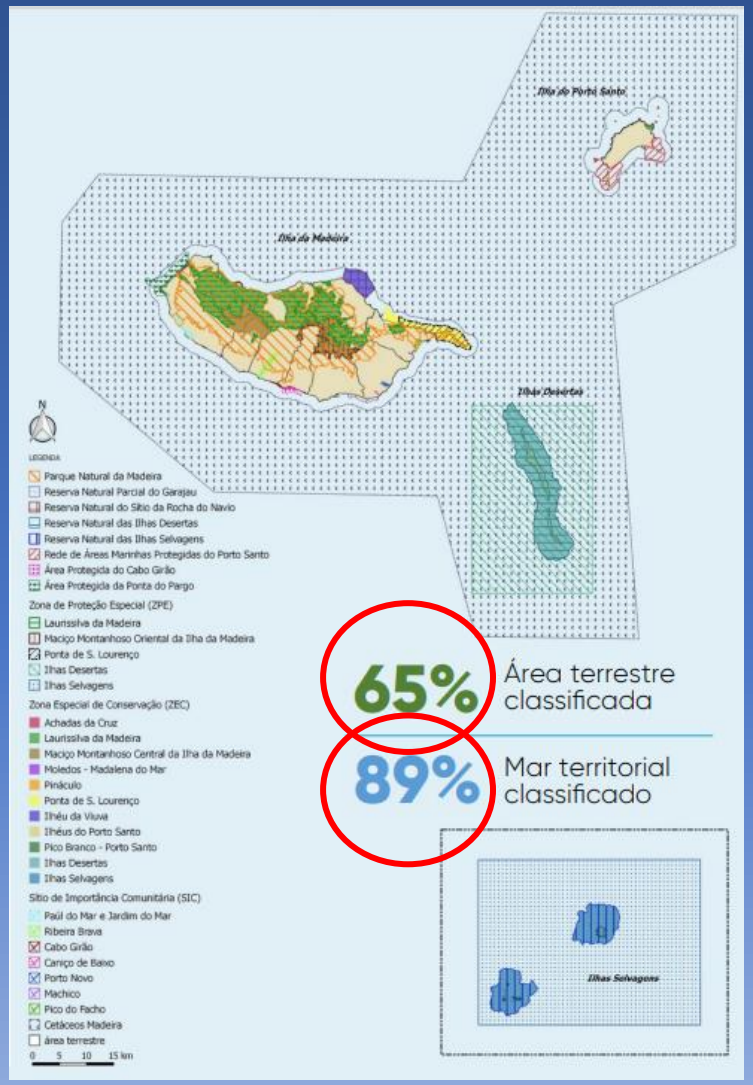
- Reduce effect
- Compensate
- Adapt

- Local effect

Examples of local adaptation measures



Biodiversity protection



United Nations Educational, Scientific and Cultural Organization · World Heritage Convention

Santana Madeira Biosfera

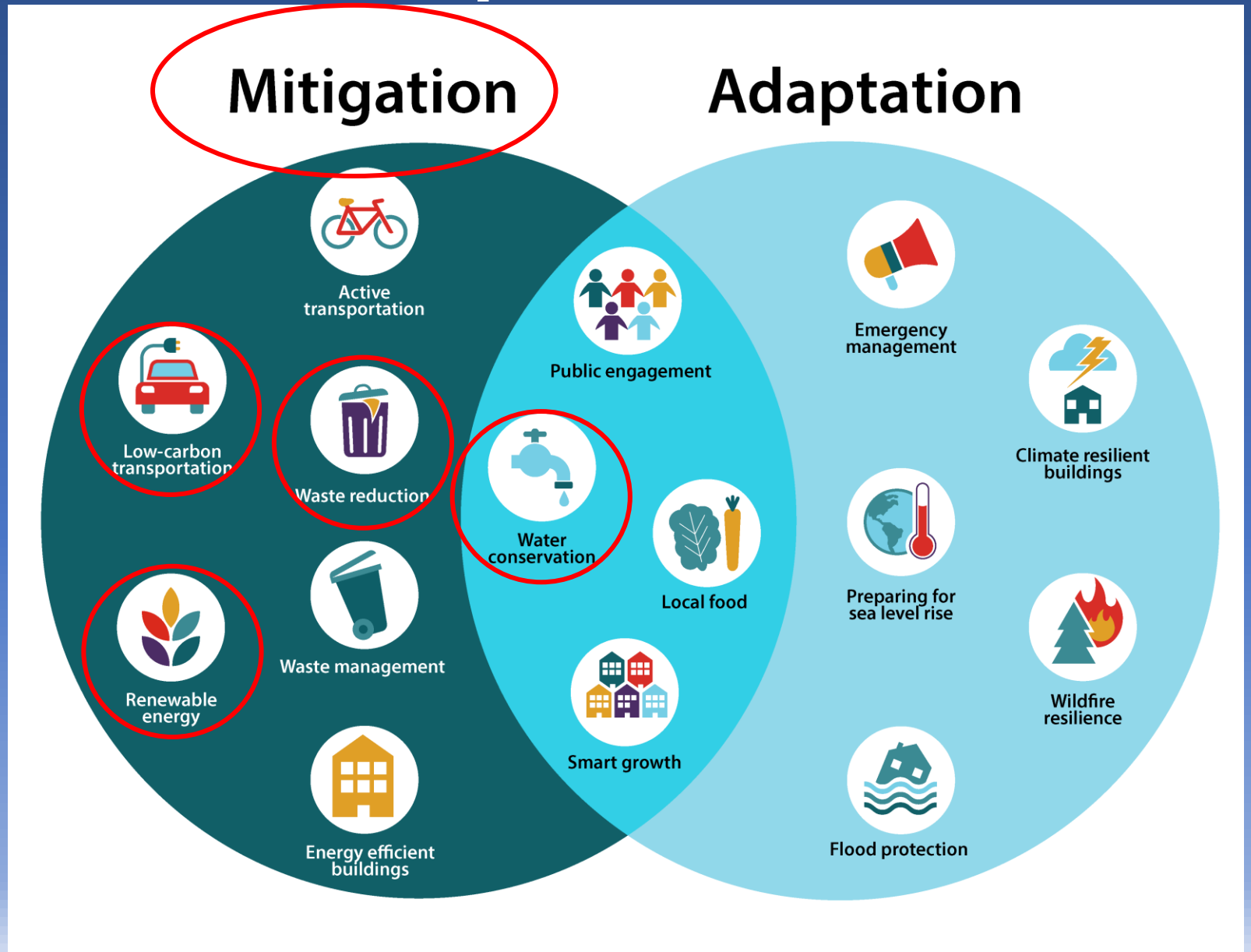
ILHA DO Porto Santo RESERVA DA BIOSFERA

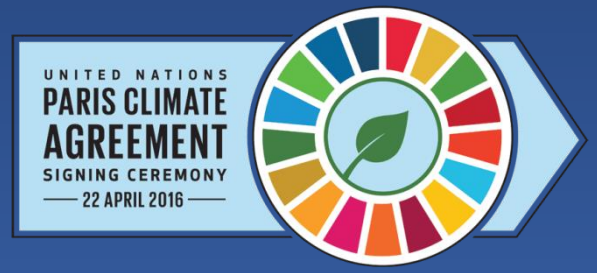
unesco Man and the Biosphere Programme

NATURA 2000

Mitigation and Adaptation

- Halt GHG emission
- Prevent
- Global effect

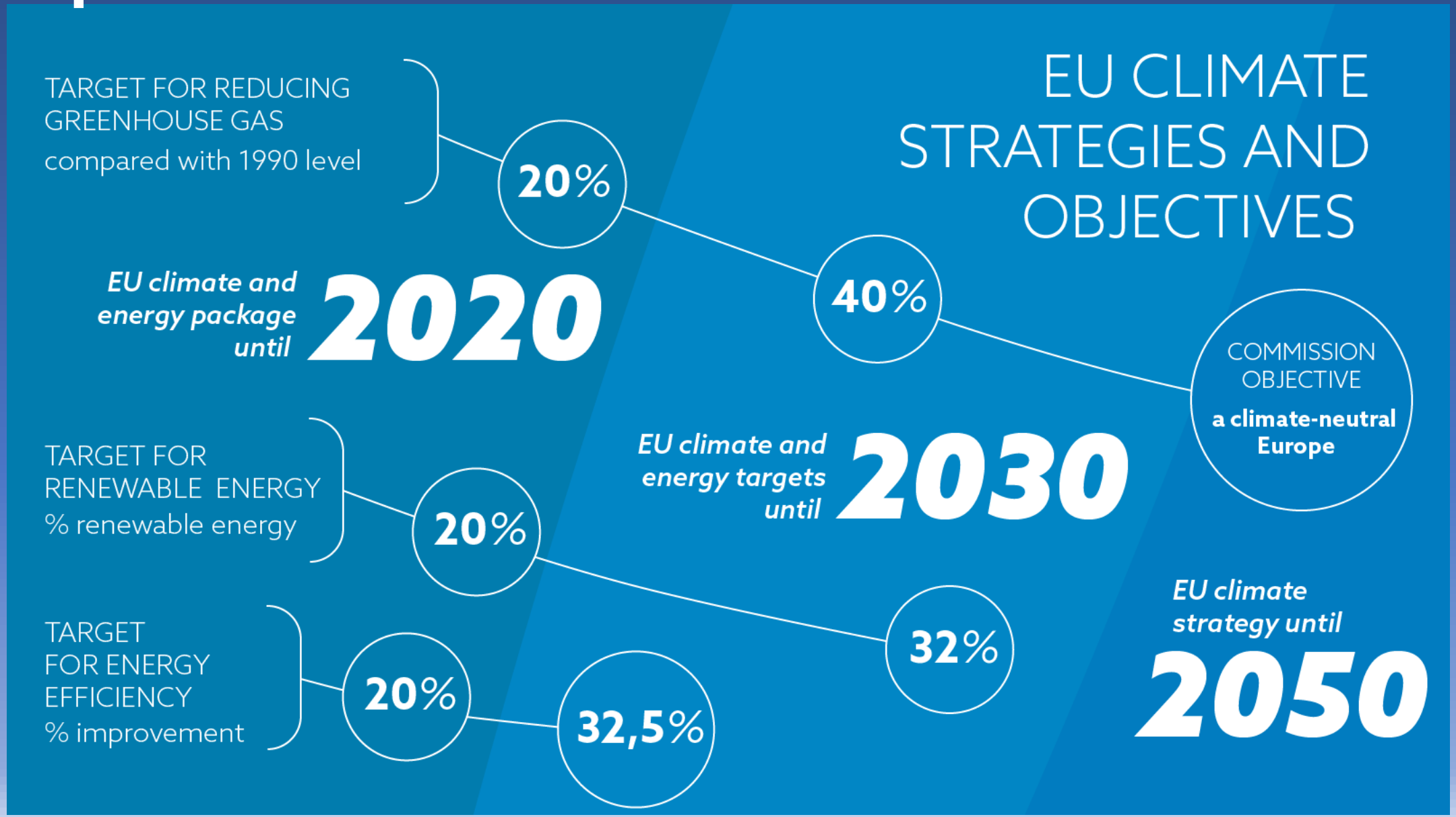




Climate Action- Mitigation

- Paris agreeement - 2015
- Action plan to limit global warming
- Objective – keep mean temperature rise well below 2 °C and envide efforts to limit the rise to just 1,5 °C
- Ambition – Action plans each 5 years, with increasing ambition goals
- Transparency – public reports

European Union commitments



European Union commitments

GOOD NEWS ON CLIMATE ACTION

The EU will be able to reach two of its main climate targets by 2020:

Fewer greenhouse gas emissions*

The target: -20 %
Achieved by 2019: -24 %

*compared to 1990

More energy from renewables

The target: 20 %
Achieved by 2019: 19,7 %

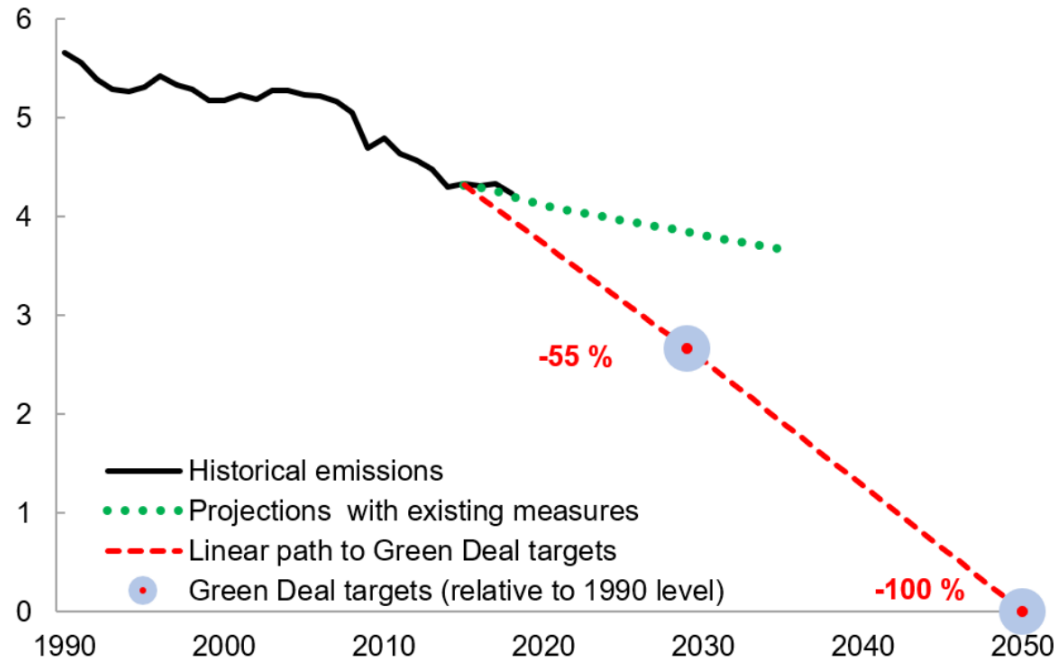
Source: European Environment Agency

European Union commitment

New EU targets

The European Union proposes an ambitious reduction of emissions.

(millions of kilotons of CO_2 equivalents)



Sources: United Nations Framework Convention on Climate Change; and European Environment Agency.

INTERNATIONAL MONETARY FUND

- 2020 target met
- Projected pathway seems unlikely to achieve
- We need more measures and quick action!!

European Union commitment

What about you?

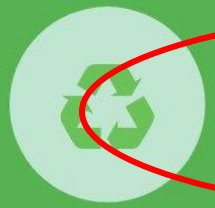
Individual actions

Use the car less

Walking, cycling and other forms of active travel are better for your health, reduce carbon emissions and improve air quality.

Use less energy

Switch off lights, switch to LED, use less water.



Produce less waste

Reduce consumption, re-use and repair what you can, recycle what you can't.

Be a responsible consumer

Buy fair trade where possible, check whether products can be recycled before purchase, support local businesses.

Eat less meat

Try going vegan or vegetarian for one or two days a week, make conscious choices about the meat you do buy.

Fly less

As travel starts up again post-covid, think about staying closer to home and travelling by train whenever possible.

if not now, then when?

if not me, then who?

Região Autónoma da Madeira
Governo Regional

Secretaria Regional
de Ambiente, Recursos Naturais
e Alterações Climáticas
Direção Regional do Ambiente
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Thank you for your attention!

Pedro Sepúlveda

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