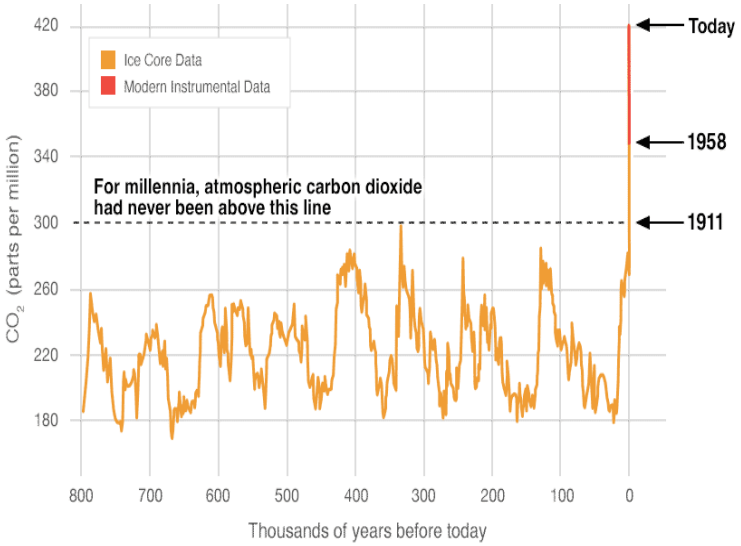
Climate Change - Temperature

The **EU Copernicus Project** collects measurements of scientific institutions and provides meta-analysis. Their **short prognosis** for the temperature increase above pre-industrial time (1850-1900) until now:

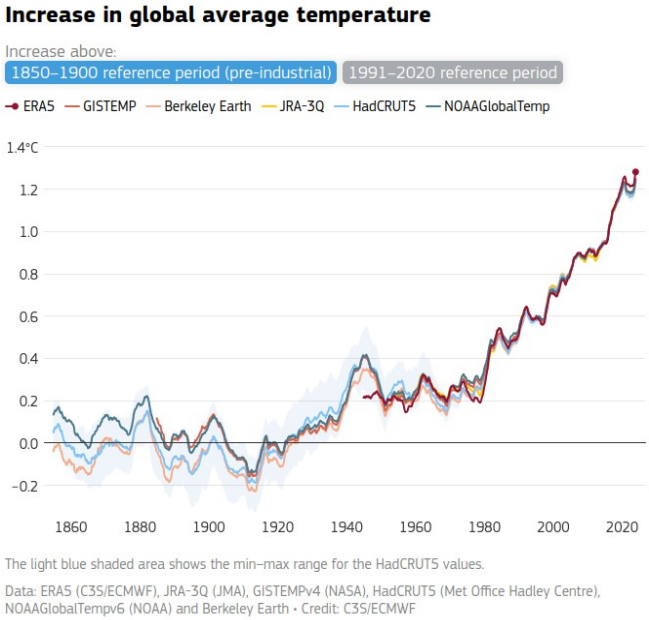
Global: +1,3°C **Europe: +2,3°C** **Arctis: +3,3°C**

(Averages of the past 5 years to decrease the influence of annual variation)

This is more comprehensible if we consider the annual atmospheric CO_2 concentration[1,2] and annual temperature.[3]



Daten: reconstruction from ice cores. Credit: NOAA



For the interpretation the following scientific explanations are useful:

1) An increase of atmospheric CO_2 increases the temperature on earth.
2) Human-caused CO_2 emissionen are responsible for these increases.
3) Our emissions are still increasing (36,8 Giga tons, 2024).[4]
4) EU has historically the **second highest CO_2 emissions**.[5,6]
5) **350ppm** atmospheric CO_2 is considered a safe value for human civilisation.[7]
6) In 2024 the atmospheric CO_2 is at **420ppm**.
7) Annually the atmospheric CO_2 increases by **2-2.5ppm**.[8] (tendency increasing)
8) A stable temperature increase of **max. 1.5°C**, requires less than **430ppm** atmospheric CO_2.[9] (reached around 2029)
9) A value of **450ppm** means the global temperature increase is about **2.0°C**. (reached around 2039)

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1 https://climate.nasa.gov/vital-signs/carbon-dioxide/?intent=121
2 https://climate.copernicus.eu/climate-indicators/greenhouse-gas-concentrations
3 https://climate.copernicus.eu/climate-indicators/temperature
4 https://www.pik-potsdam.de/en/news/latest-news/co2-emissions-at-record-high-in-2023
5 Jones, Matthew W., et al. "National contributions to climate change due to historical emissions of carbon dioxide, methane, and nitrous oxide since 1850." *Scientific Data* 10.1 (2023): 155.
6 https://ourworldindata.org/contributed-most-global-co2
7 https://www.pik-potsdam.de/en/output/infodesk/planetary-boundaries/planetary-boundaries
8 https://gml.noaa.gov/ccgg/trends/gl_gr.html
9 *IPCC Fourth Assessment Report, WG I, Chapter 10, Table 10.8,* 1.5°C is interpolated as the dependence is linear.

A few consequences of the global temperature increase

- Increased risk of **forest fires** (e.g., Griechenland 2023, Kanada 2023), **drying up** of rivers and lakes.[10] (e.g. Po, Italy, 2022)
- **Extreme Weather events** are much more likely (heat waves, droughts, heavy rainfall, hail, etc.)
- **Crop failure** not only caused by droughts and hail; yet also by earlier blooming time of plants like apples as late frosts cause flowers to die and insects do not polinate.[11]
- **Freshwater shortness**[12,13]
- Spread of **tropical diseases, deaths and sickness due to heat**
- **Flight and Migration** because of food shortage and ressource wars

- **Pariser Agreement** of 1.5°C until 2100 **NOT** achievable **WITHOUT** atmospheric CO_2 removal and quick reduction of emissions. (48% CO_2 emissions reduction until 2030 compared to 2019)[14]
- **Loss of ice sheets** (Glacier, sea ice) and the cooling Albedo effect.[15]
- **Sea level rise:** approx. 0.4-2m until 2100 (up to 15m 2300)[16]

- **Tipping point** with irreversible damage and additional temperature increases:[17]
  - **melting** of *Greenland ice sheet*, *western antarktic ice sheet* and *Barents Sea ice sheet* (between **1.5°C-2°C**)
  - **collaps** of oceanic circulation in the Labrador and Irminger sea (between **1.5°C-2°C**)
  - **dying** of coral reefs (between **1,5°C-2°C**)
  - **dying** of the Amazonas rainforest (between **2°C-3,7°C**)
  - **thawing** of boreal permafrost (between **3,7°C-6°C**)
  - **collaps** of the atlantic oceanic circulation (between **3,7°C-6°C**)
  - …

  The effects of these tipping points on the global climate are hard to predict as they play a complex role in the climate system.

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10 Yao, Fangfang, et al. "Satellites reveal widespread decline in global lake water storage." *Science* 380.6646 (2023): 743-749. pdf

11 Wyver, Chris, et al. "Climate driven shifts in the synchrony of apple (Malus x domestica Borkh.) flowering and pollinating bee flight phenology." *Agricultural and Forest Meteorology* 329 (2023): 109281. doi

12 https://www.eea.europa.eu/en/analysis/indicators/use-of-freshwater-resources-in-europe-1

13 https://www.un.org/en/climatechange/science/climate-issues/water

14 IPCC th Assessment Report, Table SPM.1, https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf

15 https://climate.copernicus.eu/climate-indicators/glaciers, https://climate.copernicus.eu/climate-indicators/ice-sheets, https://climate.copernicus.eu/climate-indicators/sea-ice

16 https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level

17 https://www.pik-potsdam.de/en/output/infodesk/tipping-elements