

Scientists find three years left of remaining carbon budget for 1.5°C

Embargoed until 19 June 2025, 00:01 (CEST)

19 June 2025, Bonn – The central estimate of the remaining carbon budget for 1.5°C is 130 billion tonnes of carbon dioxide (CO₂) (from the beginning of 2025). This would be exhausted in a little more than three years at current levels of CO₂ emissions, according to the latest *Indicators of Global Climate Change* study published today in the journal *Earth System Science Data*, and the budget for 1.6°C or 1.7°C could be exceeded within nine years.

Prof. Piers Forster, Director of the Priestley Centre for Climate Futures at the University of Leeds and lead author of the study, said: “Our third annual edition of *Indicators of Global Climate Change* shows that both warming levels and rates of warming are unprecedented. Continued record-high emissions of greenhouse gases mean more of us are experiencing unsafe levels of climate impacts. Temperatures have risen year-on-year since the last IPCC report in 2021, highlighting how climate policies and pace of climate action are not keeping up with what’s needed to address the ever-growing impacts.”

This year’s update of key climate system indicators carried out by a team of over 60 international scientists included two additional indicators, sea-level rise and global land precipitation, to give a total of 10 indicators¹. This information is crucial for decision-makers seeking a current, comprehensive picture of the state of the global climate system.

In 2024, the best estimate of observed global surface temperature rise was 1.52°C, of which 1.36°C can be attributed to human activity². The high level of human-induced warming and its high warming rate are due to global greenhouse gas emissions remaining at an all-time high in recent years.

According to the study, 2024’s high temperatures are “alarmingly unexceptional”, given the level of human-caused climate change. This human influence is at an all-time high and, combined with natural variability in the climate system (which causes temperatures to vary naturally year-to-year), has pushed global average temperature rise to record levels.

While reaching 1.5°C of global temperature rise in a single year does *not* mean there has been any breach of the landmark Paris Agreement – for that, average global temperatures would need to exceed 1.5°C over multiple decades – these results *do* reaffirm how far and fast emissions are heading in the wrong direction. And the impacts will only stop worsening when CO₂ emissions from fossil fuels and deforestation reach net zero.

When analysing longer-term temperature change, best estimates show that between 2015-2024 average global temperatures were 1.24°C higher than in pre-industrial times, with 1.22°C caused by human activities, meaning that, essentially, our best estimate is that all of the warming we have seen over the last decade has been human-induced.

Human activities have resulted in the equivalent of around 53 billion tonnes of CO₂ (Gt CO₂e) being released into the atmosphere each year over the last decade, primarily due to increasing emissions

from burning fossil fuels and deforestation. In 2024, emissions from international aviation – the sector with the steepest drop in emissions during the pandemic – also returned to pre-pandemic levels.

GHG emissions have also led to higher levels of greenhouse gases accumulating in the atmosphere. Combined with declines in emissions of planet-cooling aerosols, the outcome is that the planet is continuing to heat up. The damage caused by aerosols to human health far outweighs any minimal cooling ‘gains’, and there are other short-lived GHGs that can and should be tackled alongside CO₂, such as methane (CH₄) or nitrogen dioxide (NO_x), that could provide a short-term cooling compensating for the aerosol decline.

Human activities have also been affecting the Earth's energy balance. Surplus heat accumulating in the Earth's system at an accelerating rate is driving changes in every component of the climate system. The rate of global heating seen between 2012 and 2024 has about doubled from the levels seen in the 1970s and 1980s, leading to detrimental changes of vital components, including sea level rise, ocean warming, ice loss, and permafrost thawing.

Dr. Karina Von Schuckmann, Senior Advisor, Ocean Science for Policy at Mercator Ocean International said: “The ocean is storing about 91% of this excess heat driven by greenhouse gas emissions, which leads to ocean warming. Warmer waters lead to rising sea levels and intensified weather extremes, and can have devastating impacts on marine ecosystems and the communities that rely on them. In 2024, the ocean reached record values globally.”

Between 2019 and 2024, global mean sea level has also increased by around 26 mm, which translates to a rate of about 4.3 mm per year – more than doubling the long-term rate of 1.8 mm per year seen since the turn of the twentieth century.

Dr. Aimée Slangen, Research Leader at the NIOZ Royal Netherlands Institute for Sea Research said: “Since 1900, the global mean sea level has risen by around 228 mm. This seemingly small number is having an outsized impact on low-lying coastal areas, making storm surges more damaging and causing more coastal erosion, posing a threat to humans and coastal ecosystems. The concerning part is that we know that sea-level rise in response to climate change is relatively slow, which means that we have already locked in further increases in the coming years and decades.”

IPCC's last assessment of the climate system, published in 2021, highlighted how climate change was leading to widespread adverse impacts on nature and people, with rapid and deep reductions in GHGs emissions needed to limit warming to 1.5°C.

Prof. Joeri Rogelj, Research Director at the Grantham Institute and Climate Science & Policy Professor at the Centre for Environmental Policy at Imperial College London said: “The window to stay within 1.5°C is rapidly closing. Global warming is already affecting the lives of billions of people around the world. Every small increase in warming matters, leading to more frequent, more intense weather extremes. Emissions over the next decade will determine how soon and how fast 1.5°C of warming is reached. They need to be swiftly reduced to meet the climate goals of the Paris Agreement.”

Other key findings:

- Human-caused warming has increased at a rate of around 0.27°C/decade (2015-2024).
- The most recent decade (2015-2024) was 0.31°C warmer than the previous decade (2005-2014). These changes, although amplified somewhat by the exceptionally warm years in 2023 and 2024, are broadly consistent with warming rates over the last few decades.
- The rapid warming over the last few decades has resulted in record extreme temperatures over land, with average maximum temperatures reaching 1.9°C over the decade 2015-2024 and rising at a substantially faster rate than global mean surface temperature.

- ENDS -

Notes to editors:

- **For media enquiries**, please contact climate@leeds.ac.uk
- **Press pack** available at this [link](#)
- How to cite the paper: Forster et al., 2025. DOI accessible here

The **press conference** will be held on June 19, 2025, at 09:30 am (CEST) in [Nairobi 4, Main Building](#), in Bonn, Germany. It will be broadcast at this [link](#). Panelists:

- Prof. Piers Forster, Director of the Priestley Centre for Climate Futures at the University of Leeds
- Dr. Karina Von Schuckmann, Senior Advisor, Ocean Science for Policy at Mercator Ocean International
- Dr. Anna Pirani, Senior Research Associate of the research division “Risk assessment and adaptation strategies”, Euro-Mediterranean Center on Climate Change (CMCC)
- Dr. William Lamb, Senior Scientist, Potsdam Institute for Climate Impact Research (PIK)

1) Full list of indicators:

- Greenhouse gas emissions
- Greenhouse gas concentrations and emissions of short-lived climate forcers
- Effective radiative forcing
- Earth energy imbalance
- Observations of global surface temperature change
- Remaining carbon budget for policy-relevant temperature thresholds
- Maximum land surface temperatures
- Global land precipitation
- Global mean sea-level rise

2) The study calculated 1.52°C as the best estimate of observed global surface temperature in 2024. This number differs from the 1.55°C given by the World Meteorological Organisation (WMO) [State of the Global Climate 2024](#) report. This is owed to slightly distinct selections from the available datasets included. The number has varied by similar amounts in past years. Future work will aim to harmonise the approaches.

University of Leeds

The University of Leeds is one of the largest higher education institutions in the UK, with more than 40,000 students from about 140 different countries. We are renowned globally for the quality of our teaching and research.

We are a values-driven university, and we harness our expertise in research and education to help shape a better future for humanity, working through collaboration to tackle inequalities, achieve societal impact and drive change.

The University is a member of the Russell Group of research-intensive universities, and is a major partner in the Alan Turing, Rosalind Franklin and Royce Institutes www.leeds.ac.uk

Follow University of Leeds or tag us in to coverage: [Bluesky](#) | [Facebook](#) | [LinkedIn](#) | [Instagram](#)

About the IGCC

An international team of scientists comes together annually to provide the latest evidence on how the climate system is changing through the [Indicators of Global Climate Change \(IGCC\)](#) initiative. IGCC provides annual updates of key climate indicators reported by the Intergovernmental Panel on Climate Change (IPCC), following as closely as possible the methods used in IPCC Sixth Assessment Report (AR6) Working Group One (WG1) report. The report follows the causal chain from GHG emissions to the level of human-induced warming and their impact on the remaining carbon budget, demonstrating how human activity is affecting the physical climate system.

More information on IGCC can be found on the [website](#).

IGCC is also working with the [Climate Change Tracker](#) to provide a reliable, user-friendly platform for tracking, visualising and understanding these indicators.

This year's study has been produced by an international team of 61 scientists, including IPCC Lead Authors, Contributing Authors, and Chapter Scientists, from 54 institutions across 17 countries.