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Earth's average 2023 temperature is now likely to reach 1.5 °C of warming

But to breach the Paris agreement's limit, the heating must be sustained for many years.

• [Katharine Sanderson](#)



Climate protests are increasingly common, as the world heads towards its self-defined heating limit. Credit: Alain Pitton/NurPhoto via Getty

Earth is hurtling towards its average temperature rising by 1.5 °C above pre-industrial levels. One climate model suggests that the likelihood of reaching that threshold in 2023 is now 55%.

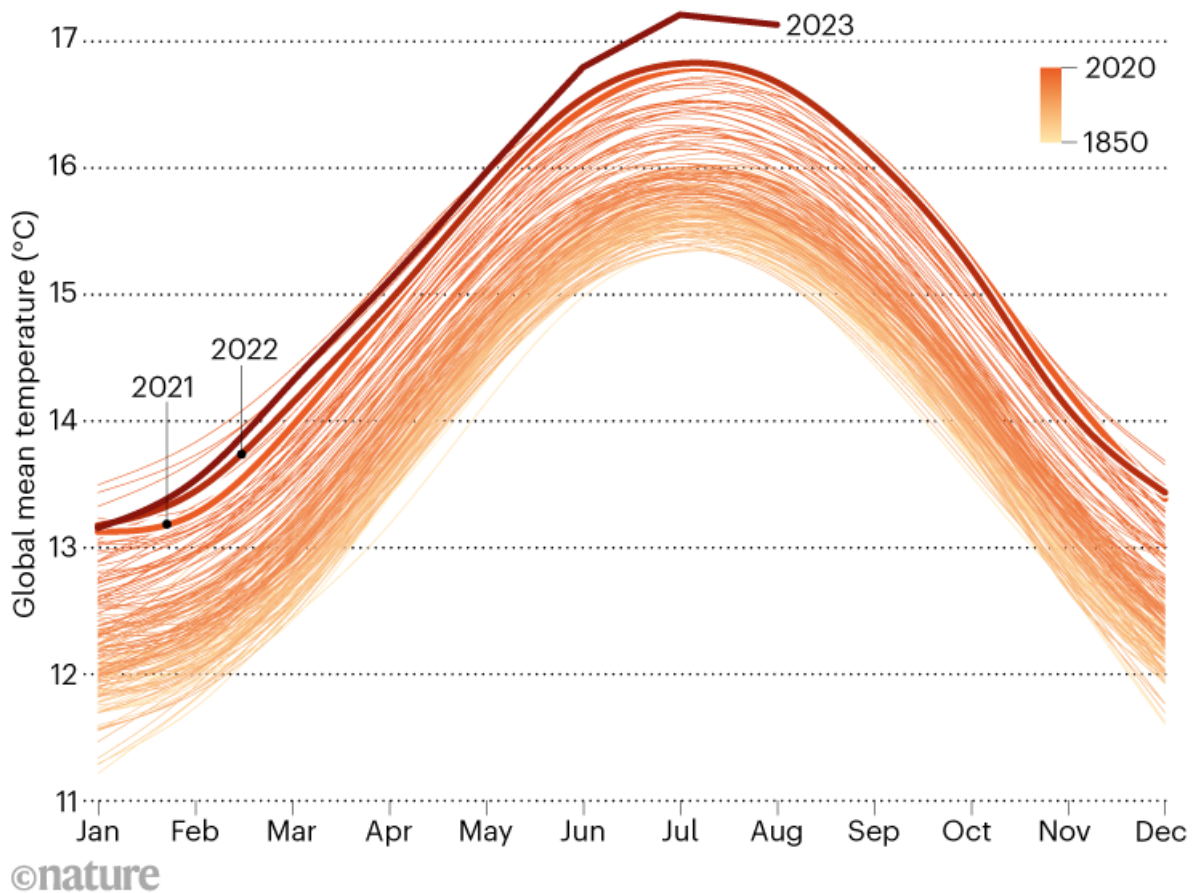
The 1.5 °C figure was a preferred maximum warming limit set by the United Nations in the landmark 2015 Paris agreement on climate change. Climate scientists use different models to make predictions. In Breaching the Paris limit requires a long-term trend of warming of 1.5 °C or more, but some research groups tracking average annual temperatures in isolation are already predicting 1.5 °C of warming this year. In May, a World Meteorological Organization [report](#) said that there was a 66% chance that the average annual temperature would breach 1.5 °C of warming between 2023 and 2027.

In its August 2023 [monthly update](#), Berkeley Earth — a non-profit climate-monitoring organization — has put the chance of 2023 being on average 1.5 °C warmer at 55%. This is up from a chance of less than 1% predicted by the team before the start of the year, and the 20% chance estimated using July's figures. "So this year has played out in a very unusual fashion," says Robert Rohde, Berkeley Earth's lead scientist in Zurich, Switzerland.

"I will admit to being surprised," says Rohde. "I was surprised at how warm August came in."

HEAT RISING

The global average temperatures in the past three months have set new records every month, often by a large margin.



Source: Berkeley Earth

Joeri Rogelj, a climate science and policy researcher at Imperial College London, cautions that the figures do not mean that Earth is heating faster than previously thought. “There is absolutely no indication that the underlying warming trend, which is very worrying in its own right, has significantly accelerated.”

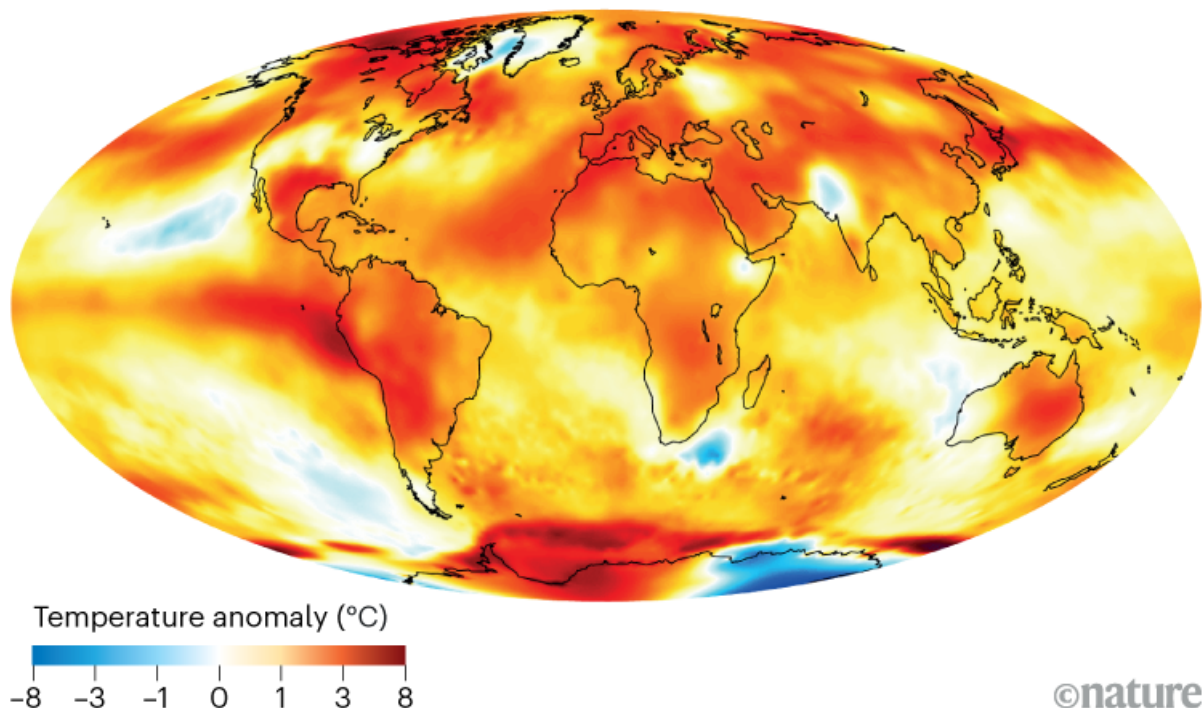
Hot summer

Rohde was expecting that things would cool down a little after [an extremely hot July](#) (see ‘Heat rising’).

However, factors, including the strengthening of the ocean-warming event called El Niño, have contributed to the temperature increase. “It’s pretty startling to be at this position now where we may get to 1.5 °C” in 2023, says Rohde. “We thought it was very unlikely that 1.5 °C will arrive this year.”

NEARING THE THRESHOLD

The months of June to August 2023 have been by far the warmest such period on record globally. The average temperature in some places has already risen by 1.5 °C or more above pre-industrial levels, but the Paris agreement threshold requires a sustained change.



Source: Berkeley Earth

He attributes some of the extraordinarily high temperatures to phenomena that are not directly linked to human activity. “One of the very significant ones is that there was unusually low dust coming off the Sahara in the early part of the season,” he says. This allowed

the Atlantic Ocean to heat to higher-than-usual temperatures.

“It’s really about how El Niño has played out, which is not easy to predict,” says Rogelj.

The US National Oceanic and Atmospheric Administration (NOAA) also tracks temperature changes closely. Its analysis does not show that 2023 will reach an average of 1.5 °C of warming. “Our analysis broadly agrees with Berkeley in that Aug 2023 was the warmest Aug in our record (by a long shot) and that the odds of 2023 being the warmest year since 1850 exceed 90%,” says climate scientist Russell Vose, at NOAA’s National Climatic Data Center in Asheville, North Carolina. “Our Aug 2023 anomaly is 1.25 °C, but that is relative to the twentieth-century average, whereas Berkeley uses 1850–1900. That accounts for some of the difference between our numbers.”

Rohde keeps close tabs on other organizations that make similar predictions, including NOAA and NASA.

“Based on where we’re tracking, there’s not a lot of difference between our analysis and other groups. So it may well be at the end of the year, some of us are just above 1.5 and some of us are just below,” he says.

Rohde’s colleague at Berkeley Earth, Zeke Hausfather, analysed the difference between four major groups that are tracking global temperatures. Each group uses

slightly different values for Earth's historical temperature average. For each model to show 2023 as being a 1.5 °C above average, Hausfather looked at how much warmer than average the rest of the year would need to be. For the NOAA dataset, they estimate temperatures would need to be an "implausible ~ 2 C" higher. For NASA's GISTEMP data set that figure is 1.9 °C and for the ERA5 data, it is 1.8 °C.

"The exact number of 1.5 is less important than the fact that this will be again the highest annual temperature on record," says Rogelj. The Berkeley data set shows an estimated global mean temperature for just this year (see 'Nearing the threshold'), whereas the Paris agreement target was clarified in 2021 as being the middle of a 20-year period during which the average global temperature hits 1.5 °C above the average temperature between 1850 and 1900. "This data doesn't mean that we have breached the lower 1.5 °C safety limit of the Paris agreement, because that will apply to the long term," says Rogelj.

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