World may warm by 25 per cent more than current projections suggest

Official projections for how much the world will warm are already catastrophic, and now it appears they significantly underestimate future warming

By Michael Le Page on August 19, 2026



The Edersee, a lake in Waldeck, Germany, on 11 August. Ina FASSBENDER / AFP via Getty Images

Climate models projecting higher warming for a given level of carbon dioxide have been discounted as unrealistic, but a new way of assessing models suggests they are accurate.

“For a given emission trajectory, we expect warming to be 25 per cent higher,” says Gergana Gyuleva at ETH Zurich in Switzerland.

The conclusion has enormous implications. For instance, a project called the Climate Action Tracker currently projects that average global surface temperatures will rise by 2.6°C above pre-industrial levels by 2100 if countries implement existing policies. Gyuleva team’s results suggest we are instead heading for 3.25°C.

How much the world will warm depends on how much more CO_2 we put into the atmosphere and how the planet responds to that CO_2. Different climate models vary in how much warming they project for a given CO_2 level. For instance, some models suggest that a doubling of CO_2 will result in the average global surface temperature increasing by around 1.6°C above pre-industrial levels in the short term. Others suggest it could be as high as 3°C.

“The range is big, and it really matters,” says Gyuleva. “So the point is to find out which ones are right.”

Previously, this was done by using climate models to simulate the recent past. The models are fed data on greenhouse emissions over the past century or so, and their projected climate response is compared with what actually happened.

For the last report by the Intergovernmental Panel on Climate Change, a lot of these models simulated more warming than had happened, so were discounted. Based on the remaining models, the panel’s last report concluded that a doubling of CO_2 would result in between 1.2°C and 2.4°C of warming in the short term, with a best estimate of 1.8°C.

But there is lots of variability in Earth’s climate. For instance, during the La Niña climate pattern, cooler seawater from deeper down spreads across the ocean, resulting in cooler surface temperatures. So, Gyuleva and her colleagues have filtered the historical climate record to try to remove the effect of variability due to phenomena like La Niña.

Their results suggest that natural variability limited temperature rises between 1981 and 2014 – a period that includes the so-called global warming hiatus in the first decade of the 21st century. “It’s really exactly this period 1981 to 2014, which was used in the previous papers, where you see the strongest bias down,” she says. “It was really bad luck.”

Correcting for this bias alone leads to higher estimates of the warming expected from a doubling of CO_2. But Gyuleva’s team also assessed models using a new approach. Instruments on several satellites have been measuring how much short-wave radiation from the sun enters the atmosphere, and how much long-wave radiation is emitted. The difference between how much heat energy enters the atmosphere and how much leaves is the most fundamental measure of global warming.

So, how well models project the trends in incoming and outgoing radiation as the world warms can be seen as a better measure of their performance than their projections of surface temperatures. But because the satellite measurements required to do this only began in 2001, this kind of assessment has only recently become possible.

The team found the models that best match the observed trends in short-wave and long-wave radiation project much greater warming. Based on the models that perform best at both kinds of assessments, the team concludes that a doubling of CO_2 will lead to a rise of between 1.9°C and 2.6°C, with a best estimate of 2.25°C. “Our results need to be confirmed by more evidence from different sources before we can be fully confident,” says Gyuleva.

“This seems to be a sound approach,” says Trude Storelvmo at the University of Oslo in Norway.

“In my opinion, the filtering out of natural variability is a valuable step forward,” says Drew Shindell at Duke University in North Carolina, although he isn’t yet convinced that the short-wave and long-wave trends are a good way to assess models.

“I think it’s a plausible conclusion and a reasonable approach,” says Steven Sherwood at the University of New South Wales in Sydney.

But the findings are based on climate models, and none of them reproduces the key phenomena very well, says Sherwood. “To do a better job of this we really need better climate models. On the other hand, the steep temperature rises of the last few years are going to lead to higher estimated ranges regardless of method.”

In climate jargon, what Gyuleva’s team has estimated is known as the transient climate response. It is just one of three types of climate sensitivity, which vary in terms of the timescales involved.

In the decades after a doubling of CO_2, various feedbacks will kick in that lead to further warming, such as the continued warming of the oceans. The response after these medium-term feedbacks have kicked in is known as the equilibrium climate sensitivity. Last year, it was shown that the trends in short-wave and long-wave radiation suggest the equilibrium climate sensitivity is higher than previous estimates.

There are also very slow feedbacks that take centuries or more, such as the melting of ice sheets. Estimates of this earth system sensitivity – the full response to a doubling of CO_2 over many millennia – are as high as 7°C.

However, if atmospheric CO_2 levels were lowered by carbon removal, some of the longer-term consequences would be avoided.

Journal Reference:

Earth's Future DOI: 10.1029/2026EF008356