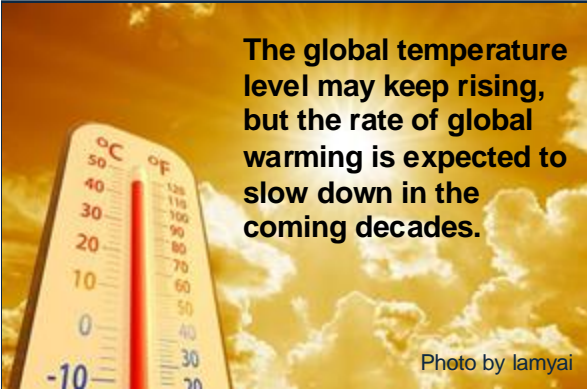


KEY POINTS FOR DECISION-MAKING

- ▶ **The rate of global warming, i.e. the speed of global mean temperature increase, is projected to decline in the coming decades due to reductions in carbon emissions under current policies.** Achieving nationally determined contributions (NDCs) or long-term net-zero targets would lead to a greater downward trend, and a failure to meet current commitments could reverse this trend.
- ▶ **The long-term warming trend from greenhouse gas emissions is complicated by short-term variations from multiple processes, such as the El Niño Southern Oscillation and aerosol emissions reductions.** Understanding the impact of these processes is important to isolate the long-term trend due to anthropogenic activities and assess current mitigation efforts. .
- ▶ **The Earth is expected to continue getting hotter.** As long as the rate of carbon dioxide emissions remains positive, the temperature level is expected to keep increasing, but this rate of increase may be slower than in the recent past.



The global temperature level may keep rising, but the rate of global warming is expected to slow down in the coming decades.

Photo by lamyai



Research Brief

The rate of global warming is expected to slow under current policy

Global warming during 2023 broke the record in a 143-year series of temperature observations. Everyone agrees that, as long as we are emitting greenhouse gases such as carbon dioxide, the Earth will continue to get hotter. The question is whether it will get hotter faster or slower than it has in the recent past.

The long-term warming trend is primarily determined by anthropogenic activities that emit greenhouse gasses – mostly carbon dioxide (CO₂) – into the atmosphere. Evidence has shown that the amount of global warming closely tracks cumulative carbon dioxide emissions, and the rate of global warming is closely related to current carbon dioxide emissions. While we can't change the past, our current and future carbon dioxide emissions can be affected by policies that influence the amount and rate of emissions. Acknowledging current mitigation efforts, recent analyses project an imminent reversal in the trend of global carbon emissions.

In this study, we examine the rate of temperature change using projections of annual mean global-scale temperature response from the existing literature. We focus on scenarios that consider only currently deployed domestic policies and ignore zero-emissions commitments that may or may not materialize. The temperature record and projections are smoothed to separate the climate signal from shorter-scale variability. Our results indicate that as emissions peak and start to decline, so should the rate of global warming.

Summary

Our analysis confirmed the historical increases in the rate of global warming. Meanwhile, the central estimate for the projected temporal-smoothed rate of warming shows a declining trend in the coming decades. Our central estimate of the rate of warming is projected to be 0.21 °C/decade around the year 2025, and 0.15 °C/decade around the year 2050. This downward trend would be greater if both nationally determined contributions and long-term net-zero climate targets were achieved.

Due to noise from multiple factors that feature short-term variations, identifying the long-term trend using real-world observations is less straightforward.

Nevertheless, our study projects a decreasing rate of global temperature increase in the coming decades. As long as the rate of increase remains positive, the global temperature level will keep rising, potentially with accelerated damages.

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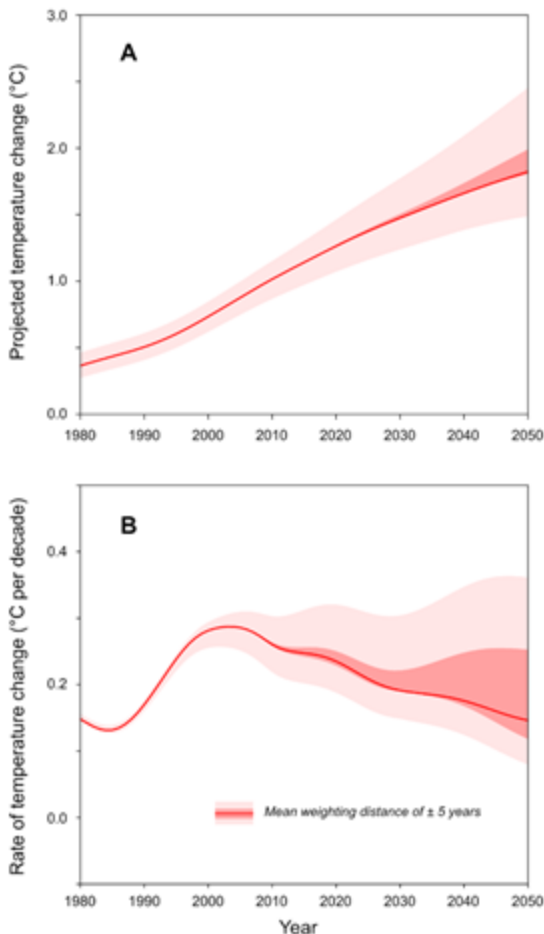
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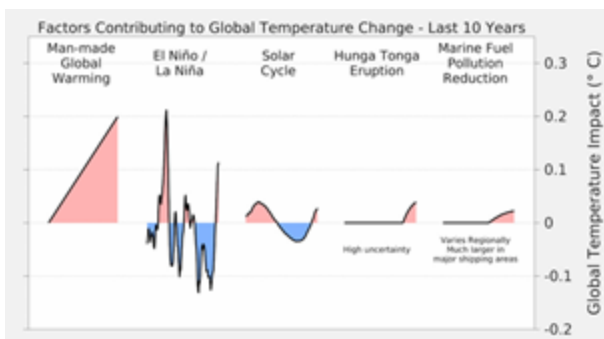
This brief is based on Duan and Caldeira, *Rate of global warming projected to decline under current policy*, published in *Environmental Research Letters* **19** (2024) 092001.

FOR MORE INFORMATION

Visit the Climate Energy Lab Website at ClimateEnergyLab.org



Historical and projected amount and rate of temperature increase for years 1980 to 2050. For the main results, we consider a 33-year Hanning window for smoothing, analogous to a mean weighting distance of ± 5 years. The solid red line shows the central projections, dark shaded areas show uncertainties related to emission projections, and light shaded areas show further uncertainties related to temperature projections.



Short-term factors with global temperature impact (°C) may help explain 2023's record-breaking heat. This figure is credited to Robert Rhode / Berkeley Earth, Global Temperature Report for 2023.