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Energy and Environment

Carbon dioxide levels could reach their highest point in 50 million years by the end of the century

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A business-as-usual trajectory suggests that carbon dioxide levels could exceed 2,000 parts per million by the year 2250, concentrations that were last seen about 200 million years ago. But thanks to the combined influence of a hotter future sun, the planet's resulting warming will probably be greater than at almost any point in the past 420 million years.

Additionally, at least one study has suggested that concentrations could be as high as 5,000 parts per million by the year 2400 if humans were to burn through all the fossil fuels on Earth, and that would result in both the highest carbon dioxide levels and the highest temperatures seen throughout the study period.

The Intergovernmental Panel on Climate Change has presented estimates of how much the Earth might warm under a business-as-usual trajectory over certain time periods. It suggests that by the year 2300, the Earth could warm by nearly 9 degrees Celsius (or about 16 degrees Fahrenheit). But there are many factors that could affect temperature trends in the long-term that remain uncertain, Foster suggested, such as changes in terrestrial vegetation or the amount of carbon dioxide the ocean has room to absorb in the coming centuries.

As a result, he said, long-term warming could end up being even more intense than we estimate now.

The new study helps address a kind of paradox in the Earth's climate history. Based on our knowledge of the way stars generate energy, scientists know that our solar system's young sun would have been much dimmer millions of years ago. Over time, its intensity has increased, and will likely continue doing so for millions or even billions of years.

If the sun has been getting hotter for millions of years, though, then one would expect the planet's climate to have steadily warmed during that time as well, Foster noted. But there is ample evidence from the fossil record to suggest that the planet's climate actually remained mostly stable for millions of years before humans began burning fossil fuels. Scientists have hypothesized that this stability comes from a long-term reduction in atmospheric carbon dioxide levels, which offset the warming caused by a brightening sun.

And the new study supports this idea. The researchers' record suggests that, while there have been fluctuations throughout history, the long-term average carbon dioxide concentration generally declined right up until the Industrial Revolution as a result of natural processes related to the formation of the terrestrial Earth.

Thanks to human activity, however, carbon dioxide levels are now on the rise again, and they're on track to break millennial-scale records if serious mitigation efforts aren't undertaken, the study suggests.

Foster emphasizes that the new historical record is not necessarily perfect. There are still gaps and uncertainties, that could be filled in with more discoveries over time.

But, he added, "just as far as we know, that the [warming] in the future is going to be unprecedented."

Correction: This article previously contained an incorrect conversion from Celsius to Fahrenheit. We regret the error and it has been corrected.

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