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UCSB staff

Scientists match Earth's ice age cycles with orbital shifts

Beginning around 2.5 million years ago, Earth entered an era marked by successive ice ages and interglacial periods, emerging from the last glaciation around 11,700 years ago. A new analysis suggests the onset of the next ice age could be expected in 10,000 years' time.

An international team, including researchers from UC Santa Barbara, made their prediction based on a new interpretation of the small changes in Earth's orbit of the sun, which lead to massive shifts in the planet's climate over periods of thousands of years. The study tracks the natural cycles of the planet's climate over a period of a million years. Their findings, published in [Science](#), offer new insights into Earth's dynamic climate system and represent a step-change in understanding the planet's glacial cycles.

The team examined a million-year record of climate change, which documents changes in the size of land-based ice sheets across the Northern hemisphere together with the temperature of the deep ocean. They were able to match these changes with small cyclical variations in the shape of Earth's orbit of the sun, its wobble and the angle on which its axis is tilted.

"We found a predictable pattern over the past million years for the timing of when Earth's climate changes between glacial 'ice ages' and mild warm periods like today, called interglacials," said co-author [Lorraine Lisiecki](#), a professor in UCSB's Earth Science Department. One type of change in Earth's orbit was responsible for the end

of ice ages, while another was associated with their return.

“We were amazed to find such a clear imprint of the different orbital parameters on the climate record,” added lead author Stephen Barker, a professor at Cardiff University, in the UK. “It is quite hard to believe that the pattern has not been seen before.”

Predictions of a link between Earth’s orbit of the sun and fluctuations between glacial and interglacial conditions have been around for over a century but were not confirmed by real-world data until the mid-1970s. Since then, scientists have struggled to identify precisely which orbital parameter is most important for the beginning and ending of glacial cycles because of the difficulty of dating climatic changes so far back in time.

The team was able to overcome this problem by looking at the shape of the climate record through time. This allowed them to identify how the different parameters fit together to produce the climate changes observed.

The authors found that each glaciation of the past 900,000 years follows a predictable pattern. This natural pattern — in the absence of human greenhouse gas emissions — suggests that we should currently be in the middle of a stable interglacial and that the next ice age would begin many millennia in the future, approximately 10,000 years from now.

“The pattern we found is so reproducible that we were able to make an accurate prediction of when each interglacial period of the past million years or so would occur and how long each would last,” Barker said. “This is important because it confirms the natural climate change cycles we observe on Earth over tens of thousands of years are largely predictable and not random or chaotic.” These findings represent a major contribution towards a unified theory of glacial cycles.

“And because we are now living in an interglacial period – called the Holocene – we are also able to provide an initial prediction of when our climate might return to a glacial state,” said co- author Chronis Tzedakis, a professor at University College London.

“But such a transition to a glacial state in 10,000 years’ time is very unlikely to happen because human emissions of carbon dioxide into the atmosphere have

already diverted the climate from its natural course, with longer-term impacts into the future,” added co-author Gregor Knorr from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research.

The team plans to build on their findings to create a baseline of the Earth’s natural climate for the next 10,000-20,000 years by calibrating past changes. Used in combination with climate model simulations, researchers hope to quantify the absolute effects of human-made climate change into the far future.

“Now we know that climate is largely predictable over these long timescales, we can actually use past changes to inform us about what could happen in the future,” Barker added. “This is something we couldn’t do before with the level of confidence that our new analysis provides.”

“This is vital for better informing decisions we make now about greenhouse gas emissions, which will determine future climate changes.”

A version of this story was released by Cardiff University.

Tags

[Climate Change](#)

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