CENOGRID
66 Ma of high-precision climate history

International researchers, including eight UK scientists, have used IODP sediment cores to reconstruct 66 million years of Earth's climate record with an unprecedented temporal resolution, as published yesterday in Science**.** "Our goal was to create a new reference of past climate over the last 66 million years, which not only incorporates the highest-resolution data but is also more accurately dated," **explained Thomas Westerhold, of University of Bremen, who is lead author of the paper.** "We now know more accurately when it was warmer or colder and we also have a better understanding of the underlying dynamics behind past climate changes."

The compilation includes 14 sediment cores from sites (Fig. 1) drilled between 1994 and 2009 (ODP Legs 154, 184, 199, 207, 208 and IODP Expedition 321). Carbon and oxygen isotopes were measured in deep sea benthic foraminifera from the cores in order to create the new astronomically tuned reference record for the entire Cenozoic – called CENOGRID. Using improved sediment records from the last couple of decades of deep ocean drilling, CENOGRID is able to

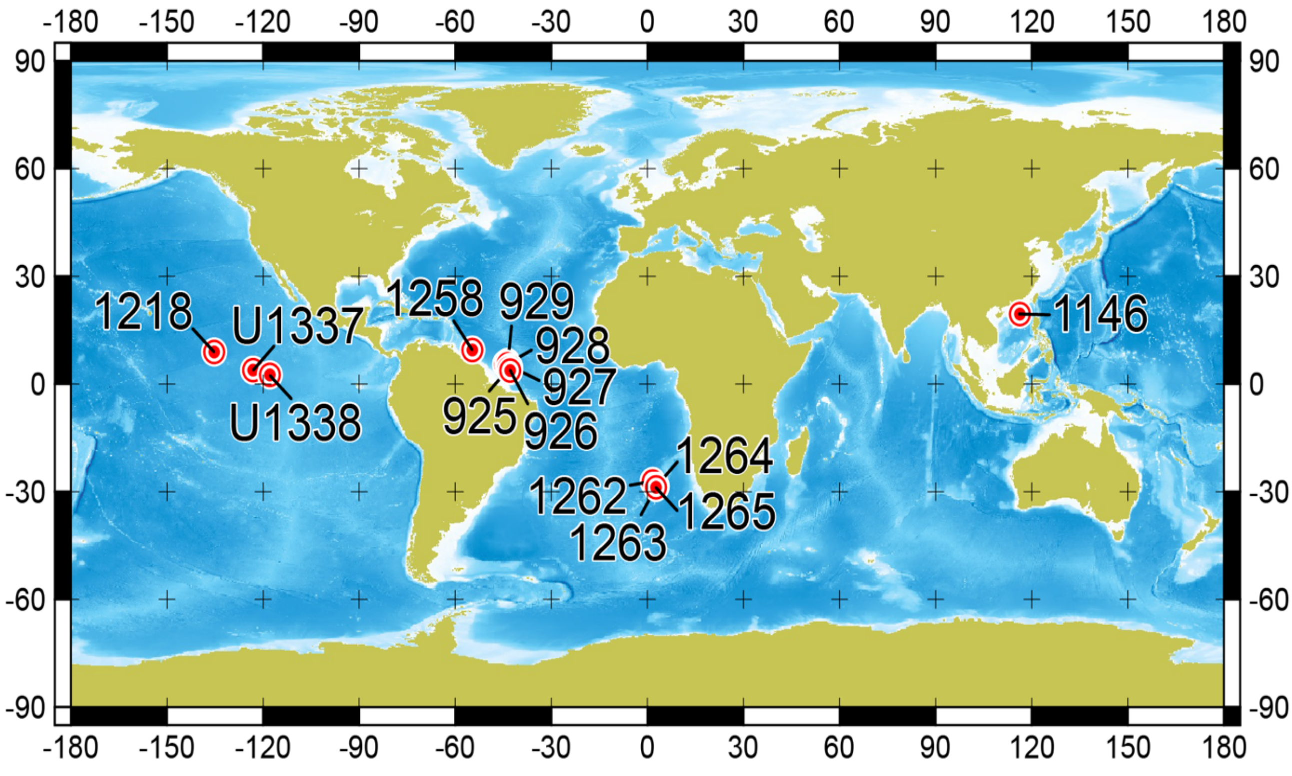

Figure 1. The locations of the ODP and IODP sites from which the sediment cores used for CENOGRID were sampled.

provide a better resolution record with more comprehensive coverage and reduced noise compared to previous compilations, which suffer from coarse temporal resolution and/or gaps in the record, especially going back further than 34 Ma.

The authors used statistical analysis to distinguish key climate states from "hothouse" (no continental glaciers) to "icehouse" (ice sheets on both poles). While this evolution throughout the Cenozoic Era from warmer to cooler climate is not novel, the improved resolution and coverage of CENOGRID facilitates precise statistical definition of these states and analysis of the recurring patterns of change that occur in response to natural cyclic changes in Earth's orbit on astronomical timescales. It also allows the team to investigate how the response of Earth's climate to these has evolved over 66 Ma (Fig. 2).

CENOGRID shows that climate variation during hothouse and warmhouse states was more predictable and dominated by low latitude response to orbital eccentricity. In contrast, the growth of ice caps at both poles during the icehouse state led to less predictable climate response, resulting from increased influence of complex high latitude feedbacks dominated by orbital obliquity.

This advance in understanding of past climate has important implications for the future, as Professor David Hodell (University of Cambridge), who sailed on ODP Leg 208 as an inorganic geochemist, explained "Earth's climate has fluctuated dramatically on scales of millions of years, but we are entering a new and uncertain phase, with rising anthropogenic greenhouse emissions and shrinking ice sheets. The current rates of change are unprecedented compared to the long-term history of Cenozoic climate".

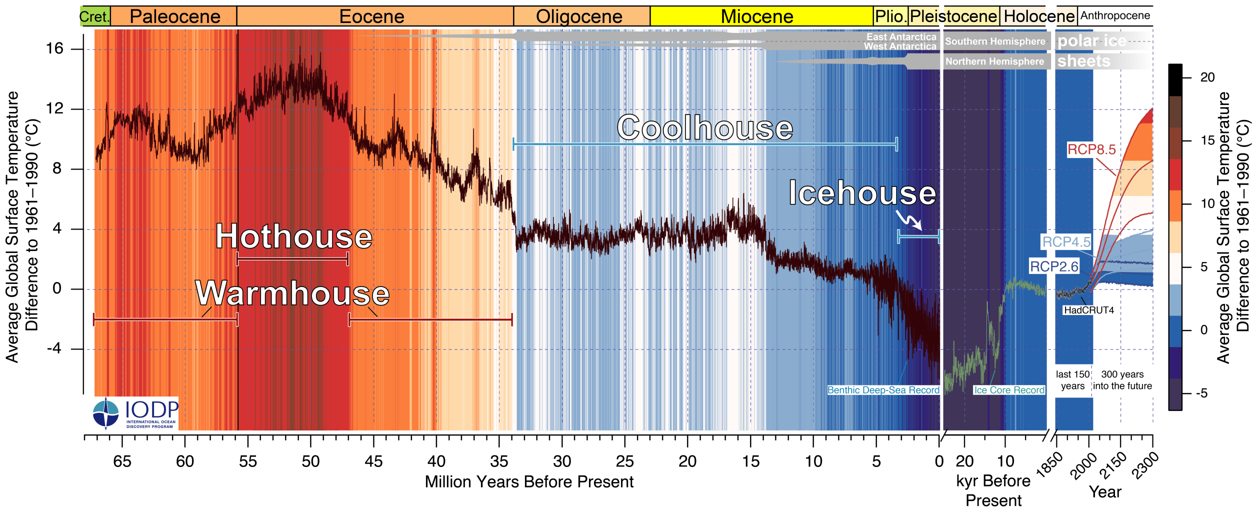

Figure 2. Past and future trends in global mean temperature show we are entering a phase of unprecedented climate change. The new Cenozoic climate curve is placed alongside ice core records, which show the changing climate over the last 25,000 years and instrumental climate data from 1850 to the present day. The future projections of global temperature (RCP scenarios) are shown for illustration. Under a business as usual emissions scenario temperatures may be pushed towards the hothouse conditions last seen 55 million years ago.

Read the paper in full here:

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