Atmospheric CO2 drove climate change during longest interglacial

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Known as the marine isotope stage 11 (MIS 11), the interglacial period centered around 400,000 years ago was the longest and possibly the warmest interglacial in the past 0.5 million years. Because the orbital configurations, atmospheric greenhouse gas concentrations, climate, and faunal characteristics during MIS 11 closely resemble those of the past 5,000 years, paleoclimatologists use MIS 11 as a geological analogue of the present and the near future.

There exist several high-resolution records documenting almost all aspects of terrestrial and marine climate through MIS 11. However, there is neither a clear understanding about how climactic parameters such as atmospheric carbon dioxide (CO2), sea surface temperature, the isotopic makeup of carbon in marine and terrestrial reservoirs, and annual air temperature interact, nor a consensus regarding the major drivers of climate change during this interval.

Using 15 of the most robust proxy records of marine and terrestrial climate, Das Sharma et al. employ new statistical and mathematical techniques to quantify the interactions among climatic parameters and to investigate which of these parameters could be the primary drivers of climate change during MIS 11. The authors find that atmospheric CO2 concentration was indeed the primary driver of both terrestrial and marine climate: Sea surface temperature and the isotopic makeup of carbon in terrestrial and marine reservoirs responded “instantaneously” (i.e., within 1,000 years) to changes in atmospheric CO2 content.

They further report that MIS 11 had warm and cool phases that can be detected from sea surface temperature records alone. During the relatively cold phases, sea surface and air temperatures behave coherently and respond to atmospheric CO2 faster. However, during warmer intervals, ocean surface and air temperatures behave more independently of each other and atmospheric CO2. The authors suggest that over the course of the next century, air and sea surface temperatures are likely to change in ways that will be difficult to predict.

More information: Sea surface temperatures in cooler climate stages bear more similarity with atmospheric CO2 forcing, *Journal of Geophysical Research-Atmospheres*, doi: 10.1029/2012JD017725, 2012

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