Global warming – we have lessons to learn from the Pliocene epoch

February 9 2018

Credit: AI-generated image (disclaimer)

Carbon levels around 3 million years ago were similar to those of today and temperatures were even warmer. If something so significant is mirrored in the past, what else can we learn about extreme climate changes?

Three million years ago the Earth's climate was warm enough to permit a forested High Arctic inhabited by large mammals. If the idea of melting icebergs, rising sea levels and 400 parts per million of carbon dioxide in the atmosphere sounds all too familiar – welcome to the Pliocene.

For many researchers, the Pliocene, which lasted from 5.3 million to 2.6 million years ago, is our best reference for today's warming. It was the last time atmospheric CO2 levels were similar to today's, trapping heat and raising global temperatures to above the levels Earth is experiencing now. A better understanding of the response of the ice sheets to increasing temperature is needed to make more rigorous projections of how much sea level change could be expected in the future.

We live in uncertain times when it comes to the impact of climate change and global warming, so any insights we can gain from the past is an area of scientific interest. EU support under the PLIOTRANS fellowship is helping to further our understanding of the responses of the ice sheets to a warming climate.

When it comes to ice sheets, one size does not fit all

Recent research by a team of scientists, including PLIOTRANS, has been considering how the planet responded to Pliocene warmth. They have published a new paper presenting, for the first time, the transient nature of ice sheets and sea level during the late Pliocene. They show that the Greenland and Antarctic ice sheets might have responded differently to Pliocene heat, melting at different times.

Their transient ice sheet predictions are forced by multiple climate snapshots derived from a climate model set up with late Pliocene boundary conditions with different orbital forcing scenarios appropriate to two Marine Isotope Stages (MISs): KM5c (from 3.226 to 3.184 million years ago), and K1 (from 3.082 to 3.038 million years ago).

Their findings support previous studies, which have shown model results indicate peak MIS KM5c and K1 interglacial temperatures were not globally synchronous: there are leads and lags in temperature in different regions.

When it comes to modeling, this highlights the potential pitfalls of aligning peaks in proxy-derived temperatures across geographically diverse data sites. A single climate model simulation for an interglacial event is inadequate to capture peak temperature change in all regions.

The team explains, 'We present a first step toward a fully coupled system of ice volume and climate variability across the late Pliocene (…) The model simulations presented here attempt to capture the transient response of climate and ice volume to orbital variations.'

The shape of the Earth's orbit, the tilt of its axis and the fact that it wobbles, all have a part to play

The episodic nature of the Earth's glacial and interglacial periods within the present Ice Age (the last couple of million years) have been caused primarily by cyclical changes in the Earth's circumnavigation of the Sun. The study found that when the cyclical change known as precession variability is large, caution is advised when directly inferring the behaviour of ice sheets from oxygen isotope records in the Pliocene.

Their simulations indicate that the asynchronous response of ice sheets, combined with their transient modelling, is indeed a key factor in predicting orbital timescale sea level for a climate that is warmer than ours is now.

The PLIOTRANS (PLIOcene TRANSient Climate Modelling: Towards a global consensus between ice volume, temperature and relative sea level for the Late Pliocene) fellowship ended last year. Its goal was to

reduce the uncertainties associated with future projections of sea-level change.

More information: Project page: cordis.europa.eu/project/rcn/196017_en.html

Provided by CORDIS