Past climate change and continental ice melt linked to varying CO2 levels

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Scientists at the Universities of Southampton and Cardiff have discovered that a globally warm period in Earth's geological past featured highly variable levels of CO2.

Previous studies have found that the Miocene climatic optimum, a period that extends from about 15 to 17 million years ago, was associated with big changes in both temperature and the amount of continental ice on the planet.

Now a new study, published in *Paleoceanography*, has found that these changes in temperature and ice volume were matched by equally dramatic shifts in atmospheric CO2.

Using more detailed records than has previously been available, scientists have shown that CO2 levels in this period reached around 500 ppm (parts per million), the same level that the Intergovernmental Panel on Climate Change (IPPC) projects for the end of the century.

Lead author Rosanna Greenop, from Ocean and Earth Science at the University of Southampton, says: "The drivers of short term, orbital-scale temperature and ice volume change during warm periods of the Earth's history have never been analysed before. Here we are able to show that in the same way as the more recent ice ages are linked with cycles of CO2, it also plays an important role in cyclical climate changes during warm periods."

Researchers also showed that at low levels of CO2, ice volume varied strongly, but at higher levels, there was little or no additional change in volume. The authors of the study hypothesis that there must be a portion of the East Antarctic ice sheet that varies in volume at the lower end of the CO2 range. However, the absence of additional ice melt at higher CO2 levels suggests that there is also a portion of the ice sheet that remains stable at the maximum CO2 levels.

Evidence suggests that the northern Hemisphere and West Antarctic ice sheets did not exist during the warm Miocene climatic optimum.

"While we recognise that the Miocene climatic optimum is not a perfect analogue for our own warm future, the geological past does represent an actual reality that the Earth system experienced," says the University of Southampton's Dr Gavin Foster, co-author of the study. "As such the findings of this study have large implications for the stability of the continental ice sheets in the future. They indicate that portions of the East Antarctic ice sheet can act in a dynamic fashion, growing and shrinking in response to climate forcing."

Co-author Caroline Lear, of Cardiff University, adds: "We tend to think of the Antarctic ice sheet as a sluggish ice sheet, but these records show that in past warm climates it has been surprisingly sensitive to natural variations in carbon dioxide levels."

Provided by University of Southampton