Climate model experiments using state-of-the art boundary conditions for the Mid to Late Pliocene

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The Mid to Late Pliocene (3.3-3.0 million years ago) represented a period during which atmospheric CO_2 concentrations were similar to that of present day. Globally, the climate was warmer by about 2-3^{o}C, and warmer for prolonged periods. The idea of an analogue to future global climate change, albeit with caveats, has created much interest in this period, with focus on both climate proxy data and model simulations. At a time when there was reduced glaciation in Antarctica, there is evidence from benthic foraminifera to suggest that North Pacific deep waters were much colder than North Atlantic Deep Water and that subsequent glaciation of Antarctica had global ramifications by altering the deep ocean circulation and contributing to the intensification of glaciation in the opposite hemisphere.

The Pliocene Model Intercomparison Project (PlioMIP) was established by bringing together the paleodata analysis group, PRISM, and various climate modelling groups to further our knowledge of this period. Specific protocols have been set up for climate model experimental design, utilizing the latest paleoenvironmental reconstruction datasets which include Pliocene vegetation, soils, ice distribution and ocean bathymetry. In particular, Pliocene ice sheet reconstructions depict a West Antarctic seaway, no ice over West Antarctica, small increases in the elevation in the interior of Antarctica and retreat of ice sheet in the low-lying Wilkes and Aurora subglacial basins, in accordance to proxy evidence. In the present study, we ran experiments using the atmosphere-ocean coupled model, MIROC4m, to investigate their effects on the climate by incorporating all these latest boundary conditions from PlioMIP2. Related sensitivity experiments help to quantify the relative contribution to Pliocene warmth from individual boundary conditions and to investigate the climate and Earth system sensitivity.

Keywords: Pliocene, Climate modelling, Climate change, Antarctic ice sheet

