Geophysical Research Abstracts
Vol. 13, EGU2011-436, 2011
EGU General Assembly 2011

Sensitivity of Pliocene Ice Sheets to Orbital Forcing

Aisling Dolan (1), Alan Haywood (1), Daniel Hill (2), Harry Dowsett (3), Stephen Hunter (1), Daniel Lunt (4,5), and Steven Pickering (1)

(1) University of Leeds, Leeds, UK (eeamd@leeds.ac.uk), (2) British Geological Survey, Keyworth, Nottingham, UK, (3) U.S. Geological Survey, Reston, VA, USA, (4) University of Bristol, Bristol, UK, (5) British Antarctic Survey, Cambridge, UK

The stability of the Earth's major ice sheets is a critical uncertainty in predictions of future climate and sea level change. One method investigating the behaviour of the Greenland and the Antarctic ice sheets in a warmer-than-modern climate is to look back at past warm periods of Earth history, for example the Pliocene. Here we present climate and ice sheet modelling results for the mid-Piacenzian warm period (mPWP), which has been identified as a key interval for understanding warmer-than-modern climates (Jansen et al., 2007). Using boundary conditions supplied by the USGS PRISM Group (Pliocene Research, Interpretation and Synoptic Mapping), the Hadley Centre coupled ocean-atmosphere climate model (HadCM3) and the British Antarctic Survey Ice Sheet Model (BASISM), we show large reductions in the Greenland and East Antarctic Ice Sheets (GrIS and EAIS) compared to modern in standard mPWP experiments.

We also present the first results illustrating the variability of the ice sheets due to realistic orbital forcing during the mid-Piacenzian. While GrIS volumes are lower than modern under even the most extreme (cold) mid-Piacenzian orbit (losing at least 30% of its ice mass), the EAIS can both grow and shrink losing up to 15% or gaining up to 10% of its present-day volume. The changes in ice sheet volume incurred by altering orbital forcing alone means that global sea level rise can vary by more than 23 m during the mid-Piacenzian. However, we have also shown that the response of the ice sheets to mPWP orbital hemispheric forcing can be in anti-phase, whereby the greatest reductions in EAIS volume are concurrent with the smallest reductions of the GrIS. If this relationship holds true throughout the mPWP then the total eustatic sea level response would be dampened compared to ice sheet fluctuations. Future work may show that maximum eustatic sea level rise does not correspond to orbital maxima, but occurs at times where the anti-phasing of Northern and Southern Hemisphere ice sheet retreat is minimised.