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Modelling climate evolution through the last interglacial

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The last interglacial, from approximately 130-116 kyr before present (often referred to as the Eemian), was a period of sustained warmth which serves as a partial analogue for future, warmer climate conditions. Polar ice-core data suggest that temperatures at high latitudes were up to 4°C higher than during the pre-industrial, and a recent assessment of eustatic sea level concluded that a high-stand of up to 9m is consistent with available data. This implies that parts of either the Greenland or Antarctic ice sheets (or both) were ablated relative to present, suggesting that climate conditions were very different from the recent past. An important forcing mechanism during the early part of the last interglacial was the increased level of incident solar radiation in the Northern Hemisphere summer resulting from the particular configuration of Earth's orbit at this time. However, the climate system response is complicated by numerous feedback mechanisms which can be (partially) accounted for in coupled climate model evaluations.

We make use of a fast version of the coupled climate model HadCM3 to investigate the nature and possible mechanisms of Eemian climate change by running a series of snapshot simulations spaced at 2kyr or 4kyr intervals. Using this approach we attempt to illustrate the temporal evolution of climate at this time. Each individual simulation is forced with appropriate values of orbital parameters and trace gases (derived from ice-core data) and with estimates of global ice sheet extent. The resulting time-series of the modelled climatic state is used to quantify whether these forcings are able to give adequate agreement with inferences derived from ice-core data concerning the timing and magnitude of polar warmth. We also make comparisons with a precisely dated, high-resolution speleothem record from Germany which suggests diverging trends in temperature and precipitation over the Eemian period in Europe.