Geophysical Research Abstracts
Vol. 16, EGU2014-6897, 2014
EGU General Assembly 2014

The climate and vegetation of Marine Isotope Stage 11

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The climate of Marine Isotope Stage (MIS) 11, the interglacial roughly 400,000 years ago, is investigated for four time slices, 416, 410, 400, and 396 ka BP. We compare results from two climate models, the EMIC CLIMBER2-LPJ and the GCM CCSM3, to reconstructions of MIS 11 climate and vegetation, mainly from terrestrial records.

The overall picture is that MIS 11 was a relatively warm interglacial in comparison to preindustrial, with NH summer temperatures early during MIS 11 (416 – 410 ka BP) warmer than preindustrial, though winters were cooler. Later in MIS 11, especially around 400 ka BP, conditions were cooler in the NH summer, mainly in the high latitudes.

Climate changes simulated by the models were strongly driven by insolation changes, with the exception of two local feedbacks that amplify climate changes. Here, the NH high latitudes, where reductions in sea ice cover lead to a winter warming early in MIS 11, as well as the tropics, where monsoon changes lead to stronger climate variations than one would expect on the basis of latitudinal mean insolation change alone, are especially prominent.

Both models support a northward expansion of trees at the expense of grasses in the high northern latitudes early during MIS 11, especially in northern Asia and North America, in line with the available pollen-based reconstructions. With regard to temperature and precipitation changes, there is general agreement between models and reconstructions, but reconstructed precipitation changes are often larger than those simulated by the models. The very limited number of records of sufficiently high resolution and dating quality hinders detailed comparisons between models and reconstructions.