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Northern high latitudes climate response to mid-Holocene insolation: model-data comparison

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The orbitally_induced changes in mid-Holocene insolation cause an amplification of the seasonal cycle in the Northern Hemisphere. The climate response over Northern high latitude in mid-Holocene has been investigated in three types of PMIP (Paleoclimate Modelling Intercomparison Project) simulations to study the different feedbacks in the climate system. The model results have also been compared with the collected reconstructions, which is mostly distributed over the Northern Atlantic region.

The orbital forcing in PMIP models leads to an increase by 23.5W/m2 of the insolation in northern high-latitude (60˚N north) in summer, and a slight decrease by -2.3W/m2 in winter over the region. PMIP1 simulations with the fixed SST show that the atmospheric response to this orbital forcing produces a 0.8˚C warming in summer and a cooling in the rest of the year. In PMIP2 ocean-atmosphere coupled simulations, the sea-ice-albedo feedback enhance the summer warming to 1.1˚C, and the thermal inertia of the ocean lead to a 1.2˚C warming in autumn and a 0.5˚C warming in winter, while the cooling in spring remains the same as in PMIP1 simulations. The PMIP2 ocean-atmosphere-vegetation coupled simulations show warming in all seasons, the changes beyond 1˚C in winter, summer and autumn.

The collected reconstructions show about 1.0˚C warming in summer and 0.6˚C warming in winter during mid-Holocene. It is indicated that the climate response in PMIP2 simulations is better agreement with the reconstruction data than the PMIP1 simulations, while the vegetation feedbacks amplify the response in temperature both in summer and winter.