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Validation of an atmosphere-ocean-vegetation model with mid-Holocene palaebotanic data for the Northern extratropics

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Simulations of mid-Holocene climate (some 6000 years before present) using the comprehensive atmosphere-ocean-vegetation model ECHAM5-MPIOM-LPJ have been analysed by using the diagnostic biogeographical BIOME4 model. These reconstructions characterize combinations of climate parameters like changes in the seasonal cycles of temperature and moisture balance, which induce complex changes in vegetation distribution. Comparison with a previous version of the ECHAM model (ECHAM3-LSG) shows clear differences in vegetation reconstructions but not in their orbital induced mean changing signals. In agreement with the palaeovegetation data, mid-Holocene boundary conditions cause a decline in tundra, an increase of xerophytic types and a shifting of forest communities. North of 40 °N forests occupy almost 70 % of the extratropical habitats and especially the boreal forest increases evidently in the mid-Holocene (6ka) runs in contrast to the less realistic reduction in previous simulations concerning the competition to southern vegetation. The main response to mid-Holocene climate change refers to the increase of temperate grassland caused by drier interior environments. The widespread shrubby tundra types are reduced evidently, consigning a tree suitable prolongation of the growing season mainly in autumn and a considerable reorganization of tundra types reflecting asymmetric polar changes and high intra-tundra variability.