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Assessment of uncertainty in simulations of the mid-Holocene climate

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Modelling paleoclimates still represents a challenge for models of all complexities. For the mid-Holocene, modelling studies agree that the response of the ocean and the vegetation to the insolation changes feeds back on the climate. There is less consensus, however, on the relative magnitude of the two feedbacks and the strength of the synergy between them. This discrepancy may arise either from statistical uncertainty caused by internal climate variability or systematic errors due to insufficient model parameterisation.
We quantify both the statistical and partly the systematic errors by extensive simulations with the general circulation model ECHAM5/JSBACH-MPIOM. First, we determine the statistical uncertainty in an ensemble of centennial-scale simulations. Second, we investigate the sensitivity of the atmosphere-vegetation feedback with respect to the parameterisation of the albedo of snow-covered land. This includes the reflectivity of snow as well as the masking of the snow by boreal forest.
Our study reveals that the divergent results of the previous mid-Holocene studies can partly be related to the statistical uncertainty. The simulations including a dynamic ocean show a large variability. This leads to a sampling error which affects the magnitude of the diagnosed feedbacks. Furthermore, our results suggest that previous models included a more sensitive atmosphere-vegetation coupling than ECHAM5/JSBACH.