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Interglacial vegetation dynamics within the MPI-ESM

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Two model studies based on the Earth System Model (ESM) ECHAM5/MPI-OM1/JSBACH of the Max-Planck-Institute for Meteorology will be presented showing the vegetation response to orbital forcing. A 6000 years transient simulation of the Holocene and a time-slice model experiment for the Eemian are investigated. The model comprises dynamical components for atmosphere, ocean, and biosphere including an approach to simulate vegetation disturbance by fire dynamics and wind.

The model results show reasonable patterns for temperature and precipitation changes (compared to present day climate). For the Holocene the annual mean global temperature is slightly decreasing (approximately 0.1 K), but the regional and seasonal changes are much larger. For example, Arctic temperatures are in winter up to 5 K higher (for the Holocene) and differences of up to -3 K are simulated for tropical west Africa, but only minor changes in the precipitation patterns related to changes within the tropical rain belt are simulated by MPI-ESM. At the same time shifts in the fractional vegetation cover are computed. Striking is for example the shift of the boreal tree line and the greening of West Africa during the early Holocene. The patterns derived from the Eemian snap-shot simulation feature similar, but more pronounced changes. All these vegetation changes are also reflected in the carbon storage on land. The amount of carbon stored in biomass decreases during the transient 6000 years from the Holocene to present day, as the fraction of forest covered area decreases with time and is replaced by grass and shrubs.