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Vegetation feedbacks during the Last Interglacial Climate

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The Community Climate System Model version 3 (CCSM3) with a Dynamic Global Vegetation Model (DGVM) is used to study vegetation related feedbacks during the last interglacial (125 ka BP), and the glacial inception (115 ka BP). These times represent periods with maximum and minimum summer insolation in the northern hemisphere. Two simulations with adapted orbital parameters and greenhouse gas concentrations have been performed. In CCSM3, a vegetation decrease in North Siberia and North America at 115-ka is associated with a long-term cooling trend, which is connected with a continuous increase in northern hemisphere sea ice volume and an expansion of the permanently snow-covered areas. A closer inspection of the summer situation in the 115-ka simulation shows that although the total amount of precipitation in this region decreases, an increase of snowfall is simulated. The reduced summer insolation leads to reduced summer temperatures to a level that allows perennial snow coverage in the extreme regions.

By contrast, simulation period at 125-ka represents the warm phase of the last interglacial and show a presence of vegetation in high north latitude and northern hemisphere monsoonal regions which disappears at 115-ka simulation. The increased vegetation can be directly explained by enhanced rainfall in most regions. In North Africa, this is associated with a northward shift of the Inter-Tropical Front and a low-level westerly inflow of moist air from the subtropical Atlantic. In summer, reduced temperatures in North Africa due to enhanced cloudiness are caused by additional moisture transport. The resulting changes in the meridional surface-temperature gradient lead to a northward shift of the mid-tropospheric African Easterly Jet. These results suggest that the model is able to simulate essential features of the transition from a cold to a warm stage and also in this case the changes in Earth's orbital parameters are sufficient to trigger this behaviour. Hydrologic-cycle changes (i.e. moisture recycling, water vapour fluxes, etc.) in the last interglacial will be discussed in detail (the importance of biogeophysical feedbacks between vegetation and climate as well as the role of terrestrial carbon storage will be analysed as the next step).