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# Modeling the Global Monsoon System During Glacial Climate Events

U. Merkel (1), M. Prange (1,2), M. Schulz (1,2)

(1) MARUM - Center for Marine Environmental Sciences, University of Bremen, 28334 Bremen, Germany (umerkel@marum.de), (2) Faculty of Geosciences, University of Bremen, 28334 Bremen, Germany

We employ the comprehensive NCAR Community Climate System Model (version 3) to assess the state of the global monsoon system during specific time intervals of the last glacial period. In contrast to previous studies, we take into account changes in ice-sheet distribution, greenhouse-gas concentrations and orbital parameters for marine isotope stage 3 (MIS3, centered on 35 ka BP) and the last glacial maximum (LGM, centered on 21 ka BP). Both simulations result in a significant reduction of the Atlantic Ocean meridional overturning circulation as compared to modern conditions. Perturbing deep-water formation in the North Atlantic Ocean in these glacial baseline simulations results in explicit representations of Dansgaard-Oeschger-type stadials and interstadials as well as Heinrich-type events.

LGM boundary conditions induce a large-scale drying in the West African monsoon region associated with a strengthening and southward shift of the African easterly jet. Through atmospheric dynamics, the effect of ice-sheets is rapidly communicated into a response of the Indian and South East Asian summer monsoon systems and the South American monsoon.

Dansgaard-Oeschger-type stadial boundary conditions lead to a pronounced intensification of the African, Indian and South East Asian summer monsoon compared to the LGM. In the Dansgaard-Oeschger-type interstadial simulation, the response of all tropical monsoon systems is similar to the stadial simulation but exhibits a stronger amplitude. This suggests a predominance of the orbital and ice sheet forcing over the imposed Dansgaard-Oeschger climate variability. Furthermore, the hydrological response to the different glacial boundary conditions exhibits a strong seasonality and even suggests phase shifts in the annual cycle on a regional scale.

Tropical inter-ocean basin teleconnections appear to be weakened during MIS3 stadials compared to the LGM as illustrated by a less pronounced covariation between tropical Atlantic hydrological conditions and the El Niño/Southern Oscillation in the eastern tropical Pacific.