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Influence of a small and maximum lake and wetland extent on the simulated West African monsoon precipitation during the mid-Holocene

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During the mid-Holocene, an expansion of vegetation, lakes and wetlands over North Africa reinforced the West African monsoon precipitation increase that was initiated by changes in the orbital forcing. Sedimentary records reflect these surface changes, however, they provide only limited spatial and temporal information about the size and distribution of mid-Holocene lakes and wetlands. Previous simulation studies that investigated the influence of mid-Holocene lakes and wetlands on the West African monsoon precipitation, prescribed either a small lake and wetland extent or focusing on mega-lakes only. In contrast to these simulation studies, we investigate the range of simulated West African monsoon precipitation changes caused by a small and a potential maximum lake and wetland extent during the mid-Holocene.

Therefore, four mid-Holocene sensitivity experiments are conducted using the atmosphere model ICON-A and the land model JSBACH4 at 160 km resolution. The simulations have a 30-year evaluation period and only differ in their lake and wetland extent over North Africa: (1) pre-industrial lakes, (2) small lake extent, (3) maximum lake extent and (4) maximum wetland extent. The small lake extent is given by the reconstruction map of Hoelzmann et al. (1998) and the potential maximum lake and wetland extent is given by a model derived map of Tegen et al. (2002).

The simulation results reveal that the maximum lake extent shifts the Sahel precipitation threshold (> 200 mm/year) about 3 ° further northward than the small lake extent. The major precipitation differences between the small and maximum lake extent results from the lakes over the West Sahara. Additionally, the maximum wetland extent causes a stronger West African monsoon precipitation increase than the equally large maximum lake extent, particularly at higher latitudes.