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Astronomical forcing of an exceptionally long Sahel wet phase during Marine Isotope Stage 11c

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Increased rainfall and expanded vegetation over North Africa during the early-to-mid Holocene was related to an intensified West African monsoon and a northward displacement of the monsoon trough triggered by astronomical forcing. Similar wet phases are evidenced for earlier interglacials including Marine Isotope Stage (MIS) 11c (ca. 425-395 ka before present). We performed a series of time slice simulations using the comprehensive coupled climate model CCSM3 including a dynamic vegetation module in order to examine the dynamics of the MIS 11c humid period. Proxy records from a marine sediment core site off Northwest Africa suggest an extremely long Sahel/Sahara wet phase during MIS 11c between ca. 420 and 405 ka ago, revealing that North African rainfall changes did not simply follow local summer insolation. Instead, the climate model simulations suggest an important role of the obliquity-driven intra-hemispheric insolation gradient in forcing Sahelian rainfall changes. The specific phasing between precession and obliquity during the MIS 11c interglacial resulted in the exceptionally long wet phase in the Sahel region. The early part of this wet phase was primarily induced by northern-hemispheric differential warming in response to maximum obliquity around 416 ka before present. As such, this interval may well serve as an analog for potential future Sahel rainfall increase induced by strong northern hemisphere extratropical warming.