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Astronomically forced western African (21°N-20°S) rainfall variations during the Last Interglacial

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Many studies document an intensified NW African monsoon during the African Humid Period (11.5-5.5 ka) in response to increased summer insolation. Similarly, the particularly high summer insolation during the Last Interglacial (LIG, 129-116 ka) led to enhanced North African rainfall and a "green Sahara". Although this pluvial period seemed to facilitate the migration of modern humans out of Africa, the precise evolution of African wet conditions during the LIG remains unknown.
Here we aim to document the evolution of western African precipitation during the LIG and identify the climate forcing associated. We use the major element compositions of nine marine sediment cores located along the W African margin (21°N-20°S) in order to characterize the terrestrial climatic conditions in the region where terrigenous material originates and infer past western African precipitation changes. Geochemical data are compared to results from a transient simulation (130-115 ka) performed with the coupled ocean – atmosphere Community Climate System Model CCSM3 and forced by insolation variations only.
Both geochemical and model data indicate humid conditions in NW Africa (9-21°N) between 127 and 122 ka, in response to the high summer insolation. The period of intensified NW African monsoon starts ∼3 ka later in geochemical data (127 ka) than in the simulation (130 ka). This result suggests that the persistent melting of northern ice sheets and associated cooling at the beginning of the LIG delayed the orbitally-induced intensification of the NW African monsoon. In addition, geochemical and model data indicate a slight precipitation increase in equatorial Africa throughout the LIG, in response to the small increase in annual insolation induced by the obliquity decrease. At ∼5-10°S, sediment cores and model results document a small decrease in annual precipitation that is consistent with increasing sea level pressure in southern Africa during the LIG. This pattern seems to follow the decrease in June-July-August (JJA) insolation. Although modern JJA rainfall is very limited at 5-10°S, the contribution of JJA precipitation to the annual rainfall amount is enhanced during the LIG. Finally, the data indicate very limited rainfall changes at 20°S during the LIG. The model shows east-west contrasting rainfall patterns in Southern Africa (similarly to what is observed during the Holocene), which lead to negligible rainfall variations when averaged over the core catchment area.
To conclude, long-term changes in western African precipitation respond to insolation variations during the LIG, except during its early part when persistent melting of northern ice sheets delayed the intensification of the NW African monsoon.