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Tropical African Rainbelt dynamics since the Last Glacial Maximum

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The tropical rainbelt delivers nearly all of the rainfall between 20°N and 20°S in Africa and so is a vital part of the African climate system. On millennial timescales, rainfall fluctuations in Africa are commonly attributed to a latitudinal migration in the position of the rainbelt. However, this mechanism is not consistent with new proxy data, which suggest synchronous wet and dry conditions in both hemispheres. As such, we tested the migration hypothesis by reconstructing the dynamics of the rainbelt for extreme climate states of the past. Proxies utilised for this purpose were estimates of weathering intensity based on major element composition of sediments derived from terrigenous soils and estimates of vegetation type based on δ^{13}C of plant-wax n-alkanes. Samples were taken from a large-scale latitudinal transect of 8 marine sediment cores located offshore tropical western Africa, covering the entire seasonal range of the tropical rainbelt.

We find that, contrary to the prevailing hypothesis, the rainbelt was not located in a more southerly position relative to modern-day during Heinrich Stadial 1 and the Last Glacial Maximum but instead was contracted latitudinally in both hemispheres. A contraction rather than a southward shift may have been linked to the extension of Antarctic sea ice or to the cool glacial atmosphere during Heinrich Stadial 1 and the Last Glacial Maximum. During Heinrich Stadial 1, the rainbelt was shifted slightly southwards relative to the Last Glacial Maximum, which was likely associated with an enhanced inter-hemispheric SST gradient, although nonetheless, the rainbelt was compressed relative to modern-day conditions. These results suggest that glacial boundary conditions had a much larger influence on African rainfall distribution than ocean circulation.