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# Late Quaternary climate variability in southeast Africa driven by the southern westerlies and local insolation

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A scarcity of continuous, non-marine, palaeoenvironmental records in southeast Africa has led to uncertainty surrounding both past climate variability and its associated mechanisms. An 8.8-m long core extracted from the Mfabeni coastal peatland (KwaZulu-Natal, South Africa) provides the unique opportunity to reconstruct past climate continuously for the last 30 thousand years (ka BP). Here we explore vegetation ($C_3$/$C_4$) and hydrological variability using stable carbon ($\delta^{13}C_{wax}$) and hydrogen isotopes ($\delta D_{wax}$) from plant wax $n$-alkanes preserved in sediments from Mfabeni peat bog. $P_{aq}$ (a proxy representing aquatic vs. terrestrial $n$-alkanes) reflects Mfabeni water table levels. The Last Glacial Maximum at Mfabeni was characterized by higher contributions of $C_4$ grasslands, high evapotranspiration rates and a low water table. Northerly displacement of the westerlies during that time likely resulted in higher evapotranspiration rates and an extended dry season in southeast Africa. Between $c.$ 19 and 5 ka BP an expansion of $C_3$-type vegetation, less evapotranspiration and a rise in the water table occurred. A southward migration of the westerlies after 19 ka BP and an increase in local summer insolation resulted in more convective precipitation and an increase in the length of the wet season at Mfabeni. In the Late Holocene ($c.$ $<$5 ka BP), highly variable $\delta^{13}C_{wax}$ and $\delta D_{wax}$ values (but with a trend towards heavier values) and fluctuating $P_{aq}$ values (with a trend towards decreasing values) at Mfabeni, indicates environmental instability. We attribute this instability, and the observed trends, to the concurring high local summer insolation (causing strong convective rainfall during summer), and the returning influence of westerlies on the area (resulting in high evapotranspiration rates during winter). Furthermore, the increased influence of the westerlies during the Late Holocene may have heightened environmental sensitivity at Mfabeni, rendering the region increasingly susceptible to amplified El Niño-Southern Oscillation activity recognized in other records. Our findings document the importance of high latitude (westerlies) and low latitude (easterlies/monsoonal) climatic forcing mechanisms in southeast Africa, both inherent drivers of southern African climate variability.