Time Series Analyses of Northeast African Hydroclimate Variability

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Analysis of the complex relationship between orbital cycles and climate variability in Africa, where human life first emerged, can help us better understand the climate conditions that drove hominin evolution. Variability selection poses that the effects of natural selection are heightened during periods of high amplitude climate variability, leading to more adaptations and morphological changes of organisms living in that environment (Potts, 1996). However, the lack of quantitative, high resolution records of rainfall make it difficult to test these hypotheses. To overcome these hurdles, we synthesize multiple indicators of climate and analyze trends and rhythms of variability from ODP Site 967, a marine core located in the eastern Mediterranean that preserves most sapropel events from 3 Ma to today. We utilize the high resolution wet-dry index from Grant et al. (2017), which is derived from the PC2 component of XRF data and an aeolian dust record previously published by Larrasoaña et al., 2013, along with a lower resolution, yet arguably more representative of rainfall amount, leaf wax hydrogen isotope (δD_{wax}) record from the same archive. We perform time series analyses such as Lomb-Scargle and wavelet spectral analyses, cross spectral analysis, and gaussian filtering to study the spectral properties of both datasets. Our analyses have revealed a strong eccentricity band (400 kyr) periodicity in both the XRF and δD_{wax} records, which indicates the dominant importance of long-term eccentricity cycles on modulating the amplitude of the shorter eccentricity cycle and precessionally driven insolation. The relationship between low frequency orbital cycles and high-amplitude hydroclimate variability indicates that variability selection may operate on a wide range of timescales and has the potential to be the main driver of major hominin evolutionary changes.