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Warm mean annual air temperatures during Miocene to Pleistocene central Arabian humid periods

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The hydroclimate change in the hot and arid Arabian Desert under anthropogenic global warming is a subject of ongoing discussions. Climate models project rising mean annual temperatures coupled with decreasing precipitation averaged over Saudi Arabia with regional variance (Almazroui, 2020). Stable isotope analysis on a combined speleothem record from central Arabia revealed recurring local humid periods during globally warmer intervals over the past ~8 million years (Markowska et al., in review). The speleothem record showed a long-term drying trend towards present, which may potentially be controlled by temperature change. The present study aims to reconstruct mean annual air temperatures (MAATs) of central Arabia during humid periods. These temperatures provide valuable benchmark data for past and future climate models in a region where terrestrial climate archives are scarce. Recent advances in speleothem-based paleothermometry facilitate extracting robust MAATs. We present data from several independent paleothermometers: Fluid inclusion isotopes (de Graaf et al., 2020), TEX_{86} (Meckler et al., 2021; Wassenburg et al., 2021), fluid inclusion microthermometry (Krüger et al., 2011), and dual clumped isotopes (Bajnai et al., 2020). These reconstructions show that recurrent wet intervals during the Miocene to Pleistocene in the Arabian Peninsula occurred at warmer than modern MAATs. We note, however, that temperature is not the only driver of humidity in the Arabian Peninsula and that both dry and humid periods likely existed under a warmer than today's climate. Therefore, these observations cannot directly be interpreted as indicator that anthropogenic global warming will lead to future wet conditions in Saudi Arabia. Overall, we provide novel quantitative paleoclimate parameters that can inform climate model experiments leading to improved predictions for future climate scenarios.