

Behavior of the Azores High from 1200 Years of Proxy Records and Climate Model Simulations

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PAGES Open Science Meeting 2022, Virtual

The Azores High (AH), a subtropical ridge in the atmosphere over the North Atlantic comprising one node of the North Atlantic Oscillation (NAO) system, has a dominant influence on the weather and climate of the Iberian Peninsula and northwest Africa. The behavior of the entire NAO system over the last millennium has been the subject of much debate in both proxy- and model-based studies. Many studies have focused on the behavior of the entire NAO system, but we focus solely on the behavior of the AH due to its proximity to this region. Other proxies from this region, mainly from Spain and Morocco, have provided details about atmospheric dynamics yet spatiotemporal gaps remain. In this study, we present a continuous, sub-decadally-resolved composite stalagmite carbon isotopic record from three partially overlapping stalagmites from Buraca Gloriosa (BG) cave, western Portugal, situated within the center of the AH, that preserves evidence of regional hydroclimate variability from approximately 800 CE to the present. This composite record, developed from U-Th dating and laminae counting paired with carbon isotopes, primarily reflects effective moisture in western Portugal. Given the close pairing of AH behavior (intensity, size, and location) and moisture transport in this region, the BG composite record allows for a thorough analysis of AH behavior over time. Multidecadal to centennial scale variability in the BG record and state-of-the-art last millennium climate model simulations show considerable coherence with precipitation-sensitive records from Spain and Morocco that, like BG, are strongly influenced by the intensity, size, and location of the AH. Synthesis of model output and proxy data suggests that western Portugal was persistently dry during much of the Medieval Climate Anomaly (MCA; ~850-1250 CE) and Modern era (1850 CE-present) and experienced wetter conditions during Little Ice Age (LIA; ~1400-1850 CE). Even considering age uncertainties from the Iberian Peninsula and northwest Africa proxy records, the apparent timing in the transition from a relatively dry MCA to a wetter LIA is spatially variable across this region, likely due to the non-stationary behavior of the AH system.