The Link Between Southern Portuguese Climate and the East Atlantic Mode from Highly Resolved Speleothem Records

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Climate in the Iberian Peninsula is impacted by both internal and external climate modes, which are expected to shift in position and intensity due to anthropogenic climate change. Examples of such modes include the North Atlantic Oscillation (NAO) and the East Atlantic mode (EA). Changes in the behavior in these regional climate modes could significantly alter water availability in the Iberian Peninsula, a region identified by model projections as particularly sensitive to future warming scenarios. There has been extensive research and paleoclimate reconstructions of the NAO and its impacts on Iberian climate. However, to date few paleoclimate records have been developed to evaluate the behavior of the EA over the late Holocene and into the present. The development of highly resolved regional paleoclimate records from Iberia is critical for improving the predictive capability of regional climate models under future warming scenarios and to determine the extent to which different teleconnection patterns are influencing climate. Here we present a near annually resolved stable carbon isotope (δ13C) and oxygen (δ18O) isotope time-series from three stalagmites from the Algarve region of southern Portugal from two caves within 2.3 km of each other. The southern coast of Portugal offers an ideal location to study the behavior of the EA due to the modulation of storm tracks coming across the North Atlantic Ocean into Iberia associated with the EA. U/Th dating indicates that our composite record spans the last millennia continuously through 2018 CE. Two stalagmites (GIA-19-1 and C-18-1) stopped growing around 1600 CE, during a dry interval, and sample GIA-19-2 grew continuously since the 15th century. GIA-19-2, with sub-annual resolution, is compared to modern instrumental records to evaluate the influence of specific environmental controls, including temperature and precipitation amounts. Isotope data from all three stalagmites exhibit substantial multidecadal variability indicating relatively wet and dry intervals. Based on our initial results, it is likely that both temperature and precipitation amount effects are the dominant controls on isotopic variability in these stalagmites. Comparison of the GIA-19-2 oxygen isotope time-series with the instrumental index (1950 to present) and reconstructed index (1650 CE to present) of the EA mode shows strong coherence with both index records. Hence, multidecadal variability observed in our stalagmite isotope time series may provide insight into the historical behavior of the EA mode and its resulting impacts on southern Portuguese climate.