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Regional influence of decadal to multidecadal Atlantic Oscillations during the last two millennia in Morocco, inferred from two high resolution δ18O speleothem records

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Climate projections predict substantial increase of extreme heats and drought occurrences during the coming decades in Morocco. It is however not clear what can be attributed to natural climate variability and to anthropogenic forcing, as hydroclimate variations observed in areas such as Morocco are highly influenced by the Atlantic climate modes. Since observational data sets are too short to resolve properly natural modes of variability acting on decadal to multidecadal timescales, high resolution paleoclimate reconstructions are the only alternative to reconstruct climate variability in the remote past.

Herein, we present two high resolution and well dated speleothems oxygen isotope (δ18O) records sampled from Chaara and Ifoulki caves (located in Northeastern and Southwestern Morocco respectively) to investigate hydroclimate variations during the last 2000 years. Our results are supported by a monitoring network of δ18O in precipitation from 17 stations in Morocco. The new paleoclimate records are discussed in the light of existing continental and marine paleoclimate proxies in Morocco to identify significant correlations at various lead times with the main reconstructed oceanic and atmospheric variability modes and possible climate teleconnections that have potentially influenced the climate during the last two millennia in Morocco. The results reveal substantial decadal to multidecadal swings between dry and humid periods, consistent with regional paleorecords. Evidence of dry conditions exist during the Medieval Climate Anomaly (MCA) period and the Climate Warm Period (CWP) and humid conditions during the Little Ice Age (LIA) period. Statistical analyses suggest that the climate of southwestern Morocco remained under the combined influence of both the Atlantic Multidecadal Oscillation (AMO) and the North Atlantic Oscillation (NAO) over the last two millennia. Interestingly, the generally warmer MCA and colder LIA at longer multidecadal timescales probably influenced the regional climate in North Africa through the influence on Sahara Low which weakened and strengthened the mean moisture inflow from the Atlantic Ocean during the MCA and LIA respectively.

Keywords: Speleothems, δ18O, Morocco, Hydroclimate, AMO, NAO.