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Stable isotope evidence for shifting Mediterranean climatic influences in Western Romania, East-Central Europe

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The stable isotopic composition of oxygen and hydrogen in precipitation, preserved in various sedimentary archives (speleothems, cave ice, tree rings) is being intensively used to reconstruct past climatic variability in western Romania. These studies heavily rely on the assumption that air temperature is the main factor controlling the isotopic composition of precipitation and hence this climatic parameter is the one reconstructed. However, ongoing monitoring studies are increasingly showing that this, especially along Romania's western border, moisture source is playing an important role in determining the isotopic composition of precipitation, hence complicating the simplistic picture outlined above. One of the main factors influencing climate variability in Romania is the North Atlantic Oscillation (NAO), a measure of the strength of the Icelandic Low and Azores High. Over During the positive NAO phase, the Atlantic storms are displaced northward and, although reduced in strength, Mediterranean cyclones penetrate further north. During the negative phase however, the Atlantic storms track is displaced southward, restricting the area receiving Mediterranean precipitation to the SW corner of Romania.
Here we present isotopic evidence for a shift in the source of precipitation from North Atlantic to Mediterranean ones in SW Romania that masks the temperature signal recorded in the stable isotopic composition of precipitation. Between April 2012 and 2014 we have collected monthly samples of precipitation along a N-S transect in Western Romania and have analyzed them for their δ18O and δ2H. Precipitation in NW Romania are derived solely from North Atlantic sources, while those in SW Romania mix moisture evaporated from both the North Atlantic and the Mediterranean Sea. The northern boundary of the Mediterranean influence is shifting in phase with the NAO index and the position of the jet-stream. As a result, during periods with high NAO index, the stable isotope composition of precipitation in north and central Romania is similar, while during periods of low NAO index, precipitations in NW and SW Romania have different isotopic patterns, clearly showing the influence of the Mediterranea moisture (i.e. a shift towards more positive values and a higer d-excess, closer to the Eastern Mediterranan Water Line, in SW).
These finding suggest that it is possible to reconstruct past change in the strength of the NAO and the northward expansion of Mediterranean climatic influences, by analyzing (for their isotopic composition) pairs of similar sedimentary archives from N and S Romania.