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Moisture sources of precipitation over a site in central Europe and implication of its oxygen isotope composition

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The source of moisture is an important part of the hydrological cycle that affects climate system. Potentially, moisture sources are important controls of the isotope composition of precipitation, but their studies in the continental mid- and low-latitudes are still scarce. We identify moisture uptake locations of precipitation over Postojna (Slovenia) for period from 2009 to 2013. By using HYSPLIT trajectory model of NOAA, we did 5-day reconstruction of air mass history for the days with precipitation and determined the moisture uptake locations along back trajectories. Moisture uptake locations were identified along each trajectory using HYSPLIT output data and standard equations for saturation humidity mixing ratio, saturation vapour pressure and specific humidity. Our analysis showed that during studied period around 45% of the precipitation over Postojna originated from Mediterranean and south Atlantic area, with majority of locations originated in the Adriatic Sea. On the other hand, 41% of precipitation originated from moisture recycled over continents, predominantly from Pannonian basin.

Multivariable analyses of source regions do not explain any variability of the oxygen isotope composition of precipitation over Postojna. The large proportion of recycled moisture is originated from transpiration rather than evaporation, which produced water vapour with less negative δ18O values. Thus, recycled moisture has and isotope signature undistinctable from the oceanic moisture sources. Climate parameters partly control δ18O values of precipitation, being highly important in paleoclimate studies. In case of Postojna δ18O values of precipitation, surface temperature is the main climate control, whereas amount effect was not recorded, and winter North Atlantic Oscillation (NAO) does not impact the δ18O values of precipitation.

We corelated Western Mediterranean Oscillation (WeMO) with oxygen stable isotope composition and found small, but significant correlation. However, multivariate analyses correlation of WeMO and temperature du not explain more variability than temperature alone. Therefore, our interpretation of δ18O values of precipitation in terms of climate is limited to surface temperature, although at least half of the variability observed still depends on unknown controls of the hydrological cycle.

Speleothems from Postojna Cave are under investigation and have the potential to record a δ18O signal related to the δ18O values of precipitation. Therefore, these speleothems may be used to reconstruct temperature in the region.