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# Identification of source-sink relationships in southern Africa by stable water isotopes analysis and Lagrangian moisture source diagnostics

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Many palaeoclimate reconstructions are based on the fact that stable water isotopes are conserved in different highly resolved paleo-archives such as ice cores or calcium carbonates. Stable water isotopes are tracers of moisture in the atmosphere because they record information about evaporation and condensation processes during the transport of air parcels. These processes cause isotopic fractionation that leads to isotopic enrichment or depletion. The isotopic composition of precipitation is strongly correlated with altitude above sea level, distance to the coast and local surface air temperature. Knowledge on the source and transport of moisture is thus crucial for the interpretation of stable isotopes in precipitation and in palaeo-archives.
Studies analysing the linkage between stable water isotope measurements and moisture sources in southern Africa are scarce. Yet, as changes in the transport pattern can influence precipitation patterns and amounts, in a semi-arid region like southern Africa that is threatened by droughts, this knowledge is of particular interest. Thus, the aims of this study are (1) to reveal the principal moisture source areas and transport routes of specific target areas in southern Africa, (2) to assess the influence of different transport patterns on the isotopic composition of precipitation and by this (3) to create a modern analogue for palaeoclimate studies in this region.
About 200 water samples, mainly from headwaters of rivers, but also from precipitation events, springs and lakes, were collected throughout southern Africa and the stable water isotope composition ($\delta^2H$ and $\delta^{18}O$) was analysed. To detect moisture sources for this set of isotope measurements, backward air parcel trajectories were calculated from the sample location, using the LAGRANTO tool based on ERA5 reanalysis data. Variations in specific humidity along the trajectories were then used to detect moisture uptake.
The analysis reveals main transport patterns related to the Intertropical Convergence Zone and easterly winds as well as the effects of topographical forcing, which is, for example, very pronounced above Lesotho. The results provide detailed insights into the relationships between atmospheric circulation and $\delta^2H$ and $\delta^{18}O$ values of precipitation over southern Africa, which is a

prerequisite for the interpretation of isotopic records that are used for palaeoclimatic reconstructions.