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Patterns of spatial and temporal variability of speleothem δ^{18}O records in Western Europe: an initial assessment of SISAL database

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Speleothems (secondary cave carbonates) are a widely used archive for the palaeoclimate reconstruction, particularly for high-resolution climate variability, due to their exceptional chronological control. The first version of the SISAL database contains 376 speleothem records from across the globe; about a quarter of these records are from Western Europe, making it the region with the highest density of published speleothem datasets. Western Europe also possesses the highest density of Global Network of Isotopes in Precipitation (GNIP) stations, some of the longest meteorological records, and global modelling and reanalysis datasets, as well as a large number of continuous, high-resolution multiannual cave monitoring time-series. This is a great advantage for the interpretation of δ^{18}O value in speleothems, which is driven by a complex interplay of regional and site-specific factors.

This study is the first assessment of the Western European data from the SISAL database, which reviews the SISAL records within the wider (palaeo-)climatic context of Western Europe, with the objective to investigate the suitability of large compilations of speleothem records to reveal the existence of regional trends in time, as well as to identify and promote the potential of cave sites in the region for future palaeoclimate studies. We find that i) present-day spatial trends in δ^{18}O from Western European speleothems generally mirror the trends in precipitation δ^{18}O. ii) Over the late Quaternary, site-specific noise in speleothems δ^{18}O presents the main issue for the extraction of a regional climate signal, especially over the Holocene. iii) Results are improved through the use of statistical methods, allowing the extraction of regional climate modes. Use of other types of data and more information about cave monitoring as well as an updated age modelling technique intercomparison study, can significantly enhance the potential of these records for regional palaeoclimate studies.

SISAL is a new valuable tool for intercomparison of speleothem δ^{18}O in a regional and global context. Inclusion of missing records in the future of versions of SISAL can considerably improve temporal and spatial coverage of the dataset. Furthermore, updating the age-models to include age-model uncertainties for all records would reduce the overall uncertainty of δ^{18}O time-series, and thus improve the level of accuracy in subsequent analyses.