Spatio-temporal coherency analysis of European Holocene speleothem $\delta^{18}O$ records reveals temperature driven changes

MICHAEL DEININGER[12] AND FRANK MCDERMOTT[34]

[1]Institute of Earth Sciences, University of Heidelberg, Im Neuenheimer Feld 234, 69120 Heidelberg Germany, michael.deininger@iup.uni-heidelberg.de
[2]Institute of Environmental Physics, University of Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg, Germany
[3]UCD School of Geological Sciences, University College Dublin, Belfield, Dublin 4, Ireland, frank.mcdermott@ucd.ie
[4]UCD Earth Institute, University College Dublin, Belfield, Dublin 4, Ireland

Speleothem $\delta^{18}O$ records are valuable continental archives of past environmental and climatic conditions. However, their interpretation is challenging because several processes can influence the $\delta^{18}O$ signal that is ultimately recorded. Here we investigated the spatio-temporal coherency of 10 European speleothem $\delta^{18}O$ records that grew during the Holocene and which span almost the entire European continent. For this we have applied a Monte Carlo Principal Component Analysis (MC-PCA) approach that accounts on the one hand for the uncertainties in individual speleothem age models, and on the other hand for the different and varying temporal resolutions of each speleothem $\delta^{18}O$ record. The MC-PCA approach allows the decomposition of speleothem $\delta^{18}O$ signals into components of common and individual variance. This methodology allows the identification of temporally coherent changes in speleothem $\delta^{18}O$ records, but it also facilitates their depiction spatially. The MC-PCA approach was performed on 1000 year time slices at a temporal resolution of 500 years during the last 6000 years. Our results suggest firstly a spatio-temporal coherency of the analysed speleothem $\delta^{18}O$ records and secondly that in these periods speleothem $\delta^{18}O$ records were influenced mainly by variations in air temperature.