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Calibration of isotope-climate transfer function for the interpretation of high-resolution speleothem records

M. J. Fischer (1), P. C. Treble (2)

(1) Australian Nuclear Science and Technology Organisation, Australia (mjf@ansto.gov.au), (2) Research School of Earth Sciences, Australian National University, Australia (pauline.treble@anu.edu.au)

Providing estimates of past climate changes on interannual-millenial timescales requires suitable proxy-climate transfer functions. Many proxies appear to show proxy-climate relationships that are characterised by different patterns at different timescales. An effective proxy-climate transfer function should be able to replicate all the patterns that are observed at multiple timescales. Here we develop a new climate-isotope transfer function for speleothems from middle latitude sites. In the low to middle latitudes, daily variation in precipitation isotopes (within individual months) is largely negative correlated with daily rainfall amount, this is true from year to year. However, the slope and intercept of this 'daily rainout line' may vary from year to year. These two points provide a theoretical basis for a new climate-isotope transfer function in which the slope and intercept of a daily ^{18}O-Precipitation line for a given month (or season) are modulated by organised patterns of climate variability, such as the tropical Southern Oscillation (SOI) and the extratropical Northern and Southern Annular modes (NAM, SAM). In constructing this new transfer function, we show how daily P-^{18}O relationships can be estimated using only monthly ^{18}O data and daily rainfall amounts! In this talk, we present an example (Perth region, Australia) of how the new transfer function is calibrated for the period 1960-present using monthly ^{18}O, daily Precipitation, and monthly EOFs from HadSLP2 (global sea level pressure). We then apply the new transfer function to back-predict monthly ^{18}O to 1900, and compare with the Moondyne Cave boardwalk speleothem record over the last century. The new transfer function provides a consistent picture of ^{18}O variability over a range of timescales,

and this has not been the case with any previous climate-isotope transfer function.