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Are temperature calibrations for Sr/Ca and δ^{18}O in corals and δ^{18}O in ice-core records site and time-scale dependent?

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Temperature calibrations are the core of any paleoclimate reconstruction and directly affect the amplitude and variability of reconstructed climate trends. Still, there is large variety of site and type specific calibrations and it is unclear whether this points to true differences in the proxy to temperature relationship or to uncertainties in the datasets and estimation methods.

The variety of temperature calibrations for δ^{18}O and Sr/Ca based proxies in coral aragonite and δ^{18}O proxies in ice share some similarities. Proxies from both archive types have been calibrated using both intra- and inter-annual resolution data sets, as well as by using spatial "core-top" style correlations. All are subject to measurement error on both the proxy carrier itself (the δ^{18}O or Sr/Ca measurements) and the target variable (temperature). Similarly, calibration parameters vary between data from different sites for both ice and coral based proxies.

In corals, the δ^{18}O - SST sensitivity (calibration slope) appears to be systematically less steep for intra-annual calibrations than for inter-annual or spatial calibrations. Similarly, for δ^{18}O in ice there is some indication for a time-scale dependency. However, much of the variation between calibrations is unexplained and there has been no rigorous test of these variations.

Here we test whether there are real differences between individual calibrations that cannot be accounted for by uncertainty in the datasets or differences in the statistical methods. We then quantify any variation and look for systematic dependencies on location, time- and spatial-scales. This will provide the basis for a better quantification of past climate trends and long term variability.