Geophysical Research Abstracts
Vol. 19, EGU2017-18340, 2017
EGU General Assembly 2017


# Quantifying uncertainty in proxy-based paleoclimate reconstructions

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There are now numerous geochemical tools that can provide quantitative estimates of past temperatures and hydrologic variables. These proxies for past climate are usually calibrated using empirical relationships with quantifiable uncertainty. Laboratory analysis introduces additional sources of uncertainty that must also be accounted for in order to fully propagate the uncertainty in an estimated climate variable. The aim of this presentation is to review the sources of uncertainty that can be quantified and reported when using different geochemical climate proxies for paleoclimate reconstruction. I will consider a number of widely used climate proxies, discuss the relative importance of various sources of uncertainty for each, and attempt to identify ways in which the scientific community might reduce these uncertainties. For example, compound-specific $\delta$D measurements can be used for quantitative estimation of source water $\delta$D values, a useful tracer for paleohydrologic changes. Such estimates have quantifiable levels of uncertainty that are often miscalculated, resulting in inaccurate error reporting in the scientific literature that can impact paleohydrologic interpretations. Here, I will summarize the uncertainties inherent to molecular $\delta$D measurements and the quantification of source water $\delta$D values, and discuss the assumptions involved when omitting various sources of uncertainty. The analytical uncertainty of $\delta$D measurements is often improperly estimated and secondary to the apparent fractionation between $\delta$D values of source water and molecule, normalization of data to the VSMOW scale introduces the largest amount of uncertainty.