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Estimating sedimentary proxies along with associated uncertainties

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Sedimentary proxies such as oxygen isotopes, pollen count, biomarkers, etc. allow us to investigate past climate variability and transitions. However, due to dating uncertainties that are inherent in the construction of proxy records, interpretations regarding past climatic shifts and variability are necessarily vague and/or difficult. Moreover, age uncertainties also make the inter-comparison of records from different geographical locations non-trivial.

We present here a generic, analytical, Bayesian framework that estimates the proxy versus time relations along with the uncertainty involved in such an estimation. We use this to reconstruct groundwater inflow and surface erosion proxies from the Lonar lake in central India.

We find that the variance of the proxy along the depth of an archive are inherently linked to its uncertainty of estimation along time, and consequently its variance in the time domain as well. For the Lonar lake data, we show that the variance of the proxies along depth is the major factor contributing to the final uncertainty rather than the dating uncertainties. Moreover, our framework naturally incorporates the proxy versus time estimates on an error-free, precise time scale that allows for easier interpretation of climatic shifts as well as inter-record comparisons.