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How to overcome data based difficulties in geoscience?

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There are many challenges in the field of time series analysis such as cumulative trends or sampling irregularities. Geophysical time series, particularly paleo-climate ones, have such problems almost in all proxies. The novel TrAnsformation-Cost Time-Series (TACTS) method is a suitable approach to overcome these challenges of cumulative trends and irregular sampling without degenerating the quality of the data set by, e.g., interpolation.

The standard method to regularize time sampling of time series is interpolation, but it collapses the quality of the proxies. Moreover, there are many different approaches to de-trend time series such as Gaussian high-pass filter, the de-trended fluctuation analysis. At the same time, the TACTS is able to de-trend and regularize the time series at the same time with keeping the quality of time series rather high. After applying the TACTS method the resulting cost time series shows regular sampling and can be further analyzed using standard methods.

The TACTS method has been developed and tested by using prototypical mathematical models. We have demonstrated its use by studying paleoclimate dynamics derived from speleothem data from the Secret Cave in Borneo, the KNI-51 cave in North Australia, and Dongge Cave, East China. By using the TACTS, we could distinguish all extreme transition events and found interesting alternating monsoon dynamics between North Australia and East China.