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SINOMA - a better tool for proxy based reconstructions?

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Our knowledge on past environmental conditions largely relies on reconstructions that are based on linear regressions between proxy variables (e.g. tree-rings, lake sediments, ice cores) covering a comparably long period (centuries to millennia) and environmental parameters (e.g. climate data) of which only rather short measurement series exist (mostly decades). In general, the corresponding measurements are prone to errors. For instance, air temperature records that are to be prolonged by reconstruction from tree-rings are normally not measured in situ, i.e. where the trees used for reconstructions are growing. In contrast, the variation of tree-ring properties which are used as proxies does not only depend on temperature variations but also on other environmental variables and biological effects. However, if regressions are based on noisy data, knowledge on the noise intensity of both predictor and predictand is needed and model parameter estimates (slope and intercept) will be erroneous if information on the noise is not included in their estimation (Kutzbach et al., 2011).
Here, we investigate the performance of the new Sequential Iterative Noise Matching Algorithm (SINOMA; Thees et al., 2009; and Thees et al., submitted) on a variety of typical proxy-data of differing temporal resolution (i.e. hourly (dendrometers, piezometers), seasonally (tree-rings), and annually (tree rings and varved lake sediments)). For each of the investigated proxies a number of pseudo-proxy datasets is generated. I.e. to each proxy variable two different noises are added, resulting in two noisy variables that originate from a common signal (the proxy) and of which the respective error noises and the true model parameters (slope and intercept) between both are known. SINOMA is applied to each of these pseudo-proxy datasets and its performance is evaluated against traditional regression techniques. The herewith submitted contribution thus focuses on the applicability of SINOMA rather than on its mathematical background which we intend to present in another contribution to this EGU session (Thees at al., 2014).
On average, SINOMA performs better than or, under specific error noise conditions, equal to the traditional modeling techniques. However, some of the investigated data reveal constraints of SINOMA, which have to be considered in 'real-world' applications. Nevertheless, our results indicate that SINOMA likely is a more reliable tool for estimating regression parameters if compared to traditional techniques. Based on the generally noisy characteristics of proxies used typically, applications of SINOMA to already existing reconstructions will probably result in different model parameter estimates, most likely leading to differing amplitudes of reconstructed past environmental conditions. Therefore, SINOMA has the potential to reframe our picture of the past.

References:

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