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Generating Stochastic Models for Climate Field Reconstructions using Instrumental Data

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Over the last decades, several different methods have been used to reconstruct past climatic change. These methods consist of an - often statistical - model and a related inference step. While recently a lot of the discussion has been focused on the latter (Smerdon et al. 2011, Christiansen et al. 2011), we here turn to the modelling part.

In a series of recent pseudoproxy experiments (PPE) for climate field reconstructions (Tingley+Huybers 2010a,b; Werner et al. 2012), Bayesian inference was used based on a localised stochastic description of the spatio-temporal evolution of annual temoerature fields. In contrast to other methods, where large scale patterns are used over the full reconstruction domain, local temporal evolution and spatial coherence are modeled directly. While the stochastic model, a multivariate AR(1) process, was based on few simple assumptions it could nevertheless reconstruct most of the climate variability in the used dataset.

Here we show how such a simple localized model could be derived from available observational data or at least be validated using the Kramers-Moyal-Expansion (KME). While KME often can require large amounts of data, we show that at least some results are stable in the context of PPEs with respect to data availability. Finally we apply this method to real world climate data from the CRU and the Global Historical Climate Network (GHCN) to arrive at a suitable model for European gridded mean summer temperature reconstructions.

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