Paleoclimate reconstruction using statistical nonlinear forward models

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There is a growing interest in reconstructing climate using hierarchical models that link paleoclimate proxies and instrumental records to an underlying latent climate process. This allows for a full propagation of uncertainty in predicting the underlying climate process. A critical component in constructing such hierarchical models is to parameterise the forward model that links the proxy with the climate process. Typically these forward models are either based on simplified assumptions, such as a linear relationship between the proxy and climate, or by building physical models (e.g., models for tree growth, heat transfer for boreholes) that may involve components that are hard to parameterise and complicate the model fitting. In this talk Bayesian spatio-temporal hierarchical models are developed for paleoclimate reconstruction with statistical forward models. These forward models assume an adaptive semiparametric model linking the proxy and climate, while capturing necessary nonlinear and monotonicity contraints. These Bayesian models can be fitted using Markov chain Monte Carlo techniques. This methodology is applied to the reconstruction of temperatures based on tree ring series.

Keywords:
Bayesian methods, Monotonicity constraints, Spatio-temporal models, Tree rings