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Combining pollen records and climate simulations for spatial reconstructions of Asian climate

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Spatial reconstructions of past climate are important to compare the state of the climate under different forcing conditions. Pollen records can be used for local climate reconstructions, while equilibrium global climate simulations contain information about possible large scale structures given a set of external forcings. We present spatial reconstructions of Asian climate for the Mid Holocene (MH, 6K BP) and the Last Glacial Maximum (LGM, 21K BP) using a Bayesian framework that combines the strength of Pollen records and of climate simulations.

Our framework combines pollen-climate transfer functions with a spatial prior distribution that is computed from a set of climate simulations. The local climate reconstructions from the pollen network are performed with the well-known WA-PLS algorithm. To create the spatial prior distribution, we calculate a mixture of Gaussian distributions, where each mixture component corresponds to a different climate model taken from the PMIP3 database for the MH and LGM time slices. Our inference strategy uses analytical computations as well as a Metropolis coupled MCMC algorithm.

We include pollen records which cover large parts of China and Siberia. They were synthesized at the Alfred Wegener Institute. Previous analyses identified mean temperature of the warmest month (MTWA) and mean annual precipitation (P_{ann}) as the most promising variables for climate reconstructions. Therefore, we choose these two variables for our reconstructions.
Our inference framework allows us to calculate a posterior probability distribution including a spatially dependent uncertainty structure, to compare the performance of different PMIP3 models given a set of pollen records, and to assess the skill of the reconstructions in different sub-regions using a cross-validation approach with proper score functions.