

A SPATIO-TEMPORAL MODEL FOR FOSSIL POLLEN BASED RECONSTRUCTION OF THE PALEOCLIMATE

**Lasse Holmström¹, Liisa Ilvonen¹, Heikki Seppä² and
Siim Veski³**

¹ University of Oulu, Finland

² University of Helsinki, Finland

³ Tallinn University of Technology, Estonia

Holocene (the last 12 000 years) temperature variation is reconstructed at multiple locations in southern Finland, Sweden and Estonia, based on pollen fossil data from lake sediment cores. A novel Bayesian statistical approach is proposed that allows the reconstructed temperature histories to interact through shared environmental response parameters and spatial dependence. The prior distribution for past temperatures is partially based on numerical climate simulation. The main patterns of the reconstructions are the marked rise of mean annual temperature from the early Holocene to the Holocene thermal maximum in northern Europe, followed by a gradual cooling towards the present. A brief cold episode is indicated 8200 years ago at two sites with particularly high sample resolution. These features are consistent with the quantitative climate reconstructions based on more commonly used reconstruction techniques. The results suggest that the novel spatio-temporal approach can provide quantitative reconstructions that are smoother, less uncertain and generally more realistic than the site-specific individual reconstructions.

Figure 1 show two example temperature reconstruction for Lake Arapisto in southern Finland, one (upper panel) where historical sediment data only from this lake was used, and another (lower panel) where correlations between different lakes is also taken into account. The reconstruction based on the spatio-temporal model that includes these correlations better captures the Holocene climate features also found in reconstructions based on different methods and different temperature proxy data.

Keywords: Bayesian modeling, Paleoclimate, Regression, Space-time modeling, Temperature proxy.

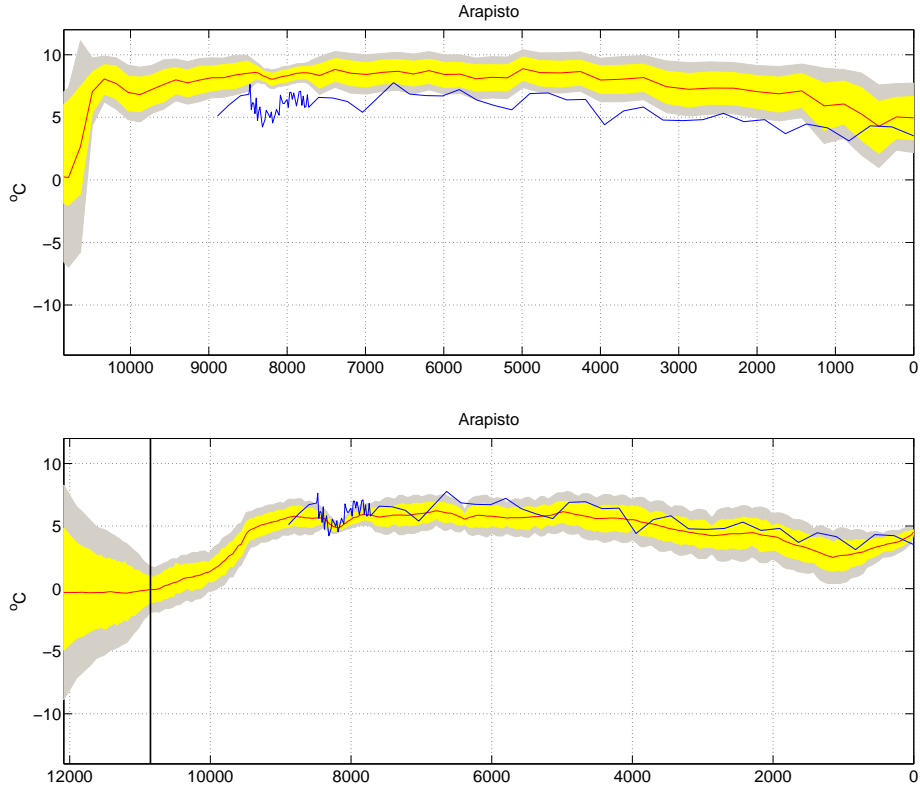


Figure 1: Reconstructions of the past mean annual temperature for Lake Arapisto, together with point-wise and (broader) simultaneous 95% credible bands. Horizontal axis shows time in years before present and vertical axis shows temperature in centigrades. Upper panel: reconstruction made independently for Lake Arapisto. The curve in the middle of the credibility bands is the posterior mean and the other curve is the WA-PLS (Weighted Average Partial Least Squares) reconstruction often used in paleoclimate research. Lower panel: Temperature reconstruction based on the full spatio-temporal model. The vertical black line marks the oldest date in Lake Arapisto's own sediment chronology.