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# North Fennoscandian summer temperatures for the last millennium reconstructed from Scots pine maximum density

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This paper explores novel techniques of calibration and climate reconstruction using new tree-ring maximum density data for the last millennium from sites in northern Norway, Sweden, and Finland. Site specific chronologies are constructed and, for each series, climatic sensitivity is assessed using response function analysis and correlation to local mean monthly temperatures and corresponding 5°x5° CRUTEM3 grid boxes.

Different approaches to climatic reconstruction are then tested and evaluated. First we use the two extremes of ordinary least square regression (OLS): 1) the commonly used direct OLS where the proxies are the predictors and the target climate quantities are the predictands, assuming all the noise is in the temperature measurements, and 2) inverse OLS where the climate quantities and the proxies change place, hence assuming all the noise is in the proxies. Both these methods are theoretically incorrect since there is noise in both the proxies and the instrumental temperature series: The direct method will underestimate the variance in the reconstruction and the indirect method will overestimate variance. Secondly, we explore error-in-variables regression methods that presumably provide a realistic variability in the reconstructed series.

Statistical confidence is estimated by allowing sliding and cascading time windows for the calibration period to produce ensembles of reconstructions. Finally, a grand ensemble of summer temperatures for the last millennium in northern Fennoscandia is presented using maximum entropy bootstrapping.