



## **Reconstruction of European summer and winter surface air temperature fields: Applications and constraints**

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Hemispheric annual temperature reconstructions do not provide information about regional-scale variations, such as the intrinsic seasonal patterns of past climate change in Europe. Recent studies provide evidence on the importance of the spatial distribution and quality of predictor data, as well as the robustness and skill of reconstructions, and introduce improved techniques for Europe. A regional-scale comparison of principal component (PC) regression and regularized expectation maximization (RegEM) has shown that more skilful results are achieved with RegEM for the European average over the last millennium. Reconstruction has been performed within a surrogate climate (National Center for Atmospheric Research (NCAR) Climate System Model (CSM) 1.4 and ECHO-G 4).

The sensitivity tests performed in the surrogate climate have led to valuable "a priori" information that provides a basis for the improvement of real world proxy reconstructions. We present examples of reconstructed European summer and winter air temperature fields, focusing on the validation of warmest summer and coldest winter periods over the past 500 years. The similarities and differences between the skill of PC regression and RegEM are hereby quantified, applying the two techniques to real world data. Seasonal differences are found in the performance of PC regression and RegEM, in the surrogate climate as well as the real world. Furthermore, the accurate

selection of RegEM input parameters needs detailed investigation, as the choice of the input parameters turned out to be not unique. We conclude that CFR techniques have to be better adapted to the specific scale and character of the predictor and predictand data to which they are applied.