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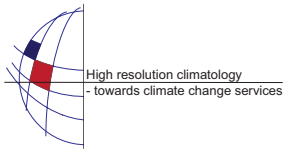

European temperature reconstruction based on model analogs constrained by proxy data

J. Franke (1), J.F. González Rouco (2), and D. Frank (1)

(1) Swiss Federal Research Institute WSL, Dendro Sciences Unit, Birmensdorf, Switzerland, (2) Universidad Complutense, Department of Astrophysics and Atmospheric Physics, Madrid, Spain.

In the pre-instrumental period, climate variability can be assessed using proxy records which exist only at selected locations. This lack of spatial information hampers an understanding of many key features of the climate system. Most widely used approaches to reconstructed spatially resolved climate fields are based on methods involving principal components and regression analysis. These methods have been i) suggested to underestimate low-frequency variability, ii) assume that modes of climate variability identified in the 20th century are stationary and thus representative of natural climate variation back in time and iii) suffering from variance changes over time. Climate models on the other hand simulate comprehensive and physically consistent climate states, though the simulations produced with them cannot be regarded as a detailed representation of the real past climate trajectory, particularly at higher frequency ranges where natural internal variability dominates. A systematical exploration of a new method, PSR (Proxy Surrogate Reconstruction) indicated that it circumvents pitfalls associated to previously applied methods by simultaneously capitalizing on the individual strengths of proxy data and model simulations. This is achieved by selecting the model states (analogs) that are most similar to arrays of proxy data available for specific moments of time. Based on an extensive database of long instrumental record, documentary archives and proxy data, we will present the longest possible spatially resolved temperature reconstruction for Europe which the currently available proxy data permit. Its quality due to the usage of noisy proxy data instead of instrumental measurements will be evaluated and discussed on the basis of methodological tests. The spatial reconstructions will provide new insides into the stability of the main modes of climate variability over the last centuries. Beyond that, it will allow for a better understanding of the dynamical causes that led to past climate change.