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Testing a European winter surface temperature reconstruction in a surrogate climate

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Using pseudoproxies obtained within the surrogate climate of AOGCMs, reconstructions of past climate variability have recently been subject to investigative studies focusing on their ability to properly represent low-frequency temperature variability (e.g. von Storch et al., Science, 2004; Mann et al., Journal of Climate, 2005; Wahl and Ammann, Climatic Change, 2007). These studies however exclusively addressed reconstructions on hemispheric or global scale. It is therefore of great importance to apply this approach at seasonal resolution and on a more regional/continental scale where larger temperature variability are prevalent.

We evaluate the skill of the 500-year long European winter surface air temperature reconstruction by Luterbacher et al. (Science, 2004) using pseudoproxies obtained from the ECHO-G and HadCM3 climate models. The emphasis is thereby on the effect of the reduction of available predictors back in time, an issue that has not yet been investigated in detail at continental and seasonal scale (Küttel et al., Geophysical Research Letters, 2007)

It is found that the key factor in determining the reconstruction skill is the number of predictors and particularly their spatial distribution, with the quality of the predictors being of secondary importance. However considering the usually insufficient spatial and temporal predictor availability in paleoclimate-reconstructions, the quality of the predictors becomes more important further back in time (Küttel et al., Geophysical Research Letters, 2007).

The lowest reconstruction skill is therefore found in the pre-1750 period when the

predictor network is spatially reduced, particularly in the European periphery. During that period, a dependence on the predictors' quality is clearly visible. The post-1750 period shows very good reconstruction skill, primarily due to a large number of predictors (mainly instrumental data) which are spatially well distributed (Küttel et al., Geophysical Research Letters, 2007).

As a test to determine and highlight the importance of a spatially uniformly distributed predictor network, an experiment was performed with a single predictor made available over Scandinavia (the region showing the largest underestimations) in the pre-1750 period. It is clearly found that this single predictor significantly improves the reconstruction skill, almost completely eliminating the pre-1750 underestimation visible when the non-improved Luterbacher et al. (Science, 2004) network is used (Küttel et al., Geophysical Research Letters, 2007).

Furthermore, the results appear to be partly dependent on the amplitudes of the simulated temperature variability, emphasizing the need of performing such studies with more than one climate model. Particularly, in order to make conclusions for the improvement of real-world reconstructions, future pseudoproxy-based studies should thus try to use climate simulations that are in terms of simulated temperature amplitudes and evolution closest to reality.