

EGU21-9865

<https://doi.org/10.5194/egusphere-egu21-9865>

EGU General Assembly 2021

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## Climate field reconstruction of North Atlantic sea surface temperatures

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Pseudo-proxy experiments test the skill and sensitivity of two extended climate field reconstruction (CFR) methodologies in reconstructing northern North Atlantic Summer sea surface temperatures (SSTs). The Summer target data originate from one millennium-long simulation of the CESM LME (Otto-Bliesner et al. 2016). The experiments test the reconstruction skill systematically for input data mimicking SST marine proxies and instrumental observations, including characteristics such as sparse distribution in space, varying signal-to noise ratio and age uncertainties.

The Bayesian hierarchical model BARCAST assumes implicitly that the target variable is described as an AR(1) process in time (Tingley & Huybers 2010), while the proxy surrogate reconstruction (PSR) method makes no such assumption (Graham et al. 2007). The PSR selects climate analogues from the simulated instrumental period in our study.

Results show that both methodologies generate skillful reconstructions for perfectly dated input data, and the PSR is superior when realistic noise levels are chosen for the input data. When the input is perturbed with age-uncertainties, the methodologies are unable to generate acceptable skillful reconstructions. Facilitating in form of data clustering is tested for both methodologies in the attempt of improving reconstruction skill. This proves successful for the PSR methodology, with the best skill obtained using  $n=3$  clusters over the reconstruction region.

Additionally, and addressed as a topic for discussion, we detect weak temporal persistence in the input data and the BARCAST reconstructions. The lack of SST persistence is found to be partly due to the input data sampling frequency: Summer means (June, July, August) averaged for every year. Analyses show that the simulated SST data exhibit weaker memory from one Summer to the next, compared to year-to-year variability based on annual means. Similar results are also found for instrumental observations. This finding stands in contrast to results of previous studies on terrestrial reconstruction, where climate reconstructions and individual proxy records exhibit strong persistence properties, also targeting the Summer season (Werner et al. 2018, Nilsen et al. 2018).

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