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How many proxy are necessary to reconstruct the temperature of the last millennium?

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Decades of scientific fieldwork have provided extensive sets of paleoclimate records to reconstruct the climate of the past at local, regional, and global scales. Within this context, the paleoclimate community is continuously undertaking new measuring campaigns to obtain long and reliable proxies. However, as most paleoclimate archives are restricted to land regions of the Northern Hemisphere, increasing the number of proxy records to improve the skill of climate field reconstructions might not always be the best strategy.

By generating pseudo-proxies from several model ensembles at the locations matching the records of the PAGES-2k network, we show how biologically-inspired artificial intelligence can be coupled with reconstruction methods to find the set of representative locations that minimizes the bias in global temperature field reconstructions induced by the non-homogeneous distribution of proxy records.

Our results indicate that small sets of perfect pseudo-proxies situated over key locations of the PAGES-2k network can outperform the reconstruction skill obtained with all available records. They highlight the importance of high latitudes and major teleconnection areas to reconstruct temperature fields at annual timescales. However, long-term temperature variations are better reconstructed by records situated at lower latitudes. According to our experiments, a careful selection of proxy locations should be performed depending on the targeted time scale of the reconstructed field.