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# Sensitivity of proxies on non-linear interactions in the climate system

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To understand natural and anthropogenic induced processes, feedbacks, trends, and dynamics in the climate system, it is essential to consider longer timescales. In this context, annually resolved tree-ring data are often used to reconstruct past temperature or precipitation variability as well as atmospheric or oceanic indices. Due to the interrelation of processes at different spatiotemporal scales in the climate system (micro, local, meso, synoptic and global scale), it is even possible to use proxies – such as tree rings – which react to micro/local climate conditions, to reconstruct phenomena on the global scale of the climate system such as the Pacific Decadal Oscillation (PDO) or the North Atlantic Oscillation (NAO).

The dependencies between tree-ring chronologies and climate parameters are not always stable over time and trees growing under temperate climate conditions are often sensitive to different climate parameters. Consequently, for climate reconstructions trees are often used which grow under extreme environmental conditions.

We utilized nine weather-/circulation-type classifications in combination with two tree-ring datasets to assess weather-type sensitivity across the Northern Atlantic region. Our results demonstrate that nonstationarities in superordinate space and time scales of the climate system (here synoptic to global scale NAO, AMO) can affect the climate sensitivity of tree-rings for phenomena in subordinate levels of the climate system (here weather-types, meso- to synoptic scale). This scale bias effect, has the capability to impact even large multiproxy networks and the ability of these networks to provide information about past climate conditions. The results – recently published in Scientific Reports – indicate that more research is needed to understand how processes or phenomena on different space-/time scales of the climate system interact. They show that the role of non-linear interactions in the climate system which can lead to scale bias in climate reconstructions must be reassessed. The presentation gives an extensive overview how to avoid and detect scale biases and consequently reduce uncertainties in climate models and reconstructions.