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Are tree-ring based estimates for Northern Hemisphere medieval temperatures fit for purpose?

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At present, there are numerous millennial-length northern hemisphere reconstructions. However, only a small subset utilise just tree-ring data. Despite the theoretical ideal of the multi-proxy approach for producing large scale reconstructions, there still exist many problems with implementing such studies; (1) they generally do not take into account the varying seasonality of the climate signal that each constituent proxy record contains, resulting in a composite reconstruction that is a seasonal melange which is often calibrated to annual temperatures and (2) all non-tree-ring proxy archives contain small to substantial dating uncertainties that at best affords capture of temperature variations at decadal or longer time scales. These two problems conspire against the multi-proxy experiment for the robust attribution of climate forcing and characterizing the full spectrum of natural variability. We suggest that focusing on tree-ring based reconstructions will substantially improve our understanding of past climate variability as they are precisely dated and have the potential to reconstruct warm season temperatures on inter-annual to multi-centennial time scales.

We present the development of an updated and expanded collection of published temperature sensitive tree-ring series (both ring-width and ring-density) for the Northern Hemisphere, which can be used not only to improve our understanding of past large-scale temperature changes but also to identify regions where currently too few data exist. Our main goals are; (1) enumerate the unique qualities of ring-width and maximum latewood density chronologies, especially for assessing volcanic forcing and seasonal response; and (2) compare the spatial robustness of gridded reconstructions, especially during the supposed warm medieval period and the more recent, but better represented, Little Ice Age. Currently, large scale single series NH temperature reconstructions do not agree well with climate model output prior to ~1300 CE. This is partly related to the paucity of proxy data and forcing uncertainty during this time. Recent research suggests that weak volcanic forcing dominated during the medieval period, and the resultant internally driven climate variability may not be well represented in climate models.

The main emphasis of this research is not to develop a new large scale tree-ring based temperature reconstruction per se, but rather to communicate the strengths and limitations of tree-ring data to the wider palaeoclimatological community and highlight locations where investment is needed to update tree-ring data collections and extend tree-ring reconstructions back into the medieval era.