



## Large scale temperature reconstructions from tree-rings

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Six annually resolved warm season temperature reconstructions integrating tree-ring data from the Northern Hemisphere extratropics have been developed over the past two decades. The differences between these records remain unclear for non-specialists, however, and researchers from related disciplines seek guidance on which of the records to use to address their objectives. I here provide an overview of the large-scale temperature reconstructions from tree-rings, and compare all annually resolved records extending back to 831 CE. Whereas the recently published reconstructions integrate many more tree-ring site chronologies, the imbalance, between only a few chronologies covering the full millennium and numerous chronologies covering the past few centuries, remains. As the new reconstructions also integrate many more maximum latewood density chronologies, the calibration against observational data substantially improved, approaching ca. 50% of large-scale summer temperature variance. Covariance among the six reconstructions is  $r = 0.59$  since 1401, but declines dramatically to  $r = 0.17$  before the 15th century, most likely reflecting a generally weakened reconstruction skill due to massively reduced sample replication. The combination of large-scale temperature reconstruction is non-trivial, as all six records reviewed here share substantial fractions of the same site chronologies. To improve our understanding of past millennium temperature variability, it is recommend to (i) update existing reconstructions, (ii) develop new temperature-sensitive chronologies covering the full millennium, (iii) measure tree-ring density (in addition to tree-ring width), and (iv) improve the statistical estimation of the effects of replication changes on reconstruction skill.