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# Large-scale, millennial-length temperature reconstructions from tree-rings

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## Abstract

Over the past two decades, the dendroclimate community has produced various annually resolved, warm season temperature reconstructions for the extratropical Northern Hemisphere. Here we compare these tree-ring based reconstructions back to 831 CE and present a set of basic metrics to provide guidance for non-specialists on their interpretation and use. We specifically draw attention to *(i)* the imbalance between (numerous) short and (few) long site chronologies incorporated into the hemispheric means, *(ii)* the beneficial effects of including maximum latewood density chronologies in the recently published reconstructions, *(iii)* a decrease in reconstruction covariance prior to 1400 CE, and *(iv)* the varying amplitudes and trends of reconstructed temperatures over the past 1100 years. Whereas the reconstructions agree on several important features, such as warmth during medieval times and cooler temperatures in the 17th and 19th centuries, they still exhibit substantial differences during 13th and 14th centuries. We caution users who might consider combining the reconstructions through simple averaging that all reconstructions share some of the same underlying tree-ring data, and provide four recommendations to guide future efforts to better understand past millennium temperature variability.

Keywords: Tree-ring width, Maximum latewood density, Warm season temperatures, Medieval Warm Period, Little Ice Age, Northern Hemisphere

## 1. Introduction

Anthropogenic greenhouse gases are currently the dominant climate forcing on our planet, but that fact does not imply that natural forcings such as volcanic eruptions and solar variability will no longer be important. Reconstructing pre-Anthropocene (Crutzen, 2002) climate variability is therefore of critical importance to improve our understanding of the complex interactions within the Earth's climate system and to reduce uncertainties in projecting future climate change using model simulations. This requirement is not only relevant for climate variations over the past million years during which several