Response to Samuli Helma:

We thank Samuli Helama for his comments and recommendations regarding the potential influence of age-related growth trends and standardization choices on the representation of low-frequency climate variability. In the revised version of the manuscript, we are now more specific regarding statements about long-term temperature change. Rather than referring to the LIA, we focus on the lack of warming during the early-industrial period. Except from the periods with strong volcanic forcing (1810s and 1830s), reconstructed temperature in the 19th century is warmer as the coldest decades of the 20th century, 1914-1923, and 1983-1992. Using this more specific framing and considering the corroboration of our results by the experiments described below, we are confident that this feature is noteworthy and to some degree in contrast to other MXD-based records (Esper et al., 2025; Kuhl et al., 2024) *and large-scale reconstructions* (Anchukaitis et al., 2017; Büntgen et al., 2021)*. An adjusted title and revisions in the discussion-section now account for the concerns raised.*

Regarding the detrending method used during chronology development, we are aware that the age structure of our tree-ring data is not ideally suited for the Regional Curve Standardization (RCS) method. The current dataset is primarily composed of tree-ring records from living trees, which results in an age structure that does not adequately represent the different age classes required for an unbiased RCS chronology. For this reason, we opted for age dependent spline-based detrending, which is more appropriate for the available age structure, though it comes with its own limitations in preserving low-frequency variability. While the spline method is effective for preserving short- to medium-term climate variability, it may attenuate longer-term trends, such as those potentially associated with the LIA. To explicitly evaluate whether age structure or juvenile growth could obscure preindustrial cooling in our record, we conducted an additional sensitivity analysis based on RCS.

We compared our signal-free age-dependent spline chronology with two RCS-based chronologies: one derived from the full dataset and one derived from an artificially trimmed dataset in which each series was restricted to its first 100 cambial years. All subsequent rings were removed. As a result, the end year of each series varies among trees and is determined just by the year of establishment plus the selected truncation length. This procedure stabilizes the mean age of samples used for chronology building.

This experiment represents a conservative test designed to maximize low-frequency signal retention and reduce biases associated with exclusively living-tree chronologies. While the RCS chronologies deviate in the early, low replicated part of the record, differences among standardization methods remain stable from ~1740-1900. After 1900 the ADS-SF chronology shows the strongest increase compared to previous temperatures. Differences among chronologies become very pronounced mainly after ~1950 due to low replication in the trimmed RCS version (Fig. A1). Both RCS versions are subject to biases: the "full RCS" is subject to the 'modern sample' bias (Briffa and Melvin, 2011) *while the "trimmed RCS" clearly suffers from the end effect due to artificially reduced replication.*

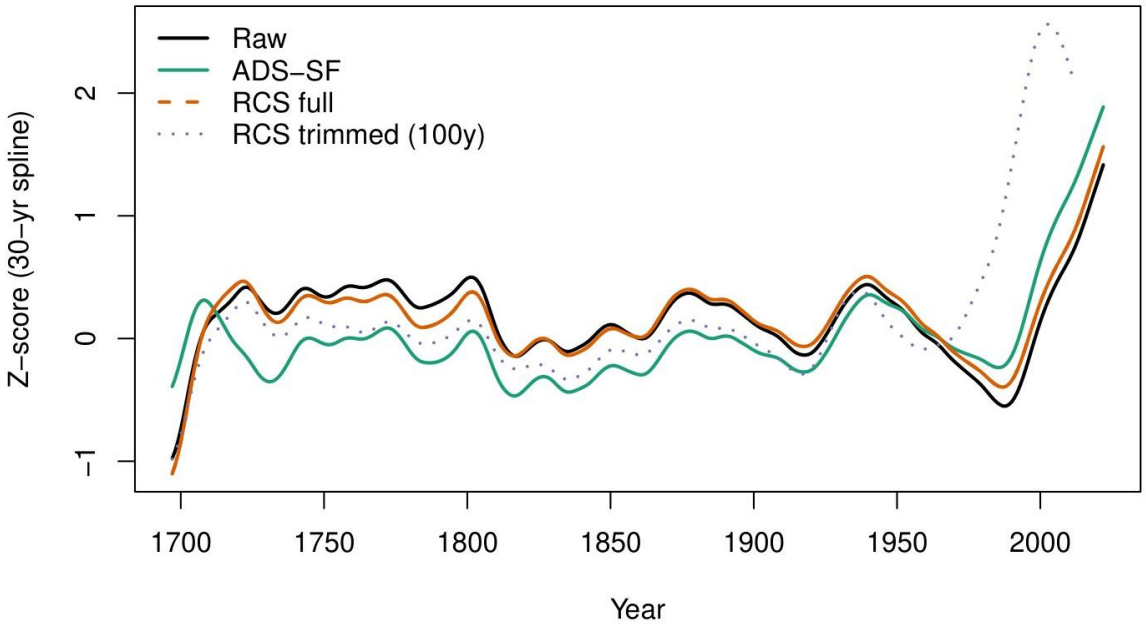

Fig. A1: Comparison of the signal-free age-dependent spline chronology (ADS-SF) with the raw chronology and two RCS-based chronologies: one derived from the full dataset (RCS full) and one derived from an artificially trimmed dataset (RCS trimmed) for first 100 years of cambial age

These additional analyses demonstrate that applying a detrending with presumably better preservation of low-frequency variability does not reveal stronger long-term trends and thus corroborates our finding that early-industrial warming was likely weak in the region covered by our reconstruction.

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