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Climate reconstructions from tree-ring widths for the last 850 years in Northern Poland

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Tree-ring based temperature reconstructions form the scientific backbone of the current debate over global change, and they are the major part of the palaeo data base used for the IPCC report. However, long temperature reconstructions derived from temperate lowland trees growing well within their distributional limits in central Europe are not part of the IPCC report, which is an essential gap in the international data base. It appears that dendroclimatological analysis at temperate lowland sites was so far difficult to perform mainly for three reasons: diffuse climate-growth relationships, the lack of long chronologies due to absence of sufficient numbers of long-living trees and the potential loss of low-frequency signals due to the short length of the sample segments.

We present two robust multi-centennial reconstructions of winter temperatures and summer precipitation based on pine and oak tree-ring widths chronologies from northern Poland, where so far no long tree-ring based reconstructions were available. We compared the new records with global, hemispherical and regional reconstructions, and found good agreement with some of them. In comparison, the winter temperature of our reconstruction, however, did not indicate any modern warming nor did the summer precipitation reconstruction suggest any modern 20th century changes.

In a second step, we measured cell structures and developed chronologies of parameters such as cell wall thickness and cell lumen area. We used our new method (Liang et al. 2013a,b) applying confocal laser scanning microscopy to increment core surfaces for efficient histometric analyses. We focused on samples covering the last century because meteorological data necessary for calibration studies were available for direct comparisons. It was demonstrated that the correlations with climate were strong and different from those found for tree-ring widths (e.g., N-Poland oak-vessel-lumen-area-chronology with previous September-to-December mean temperature r = 0,61 and N-Poland pine-tracheid-lumen-area-chronology with mean Feb-to-June temperature r = -0,66). By using only raw values, low-frequency signals could be sustained in the chronologies.

Liang, W.; Heinrich, I.; Helle, G.; Dorado Liñán, I.; Heinken, T. (2013a): Applying CLSM to increment core surfaces for histometric analyses: A novel advance in quantitative wood anatomy. Dendrochronologia 31, 140-145.

Liang, W.; Heinrich, I.; Simard, S.; Helle, G.; Dorado Liñán, I.; Heinken, T. (2013b): Climate signals derived from cell anatomy of Scots pine in NE Germany. Tree Physiology 33, 833-844.