Evaluating tree-ring climate relationships from various climate data sources as predictors: A case study from the South- Eastern Tibetan Plateau

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Climate reconstructions inferred from tree-ring data were successfully carried out almost everywhere trees are growing (http://www.ncdc.noaa.gov/paleo/treering.html). Fitting calibration models to tree-ring data is challenging in mountainous regions due to the sparse climate station distribution and the high variance of climate parameters (altitude effects). The aim of this study is to show a broader approach of tree-ring model fitting under these conditions.

We present a 518 years long ring width chronology (2012-1495) from the South-Eastern part of the Tibetan Plateau (Mi Mei valley; lat/long: 29°28' N/96°26' E; 3973m asl). In autumn 2012 we sampled 35 *Picea balfouriana* trees with a mean age of 273 years and one very old individual dating back to 1354. Statistical parameters like the 'Expressed Population Signal' (0.96) indicate a high reliability of the chronology and the 'Gleichläufigkeit' (0.62) a strong common forcing of the tree-ring growth. A wavelet analyses revealed a significant cyclicity of 30 years over the whole chronology, except from the middle to end of the 19th century. Additional, an 80 years cyclicity was found over the complete time span. Well known climatic depressions like the Maunder Minimum (AD 1645-1715) but also single events like the Tambora eruption, or the severe drought from 1920s are expressed by decreasing ring width (see Figure 1).

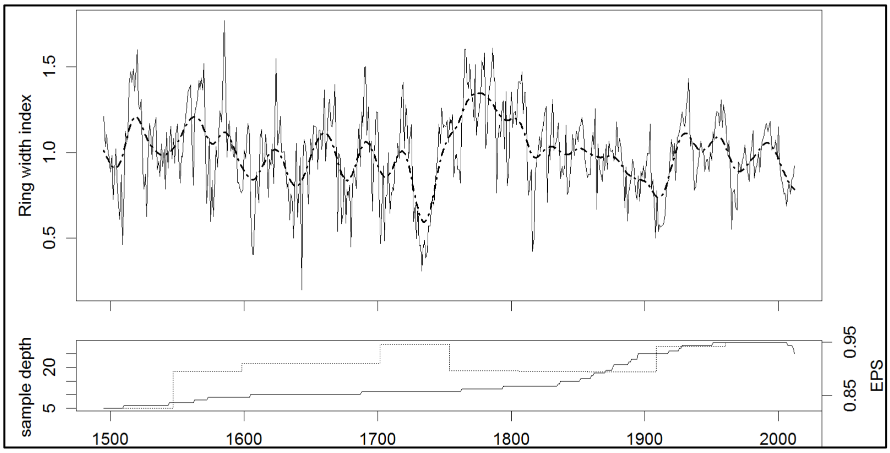

Figure 1: Tree ring width chronology from *Picea balfouriana* (SE Tibetan Plateau) with 32 years running spline. Solid line in the lower panel represents the sample depth, dotted curve the EPS.

To analyze the impact of climate on tree growth, we calculated correlation and response functions between the ring width chronology and different climate data sets i.e. CRU TS 3.20, NCEP-1, ERA-Interim and data from a local climate station (Bomi). A comparison between the different data sets regarding their variance of temperature and precipitation was conducted. We computed a linear model to the best fitted proxy- climate data- relationship. The final reconstruction of summer temperature dates back to 1495. In agreement with Zhu (2011) [1], low temperatures were found during 1727-1742, 1816/1817 and 1905-1916.

The use of reanalysis data did not improve our tree-ring models substantially. Our analysis has demonstrated, that the computation with all climate data stets did not capture the high spatio-temporal climatic variability. Instead, we suggest giving more attention to recently developed estimations, such as a nested spatial WRF (Weather Research and Forecasting) modeling [2] or a geostatistical downscaling approach [3].

[1] H.-F. Zhu, X.-M Shao,Z.Y. Yin, P. Xu and H. Tian, August temperature variability in the southeastern Tibetan Plateau since AD 1385 inferred from tree rings, Palaeogeography, Palaeoclimatology, Palaeoecology 305 (2011).

[2] F. Maussion, D. Scherer, R. Finkelnburg, J. Richters, W. Yang and T. Yao, WRF simulation of precipitation event over the Tibetan Plateau, China- An assessment using remote sensing and ground observations, Hydrology and Earth System Sciences 15 (2) (2011).

[3] L. Gerlitz, O. Conrad, A. Thomas and J. Böhner, Assessment of warming patterns for the Tibetan Plateau and its adjacent lowlands based on an elevation- and bias corrected ERA- Interim data set, Climate Research (submitted), 2013.

Key words: Tree-ring width, Reanalysis data (CRU TS 3.20, NCEP-1, ERA- Interim), Response function