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The impact of proxy characteristics on a millennium-long ensemble of hydroclimatic records in monsoonal Asia

Lea Schneider (1), Fredrik C. Ljungqvist (2,3), Stefanie Talento (1), and Jürg Luterbacher (1)

(1) Department of Geography, Climatology, Climate Dynamics and Climate Change, Justus-Liebig-University, Giessen, Germany, (2) Department of History, Stockholm University, Stockholm, Sweden, (3) Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden

Using multi-proxy networks for large-scale palaeoclimate reconstructions offers the possibility to overcome limitations of single proxy archives. Furthermore, the spatial coverage can typically be improved and the frequency spectrum often extended. Here, we analyze a network of 61 millennium-long terrestrial proxy records from monsoonal Asia (including the Tibetan Plateau and the Chinese lowlands), representing the region's diverse hydroclimatic past. Many of the proxy archives appear in regional clusters according to their specific environmental requirements. We investigate potential effects of the heterogeneity in the multi-proxy network on key features of spatially aggregated hydroclimate records.

Our network generally confirms the assumption that documentary and tree-ring data have a restricted ability to represent millennial-scale low-frequency hydroclimate variability. Most lake and speleothem series reveal a more pronounced shift between the Medieval Climate Anomaly and the Little Ice Age, but less decadal to multidecadal variability, although some of them are rather highly temporally resolved. A thorough review of the single proxy records and several regional coherency tests prove that dating accuracy and a verified climate signal are important benchmarks for the evaluation of the record's quality.

Selecting records based on these quality measures reduces the spatial coverage, but may also reduce the non-climatic noise in regional ensemble averages. Particularly, removing records with uncertain dating has a strong effect on frequency spectra of regional means. The verification of the climate signal has less impact in our study setup. While many large-scale multiproxy studies consider the strength of the climate signal as the main proxy selection criterion, our findings suggest that it is advisable to additionally consider other quality measures, e.g. the dating accuracy. Such an approach will likely improve the precision of the resulting large-scale hydroclimate reconstruction.