GÖTEBORGS UNIVERSITET

Tree Rings and Climate
Standardization, Proxy-development and Fennoscandian Summer Temperature History

Jesper Björklund
Institutionen för geovetenskaper
Naturvetenskapliga fakulteten

Akademisk avhandling för filosofie doktorsexamen i Naturvetenskap, inriktning naturgeografi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras tisdagen den 5 juni, 2014, kl. 10:00 i Stora hörsalen, Institutionen för geovetenskaper, Guldhedsgatan 5C, Göteborg.

ISBN: 978-91-628-9062-9

GÖTEBORGS UNIVERSITET

ABSTRACT

Instrumental meteorological observation are too short for trying to estimate climate change and variability on multi-decadal and centennial time-scales, *and* when trying to evaluate the response of the climate system to human influence, such as raised concentrations of green house gases (GHG), altered land-use, black carbon etc. To access information about the climate system predating instrumental observations, reliable proxy records (natural archives) are necessary. These proxies include for example tree rings, ice cores, fossil pollen, ocean sediments, corals and historical documentary data.

Tree rings is one of the most widely used proxy for high-resolution growing season temperature reconstructions during the last millennium, and in Fennoscandia some of the best-calibrated records in the world exist. Yet, in this available body of work, there is limited homogeneity on decadal to centennial scales. Since this tree-ring data is targeting growing-season temperatures and growing-season temperatures in this region are very well correlated on annual to decadal scales this is unexpected. This thesis is concerned with trying to address this issue by 1) developing existing standardization-tools in order to display centennial scale variability and at the same time reduce noise arising from internal and external disturbances and mismatches in actual growth trends compared to the expected growth trend. 2) By developing the new un-exploited ΔDensity and ΔBlue Intensity proxies (the difference between the latewood and earlywood for density and blue intensity respectively) to act as complement or quality control to the established maximum latewood density (MXD) which is the state of the art proxy for high latitude temperature reconstructions, and also to the Blue Intensity measurement scheme, that potentially could be an inexpensive complement to the radiodensitometric methodology.

Results showed that using the Δ parameter for both density and Blue Intensity, give added value in a more focused annual scale summer temperature signal, and an improved coherence between different chronologies on decadal to centennial scales. Methodological protocols such as data analysis and standardization seem to be critical when trying to attain adequate low-frequency signals from tree-ring data. A more coherent view of the summer temperature history for the last 900 years in Fennoscandia is provided using the methodological improvements outlined in this thesis. Future challenges include trying to extend this excellent network back in time to not only cover the Little Ice Age (1450-1900 CE) but also to cover the debated Medieval Climate Anomaly (850-1250 CE).

Keywords: Tree rings, Fennoscandia, summer temperature, maximum latewood density (MXD), blue intensity (BI), standardization