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Tree rings and Climate in Scandinavia and Southern Patagonia

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Abstract

The present knowledge of temperature variability during the past millennium has been greatly improved due to an increasing availability of reconstructions made based on paleoclimate proxies, such as tree-rings. These improvements however, do not suffice to provide a coherent representation of the past climate at local to regional scale at higher latitudes. The reasons, are mainly due to the poor spatial density of the networks and the little understanding of how microsite variability affects the signal stored in the varied tree-ring proxies. Fennoscandia and Patagonia are strategic locations for studies on past climates, and were chosen to extend and improve the existing dendrochronology networks. This work also aimed to provide high quality improved chronologies with skills to reconstruct primarily temperature, with attention to the effects of microsite conditions and large scale atmospheric and oceanic patterns. Using *Pinus sylvestris* L., two temperature reconstructions were made: a local from the west central Scandinavian mountains extending 970 years using the blue light intensity absorption from tree-rings, and a regional built on ten chronologies extending through the Scandinavian mountains using density and blue intensity information from the tree rings. Additionally, a gridded reconstruction was made on the latter. In Patagonia six *Nothofagus betuloides* and one *Pilgerodendron uviferum* chronologies were developed and analyzed. These contained limited and non-statinary information on temperature and precipitation, probably on account of microsite conditions. Chronologies at both study sites were proven to contain information of large-scale atmospheric and oceanic patterns. In Fennoscandia, Atlantic Multidecadal Oscillation and Summer North Atlantic Oscillation in addition to volcanic forcing modulate significantly local to regional climate and therefore tree-growth. In Southern Patagonia in turn, tropical and subtropical sea surface temperatures seem to affect tree-growth. While relationships between tree-growth with the Southern Annular Mode were found on years of extreme growth, they were marginal and non-stationary when tested with index at interannual scale. Patterns of spatial correlations with sea level pressure further suggest these links. Moreover, the Pacific sector of the Southern Ocean, specifically the areas of the Amundsen and Bellingshausen Seas are indicated to have an unprecedented importance to the growth dynamics of the southernmost forest in the world. The new chronologies developed in the study areas possess potential to be used on studies of climate evolution at higher latitudes taking into account that microsite conditions affect the climate signal recorded in the tree-growth.

Key words: Tree-rings, *Pinus sylvestris* Fennoscandia, Atlantic Multidecadal Oscillation, Scandinavian Pattern, *Nothofagus betuloides*, *Pilgerodendron uviferum*, temperature precipitation, Southern Annular Mode, Southern Oscillation Index, Amundsen Lows, Sea Level Pressure, Sea Surface Temperature, Southern Pacific Patagonia