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TEMPERATURE RECONSTRUCTIONS AND COMPARISONS WITH INSTRUMENTAL DATA FROM A TREE-RING NETWORK FOR THE EUROPEAN ALPS

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ABSTRACT

Ring-width and maximum latewood density data from a network of high-elevation sites distributed across the European Alps are used to reconstruct regional temperatures. The network integrates 53 ring-width and 31 density chronologies from stands of four species all located above 1500 m a.s.l. The development and basic climatic response patterns of this network are described elsewhere (Frank and Esper, 2005). The common temperature signal over the study region allowed regional reconstructions to be developed using principal component regression models for average June–August (1600–1988) and April–September (1650–1987) temperatures from ring-width and density records, respectively. Similar climatic histories are derived for both seasons, but with the ring-width and density-based reconstructions seemingly weighted toward carrying more of their variance in the lower and higher frequency domains, respectively. Distinct warm decades are the 1940s, 1860s, 1800s, 1730s, 1660s and the 1610s, and cold decades, the 1910s, 1810s, 1710s, 1700s and the 1690s. Because of the model fitting and the shorter time spans involved, comparisons between the reconstructions with high-elevation instrumental data during the majority of the 1864–1972 calibration period show good agreement. Yet, prior to this period, from which only a few low elevation temperature records are available, a trend divergence between tree-ring and instrumental records is observed. We present evidence that this divergence may be explained by the ring-width data carrying more of an annual rather than warm-season signal in the lower frequency domain. Other factors such as noise, tree-ring standardization, or the more uncertain nature of low-frequency trends in early instrumental records and their homogenization, might help explain this divergence as well. Copyright © 2005 Royal Meteorological Society.

KEY WORDS: dendrochronology; dendroclimatology; temperature reconstruction; Alps; instrumental data; tree-ring width; maximum latewood density

1. INTRODUCTION

The use of proxy data plays a significant role in the characterization and assessment of climate variations prior to the instrumental period. Prominent reconstructions of past variability have called upon a combination of tree-ring sites and other proxies (Jones *et al*., 1998; Mann *et al*., 1999; Moberg *et al*., 2005) or specific selections of tree-ring chronologies processed to preserve long-term climate variability (Jacoby and D'Arrigo, 1989; Briffa, 2000; Esper *et al*., 2002; Cook *et al*., 2004; Esper *et al*., 2004). In addition to these large-scale approaches, more detailed studies of regional variations are needed to obtain insight into regionally specific variations and driving factors. In this paper, we consider the climatic signal from a high-elevation temperature sensitive tree-ring network from the European Alps.

The European Alps are influenced by Mediterranean, Atlantic, and Continental Eurasian synoptic systems. In the winter, climate is generally dominated by the North Atlantic Oscillation with some influence from the

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