The influence of climate on the $^{13}$C/$^{12}$C ratios in tree-ring cellulose of Pinus sylvestris growing in the central Scandinavian Mountains

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Tree ring stable isotope composition is known to contain information of past climatic and environmental changes, and may be used as a complement to TRW and MXD in climatic reconstructions. In this study we examine the character and strength of the climate signal captured in the $^{13}$C values of Scots pine ($Pinus sylvestris$ L.) trees growing at a tree-line site in the central Scandinavian Mountains (fig. 1). Between 4 and 14 pine trees was pooled to obtain isotopic ratios of annual tree ring cellulose spanning the period AD 1736–2006 (fig. 2).

CLIMATE - $^{13}$C RELATIONSHIP: The weather conditions of the current growing season are most strongly influencing the ratios of C. The climate controls are, in order of descending importance, summer temperature, sunshine and precipitation (fig. 3).

Analyses of the spatial extension of the temperature signal shows that the $^{13}$C values from Furuberget captures the summer signal of a major region in the mid-west Sweden and the eastern part of Norway, which is greatly exceeding the spatial coverage of the signal derived from ring widths of pine trees growing in the central Scandinavian mountains (fig. 4).

TEMPORAL STABILITY OF THE TEMPERATURE - $^{13}$C RELATIONSHIP: To test for time stability, the $^{13}$C series was compared to the Uppsala summer (June-August) temperature record using a running correlation approach. Although the overall correlation between the two records was positive and significant ($r = 0.55$, $P < 0.01$) there were, nevertheless, periods over the last 270 years when the relationship was below significance (fig. 5). We believe that past shifts in climate, such as the region-wide dry spell in the 1810s-30s (Linderholm, 2002; Linderholm et al., 2004), may partly explain the non-stationary temperature- $^{13}$C relationship.

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