Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11279, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11279
EGU General Assembly 2008

Climate from a millennial pine chronology from coastal North-Norway

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The tree-ring chronology of Scots pine (*Pinus sylvestris* L.) from Forfjorddalen, Vesterålen archipelago (68˚47.5'N, 15˚43.5'E) extends back to AD 877 and includes Norway's oldest living pines. It consists of a minimum of nine trees since AD 1000 and more than 40 trees since the mid 13^{th} century. Characteristic features of the raw chronology are; rather narrow rings in the pine remains pre-dating AD 1100, high growth rates in Medieval times (AD 1100-1280) and slow growth along with increasing segment length in the early part of the Little Ice Age (AD 1420-1650) indicating an ageing forest. Growth again culminated around 1800 due to young trees entering the chronology and potential natural or anthropogenic forest opening. The following age-related growth decline was interrupted by the 1915-1955 growth amelioration.

Standardization by negative exponential or non-ascending linear functions yielded periods of good growth ca. 1100-1185, 1330-1375, 1480-1540, 1650-1710, 1790-1850 and 1915-1955, as well as periods of poor growth ca. 1030-1090, 1145-1155, 1185-1210, 1420-1465, 1540-1560, 1600-1620, 1715-1750, 1855-1910 and 1960-1980. From 1205-1440 no extreme negative events were recorded, indicating a prolonged phase of stable climate. The good growth of 1915-1955 is comparable only with that of the 12^{th} century and a short spell in the mid 17^{th} century.

Although the chronology signal is strong back to AD 1050 (expressed population signal EPS $>$ 85%), its climate signal is rather low. The annual tree-ring variability is

determined by summer temperatures (July r = 0.57, July-August r = 0.58). However, only 35 % of the regional July-August temperatures since 1875 can be explained by ring widths. This might partially be explained by, on the decadal scale, pine growth suffering from factors related to warm winters. While the interpretation of this mixed climate signal is on-going, this tree-ring record promises to contribute to the understanding of low-frequency climate variability at the north-western edge of the Eurasian continent; an exploratory RCS chronology (detrended by a regional growth curve) preserves high Medieval (1100-1250) and low early LIA (1370-1480, 1600-1650) growth rates, respectively, while unveiling relatively good growth conditions during ca. 1480-1590 and removing parts of the age-related trends after ca. 1600, now recording the years 1915-1955 as the best period of pine growth for the whole millennium. Thus, this chronology shares hemispherical to global low-frequency information attributed to solar forcing, volcanic activity and changes in greenhouse gases.