Geophysical Research Abstracts
Vol. 12, EGU2010-1427, 2010
EGU General Assembly 2010

Climatic variations on longest tree-ring chronologies for Kola Peninsula and Finnish Lapland

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We investigated the external factor (solar activity, volcanic eruptions) influence on tree growth at high latitudes. We analysed a 561-year tree-ring record of pine (Pinus sylvestris L.) and a 676-year juniper (Juniperus Sibirica Burgst.) tree-ring chronology collected nearby the northern timberline (67.77-68.63N; 33.25-36.52 E) at the Kola Peninsula, northwestern Russia. As well known the climatic impacts of solar and volcanic activity vary regionally, and major volcanic eruptions do not always result in regional cooling. A response of tree growth at the Kola Peninsula to climatic changes due to solar variability and volcanic eruptions was revealed. For example, Dalton minimum of solar activity (1801-1816 AD) and Laki (1783 AD) and Tambora (1815 AD) volcanic eruptions appeared to cause the greatest ring-width reduction and cooling. The minima of solar activity Sporer (1416-1534 AD) and Maunder (1645-1715 AD) were as well accompanied by temperature decreases. Intervals with an absence of significant volcanic eruptions correspond to intervals of increased ring-width values. A superposed epoch analysis of 19 large (Volcanic Explosivity Index, VEI>5) volcanic events revealed a significant suppression of tree growth for up to 8 years following volcanic eruptions. The similar effect (supression of tree growth after powerful volcanic eruptions) was obtained under analysis of the 7641-year supra-long pine tree-ring chronology for Finnish Lapland. Our results documenting the regional climatic impacts of solar and volcanic activity permit us to understand the dynamics of the climate system and its response to external forcing.

This work is financially supported by grant from Russian Foundation for Basic Research (grant No. 09-04-98801), by the Program of the Russian Academy and by the Regional Scientific Program of Murmansk region.