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The synchronism of the large-scale coldest events during the Holocene in proxy data

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Numerous natural events documented in instrumental, historical and palaeoclimate records clearly indicate that large regions of the Earth have experienced occurrences of both slow and sharp climate change in the past. From more recent analysis of historical sunspot and aurora records, Alpine glaciers and high-resolution palaeoclimatic records, there is evidence of long-term cycles of about 2500 and 1500 years in the Holocene. A reconstruction of the 14C concentration from tree-rings has been done for the last 11,000 years based on bi-decadal and decadal wood samples. This reconstruction shows that 14C production was higher during the Little Ice Age, when solar activity was extremely low. After subtraction from the initial radiocarbon time series of the long trend the residual time series clearly shows centennial and millennial changes. The major oscillations are at 8500-7800 cal year BP, 5400-4700 cal year BP, 2680-2200 cal yr BP and 1100-400 cal yr BP with ˜2400-year periodicity between them. It should be noted that power spectra of 14C and 10Be cosmogenic isotopes point to the millennial periodicity of about 2400 and 1500 year. Bond et al. (1997, 2001) using spectral analysis of ice-rafted debris, transported by floating icebergs in times of glacial activity in the last 12,000 years, found that iceberg debris jumped in abundance every about 1500 years, indicating that much more ice was present during those regular periods. The most pronounced abrupt shifts in climatic conditions are repeated with an about 2400-year period. The less pronounced changes in climatic conditions occur every about 1500 year. It is important to stress that the periodicity of about 2400 years in cosmogenic isotope concentration appears synchronous to cooling events documented in Greenland ice cores, to the timing of worldwide Holocene glacier expansions, to the periods of lower lake depth and so on. Thus, climatic data

during the Holocene vary on centennial-millennial scales, giving information about possible forcing mechanisms: external - changes in solar activity and cosmic ray intensity and internal - oscillations of the ocean-atmosphere system. The research was supported by INTAS (No. 2001-0550 and No. 03-51-4445), RFBR (projects 03-04-48769 and 03-05-65063), NorFA Grant "Network for Dendroecological and Dendrochronological Research in Northern Europe", General Physics Department of RAS (program N 16), and Russian Federal Program "Astronomy".