Recurrent large-scale solar proton events before the onset of the Wolf grand solar minimum indicated by carbon-14 content in tree rings

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Based on the analyses of cosmic-ray induced radionuclide (carbon-14) in tree rings, a number of past large-scale solar proton events have been discovered. While the largest events such as in 774–775 CE cause more than 1 % increase of carbon-14 content in tree rings and can be significantly detected by the typical precision of accelerator mass spectrometry (0.2-0.3%), it has been difficult to detect smaller but possibly more frequent events. Thus, the frequency or any characteristics of such relatively small events are largely unknown. In this paper, we report on our attempt to improve the precision of carbon-14 analyses using the accelerator mass spectrometry and on the three solar proton events found just before the Wolf grand solar minimum.

Keywords: solar proton events, grand solar minimum, carbon-14

