EGU2020-11654
https://doi.org/10.5194/egusphere-egu2020-11654
EGU General Assembly 2020

Tree-ring radiocarbon reveals reduced solar activity during Younger Dryas cooling

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The Younger Dryas stadial (YD) was a return to glacial-like conditions in the North Atlantic region that interrupted deglacial warming around 12900 cal BP (before 1950 AD). Terrestrial and marine records suggest this event was initiated by the interruption of deep-water formation arising from North American freshwater runoff, but the causes of the millennia-long duration remain unclear. To investigate the solar activity, a possible YD driver, we exploit the cosmic production signals of tree-ring radiocarbon (^{14}C) and ice-core beryllium-10 (^{10}Be). Here we present the highest temporally resolved dataset of ^{14}C measurements (n = 1558) derived from European tree rings that have been accurately extended back to 14226 cal BP (±8, 2-σ), allowing precise alignment of ice-core records across this period. We identify a substantial increase in ^{14}C and ^{10}Be production starting at 12780 cal BP is comparable in magnitude to the historic Little Ice Age, being a clear sign of grand solar minima. We hypothesize the timing of the grand solar minima provides a significant amplifying factor leading to the harsh sustained glacial-like conditions seen in the YD.