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Author(s):
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Tree-ring radiocarbon reveals reduced solar activity during Younger Dryas cooling

Adam Sookdeo[1,2], Bernd Kromer[3], Florian Adolphi[4,5], Jürg Beer[6], Nicolas Brehm[2], Ulf Büntgen[7,8,9], Marcus Christl[2], Timothy Eglinton[10], Micheal Friedrich[3,11], Giulia Guidobaldi[2], Gerd Helle[12], Raimund Muscheler[5], Daniel Nievergelt[8], Maren Pauly[13], Frederick Reinig[8,14], Willy Tegel[15], Kerstin Treydte[8], Chris Turney[2,16], Hans-Arno Synal[2], and Lukas Wacker[2]

[1]UNSW, Analytical Chemistry, Chronos 14Carbon-Cycle Facility, Sydney, Australia (a.sookdeo@unsw.edu.au)
[2]ETH-Zürich, Laboratory of Ion Beam Physics, Zürich, Switzerland
[3]Heidelberg University, Institute of Environmental Physics, Heidelberg, Germany
[4]University of Bern, Climate and Environmental Physics & Oeschger Center for Climate Change Research, Bern, Switzerland
[5]Lund University, Department of Geology-Quaternary Sciences, Lund, Sweden
[6]Swiss Federal Institute of Aquatic Science and Technology EAWAG, Zürich, Switzerland
[7]Swiss Federal Research Institute WSL, Birmensdorf, Switzerland
[8]University of Cambridge, Department of Geography, Cambridge, UK
[9]University Brno, Global Change Research Institute CAS and Masaryk, Brno, Czech Republic
[10]ETH-Zurich, Carbon Cycle Biogeoscience, Zürich, Switzerland
[11]Hohenheim University, Institute of Botany, Stuttgart, Germany
[12]GFZ German Research Centre for Geosciences, Potsdam, Germany
[13]Bath Spa Univerisity, School of Science, Bath, UK
[14]University Mainz, Department of Geography, Johannes Gutenberg, Germany
[15]Albert-Ludwigs University of Freiburg, Freiburg, Germany
[16]Palaeontology, Geobiology and Earth Archives Research Centre (PANGEA), University of New South Wales, Sydney, Australia

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.