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Reconstructing 14C production rate and solar activity for the late Holocene

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Reconstructions of the radiocarbon (^{14}C) production and solar magnetic activity are presented for the late Holocene. Solar irradiance variations may form an important role for externally driven Holocene climate variability. Multi-decadal to century scale irradiance variations have been reconstructed from the ^{10}Be or radiocarbon record. This has been done using simple linear relationships between the ^{10}Be deposited on ice or the atmospheric radiocarbon concentration recorded in tree rings and irradiance variations (1).

Radiocarbon production and atmospheric radiocarbon ratios are linked in a non-linear way through the carbon cycle. In addition, radiocarbon production depends non-linearly on solar magnetic activity and the geomagnetic field. In more sophisticated attempts, solar magnetic activity is inferred from cosmogenic ^{14}C production and by considering variations in the geomagnetic field (2).

Here, we apply a 3-dimensional ocean model that includes formulations describing the cycling of carbon and the isotopes ^{13}C and ^{14}C to invert the Holocene tree-ring radiocarbon records for radiocarbon production. Then, the solar modulation parameter, a measure of solar magnetic activity, is calculated from the ^{14}C production and the strength of the geomagnetic field by applying a ^{14}C production model. Results are compared with available irradiance and sunspot reconstructions. Our results suggest that solar activity was comparable to today during several periods of the last millennium. This is in contrast to claims by Solanki et al. (3) that today's solar activity is without precedence during the last 8'000 years.

1. E. Bard et al., Solar irradiance during the last 1200 years based on cosmogenic

nuclides, Tellus (2000)

2. R. Muscheler et al., Record high solar activity? - Radiocarbon tells a different story, Nature (2005), submitted

3. S. K. Solanki et al., Unusual activity of the Sun during recent decades compared to the previous 11,000 years, Nature (2004)