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Reconstructing the 11-year solar cycle length from cosmogenic radionuclides for the last 600 years

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The cyclic behavior of the solar magnetic field has been known for centuries and the 11-year solar cycle is one of the most important features directly visible on the solar disc. Using sunspot records it is evident that the length of this cycle is variable. A hypothesis of an inverse relationship between the average solar activity level and the solar cycle length has been put forward (e.g. Friis-Christensen & Lassen, 1991), indicating longer solar cycles during periods of low solar activity and vice versa. So far, studies of the behavior of the 11-year solar cycle have largely been limited for the last 4 centuries where observational sunspot data are available. However, cosmogenic radionuclides, such as 10Be and 14C from ice cores and tree rings allow an assessment of the strength of the open solar magnetic field due to its shielding influence on galactic cosmic rays in the heliosphere. Similarly, very strong solar storms can leave their imprint in cosmogenic radionuclide records via solar proton-induced direct production of cosmogenic radionuclides in the Earth atmosphere.

Here, we test the hypothesis of an inverse relationship between solar cycle length and the longer-term solar activity level by using cosmogenic radionuclide records as a proxy for solar activity. Our results for the last six centuries suggest significant solar cycle length variations that could exceed the range directly inferred from sunspot records. We discuss the occurrence of SPEs within the 11-year solar cycle from a radionuclide perspective, specifically the largest one known yet, at AD 774-5 (Mekhaldi et al., 2015).

References:
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