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Variation of the solar activity over the last 1300 years based on two new 10Be high-resolution records from Dome C and Talos Dome (Antarctica)

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Documenting the solar activity before the instrumental period is important to improve our knowledge of the solar-dynamo process which generates the cyclically-varying solar magnetic field. Cosmogenic nuclides, such as beryllium-10 (10Be) and carbon-14 (14C), measured in ice cores and tree rings, respectively, provide information on the variation of past solar activity. We present two new 10Be records, covering the last 1300 years, from the Dome C and Talos Dome ice cores drilled in the frame of the VOLSOL and TALDICE projects, respectively. We based the Dome C chronology on the WAIS Divide chronology (WD2014, Sigl et al., Nature, 2015), the Talos Dome chronology is based on a combination of WD2014 and AICC2012 (Veres et al., Clim. Past, 2013, Bazin et al., Clim. Past, 2013). Sub-annual resolution was achieved at the Dome C site through the 1700 10Be measurements that were made on the first 58 m of the ice core, while the 450 samples measured on the first 140 m of the Talos Dome ice core allowed an average resolution of 2.5 - 3 years.

The five minima of solar activity (Oort, Wolf, Spörer, Maunder and Dalton) are detected and characterized by a 10Be concentration increase of ca. 20% above average in agreement with previous studies of ice cores drilled at South Pole and Dome Fuji in Antarctica (Bard et al., EPSL, 1997; Horiuchi et al., Quat. Geochrono., 2008) and at NGRIP and Dye3 in Greenland (Berggren et al., GRL, 2009). We propose a reconstruction of the 10Be production signal based on our two new 10Be records which is in a very good agreement with the 14C production obtained from new tree rings records covering the last millennium (Brehm et al., Nat. Geo., 2021). This shows, firstly, that the chronologies of Dome C and Talos Dome are well established, and secondly, that the production signal obtained, independently, from these two cosmogenic nuclides records, is robust.

At Dome C, the high resolution allows the detection of the 11-year solar cycle. We will show the importance of applying a correction to 10Be ice core records in order to remove the volcanic disturbance on the 10Be deposition (Baroni et al., JGR Atm., 2019). This correction is based on the relationship between the 10Be and the sulphate concentrations obtained from the exact same samples. We will discuss the persistence of solar cycles throughout the last millennium and the comparison with the 11-yrs solar cycles detected in annual tree-ring 14C data over the same period (Brehm et al., Nat. Geo., 2021).

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