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Solar Forcing of Greenland Climate during the Last Glacial Maximum

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The role of solar forcing in climate changes is a matter of continuous debate. Challenges arise from the short period of direct observations of total solar irradiance (TSI), which indicate minor TSI variations of approximately 1 ‰ over an 11-year cycle, and the limited understanding of possible feedback mechanisms. Opposed to this, there is evidence from paleoclimate records for a tight coupling of solar activity and regional climate (e.g., Bond et al. 2001, Martin-Puertas et al. 2012). One proposed mechanism to amplify the Sun's influence on climate involves the relatively large modulation of the solar UV output (Haigh et al. 2010). This alters the radiative balance in the stratosphere via ozone feedback processes and eventually propagates downwards causing changes in the tropospheric circulation (Inesson et al. 2011). The regional response to this forcing may, however, also depend on orbital forcing of the mean state of the atmosphere (Dietrich et al. 2012).
Prior to direct observations cosmogenic radionuclides such as 10Be and 14C are the most reliable proxies of solar activity. Their atmospheric production rates depend on the flux of galactic cosmic rays into the atmosphere which in turn is modulated by the strength of the Earth's and the solar magnetic fields. However, archives of 10Be and 14C are additionally affected by changes of their respective geochemical environment. Owing to their fundamentally different geochemistry, a combined analysis of 10Be and 14C records can aid to isolate production rate variations more reliably and thus, lead to improved reconstructions of solar variability. Due to the absence of high-quality high-resolution data this approach has so far been limited to the Holocene.
We will present the first solar activity reconstruction for the end of the last glacial (22.5 – 10 ka BP) based on the cosmogenic radionuclides 10Be and 14C. We will compare glacial solar activity variations to Holocene features through combined interpretation of new 10Be data from the GRIP ice core and published 14C records (Reimer et al. 2013, Southon et al. 2012). We will present evidence for solar forcing of sub-millennial climate changes during the last glacial maximum and will discuss potential mechanisms involved.