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Be-10 measurements and modeling results from the South Pole ice core – here comes the sun!

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The production of 10Be in the atmosphere in the high latitudes is modulated by solar variability. Time-series records of 10Be from ice cores therefore provide important information on variations in solar activity through time, which is fundamental to understanding climate variability. However, deposition of 10Be to the ice surface is also influenced by variability in atmospheric circulation and deposition processes, and thus, many 10Be ice core records remain difficult to interpret.

South Pole is arguably the best available location for minimizing the influence of variable atmospheric circulation on 10Be deposition. The single existing 10Be record from South Pole covers the last millennium and ends in CE 1982.

We present a new South Pole 10Be record from the late Holocene, together with examplary measurements from the last glacial period, complemented by climate modeling experiments of atmospheric 10Be production, transport and deposition physics. Our continuous one-meter resolution record covers so far the last three millennia. The data from the last millennium agree well with the existing 10Be record by Raisbeck et al. (1990). The 10Be data from the South Pole ice core matches the historic sunspot records strikingly, providing a robust calibration between sunspot number and 10Be deposition. The coincident timing of major shifts in sunspot number and 10Be provides an independent confirmation of the South Pole ice core timescale.

Independently, our model simulations of both internannual variablity and glacial vs. interglacial 10Be production, transport and deposition indicate that 10Be in South Pole snow is robust even to significant climate changes, suggesting that the measured 10Be primarily reflect changes of solar activity over that period. In turn, our model-data comparison allows to evaluate potential shifts in solar activity through the late Holocene, and during the glacial-interglacial transition.