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The mid-Holocene Climate Change Traced by Cosmogenic Be-10

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Climatic changes during the Holocene are characterized by relatively small variability in temperature with rather different regional responses globally. Periods of reduced solar activity comparable to the Maunder Minimum (1645 to 1715 AD) and short-lived (days to months) solar storms are likely to occur throughout the Holocene time. The radioactive isotope Be-10 has been a crucial source of information related to the past activity of the Sun and cosmic rays and the consequent impact on the Earth's climate. Be-10 occurs in the ice of Greenland after a complex pathway from production in the stratosphere and troposphere. The isotope production signal can be obscured by transport in the troposphere, fallout cascades, snow transport and ice formation processes. Here we show that the Be-10 signal preserves rather significant imprints of the natural production pathway that still reflects climatic changes. The materials used here include saw dust samples taken from the NEEM ice core (North Greenland, 77.45°N, 51.06°W) and cover the period 6500-4500 BP (b2k time scale). This Holocene period is characterized by climatic transition from a relatively warmer to colder conditions and the end of the Holocene climate optimum. The results show Be-10 concentrations range at 0.5-3x10e4 atoms/g with a general decreasing trend towards recent times. Within this trend there are periods of high and low Be-10 values spanning variable time intervals. These fluctuations in the Be-10 values suggest both cyclic and noncyclic events that are largely related to changes in solar activity and/or flux of cosmic rays. The imprint of these events in the Holocene climate (translated in the temperature record) is oscillations in the climate from relatively warmer to colder periods. Understanding the Be-10 behavior in the ice archives during the Holocene will further the knowledge about effects of the atmosphere and land surface processes on past proxy records of solar activity and cosmic rays.