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Ocean surface conditions on the SE Greenland shelf during the last millennium – from abrupt changes to centennial variability

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August sea surface temperatures (aSST) and April sea-ice concentrations (aSIC) covering the last 2900 years have been reconstructed in order to investigate the variability of summer surface conditions along possible forcing factors on the SE Greenland shelf. In this diatom-based study, we focus on the interval ca. 870–1910 Common Era (CE) reconstructed at a high temporal resolution of 3–8 years.

The results demonstrate both abrupt changes and a clear centennial-bicentennial variability for the last millennium. The Medieval Climate Anomaly (MCA) between 1000 and 1200 CE represents the warmest ocean surface conditions of the SE Greenland shelf over the late Holocene (880 BCE–1910 CE). MCA in the current record is characterized by abrupt, decadal to multidecadal changes, such as an abrupt warming of ∼2.4 °C in 55 years around 1000 CE. Temperature changes of these magnitudes are rarely observed in other proxy records from the North Atlantic. Compared to regional air temperature reconstructions, our results indicate a lag of about 50 years in ocean surface warming either due to increased freshwater discharge from the Greenland ice sheet or intensified sea-ice export from the Arctic as a response to atmospheric warming at the beginning of the MCA. A cool phase, from 1200–1890 CE, associated with the Little Ice Age (LIA), ends with the rapid warming of aSST and diminished aSIC in the early 20th century.

The phases of warm aSST and aSIC minima on the SE Greenland shelf and solar minima of the last millennium are antiphased, suggesting that solar forcing possibly amplified by atmospheric forcing has been behind the aSST variability on the SE Greenland over the last millennium. The results might indicate decreased sea ice formation on the SE Greenland shelf due to diminished freshwater input from the Greenland Ice Sheet during the cold climate periods.

The results show that the SE Greenland shelf is a climatologically sensitive area where extremely rapid changes are possible. The regional influence of the Greenland ice sheet can be prominent in specific conditions, as seen during the early MCA. Because these oceanic changes can have a global impact through their potential influence on the AMOC, this highlights the importance of Greenland ice sheet and the neighboring ocean with its major surface current, the East Greenland Current, under the present warming conditions.