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Late Holocene abrupt climate variations of the Norwegian Atlantic current in response to changing solar insolation.

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A high-resolution (2-40 years) summer Sea Surface Temperature (SSST) record based on fossil diatom assemblages is generated from a marine sediment core MD95-2011 from the Vøring Plateau, Norwegian Sea. The record has been studied to document past response of the surface water conditions in the Norwegian Atlantic current during the Late Holocene Period (LHP) to solar insolation changes, inferred from the ice-core 10Be-based Holocene reconstruction of total solar irradiance (TSI). Analysis shows that the submillennial scale mode of variability (640-900 years) in SSST is directly associated with a varying solar forcing. At the shorter scale of 260-450 year, the SSST during the LHP display a lagged response to solar forcing with a phase locked behavior. The lag of about 100 years is consistent through time and points to existence of a feedback mechanism in the climate system triggered by variations in TSI as well as the role of the thermal inertia of the ocean. The most prominent cooling events in the SSST record at 2300 and 500 years BP (onset of the Little Ice Age) are observed for the periods with the minimums of the submillennial and multicentennial scale TSI variations nearly in phase. The abruptness of these cooling events, with the SSST drop of about 1.5˚C within a decade (500 yrs BP) matches well the proposed and modeled mechanism of the deep convection shutdown and sea ice expansion in the Nordic seas in response to lasting negative TSI anomalies. It signifies the role of the duration of TSI anomalies increasing the probability of the deep convection shutdown, so even moderate variations in TSI on longer scales are capable of generating pronounced lasting anomalies in SSST. The onset of LIA recorded in the analyzed SSST leads by 40-50 years the shift in NAO, from a consistently positive to a more variable, similar to the one observed at present. The inferred lag is in agreement with the modeled delayed response of atmospheric NAO to changes in TSI and SST.