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First year sea ice in the eastern Arctic Ocean during the early-mid Holocene

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The Arctic sea-ice cover recorded important changes over the last decades. Whether or not the recent minimum of September sea-ice extent recorded in 2007 and 2012 are the single result of anthropogenic forcing or partly of natural variability, is still an open question. A way to answer this question is through examining time series documenting sea ice changes prior to its satellite monitoring, as illustrated here based on the analysis of six deep-sea cores collected from west to east along the Lomonosov Ridge. These cores show contrasted sedimentary regimes. In the west, extremely low sedimentation rates, < 5 mm/kyr, and good preservation of calcareous microfauna characterize perennial sea ice environments. In the east, relatively high sedimentation rates ranging up to ∼5 cm/kyr relate to high sea ice rafting rates and active Transpolar Drift dynamics. At sites near the easternmost edge of the Ridge, early-mid Holocene sediments are characterized by low to nil biogenic carbonates, but contain phototrophic organic-walled dinocysts. These features indicate phytoplankton productivity but poor $CaCO_3$ preservation that we link to intense brine production rates leading to vertical convection and CO_2 transfer from surface to bottom waters. Such conditions are likely related to first-year seasonal sea ice in the eastern Lomonosov Ridge area until ca. 4000 years ago. Whereas highly resilient perennial sea ice on long time scales characterizes the western Arctic Ocean, seasonal sea ice in the Russian Arctic seems to be a recurrent feature during warm episodes of the past. This suggests that the recent minimum in summer Arctic sea ice extent is part of the natural variability, but could well become a dominant mode in the future due to global warming and its Arctic amplification.