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The sensitivity of Arctic sea ice production to shelf flooding during the early Holocene: a modelling study

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During the last deglaciation, the global sea-level started rising, changing the coastlines from an early Holocene stand (40 m lower than today at approximately 10 kyr BP, *Siddall et al., 2003*) to modern day coastlines. Proxy evidence shows that this transgression occurred non-uniformly over the globe. For instance, *Bauch et al. (2001)* report for the Laptev Sea (Arctic Ocean), that the modern coastline was only established at 5 kyr BP after a fast transgression from the early Holocene, leading to a flooding of the extensive shelf area. This shelf area is presently regarded to be an important production zone of Arctic sea ice, playing an important role in the dynamics of sea ice in the Arctic, as well as its export to the Nordic Seas along the East Greenland Current (EGC). Through this sea ice export, changes in the Laptev Sea shelf area during the Holocene could potentially have had a substantial impact on the sea surface conditions of the EGC, and the Denmark Strait, which is known to be sensitive to sea ice. This is consistent with a rapid increase in sea ice export through the EGC around 5 kyr BP as reported by *Jennings et al. (2002)*.

In this study we investigate the impact of this Arctic shelf flooding on sea ice production in the Holocene, and on the climate of the Nordic Seas in the LOVECLIM1.2 global ocean-atmosphere-vegetation model. We present results of several experiments in which we study the sensitivity of Arctic sea ice production to various Arctic shelf areas under early Holocene conditions (9 kyr BP). We approach this by changing the land-sea mask to represent different lower-than-present sea-level coastlines. For example, we perform experiments with the Last Glacial Maximum (LGM) land-sea mask, representing a lowering of the sea-level by 120 m, while keeping other forcings at 9 kyr BP. A further step is to modify selected areas in the Arctic, such as the Laptev Sea area, to examine the importance of different areas. Our results help to explain long-term climate variability in the Arctic and sub-Arctic during the Holocene.

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