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Holocene Variability of Atlantic Water Advection to the Arctic Ocean

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Oceanic heat advection to the Arctic occurs mainly through the Fram Strait where Atlantic water of T = 2–8 °C and S > 35 flows northward along western Svalbard, around northern Svalbard and further eastward along the northern Eurasian continental margin. Together with water from a second inflow path across the Barents Sea it is the major contributor to the characteristic intermediate warm water layer separated by a halocline from the upper fresh, cold, and ice-covered surface layer in the Arctic Ocean. Oceanographic observations over the last 120 years have revealed a general warming trend in the Atlantic water layer, superimposed over multidecadal and subdecadal variabilities of temperature and inflow volume. This oceanic warming is considered to have contributed to the sea ice loss observed in the last few decades (POLYAKOV et al. 2010).

To reconstruct the longer-term variability of Atlantic water advection, sediment cores with high temporal resolution from the Fram Strait and the Laptev Sea continental margin were analyzed for indicators of past temperature and water mass variability. The foraminiferal fauna reveals an unusually warm and strong Early Holocene inflow to the Arctic which has been identified in many sediment core records from the Fram Strait and northern Eurasian shelves and margins, though apparently with quite variable timing (SPIELHAGEN 2012). In cores from the eastern Fram Strait variable planktic foraminifer faunas imply a stepwise transition from deglacial/Early Holocene to contemporary conditions. The phase of generally strong heat transport to the Arctic Ocean during the Early to Mid-Holocene until ca. 5 cal ka was punctuated by several short-term cold events with southeastward advances of the sea ice margin. The Late Holocene Neoglacial phase was characterized by the dominance of the cold water-indicating planktic foraminifer species *Neogloboquadrina pachyderma* in the sediments. Consistent with the decreasing insolation, cooler (sub-)surface conditions established after ca. 5 cal ka, most likely related to a weakening of the Atlantic Water advection and strong export of Arctic sea ice through Fram Strait. A similar series of events with a strong Early Holocene Atlantic water advection and a pronounced cooling thereafter is found also in sediments from the Laptev Sea margin, underlining the prominent role of Atlantic water advection as a factor for large-scale environmental changes in the Arctic. A high-resolution record from the Fram Strait (SPIELHAGEN et al. 2011) reveals that upper Atlantic water summer temperatures in the last 2,000 years fluctuated in the range of 3.0–4.5 °C until the onset of the present, anthro-

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pogenically influenced period when a rapid rise in modern summer temperatures of ~6 °C was noticed. Such temperatures are unprecedented in the last several thousand years and it must be assumed that a further rise will eventually contribute to a summer ice-free Arctic later in this century, as is suggested by coupled ocean-climate models.

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