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Oceanic heat advection to the Arctic in the last Millennium

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At present, the Arctic is responding faster to global warming than most other areas on earth, as indicated by rising air temperatures, melting glaciers and ice sheets and a decline of the sea ice cover. As part of the meridional overturning circulation which connects all ocean basins and influences global climate, northward flowing Atlantic Water is the major means of heat and salt advection towards the Arctic where it strongly affects the sea ice distribution. Records of its natural variability are critical for the understanding of feedback mechanisms and the future of the Arctic climate system, but continuous historical records reach back only ca. 150 years. To reconstruct the history of temperature variations in the Fram Strait Branch of the Atlantic Current we analyzed a marine sediment core from the western Svalbard margin. In multidecadal resolution the Atlantic Water temperature record derived from planktic foraminifer associations and Mg/Ca measurements shows variations corresponding to the well-known climatic periods of the last millennium (Medieval Climate Anomaly, Little Ice Age, Modern/Industrial Period). We find that prior to the beginning of atmospheric CO2 rise at ca. 1850 A.D. average summer temperatures in the uppermost Atlantic Water entering the Arctic Ocean were in the range of 3-4.5°C. Within the 20th century, however, temperatures rose by ca. 2°C and eventually reached the modern level of ca. 6°C. Such values are unprecedented in the 1000 years before and are presumably linked to the Arctic Amplification of global warming. Taking into account the ongoing rise of global temperatures, further warming of inflowing Atlantic Water is expected to have a profound influence on sea ice and air temperatures in the Arctic.