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Eurasian Arctic climate over the past millennium as recorded in the Akademii Nauk ice core (Severnaya Zemlya)

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The 724 m deep ice core drilled on the low-altitude Akademii Nauk (AN) ice cap (Severnaya Zemlya, 80.52°N, 94.82°E, about 750 m a.s.l.) provides high-resolution climate proxy data from the Western Eurasian Arctic, although the ice cap is affected by summertime melting and melt water infiltration.

We present stable water isotope data (δ^{18}O and deuterium excess) of the upper 410 m, representing approximately the last eleven centuries in annual to decadal resolution. The ice core chronology is based on five volcanic reference horizons (Bezymianny 1956, Katmai 1912, Laki 1783, unknown volcano 1259, Eldgja 934) and on stable-isotope based annual layer counting.

The multi-annual AN δ^{18}O data are highly correlated to instrumental temperature data from the Western Eurasian Arctic (e.g. r=0.76 for Vardø/Northern Norway, 1840-1998) and, thus, provide a valuable near-surface temperature proxy for this region. Moreover, AN δ^{18}O data coincide well to a surface temperature compilation for the Atlantic-Arctic boundary region, indicating the strong Atlantic influence on the Western Eurasian Arctic climate.

AN δ^{18}O data reveal major temperature changes in the last 1100 years. The lowest temperatures occurred around 1800 representing the absolute minimum of the Late Holocene. Afterwards an exceptional warming took place leading to the double-peaked early 20^{th} century maximum, which represents the warmest temperatures in the Late Holocene.

A long-term decrease of AN δ^{18}O data does not solely reflect climate cooling but probably also the growth of AN ice cap. Neither a pronounced Medieval Warm Period nor a Little Ice Age could be identified in AN ice core data. However, AN proxy records show evidence for several abrupt climate changes, e.g. strong cooling and warming events in the 15^{th} and 16^{th} as well as in the 18^{th} and 19^{th} centuries. They indicate considerable changes in the internal dynamics of the Arctic climate system comprising shifts in the atmospheric circulation patterns and accompanied sea ice extent changes. Variations in the deuterium excess data indicate changes in moisture generation and transport, probably related to changes in the atmospheric circulation patterns and/or sea ice dynamics.

The AN δ^{18}O record coincides well with that of the Austfonna ice core (Svalbard), confirming the regional significance of AN ice core data, which represent annual climate signals. However, there are major differences to Arctic-wide temperature compilations which are dominated by climate records of the American Arctic and mostly based upon summer climate indicators. This underlines the importance of high-resolution climate records from the Eurasian Arctic such as the AN ice core record for a better understanding of the Arctic climate history.