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Reconstructing the past climate variability in Svalbard from the Lomonosovfonna and Holtedahlfonna δ^{18}O ice core records

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We examine the isotopic records (δ^{18}O) from two ice cores drilled on small Arctic ice caps in Svalbard in 1997 and 2005 for their potential as proxies for past surface air temperatures (SAT) on Svalbard. The isotope concentrations in the snow pack are considered to be a proxy for condensation temperatures at the time of precipitation at the core. They can subsequently be associated with past local SAT variations. The core sites are located at Lomonosovfonna at 1250 m asl and Holtedahlfonna at 1150 m asl. The analyzed isotopic time-series are estimated to cover the periods of AD 1130-1997 and AD 1700-2005, respectively. The analysis of δ^{18}O series against the instrumental temperature record from Longyearbyen on Svalbard (regular data available since 1912) and longer but more remote Vardø series from northern Norway (since 1840) suggests that δ^{18}O can successfully be used as a proxy for winter SAT on Svalbard. The residuals of the difference between the two annual mean δ^{18}O series are randomly distributed. It suggests similar processes to drive the variability in precipitation seasonality and δ^{18}O and indicates that stacking (standardization and averaging) of these records can reduce the non-climatic noise variance in the resulted series. We then applied scaling approach to reconstruct the winter temperature variability in Longyearbyen (Svalbard) and Vardø (Northern Norway). All reconstructions suggest the culmination of the Little Ice Age - associated cooling in the second half of the 18^{th} century and abrupt warming in the beginning of the 20^{th} century. The coldest period in Longyearbyen and Vardø during the 1800s is characterized by winter cooling of the order of 5 and 2 ^{o}C, on average, respectively. The records show, however, that some few year-long sporadic events of increased winter SAT, as high as up to the modern levels could also have place even during the LIA. Analysis of the longer Lomonosovfonna record alone suggests a relatively smooth climate transition from the Medieval Climate Optimum to the LIA, making it difficult to associate one with any specific time interval. The inferred winter SAT during the 1100s are even higher than the winter SAT which were observed on Svalbard in the end of the 1990s. Ionic washout indices indicative of the intensity of summer melting, in turn, indirectly confirms that summers on Svalbard in the 1100s might be as warm as during the last decade. It suggests that the climate conditions on Svalbard during the Medieval Warm Period were quite similar to those observed at the present time.