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Updated chronology of the Lomonosovfonna ice core, Svalbard: implications for paleotemperature reconstruction

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We present an updated reconstruction of past winter surface air temperature (SAT) for Svalbard derived from the analysis of the isotopic (δ18O) Lomonosovfonna ice core series. The 121 m long core was retrieved in 1997 at the summit of Lomonosovfonna at 1250 m asl, Svalbard. Modifications made to the previous version of the SAT reconstruction stems from the revised version of the core chronology. The updated core timescale uses three absolutely dated reference horizons comprising the radioactivity peak of 1962/63, the 1903 Grimsovotn and the 1783 Laki volcanic eruptions detected by ion analyses and identification of tephra particles. The new higher resolution oxygen isotope stratigraphy in the 74-90 m section of the core enabled us to extend the summer peak counting by ca. 100 years, back to 1613 AD, thus providing an annual time scale for this time period. The timescale error for the section of the core younger than 1613 AD is estimated to be 1 year in the vicinity of the tiepoints used and roughly 5 years between the dating horizons. The chronology of the deeper section below 90 m core depth (before 1613 AD) is based on Nye age modelling with the accumulation rate of 0.36 m weq year-1 – the average value for the 1783-1997 period. Modelling results suggest the ice in the very bottom of the core at 121.6 m core depth is dated to 770+-150 AD, which is much older than the previous estimate of about 1100 AD. Since the Nye model-based dating below the $\frac{3}{4}$ depth to the bedrock is often considered less reliable we estimated the dating uncertainty taking the partial derivatives of the Nye relationship. The multitude of the ice core timescales was then generated creating a number of possible realisations of the winter SAT reconstruction in the time domain. The updated reconstruction features a gradual winter temperature decline during 800-1800 AD. This relatively smooth climate transition from the Medieval Climate Optimum to the LIA makes it difficult to associate one with any specific time interval. The culmination of the Little Ice Age - associated cooling in the second half of the 18th century was followed by abrupt warming in the beginning of the 20th century. The coldest period in Svalbard during the 1800s is characterized by winter cooling of the order of 5'C on average. 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. We note that the inferred winter SAT variability for Svalbard is in line with the most recent assessments of the Arctic climate evolution for the last Millennium.