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Explaining Holocene glacier variability of Austre Okstindbreen with changes in Arctic air masses

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Lacustrine evidence in combination with independently dated marginal moraines have been used to reconstruct continuous Holocene glacier fluctuations of Austre Okstindbreen (66^{o}00‘ N 14^{o}16‘E; altitude 1900-730 m) in Nordland, northern Norway. The Okstindan area is ideal for reconstructing past glacier activity because the sedimentary signal carried by the meltwater can be traced through several downstream lakes. Moreover, the influence of non-glacial material is negligible since the surrounding landscape is only sparsely covered with superficial sediments.

The Okstindan area has a maritime climate ($_{winter}$P = 2235 mm, $_{summer}$T = 2.2^{o}C). Anti-cyclonic conditions characterized by low temperatures and little precipitation are typical for cold winters. Conversely, mild winters are dominated by cyclonic conditions associated with relatively frequent incursions of humid air masses. This synoptic weather pattern commonly causes heavy solid precipitation during mild winters.

Data from lake sediments indicates that the glacier existed continuously throughout the Holocene. Hence, this is the first suggested continuous glacier reconstruction in entire Scandinavia, implying that Austre Okstindbreen existed throughout the “*Holocene Thermal Optimum*”. The four largest glacier advances have been dated to c. 7000, 1300, 800 and 250 cal. yr BP. The largest glacier advance occurred c. 1300 cal. yr BP, which is anomalous compared to other glacier records in Scandinavia. The large pre

Little Ice Age (LIA) glacier advances are well documented and dated due to the fact that the glacier crossed a local watershed when this occurred, producing a particular sedimentary imprint in the downstream lacustrine records of Lake Kjennsvatnan.

The anomalous glacial history of Austre Okstindbreen can be explained by the influence of arctic and sub-arctic air masses as the glacier is situated in the transition zone between mild and humid air masses from the south versus dry and cold air masses from the arctic. During periods when the polar air masses expanded, the glacier received little precipitation in contrast to periods when the westerlies dominated the Okstindan area. Our reconstruction indicates that the prevailing position of the atmospheric polar front has varied frequently during the Holocene.

This study demonstrate the importance of using a multi–proxy approach as well as collecting cores from different downstream lakes in order to better understand the processes that govern transport and deposition of suspended glacigenic sediments. We have employed proxies that reflect the energy of the glaciofluvial system in addition to a new proxy that reflect glacial erosion in order to improve the quality of the glacier reconstructions. Finally, independent dating of marginal moraines combined with historical information derived from old photos and maps secure a robust Holocene chronology.