



Mapping and analysis of the glacier inventory data at the maximum of the 'Little Ice Age' in Jotunheimen, Norway

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Glaciers are determined by variations of several climatic parameters and, therefore, good indicators for climate change. In Norway, there is a long history of glacier monitoring, mainly due to their importance for hydro power generation. Therefore, a detailed and accurate data basis is available. Within southern Norway, there is a strong climatological gradient from the coast eastwards to the drier and, therefore, more continental interior. Jotunheimen represents the most continental glacier area of Norway.

For any characterisation of the recent glacier dynamics and for verification of existing models of their future behaviour, it is essential to understand the glacier reaction in the most recent past, e.g. during the so-called 'Little Ice age'. However, related previously investigations focussed on selected single glaciers. In this study, the glacier extent at the maximum of the Little Ice Age (LIA) in the glacier area Jotunheimen, South Central Norway, was mapped on a regional scale by using remote sensing. For its verification, ground truth data of different sources were applied. Furthermore, the inventory data of the LIA-glaciers, e.g. flow length or maximum height, was assessed with a digital elevation model (DEM). These data were compared with the existing modern inventories. The change of glacier area and length since about the last 250 years was calculated on that basis. Further parameters and fluctuation data was estimated by application of a simple but robust parameterisation for distinct time steps between the maximum of the LIA and AD 2003.

In detail, glacier extent at the maximum of the LIA was mapped on a Landsat TM image 2003 and vertical air photos. The maximum LIA- extent is indicated by the outermost Neoglacial moraine and the sparsely vegetation cover inside the glacier foreland. The actual dating of the outermost moraines was taken from the literature. Chronological studies at several individual glaciers using e.g. lichenometry, Schmidt-Hammer, or radiocarbon dating indicated that there are no pre-LIA Neoglacial moraines in the glacier forelands. The only exceptions are some ice-cored moraines on high-lying glaciers mainly in the eastern part of Jotunheimen. Maps of these glaciers and own field-work data were used for verification of the remote-sensing mapping and a sensitivity analysis was made to confirm the accurateness of the mapping.

Following this results, 233 glaciers existed during the LIA-maximum in Jotunheimen, comprising a total glacier area of about 290 km². The mean glacier flow length was about 1550 m. Three glaciers showed an areal extent exceeding 10 km². The majority of all glaciers (about 41 %), however, belongs to the area class of less than 0.5 km². In comparison to the inventory data of AD 2003, the glacier area shrank about 35% and the flow length about 34%. By contrast to the westwards located Jostedalbreen ice cap with its maritime glaciological regime, the glaciers of Jotunheimen showed a rather continuous area and flow length decrease following LIA-maximum until AD 2003.