



Airborne LiDAR DEMs as a tool for deriving information on past glacier extent and ice flow

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The quantification of ice volumes and the identification of ice flow regimes within historical glacier systems are important steps towards understanding historical phases of glacier advance and disintegration in the context of Holocene climate fluctuation. Topographic LiDAR DEMs provide an excellent tool for gaining various kinds of spatially distributed information.

Several case studies have been performed in the Austrian Alps, where LiDAR DEMs are available for almost the entire glacier area. LiDAR DEMs achieve vertical accuracies of few decimetres and can be used to calculate hillshade images with flat incidence angles, so that the surface structures of moraines and other glacial deposits can be identified.

These hillshade images were used together with aerial photographs to identify the LIA (Little Ice Age) moraines and the elevation of the lateral moraines, so that, together with information on today's ice volume, a lower limit for the LIA ice volume could be calculated. The resulting LIA glacier areas showed good coincidence with former reconstructions based on field mapping and airborne photogrammetry.

In addition to that, historical ice flow directions could be derived from the structure of basal moraines. These data allow an interpretation of the changing contribution of specific tributary glaciers to a joint glacier tongue, which may result in an important switch in ice dynamics leading to fast glacier advances recorded by frontal moraines. The combination of terrestrial long-term observations and LiDAR data documents the genesis of specific geomorphological features in the periglacial area by recording the processes occurring during the disintegration of glacier tongues. For example, the deposition of the material from former medial moraines in the newly formed periglacial area can be identified and quantified from the LiDAR data as well as debris flows or rock falls from the LIA moraines.