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Monitoring mountain glaciers with airborne laser scanning technology – Results from the OMEGA project

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Key issues of alpine glacier monitoring are changes in both glacier geometry and glacier mass. As accurate direct measurements are costly and time-consuming, the utilisation of new spaceborne and airborne remote sensing data for glacier monitoring is of high interest . One method used and described here is Airborne Laser Scanning, a method that allows for deriving high-quality digital elevation models (DEMs) with a horizontal accuracy in the sub-meter range and vertical accuracy up to one decimeter. Airborne laser scanning is a state-of-the-art technology for topographical mapping in many application fields, but there are only a few attempts in high mountain environments yet. Over snow and ice surfaces there is substantial experience with airborne laser ranging technology for the Greenland ice sheet, but again there are only a few attempts for high mountain glaciers yet, especially with view on covering the whole glacier area and on multitemporal applications.

The investigations presented here are part of the EU-financed OMEGA project. Between September 2001 and October 2004 15 laser scanner campaigns were carried out, four flights covering Engabreen, Norway (62 km^2) and eleven flights covering Hintereisferner and Kesselwandferner, Austria (40 km^2), comprising a data set of high significance for alpine glaciers. Here, results from both test sites are presented with a certain focus on the Austrian test site. The main results include quality checks of the DEMs (e.g. comparison with independently surveyed control areas), calculations of elevation changes and consequently volume changes for the whole glacier surface and comparisons with reference data from “traditional” sources. Both the aerial and the al-

titudinal distribution of the change patterns are described and discussed. Deliberations towards a mass balance estimation are made with regard to issues of snow density and ice dynamics.

Further research is outlined, e.g. the analysis of the laser intensity signal in order to classify different glacier surface types (e.g. snow – firn – ice) or to derive glacier flow velocity fields. General remarks are made on the planning and organisation of further laser campaigns with emphasis on high mountain environments.

The results show the high potential of airborne laser scanning technology for a variety of glaciological applications.

An oral presentation is preferred.