Geophysical Research Abstracts,
Vol. 11, EGU2009-7405-3, 2009
EGU General Assembly 2009

The Hintereisferner - eight years of experience in method development for glacier monitoring with airborne LiDAR

M. Vetter (1), B. Höfle (2), N. Pfeifer (2), M. Rutzinger (3), R. Sailer (1), J. Stötter (1), and T. Geist (4)

(1) Institute of Geography, University of Innsbruck, Innsbruck, Austria (michael.vetter@uibk.ac.at), (2) Christian Doppler Laboratory for Spatial Data from Laser Scanning and Remote Sensing, Institute of Photogrammetry and Remote Sensing, Vienna University of Technology, Vienna, Austria , (3) International Institute for Geo-Information Science and Earth Observation (ITC), Enschede, The Netherlands, (4) Austrian Research Promotion Agency (FFG), Vienna, Austria

Topographic data acquisition with LiDAR technology, airborne or terrestrial, has become the state-of-the-art procedure for Earth surface surveying. For glacier monitoring different remote sensing technologies are used for many years. With the advent of airborne LiDAR a paradigm shift in glacier monitoring has taken place. Eight years ago pioneer work within glacier surface surveying and monitoring has been carried out at the Institute of Geography (Innsbruck) within the OMEGA (Development of Operational Monitoring System for European Glacial Areas) project by using airborne LiDAR. Since 2001, 16 single airborne LiDAR campaigns have been carried out by collecting data of Hintereisferner, Kesselwandferner and adjacent small glaciers as well as their surrounding areas (Ötztal Alps, Tyrol, Austria).

We present the main results of this period of glacier monitoring based on LiDAR data. One major task was to set up a geo-database system to manage the huge amount of LiDAR data, offering the opportunity to compute various point features and different rasterized data sets using this LiDAR data management and analysis system. In this context some basic routines were developed (e.g. a tool for intensity calibration, for derive intensity and point density images, and for modeling the locations of laser shot dropouts). In addition, tools for the analysis of the glacier surface have been developed: (a) a glacier delineation tool, using intensity and roughness information, (b) tools to compute and visualize the volume and elevation changes using multitemporal data, (c) a tool to calculate the ice flow velocity at the glacier surface, (d) a classification tool to detect crevasses, snow, firn, ice and debris covered ice areas, using calibrated intensity data, roughness information and modeled laser shot dropouts. For the analysis of glacial geomorphologic processes (i) a routine for the delineation of moraine ridges and rock glaciers works on the basis of break lines, (ii) a classification method distinguishing water from dry land on proglacial braided river system based on multitemporal data, (iii) a computation method to localize debris flows and other mass movements have been implemented.

LiDAR data provide a huge potential for monitoring glacier surfaces because of the different surface attributes, which are recorded by the sensor (i.e. intensity and elevation) or can be derived by combining different features (e.g. point density, local roughness, etc). Within the next few years, full-waveform LiDAR systems will be established as standard LiDAR system specification. An increase of the point density using full-waveform systems will provide more accurate elevation and radiometric information of the terrain.