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Derivation of the horizontal glacier velocity from multitemporal airborne laser scanner data - case study: Hintereisferner, Austria

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Accurate direct measurements of changes in glacier geometry and glacier mass as well as ice dynamics are costly and time-consuming. Therefore the utilisation of new spaceborne and airborne remote sensing data for glacier monitoring is of high interest. Airborne laser scanning is a method that allows the derivation of high-quality digital elevation models (DEMs) with horizontal accuracy in the sub-meter range and vertical accuracy up to $\pm$ one decimeter.

October 2001 and September 2003 there have been 10 laser scanner campaigns between in the context of the EU-financed OMEGA project covering both Hintereisferner and Kesselwandferner (overall 40 km^2). The DEMs show the high potential of airborne laser scanning technology for glaciological applications. In previous studies it is shown that accurate elevation and volume changes of glaciers can be obtained. Now the investigations concentrate on the derivation of horizontal flow velocity.

For the calculation of the glacier velocity vectors the open source software IMCORR was used, which was primarily developed to co-register aerial photographs and satellite imagery. IMCORR takes two images and a series of input parameters to attempt matching small subscenes from the input images. The output file consists of displacement values for distinct features in the x and y direction as well as the total displacement. By converting this point information into a grid covering the whole glacier area a complete velocity model can be achieved. Previously this method has been applied to monitor big iceshelfs of the Antarctica and Greenland. The ice dynamics of only a few smaller glaciers have been analyzed by IMCORR (e.g. Engabreen, Norway).

The usual input are aerial photographs or satellite imagery, but there has not been any application by high-resolution laser scanner data yet.

The correlation of subscenes works well, as long as a) there are enough structures (crevasses, drainage channels, big stones) which can be identified on both images and b) these features show little change in their appearance. Limitations are due to the surface characteristics at the moment of the laserscan flight, the spatial resolution of the laser data and the temporary difference between the two compared data sets.

In this presentation the application of the method is described, the results are compared with reference data, interpreted and quality issues as well as limitations are discussed.