



Comparison of geodetic and direct glaciological method for three long term mass balance series in the Austrian Alps

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Glaciers are sensible indicators for climate change. Glacier mass balance provides the most direct link between the glacier and climate. The direct glaciological method and the geodetic method are most common to measure glacier mass balance. The direct glaciological method provides information on mass changes for several locations on the glacier surface which is extrapolated to the total area of the glacier. The direct method requires a lot of effort in the field and therefore long time series of measurements are rare, especially in remote areas. The geodetic method for determination of mass balance is based on volume change calculated from DEMs. For a single location on a glacier, volume changes result from the vertical component of ice velocity and changes in ice mass. Therefore, this method does not allow the determination of mass balance for single locations on the glacier surface. The possibility to use remote sensing data for the monitoring of volume changes over the total glacier area points out the importance of this method for the monitoring of remote and large glaciers.

Investigations in the Ötztal Alps using yearly Laser Scan DEMs showed that the results of the geodetic and direct glaciological method can deviate significantly. To find out if these deviations are typical for short term volume changes, several long term volume changes are analyzed. The study focussed on three glaciers with long time mass balance series in the Austrian Alps. For Jamtalferner, Silvretta, three digital elevation models (DEMs) were acquired since mass balance measurements started in 1989. For Kesselwandferner, Ötztal Alps, where the direct measurements started in 1962, DEMs

were compiled in 1969, 1971, 1997 and 2007. For Hintereisferner, Ötztal Alps, the volume changes calculated from the DEMs of 1953, 1964, 1967, 1969, 1979, 1991, 1997 and 2007 were compared to the mass balance data. On Hintereisferner and Kesselwandferner also time series of flow velocities are available. This allowed the comparison of volume change, mass balance and vertical flow velocity for single locations.