

Glacier field Monitoring: Sulzbachkees, Salzburg, Austria Monitoring Campaign 2008 with *Riegl's* LPM-321

Before following this paper please refer to the paper published January, 2007 on our webpage. The monitoring time series of this glacier-field started in 2001. The first three measurement campaigns were realized by the use of LMS-Z210 and LMS-Z210ii. Due to the fact of the enormous decrease of the ice-shield within the last years, hiking-access on the glacier itself is not longer possible. The only reachable measuring-points are far away from the glacier. No instrument of our Z-series can realize such long measuring-distances. For this reason we have used in August, 2008 our new LPM-321, which offers a maximum range up to 6000m. The glacier-field was scanned from two different positions. The resulting DEM is covering an enormous area of more than 5 km².

Project Key-Facts:

RIEGL instrument	LPM-321
Object of interest	Sulzbachkees, a glacier field in the "Hohe Tauern" (Austria)
Client's order	high resolution full 3d digital terrain models of different years, as base-data to verify climate change in the alps
Project management	EGEO and Riegl LMS in coordination with university of Salzburg (Institut of Geography) and local government of Salzburg

Process Key-Facts:

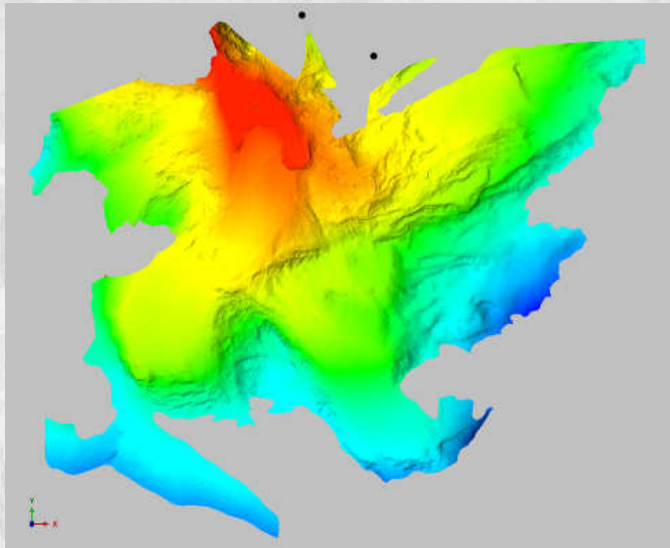
Acquisition time	3 hours for each scan-position
Time needed for post processing	2 hours
Acquisition workflow	Field of view (VxH 40°x100°), scan-resolution 0.06 deg, long-range measurement program (delivering 100 meas. /sec.), registration of scan-data was realized by GPS-data and RiSCANPRO "Multi Station Adjustment"-plugin
Acquisition platform	standard surveying tripod

Scanner at work:

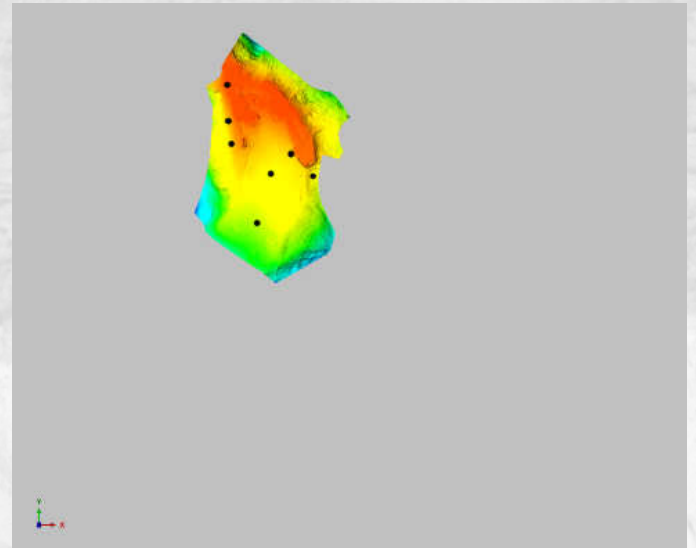


At the Obersulzbachkees (OSK) in Summer 2008 the fourth laser scan survey campaign of the tongue area and the recently formed front end of the glacier (proglacial lake) took place after 2001, 2003, and 2006. This year the LPM-321, which offers a maximum measuring range up to 6000m, was used. The following comparison shows the extreme area-coverage, which can be realized by this instrument. The black-spots are indicating the scan-positions.

DEM of 2008/2006 showing the difference in area extent

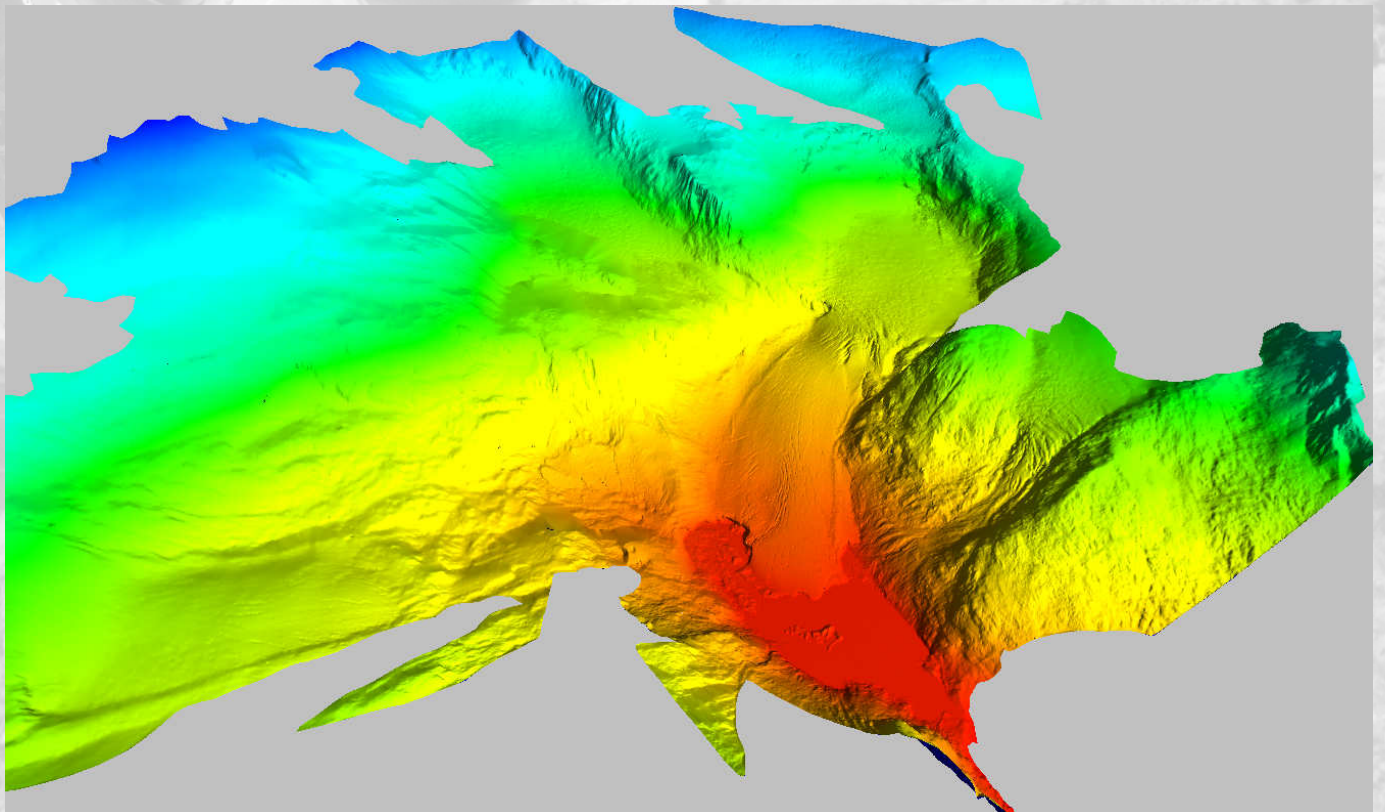


2008, 2 scan-positions, > 5km², LPM-321



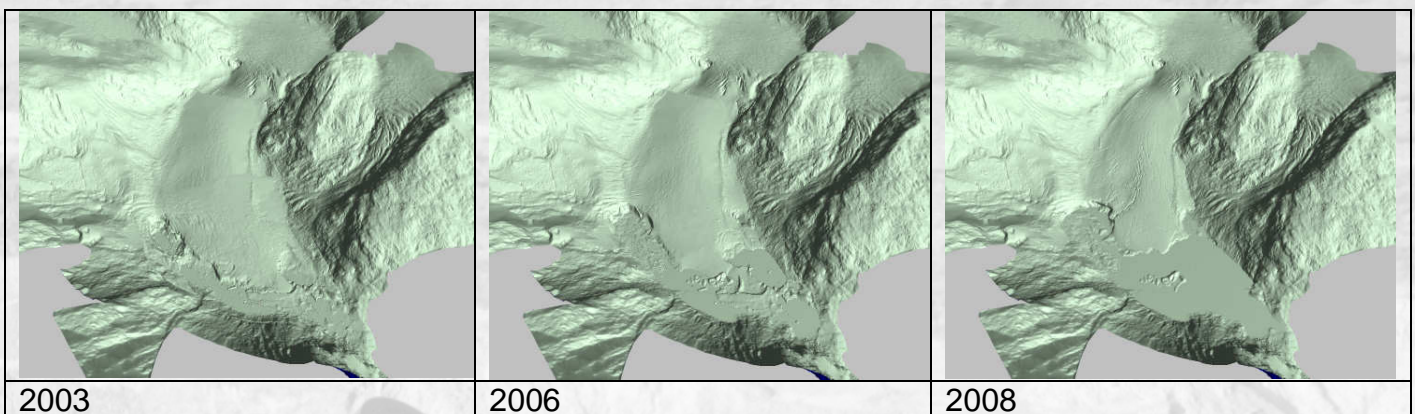
2006, 7 scan-positions, ~1km², LMS-Z210ii

Perspective view of DEM 2008 coloured by height

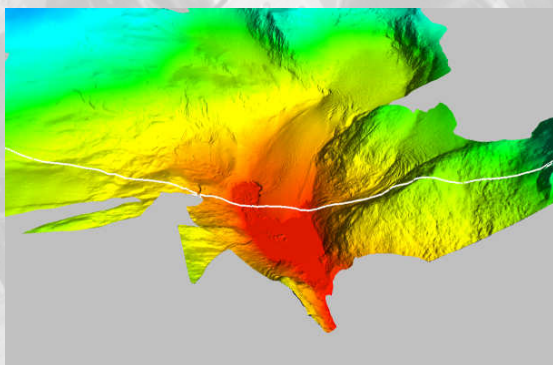


The following figure shows the DEM of 2003/2006 embedded in the new DEM 2008 acquired with LPM-321. The decrease of the glacier-tongue of Sulzbachkees can be seen clearly. Even the glacier-field on the right side has lost much of its mass within in the last years, but this area was not covered by the DEM's before 2008. Future measurements will give us the chance of monitoring a much larger glacier drainage area.

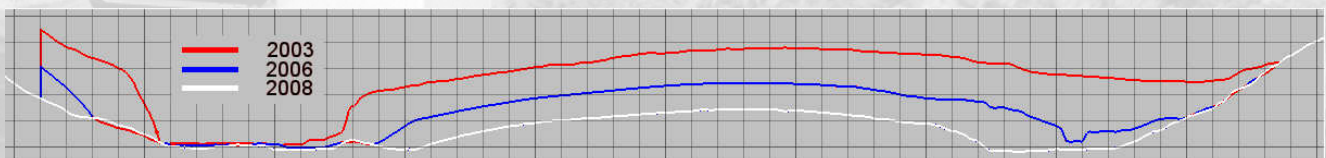
DEM of 2003 / 2006 embedded in DEM 2008 to visualize the decrease of glacier-mass



Profile through DEM's of different years



By visualizing a profile through the different DEM's we get information about the decrease of height on the glacier-field. One grid-cell of the following figure is indicating 10x10 meters. The glacier-tongue has lost in some areas within the last 5 years around 30 meters of thickness.



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