Geodesy of the Graz University of Technology. These measurements have been repeated every year until now, with one interruption in 2002. Annual horizontal creep velocities obtained are rather small and range between 5 to 11 cm a^{-1}. In this poster selected results of the measurements (1997 to 2004) will be presented numerically and graphically. Furthermore, a comparative analysis of the data will be given. Large-scale aerial photographs of three different epochs, i.e., 1974, 1998 and 2003, covering Weissenkar rock glacier were acquired in order to obtain area-wide information on the surface movement. Dense fields of three-dimensional surface displacement vectors were computed applying modern digital-photogrammetric methods. Results obtained for the time period 1998 to 2003 were compared with the respective values of the geodetic survey. The poster also comprises various thematic maps showing the mean annual creep velocity and surface height change for the time periods 1974 to 1998 and 1998 to 2003. As a basis of cartographic work a orthophoto map of the area of interest was compiled. Finally, the kinetics of Weissenkar rock glacier will be discussed in respect to its morphology and its specific topographic situation.

Studying the movement of the Outer Hochebenkar rock glacier: Aerial vs. ground-based photogrammetric methods

Ladstaedter, R., Kaufmann, V.
Institute of Remote Sensing and Photogrammetry, Graz University of Technology, Graz, Austria
key words: rock glacier monitoring, digital photogrammetry, ground-based (terrestrial) photogrammetry, Photheo 19/1318, Linhof Metrika, Rolleiflex 6006 metric, Nikon D100 digital camera

The Outer Hochebenkar rock glacier is situated in the vicinity of the village Obergurgl in the Oetztal Alps, Austria. This tongue-shaped rock glacier is about 1 km in length and 42 ha in size. It has a comparatively high but periodically changing flow velocity of up to several m a^{-1}. At the lower end of the rock glacier a landslide has occurred, which is caused by the rather steep terrain. The upper part is characterized by a steady-state creeping process. The maximum velocity can be observed right above the sliding zone (at about 2580 m).

In this work aerial as well as ground-based photogrammetric methods were used for deriving metric information of surface deformation and flow velocity. Aerial photogrammetry is a standard method for rock glacier monitoring tasks, whereas ground-based photogrammetry, being the historically older method, has not been used anymore. Nowadays, it might become a valuable tool for the monitoring of small scale periglacial phenomena again. This is due to the availability of high resolution digital consumer cameras and modern, fully automated digital-photogrammetric methods. The following aerial photographs have been acquired from the Federal Office of Metrology and Surveying (BEV): **(1)** a stereo pair dated from September 7th, 1977 (panchromatic film), **(2)** a stereo pair dated from September 11th, 1997 (panchromatic film) and **(3)** a stereo triplet dated from September 5th, 2003 (color film scanned with 20 micron). The ground-based photographs have been taken during three field campaigns using four different (metric and semi-metric) camera systems: **(1)** a stereo pair from September 23rd, 1986 (Photheo 19/1318), **(2)** stereo pairs taken on September 9th, 1999 (Linhof Metrika and Rolleiflex 6006) and **(3)** stereo pairs taken on September 19th, 2003 (Linhof Metrika, Rolleiflex 6006 and Nikon D100). Photogrammetric evaluation was done for the aerial case (1977 to 1997 and 1997 to 2003) and for the ground-based surveys (1986 to 1999 and 1999 to 2003). First, all analog images were scanned with the UltraScan 5000 photogrammetric scanner of Vexcel Imaging Austria with a resolution of 10 micron. Then an all digital photogrammetric workflow was implemented using the digital workstation ISSK of Z/I Imaging and various software tools. These have been developed for geometric and radiometric correction of the (terrestrial) images and for automatic measurement of digital terrain models (DTM) and 3D flow vectors. The results derived from the two different data sets are presented numerically and graphically. This allows to compare the ground-based method directly with the aerial case and to verify both of them with geodetic measurements provided by the University of Innsbruck. Finally the pros and cons of this two methods are discussed in detail.