Radar Interferometric Observations of Permafrost Related Surface Deformation

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ABSTRACT

In recent years we successfully applied radar interferometry to measure surface deformation over permafrost areas. The first investigations concerned the estimation of the surface deformation of rockglaciers in the Swiss Alps between 1995 and 2000 using Synthetic Aperture Radar (SAR) data of the European Remote Sensing Satellites ERS-1 and ERS-2. Based on ERS differential interferograms, with a ground spatial resolution of about 20 m and a radar wavelength of 5.6 cm, an inventory of mass moving objects could be elaborated over a large part of the Swiss Alps. Rockglaciers were classified into the four displacement rate classes: cm's/day, dm's/month, cm's/month and cm's/year (Lambiel et al. 2008). More recent satellite SAR images of the ENVISAT ASAR, ALOS PALSAR and TerraSAR-X sensors permitted updating the inventory with respect to the more recent rockglacier activity, the spatial resolution (which is 3 m in the case of TerraSAR-X), and the detection of displacement at more densely vegetated lower altitudes (higher coherence of 23 cm wavelength of ALOS PALSAR). Considering that the quantification of displacement rates larger than about 0.5 cm/day is currently limited by the orbit repeat time interval of the satellites, radar interferometric observations with a ground-based instrument were also performed. Our ground-based radar interferometer operates from a tripod with a signal wavelength of 1.8 cm and a temporal interval of about 15 minutes (Werner et al. 2008), permitting the detailed survey of mass movements with displacement rates of cm's/day like destabilized rockglaciers and rockwalls. Furthermore, preliminary encouraging results using TerraSAR-X data for the monitoring of Arctic permafrost subsidence over an area around Tuktoyaktuk near the Mackenzie River Delta in Canada will be presented.

References

Lambiel, C., Delaloye, R., Strozzi, T., Lugon, R., Raetzo, H. (2008). ERS InSAR for detecting the rockglacier activity. Proceedings of the Ninth International Conference on Permafrost, July 2008, Fairbanks, Alaska, 1, 1019-1024.

Werner, C., Strozzi, T., Wiesmann, A., Wegmüller, U. (2008). GAMMA's portable radar interferometer. Proceedings of IAG/FIG, Lisbon, Portugal.