Geophysical Research Abstracts
Vol. 16, EGU2014-5203-1, 2014
EGU General Assembly 2014

High rate and high spatial resolution surface deformation monitoring of the Argentiere glacier from complementary remote sensing and geodetic data

Lionel Benoit (1), Ha-Thai Pham (2), Emmanuel Trouvé (2), Flavien Vernier (2), Luc Moreau (3), Olivier Martin (1), Christian Thom (1), and Pierre Briole (4)

(1) IGN, Saint-Mandé CEDEX, France (lionel.benoit@ign.fr), (2) Université de Savoie-Polytech Annecy-Chambéry-LISTIC, BP 80439, 74944 Annecy-le-Vieux cedex, France, (3) EDYTEM, CNRS, Université de Savoie, 73376 Le Bourget du Lac, France, (4) ENS, Laboratoire de géologie, UMR 8538, 24 rue Lhomond 75231 Paris CEDEX 5, France

The Argentière glacier in the French Alps (Mont-Blanc massif) is a 10 km long glacier covering 19 km^2. Its flow on a large scale has been studied for over a hundred years by glaciologists, but the time and space fluctuations of its flow are still poorly documented.
We selected a small area of the glacier, about 1 km upstream of the Lognan serac fall to measure the glacier flow with in-situ GPS measurements combined with time series of ground based pictures and time series of synthetic aperture radar images from the TerreSAR-X satellite. The experiment took place during two months between September and November 2013 with a network of thirteen single-frequency GPS receivers (eleven set up on the glacier and two on the nearby bedrock) deployed in the field with a sampling rate of 30s.
Our data processing allows us to estimate epoch by epoch coordinates of each GPS site with a centimetric precision. The main interest of this approach is twofold : the monitoring of the temporal evolution of the flow and the providing of ground control points for the local and satellite remote sensing imagery. The average velocities of the stations is around 15 cm/day with peaks reaching 25cm/day lasting a few hours to one day after rainfalls or cooling periods. We explain these accelerations as the consequence of an increased basal water pressure. The strain tensor analysis shows a good consistency between the main strain axis and the orientation of the cracks on both sides of the glacier. However, available only at eleven points, the GPS data can not in any case give a picture of the overall deformation of the glacier.
In order to map the glacier flow as a whole, including crevasse areas or serac falls, two automatic digital cameras were installed during the experiment on the bedrock on the shore of the glacier with acquisitions every three hours during day time. The processing of the stereo pairs produces maps in which the pixels coordinates (and their changes) are estimated with a decimetric accuracy. Thus, given the average stream velocity, the ground based stereo imagery can detect changes beyond a cut-off period of one day.
In addition to the in-situ measurements three TerraSAR-X images acquired at an interval of ten days each were used to estimate the velocity field of the whole glacier. The precision of the displacements derived from TerraSAR-X is around 1m and this level of precision fits well with the time interval between acquisitions and provides a set of stream velocity maps highly complementary to that obtained from ground based imagery.