Geophysical Research Abstracts
Vol. 13, EGU2011-6496, 2011
EGU General Assembly 2011

Movement detection by InSAR in permafrost area, Queyras Natural Regional Park, Hautes-Alpes, France.

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Interferometric Synthetic Aperture Radar (InSAR) is a method of measurement based on the phase difference between two radar images, which represent the same area but at different time intervals. The technique generates inferograms, maps of surface deformation in two-dimensions allowing for the detection and quantification (in centimetres) of variations in distance between the target and the radar between two different data acquisitions. Recent research has shown that the InSAR technique can be used to quantify rockglacier deformation (under the assumption that certain conditions are respected with regard to generating and interpreting the interferograms) (Strozzi et al., 2004 ; Delaloye et al., 2005).

The present study aims to detect movements in permafrost. The radar images (dating from 1993 to 1999) were obtained by ERS-1 and ERS-2 satellites with the aim of generating interferograms. In contrast to previously used detection methods (Delaloye et al., 2005), which follow an empirical analysis of the interferograms, the present study suggests a method of automatic detection of deformation zones. Interferometric products (phase, amplitude and coherence) were used for detect movement areas through the use of filtering and confidence images (Barboux et Gay, 2009). The final product is a raster image representing the zones of movement as polygons.

The research aims to validate the methodology used by analysing the movement polygons obtained. In parallel a study of coherence images was made following the assumption that coherence is reduce on slow movement zones in terms of ERS characteristics (few centimetres by time lag). With the interferograms covering a considerable proportion of the South Alps, an initial study was carried out which focused on the Queyras Natural Regional Park. Here, the topo-climatic conditions are conducive to the development of periglacial formations. Three different time scales are provided: one month, two months and one year, allowing for the identification of four different rates (cms/month, cms/2months and cms/year respectively). A periglacial shape inventory was completed to provide a range of potentially creeping formations. For each form several variables (aspect, minimum and maximum altitude, activity, potential received solar radiation, etc.) were described and collected in a data base. The aim was to compare the inventory with the detected movement zones by InSAR. Measurements of the movement on two rockglaciers were carried out in the field (DGPS). Using the results of this validation, statistical analyses were carried out to allow greater understanding of the limits of the InSAR method. It seems that phase analysis is difficult for detect movement on small features. In fact, small rockglaciers represent a reduced number of pixels on ERS pictures. The coherence analysis seems more suited to the detection of small movement area.

The ultimate objective of the study is to allow for the inventory of creeping landforms over vast areas (100 km width for ERS-1-2 by 100 km length making 10,000 km2) and to keep a record of their evolution.

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