Geophysical Research Abstracts
Vol. 13, EGU2011-6057, 2011
EGU General Assembly 2011
© Author(s) 2011

Continuous monitoring and near-real time processing of GPS observations for landslide analysis: a methodological framework.

Aline Deprez, Jean-Philippe Malet, Frédéric Masson, and Patrice Ulrich

Institut de Physique du Globe de Strasbourg, CNRS UMR 7516, Université de Strasbourg, Strasbourg, France (jeanphilippe.malet@eost.u-strasbg.fr)

The objective of this work is to present a methodology developed for the near-real time characterization of displacements using permanent GPS stations installed on landslides. The GPS is a radio-navigation, timing and positioning system with a wide set of applications. By tracking the electromagnetic waves that the GPS satellites are sending continuously, the system can obtain the antenna position (Longitude, Latitude, and Height, or X, Y, Z coordinates). The use of the phase measurements allows determining the relative positions of points located as far as several hundred kilometres apart with an accuracy of 2-5 mm in planimetry and 5-10 mm in altimetry. This accuracy allows the fast detection of weak displacements and, thus the survey of the temporal evolution of crustal deformation and natural hazards (volcanoes, tectonic faults, ice glaciers, landslides).
In France, several GPS receivers have been installed on active landslides (e.g. La Clapière rockslide, Avignonet and Villerville rotational slides, Super-Sauze and La Valette mudslides) since a few years. These landslides show very different displacement rates (ranging from a few centimetres to several meters per year) and different kinematic regimes (e.g. continuous displacement of nearly constant rate or succession of periods of acceleration/deceleration). All landslides are part of the French 'Observatory of Landslides' (e.g. OMIV), a collaborative structure aiming at collecting the same type of kinematic, hydrologic and seismic observations on landslides and at disseminating the data to the scientific community (e.g. http://eost.u-strasbg.fr/omiv).
For the monitoring of landslides where the required degree of accuracy is millimetric, GPS has been mainly used for repeated measurements, as a complement to conventional geodetic methods. Permanent monitoring is still not usually performed operationally, mostly because of the cost of the GPS system compared to conventional deformation monitoring techniques. In addition, if GPS measurements can reach a millimetre-level of accuracy for long observation sessions (typically 12h), their accuracy decreases with the duration of the observation sessions, because of errors introduced by variations of the satellite constellation and multi-path effects at the sites. Moreover, one millimetre-level accuracy requires sophisticated a posteriori data processing techniques. However, to acquire a very precise 3D coordinate that can be used as a reference for other monitoring techniques and to develop early-warning systems based on real-time displacement analysis, permanent GPS with automatic transmission of the data is certainly the only solution that can be used on very constraining sites with either difficult accessibility, absence of long-term stability of the slopes around the landslide, or absence of direct visibility.
The objectives of this work are (1) to present the permanent GPS monitoring system and data transfer system installed on several landslides in France, (2) to present the automatic processing of the data using the GAMIT/GLOBK analysis package, and (3) to define quantitatively the contribution of permanent GPS observations for the fast detection of small displacements.