

Geophysical Research Abstracts
Vol. 12, EGU2010-8097, 2010
EGU General Assembly 2010
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Using a Ground Based radar interferometer during emergency: the case of A3 motorway (Salerno Reggio-Calabria) treated by landslide

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An application of Ground Based radar interferometry (GB-InSAR) technique to monitor a landslide threatening infrastructures in emergency conditions is presented. During December 2008 and January 2009 intense rainfalls occurred in Italy, especially in the southern regions. These rain events occurred in the last days of January, worsened the already critical hydrogeological conditions of some areas and triggered many landslides. One of these landslides, named Santa Trada landslide, is located close to a periodical stream called Fiumara di Santa Trada, near Villa San Giovanni municipality (Reggio Calabria, Calabria Region).

The volume involved is about 100 000 m³. This estimate represents the case of a collapse of the landslide which destabilize a larger part of the slope, involving other areas delimited by some fractures observed upstream. Nevertheless the landslide does not directly threaten the roadway, its complete collapse would hit the pillars of a motorway viaduct.

Through GB-InSAR data it has been possible to obtain an overview of the area affected by movement and to quantify the displacements magnitude. The main benefit of the system was not only limited to the capability of fully characterizing the landslide in spatial terms, it also permitted emergency operators to follow, during the whole campaign, the evolution of the mass movement and to study its cinematic behaviour. This aspect is fundamental to evaluate the volume of the material involved and to assess the temporal evolution of the risk scenario.

The GB-InSAR installed at Santa Trada points up toward the landslide from a distance of 250 m. The apparatus produces a synthesized radar image of the observed area every 6 minutes, night and day, with a pixel resolution of about 0.75 m in range and 1.2 m on average in cross range, performing a millimeter accuracy on the final displacement maps. The interferometric analysis of sequences of consecutive images allows the operator to derive the entire line of sight (LoS) displacement field of the observed portion of the slope in the elapsed time.

Despite the GB-InSAR can measure only the displacement component along the LoS direction, an accurate alignment of the system with respect to the moving direction, allowed us to assess almost completely the motion of the landslide.

The landslide, never detected before, occurred on the 30th of January; at 8.00 PM of the same day the Civil Protection Department entrusted the monitoring of the unstable slope to the Earth Science Department - University of Firenze. On the 31st of January a GB-InSAR system was installed (by Ellegi-Lisalab s.r.l.) and, after the test, carried out on the 1st of February, just 48 hours after the occurrence of the landslide, the monitoring campaign started. On the 2nd of February, thanks to GB-InSAR data interpretation, the A3 motorway, previously inhibited to vehicular traffic, was already partially re-opened. The opening of the A3 motorway was particularly significant considering that the by-pass constituted by the state highway SS18 and other 28 country roads in the neighbour area were inhibited due to rainfall. The campaign lasted until the 24th of April when the alarm ceased definitely. The brief chronicle and the analysis of the data acquired during this period described in this contribution highlights the potentiality of this system during emergency.