Geophysical Research Abstracts
Vol. 17, EGU2015-15261, 2015
EGU General Assembly 2015

An Early Warning System from debris flows based on ground vibration monitoring data

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Among the different countermeasures that can be adopted for the mitigation of landslide hazard, Early Warning Systems (EWSs) are receiving an increasing attention. EWSs are the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals and communities threatened by a hazard to appropriately act, in sufficient time, to reduce the possibility of harm or loss (UNEP, 2012). An EWS from debris flows can be classified into two main categories: advance and event EWSs. Advance EWSs predict the occurrence of a debris flow by monitoring hydro-meteorological conditions that may lead to its initiation. Despite their widespread adoption, these latter systems are prone to false alarms because they are heavily affected by bias between regional rainfall threshold and local conditions. Event EWSs, on the contrary, detect the occurrence of a debris flow when the process is already in progress. They usually rely on the use of algorithms for processing in real time the monitoring data. Their effectiveness depends on the reliability of those algorithms, which require long development and testing phases.

A specific testing field for event EWSs has been equipped in the Gadria instrumented basin, located in the Eastern Italian Alps. A specifically designed monitoring unit capable to record data from different type of sensors and to implement aboard warning algorithms has been installed along a straight reach of the torrent. A flashing light, installed on the bank of the torrent, has been wired to this unit. The flashing light is framed by a fixed video camera that also shoots the passage of debris flows in the torrent. This provides a visual verification of the efficacy of the algorithm under test, particularly useful to show to practitioners and administrators a clear demonstration of the warning outcome.

In this work, we present the performance of a warning algorithm that has been experimented in the Gadria testing field in 2013-2014. The algorithm is based on the real time processing of ground vibration data detected by three vertical geophones. During the testing period, two debris flow events occurred that were both correctly detected by the algorithm with a relatively limited number of false alarms.