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Radar data as a tool for advanced landslide Early Warning System: an innovative approach

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A landslide Early Warning System(EWS)has a complex structure and depends on several variables, such as the scale of the analysed phenomena(local or regional),its time validity(temporary or permanent),the characteristics of the analysed event etc.;these factors imply that it is impossible to develop a globally valid EWS.
This research is aimed at the exploitation of ground based and satellite Synthetic Aperture Radar(SAR)techniques in the field of landslide EWS.The idea is to evaluate the potentiality of these techniques,with the final aim to employ the monitoring results in a well-structured EWS,completely based on radar data.
Before the launch of the ESA(European Space Agency)Sentinel-1 mission in April 2014,the long revisiting times of orbiting satellites,i.e. the time elapsed between two successive observations of a certain area from the same acquisition geometry,was a serious limit to an operational use of satellite SAR data as a monitoring tool.Nowadays,the Sentinel-1 mission opened new possibilities for interferometric SAR applications:Sentinel-1 sensors provide regular and systematic acquisitions with the increased frequency of 6 days, allowing to perform monitoring activities which could be conceived as “near real time”.
Taking into account this advance in the performance of satellite systems, a SAR based EWS could potentially benefit from some features intrinsically related to the SAR techniques.
Satellite SAR techniques are capable of scanning wide areas, by performing regular and financial acceptable measurements with high accuracy and fast data elaboration; moreover, the availability of historical archives allows to analyse data over long periods.
On the other hand, ground based SAR systems are characterized by high operative flexibility, high versatility and transportability, high measurement precision, high temporal frequency together with the possibility of detecting a wider range of velocity values than the satellites.
The EWS proposed in this research has been structured in two main steps: a first step definable as a sort of “pre-EWS”, based only on satellite SAR data and designed for expert operators, and a successive step represented by the effective EWS, based on SAR data acquired both from ground based and space borne platforms.
In the “pre-EWS” activity, a regional scale study of the slope instability, based on satellite SAR data analysis, is proposed. It is conceived as a sort of EWS addressed to expert people, organized to exist permanently and produced on limited budgets.This “pre-EWS” will be able to identify those localized areas affected by an increase in the activity of the observed phenomena, which could represent a possible threat for population or economic activities.
An effective structure of early warning will become necessary and in relation to the risk intensity, the allocated budget will increase. Therefore, in this phase (the so-called “pre-alarm phase”), the monitoring activity will be increased with the installation of ground based radar systems. The increase in the costs, mainly related to the purchase of the ground based radar system, will be balanced with an increase in the precision of the measurements, an improvement in the flexibility of the instrument in the acquisition phase and in the possibility to detect a bigger range of velocity values.