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Efficient near-real-time monitoring of 3D surface displacements in complex landslide scenarios

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Ground deformation measurements play a key role in monitoring activities of landslides. A wide spectrum of instruments and methods is nowadays available, going from in-situ to remote sensing approaches. In emergency scenarios, monitoring is often based on automated instruments capable to achieve accurate measurements, possibly with a very high temporal resolution, in order to achieve the best information about the evolution of the landslide in near-real-time, aiming at early warning purposes. However, the available tools for a rapid and efficient exploitation, understanding and interpretation of the retrieved measurements is still a challenge. This issue is particularly relevant in contexts where monitoring is fundamental to support early warning systems aimed at ensuring safety to people and/or infrastructures. Furthermore, in many cases the results obtained might be of difficult reading and divulgation, especially when people of different backgrounds are involved (e.g. scientists, authorities, civil protection operators, decision makers, etc.).

In this work, we extend the concept of automatic and near real time from the acquisition of measurements to the data processing and divulgation, in order to achieve an efficient monitoring of surface displacements in landslide scenarios. We developed an algorithm that allows to go automatically and in near-real-time from the acquisition of 3D displacements on a landslide area to the efficient divulgation of the monitoring results via WEB. This set of straightforward procedures is called ADVICE (ADVanced dIsplaCement monitoring system for Early warning), and has been already successfully applied in several emergency scenarios. The algorithm includes: (i) data acquisition and transfer protocols; (ii) data collection, filtering, and validation; (iii) data analysis and restitution through a set of dedicated software, such as ©3DA [1]; (iv) recognition of displacement/velocity threshold and early warning (v) short term prediction of the temporal evolution of the landslide, e.g. through the failure forecast method; (vi) publication of the results on a dedicated webpage. Here we show the results gained in the area of Montaguto (southern Italy, ca. 100 km northeast from Naples), where a large-scale earthflow reached the bottom of the valley and severely damaged the SP90 provincial road, as well as the national railroad [2]. We discuss how the use of ADVICE has speed-up and facilitated the understanding of the landslide evolution, the communication of the monitoring results to the partners, and consequently the decision-making process in a critical landslide scenario.

[1] Manconi, A., P. Allasia, D. Giordan, M. Baldo, G. Lollino and A. Corazza, Near-real-time 3D surface deformation model obtained via RTS measurements. In Procedings of World Landslide Forum 2, October 3-9, 2011, Rome, Italy.

[2] Giordan, D., P. Allasia, A. Manconi, M. Baldo, G. Lollino, M. Santangelo, M. Cardinali and F. Guzzetti, "Morphological evolution of a large earthflow: the Montaguto landslide southern Italy", Geomorphology, in press.