IAHS2017-152
IAHS Scientific Assembly 2017

An integrated system for monitoring and early warning of rainfall-triggered landslides

Pasquale Versace (1), Giovanna Capparelli (2), Davide Luciano De Luca (3), and Ennio Ferrari (4)

(1) Department of Computer Engineering, Modeling, Electronics, and Systems Science, University of Calabria, Rende (CS), Italy (linoversace@libero.it), (2) Department of Computer Engineering, Modeling, Electronics, and Systems Science, University of Calabria, Rende (CS), Italy (giovanna.capparelli@unical.it), (3) Department of Computer Engineering, Modeling, Electronics, and Systems Science, University of Calabria, Rende (CS), Italy (davide.deluca@unical.it), (4) Department of Computer Engineering, Modeling, Electronics, and Systems Science, University of Calabria, Rende (CS), Italy (ennio.ferrari@unical.it)

The reliable risk mitigation of rainfall-triggered landslides needs integrated strategies that links scientific and technological skills to practical decision making procedures, including qualitative and quantitative risk analyses, mathematical models for both triggering and propagation of landslides induced by rainfall, real-time monitoring, and policy for risk reduction measures aiming at advanced early warning systems. More specifically, an efficient warning system is composed by landslide susceptibility maps, monitoring equipment for measuring the onset of landslide movement, models for risk scenario forecasting, units for data acquisition and transmission, mathematical models and data processing for both current hazard evaluation and future hazard forecasting, and emergency plans for avoiding or reducing damages and loss of life. Within this perspective, this paper describes an integrated project (LEWIS, Landslides Early Warning Integrated System) developed in Italy for early warning of rainfall-triggered landslides that can be adapted to different environmental contests. The project takes into account both local and monitoring systems, and is mainly based on standardized and shared procedures for risk scenario identification, survey plans, data assimilation techniques, and presentation of results, such as highway risk maps and landslides susceptibility maps.
Specifically, the mathematical approach used for simulating rainfall-triggered landslides relies on forecasting models, based on observed and predicted rainfall heights. The complete model considers the hydrological and geotechnical processes involved at slope scale and affecting stability. In particular, the mechanism behind rainfall-triggered landslides is modeled by using combined infiltration, seepage and stability analyses. This method allows the evaluation of the terrain and its response based on geological, physical, hydrogeological and mechanical characteristics. The intervention model depend on event and risk scenarios, and on criticality and alert levels. Event scenarios describe the properties of expected phenomena in terms of dimension, velocity, involved material and occurrence probability. Evaluation of occurrence probabilities, which depends on the associated time horizons, is carried out by using information from monitoring systems and/or from outputs of adopted mathematical models for nowcasting. The whole system aimed to provide an innovative and efficient solution to manage risk issues associated to landslide prone infrastructures, by developing and testing procedures and devices able to timely identify potentially dangerous landslides, and to activate all needed measures for impact mitigation, including the information delivery through proper telecommunication networks. The flexibility of the final system depends essentially on the considered wide range of monitoring equipment, both traditional and innovative, and on the different kind of mathematical models that can be realized.