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Preliminary developments and implementation of an early warning system for landslides based on real-time ground based meteorological monitoring in Povoação County (S. Miguel, Azores)

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Early warning systems are becoming one of the main tools for disaster prevention in natural hazards. Nowadays, the monitoring of natural hazards is improving steadily, and there is an urge for multi-hazard early warning systems. Additionally, data acquisition and its integration with empirical models constitute topics of particular challenge as well as the dissemination of information from early warning networks to end users.

Since its first human settlers, in the 15th century, São Miguel Island (Azores) has been affected by hundreds of destructive landslides. This large number of landslide events has been triggered either by earthquakes, volcanic eruptions or rainfall episodes and were responsible for many deaths and very important economic losses. Among the instability causes, meteorological factors are of primary importance on Povoação County, located in the SE part of the island.

Using 15 landslide occurrences of different type and magnitude occurred after 1980, Marques et al. (2007) showed recently, that the occurrence of rainfall-triggered landslides in the study area are related with the intensity (mm/day) – duration (days) function I=144.06D$^{-0.5551}$, calculated based on different cumulative methods coupled with Gumbel extreme values distribution. Additionally, the authors have showed

that landslide events are related both to short duration precipitation events (1–3 days), with high average intensity (between 144 and 78 mm/day) and long-lasting rainfall episodes (1–5 months), with a lower intensity (between 22 and 9 mm/day).

The application of empirically based rainfall triggering thresholds, in the study area, is discussed in this work. The reliability of empirical functions is assessed for recent landslide events, independent from those used for the threshold calculation applying back analysis. This process allowed the calibration and refinement of the alarm functions. For operational proposes, the rainfall threshold related to landsliding activity as well as the alarm functions, will be constantly updated for each new landslide event in the study area, granting a dynamic behavior of these functions with time.

Finally, we present the operational procedures which are presently being implemented and tested, as well as the complete information chain, starting from the automatic data acquisition from a dense automatic meteorological network that uses a radio/microwave communication system for data transference. The proposed approach emphasizes the funding targets of cost-reduced and easy deployable automatic meteorological stations, as well as the modern data acquisition and transmission equipments. Interfaces will be created allowing a flexible adaptation, integration and visualization of data. Thus, it will be ensured that the early warning system will reach a wide variety of potential users and will provide a maximum flexibility for land-use and emergency planning.

Marques, R., Zêzere, J.L., Trigo, R., Gaspar, J.L., Trigo, I. (2007) - Rainfall patterns and critical values associated with landslides in Povoação County (São Miguel Island, Azores): relationships with the North Atlantic Oscillation. *Hydrological Processes*, DOI: 10.1002/hyp.6879.