Latest progresses in rainfall thresholds, a fundamental component for regional landslide early warning systems

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The calculation of reliable, objective, reproducible, and effective rainfall thresholds for landslide forecasting is a fundamental component in the definition of a regional landslide early warning system. The process regarding the definition of rainfall thresholds was deeply investigated, producing numerous case studies at different scales and several important technical and scientific advances. Rainfall thresholds were broadly used considering: different scale of analysis, a wide variety of rainfall parameters, various physiographic settings, and different landslide types.

In the recent years, several methods were proposed to define thresholds and to implement them into landslide early warning systems. Therefore, we found necessary to review the recent international literature (papers published in international peer-reviewed scientific journals), gathering information about the definition, the employment and the validation of landslide rainfall thresholds worldwide. We collected and grouped all the information on rainfall threshold for landslide occurrence according to four categories: publication details, geographical distribution and uses, dataset features, thresholds definition. In each category, we selected descriptive information to characterize thoroughly each one of the 115 rainfall thresholds published in the 9-year period 2008-2016. We highlighted the most significant advances, the best practices, the main drawbacks still affecting recent case studies (e.g., lack of objective and reproducible methods for calibrating and validating the thresholds), the most common critical problems and the most effective solutions adopted.

With this work, we aim at describing the main characteristics of the reviewed thresholds and to produce a complete framework of new procedures to be used as guideline for future studies and applications by scientists and stakeholders involved in landslide hazard management and early warning.