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Five years of EDuMaP for the performance analysis of territorial landslide early warning systems

Luca Piciullo[1] and Michele Calvello[2]
[1]Norwegian Geotechnical Institute - NGI, Natural Hazards, Oslo, Norway (luca.piciullo@ngi.no)
[2]Department of civil engineering, University of Salerno, Fisciano, Italy

Landslide early warning systems (LEWS) can be classified in either territorial or local systems (Piciullo et al., 2018). Systems addressing single landslides, at slope scale, can be named local LEWS (Lo-LEWS), systems operating over wide areas, at regional scale, can be referred to as territorial systems (Te-LEWS). Te-LEWS deal with the occurrence of several landslides within wide warning zones at municipal/regional/national scale. Nowadays, there are around 30 Te-LEWS operational worldwide (Piciullo et al., 2018; Guzzetti et al., 2020). The performance evaluation of such systems is often overlooked, and a standardized procedure is still missing. Often the performance evaluation is based on 2 by 2 contingency tables computed for the joint frequency distribution of landslides and alerts, both considered as dichotomous variables. This approach can lead to an imprecise assessment of the warning model, because it cannot differentiate among different levels of warning and the variable number of landslides that may occur in a time interval.

To overcome this issue Calvello and Piciullo (2016) proposed an original method for the performance analysis of a warning model, named EDuMaP, acronym of the method's three main phases: Event analysis, Duration Matrix computation, Performance assessment. The method is centered around the computation of a n by m duration matrix that quantifies the time associated with the occurrence (and non-occurrence) of a given landslide event in relation to the different warning levels adopted by a Te-LEWS. Different performance criteria and indicators can be applied to evaluate the computed duration matrix.

Since 2016, the EDuMaP method has been applied to evaluate the performance of several Te-LEWS operational worldwide: Rio de Janeiro, Brazil (Calvello and Piciullo, 2016); Norway, Vestlandet (Piciullo et al., 2017a); Piemonte region, Italy (Piciullo et al., 2020), Amalfi coast, Italy (Piciullo et al., 2017b). These systems have different structures and warning models with either fixed or variable warning zones. In all cases, the EDuMaP method has proved to be flexible enough to successfully perform the evaluation of the warning models, highlighting critical and positive aspects of such systems, as well as proving that simpler evaluation methods do not allow a detailed assessment of the seriousness of the errors and of the correctness of the predictions of Te-LEWS (Piciullo et al., 2020).

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