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Integrating landslide susceptibility maps into warning models at regional scale in Italy

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The importance of susceptibility maps in the initial phase of landslide hazard and risk assessment is widely recognized in the literature, since they provide to stakeholders a general overview of the location of landslide prone areas. Usually, the use of these maps is limited to support land use planning. However, many researchers have recently recognized that susceptibility maps may also be used to improve the performance and spatial resolution of landslide warning at regional scale and provide a better updating of hazard assessment over time. Indeed, landslides prediction may be difficult at regional scale only considering rainfall condition, due to the difference of the spatial and temporal distribution of rainfall and the complex diversity of the disaster-prone environment (topography, geology, and lithology). As a result, a critical issue of models solely based on rainfall thresholds may be the issuing of warnings in areas that are not prone to landslide occurrence, resulting in an excessive number of false positives. In this work, we propose a methodology aimed at combining a susceptibility map and a set of rainfall thresholds by using a matrix approach to refine the performance of an early warning model at regional scale. The main aim is the combination of rainfall thresholds (typically used to accomplish a dynamic temporal forecasting with good temporal resolution but very coarse spatial resolution), with landslide susceptibility maps (providing static spatial information about the probability of landslide occurrence with a finer resolution). The methodology presented herein could allow a better prediction of “where” and “when” landslides may occur, thus: i) allowing to define a time-dependent level of hazard associated to their possible occurrence, and ii) markedly refining the spatial resolution of warning models employed at regional scale, given that areas susceptible to landslides typically represent only a fraction of territorial warning zones.