Combining climate and soil moisture information in statistical modelling for landslide early warning

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Shallow landslides events triggered by rainfall events pose a serious threat to people and infrastructure in mountainous areas. Regional landslide early warning systems (LEWS) have proven to be a cost-efficient tool to inform the public about the imminent landslide danger (Stähli, et al., 2015). Previous studies have demonstrated the efficacy of using landslide inventories from Switzerland to effectively forecast periods of increased landslide danger by considering rainfall characteristics (Leonarduzzi, et al., 2017) or relative changes in volumetric water content measured at soil moisture measurement stations across the country (Wicki, et al., 2020). In this study, we build upon the knowledge gained from these investigations and combine antecedent soil moisture information (including soil water potential data) with climatic data (starting with rainfall and temperature) to establish dynamic thresholds that enable the prediction of landslide probability in both time and space. To achieve this objective and to separate between critical and non-critical rainfall events, we explore machine learning approaches. We apply these models to different subsets of data and test them for different combinations of input variables. We aim to: 1) evaluate the effectiveness of different statistical models in predicting landslide hazard, 2) assess the significance of various climatic and soil moisture variables, and 3) evaluate the benefits of integrating soil moisture and climatic information within LEWS. By accomplishing these objectives, we aim to enhance the accuracy and reliability of landslide forecasting, contributing to improved landslide risk management in areas with steep slopes.

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