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## Can we get more out of rainfall thresholds? The temporal resolution tradeoff and the role of antecedent wetness and rainfall spatial variability

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Rainfall event properties like maximum intensity, total rainfall depth, or their representation in the form of intensity-duration (ID) or total rainfall-duration (ED) curves, are commonly used to determine the triggering rainfall (event) conditions required for landslide initiation. This rainfall data-driven prediction of landsliding can be extended by the inclusion of antecedent wetness conditions. Although useful for first order assessment of landslide triggering conditions in warning systems, this approach relies heavily on data quality and temporal resolution, which may affect the overall predictive model performance as well as its reliability.

In this work, we address three key aspects of rainfall thresholds when applied at large spatial scales: (a) the tradeoffs between higher and lower temporal resolution (hourly or daily) (b) the spatial variability associated with long term rainfall, and (c) the added value of antecedent rainfall as predictor. We explore all of these by utilizing a long-term landslide inventory, containing more than 2500 records in Switzerland and 3 gridded rainfall records: a long daily rainfall dataset and two derived hourly products, disaggregated using stations or radar hourly measurements.

We observe that while predictive performances improve slightly when utilizing high quality hourly record (using radar information), the length of the record decreases, as well as the number of landslides in the inventory, which affects the reliability of the thresholds. A tradeoff has to be found between using long records of less accurate daily rainfall data and landslide timing, and shorter records with highly accurate hourly rainfall data and landslide timing. Even daily rainfall data may give reasonable predictive performance if thresholds are estimated with a long landslide inventory. Good quality hourly rainfall data significantly improve performance, but historical records tend to be shorter or less accurate (e.g. fewer stations available) and landslides with known timing are fewer. Considering antecedent rainfall, we observe that it is generally higher prior to landslide-triggering events and this can partially explain the false alarms and misses of an intensity-duration threshold. Nevertheless, in our study antecedent rainfall shows less predictive power by itself than the rainfall event characteristics. Finally, we show that we can improve the performances of the rainfall thresholds by accounting for local climatology in which we define new thresholds by normalizing the event characteristics with a chosen quantile of the local rainfall distribution or using the mean annual precipitation.

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