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Hydrological perspective on precipitation intensity-duration thresholds for landslide initiation.

Thom Bogaard (1) and Roberto Greco (2)

(1) Delft University of Technology, Water Resources Section, Delft, Netherlands (t.a.bogaard@tudelft.nl), (2) Dipartimento di Ingegneria Civile Design Edilizia e Ambiente, Università degli Studi della Campania Luigi Vanvitelli, Aversa (CE), Italy (Roberto.GRECO@unicampania.it)

Many shallow landslides and debris flows are precipitation initiated. Therefore, regional landslide hazard assessment is often based on empirically derived precipitation intensity-duration (ID) thresholds and landslide inventories. Generally, two features of precipitation events are plotted and labeled with (shallow) landslide occurrence or non-occurrence. Hereafter, a separation line or zone is drawn, mostly in logarithmic space. The practical background of ID is that often only meteorological information is available when analyzing (non-)occurrence of shallow landslides and, at the same time, it could be that precipitation information is a good proxy for both meteorological trigger and hydrological cause. Although applied in many case studies, this approach suffers from many false positives as well as limited physical process understanding. Some first steps towards a more hydrologically based approach have been proposed in the past, but so far these efforts received limited follow-up.
Aims of this study are to: (a) critically analyze the concept of precipitation ID thresholds for shallow landslides and debris flows from a hydro-meteorological point of view; (b) propose a trigger–cause conceptual framework for lumped regional hydro-meteorological hazard assessment, based on the evidence from published examples and associated discussion. ID thresholds are discussed in relation to return periods of precipitation, soil physics, and slope and catchment water balance. With this study, we aim to contribute to the development of a stronger conceptual model for regional landslide hazard assessment based on physical process understanding and not only on empirical data.