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Rainfall characteristics associated to the triggering of fast- and slow-moving landslides - a comparison between the South French Alps and Lower Austria

Alexandre Remaitre (1), Stefan Wallner (2), Catrin Promper (2), Thomas Glade (2), and Jean-Philippe Malet (1)
(1) EOST-IPGS, CNRS UMR 7516, University of Strasbourg, Strasbourg, France (a.remaitre@unistra.fr), (2) Department of Geography and Regional Research, Geomorphic Systems and Risk Research Unit, University of Vienna, Vienna, Austria

Rainfall is worldwide a recognized trigger of landslides. Numerous studies were conducted in order to define the relationships between the precipitations and the triggering or the reactivation of landslides. Hydrological triggering of landslides can be divided in three general types: (1) development of local perched water tables in the subsoil leading to shallow slope instabilities and possible gravitational flows, (2) long-lasting rise in permanent water tables leading to more deep-seated slope instabilities, and (3) intense runoff causing channel-bed erosion and debris flows. Types (1) and (3) are usually observed during high rainfall intensities (hourly and daily rainfall) associated to heavy storms; type (2) is usually observed through increasing water content in the subsoil due to antecedent rainfalls (weekly or monthly rainfall) and/or massive snowmelt.
Many investigations have been carried out to determine the amount of precipitation needed to trigger slopes failures. For rainfall-induced landslides a threshold may be define the rainfall, soil moisture or hydrological conditions that, when reached or exceeded, are likely to trigger landslides. Usually rainfall thresholds can be defined on physical process-based or conceptual models or empirical, historical and statistical bases. Nevertheless, both the large variety of landslides and to the extreme variety of climatic conditions leading to the triggering or the reactivation of a landslide lead to a regional definition of relationships between landslide occurrence and associated climatic conditions. The purpose of this case study is to analyze the relationships between the triggering of three types of landslides, debris flows, shallow landslides and deep-seated mudslides, and different patterns of rainfall in two study sites with different physiographic and climatic characteristics: the Barcelonnette basin in the South French Alps and the Waidhofen an der Ybbs area in Lower Austria. For this purpose, we exploit for the two test sites a landslide catalogue and rainfall data series to define a typology of rainfall induced-landslides for the relevant landslide types. Results from an analysis of the rainfall conditions associated to these events at different time scale (yearly, monthly, daily and hourly) show a clear distinction between these landslides. Slow-moving landslides are often associated to persistent rainstorms with low intensities during long periods causing the saturation of the soils while fast-moving landslides are usually triggered by short rainfall events with high intensities that occur in summer.