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Relationships between landslide occurrences and rainfall patterns at different time scale: application to the Barcelonnette Basin (South French Alps)

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Triggering of mass movements can be divided in three general types: i) development of local perched water tables in the subsoil leading to shallow slope instabilities and possible gravitational flows, ii) long-lasting rise in permanent water tables leading to more deep-seated slope instabilities, and iii) intense runoff causing channel-bed erosion and debris flows. Types i) and iii) are usually observed during heavy storms characterized by high rainfall intensities (hourly and daily rainfall); type ii) is usually observed through increasing water content in the subsoil due to previous rainfalls (monthly rainfall). The objective of this work is to analyze the relationships between mass movement (landslide and debris flows) events and different pattern of rainfalls at different time scale.

The study has been performed in the Barcelonnette Basin (South French Alps) where an important database on mass-movement events is available. Still two centuries, about 600 references with exact date and location of triggering have been recorded. The rainfall pattern has been recorded in six meteorological stations. Principally, data are available for 24h-periods and only a small amount of new installed stations include automated recording with 6-minute data. A detailed study has been performed for 145 well known mass-movement events. For each of these events, a study of the rainfall conditions for different time scale has been performed, and for some relevant events, the regional climate conditions has been determined by defining the related weather type (synoptic point of view).

The analyses of the rainstorm episodes indicates that the determination of a clear rainfall threshold for shallow landslide and debris flows in the Barcelonnette Basin is still very difficult; this has to be put in relation with the geomorphologic settings of the different slopes and torrents. Nevertheless, two main rainfall conditions can be clearly distinguished: i) persistent rainstorms with low intensities during long periods causing the saturation of the soils and ii) short rainfall events with high intensities that occur in summer. Most of the events were triggered by heavy rainstorms without any antecedent precipitation.