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Hydrological disposition of flash flood and debris flows events in an Alpine watershed in Austria

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Debris flows and flash floods including intensive bedload transport represent severe hazards in the Alpine environment of Austria. For neither of these processes, explicit rainfall thresholds – even for specific regions – are available. This may be due to insufficient data on the temporal and spatial variation of precipitation, but probably also due to variations of the geomorphic and hydrological disposition of a watershed to produce such processes in the course of a rainfall event. In this contribution we investigate the importance of the hydrological system state for triggering debris flows and flash floods in the Ill/Suggadin watershed (500 km^2), Austria, by analyzing the effects of dynamics in system state variables such as soil moisture, snow pack, or ground water level. The analysis is based on a semi-distributed conceptual rainfall-runoff model, spatially discretizing the watershed according to the available precipitation observations, elevation, topographic considerations and land cover. Input data are available from six weather stations on a daily basis ranging back to 1947. A Thiessen polygon decomposition results in six individual precipitation zones with a maximum area of about 130 km^2. Elevation specific behavior of the quantities temperature and precipitation is covered through an elevation-resolved computation every 200 m. Spatial heterogeneity is considered by distinct hydrological response units for bare rock, forest, grassland, and riparian zone. To reduce numerical smearing on the hydrological results, the Implicit Euler scheme was used to discretize the balance equations. For model calibration we utilized runoff hydrographs, snow cover data as well as prior parameter and process constraints. The obtained hydrological output variables are linked to documented observed flash flood and debris flow events by means of a multivariate logistic regression. We present a summary about the daily hydrological disposition of experiencing a flash flood or debris flow event in each precipitation zone of the Ill/Suggadin region over almost 65 years. Furthermore, we will provide an interpretation of the occurred hydrological trigger patterns and show a frequency ranking. The outcomes of this study shall lead to an improved forecasting and differentiation of trigger conditions leading to debris flows and flash floods.