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Daily to sub-daily rainfall thresholds and the importance of convective weather types for predicting torrent hazards in Styria, Austria

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Hazardous sediment flows in steep mountain channels – like flash flooding and associated bedload transport – are among the most frequent natural hazards in the Alpine region causing humanitarian, environmental and financial losses. While there is a broad consensus that such events are generally triggered by local heavy rainstorms, it has been difficult to substantiate this finding on regional scales due to a lack of climate data with appropriate resolution. We used a torrent hazard inventory covering the south-eastern Austrian Alps over the period 2004 – 2014 and linked it to a rainfall dataset of sub-daily resolution combining precipitation radar and station gauge data. We analyzed critical rainfall characteristics leading to torrential hazards and threshold performance comparing hourly and daily time scales. A weather type classification allowed us to distinguish between convective and stratiform weather patterns.

The study shows that the vast majority of torrential hazards (88 %) occurs during convective type situations associated with heavy rainfall (>90th percentile of daily / hourly intensity). All rainfall parameters, except for duration, have very strong predictive power. Weather type and event definition impact the threshold characteristics and performance considerably. We found intensity thresholds of 20 – 29 mm d-1 and 8 – 10 mm h-1 to be critical. Although we did not find a significant improvement of the overall predictive power by using hourly instead of daily resolution, the performance of storm duration measures increases remarkably for small-scale heavy rainstorms. The results will be the basis of a future hazard assessment based on rainfall predictions under climate scenarios and can potentially contribute to improved hazard warnings.