A new approach for the description of discharge extremes in small catchments

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Introduction
Several catchments in Northwestern Switzerland have been recurrently flooded within the past years. Statistical models that consider all flood processes under the same distribution are commonly used in this region for estimating flood protection measurements. However, this approach does not represent the weather variability in time and does not differentiate between flood mechanisms. On the contrary, floods provoked by several mechanisms (e.g. flash floods, rain-on-snow floods, snowmelt floods, etc.) are assumed the same and equally likely to occur. We investigate regional patterns and dominant parameters that differentiate flood processes, by using discharge observations with high temporal resolution (e.g. 10-15 min) of different catchments sizes (~10 to 74 km²).

Motivation
895 flood events were obtained by using the peak over a threshold (POT) approach. Fig. 2 illustrates the frequency of occurrence of POTs and annual maximum floods (AMax) over the twelve calendar months. Both have a similar frequency distribution over the months; the maximum number of events occur in July for the summer season (Apr-May-Jun-Jul-Aug-Sept) and in December for the winter season (Oct-Nov-Dec-Jan-Feb-Mar). Nevertheless the frequency of the POT floods has a smoother distribution, which indicates that the AMax method misses important floods of the not dominant months.

Fig. 3 displays that the period Jun-Jul-Aug has on average the highest number of floods in the majority of the catchments. It suggest that flooding in the south hills of the Jura mountains occur in other months than in the rest of Northwestern Switzerland.

Precipitation Entropy
We investigate the entropy of precipitation as a parameter that describes the meteorological input of the flood event. Higher entropy values indicate that the input is uniformly distributed within all intervals of the evaluated period. On the other hand, lower entropies indicate that the precipitation came within a short time interval.

Fig. 4 shows the spatial linear correlation coefficient of the entropy and the daily precipitation for extreme precipitation events of different durations (selected with different aggregations). The space correlation of the entropy and the daily precipitation increase as the duration of the extreme event does (Fig. 6), because poor entropy correlations correspond to local convective events (top) and larger entropy correlations correspond to frontal events, that take place in larger areas (bottom). For all durations analyzed (only 30 min and 360 min shown), the entropy correlations are larger than the daily precipitation correlations. Fig. 6 suggests entropy as a better estimator of the spatial distribution of the meteorological extremes than the daily precipitation.

Fig. 8 shows the entropy (for the interval 12 hours before the peak) vs. the peak to volume ratio of the two summer and winter seasons. In winter the extremes are by average higher than those in summer, due to the presence of convective precipitation in summer (Fig. 8). This is also notable by the higher average peak to volume ratios, where convective precipitation leads to flashfloods.

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