Anonymous Referee #1

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General comments

This paper presents the use of weather radar data for regional extreme rainfall analysis together with a relevant application for automatic heavy precipitation alerts. The authors not only clearly explain methodology and describe the data employed, but they also show how they addressed issues that otherwise might have introduced biases in their calculations, as for example the presence of residual ground clutter. The presentation is clear and the text completed with an interesting case study which illustrates how the proposed system is complementary to thunderstorm nowcasting in case of low convective, but heavy precipitation events. Finally, the study not only touches at topics that are particularly relevant for operational weather services, as the production of warnings for severe weather, but it also introduces practical methods for exploiting the potential of increasingly growing weather radar archives.

Specific comments

p. 8, line 13: The use of monthly block maxima for the regional extreme analysis is certainly appropriate and has the advantage of introducing a robust temporal independence of the extremes. However, given the seasonal variation of the precipitation, just taking one value per month might lead to the exclusion of some of the extremes: the second peak in August may be larger than the highest value in May. The issue is of some importance considering the short duration of the dataset (10 years). Often a peaks-over-threshold approach is proposed to overcome the limitation. Have you considered this approach for your application?

Reply Applying a peak-over-threshold methodology in order to select the regional maxima would have certainly been a valid alternative to the chosen monthly block maxima approach. However, in such approach the choice of the threshold is a difficult and questionable task; it would imply also some grade of subjectivity since there are no common or objective rules. A preventive study about the stability of the Generalized Pareto Distribution parameters derived with different thresholds would give useful hints, but this would require an extra load on the preparation of partial duration series. Hence, we opted for the monthly maxima because this method is less sensitive to implementation and parameter settings and makes the results more comparable, convinced that for the operational scopes of this study it is a valid alternative to peak-over-threshold. One could also redo the same study using the peak-over-threshold methodology, but this would not change the main message of the paper.

p. 9, lines 4-20: You are not only assuming that the GEV parameters are spatially constant within each warning region, but also that they are stationary throughout the warm/cold season. The assumption is justified by the need to compensate for the limited number of years in the record, but in my opinion it might be appropriate to mention it more explicitly in the text. There are also examples of studies trying to explicitly account for seasonality (e.g. Rust et al., 2009).

Reply Thank-you for highlighting this important assumption we made which, as you noticed, is motivated by the need to extend the empirical observations of maxima.

Explicitly accounting for seasonality seems to be a too refined methodology for the application of this study, i.e. the issuance of heavy precipitation alerts for the general public in case of threshold exceedance. A comprehensive study about the seasonality of extreme precipitation over Switzerland in order to explicitly model the annual cycle of precipitation, like the one you cited, is beyond the scopes of this work. However, in order to make the reader conscious about this fundamental assumption, we inserted a sentence at the end of section 2.3:

Moreover, the analysis was performed separately for the warm (May to October) and cold (November to April) seasons in order to reduce the effect of seasonality on the choice of maxima, assuming that the GEV parameters are constant within each season. Thus, a total of 6 (months) x 10 (years) = 60 monthly maxima are considered for each season.

Technical corrections

Figure 8: If alert thresholds are defined per region and correspond to given return periods, why is the colorbar on Figure 8 showing both alert levels and rainfall thresholds? As I understand it, two regions at the same alert level (and therefore experiencing precipitation events with similar return periods) may get very different 1-hour rainfall totals (as shown in Figure 6).

Reply Thank-you for noticing it. Figure 8 represents the visualization of NowPAL alerts as they are currently obtained at MeteoSwiss, where for practical reasons the system is still working with the same rainfall thresholds for all the regions for 1-hour rainfall accumulation. The diversification of rainfall threshold will be inserted in the system in the next few months. In order to not confuse the reader, we deleted the rainfall thresholds from figure 8.

References

Rust, H. W., Douglas Maraun, and T. J. Osborn. "Modelling seasonality in extreme precipitation." The European Physical Journal Special Topics 174.1 (2009): 99-111.