Response to Referee #2,

Dear Referee,

Thank you for taking the time to evaluate our work and as well for your comments that will for sure improve our manuscript. Please find below our answers (in blue) to the issues you raised (in black):

- **Comment 1:** Short durations have a quite large uncertainty that, in absolute value, may be very relevant for practical applications (e.g., from Fig 12 it can be about +/- 2 or 3 on a mean value of 6 or 7). This can be expected as the rainfall processes that generate short-duration extremes are usually different from those generating hourly/daily maxima. In general, these short-duration events are more difficult to interpolate because are very "local". Do the authors have investigated this aspect and studied how the variogram characteristics (in particular the range) vary with the duration and impact the uncertainty?

  Response: Yes, we agree with your point of view. However please note that we haven't interpolated the GEV-parameters or -quantiles for each duration independently. Prior to interpolation, we have used the Koutsoyiannis framework to pool together all durations (from short to very long). Therefore, we haven't investigated the independent interpolation of parameter or quantiles for each duration separately. This would for sure be something interesting to investigate in future works, but on the other hand it might be problematic as quantile crossing may occur. With quantile crossing here is meant when the quantiles of two durations are interpolated independently and consequently the rainfall depth of a longer duration may be smaller than those of a shorter duration.

  In the methodology that we have applied here, the spatial structure of durations shorter than 60min is dictated mainly by the θ parameter, while the structure of durations longer than 2 hour by the η parameter (although please note that the η parameter has still some effect on the short durations). The variograms or these two parameters are shown in Figure 5, where it is visible that the range of the θ parameter is approximately 50km, while that of the η parameter approximately 70-150 km. This suggest that the short duration have shorter range and hence are more local.

  We have performed experiment 2 to investigate how different variogram characteristics are affecting the interpolation and the uncertainty of the parameter θ (please refer to figure 5, 9, and 10 in the manuscript). So, when we perform the interpolation with different variograms that differ in sill, nugget and range, there is not a considerable difference in the interpolation accuracy or precision. The uncertainty variation among the different duration is small, but the short duration levels are still slightly less certain. In the experiments conducted here, we have not varied each of the variogram features (nugget, sill and range) independently, to see their exact influence on the uncertainty. This is something that we will consider for future works.

- **Comment 2:** In fig 10, bottom row, there are several outliers. Do the authors have an interpretation for this behavior (e.g., can be related short time series)? Are these points also "extreme" in terms of parameters (mu, sigma, theta and/or eta) or this behavior emerges only looking at quantiles? Are these stations geographically clustered?

  Response: We have identified the reasons why some of the outliers are present, and this behavior emerges actually both from parameter extremes and by looking at the quantiles. For instance, there is the station in Münster City (also mentioned in the manuscript) where a scale parameter outlier is located (this location is also visible from the spatial uncertainty maps where a local high uncertainty is visible). Here a very rare extreme event was observed which is shifting the scale GEV parameter to be particularly different from the stations in the surrounding. This causes as well the RMSE of high return periods (T100a) rainfall depths to be higher in this location. Other examples are for instance

stations whose parameters are considerably different from the neighboring long observations, and hence when simulated they exhibit a high error (both parameters and consequently rainfall depths). This is observed in singular stations in the Black Forest or in the German Alps.

However, on the other side, we have also observed that the locations of rainfall depth outliers do not correspond to the locations of parameter outliers (and vice versa parameter outliers do not always lead to rainfall depth outliers). This suggests that these outliers are also emerging from looking at the quantiles of different simulations. Also, we haven't recognized any regional clusters where several stations in the vicinity are exhibiting outliers in terms of RMSE.

- **Comment 3:** P12 L360 the meaning of "reduction factor" is not clear and the symbol lambda is already used in eqs 7-8. I suggest removing it.

  Response: The idea is to start with a high temperature at the beginning, and each iteration a perturbation is accepted, the temperature is reduced by multiplying it with a factor (in our case the factor is 0.1). With decreasing temperature, it is more difficult to accept the perturbation, until the moment the temperature is very low and the image is frozen (the optimization has been reached). We will add a brief explanation to clarify the read and change the lambda symbol.

- **Comment 4:** FIG 14 Please consider using the same color scale for each plot of the same duration to facilitate comparison

  Response: I understand your concern; however, we would prefer to leave the figures as they are in order to recognize better the spatial structure of the uncertainty. As the difference between the experiments is quite big (mainly between Exp.1 and Exp.5) the spatial structures will be lost. For instance, in Exp 1 it won't be visible that the uncertainty is higher at the long station locations and that the vice versa is true for Exp.5. Nevertheless, we have included below Figure 14 with a same color scale for all durations and experiments.

- **Comment 5:** Typos
  P7 L223 "Wakely" should be "Wakeby"
  EQ 5 fix the parenthesis
  P14 L428 "In contract" should be "in contrast"

  Response: Thank you for pointing out the typos. We have fixed them.

With kind regards,

Bora Shehu

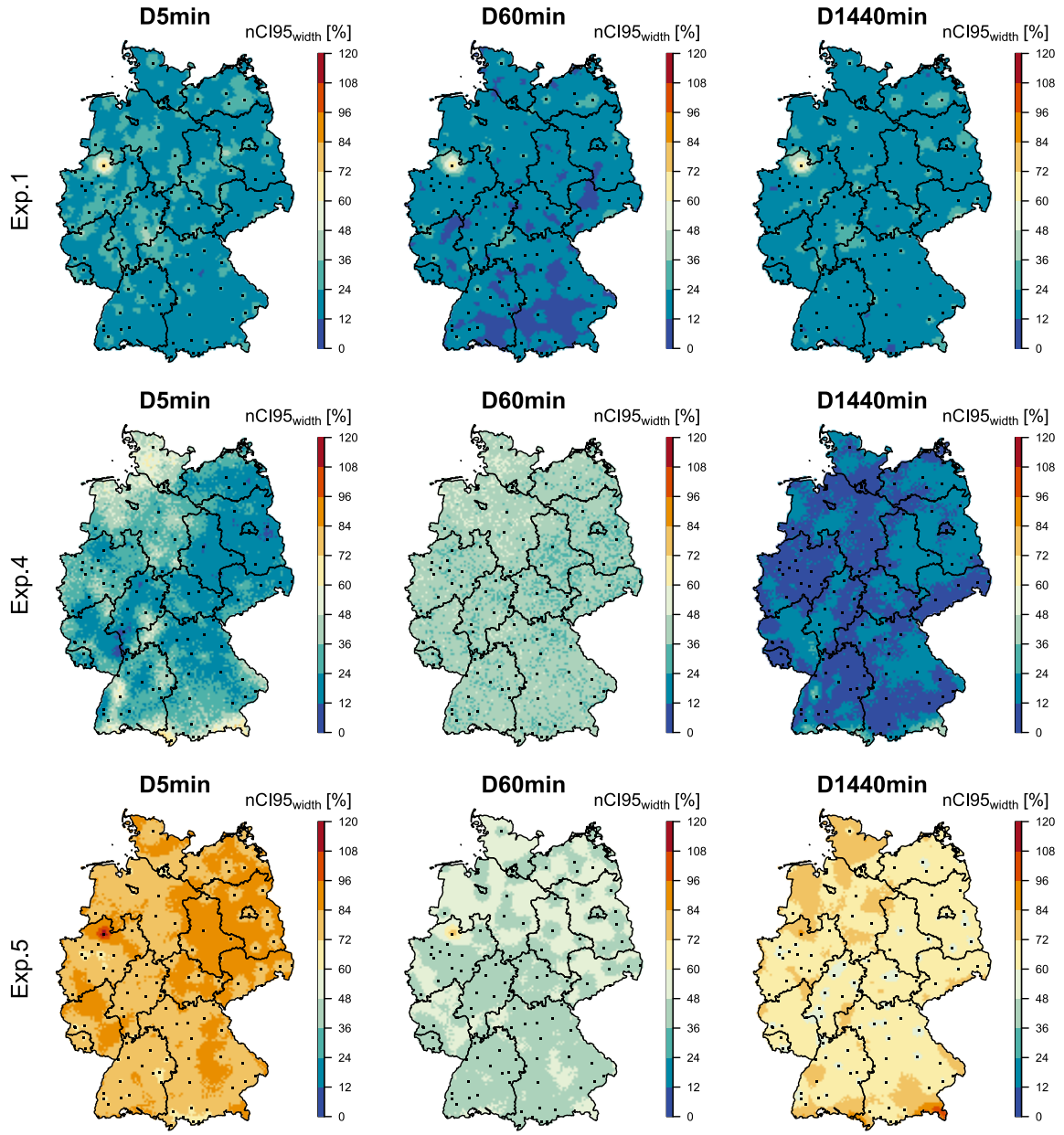

Figure 14 *The precision (nCI95[%]) in estimation rainfall depth at different durations and 100 year return period for whole Germany with all available data for three experiments: upper row – results obtained from the propagation of 100 local resampled data to the final regionalisation (Exp. 1), middle row –results obtained from 100 spatial simulations of KED[LS|SS] (Exp. 4), lower row – results obtained from 10,000 local resampling and spatial simulations of KED[LS|SS] (Exp. 5). The black squares indicate the locations of LS, while the black lines illustrate the boundaries of German Federal states. Note that the ranges for the legend colours are changing for each experiment in order to emphasize the spatial structure of each experiment.*