Partitioning spatial and temporal rainfall variability in urban drainage modelling - Supplementary Material

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1 STREAP Evaluation - Climate Variability

The ability of STREAP to reproduce the natural climate variability in relation to the annual maxima rainfall intensity is presented in Fig. S1. The mean and standard deviation of the observed annual maxima rainfall intensity are compared to the mean and standard deviation of annual maxima rainfall intensity that were generated for 30 realizations (each of 30 years) by STREAP. The observed point presented in Fig. S1 is located within the cloud of possible annual maxima rainfall statistics generated by STREAP. The "real" extent of the cloud is of course unknown, which hinders a direct validation of the results. STREAP results can be compared to other methods that are being used to estimate climate variability. One method is bootstrapping procedure (Efron, 1992) which was applied many times in the past to resample climate variability (e.g. Hänggi and Weingartner, 2011; Köplin et al., 2014; Peleg et al., 2016). Bootstrapping is based on the assumption that the 34-years of observed data are just one possible realization out of a larger population. Here, 1000 realizations of 30-years each are generated out of the original sample by re-sampling with replacement the annual maxima rainfall intensity, i.e. a specific annual maxima value from the sample can appear numerous times or never in each realization. Bootstrapping results yield a range of 64.7–82.2 for the annual maxima mean and a range of 10.8–20.5 for the annual maxima standard deviation. 3 out of the 30 realizations generated by STREAP fall out of this range. However, the bootstrapping technique is much more rigid than STREAP in its estimation, as it does not allow annual maxima to be higher or lower than the observed one.

References

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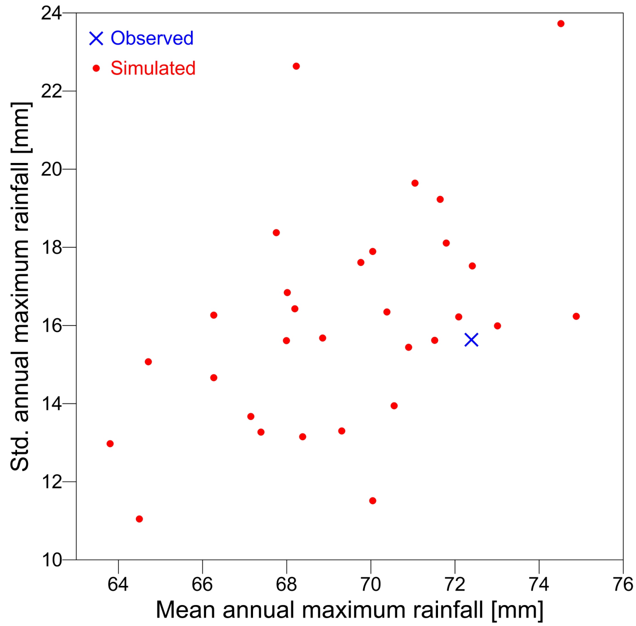

Figure S1. Example of STREAP ability to reproduce the climate variability in relation to the annual maxima rainfall intensity. The mean and standard deviation of the observed annual maxima rainfall intensity for the years 1981–2014, as recorded by Lucerne rain–gauge, is presented (blue x symbol). Red dots represent the same, but for 30 realizations of 30 years each reproduce by STREAP.

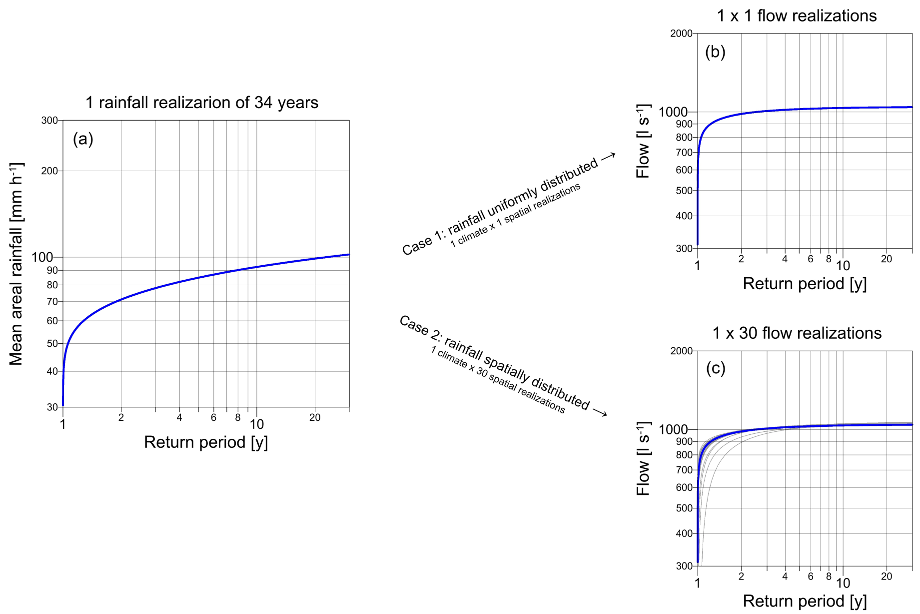

Figure S2. Rainfall and flow results for cases 1 and 2. In the left panel, the IDF curve computed for the mean areal rainfall over the catchment is presented. In the right panels, FDF curves for location A are presented. Gray lines represent the FDF curves computed for the different spatial simulations and blue line represents the FDF curve computed for the uniform rainfall simulation.

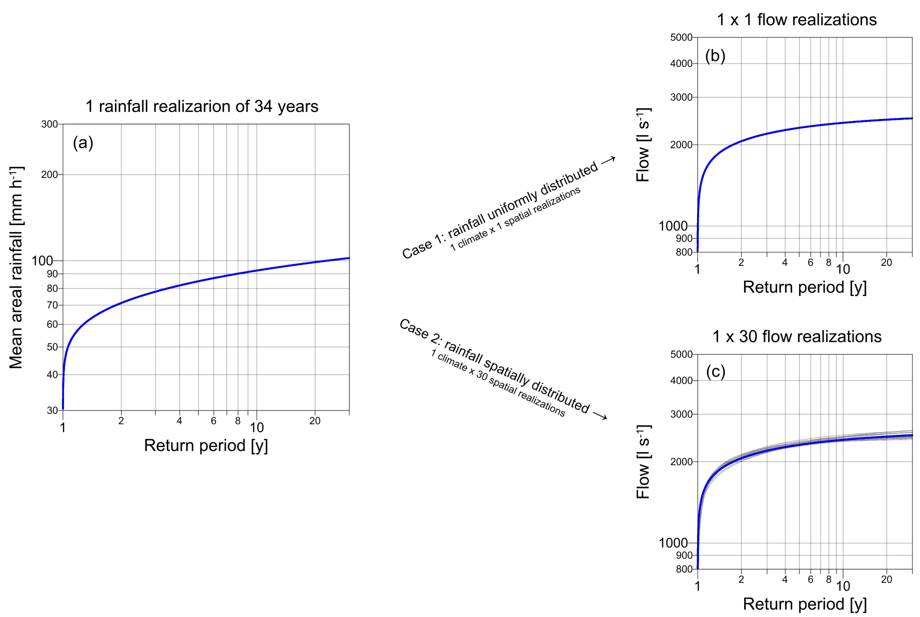

Figure S3. Same as Fig. S2, but for location C.

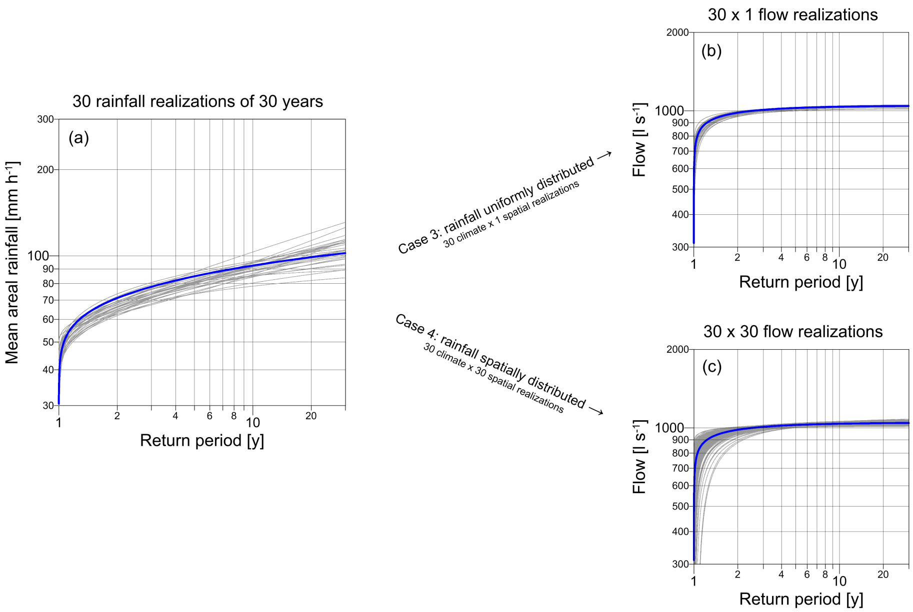

Figure S4. Rainfall and flow results for cases 3 and 4. In the left panel, the IDF curve computed for the mean areal rainfall over the catchment is presented. In the right panels, FDF curves for location A are presented. Gray lines represent the FDF curves computed for the different spatial simulations and blue line represents the FDF curve computed for the uniform rainfall simulation.

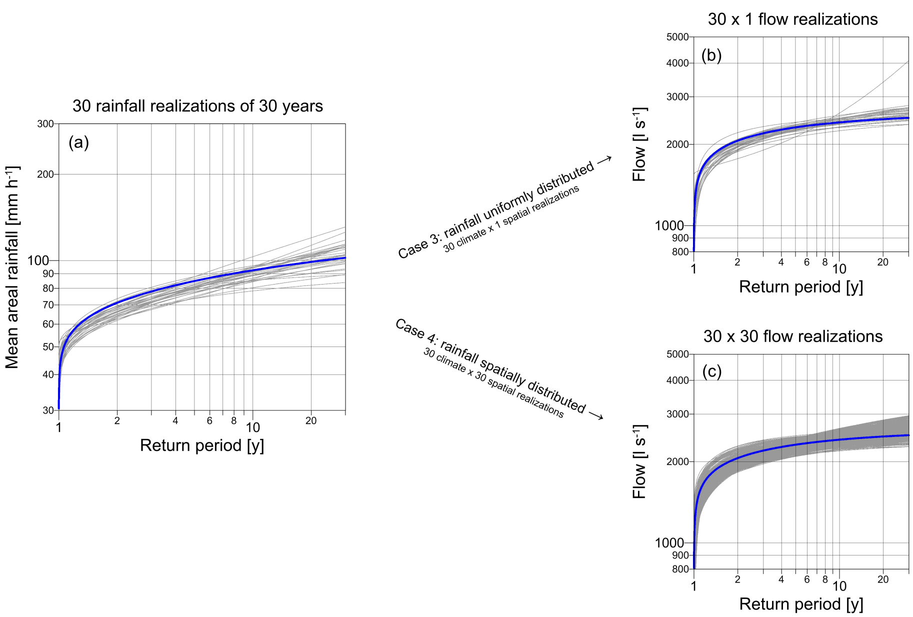

Figure S5. Same as Fig. S4, but for location C. The poorly fitted GEV distribution for one realization presented in (b) was excluded from the flow variability partitioning presented in the main text.