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Discussions

Interactive comment on "Precipitation variability within an urban monitoring network in terms of microcanonical cascade generators" *by* P. Licznar et al.

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Here we would like to reply to Reviewer's comments, point by point, and try to clarify some issues of our manuscript.

Comment 1. "**I can hardly find the novelty of this paper with respect to Licznar et al. (2011a, b) and Rupp et al. (2012). I mean that the vast majority of the concepts presented in the paper under review seems to have been already discussed elsewhere**."
We disagree with this comment, and we try to explain why in the next.

First of all, there is any connection between this current study and Rupp et al. (2012), except for the fact that they use the same dataset of time series recorded by 25 modern weighing type gauges installed in Warsaw. The study by Rupp et al. (2012) was focused on the development of 2-D cascade of canonical type whereas here we focus the attention on apparently much more prosaic topic of 1-D cascades of microcanonical type. We do not judge improper, from the scientific perspective, the use of already reported in literature databases. This kind of practice seems to be correct especially if we consider the still limited access to experimental data, especially in the form of high-resolution time series, recorded over urban areas. Warsaw gauging network is one of the largest rainfall recording networks in Europe, and in our opinion, scientific investigations should and could not be limited to a single paper. Simultaneously, we have considered that performing our analysis on a dataset already verified by other authors would be treated as rather positive issue of our study. Finally, in the manuscript, as additional value, we report also a check about the proper functioning of gauging network.

Regarding the connection between our manuscript and Licznar et al. (2011 a, b), it is reported through the text. Licznar et al. (2011 a, b) have questioned the common practice of BDCs distributions fitting with symmetrical beta theoretical distribution for all hierarchy of sub-daily timescales. Licznar et al. (2011a) was based on a single Wroclaw gauge (digitized paper charts) while Licznar et al. (2011 b) based on 4 gauges from Germany. From this perspective, one aim of this study was to confirm the methodology of Licznar et al. (2011 a, b) through a dataset of 25 modern gauges.
However this is not the main motivation of our study and the source of novelty. We believe that existing published communications, concerning microcanonical cascades for the rainfall disaggregation at sub-daily timescales, miss at least two important issues, especially if we believe in declared practical goal, i.e. to develop a practical tool to obtain 5-minute time series from daily precipitation totals, suitable for hydrological modelling (most of all for urban drainage modeling) in situations of small observed time-series.

The first issue regards the conditions of data scarsity, generally occurring in the applications. This issue can be formulated through the following question: "How long should be the high-resolution time series to derive the microcanonical cascade model parameters?" If the series have to be 20–40 years long, like in studies by Molnar and Burlando (2005, 2008) and Licznar et al. (2011a, b), microcanonical cascades could be of limited value for engineers. According to technical codes (Schmitt 2000), precipitation time series of length of about 20-30 years are suitable for hydrodynamic urban drainage modeling. When the access to long time series is possible, engineers are not interested in use of synthetic time series any longer. Here we propose an overlapping moving window algorithm to solve the common problem of scarce representation of BDCs at large timescales, and we show the possibility of microcanonical cascade generator fitting based on short time series of about 2 years length only. In our opinion, this is novelty of our study, which we do not find in previous studies. We fully agree that statistical implications of overlapping moving window algorithm are worth to be studied in more detail in the future, however we are not able to do it now as a part of current study for Warsaw due to limited observational series.

The second issue accounts for the variability of cascade generators within urban area. For the practical implementation of cascade models (not only microcanonical), it is important the site-specificity of cascade generators. From previous studies, we know that cascade generators vary, from city to city, but we do not know if they display variability within single city. We investigate the variability of precipitation within urban area through the variability of cascade generator from a gauge site to another. Thus we try to address the following question: "Is one cascade generator is enough for a city?" We believe this is another novel point of our manuscript. We consider cluster analysis techniques, for the first time, to compare BDCs histograms.

Lastly, we would like to put the attention on the fact that the development of 25 microcanonical cascades generators was not a goal in itself but important for assessing the precipitation variability within an urban monitoring network. Thus, we are not in-

terested here in developing microcanonical cascades to generate synthetic rainfalls rather than to study the variability of precipitation within urban area. We illustrate that the comparison of BDCs distributions among gauges with the cluster analysis could be very simple method for the identification of clusters of gauges of similar precipitation variability dynamic, as well as, for the detection of outliers.

In the revised version of the manuscript, we will stress clearly the differences with previous contributions [Licznar et al. (2011a, b) and Rupp et al. (2012)].

Comment 2. "**The Authors state (p. 5253, lines 14-18): "(: : :) when some local precipitation datasets are accessible, questions and doubts about the representativeness and reliability of data arise. Synthetic time series, generated from precipitation models, could be considered as probable precipitation scenarios to feed hydrodynamic urban drainage system models". Actually, this is a general comment, but it is very important in my view. I believe that the dangers for science become most evident when models (abstracts of more complex real-world problems, generally rendered in mathematical terms) are assumed to be more reliable than observational data (even if uncertain). This is particularly the case for statistical models like the model proposed in the paper under review**."
Probably, We are misinterpreted here. Of course, our intention was not to favor synthetic series over local observational data. No danger in this sense. Our intention was to focus the attention of the Reader on the issue of data representativeness due to:
1) A common practice of airport gauges data use for hydrodynamic simulation of urban drainage system in nearby located cities (from our engineering experience we know it is every day practice not only in Poland). Our results are very practical in this point proving that it is a bad practice to assume time series from airport gauge or suburban gauges as representative for city centers (see discussion of outlier gauges R15 and R25).
2) Problems with proper location of gauges in urban areas, which involves also the issue of gauges installation on building roofs and in general local standards of gauges

locations discussed in detail in WMO-No. 8.
3) Usually strongly limited length of precipitation time series eliminating occurrence of singularities i.e. extreme rainfall intensities of special interest for urban hydrology.
4) Quality of precipitation time series recorder often by old type gauges and subjected to clear errors (e.g. underestimation of highest rainfall intensities and improper intermittency recording – detailed discussion of these errors could be found in de Lima, 1998).

Comment 3. "**There is ongoing discussion about the inappropriateness of multiplicative random cascade models in providing credible simulations of rainfall time-series. For example Lombardo et al (2012) show that the autocorrelation function of the simulated series corresponds to a non-stationary process simply inherent to the model structure (see also Mandelbrot, 1974; Over, 1995; Veneziano and Langousis, 2010). The Authors should investigate whether or not their model is affected by this problem, because the reproduction of the autocorrelations as well as marginal probabilities are major requirements for statistical models**."
Many thanks for this comment. Even if the issue is surely interesting, it is out of the scope of this manuscript, because out interest is to study the variability of precipitation within urban area.

Comment 4. "**The Authors are also encouraged to study the statistical implications of the so-called "overlapping moving window algorithm" for the calculation of the breakdown coefficients (see paper eq. (2)). In other words, the Authors should investigate the joint distributional properties of their simulations when using the classical non-overlapping and their overlapping methods. I guess the dependence of the generated rainfall at a certain time interval with the time intervals preceding and following it may change significantly for the two methods**."
Many thanks for this comment. We fully agree that statistical implications of overlapping moving window algorithm are worth to be studied in more detail in the future,

however we are not able to do it now as a part of current study for Warsaw due to limited observational series.

Comment 5. "**It is well acknowledged that parsimony is a very important and desirable property in good modelling practice. However, the model proposed is over-parameterized and thus not parsimonious because it uses a somewhat artificial probability distribution for the breakdown coefficients (i.e. 2N-B distribution, which combines two Normal (N) and one Beta (B) distribution). Then, being a complicated discrete-time model, it does not correspond to a continuous time process; but natural processes typically evolve in continuous time**."
Clearly, the parsimony is a desirable property, where and when it is possible. However we agree with the sentence: "Everything Should Be Made as Simple as Possible, But Not Simpler". We do not understand the last sentence of the Reviewer "**Then, being a complicated discrete-time model, it does not correspond to a continuous time process; but natural processes typically evolve in continuous time**." because all models are practically discrete-time in their application due to the time resolution selected.

Comment 6. "**Furthermore, as the Authors have posed the 2N-B distribution as an assumption, rather than deriving it theoretically from other principles. Then, they should apply a goodness-of-fit test to justify their choice of the 2N-B distribution**."
Many thanks for this comment. In the revised version of the manuscript, we will provide some statistical justifications to our choice.

Comment 7. "**The reason for fitting a statistical model to data is to make conclusions about some essential characteristics of the population from which the data were drawn. Such conclusions can be sensitive to the accuracy of the fitted model, so it is necessary to check that the model fits well. The main issue concerns the ability of the model to describe variations in the wider population, and this is usually achievable when there**."

In the revised version of the manuscript, we will provide some statistical justifications to our choice 2N-B distribution respect to other models.

Additional bibliography not included in the body of manuscript:

de Lima M. I. P., 1998: Multifractals and the temporal structure of rainfall. Doctoral dissertation, Wageningen Agricultural University, Wageningen

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 5251, 2014.