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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Critical scales to explain urban hydrological response" *by* Elena Cristiano et al.

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General comments:

In this research article, the authors present a comprehensive study on the effects of different levels of temporal and spatial rainfall aggregation on the hydrological response derived by three different hydrological models. These models were set-up for an urban hydrological system in Cranbrook/London and cover a broad range in terms of spatial discretization and complexity. X-band radar data from the Netherlands with high resolution in space and time was used to perform the model experiments. In a very comprehensive study, the authors apply a lot of measures to shed led on rainfall and model scale. While most of these measures are taken from literature, the authors intro-

duce three new scaling factors which might be helpful in selecting appropriate scales. In my opinion, this paper is written very well, the experiments are sound and the results are valid. The topic fits very well into the journal's scope and the results are of great interest to the community. However, in my opinion, the paper needs a few minor revisions in order to improve the readability. Some ideas might help you to strengthen the thoughts and ideas of the paper:

- As pointed out earlier by Anne Jefferson, it is very important to mention that the X-band radar in Cabauw is used to perform sensitivity studies rather than reconstructing past events. X-band radars are capable of observing precipitation with a high spatial and temporal resolution. In terms of scale, their spacing and support is high. However, their extent is small. You should at least mention in Section 2.2 that the rainfall data does not represent events observed in Cranbrook. Later, in the Conclusions Section you should critically review this issue.

- You introduce a lot of scaling measures. For the reader, it is sometimes difficult to keep everything in mind. While reading the manuscript, especially Section 4, I needed to review the methodological framework several times (sometimes I really felt lost by the symbols which are not so common). Moreover, you introduce dimensionless values based on rainfall and model characteristics. In order to better understand, how units cancel out, a small table or a list of symbols (including units) would be really helpful to improve the understandability of the manuscript if possible.

- When reading the title, I expected to read something about a framework that deals with finding best scales for rainfall input data and model resolution / complexity. The paper focus on this in a very comprehensive way based on a good structure and nice explanations. However, I feel that the paper ends up at a point when it would be most interesting for the community: How do these alpha values help us to select a specific rainfall resolution in terms of critical scales (as I would expect

it from the title)? From the manuscript I couldn't get any information regarding this question. In my opinion, even though the title reflects the content, it seems to me a little bit too general given that this specific case study does not allow to draw any conclusion about appropriate values which might be transferred to other settings. However, the methodology is for sure of great value and should be applied to other sites in the future.

- In this context, another idea might be interesting: When working with observed rainfall (even with station data; unfortunately, in most cases X-band radar is not available), we are faced with the situation that we only have a few stations with minute-scale rainfall data (especially if we would like to analyze events that happened several years ago). In reality, we cannot work with X-band radars located hundreds of kilometers away from out site of interest. Therefore, if we consider some station data, it might be feasible to apply the highest temporal resolution available. Then the question remains: What resolution / complexity of the model would be best suitable given that rainfall is restricted to a fixed interval? You figured out and mentioned that the impact of the model is smaller than the impact of rainfall. However, I was wondering if it would be worth at least to briefly consider the opposite question as well?

Specific comments:

P2L13-14: I am not sure if this is true. In principle, the sensitivity of hydrological models Is understood very well, even though it is not always reported in a quantitative way. I would suggest rephrasing this sentence. You could argue that the interactions of scales (rainfall and models) requires some more attention. Please also consider adding a reference as well.

P4L7: What means "climatological" in this context? Is this variogram constructed using a data of multi-year period? I think that nine events are a too small number to state that it is a climatology.

P5L2: In my opinion, rainfall velocity is ambiguous (velocity of raindrops vs. storm motion). Do you mean storm motion velocity? Please consider rephrasing.

P5L25: Is rainfall cluster dimension the SZ value which is introduced later? Please consider defining it here.

P8L10: Do you mean the R values? I would expect P values provided as rainfall intensity.

P8L18: Does parallel mean in upstream or downstream direction? As far as I understand your explanations, this information is missing.

P15L31: Here it would be helpful to add the meaning of each symbol in parentheses.

P16L4-8: Here, you should also refer to Figure 12(a).

P17L20: Here, it would be interesting to address the opposite question as well (what model setting would be best suitable for a given rainfall spatial and temporal scale).

Technical corrections:

P2L1: led?

P2L16 the sensitivity

P3L19: models (plural)

P4L24: in a basin?

P5L23: pixels (plural form)

P6L27: Please consider replacing bigger by larger. The same might apply to the next line.

P8L29: Reference to Section 3.3?

P9L8: Kolmogorov's theory

P10L28: as well as the required

P16L13: plot

P25: In the caption of Figure 3 (first line) it would be helpful to mention that the temporal percentage is shown in b,e,h,k in order to underline the difference between the first and the second column.

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