

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

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Dear Kristian Förster,

Thank you for comments and suggestions. Below you can find the reply [AR] to your comments [RC].

General comments:

[RC] 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

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does not represent events observed in Cranbrook. Later, in the Conclusions Section you should critically review this issue.

[AR] As replied also to Anne Jefferson, we will add a paragraph to explain better the assumptions we made to apply data measured in the Netherlands to the hydrological model in the London area and to describe the possible effects that can derive from this choice.

[RC] 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.

[AR] Thank you for the suggestion. We will add a table with list of symbols used, units and a small description of the parameters to help the reader follow the manuscript.

[RC] 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.

[AR] We will consider to change the title or part of the conclusions in order to highlight

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the fact that this work refers to a specific study case, with particular characteristics. However, specific critical scale are derived, in association with the alpha values. A paragraph will be added in order to explain better how the alpha values help us to select the rainfall resolution required.

[RC] 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 our 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?

[AR] Thank you for the suggestion. It will indeed be interesting to investigate what model complexity is reasonable when high-resolution rainfall data are not available. We will add a brief comment about what we learn in this respect from our results, based on 3 different model complexities and add suggestions in the future steps section.

Specific comments:

[RC] 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

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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).

[AR] Thank you for these comments, we will consider rephrasing unclear sentences, adding a more complete explanation where requested in order to increase the readability of the manuscript and avoid misunderstanding. Proper references will be added where needed.

Technical corrections [AR] Thank you for highlight typos and writing errors. They will be corrected in the new version of the manuscript.

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