EGUsphere, author comment AC2
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Reply on RC2

Agnethe Nedergaard Pedersen et al.

Author comment on "All models are wrong, but are they useful? Assessing reliability across multiple sites to build trust in urban drainage modelling" by Agnethe Nedergaard Pedersen et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-615-AC2, 2022

The original reviewer comments are included in *italics* and sequentially provided with numbers for easy cross-referencing.

Author's responses are written in normal style, and the line numbers and Figure numbers refer to the original manuscript

Reviewer RC2

B.1. The manuscript "All models are wrong, but are they useful? Assessing reliability across multiple sites to build trust in urban drainage modelling" by Pedersen et al. introduces a well devised and clear described framework to assess reliability of urban drainage models. The manuscript is on a high level, and I think it will be of interest to the readers. However, there are some weaknesses that should be addressed. One point is the link to existing uncertainty assessment frameworks, be it in urban drainage or other fields. Throughout the paper the link to uncertainty is observable but is never clearly made. There is a need to elaborate on this, also including more literature on the topic, and define the links and boundaries of this study. A second point is the statement of the missing studies on spatial variability of rain events. I would encourage a more through look into that also in the view of radar data. Some of the figures could also need a bit of work to clarify them to the reader (see also detailed comments). Finally based on the a bit provocative title, I would have expected more suggestion for possible ways forward and an applicability discussion of the framework in the conclusion rather than a mere summary of the results.

Thank you very much for your review of the manuscript and for your comments, which have given us ideas for improving the clarity of the manuscript.

We understand your concern with regards to linking to existing uncertainty assessment frameworks, which is in the submitted manuscript not as clear as is could be. We suggest addressing this more explicitly in the Introduction an moving Figure 4, which is in the submitted manuscript only briefly referred to in section 2.3.2 about event weighting methods), forward to section 2.1 (where the framework for model adequacy assessment is introduced) and explaining it thoroughly there. See also our reply your comment B.6.

Regarding the spatial variability of rainfall, we thank you for pointing out this oddly formulated sentence. It sends another message than intended and will thus be modified,

see our reply to you comment B.4.

As a response to the provocative title, we will include a section at the end of Chapter 4 elaborating on the usefulness of the models, and what needs to be investigated and discussed in the future within this field.

B.2. Line 50 – 51: There is more to say about quantifying uncertainties than GLUE.
Yes, you are completely right. We will expand this section part of the manuscript referring also to other uncertainty quantification methods than GLUE.

B.3. Line 59 – 64: The assumption of only future low-cost level meters may be not the full picture, when also low-cost flow meters may occur (e.g. image based).
Yes, you are right. With new technologies on the flow meters, flow-meters will probably also be installed. We will adjust the text accordingly.

B.4. Line 91 – 91: Spatial variability of rain events and their impact on urban drainage models has been investigated several times.
We see that this sentence was written oddly and thus suggest changing it from

"Uncertainty of input data, such as unrealistic representation of rain events due to spatial variability, has not to the authors awareness been investigated"

to

"Although many studies have shown that rainfall varies spatially at scales significant to urban drainage modelling (e.g. Gregersen et al., 2013; Thomassen et al., 2022), a method that accounts for unrealistic representation of rainfall spatial variability when using rainfall data from point gauges in model assessment has not to the authors awareness been investigated".

B.5. Figure 2: I think the figure could be improved. Now it is a bit unsure why the cross sections are needed.
The cross-sections are needed to make it easier to understand the other parts of the figure. Reviewer RC1 also asks for improvements to this figure, please see our response to RC1, comment A.2.

B.6. Figure 4: Location of uncertainties are defined in several papers. Why did you use the one shown here?
To our experience, the urban drainage research community has to some extent forgotten to consider the different location of uncertainties, focusing mostly on rain input uncertainty and parameter uncertainty – with the main purpose of developing methods for auto-calibration of models. In utility companies (two of three authors of this paper are form a utility company) it is however well know that the asset databases are not always correct. As the utility companies get bigger and the urban drainage systems get more complex, the overview of the validity of the asset databases can be lost. With increasing application of digital twins, we however get the opportunity to look closer at the uncertainties in the model structure, including the uncertainties caused by imperfect information about the system attributes.

We are aware that model uncertainty assessment is a large field and that many frameworks have been suggested in the scientific literature, which are however not always perfectly aligned across modeling fields and purposes. In our prior work (Pedersen et al., 2022) we combined the content of two well-cited papers (Walker et al., 2003) (focusing on uncertainty locations) and (Gupta et al., 2012) (focusing on the uncertainty in model structure) into a unified framework explaining the locations of uncertainties present in the semi-distributed 'integrated urban drainage models', which our work focuses on (i.e. a

lumped-conceptual rainfall-runoff module that calculates runoff to a distributed, physics-based high-fidelity pipe flow module). Figure 4 is designed to illustrate this new framework in an easy-to-refer-to manner, so that discussions related to model uncertainty can become clearer and more structured.

We realise that this message has not come well across in the submitted manuscript. We will thus address this more explicitly in the Introduction and move Figure 4, which is in the submitted manuscript only briefly referred to in section 2.3.2 about event weighting methods), forward to section 2.1 (where the framework for model adequacy assessment is introduced) and introduce it thoroughly there, along with the explanations above.

B.7. Table 3: What is the reasoning to put these exact boundaries between "green", "yellow" and "red"? Can that be changed depending on the objective or subjective factors?
As explained in Line 302-306 (the caption to Table 3) the boundaries between the categories are based subjective choices that we made based on the utility company's experience. We are well aware that this could be improved but as we are not experienced with the methods, we don't have the competencies nor experience yet to better categorize those. We will highlight this further in the manuscript text. The criteria can of course be different depending on the objective. We will include this as well.

B.8. Figure 7: Legend is quite small when printed.
We will enlarge the legend text.

B.9. Figure 10 and 11: More tables than figures I would say.
Agree. We will change this in the updated manuscript.

B.10. Figure 12: Coloring of the figure is very light.
We agree and will darken the colours. On the request of reviewer RC1, we will furthermore move this figure to the Supplementary Material.

B.11. Figure 13: The figure needs more explanation in the text. As it is at present, it is quite confusing.
Reviewer RC1 also commented on this part, and we consequently suggest moving both Figure 12 amd 13 to the Supplementary Information instead and only mentioning them briefly in the manuscript. Please see also our response to reviewer RC1, comment A.8 and A.9.

References

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