Interactive comment on "Laboratory modelling of urban flooding: strengths and challenges of distorted scale models" *by* X. Li et al.

Xuefang Li[1], Sébastien Erpicim[1], Martin Bruwier[1], Emmanuel Mignot[2], Pascal Finaud-Guyot[3], Pierre Archambeau[1], Michel Pirotton[1], Benjamin Dewals[1]

[1] Hydraulics in Environmental and Civil Engineering (HECE), University of Liège (ULiège), Liège, 4000, Belgium
[2]LMFA, CNRS-Université de Lyon, INSA de Lyon, Lyon, 69100, France
[3]ICube laboratory (UMR 7357), Fluid mechanics team, ENGEES, Strasbourg, France

Correspondence to: Xuefang Li (Xuefang.li@uliege.be)

We gratefully acknowledge Referee 2 for his/her supportive comments and insightful suggestions to improve the manuscript. We provide hereafter a point-by-point response to the Referee's comments.

General comments

We concur with Referee 2 regarding the importance of considering uncertainties in hydraulic measurements. However, we believe that these uncertainties are already carefully reported and discussed in the manuscript. Particularly, Section 4.1 is entirely devoted to the evaluation of the experimental uncertainties, with additional details provided in Supplements 2, 3, 4 and 5, as briefly summarized hereafter.

- To estimate the uncertainties affecting the experimentally measured *water depths*, we account both for the instrument accuracy and for the repeatability of the tests (flow variability). The latter is detailed in Supplements 3 and 4. The water depth profiles provided in Supplement 4 also display the corresponding uncertainties (~ 2 mm). Importantly, Figs. 3 and 5 compare the influence of the experimental uncertainties and the effect of model distortion on the *upscaled* water depths. See also L26-28 and L35-36 on p. 7: "*... despite the uncertainties in the measurements, the differences between the model runs increase very consistently as the model distortion increases ...*", as well as L18-19 on p. 8: "*… the differences arising from the change in model distortion greatly exceed the estimated experimental uncertainty*."
- The uncertainties on estimated outflow discharges are also reported in Section 4.1 and details on the repeatability of the measurements are presented in Supplement 5 (see also L7-8 on p. 7: "*comparing the repeated measurements demonstrates an excellent repeatability of the outflow discharge estimates*"). The standard deviation of estimated outflow discharges is displayed in Fig. S21, which supports the comments formulated in Section 4.3.

In addition, all our main results are presented with the corresponding uncertainties (Fig. 3, Supplements 6, 7 and 8). Nonetheless, we understand from the Referee's comment that this consideration for the uncertainties should be made more explicit. We will update the revised manuscript accordingly.

Specific comments

1. As already mentioned in our response to Referee 1, we will specify what we mean by “artefacts”. They correspond to deviations between up-scaled model measurements and real-world prototype observations due to governing non-dimensional parameters (i.e. force ratios) which are not identical between the model and the prototype (Heller, 2011). This may include alteration of the flow regime (transition vs. complete turbulent), or of the relative importance of frictional resistance …

2. We agree with the referee about the challenges associated to the use of aerial imagery to document (short duration) urban flooding. We will mention it explicitly in the revised manuscript. We will also highlight the potential of CCTV cameras to deliver valuable information on the dynamics of urban flooding.

3. In Section 2 (Background and motivation) of the revised manuscript, we will refer to the study by Moy de Vitry et al. (2017), which explores the potential of unconventional data (video data and computer vision) for monitoring urban flooding.

4. P2, L11: The wording “both scales” does not refer to the horizontal and vertical scales; but it refers to the “prototype” and the “model”. This will be clarified in the revised manuscript.

5. P5, L19: As suggested by the Referee, we know indeed the exact number of experimental runs. They are all listed in Table 3. This will be made clear in the revised manuscript.

6. On P5, L22, we mean “In contrast with the dataset of Araud (2012) …”, the dataset of Velickovic et al. (2017) does not include discharge data. We will rephrase this sentence.

7. P8, L12-17: These sentences do present results, because *upscaled* water depths (not the original experimental observations) are obtained by applying the methodology developed in the present study.

8. P8, L26 and P8, L29: The words “almost” and “most” used in the Section 4.3 refer to a general trend; but we agree with the Referee that it deserves being quantified. Hence, a detailed quantification of the distortion effect on the outflow discharges will be included in the revised manuscript.

9. Figure 6a presents the outflow discharge in each street, as described in Section 4.3. The variations of outflow discharge are presented in Fig. S21 in the form of error bar, as recommended by the Referee.

10. The *aspect ratio* is defined as the ratio between the water depth and the street width. This definition is indeed missing in the manuscript and it will be added in the revised version.

All other Technical comments (language, rewording …) will be accounted for in the revised version of the manuscript.

On behalf of all authors, Xuefang LI

References

We include below only a reference which was not cited in the original manuscript.

Vitry, M. Moy de, Dicht, S. and Leitao, J. P.: floodX: urban flash flood experiments monitored with conventional and alternative sensors, Earth System Science Data, 9(2), 657–666, doi:10.5194/essd-9-657-2017, 2017.