

## ***Interactive comment on “High-quality observation of surface imperviousness for urban runoff modelling using UAV imagery” by P. Tokarczyk et al.***

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The authors would like to thank the reviewer for his valuable comments. We are happy to address them in our preliminary reply (interactive discussion). Comments will find in-depth consideration in the formal review resulting in a revised manuscript version. Its completion is envisaged when all invited reviewers completed their assignments.

We address the comments in the same order as the reviewer.

1) Indeed, the different impervious maps we use as input into the urban drainage model result in negligible variations in the hydraulic output variables. We explain the small

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model output deviations by spatial aggregation and the applied auto-calibration. 1. We do see only small differences in the impervious maps we extract from the different [data sources x classification routines]. This is shown in Fig. 7a, illustrating the distribution of imperviousness among sub-catchments with very similar median and interquartile values. These (already) small differences propagate through the UD model but produce even smaller deviations which are compensated through calibration and the degree of spatial aggregation -> cf. Fig. 7b,c, whereas it is not differentiated whether compensation is based on auto-calibration or the degree of spatial aggregation. 2. We agree that the issue of spatial aggregation is interesting and should be more than just verbally discussed. Originally, results from test simulations with a model that contains only 30 (instead of 307) sub-catchments have been carried out, but had not been included (sensitivity analysis). These results reveal that even less deviations regarding overland runoff and in-sewer flow occur. Addressing the comment of the reviewer#2 we consider including these results either in the main paper or the supplement. Originally we took them out since we wanted to reduce the variety of issues discussed in the paper. Thank you for making us thinking about it again!

2) The exploratory analysis is criticized i) regarding its information it contributes to the problem under discussion and ii) regarding its methodological design. We certainly agree that one could argue about the statistical significance of the results (Table 5,6 in the Appendix). But therefore we placed them less prominently in the Appendix and clearly state the high p-values (cf. line 409). On the other hand we still believe the exploratory part of the analysis, e.g. the variability shown in the box plots in Fig. 7 is expressive enough to show relation between the similarity of combinations of data sources and processing methods regarding surface characteristics and resulting drainage model outputs. The regression analysis on the other hand leaves indeed room for speculations, particularly due to the little statistical significance. For the revision of the manuscript we will carefully re-consider the application of the applied methods and decide which results can reliably be interpreted.

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3) Thank you for this valuable comment. To our knowledge, no studies on application of UAVs in urban drainage existed at the time we prepared the manuscript. In the revised version of the manuscript we will expand the state-of-the-art section and add references concerning applications of UAVs in different contexts.

4) We deliberately did not include too many detailed information, because we did not want to shift the focus of the paper more on the UAVs. Technical specifications of the flight platform are available in the Supplementary Material. However, we do agree that we did not include details related to the flight itself and image post-processing. We will add this information in the reviewed version of our manuscript.

5) Concerning the features used, please refer to the line 13-15 of "Boosting" paragraph of 2.3.1 subsection. In the cited paper (Tokarczyk et al., 2015) all the details regarding applied features can be found. We did not include detailed information (and refer readers to the above mentioned paper), because we did not want to shift the focus of the paper away from the hydrological aspects.

6) Thank you for pointing this out. We will include a discussion concerning the costs of the approach in the reviewed version of our manuscript. However, in order to make a fair comparison, we would rather refrain from bringing up absolute costs, because they are location specific (e.g. labor costs), and discuss them in a relative way. In the case of small catchment, e.g. same as we presented, using UAV will be advantageous in terms of flexibility (no need to organize photogrammetric flight campaign; UAV is ready to fly in max. 1h). Conducting a standard photogrammetric flight campaign includes days of planning, renting an airplane with crew, and is very prone to weather conditions. That is why for such small areas (small-sized urban catchment) it would be inefficient to perform standard photogrammetric campaign (and probably even impossible, as the company would not acquire such a small area on-demand). In the reviewed version of the manuscript we will extend this discussion and try to quantify the cost-differences between UAV and standard aerial photogrammetry (compared to acquired area).

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7) Thank you for this valuable comment. We will take it into consideration while editing our manuscript.

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