Response to reviewer 2

General comment

Naves at all present a lab comparison of different particle imaging velocimetry techniques under (indoor) rainy conditions. I believe that analyzing this is a valuable addition to the scientific literature. I especially am happy that the authors have shown that not all PIV techniques perform equally under different rainy conditions, something very relevant when analyzing (urban) flood impact from video images. I commend the authors on their thorough effort of making the data on which they build their conclusions available to the public in true Open Science spirit.

I have a few minor issues with the paper in its current form, but am overall of the opinion that this paper should be published in HESS.

Response:

We would like to sincerely thank the reviewer for the time and effort invested in reviewing our manuscript and for the interest showed in our work. In the following, we provide detailed responses to reviewer's minor comments.

Minor issues:

The paper focusses on the application of urban flooding of streets and this is reflected in the literature cited. In river hydrology there are quite some papers also looking into using seeding for better LSPIV results. Multiple papers by Flavia Tauro and her team come to mind. Perhaps (but I'm not sure) adding these in the introduction would better frame the current research.

Response:

Thanks for the recommendation. We think that including papers related to river PIV applications will benefit the Introduction section. We will include the works of Tauro et al. (2016), Tauro et al. (2018), Pearce et al. (2020) and Manfreda et al. (2018) as follows:

> *"Imaging techniques are thus expanding in open and large-scale environments as non-intrusive methods for the characterization of surface velocity fields (Aberle et al., 2017), and their use is increasingly common in river monitoring (e.g. Tauro et al., 2016; Tauro et al., 2018; Manfreda et al., 2018; Pearce et al., 2020)."*

While the authors do make all their data available, and they do state which software packages they use for part of their analyses, it is impossible for me to check their results, since the code they use to generate their results is not shared. I would like to ask the authors to upload the code that generates the figures presented in the paper to Zenodo and cite it in the manuscript. This would also facilitate reproducing the result of this study, or expand on it.

Response:

As stated by the reviewer, our compromise with Open Science is clear, as can be seen in the experimental dataset cited in the manuscript where we made freely available our data for others to be used in replicating our work or in conducting new research. In addition, we agree with the reviewer that sharing codes is a very recommendable practice to demonstrate more robustly and transparently the reliability of the results achieved, definitely benefiting research community. In this investigation, we have used existing and available codes during all the methodology, and the original code developed have been limited to facilitating computation of a considerable number of study cases and parameters by using simple loops.

The main functions and software used during the present work were: (1) 'fitgeotrans' and 'imwarp' Matlab functions to orthorectificate the frames analyzed, and 'rgb2gray' and simple comparisons using 'if' statements to apply sliding background and binarization during the preprocessing; (2) the command line script of PIVLab to compute the PIV cross-correlation (available at https://ch.mathworks.com/matlabcentral/fileexchange/27659-pivlab-particle-image-velocimetry-piv-tool?s_tid=mwa_osa_a); and (3) 'averf' and 'showf' functions from the 'pivmat' toolbox to visualize the mean velocity fields (available at http://www.fast.u-psud.fr/pivmat/).

In view of this, we consider that we have not developed any significant original code and we preferred to cite the sources within the text. However, we will be grateful to share our code on demand in the future if researchers need help to replicate our work or expand on it. As it does not appear in the manuscript, we will specify that the Matlab functions 'fitgeotrans' and 'imwarp' have been used to perform the orthorectification:

> *"To do this, frames were scaled and ortho-rectified using the known 2D coordinates of 28 and 24 reference surface points for each camera and the Matlab functions 'fitgeotrans' and 'imwarp'."*

The authors make use of the "jet" colormap for their figures, a choice that is known to results in figures that highlight differences not present in the data. (See among others https://www.jstor.org/stable/24862699?seq=1) Please switch to a different colormap. (this is a pet peeve of mine)

Response:

Thanks for sharing the reference, interesting issue. We have analyzed and compared 'jet' colormap results against 'haline' colormap from the mentioned reference. The results, which are included in the following figures, showed that in this particular case the 'jet' colormap do not include confusing data and, as stated in the reference mentioned by the reviewer, the sharp gradients of 'jet' colormap allow proximal colors to be distinguished, showing clearer the differences between techniques. In view of this, we have preferred to maintain 'jet' colormap to facilitate comparison with our previous work using LSPIV (cited in the text as Naves et al. 2019a). In any case, we thank the reviewer for the comment, and we will have this information into account for next communications.

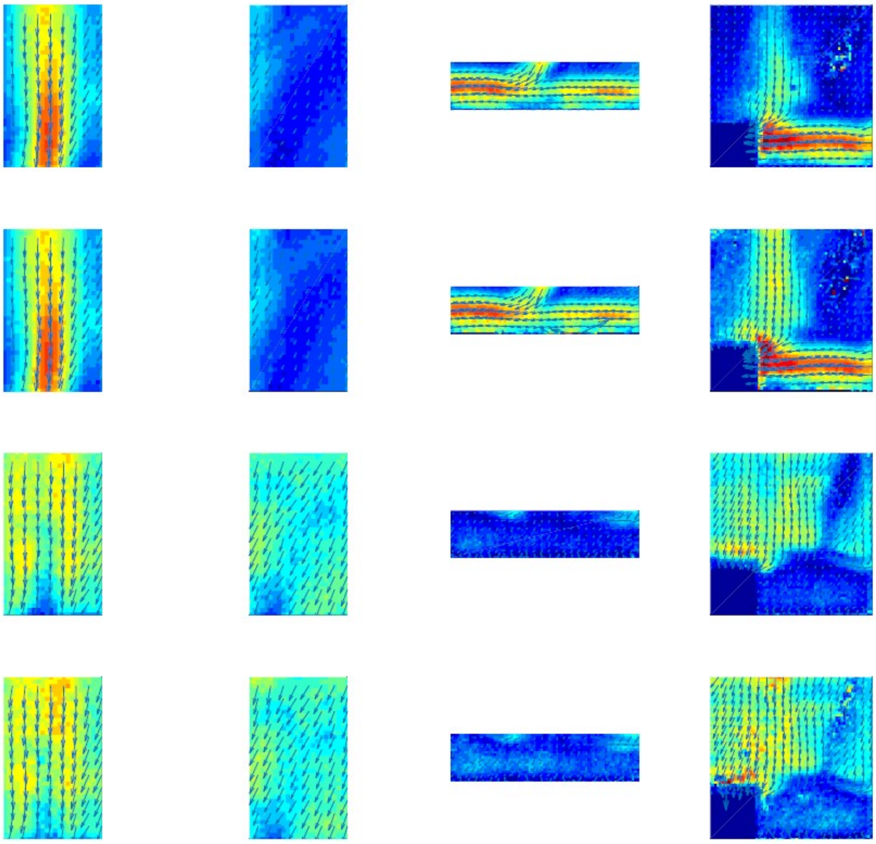

Figure R1. Velocity fields representations for the rain intensity of 50 mm/h, the four techniques (rows) and the four study areas (columns), using “jet” colormap.

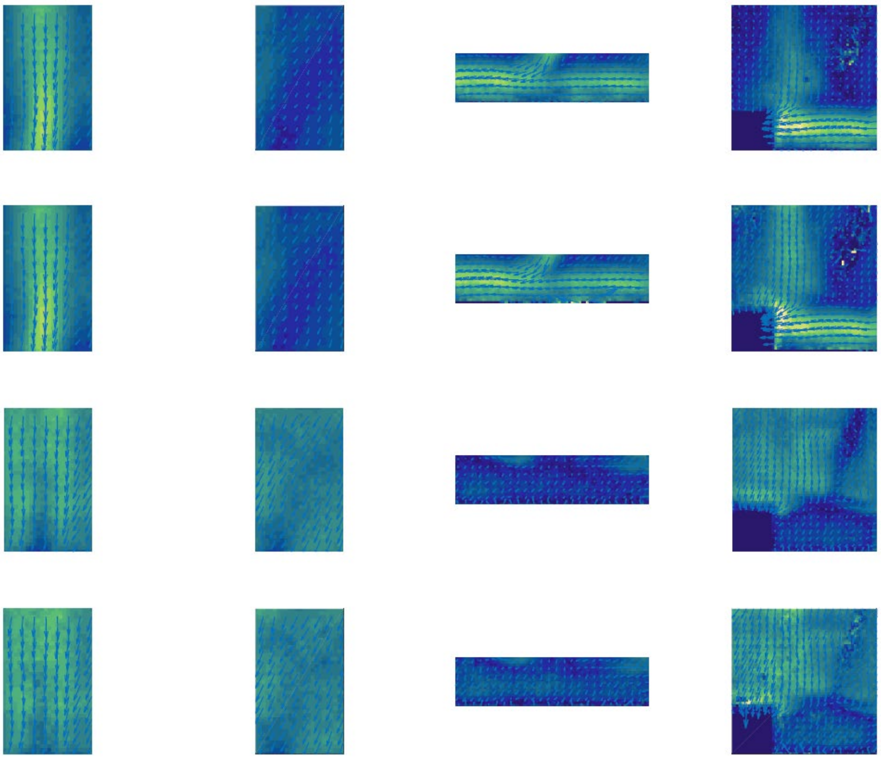

Figure R2. Velocity fields representations for the rain intensity of 50 mm/h, the four techniques (rows) and the four study areas (columns), using “haline” colormap.

Concluding: I really like the paper, the science, as presented, is sound although the actual claims cannot be verified without the software that generated their results shared alongside the paper.

Response:

Thanks again for your time and your interest in our work

References:

Pearce, S., Ljubičić, R., Peña-Haro, S., Perks, M., Tauro, F., Pizarro, A., ... & Paulus, G. (2020). An evaluation of image velocimetry techniques under low flow conditions and high seeding densities using Unmanned Aerial Systems. Remote Sensing, 12(2), 232. https://doi.org/10.3390/rs12020232

Tauro, F., Petroselli, A., Porfiri, M., Giandomenico, L., Bernardi, G., Mele, F., ... & Grimaldi, S. (2016). A novel permanent gauge-cam station for surface-flow observations on the Tiber River. Geoscientific Instrumentation, Methods and Data Systems, 5(1), 241-251. https://doi.org/10.5194/gi-5-241-2016

Tauro, F., Petroselli, A., & Grimaldi, S. (2018). Optical sensing for stream flow observations: A review. Journal of Agricultural Engineering, 49(4), 199-206. https://doi.org/10.4081/jae.2018.836

Manfreda, S., McCabe, M. F., Miller, P. E., Lucas, R., Pajuelo Madrigal, V., Mallinis, G., ... & Müllerová, J. (2018). On the use of unmanned aerial systems for environmental monitoring. Remote sensing, 10(4), 641.