Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-59-RC2, 2020

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using unmanned aerial vehicle and volunteered geographic information to sophisticate urban flood modelling" *by* Yuan-Fong Su et al.

Anonymous Referee #2

Received and published: 10 April 2020

1 General comments

The authors present a case study where UAV and VGI photos are used to run a CFS including a coupling between surface and sewer system flows and they evaluate the influence of the DEM resolution on simulation results. The UAV images are processed to create a high resolution DEM. Results of the numerical simulation are compared to VGI photos in terms of water depth to assess its correctness. A comparison is made between 2 DEM resolutions, and the conclusion is that higher resolution yields better results. The ideas developed in this paper are interesting, and are a useful contribution towards simple and flexible hydraulic numerical simulation by using remote sensing and

crowdsourcing. Nevertheless, the paper has to be improved in many points. There is a global lack of scientific rigor, of precision. Many important details are not mentioned, whereas some parts are out of the scope of the paper. Furthermore, the overall English quality is poor. Because of all the weaknesses, both on form and content, I suggest this paper should not be accepted for publication.

2 Specific comments

Many remarks are written in the technical corrections part, but in this part I sum up comments on three major issues:

2.1 DEM generation

This section should be totally rewritten. General considerations about DEM generation and application to the case study are mixed, and not put in a correct and logical order. Camera calibration should be addressed before absolute positioning of images. The authors should consider being shorter on generalities and give more information about their own input during this step. The authors do not say how they replace the DEM parts they remove: motorway bridge and vegetation. How is the new altitude chosen? Don't bridge pillars or vegetation have an influence on the surface flow? How do the authors apply the method from Rabatel et al. without removing the NIR filter of the camera in the first place?

2.2 CFS model

Very little information about the model is given in the paper. The reader is referred to 2 other papers (Jang et al. 2018 & 2019). The effort made not to be redundant

is appreciated, but some more details are needed about: 1) the numerical coupling 2) the manholes location and implementation in the model 3) the chosen hydraulic parameters, roughness distribution, boundary conditions... 4) the time extent of the simulation

2.3 Results

The DEM accuracy is checked on the same points that were used to do its absolute georeferencing, which does not prove anything. The authors' assertion that coarser resolution leads to lower quality results is not confirmed by the presented arguments. Water depths of both simulations are compatible with all the VGI photos. Water depths on rooftops are not measured nor observed (or some information is missing in the paper). Flood duration differs between resolutions, but none is contradicted by some observations. The conclusion concerning the DEM resolution is not supported enough to be stated as it is.

3 Technical corrections

Location	Comment
title	... to **sophisticated urban**
l.15	... flash flood event **that occurred on**
l.17	... network are **used to establish**
l.18	... data **is resampled**
l.21	... and VGI **lowers the**
l.26	Flash **floods resulting from extreme rainfall**
l.28-29 & Tab 1	Table 1: What is the point of this table? Is it really needed in this paper? Line 29 mentions life losses, but no figures about it in the table. The authors should consider deleting this table and modifying the text accordingly
l.52-53	Citations only refer to VGI, not UAV techniques
l.63	... can be **used as**
l.63-64	Does "boundary conditions" mean "hydraulic boundary conditions"? More explanations are needed here to understand the link between boundary conditions and spatial resolution
l.69	... event **that occurred on**
l.70	... occurred between 13:00 **and 18:00**
l.71	... 131.5 mm/h **from 14:30 to 15:30**
l.72	... rainfall intensity **exceeded**
l.73	... Chanxing street **near the National**
l.75	VGI are **used to establish**
l.79	"finally, the simulated results are compared" Contradiction with fig. 3 where VGI seems to be an input to the CFS.

Section 2.1 DEM generated by UAV	This section should be totally rewritten. General considerations about DEM generation and application to the case study are mixed and not put in a correct and logical order. Camera calibration should be addressed before absolute positioning of images. The authors should consider being shorter on generalities and give more information about their own input during this step
l.82	. . . left side of **Fig. 3**
l.82-83	. . . methods **for generating a DEM**
l.84	. . . 2004). **They are based**
l.86, 92, 93	. . . **coordinates**
l.90	The six parameters [. . .] are **determined during exterior orientation**
l.96	What resolution is chosen for resampling?
l.100	. . . condition **from 06:00**
l.117	Vegetation is removed: how the new ground altitude is computed? With which roughness? Does vegetation have no impact on the flow? How the results are biased by this removal?
l.117	The viaduct is removed: how the new groud altitude is computed? With which roughness? Do the viaduct's pillars have no impact on the flow?
l.118	. . . shrubs and **grass**
l.120-121	The authors did apparently not fully understand the publication by Rabatel et al., which needed a removal of the NIR blocking filter inside the camera. This paper does not mention this removal, nor gives any detail about the specific linear combination.
l.121-122	Some of the surrounding buildings must have heights above the 9 m threshold. However the authors claim that they remove the viaduct, but not the buildings (l. 124-125)
l.124	. . . **flow smoothly on ground surface**

l.125	Transverse is not the adequate word
l.125	There is no mention of (parked) cars and street furniture. They might have an influence on the flow. Are they in the DEM or not? The authors should give a comment on this.
l.133	. . . these photos are **used to**
l.135	The described hydrological event lasts for a few dozens of minutes. A slight shift in the image timestamp could lead to totally wrong information. The authors should only take into account photos for which the timestamp corresponds to the moment when it was taken, not when it was posted on a social network.
l.135-136	The authors should give an idea of uncertainties yielded by manual flow depth estimation. What about an automatic water level estimation?
Section 2.3 CFS model	This section lacks details about the chosen hydraulic parameters (roughness, boundary conditions) for both OFM and SFM. It is not clear how the manhole positions are determined: DEM and water levels are obtained from images, why not the manholes? It is also not clear which type of interaction between OFM and SFM is applied. The authors should also give the time limits of their simulations.
l. 153	The DEM accuracy is checked on 3 GCPs. The same 3 GCPs were used to perform the DEM georeferencing (see lines 104-108). The authors should use a different set of control points than those who were used to process the data, with a better spatial distribution in the modeled area. Furthermore, 2 DEM are created, with distinct resolutions. Accuracy should be checked for both.
l. 156	The authors did not give the initial DEM resolution
l. 159	. . . simulation, the **grid meshes**

l. 167-169	The authors state that water on rooftops is better simulated by the fine resolution model. Could they give some validation criteria to explain this statement? Could they explain why water should be on rooftops? Does their model take water evacuation from rooftops into account?
l.173	Higher: not much higher. The authors should give the values.
l.174	Lower resolution implies that small terrain features are not represented, so the topography should be smoother. The authors observe the opposite. The authors should check the DEM resampling, and give more comments about their observation.
l.178	. . . results. It **can be seen**
l.180	. . . At the **remaining points, the simulated**
l.184-186	I can not see the causal relationship between the fact that there are no VGI photos after 15:40 and the overestimation of flood duration. Since there are no photos, it is not possible to conclude in a way or another.
l.195	. . . than **that that**. . .**.**
l.207-208	DEM updates, and resulting CFS are not in real time, since weather conditions generally prevent UAVs to fly during or just after heavy rainfalls.
l.211	It has not been demonstrated in the paper that fine resolution modeling results are better. The comparison presented in table 4 shows that both resolutions give results consistent with VGI photos. Other validation data is needed to be able to draw this conclusion on this case study.
Table 1	What is the point? The list of flash floods that occurred in 2019 is not relevant to the paper. Moreover, events after July, 8th are not listed.

Table 3	The accuracy is checked on the very same points used in the DEM production process. Low error values are thus expected. It gives no information on the accuracy of the DEM everywhere else.
Figure 1	Caption: rain gauge (as in the text) In the bar chart, times are written above bars, I guess they should lie between bars
Figure 2	Rain gauge (as in the text) Top left image is not necessary. I do not understand the gray levels in top right image : shade or altitude? Bottom image is very dark, authors should improve brightness and contrast. The cartographic scale is indicated only for the bottom image
Figure 3	The right part is not consistent with the paper. VGI seems to be an input of CFS. Parameter of Drainage system: is there only one parameter? This parameter is not even mentioned in the paper.
Figure 4	Not necessary in this paper
Figure 5	- The caption reads: “images taken”, but they must have undergone some processing. The authors should tell readers what is exactly displayed in fig. 5 - The image is distorted compared to the area shown in the following figures (stretched along Y axis). Why? - GCP #1 is located just next to the viaduct, so there is a discontinuity in altitude just nearby. It is recommended to select clear zones for GCPs
Figure 6	All minutes in timestamps seem to be rounded to the nearest 10. Why? How water depths could possibly be estimated from photo #1?

Figure 7	The choice of the color scale is not adequate to allow a good perception of low value altitudes (everything is blue). Moreover, the rainbow color scale should be avoided: https://www.nature.com/articles/519291d https://www.climate-lab-book.ac.uk/2014/end-of-the-rainbow/
Figure 8	Water depths between 0.00 and 0.05 m should appear in white according to the caption. I can not see any white pixel. Why? The difference between the colors corresponding to 0.15-0.30 and 0.30-0.50 water depths is too small to be distinguished. Water accumulates on roofs, especially for the fine resolution model. It seems very unlikely, especially for the building lying in the left.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-59, 2020.