Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC1
https://doi.org/10.5194/hess-2021-20-AC1, 2021

Reply on RC1

Remy Vandaele et al.

Author comment on "Deep learning for automated river-level monitoring through river-camera images: an approach based on water segmentation and transfer learning" by Remy Vandaele et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-20-AC1, 2021

We would like to thank the reviewer for his constructive review and comments. We respond to these comments below.

Comment #1 regarding the use of alternative ways to obtain topographic data

We agree that obtaining ground surveys for the field-of-view for each camera is a significant challenge. An alternative could be to use the camera images in conjunction with a high resolution digital surface model (DSM). An open access lidar DSM is available across the UK. Over other parts of the world, it might be necessary to use a DSM that is commercially available (for example the 12m WorldDEM), but the accuracy of the results using a low resolution DSM would need to be carefully evaluated.

If we are invited to revise our paper, we would add the following sentence in the conclusion section:

"*Future work will focus on the merging of the water segmentation results with lidar digital surface model (DSM) data available at 1m resolution over the UK (Environment Agency, 2017). This would allow the water segmentation algorithms to provide a direct estimate of the water levels in the areas that are studied, without requiring any ground-surveys.*"

Environment Agency. LIDAR Composite DSM 2017 - 1m. https://data.gov.uk/dataset/80c522cc-e0bf-4466-8409-57a04c456197/lidar-composite-dsm-2017-1m (2017). Last accessed 26 February 2021.

Comment #2 regarding camera movement

From our inspection of the datasets, we found that the camera movement was negligible (a maximum of 2-3 pixels, even on objects far away from the camera). We were especially careful to choose landmark pixel locations that were not too close to the edge of the landmarked object in order to avoid confusions. We would expect typical intensity-based image registration algorithms to deteriorate the results due to changes in image illumination and movement within the image (of boats, wildlife and debris), although we have not tested this.

If we are invited to revise our paper, we would like to add the following sentence at the

end of section 4.1.1 (Dataset presentation):
"*An inspection of our datasets and results showed us that the impact of camera movement was negligible. Machine-Learning based landmark detection algorithms (e.g, Vandaele et al., 2018) could have been used otherwise, but they are unnecessary in the context of this study.*"

Vandaele, R., Aceto, J., Muller, M. et al. Landmark detection in 2D bioimages for geometric morphometrics: a multi-resolution tree-based approach. Sci Rep 8, 538 (2018). https://doi.org/10.1038/s41598-017-18993-5

Comment #3 regarding the use of area features instead of landmarks

The starting point of this study was to show how well we were able to automate the annotation process in comparison with the manual landmark annotation approach used in our former study (Vetra-Carvalho et al. 2020). We agree that the use of landmarked areas as opposed to landmarked pixels could strengthen the robustness of our results, but it would have required a new and more complex ground survey that was not in the scope of this study.

To address this comment, we would like to add the following sentence at the end of section 4.1.1, after the modification of Comment #2:
"*Also note that we focus on a simple process relying on single pixel landmark locations annotated during a former study (Vetra-Carvalho et al., 2020). The use of landmarked areas of multiple pixels sharing the same height could likely help to increase the detection performance and should be considered for an optimal use of this landmark-based approach.*"

Comment #4: Literature

We would like to add citations to the literature mentioned by the reviewer at line 41 of the introduction section as follows:

"*There have been a number of citizen science projects that investigated the use of crowdsourced observations of river level (e.g. Royem et al., 2012; Lanfranchi et al., 2014; Etter et al., 2020; Lowry et al., 2019; Walker et al., 2019; Baruch, 2018).*"

In our introduction section, we would like to add the following paragraph regarding the use of river cameras:

"*Several studies have already attempted to use videos and still camera images in order to observe flood events. Surface velocity fields can be computed using videos (e.g., Muste et al., 2008; Le Boursicaud et al.,2016; Creutin et al. 2003; Perks et al., 2020). Several studies also considered the use of river camera images to observe the water levels, either manually (e.g., Royem et al, 2012; Schoener, 2018; Etter et al, 2020) or automatically, for example by considering image processing edge detection techniques (Eltner et al. 2018). Under the right conditions, these automated water level estimation techniques can provide good accuracy with uncertainties of only a few mms (Gilmore et al., 2013; Eltner et al. 2018). However, the performance of these approaches lacks portability (Eltner et al.,2018.). "*