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Interactive comment on "Short Communication: Challenges and Applications of Structure-from-Motion Photogrammetry in a Physical Model of a Braided River" *by* P. Leduc et al.

Anonymous Referee #1

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The introduced study describes the application of SfM to measure DEMs of flumes in laboratory setups. Images for SfM are acquired in sequence and resulting DEMs are compared to each other and to TLS data. The manuscript is well written and clearly structured. Methods and results are illustrated sufficiently. However, there are some concerns, which should be addressed before the manuscript can be accepted for publication. The novelty of the introduced results seems to be not very high because many of the mentioned findings, e.g. regarding doming effects or the impact of image quality, are already discussed in other work but just for different scales (e.g. see James et al.

2017, Mosbrucker et al. 2017). The generation of a very high number of DEMs used for DoD calculation is interesting and could be novel if the potential of such data regarding the expected new insights into investigating fluvial processes would be displayed and discussed. Furthermore, the processing of such data to extract the relevant information needed to assess the processes would be of interest. Regarding the references, some more literature should be included concerning the utilization of SfM in laboratory setups in geomorphological applications. For instance, Galland et al. 2015 use SfM and time-lapse imagery in geological experiments with sub-mm accuracy, Kaiser et al. 2018 as well achieve sub-mm accuracy when they perform close-range SfM measurements to detect soil surface changes, and Balaguer-Puiga et al. 2017 use SfM to measure soil erosion at micro-plots in the lab. Furthermore, some concerns exist regarding the usage of two sets of images to estimate the error in this study due to the missing consideration of spatial correlation of errors. Please, see a more detailed description of the raised concerns in the specific comments section.

Specific comments: p. 1 l. 14-19: The DEMs are not mainly limited by the image quality. There are further important error sources leading to potential systematic errors (e.g. dome effects) as well as to random errors, which are highly spatially correlated, amongst others due to the right choice of parameters and their setting (see James et al. 2017).

p. 1 l. 21: More literature regarding SfM and fluvial morphology should be introduced, e.g. Javernick et al. 2014 or Woodget et al. 2015. These authors are one of the first to introduce SfM (in combination with UAV) to fluvial morphology.

p. 2 l. 18-20: I am afraid that I do not understand in what sequence the image pairs were acquired. Were the two sets of images taken during one acquisition (thus both images in short sequence at each position) or were two acquisitions performed in sequence (thus images once during first interval and once again during second interval)? This information would be important because if the images were acquired from the same position just in sequence their suitability to asses DEM errors would be questionable because acquisition geometry would be almost identical and thus not much change expected in the images. Generally, if camera geometry and surface texture conditions (also considering lighting) for both sets of digital images are similar, not much information regarding accuracy, utilizing DoD differencing, can be expected because errors are spatially highly correlated (James et al. 2017). The raised concern regarding spatial error correlation also relates to p. 4 l. 7-9

chapter 3.1: Why did the authors not exclude some of the coded targets (because many are given) during the bundle adjustment so these targets could be considered as check points and thus used for accuracy assessment of each SfM surface and camera geometry reconstruction?

p. 4. l. 3: What TLS has been used? What accuracy and resolution does the device provide?

p. 4 l. 9-10: The usage of just one value (mean of entire DoD) is not able to describe the spatially variable error, e.g. due to potential tilting. How is this considered for the decision of the DEM?

p. 4 l. 10-12: How certain are the authors that surface changes to the previous time interval are not conflicting the decision for the most suitable DEM of the subsequent interval?

p. 6 l. 3: Already James et al. 2017b illustrate the importance of GCP number and distribution for the DEM quality. Maybe refer to their work.

p. 6 l. 4-8: Please, refer to James & Robson 2014 regarding doming effect because they perform extensive simulations to explain the causes (i.e. image geometry) of doming errors and already show that convergent images improve data accuracy.

p. 6. l. 9: Please, refer to Mosbrucker et al. 2016 who explain very detailed the importance of image quality for DEMs derived with SfM.

p. 6. l. 11: Why is the fixed focal length essential during low light conditions and

low texture? The interior geometry does not influence these circumstances. The fixed focal length is important regarding a reliable camera self-calibration. Good texture is essential for feature extraction and matching but not influenced by the stability of the focal length. To improve texture e.g. aperture and/or exposure time should be adapted (see Mosbrucker et al. 2016 for much more detail).

p. 7 l. 1-2: How was the DEM interpolated from the dense point cloud? PhotoScan offers different options potentially influencing the final DEM.

chapter 5.2: How certain are the authors that indeed water surface has been detected/reconstructed with SfM? The "water surface" could also be the result of some interpolation artefact in PhotoScan because the water is moving and thus feature matching in this area from images captured in (although very short) temporal sequence is unreliable. Did the authors perform some independent reference measurement of the water depth to confirm the SfM results?

p. 8 l. -10: I am afraid that I do not understand what is meant by cross-sectional scale? Did the authors extract water levels at each cross section? If yes, how were the cross-sections extracted and what would be the spatial resolution?

chapter 5.3: Maybe, the authors could also test the usage of the retrieved 3D data with SfM to extract grain sizes directly from roughness estimates calculated with the DEMs. Kaiser et al. 2015 and Pearson et al. 2017 illustrate the great potential of SfM for this task. Furthermore, the authors might also refer to Woodget et al. 2018 regarding the usage of image texture and grain size estimation concerning most recent efforts in this regard because they use the original image instead of the potentially interpolated (and thus introducing further uncertainty) orthophoto.

Figures: The figures involving flume display are very small and thus difficult to read and interpret.

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