Reviewer 1 Comments (RC1)

Reviewers Comment (RC) 1.1: This contribution is unique and important for the society of research and development on the image-based hydrometry approach. Provided images are useful for the RD mentioned above. Other than images, information for validation is described in the manuscript. The unfortunate thing is that quantitative validation data was not included in the provided data set. This restricts the aim of this contribution, "validation and accuracy assessment" (the last sentence in an abstract.) To accomplish the objective of the study further, I suggest some modifications in both the manuscript and the dataset.
Authors Comment (AC) 1.1: Thanks for the considered review of our submitted article. In response to comments from Reviewers 1, 2 and 3, the revised version of the manuscript will fully describe the validation data available for each of the case studies. This validation data will be collated, standardised and published in the data archive along with the orthorectified images, which were presented in the original submission.

RC 1.2: Lines 11-14, page 2: Two sentences are discussing the image velocimetry application in labs and the logical flow between two sentences is difficult to follow. To make this part easier for reading, one option is to move "wide variety of experimental conditions" at the beginning part of the second sentence, since this part is a distinguishing point to the first sentence
AC 1.2: The sentences in question will be revised to read: 'Image velocimetry involves the application of cross-correlation, or computer vision techniques to a series of consecutive images (or extracted video frames) to generate vectors of water velocities across a field-of-view. Despite being originally developed for use in highly controlled laboratory settings (e.g., Dudderar and Simpkins, 1977; Adrian, 1984; Pickering and Halliwell, 1984), it has since been applied to a wide variety of experimental conditions.'

RC 1.3: Figure 1. I suggest dropping "Geographical" from the caption or add some more information regarding geography in the figure, e.g. water network, river basin, elevation, etc.
AC 1.3: The Figure caption will be modified to read: 'Locations of the monitoring sites from which data are presented: (a) River Arrow, UK; (b) River Dart, UK; (c) River Thalhofen, Germany; (d) Murg River, Switzerland; (e) River Brenta, Italy; (f) La Morge, France; (g) St-Julien torrent, France; (h) River La Vence, France; (i) River Tiber, Italy; (j) River Bradano, Italy; (k) River Noce, Italy. Not shown: River Karehalla, India. Map spatial reference: ETRS (1989).'

RC 1.4: Figures 2 and 3. Original and rectified images are provided in each figure and I guess the directions are rotated. Better to indicate the direction of the flow, e.g. by putting the arrow with a label of "flow" onto each panel.
AC 1.4: For both Figures 2 and 3 the flow direction will be indicated using an arrow. The Figure 2 label will also be modified to describe the flow direction.

RC 1.5: Table A2. Label, this is quite a minor thing but I suggest use "Image Aquisition" instead of "Data Aquisition" in the label.
AC 1.5: The label of Table A2 will be modified to read: 'Image Acquisition'.

RC 1.6: Table A2. Validation data, I suggest to add the description about validation data (e.g. how and where).

AC 1.6: In order to support the presentation of the validation data we will use this part of the table to provide a summary of the reference measurements undertaken for each case-study (e.g. instrument, number of points, duration of sample).

RC 1.7: Table A2. Flow information, I suggest adding the mean velocity, representative depth, Froude number, width etc. (maybe, rotate 90 degrees the table to expand the width of the table).
AC 1.7: Unfortunately, this information is not readily available for all of the case-studies. However, we will ensure that all relevant information describing the hydrological conditions for each case-study is presented within each sub-section of the text.

RC 1.8: Data-set. Better to include movie file for each site for making easier to know the image characteristics and image recording approaches. (I made by myself for the purpose of review, and I can share it if needed.) Also suggested is providing text file(s) specifying the image resolution, location of the edges of images, and frame rate, and/or provide e.g. jgw, tfw and pgw files for corresponding image/folder (for jpg, tiff and png image, respectively).
AC 1.8: For each case-study a video will be created using the orthorectified images. This video will be produced at the same image resolution as the orthorectified images, and at the frame rate required for analysis. Unfortunately, the geographical coordinates are unknown for many of the image sequences presented. In the majority of cases, the ground control points were surveyed using an instrument that utilises a local reference (e.g. total station). In these cases, it would be inappropriate to provide a tgw, tfw, etc. file.

RC 1.9: Data-set. For sites with velocity distribution measured for validation, provide the location and velocity of the data as e.g. CSV file.
AC 1.9: In response to comments from Reviewers 1, 2 and 3, the revised version of the manuscript will fully describe the validation data available for each of the case studies. This validation data will be collated, standardised and published in the data archive along with the orthorectified images, which were presented in the original submission. We will provide this reference data in a .csv format.

RC 1.10: Data-set. Type of image file and the structure of file name differ for each folder, this making the pre-processing a bit troublesome for a potential user of the data. Could you provide also a unified formatted image set, e.g. 0000.png? (I made this also by myself for review, and I can share it if needed.)
AC 1.10: The filenames will be altered to have a standardised format e.g. 0000.png.

Reviewer 2 Comments (RC2)

RC 2.1: The present manuscript is aimed to introduce the new dataset, which will help to systematize and benchmark the emerging techniques for image-based river surface velocity estimation. The corresponding dataset consists of pre-processed videos from 12 research sites located in six different countries and covered a wide range of fluvial settings. In my opinion, the introduced dataset has sound potential and of high interest in the research community. However, I recommend authors to provide major revisions which may help to increase the dataset value for the target community and make it the first benchmark dataset for image-based velocimetry techniques (e.g., as the MNIST database for image classification).
AC 2.1: We would like to thank the reviewer for taking the time to provide a thorough review of our submitted manuscript.

RC 2.2: Abstract (Page 1, Ln 10): It is mentioned that 13 case studies have been presented in the dataset, but Section 2 describes only 12.
AC 2.2: This is a typographical error and will be corrected. The abstract should read: 'Validation data is available for 11 of the 12 case studies presented enabling these data to be used for validation and accuracy assessment'.

RC 2.3: Section 2.7 St-Julien torrent, France (Page 8, Ln 24-31): As for this particular case study, the validation data is unavailable, the explicit description is needed to clarify the reasons behind the inclusion of the corresponding data to the introduced dataset. At least, it is not clear how this data will help to pursue one of the dataset objectives as "testing specific image velocimetry techniques."
AC 2.3: This particular case study represents a flash flood, which occurred in a torrent system in France producing mean velocities of approx. 6 m s^{-1}. Whilst no detailed reference measurements are available for this example, data and sensitivity tests are available in Le Boursicaud et al. (2016). Given that image velocimetry techniques perhaps offer the best opportunity to estimate flows under these extreme conditions, researchers interested in reconstructing flash flood processes may find it valuable to understand how the range of available methods perform relative to each other, and software developers may find it instructive to consider how newly developed techniques compare with existing approaches under a diverse range of flow conditions.

RC 2.4: Section 2.9 River Tiber, Italy (Page 10, Ln 13-24): In my opinion, the single measurement of average velocity, which is provided as validation data for this site has limited value for the comprehensive analysis of different image velocimetry techniques reliability and efficiency. Please, provide explicit reasoning why this data will also help to meet the declared dataset objectives.
AC 2.4: Whilst only a single reference velocity value is available for the Tiber case-study, this measurement is representative of the surface velocities within an area of approx. 3 x 3m. The RVM20 speed surface radar system measurements can be compared with outputs derived from image velocimetry analysis within the 3 x 3m footprint. Similar to the St-Julien torrent case, this data set also represents a moderate flood event captured in February 2015. Images of floods suitable for velocimetry analysis are typically very rare and we believe that researchers and software developers may find this data set valuable to refine their algorithms and procedures.

RC 2.5: Dataset: I have realized that for some sites (e.g., Arrow River, Bradano River), scenes are not aligned with each other, i.e., ground (river banks) is not stable. In my opinion, key point alignment is needed to simplify the use of the dataset. This way, if the ground is stable for all the scenes, optical flow techniques can be easily implemented out-of-the-box for velocity field estimation.
AC 2.5: We acknowledge that the image sequences for the Arrow River and Bradano River case-studies are not stabilised. This is one of the critical challenges of using mobile platforms for image velocimetry analysis and the preferred approach may vary from researcher-to-researcher. Differences in the stabilisation technique may also have implications on the subsequent velocity outputs. Therefore, we deliberately chose to omit this stage and leave this to the discretion of the author. However, in the revised manuscript we will provide both the raw footage and a stabilised version using our preferred stabilisation method. The manuscript text will also be updated to reflect the addition of these stabilised frames.

RC 2.6: Dataset: I recommend authors to consider the change of format for the provided images to GeoTIFF (or similar) to provide explicit georeferencing capabilities. It will substantially simplify the validation procedure by providing a solid basis for validation data georeferencing.

AC 2.6: Unfortunately, the geographical coordinates are unknown for many of the image sequences presented. In the majority of cases, the ground control points were surveyed using an instrument that utilises a local reference (e.g. total station).

RC 2.7: Dataset: I did not find any validation data mentioned in the manuscript (Section 2) in the provided dataset archive.
AC 2.7: In response to comments from Reviewers 1, 2 and 3, the revised version of the manuscript will fully describe the validation data available for each of the case studies. This validation data will be collated, standardised and published in the data archive along with the orthorectified images, which were presented in the original submission.

RC 2.8: Dataset: In my opinion, the additional section, which will confirm the introduced dataset validity and its corresponding value for the target community, is needed. The potential reader has to be sure that the dataset is consistent with the declared objectives and therefore serves the reader's needs the best (e.g., benchmarking the new technique/software). I recommend authors to provide a brief analysis of the single case study showing the extracted velocities and comparing them to the validation data. Authors also may consider supporting the corresponding analysis with a code example - this may significantly increase the reader's interest to the dataset and manuscript itself.
AC 2.8: Analysis of the datasets provided is beyond the scope of this Data Description paper but we invite the reviewer to explore the references cited within the sub-section of each case-study and Table A2 as the dataset presented within this manuscript have been utilised to generate flow velocity data in previous work.

Reviewer 3 Comments (RC3)

RC 3.1: I think that the work is valuable and interested in the hydrology community for the development of image-based techniques, which could be further applied in modeling and monitoring.
AC 3.1: We would like to thank the reviewer for taking the time to assess the suitability of this manuscript to be published in Earth System Science Data, and for the constructive comments provided.

RC 3.2: However, it is not clear to me what contributions this paper offers. The abstract mentions inter-comparison and validation of the various techniques, but they were not actually performed, which seems to be missing a major component of the paper.
AC 3.2: The purpose of this manuscript is to introduce datasets that can be used for inter-comparison and validation of various techniques, rather than to perform inter-comparisons. This is beyond the scope of a Data Description paper. Currently, there exist several non-intrusive flow measurement techniques, and new ones being further developed. Performance tests of such techniques require the availability of optical flow data with reference measurements. Collection of such data is a laborious process and requires special, often expensive, equipment. This equipment is not necessarily available to every researcher who develops algorithms of flow analysis through image processing. Our goal is to facilitate further development and comparative tests of new and existing non-intrusive flow measurement techniques by making the necessary test data readily available to every researcher. We invite the reviewer to explore the references cited within the sub-section of each case-study and Table A2 as the datasets presented within this manuscript have been utilised to generate flow velocity data in previous work.

RC 3.3: Abstract (Page 1, Ln 10): It is mentioned that 13 case studies have been presented in the dataset, but Section 2 describes only 12.
AC 3.3: This is a typographical error and will be corrected. The abstract should read: 'Validation data is available for 11 of the 12 case studies presented enabling these data to be used for validation and accuracy assessment'.

RC 3.4: The validation data exists for most cases, then why not present the resulting datasets in the form that is directly compared and validate, instead of the image clips?
AC 3.4: The revised version of the manuscript will fully describe the validation data available for each of the case studies. This validation data will be collated and published in the data archive along with the orthorectified images, which were presented in the original submission.

RC 3.5: Even if quantitative validation is addressed, the measurements are taken at specific time and location of the river (i.e. specific hydro-geomorphic setting), so it may not be comparable if someone uses different camera and processing technique at different time and/or location. I understand that the nature of the observation and approach is not suitable for generalization, but the paper in the current form doesn't seem to fit into the context of "towards harmonization of the techniques"
AC 3.5: The purpose of our approach is indeed specific to a particular instance and location within the river. By ensuring that images are acquired at the same time (or river stage) as the reference measurements, a comparison between the two approaches will be possible. Furthermore, this database seeks to present examples from a range of hydro-geomorphic settings, which will enable researchers to assess the suitability of their chosen approach under hydrological conditions that are of particular interest to them.