Geophysical Research Abstracts
Vol. 20, EGU2018-14407, 2018
EGU General Assembly 2018

Hydro-geomorphological monitoring of ungauged catchments with photogrammetric methods

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Monitoring of ungauged catchments is of increasing importance due to increasing occurrence of intense precipitation events. Therefore, the risk for flash floods increases, as well. However, due to the local appearance of these extreme events their measurement and hence modelling and prediction are very difficult because of a commonly sparse gauging infrastructure in small-scaled catchments. Thus, the aim of this study is to develop new approaches to measure hydromorphological parameters flexible, low-cost and with high temporal as well as spatial resolution and accuracy. The study is incorporated within the larger research project EXTRUSO (https://extruso.bu.tu-dresden.de/) aiming at the enhancement of flash flood monitoring, modelling and prediction. In the presentation two different applications are introduced, i.e. automatic water level measurement using a low-cost camera and measuring fluvial morphology with an unmanned water vehicle (UWV).

Two low-cost Raspberry Pi cameras are installed at a small-scale and a medium-scale river. The water levels are extracted using the following workflow: co-registration of image sequences, detection of water lines using image processing algorithms, and finally estimating the height of the water surface using spatial resection of a projected surface model of the river bank, retrieved with Structure-from-Motion (SfM), in the field of view of the camera. Results reveal accuracies in the range of centimeters using automatically detected water lines and even sub-cm accuracies if water lines are measured manually in the images.

In the second application an UWV is developed, which allows for an accurate measurement of the fluvial terrain above and below the water surface with high resolution. Due to the flexible utilization of the device immediate pre- and post-flash flood event change detection is possible. The UWV is equipped with a laser scanner that measures the terrain, resulting in a dense 3D point cloud describing the surface. An additional integrated 360° camera is used to colorize the 3D point cloud. The third device is an echo sounder to measure the bathymetry. To realize a direct referencing of the UWV measurements an inertial measurement unit and GPS are implemented, as well. First results show the potential to measure river sections with sub-dm accuracy.

Both introduced approaches support the densification of necessary data to better understand the process of flash floods, e.g. implementing the high resolution 3D point clouds in models and potentially use the gauge measurements as an additional warning tool.