Geophysical Research Abstracts
Vol. 20, EGU2018-14518, 2018
EGU General Assembly 2018

Using thermal imagery as a low-cost approach to measure flow velocity and discharge

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There are various approaches to measure discharge in small catchments, e.g. using current meters, Doppler systems or saline tracers. These methods can be labor- and/or cost-intensive and are hence mostly limited to selected areas. In this study, a low-cost approach utilizing a thermal camera and minimal material consumption is introduced to enable fast and flexible measurement of flow velocity and discharge in small streams.

A stream in a small catchment (< 2 km2) is gauged during low flow conditions in summer to evaluate the performance of the developed thermal flow velocity tracer. Thereby, two different cameras are tested: a high quality thermal camera, which acquires data with an image sequence of 30 frames per second, and a low-cost smartphone camera, that captures images with 15 Hz and significantly lower spatial resolution. As natural tracer heated water has been inserted into the river. Afterwards, an inhouse built workflow has been used to calculate the surface flow velocity from the image sequences of both calibrated cameras automatically utilizing particle tracking velocimetry. Scaling of the data is performed with cool ground control points clearly visible in the thermal images. Tracking results are compared to current meter measurements and reveal deviations below 0.1 m/s for the high quality camera. Finally, discharge values are retrieved using the surface flow velocities and the cross sectional area derived from a digital surface model. The surface model has been calculated from RGB images with structure-from-motion photogrammetry and coarse-resolution water level estimates.

In this contribution, the capability of a method to measure flow velocities and potentially discharge in the field is demonstrated and discussed that uses solely a low-cost smartphone thermal camera, RGB images and heated water.