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Evaluating the use of drone photogrammetry for measurement of stream channel morphology and response to high flow events

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Traditional high-precision survey methods for stream channel measurement are labor-intensive and require wadeability or boat access to streams. These conditions limit the number of sites researchers are able to study and generally prohibit the possibility of repeat channel surveys to evaluate short-term fluctuations in channel morphology. In recent years, unmanned aerial vehicles (drones) equipped with photo and video capabilities have become widely available and affordable. Concurrently, developments in photogrammetric software offer unprecedented mapping and 3D rendering capabilities of drone-captured photography. In this study, we evaluate the potential use of drone-mounted cameras for detailed stream channel morphometric analysis. We used a relatively low-cost drone (DJI Phantom 2+ Vision) and commercially available, user friendly software (Agisoft Photscan) for photogrammetric analysis of drone-captured stream channel photography. Our test study was conducted on Proctor Creek, a highly responsive urban stream in Atlanta, Georgia, within the crystalline Piedmont region of the southeastern United States. As a baseline, we performed traditional high-precision survey methods to collect morphological measurements (e.g., bankfull and wetted width, bankfull and wetted thalweg depth) at 11 evenly-spaced transects, following USGS protocols along reaches of 20 times average channel width. We additionally used the drone to capture 200+ photos along the same reaches, concurrent with the channel survey. Using the photogrammetry software, we generated georeferenced 3D models of the stream channel, from which morphological measurements were derived from the 11 transects and compared with measurements from the traditional survey method. We additionally explored possibilities for novel morphometric characterization available from the continuous 3D surface, as an improvement on the limited number of detailed cross-sections available from standard methods. These results showed great promise for the drone photogrammetry methods, which encouraged the exploration of the possibility of repeat aerial surveys to evaluate channel response to high flow events. Repeat drone surveys were performed following a sequence of high-flow events in Proctor Creek to evaluate the possibility of using these methods for assessment of stream channel response to flooding.