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Using small unmanned aerial vehicle for instream habitat evaluation and modelling

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Recent advances in digital image collection and processing have led to the increased use of unmanned aerial vehicles (UAV) for river research and management. In this paper, we assess the capabilities of a small UAV to characterize physical habitat for fish in three river stretches of North-Western Italy. The main aim of the study was identifying the advantages and challenges of this technology for environmental river management, in the context of the increasing river exploitation for hydropower production. The UAV used to acquire overlapping images was a small quadcopter with a two different high-resolution (non-metric) cameras (Nikon J1™ and Go-Pro Hero 3 Black Edition™). The quadcopter was preprogrammed to fly set waypoints using a small tablet PC. With the acquired imagery, we constructed a 5-cm resolution orthomosaic image and a digital surface model (DSM). The two products were used to map the distribution of aquatic and riparian habitat features, i.e. wetted area, morphological unit distributions, bathymetry, water surface gradient, substrates and grain sizes, shelters and cover for fish. The study assessed the quality of collected data and used such information to identify key reach-scale metrics and important aspects of fluvial morphology and aquatic habitat. The potential and limitations of using UAV for physical habitat survey were evaluated and the collected data were used to initialize and run common habitat simulation tools (MesoHABSIM). Several advantages of using UAV-based imagery were found, including low cost procedures, high resolution and efficiency in data collection. However, some challenges were identified for bathymetry extraction (vegetation obstructions, white waters, turbidity) and grain size assessment (preprocessing of data and automatic object detection). The application domain and possible limitation for instream habitat mapping were defined and will be used as a reference for future studies. Ongoing activities include the possibility of using topographic data and discharge measurements to extract average values of flow velocity in cross sections.