High resolution mapping of riffle-pool dynamics based on ADCP and close-range remote sensing data

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Present development of mobile laser scanning (MLS) and close-range photogrammetry with unmanned aerial vehicle (UAV) enable us to create seamless digital elevation models (DEMs) of the riverine environment. Remote-controlled flow measurement platforms have also improved spatio-temporal resolution of the flow field data. In this study, acoustic Doppler current profiler (ADCP) attached to remote-controlled mini-boat, UAV-based bathymetry and MLS techniques were utilized to create the high-resolution DEMs of the river channel. These high-resolution measurements can be used in many fluvial applications such as computational fluid dynamics, channel change detection, habitat mapping or hydro-electric power plant planning. In this study we aim: 1) to analyze morphological changes of river channel especially riffle and pool formations based on fine-scale DEMs and ADCP measurements, 2) to analyze flow fields and their effect on morphological changes. The interest was mainly focused on reach-scale riffle-pool dynamics within two-year period of 2013 and 2014. The study was performed in sub-arctic meandering Pulmankijoki River located in Northern Finland. The river itself has shallow and clear water and sandy bed sediment. Discharge remains typically below 10 m^{3}s^{-1} most of the year but during snow melt period in spring the discharge may exceed 70 m^{3}s^{-1}. We compared DEMs and ADCP measurements to understand both magnitude and spatio-temporal change of the river bed. Models were accurate enough to study bed form changes and locations and persistence of riffles and pools. We analyzed their locations with relation to flow during the peak and low discharge. Our demonstrated method has improved significantly spatio-temporal resolution of riverine DEMs compared to other cross-sectional and photogrammetry based models. Together with flow field measurements we gained better understanding of riverbed-water interaction