The effects of aquatic vegetation growth on discharge calculation in natural watercourses: A high-resolution study featuring novel techniques

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Aquatic and riparian vegetation growth is known to hinder the accuracy of discharge estimates by increasing flow resistance. Moreover, macrophyte growth during the summer months is often commensurate with drought and/or low discharge seasons, when water resources management is paramount. To date, few studies have addressed this problem at the field scale, and most studies were conducted at a low spatial and temporal resolution. As such, quantifying the effects of aquatic vegetation on flow resistance is still extremely challenging and prone to inaccuracies. As the estimation of flow rates during these low flow periods is related to crucial decisions concerning water allocation, assessment of drought severity and habitat conditions, this dearth of knowledge affects hydraulic engineers, biologists and hydrologists as well as, indirectly, the general public.

The purpose of this research project is to quantify the effects of aquatic vegetation growth on flow resistance and, correspondingly, discharge estimates in natural watercourses, focusing on low flow conditions. Field methods being used are non-disruptive, repeatable and incorporate the use of remote controlled aerial photogrammetry. In conjunction with these methods, a novel, lab-calibrated apparatus has been developed to estimate vegetation stiffness in-situ. Quantification of the effects of aquatic vegetation growth on channel roughness is achieved by continuously recording water levels at locations affected by seasonal vegetation growth, while local control reaches absent in vegetation are also monitored and used as a baseline comparison. Preliminary results currently show that neglecting flow resistance by aquatic vegetation at low flow may yield discharge overestimations ranging 50 –100%, which are exacerbated at low flow. Cross-sectional distribution of vegetation is found to be related to the respective increase in flow resistance, whereas sensitivity analyses highlighted how vegetation spatial distribution metrics being evaluated are greatly affected by sample size and their accuracy remarkably decreases at low resolution. Successful development of these consistent, non-disruptive, and reliable methods to quantify vegetation distribution and stiffness on site will reduce the inaccuracies of low flow estimates, benefiting people in need of reliable streamflow records or at-a-station estimates.