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Rating curve fails to model discharge in a backwater affected river reach

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Variable backwater complicates rating curve development at hydrometric gauging stations. In areas influenced by backwater effects, a single-parameter rating curve technique is inapplicable. Additional information such as a second water stage measurements or stream flow velocity is then included in the list of rating parameters. Recent developments allow discharge to be continuously monitored more directly, taking flow velocity measurements with horizontal acoustic Doppler current profiler, deployed horizontally at a river bank (H-ADCP). This measurement technique was applied in the River Mahakam, at a station located 250 km upstream of the river mouth in the Mahakam delta. The discharge station under study represents an area influenced by variable backwater effects. We applied both the standard index velocity method and a recently developed, semi-deterministic velocity profile method that corrects for a velocity dip at the surface, to obtain a continuous time-series of discharge from the H-ADCP data. Measurements with a boat-mounted ADCP were used for calibration and validation of the acoustic methods. As a comparison with conventional discharge estimation technique, a stage-discharge relation using Jones formula was also developed. Discharge series from stage-discharge relation did not capture the overall discharge dynamics, as produced using H-ADCP data. The discharge rate at the station exceeded 3300 m^3 s^{-1}. For a specific stage, the discharge range could be as high as 2000 m^3 s^{-1}, which is far beyond what could be explained from hysteresis associated with the rising stage and the falling stage of the river wave. Backwater effects from tributaries and lakes were shown to be far more significant than effects related to nonlinear flood wave dynamics.