Geophysical Research Abstracts
Vol. 13, EGU2011-11368, 2011
EGU General Assembly 2011

Method to estimate river discharge from a horizontally deployed Acoustic Doppler Current Profiler in a tidal river subject to sidewall effects and a mobile bed

Maximiliano Sassi (1), Ton Hoitink (1,2), Bart Vermeulen (1), Hidayat Hidayat (1,3)

(1) Hydrology and Quantitative Water Management Group, Wageningen UR, The Netherlands (maximiliano.sassi@wur.nl),, (2) Institute for Marine and Atmospheric Research Utrecht/IMAU, Department of Physical Geography, Utrecht University, The Netherlands, (3) Research Centre for Limnology, Indonesian Institute of Sciences, Cibinong, Indonesia

Acoustic Doppler Current Profilers (H-ADCPs) can be deployed horizontally to yield water level estimates in combination with flow velocity array data across a river transect. To maximize the percentage of the river width covered by the H-ADCP profiling range, while avoiding bottom and surface reflections from the acoustic beams, H-ADCPs are being deployed at relatively deep and narrow cross sections located at constrictions and bends, where the flow generally features a three-dimensional pattern due to the effects of curvature, bed topography and the side-wall. A new method is presented that accounts for the dip in velocity near the water surface, which is caused by sidewall effects that decrease with the width to depth ratio of a channel. A boundary layer model is introduced to convert single depth velocity data from the H-ADCP to specific discharge. The parameters of the model include the local roughness length and a dip correction factor, which accounts for the sidewall effects. A regression model is employed to translate specific discharge to total discharge. The method was tested in the River Mahakam, representing a large river of complex bathymetry, where part of the flow is intrinsically three-dimensional and discharge rates exceed 8000 m^3s^{-1}. Results from five moving boat ADCP campaigns covering separate semi-diurnal tidal cycles are presented, three of which are used for calibration purposes whereas the remaining two served for validation of the method. The dip correction factor showed a significant correlation with distance to the wall, and bears a strong relation to secondary currents. The sidewall effects appeared to remain relatively constant throughout the tidal cycles under study. Bed roughness length is estimated at periods of maximum velocity, showing more variation at sub-tidal than at intratidal time scales. Intratidal variations were particularly obvious during bi-directional flow conditions, which occurred only during conditions of low river discharge. The new method was shown to outperform the widely used index velocity method, by systematically reducing the relative error in the discharge estimates.