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Bedload transport rate measurements using ADCPs with different frequencies

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The complexity of fluvial hydro-morphological monitoring and the man ever-increasing data needs make an essential point of involving faster and modern measurement techniques as a common practice among scientist and engineers. The reliable bedload transport data is very important for optimized sediment management of big navigable rivers and reservoirs. DirectConventional sampling of the bed load transport rate is usually hindered by the turbulent near-bed conditions and the rough condition at loose bed. In relation, it is not continuous and it does not give information for the sediment dynamics.The acoustic Doppler current profilers (ADCPs) and its Bottom Tracking (BT) mode have been successfully used in evaluation of the bedload transport in the past. In the previous studies, the physical samples were necessary; hence, a calibration is required to determine the correct transport rate. However, the raw ADCP (apparent) velocity is not the average velocity of the bedload . The signal is noisy and contains erroneous data; therefore, it requires a proper filtering before calculating the transport rate. The recent laboratory studies showed that not only the working frequency and the Particle Size Distribution(PSD) are important, but also bottom roughness and the sampling frequency can significantly influence the estimation of the Doppler velocity. This study aims to develop a methodology of using the ADCP BT mode to measure the transport rate by only knowing the PSD and the frequency of the used instrument. The main idea is that the erroneous data that biases the results is being filtered. Measurements from few campaigns are presented. Four different ADCPs working on 0.6MHz, 1 MHz, 1.2MHz and 3MHz are employed to measure the bedload velocities and the water velocities. Simultaneously, the physical samples are taken from different positions in two rivers. The kinematic transport model is applied and the sensitivity of the acoustic properties towards different PSD are analyzed. Additionally, the bedload porosity of the active layer is estimated using empirical formulas that include the shear velocity. The log-law is applied on the water velocity profiles and the shear velocity is calculated. In general, the calculated transport rate and the physical samples presented a good matching and the eventual deviations are associated with the different positions of the ADCPs and the samples, the riverbed irregularities, etc. This study offers a non-intrusive technique that could significantly reduce the uncertainty in bedload measurements by introducing continuous and statistically more valid data. Nevertheless, the accurate calculation of the porosity and the thickness of the active layer still causes uncertainty in the results and remains to be investigated in the future studies.