



Robust measurement of suspended sediment concentration based on the Tikhonov regulation and L-curve

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The application of sound signal backscattered from sediments in suspension to measure suspended sediment concentration (SSC) profiles has obtained increasing acceptance in marine and fluvial environments. Challenges remain in the calculation of acoustic attenuation due to particles, which is tightly coupled with SSC. For example, the widely-used iteration algorithm (Hay et al, 2012; Thorne and Hurther, 2014) for simultaneously inverting acoustic attenuation and SSC layer by layer from the backscattered signal lacks robustness when applied to the noisy and complex environment of rivers. Our study proposes an operator equation from a generally accepted relation between the SSC and backscattered signal. It is available for the usage with the Tikhonov regulation method; the optimum regulated SSC can then be calculated based on the L-curve. It was found in our simulations that the inversion error can be effectively controlled within 5% when applying the regulation inversion, while the error of the traditional layer-by-layer iteration algorithm is about 15%. Furthermore, eight runs of experiments performed in a cylindrical tank were used to verify the simulation result. The sands ranged from 70 to 1000 μm in diameter with a lognormal size distribution. The SSC varies from 0.03 to 2 kg/m^3 . Examination against the experimental data corroborates the good potential of the regulation method and L-curve to reduce inversion error. In particular, when the SSC and measurement noise increases, the performance of the regulation method increases in comparison with the layer-by-layer iteration algorithm.