Hydrodynamic interaction in sediment-laden open channel turbulent flow

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In the present study, a theoretical model is proposed to predict the vertical distribution of suspended sediments in open channel turbulent flow. The mathematical model is derived based on six hydrodynamic mechanisms, namely upward sediment flux due to turbulent diffusion, downward gravitational settling of sediments in fluid, hindered settling phenomenon, secondary current in sediment-laden flow, fluid induced lift force on the suspended particles and the gradient of Reynolds normal stresses. The importance of including such mechanisms is described through the real characteristics of the suspended load profile. We also address the significance of the co-existence of those mechanisms for estimating the particle concentration in a flow region. The model agrees satisfactorily with a wide spectrum of experimental data. A benchmarking exercise with previously published models shows that the proposed model has better prediction accuracy—as confirmed by a detailed error analysis.