Sensitivity analysis for suspended load formulae in sediment transport

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A phenomenon of considerable interest in river mechanics is the suspended sediment that differs from bed load sediment in that it may be diffused throughout the vertical column of fluid. The suspended sediment transport models are often based on semi-empirical formulae that relate to physical properties. In engineering applications, error in these physical properties affects the accuracy of the total sediment fluxes. The present analysis quantifies error propagation from the physical properties to the sediment transport, determines which one controls the errors, and provides the relative strengths, weaknesses and limitations of eight formulae (Rouse, 1937; Lane, 1941; Hunt, 1954; Zagustin, 1968; Van Rijn, 1984; Ni, 1991; Umeyama, 1992 and Wright, 2004). Sensitivity analysis is well recognized as being an important aspect of the responsible use of sediment transport and can help in identifying critical control points, prioritizing additional data collection or research, and verifying and validating a model. Uncertainty is individually tested to see the influence of the physical properties with the method of propagation of errors and the Monte Carlo method for comparison and validation and reviews a range of methods for sensitivity analysis in a number of relations for estimating the entrainment rate of sediment into suspension. The use of global variance-based sensitivity analysis is shown to be more general in its applicability and in its capacity to reflect nonlinear processes and the effects of interactions among variables. The combined effect of errors in all the physical properties is then compared to an estimate of the errors due to the intrinsic limitations of the formulae.

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