Uncertainty quantification in a sediment transport model.

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In general, predicting the evolution of a river bed needs to take into account the erosion phenomenon and the induced sediment transport. Two process characterize this geological event: the sediments can be transported by bed load (close interaction with the bed) or by suspension (fine particles are present in the water column). Thereafter, we are only focused on the bed load transport. In this precise framework, the dynamics of the sedimentary transport is mainly modelled by the Exner equation based on a solid mass conservation. To model the interaction between the river flow and the bottom topography, we couple this equation with the well-known Saint-Venant system for shallow water flow,

$$\begin{cases} \partial_t H + \partial_x Q = 0\,, \\ \partial_t Q + \partial_x \left(\dfrac{Q^2}{H} + \dfrac{g\,H^2}{2} \right) = -g\,H \partial_x Z_b - \tau_f\,, \\ \partial_t Z_b + \partial_x Q_s = 0\,, \end{cases}$$

where H is the water height, Q the flow discharge, Z_b the bottom topography, g the gravitational acceleration and τ_f the friction term. The core of the Exner equation relies on the definition of the sediment flux Q_s. Actually, it is empirically determined and depends on the physical parameters and the configuration of the river bed. A lot of formula has been established to define this quantity in function of the nature of the considered river, the size of the grains... Anyway, it brings out the problem related to the uncertain data. It seems legitimate to study the degree of influence of each parameter on the output of the model (here, especially the aspect of the river bed). This work is devoted to the description of the method to propagate the uncertainty in the model and evaluate the influence of the random data on the final results.

Références

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