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1. Introduction

The prediction of non-cohesive sediments transport is vital importance for the maintenance and management of coastal environments. The complexity of the phenomena entails the use of semi-empirical formulas.

2. Bed load transport

Sand bed load transport was first studied in case of steady flow. The earliest formulas still widely used were based on the concept that bed load is a function of the bottom shear stress (Meyer-Peter & Müller, 1948; Einstein, 1950). The bed load appeared to be proportional to the dimensionless shear stress (or Shields parameter θ) to the power 1.5. A critical value of the Shields parameter θ_{cr} was used as a limit beyond to it no transport occurs. The effects of the waves were first added as a stirring effect that induces an increase of the total shear stress for the estimation of the bed load alongshore (Bijker, 1967; Watanabe, 1982; Van Rijn, 1993). Bagnold (1966) introduced the energetic transport models where the instantaneous transport through the wave cycle is related to the instantaneous energy dissipation rate due to bottom friction. Bailard & Inman (1981), Ribberink (1998) and more recently Camenen & Larson (2005) proposed formulas which are based on this model where bed load is treated in a quasi-steady way. Dibajnia & Watanabe (1992) showed that for high shear stress appears the sheet flow regime where large transport occurs in a layer. A phase-lag may then appear between the instantaneous velocity close to the bottom and the sediment concentration for fine sediments. This induces a relative decrease of the sediment transport (Ribberink & Chen, 1993; Ahmed & Sato, 2003).

3. Suspended load transport

The suspended load is equal to the integration over the depth of the product between the concentration and the velocity. It is extremely complex to estimate as it highly depends on the mean velocity profile (generally assumed to be parabolic), the sediment diffusion ε , and the reference concentration at the bottom c_b . The two latter parameters often induce large uncertainties because of the difficulty of their prediction in case of wave and current interaction. A constant value or a parabolic profile for ε over the depth induces an exponential or a power law profile for the concentration c , respectively (Rouse, 1938). Advanced models, directly solving the sediment continuity equation and momentum equations presents encouraging results (Davies *et al.*, 1997, 2002), but are not robust enough yet for mid and long term simulations. Einstein (1950) and Van Rijn (1993) proposed simplified formulas which still need to be integrate over the depth, and then are still quite sensitive to extreme cases like a storm. Bailard (1981) proposed a formula based on energetic models, which tends to overestimate the prediction of the suspended load for fine sediments and high shear stress. Total load formulas were also proposed (Watanabe 1982; Van Rijn, 1984; Dibajnia & Watanabe, 1992) which are more robust but not always accurate.

4. Conclusion

A balance should be found between the simplification of the physics for the robustness of the formula and the integration of the main physical aspects for the accuracy of the prediction.