

Modelling transport of graded sediment under partial transport conditions

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Introduction

Tentative plans are presented for research on the modelling of i) selective sediment transport in suspension and as bed-load, and ii) large-scale morphology in mixed sand-gravel bed rivers. Since the planning of the research is still in its early stages, the plans are flexible. Please feel free to contact me if you have an interest in this topic, would like to discuss some issues or see possibilities for collaborations.

Problem definition

Model concepts for sediment transport and suspended load in the present morphodynamic models are not yet capable of adequately describing selective transport processes of sediment mixtures.

It is unclear how the sediment exchange process of sediment size fractions occurs between the water column, the active surface layer and the deeper bed layers, in the case of partial transport conditions.

Research goals

To increase physical understanding of sediment transport dynamics of graded sediments, in particular in situations of fine sediments being transported in suspension over coarse river beds. Development of improved model concepts for bed-load and suspension dynamics of graded sediments in partial transport conditions, which can be applied in 1D, 2D and 3D morphodynamic river models.

Research Outline

The research comprises three stages

Model development

This stage covers the formulation of tentative concepts, these concepts will be implemented in morphodynamic models and their performance will be analysed.

Laboratory Experiments

In order to specifically investigate the transport of fine sediment in a coarse environment flume experiments will be conducted. This enables us to further analyse performance of the tentative models. Using the physical insight gained from the experiments final concepts can be formulated and calibrated.

Validation with field data

The model concepts will be applied to field data, the models will be validated and the

performance can be compared with the present modelling practice, e.g. a 2dh model with a Galappatti type modelling of suspended sediment.

Collaboration

WL|Delft Hydraulics

Collaboration on the implementation and testing of model concepts in Delft 3D.

Directorate for Public works and Water management. (Rijkswaterstaat) Regional department for the Eastern Netherlands (Directoraat Oost) and Institute for Inland Water management and Waste Water Treatment (RIZA)

Collaboration on the design and monitoring design of a field experiment. The experiment involves suppletion of fine dredged material in a mixed sand-gravel environment. This experiment will give an insight in the behaviour of widely graded sediment mixtures under field conditions.

Leichtweiss Institut Technische Universität Braunschweig, Germany

Collaboration on flume experiments, required to test and calibrate models.

Some processes that will receive special attention

A special case of partial transport is the transport of fine sediment over a coarse immobile bed. The processes of importance in this situation are presented in the figure below. Figure 1 represent the situation downstream of a supply of fine sediment where a coarse bed exists.

1. Solitary bed forms migrating over an armoured bed. Can they be modelled in the present models?
2. Adaptation of the suspension profile to the new environment lacking fine sediment.
3. Turbulent diffusion: strong above a rough bottom, keeps sediment in suspension.
4. Interaction of fine sediment with the rough bed: shielding / trapping of fines between coarse grains, washing out / vertical entrainment of fines?

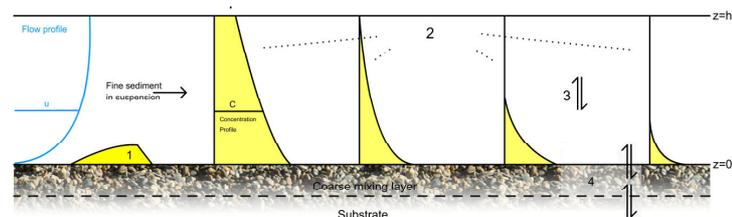


Figure 1. Transport of fine sediment over a coarse bed.