Multiphysics Approach to Sediment Transport in Shallow Water

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Abstract

Sediment transport in shallow water is of concern in many hydro-ecological problems. Erosion or sedimentation processes are not only relevant in perennial systems as rivers, lakes, reservoirs and coastal regions, but also in ephemeral phenomena like gullies, inundations and floods.
Sediments are transported by water flow, and vice-versa sediments have an effect on flow, due to changes of the ground surface level. That two-way coupling has to be taken into account when sediment transport is simulated in computer models.
We present a multiphysics approach for such a coupled model. For flow the shallow water equations (SWE) are utilized, i.e. one equation for water height and two equations for the horizontal velocity components. The vertical component can be skipped due to the averaging process over the height of the water column, from which the SWE equations are derived. The flow equations are coupled with a transport equation for particulate matter and a bed-load equation. When using the CFD toolbox, turbulent mixing can be included in the transport equations. The bed-load equations is implemented using the coefficient pde formulation.
Using COMSOL Multiphysics® software a set-up is presented that demonstrates the capability and feasibility of the approach. The non-linear system of five differential equations is solved simultaneously. For a test example of a cylindrical obstacle the model sensitivity to several physical and numerical parameters is discussed.

Figures used in the abstract

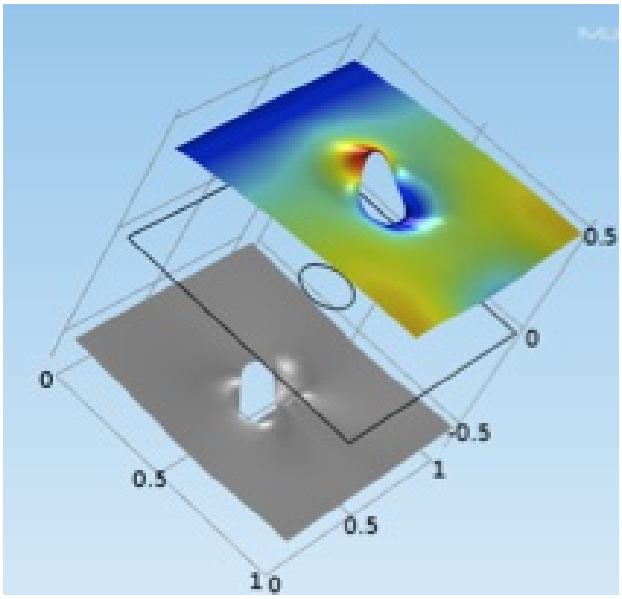

Figure 1: Shallow water flow above changing ground.