Principal Investigators

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Title

Multi-Dimensional Sediment Processes Models – Channels and Structures

Objective

This work unit will produce a state of the art modeling capability to:

1. Make hydrodynamic and sediment long-term (from several months to 10, 20, ... 30 years) simulations of rivers, estuaries, reservoirs, and the littoral zone.

2. Make flow and sedimentation simulations near and in hydraulic structures (dikes, groins, locks, etc). This will be a tool using present state-of-the-art processes that will be available to RSM Processes work units to build upon as improved processes become available.

Benefits

The Department of Defense's (DoD) ADaptive Hydraulics (ADH) framework is a computer code system that allows the hydraulic/sediment expert to concentrate on hydraulics/sedimentation and not become an expert numerical analyst as well. The engineer/scientist develops a mesh and boundary conditions that represent the problem and the code adapts the mesh and the time step to adequately capture the physics. ADH was designed from the ground up to run quickly and efficiently across many platforms. Thus, it is one of the few tools available to address regional problems.

This work unit will allow the Corps of Engineers to evaluate flow and sedimentation in channels, rivers, estuaries, and reservoirs as well as in and around hydraulic structures. The shallow water hydrostatic module will be capable of simulations over time scales ranging up to 10's of years. The non-hydrostatic Navier Stokes module will be capable of addressing months of simulation. This provides a tool that will be available quickly for the Corps of Engineers and can readily incorporate improvements developed via RSM.

Work Description

The work to be accomplished is as follows:

1. Non-cohesive sediment transport, including bed load and suspended load, will be produced. This will be added to a sediment module in ADH available for use in the Navier Stokes solver for simulations in and around hydraulic structures as well as the shallow water solver for channels, rivers, estuaries, lakes and coastal environments. This implementation will be accomplished via the DoD CHSSI Surface Water/Groundwater, Riverine and Tidal Environments work unit. Cohesive sediment transport algorithms will be produced.

2. Cohesive Sediment transport algorithms will be produced. This includes the transport, erosion, deposition, and bed building of cohesive sediments. This task is to be funded via this work unit in RSM.

3. Testing of the completed sediment transport algorithms (cohesive and non-cohesive), and documentation of the results and the user's manual will be produced. This task will be accomplished using combined funding of this work unit in RSM and the previously mentioned CHSSI work unit.

4. The density coupling with the hydrodynamics will be implemented. This will be handled in such a way that any number of constituents' effect on the currents can be included. These constituents could be salinity, temperature, sediment concentrations, or any other routed constituent. This allows ADH to address estuarine environments, lakes, or hyper concentrated sediment plumes. This will be reported in the Coastal and Hydraulics Engineering Technical Notes, the ASCE conference proceedings, and the user's manual will be updated to include these new features. This will be funded via this RSM work unit.

5. The interaction and decay of constituents will be invoked through an interaction matrix. This will be implemented using split-operator methods developed in the PET 2 Focused Effort. The tracking number is EQM 003. This RSM proposal will fund the final implementation of the concepts developed from PET 2 using a large interaction matrix and also the testing of the final product. This allows settling and flocculation processes. It also has generality for water quality computations. The User's manual will be updated to include this new feature. A technical report will be produced on the results of all testing and a journal article produced describing new modeling concepts.

Products

Product	Start	End
Multi-dimensional sediment model plan	Oct 02	Sep 03
Multi-dimensional sediment model (alpha version)	Jan 03	Mar 04
User's manual update	Feb 04	Jun 04
Sediment model (beta version) testing completed	Mar 04	Dec 05
Density coupled model with sediment	Mar 04	Mar 05
Interactions between all constituents	May 04	Sep 05
Final user's manual	Oct 04	Sep 05
Technical report and Journal article	Mar 05	Sep 05