Numerical Modeling of Eroded Mud Aggregates

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Focus Area

Sediment and Dredging Processes

Problem

Dredged sediment erodes as aggregates and is a primary transport mechanism for cohesive dredged sediment. Aggregate transport is significantly different than primary particles or floc transport and typically reduces dispersion of clay/silt. However, aggregate transport is not commonly available in sediment transport models used to evaluate beneficial use (BU). Therefore, a primary process in muddy sediment transport is missing, leading to increased model uncertainty or, in many cases, inappropriate modeling. Aggregate transport must be included in evaluating BU design alternatives for mudflat/marsh. Without aggregate processes, fine-grained sediment transport models over predict dispersion and under predict stability. Without aggregate transport, models will not be able to appropriately quantify strategically placed sediment benefits to targeted resources (such as marsh), amount returning to the nearby navigation channel, or risks associated with BU applications. NAO has funded preliminary evaluation of aggregate transport modeling, with application in the James River. NAO concerns include both presumed benefits (bank stabilization and ecosystem diversity) and concern for channel infilling for material placed adjacent to the channel. However, this application does not provide full demonstration and guidance for broader application remains unavailable.

Study Description

The purpose of this research project is to develop and document an improved sediment transport model that is capable of simulating the transport and abrasion of mud aggregates generated during dredging activities and by mass erosion of mud beds in most estuarine and coastal waters. The following three objectives will be accomplished: 1) Develop a mud aggregate transport algorithm and add it to the SEDZLJ mixed sediment bed model in the GSMB library in CORSED; 2) Develop an aggregate abrasion algorithm and add it to the SEDZLJ mixed sediment bed model in the GSMB library in CORSED; and 3) Write reports that include a) importance of mud aggregates in sediment transport predictions, b) engineering guidance for influence of aggregation on mud/clay BU evaluation, c) description of mud aggregate transport processes, and d) description of the mud aggregate and abrasion routines to be added to GSMB/CORSED. The first objective will be accomplished by: 1) Completing testing of a routine in the SEDZLJ mixed sediment bed model in GSMB to represent mud aggregates and adding it to the CORSED library. Mud aggregates are represented in GSMB as multiple separate sediment classes. 2) Completing testing of an aggregate abrasion routine recently developed and added to the SEDZLJ mixed sediment bed model in GSMB. Upon completion of the tests, this abrasion routine will be added to CORSED. The third objective will be accomplished by writing two TNs – 1) describes the importance of mud aggregates in sediment transport predictions, and 2) describes engineering guidance for influence of aggregation on mud/clay BU evaluation. The fourth objective will be accomplished by writing a TR that describes the field work, laboratory studies, and modeling of mud aggregates that has been accomplished at ERDC from DOER and RSM RTs over the past four years.

Products

- GSMB/CORSED model that includes mud aggregate transport and abrasion routines
- TN that describes the importance of mud aggregates in sediment transport predictions
- TN that describes engineering guidance for influence of aggregation on mud/clay BU evaluation
- TR that describes the field work, laboratory studies, and modeling of mud aggregates will be produced

Summary

This project will develop and document an improved sediment transport model that is capable of simulating the transport and abrasion of mud aggregates generated during dredging activities and by mass erosion of mud beds in most estuarine and coastal waters. This will result in improved sediment transport predictions, and thus will benefit the navigation program of USACE Districts by decreasing the uncertainty of evaluations of the benefits and risks for sediment management practices such as BU and strategic placement of dredged material in sites in proximity to navigation channels.

Balancing operational and environmental initiatives and meeting complex challenges of dredging and dredged material placement in support of the navigation mission.

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