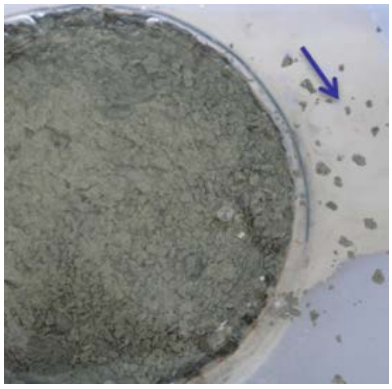
Durability of Bed Aggregates

Problem



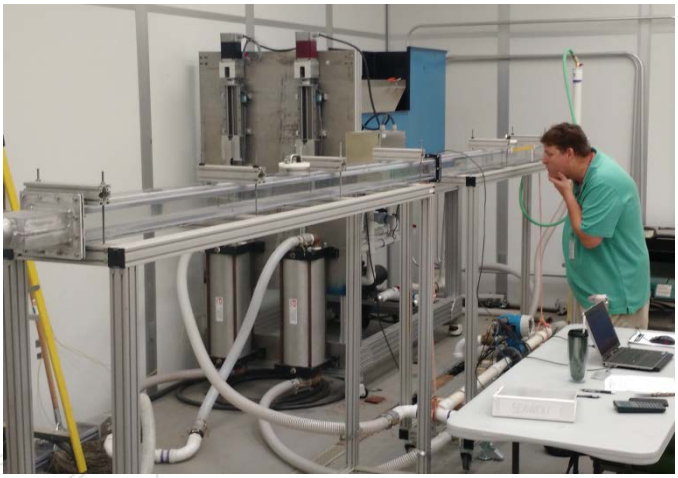
The outcomes of sustainable uses of dredged sediment, such as nearshore placement, strategic placement, and thin-layer placement, rely in part on the sediment transport characteristics of the sediment to be placed. Physical transport processes of muddy sediments (such as thresholds of motion, settling velocity, and transport modes) govern the geomorphological evolution of many dredged material placements and are critical components in engineering studies of transport at wetlands, mud flats, nearshore regions, and other locations where beneficial use of dredged sediment is proposed to mitigate land loss and create or enhance habitat. Aggregation (the clumping together of fine sediments) significantly alters the transport characteristics of fine sediments, and particularly influences the modes of transport and conditions under which the particles will deposit on the bed. Anecdotal evidence from field studies suggests that dredged and eroded aggregates can be relatively robust, remaining intact for transport over tens of miles and enduring high stresses of dredge pipelines, flooding rivers, and breaking waves. Presently, little is known of the durability of fine sediment aggregates that are either eroded from the bed, or placed onto the bed in the form of dredged sediment. Consequently, numerical sediment transport models inadequately represent the physical processes associated with aggregated dredged sediments. Laboratory testing is required to develop a fundamental understanding of the properties and processes influencing the rate at which fine-sediment aggregates breakup and decrease in size.

Study Description

Laboratory and field experiments are being performed to determine aggregate durability related to sediment characteristics. Sediment mixtures with known composition are prepared and eroded to generate mud aggregates. These aggregates are then subjected to known, constant exposures of transport and bed stress. The size distributions of the aggregates are measured over the duration of the experiment to determine the associated weathering rates of the source aggregates. A numerical, aggregate-transport modeling framework has been developed and will be tested and validated with the data obtained from the experiments. Additionally, a small-scale aggregate durability apparatus is being tested in tandem with the larger-scale flume to examine the suitability of such a device for field testing of specific dredged sediments under consideration for strategic placement.

Products

The subject research is in Year 2 of 3. To date the laboratory flumes have been constructed, instrumentation secured, and hydrodynamic testing completed. In Years 2 and 3, technical publications will describe the research findings, relating aggregate breakup rates to hydrodynamic forcing and sediment properties. Field recommendations will be provided in an ERDC Technical Note. The findings of the research will ultimately be transferred into predictive methods and algorithms incorporated into USACE numerical models, where the improved physics of fine sediment transport can benefit design and implementation of strategic placement of dredged sediments.



Summary

DOER is engaged in improving the understanding of fine-sediment transport processes to better anticipate the outcomes of innovative techniques for sustainably handling dredged material. Laboratory experiments will define hydrodynamic and sediment property controls on aggregate durability and fine sediment transport modes. This research will be transferred into practice through 1) technical reports and technical notes that will communcate general concepts and field-applicable understanding and 2) computational algorithms that can be applied to evaluate strategic placement design alternatives.

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