DOER Sediment and Dredging Processes (SDP) Focus Area

Dr. Joseph Z. Gailani
Research Hydraulic Engineer
Engineering Research and Development Center
U.S. Army Corps of Engineers

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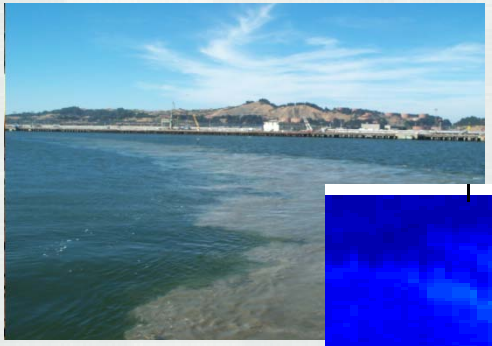
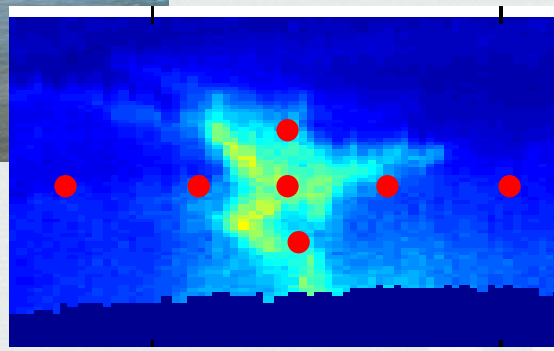
SDP Focus Area Objectives

- **Situation**: The USACE dredging community is changing the way it does business. New challenges are posed by fiscal/manpower limitations, dredging cost increases, the goal of sustainable dredging and beneficial use, and evolving environmental standards. These issues must be addressed in a timely, cost-effective manner.
- **Barriers**: Limited understanding of and experience with potentially advantageous technologies and sediment handling methods limit USACE options to address these challenges and meet project budget/schedule.
- **Solution**: These limitations, which hinder application, can be addressed by targeted research studies
  - Identify or develop innovative operations and sediment handling technologies that may be beneficial to USACE
  - Test these new technologies in locations and situations suitable to evaluate performance in terms of defined metrics
  - Facilitate implementation of well-performing technologies into Operations and Planning
  - Demonstrate potential for benefits from dredged sediment

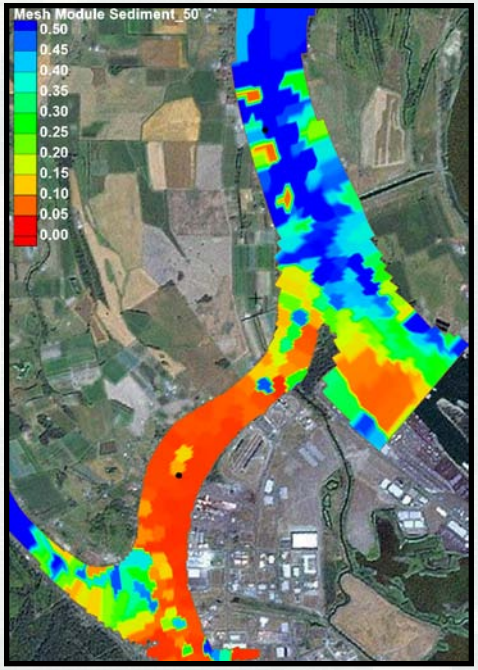
SDP and DMM Products
Everything is Connected!

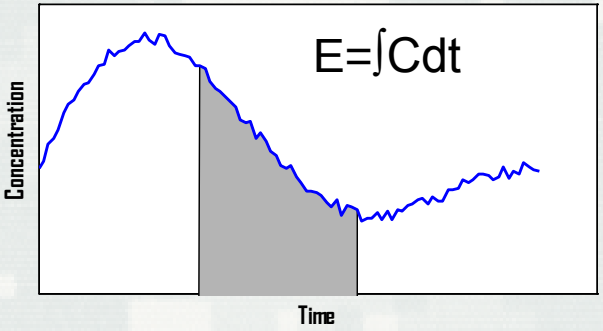
- **Process Studies**
  - ▸ Wave/current erosion
  - ▸ Sediment- Fluid Interactions
  - ▸ Settling Velocity
  - ▸ Sedimentation





- **Near-field algorithms and models**
  - ▸ STFATE
  - ▸ Plume dynamics
  - ▸ Dredge Source Terms



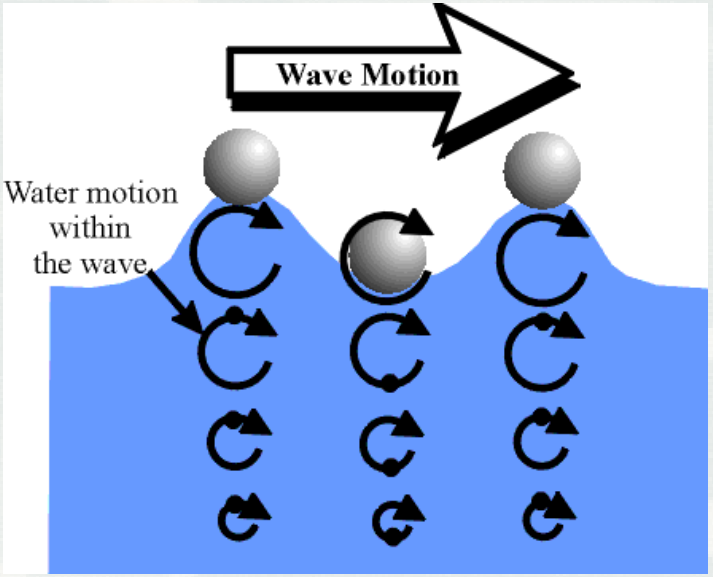


- **Far Field Models**
  - ▸ PTM
  - ▸ LTFATE
  - ▸ Sediment Budgets
  - ▸ SMS Tools for exposure

Support Risk, Effects, Habitat, DMMP, Feasibility Studies

Wave-Induced Erosion Processes for Dredged Material Mounds

- Problem
  - Dredged material mounds eroded by wave action
  - Existing wave/current erosion equations for cohesive sediment are insufficient
  - Poor predictive capabilities

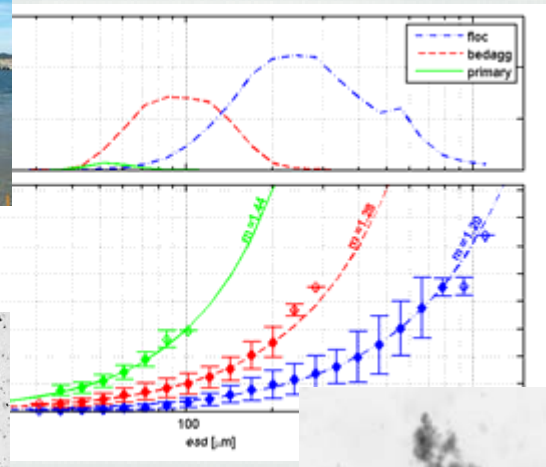


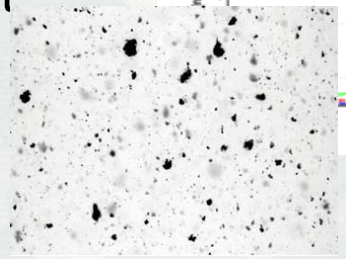
- Objective
  - Develop site-specific measurement methods for wave/current erosion
  - Develop parameterization methods for existing erosion algorithms
  - Investigate “enhanced” erosion potential due to waves

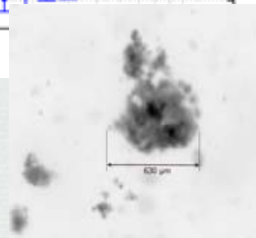
- Approach
  - Extensive laboratory testing of SEAWOLF flume
  - Compare wave/current erosion to steady state erosion for controlled sediment samples
  - Develop algorithms for wave/current erosion

Dredge Plume Settling Dynamics

- Problem
  - Dredge turbidity/TSS are a regulatory/environmental issue
  - Fate of suspended DM dependent on settling velocity
  - Aggregation/flocculation will influence settling





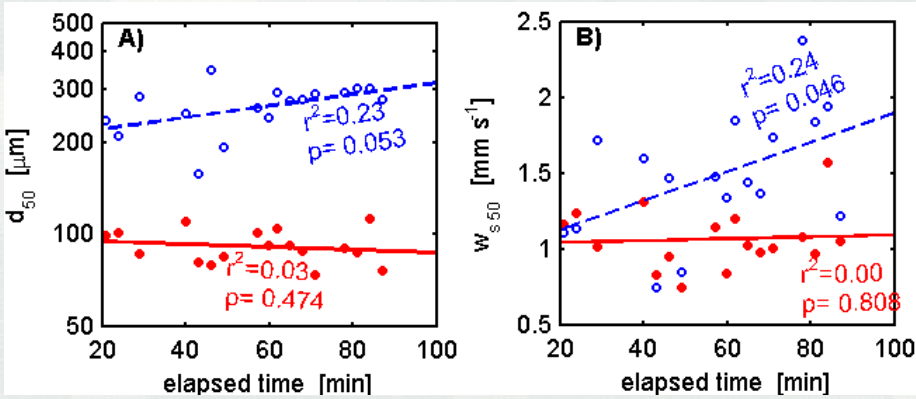


- Objective
  - Develop field deployable instrument to quantify settling of various sediment types found in dredge plumes
  - Methods to incorporate these data into predictive models

- Approach
  - Particle Imaging Camera System (PICS) for deployment in plumes
  - Data analysis tools to measure all sediment settling
  - Guidance/algorithms for DM settling

Sediment-Fluid Interactions

- Problem
  - Dredge turbidity/TSS are a regulatory/environmental issue
  - Fate of suspended DM dependent on interactions between sediments and fluid
  - Settling velocity/flocculation is time dependent

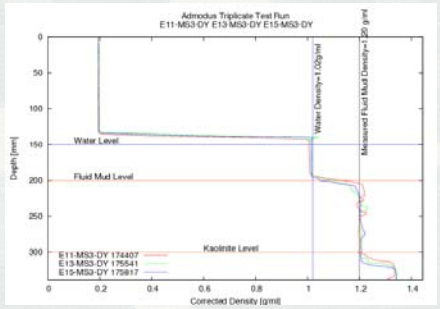


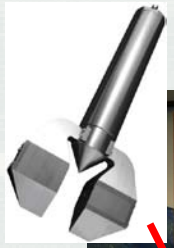
- Objective
  - Develop flocculation algorithms that are time-dependent for dredged material plumes
  - Evaluate/demonstrate algorithms in FATE models

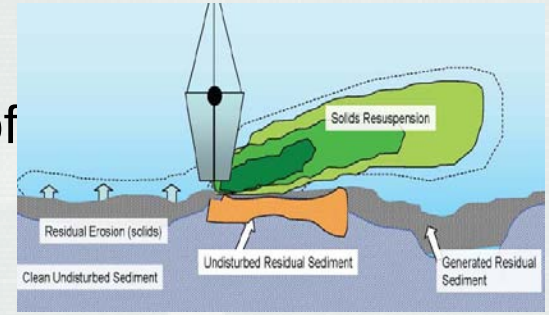
- Approach
  - Field measurement using PICS
  - Quantify flocculation rates for hopper and mechanical dredge plumes
  - Develop algorithms as function of time and conc.

Dredging Residuals Density and Fluid Mud Profiling Survey System

- Problem
  - Current methods to characterize dredging residuals inefficient.
  - No standardized USACE method to survey residuals/fluid mud.
  - This measurement paucity has hindered effective management of environmental dredging and fluid mud dredging projects





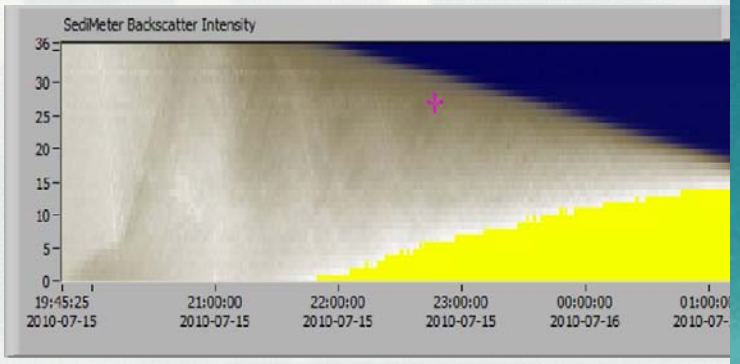


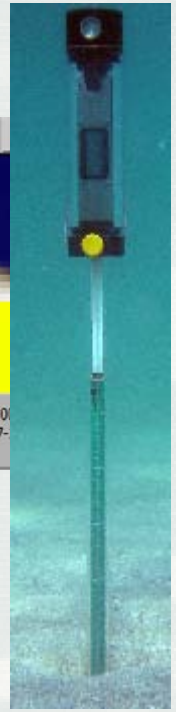
- Objective
  - Improve USACE capability to more accurately and precisely characterize fluid mud/dredging residuals
  - Produce an increased resolution density probe that doesn't require calibration.

- Approach
  - Leverage funding with EPA to develop high resolution, non-nuclear density probe

Fine-Scale Sedimentation from Dredge Sources

- Problem/Purpose
  - Environmental effects related to small-scale deposition of DM
  - This scale cannot be measured with existing survey equipment
  - Therefore, models are unverified small-scale sedimentation





- Objective
  - Evaluate and demonstrate commercially available systems for measuring sedimentation (Sedimeter) on fine (~1 mm) vertical scale

- Approach
  - Review literature available on Sedimeter and other devices
  - Laboratory evaluation
  - Field Demonstration

Open Water
Pipeline Placement Dynamics

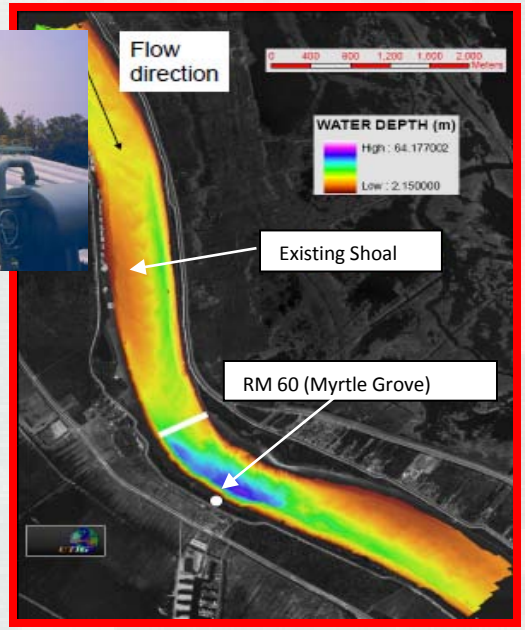
- Problem
  - Pipeline placement results in increased turbidity, burial, blockage of light, sediment toxicity
  - Dynamics of fine-grained sediment placement are poorly understood

- Objective
  - Characterize transport and deposition patterns of fluid mud turbidity during continuous discharge through laboratory experiments
  - Develop predictive algorithms for FATE models

- Approach
  - Series of laboratory experiments for pipeline placement
  - Develop algorithms that are function of time and sediment composition

Sediment Management to Reduce Dredging

- Problem
  - Channels act as sediment traps
  - We are generally fighting against nature
  - Can we work with nature to reduce dredge volumes and address funding and capacity limitations?

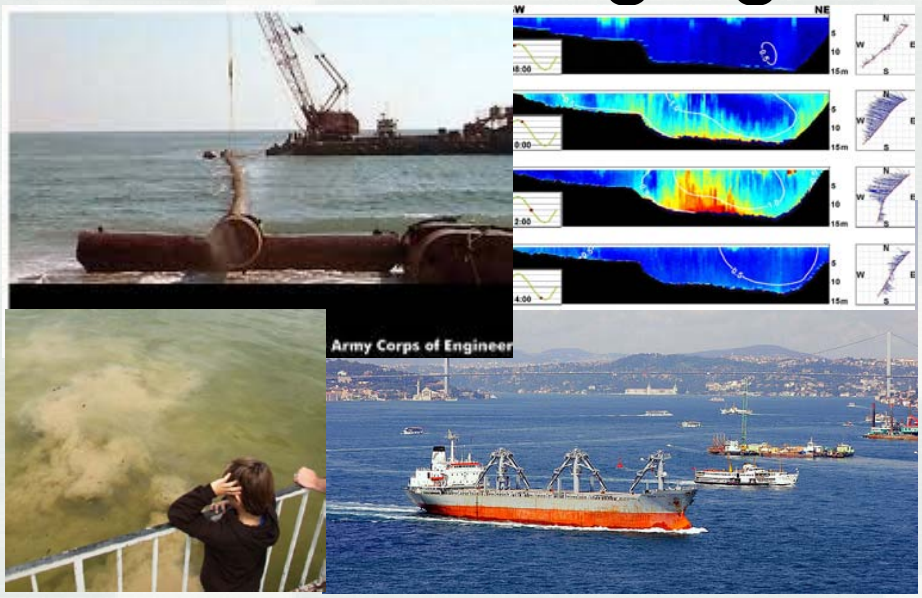


- Objective
  - Investigate one or more emerging methods for managing sediment transport using natural forces (or harvesting sediment) to reduce dredge volumes

- Approach
  - Select one or more key projects for additional monitoring and “lessons learned” that can be applied to other Corps sites
  - Possible collaboration with LaCPR

Fine Grained Sediment Budgets for Regions with Navigation and Dredging

- Problem
  - Dredging produces an exposure pathway
  - Risk from exposure to dredged material must be quantified
  - Actual risk can only be addressed within context of all exposure pathways and associated risk



- Objective
  - Develop methods for building fine grained sediment budgets that include all sources to receptors
  - Demonstrate sediment budget methods through site application

- Approach
  - Develop methods to Identify/quantify fine-grained sediment sources
    - Discharge (rivers, CSOs, etc)
    - Current/wave resuspension
    - Ships, dredging, other operations
  - Develop budget framework to quantify overall exposure
  - Develop methods for design alternatives

Open Lake and Bay Dredged Material Placement

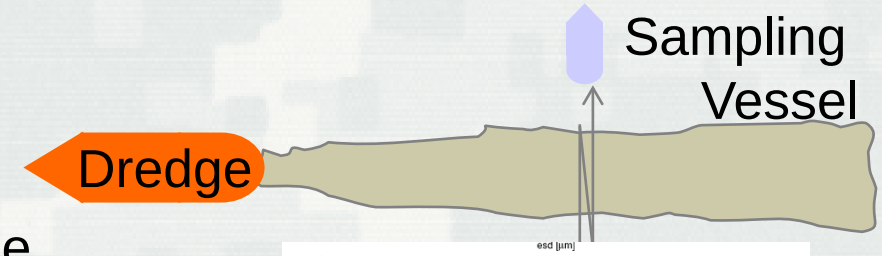
- Problem
  - DM suitable for open water placement if often placed in CDFs or far offshore due to precedent
  - CDF capacity limited
  - Stakeholders (States) are concerned about providing permits for lakes/bays

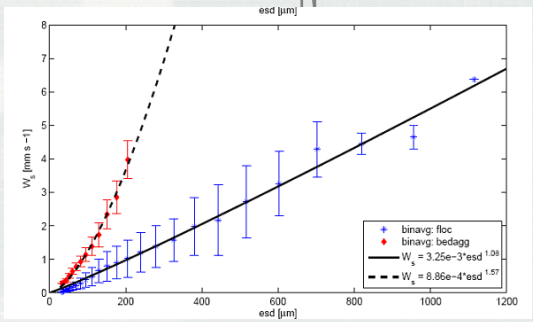
- Objective
  - Develop and demonstrate methods to quantify impacts from all aspects of open lake/bay placement (sedimentation, turbidity, chemistry, habitat, toxicity)

- Approach
  - Work with State and other regulatory agencies to develop robust, defensible methods to address permitting issues

Dredge Plume Evolution

- Problem
  - Dredge turbidity/TSS are a regulatory/environmental issue
  - Dredge TSS data are sparse
  - Data collection complex due to temporal/spatial variability



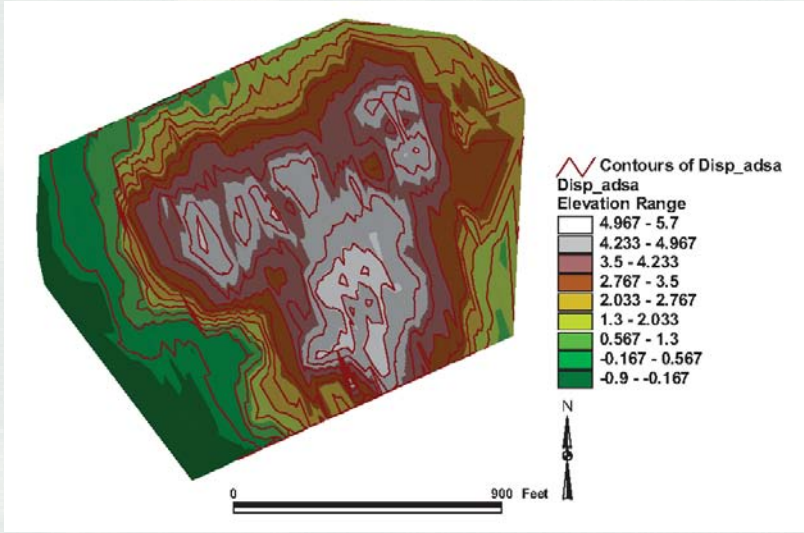


- Objective
  - Improve sampling analysis protocol for field through understanding of relevant processes

- Approach
  - Assess dredged material release in laboratory setting
  - Improve sampling analysis protocol for field
  - Test, refine, and demonstrate new protocol
  - Develop source term algorithms

Nearshore and Wetland Placement Tools

- Problem
  - WwN, BU, RSM, and sustainable solutions will require placement of DM in complex environments
  - Lack of understanding of how DM transports through these environments

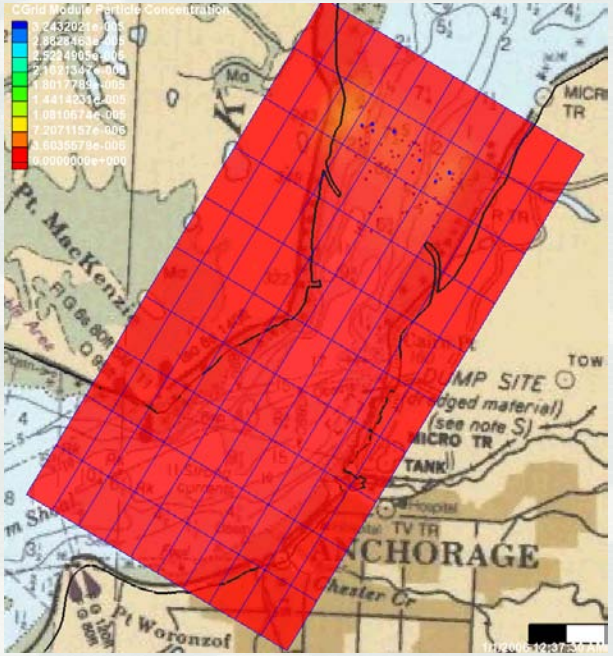


- Objective
  - Develop guidance documents and tools for placement in nearshore and wetland locations
  - Methods to optimize natural distribution of DM in these environments

- Approach
  - Work with LaCPR and others to assess success and issues with ongoing projects
  - Use ongoing field studies in conjunction with DOER research to develop guidance and tools

SMS Framework for DMM Tools

- Problem
  - DMM tools have no common interface or interconnectivity
  - Presently, it is complex and time consuming to transfer data between tools
  - This results in less use of tools

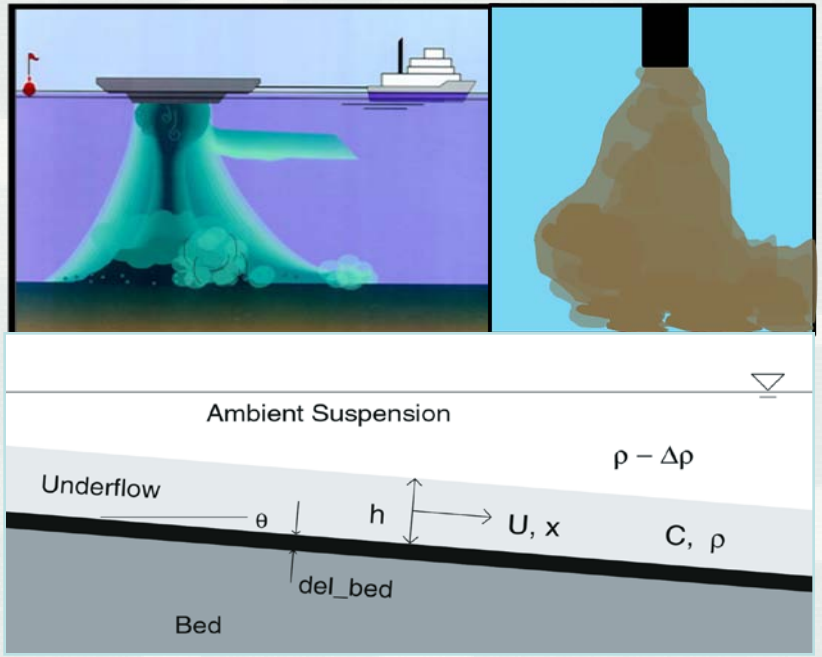


- Objective
  - Incorporate dredging models and tools into SMS
  - Integrate dredge models with other USACE large domain models
  - Integrate dredge models with SMS data sources

- Approach
  - PTM and LTFATE in SMS
  - Near-field FATE models in SMS
  - GIS data for DM models
  - Workshops/Tech transfer

Models for Dense Fluid Dynamics

- Problem
  - Current models for placement dynamics are idealized and limited in breadth of application
  - Cannot address increasingly complex Corps applications with these models



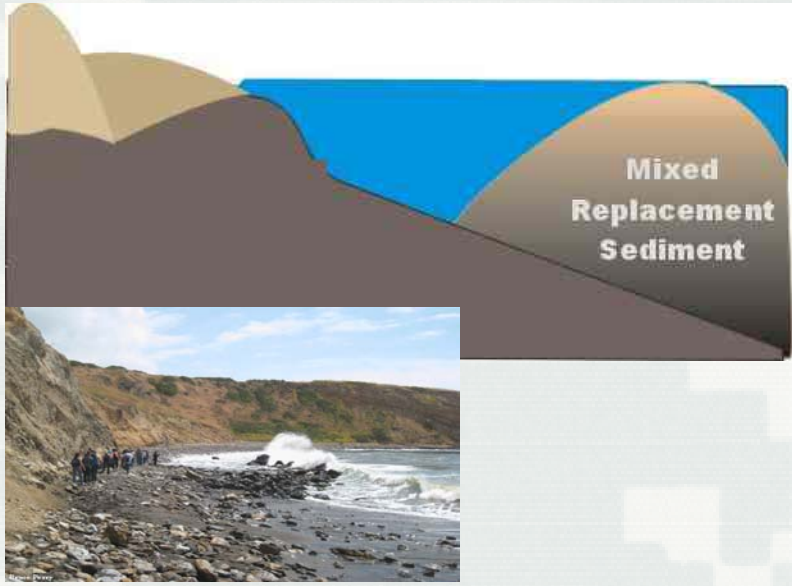
- Objective
  - Develop new generation of placement models for discrete and continuous discharge (barge and pipeline placement)
- Approach
  - Investigate existing models
  - Literature review
  - Develop new 2-phase flow algorithms
  - Validation of new models at Corps site

Future SDP Efforts?

- What are the priorities for SDP?
  - RARG
  - DMAM – give us feedback!
  - Contact focus area or program manager
  - Joe.Z.Gailani@usace.army.mil
- Support navigation (and the environment)
- Sediment is a resource – Where feasible, let's use it wisely

Bed and Fluid Mud Transport Model

- Problem
  - Dredged material placement issues are becoming more complex
    - Nearshore placement
    - Beneficial use
  - Present methods cannot represent critical processes
  - Predictive capabilities are required



- Objective
  - To develop multi-grain sediment transport algorithms that replicate critical processes for dredged material fate, including fluid mud and bed load

- Approach
  - Review existing models, new methods, and data (SDP)
  - Develop new set of comprehensive algorithms
  - Incorporate into LTFATE
  - Validate through appropriate application