# Modeling of Dredging-Induced Sediment Resuspension: Remaining Questions and Progress Toward Answers

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**Introduction:** Sediment resuspension during the dredging process forms the basis for a host of environmental concerns, particularly when dredging disturbs contaminated sediments. Knowledge of the resuspension process forms a critical foundation for studies of the associated processes of sediment particle and contaminant release, accumulation and behavior of sediment residuals, and risk linked to a given dredging project. Lagrangian particle tracking models and contaminant transport models exist that allow for the assessment of the fate and transport of sediments resuspended by dredging and contaminants released from dredged or disturbed sediments. Confidence in the predictions generated by these models is dependent upon the established accuracy of the dredging resuspension source terms. The US Army Engineer Research and Development Center (ERDC) is engaged in both field and laboratory investigations into quantifying dredging loss rates.

**Methods:** Second generation source term models for bucket [1], hopper, and cutterhead [2] dredges have recently been completed using a semi-empirical/ semi-mechanistic approach. ERDC laboratory studies are aimed at developing fully mechanistic source terms by isolating specific mechanisms for loss during mechanical bucket and hydraulic cutterhead dredging beginning with bench scale tests. These experiments will be scaled up using a unique dredging flume that allows near-full-scale experiments to be conducted in a controlled environment. The effects of sediment characteristics on resuspension will be closely analyzed, as sediment type and geotechnical properties are thought to greatly affect the amount of resuspension that can be expected from dredging operations (this may explain the one to two order of magnitude difference observed in reported loss rates in literature).

The ERDC Lagrangian Particle Tracking Model (PTM) [3] simulates the transport of sediment and contaminant sources. Using the Surface-water Modeling System (SMS) as an interface, PTM takes input from user-defined sources and computes time-accurate particle positions based on physical processes. Suspended sediment concentrations and both cumulative and net sediment deposition are also calculated. The integrated modeling system evaluates not only the fate of sediment and contaminant losses resulting from dredging resuspension, but also losses from placement operations, dredge and tender boat movements, hopper overflow, and other sources.

Predictions that are made in PTM must be calibrated and validated in the field. ERDC has conducted numerous dredge plume characterizations using acoustic Doppler current profilers (ADCP) in tandem with laser particle size sensors (LSST), optical backscatter sensors (OBS) and total suspended solids (TSS) water samples. These data provide calibration of acoustic backscatter measurement to TSS concentrations allowing for TSS concentration comparisons of far field model results. Additionally, a sediment floc camera [4] that evaluates the aggregated state of resuspended sediments will be employed so that site- and sediment-specific settling velocities can be properly calibrated in PTM.

**Results/Discussion:** Semi-mechanistic source terms [1,2] have been incorporated into PTM. Fig. 1 shows an application of PTM where the fate and transport of dredging-induced resuspension were evaluated.

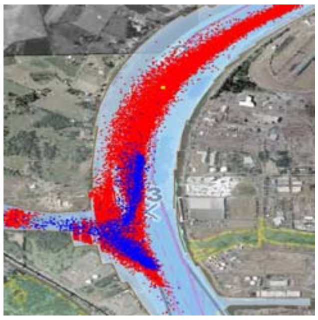

**Fig. 1:** Suspended particles (red) and deposited particles (blue) from a bucket dredging operation modeled in PTM.

Newly developed, mechanistic source terms will be similarly incorporated into PTM as they are developed so that they can be verified in the field.

**References:** [1] Hayes et al (2007) *WODCON 2007 Proc* **18**:1191-1208, [2] Hayes et al (Unpublished) *ERDC Tech Notes,* [3] Lackey et al (2007) *WODCON 2007 Proc* **18**:551-566, [4] Smith et al (Unpublished) *Proc. Marine Sci. Elsevier*.