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Title: Sediment Resuspension and Contaminant Transport in an Estuary
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EPA Project Officer: Dale Manty
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Project Amount: $99,930

Objectives/Hypothesis
The purpose of this research was to gain a better quantitative understanding of the physical, chemical, and sedimentary mechanisms and processes responsible for the fate and transport of contaminants released to the water column through natural resuspension processes in aquatic environments and, by analogy, through the excavation and disposal of dredge spoil. Specific objectives of the project were:

- tested the hypothesis that the rate at which sediments and contaminants (P) are released to the water column is a function of fluid turbulence level (J_0), the microstructural fabric of sediment particles and aggregates, and the length of time that the particles and aggregates remain in suspension;
- determined relationships between the physical nature and magnitude of resuspension events and turbidity levels, establish flux profiles for sediments and contaminants in the presence of horizontal wave-orbital and translational currents, and insofar as possible, develop transfer functions for scaling natural resuspension, transport, and deposition events to similar processes acting during dredging operations;
- investigated the direct role that mineral aggregates play in providing sites for the isolation of inorganic and synthetic organic chemicals from the prevailing chemical environment; and
- compare and contrast field observations with available relevant laboratory data and develop scaling parameters where possible.

Approach
The research consisted of an integrated program of field data collection and laboratory analysis. Data acquisition was done in Prien Lake, a shallow reach of the Calcasieu River system lying to the east of the man-made navigation cutoff channel. Prien Lake was an ideal location for at least three reasons: 1) an inlet of the lake is contiguous with the outlet of Bayou d'Inde thereby facilitating through-flow of suspended sediment, 2) the long axis of the lake is aligned in the direction of the strongest winds ensuring the development of strong current and wave induced bottom stresses during storms, and 3) earlier studies have shown lake sediments to be severely contaminated.

A preliminary bathymetric survey of Prien Lake was performed and a number of bottom sediment samples were taken to help accurately characterize the bottom. A system for studying benthic boundary layers called BLIPS (Adams, et al., 1990) was used to measure current (3 components), temperatures, and water turbidities at 5 levels above the bed at a sampling rate of 1/4 sec thus elucidating the vertical distributions of velocity and suspended sediment at boundary layer space scales and near turbulence scales. In addition a conductivity probe measures salinity continuously at one level above the bed while a pressure transducer documents surface wave activity. The sampling schedule was flexible but typically burst sampling for 17 minute intervals, every hour was accomplished. This deployment allows acquisition of 2-3 wind and surface wave driven resuspension events.

During two wind resuspension events, a water and sediment sampling program was conducted at the BLIPS site. The program entailed the collection of water samples at three depths, surface, mid-depth, and bottom and a short sediment core (.0.5m) which was sub-sampled at five levels. Water and sediment samples were taken prior to, during and subsequent to a cold front passage. During sampling activities, pH and Eh water column profiles were measured by electrode methods. Dissolved chemicals were operationally defined as those passing through a 0.25 mm Nucleopore filter, and the measured concentrations will be compared with the sediment values in order to calculate the distribution coefficient (K_d) for the compounds of interest. Water from two of the sampling experiments were analyzed for major anions and cations in order to assess trace metal stabilities by the MINTEQ program.

Results

After the first project year a preliminary conceptual model for erosion and sediment transport was established, and the analytical procedures perfected and simplified. Preliminary models coupling sediment resuspension and trace substance transport or sedimentation were generated in preparation for testing and confirmation.

Supplemental Keywords

fate and transport, dredging, and sediment dynamics

References

Adams, C.E., Jr. W. Hill, and R. Fredericks (1990). BLIPS: A system for studying benthic boundary layer dynamics. Journal of Atmospheric and Oceanic Technology, 7:774-780.

Students Supported

2 Undergrads, 2 Ph.D. candidates

For Further Information

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