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National Regional Sediment Management Program Coastal and Hydraulics Laboratory (CHL) with St. Louis (MVS) & Memphis (MVM) Districts:

Guidance Towards Optimal Collection of Chirp Geophysical Data for Regional Sediment Management Goals

Description

Traditionally, USACE determines sediment stratigraphy of a region via the collection and extrapolation of borehole data. Boreholes are expensive to collect, however, and require the frequently incorrect assumption that stratigraphy does not vary between adjacent boreholes. Geophysical data, specifically acoustic (chirp) sub-bottom profiling, allows for 3-dimensional mapping and resolution of sediment stratigraphy (i.e. the thickness and spatial extent of various sediment layers; Figure 1), at a significantly higher resolution than boreholes alone. The accurate collection, processing, and interpretation of chirp geophysical data does, however, require specialized training. To date, USACE has no guidance or accepted standards for the effective collection, processing, and interpretation of acoustic sub-bottom profile data in order to address the above challenges. As a result, success in applying this technology to USACE applications by a few Districts has been highly variable, and several projects have seen limited success.

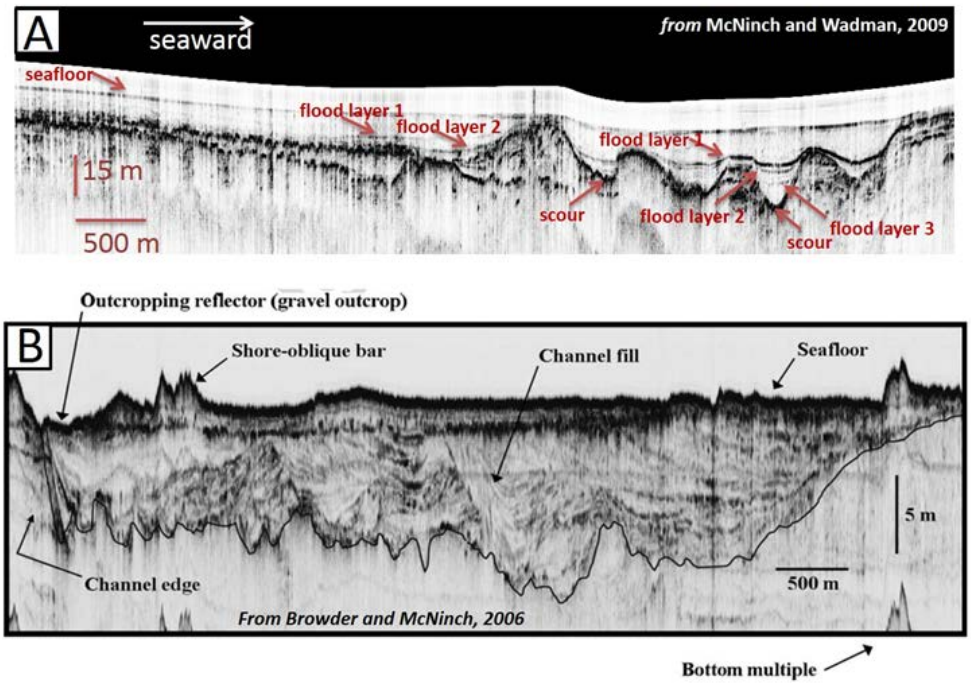

Figure 1: Examples of chirp sub-bottom profiles. (A) Sub-bottom profile showing multiple episodes of flood scour and fill underlying the flat bottom of the Waipaoa River, New Zealand. (B) Pleistocene-age paleochannel underlying the shoreface adjacent to the Kitty Hawk, NC erosional hotspot.

Issue/Challenge To Address

Spatial geophysical mapping of sediment stratigraphy via acoustic (chirp) sub-bottom profiling has been commonly used by the greater scientific community to map stratigraphy in shallow, aqueous environments. In addition, the larger geophysical community has developed very specific post-processing techniques in order to maximize the correct interpretation of the data after collection, and these techniques differ based on the nature of the stratigraphy mapped, the spacing of the survey lines, and whether or not cores or grabs are collected to groundtruth the geophysical data.

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Currently, the USACE lacks internal standards for the collection, post-processing, and interpretation of stratigraphic geophysical data. As a result, data collection risks being ad-hoc rather than targeted, as it is planned by operators with limited expertise. If the collection, post-processing, or interpretation is flawed, the benefits derived might be limited despite the significant investment made in the data collection effort.

Recently, an extensive chirp geophysical dataset was collected at Hickman, KY, in support of the Hickman Hardpoint Potamology Study. Using these data, we will develop a rigorous, flexible methodology for the collection of acoustic sub-bottom data that maximizes efficiency and minimizes cost by processing these data in multiple ways to mimic various different collection strategies. Overall, we will develop a guidance document that presents a rigorous yet flexible methodology for the collection of acoustic sub-bottom data to maximize efficiency and minimize costs.

Successes Lessons Learned

Lessons learned will be compiled during the duration of this study.

Expected Products

- A Technical Guidance Document, with Presentation, outlining various chirp collection and processing strategies, with a full cost-benefit analysis.

Stakeholders/Users

MVM and MVS will be immediate beneficiaries of this effort, but the guidance developed will be applicable to many RSM-related research and management needs.

Projected Benefits Value Added

This effort will quantify the benefits of a variety of survey planning options in terms of cost and data resolution. It will also provide much needed guidance to both the RSM and the greater USACE communities with respect to incorporating these potentially valuable data into future projects.

Leveraging Opportunities

MVM and MVS have already collected an extensive geophysical data set at a wide range of line spacings, as well as sediment grabs. This means that the proposal goals can be achieved without the collection of expensive geophysical data or boreholes.

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Participating Partners

TBD