U.S.ARMY

ESTIMATING NEARSHORE BERM DEFLATION USING LONGSHORE TRANSPORT EQUATIONS

INLET GEOMORPHOLOGY WORK UNIT

Rachel Bain
Douglas Krafft
Brian McFall

COASTAL INLETS RESEARCH PROGRAM

FY20 IN PROGRESS REVIEW

Mike Ott
HQ Navigation Business Line Manager

Eddie Wiggins
Technical Director

Katherine Brutsché
Associate Technical Director

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Can bulk longshore transport equations (*e.g.*, CERC equation) be used to predict deflation rates of nearshore placements?

- **Prior studies address *whether* placed sediment will be mobile (*e.g.*, McLellan *et al.*, 1990; Hands and Allison, 1991; Ahren and Hands, 1998; McFall *et al.*, 2016; Priestas *et al.*, 2019).**
- **Few attempts to predict the *rate* at which the nearshore placement will deflate.**
- **Goal is to predict a straightforward, computationally efficient method for applying published longshore transport equations to the question of placement longevity.**

Statements of Need:

2020-N-1564: Increasing Beach Nourishment Lifespan with Nearshore Nourishments

2020-N-1481: Improving scoping level estimates of the lifespans and deflation rates of nearshore nourishments

2019-N-1386 Strategic Nearshore Placement of Dredged Material to Sustain Coastal Beach & Dune Resilience

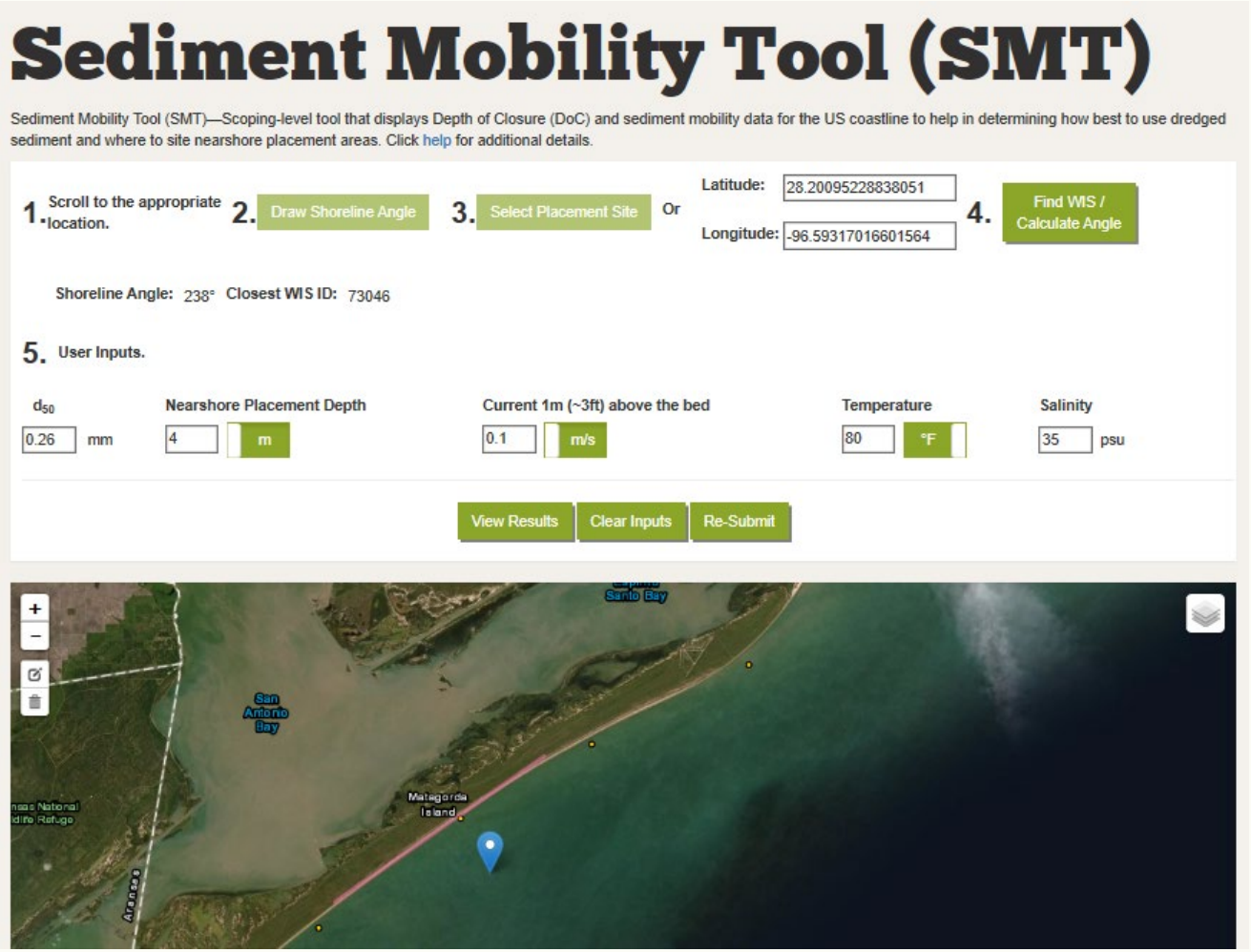
2017-N-70 Analysis of Shoreline Response to Nearshore Placement Geometry

2016-N-04 Quantifying wave and current driven sediment transport at nearshore dredge disposal sites

Capability and Strategic Impact Statement

A straightforward algorithm for estimating nearshore berm deflation rates via longshore transport will inform placement design and planning considerations at sites where a full numerical model is unavailable.

Method will be added to the Sediment Mobility Tool as an optional feature.



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Algorithm

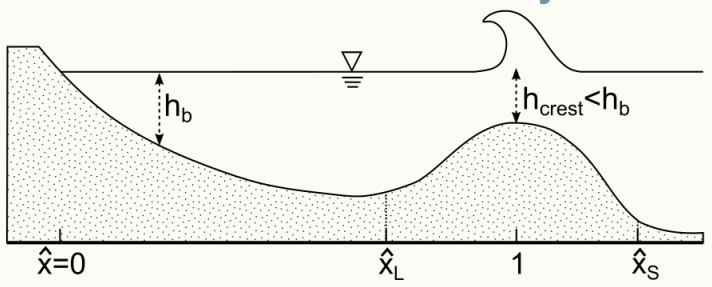
- **WIS hindcast values used to calculate a time series of total longshore transport *Q*(*t*) using various longshore transport formulations.**
  - CERC equation, Kamphuis and Readshaw (1978), Kamphuis (1991), Bayram *et al.* (2007), Mil-Homens *et al.* (2013; labeled MH-B), Van Rijn (2014), Shaeri *et al.* (2020)
- **Cross-shore distribution of longshore transport based on experimental data.**
  - Determines the fractional percentage of *Q*(*t*) directly influencing the placed sediment.

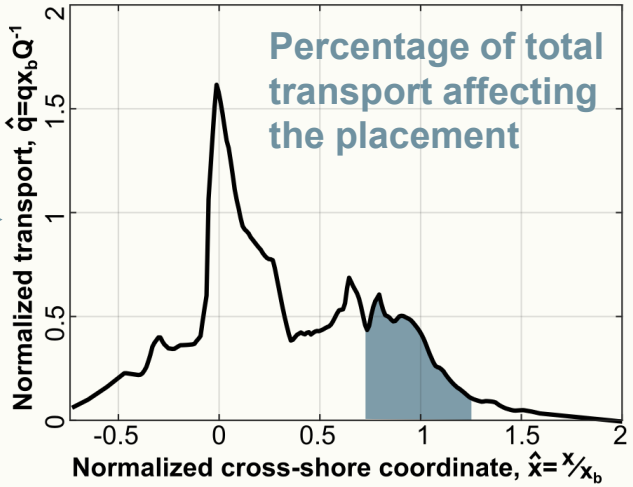
User-supplied parameters:
- Cross-shore distance to landward and seaward placement boundaries, x_L and x_S
- Water depth at crest, h_{crest}
- Shoreline orientation
- Sediment diameter
- Water and sediment density
- Optional*: transport coefficient(s), friction coefficient, beach slope

WIS hindcast:
- Time series of significant wave height, wave direction, and peak wave period at a station offshore

**Not used in all published methods.*

Time series of breaker depths, $h_b(t)$, used to normalize the cross-shore coordinate system





Time series of total longshore transport, *Q*(*t*)

Time series of nearshore berm deflation rate, $Q_b(t)$

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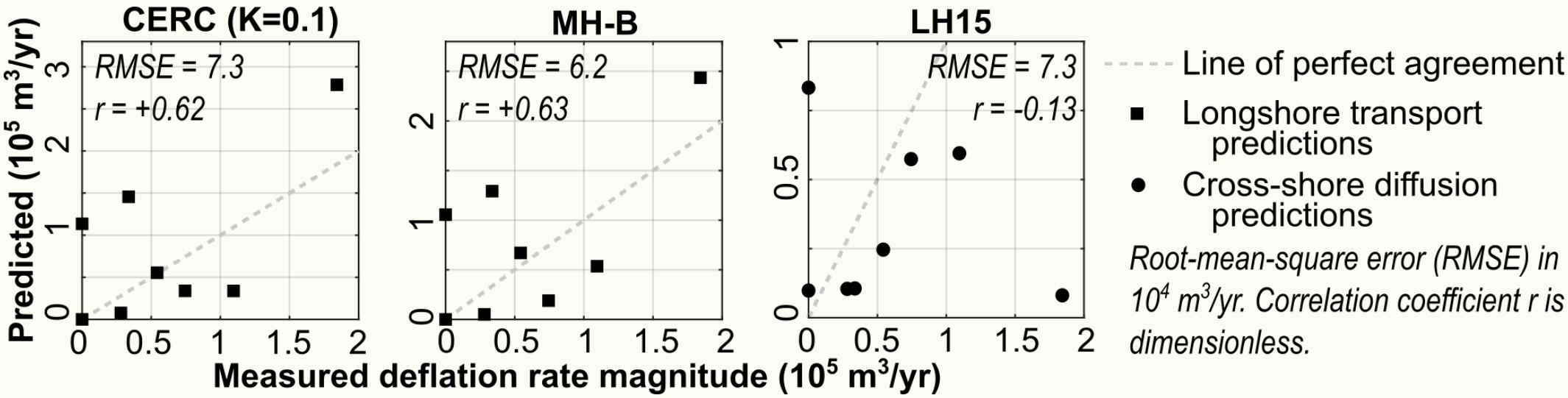
Validation

- **Tested the proposed algorithm for eight historical nearshore placements in Florida and California.**
  - Error in predicted deflation rates is large, but the method outperforms (on average) a cross-shore diffusion model from Larson and Hanson (2015; labeled LH15).



Summary

FY20 Major Advances in Capability

- Developed conceptual model of how published longshore transport equations can be applied to the particular case of nearshore sediment placement.
- Wrote MATLAB scripts for eight longshore transport formulations.

FY20 Major Products & Collaborations

- 1 technical report drafted (presently circulating among co-authors for editing)
- 1 CIRP TD

FY21 Products/Advances

- Best-performing methods will be incorporated into Sediment Mobility Tool (SMT).
- Further algorithm validation will be performed by predicting deflation rates for a new nearshore placement at Harvey Cedars, NJ.