

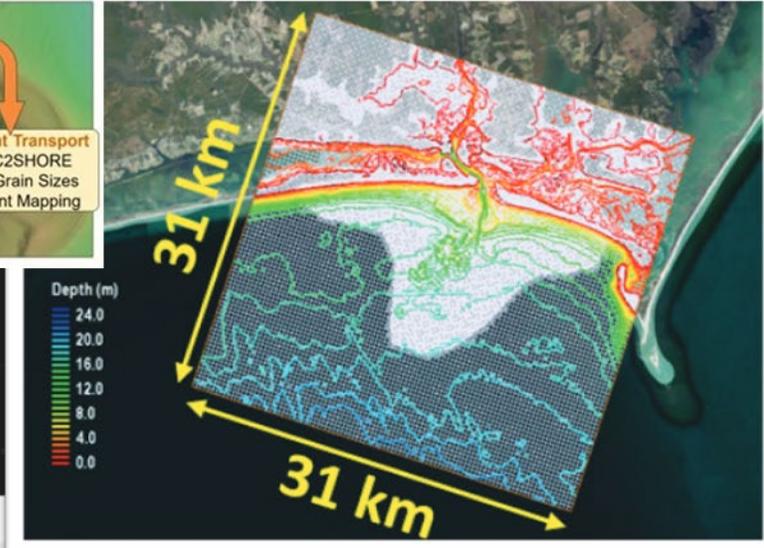
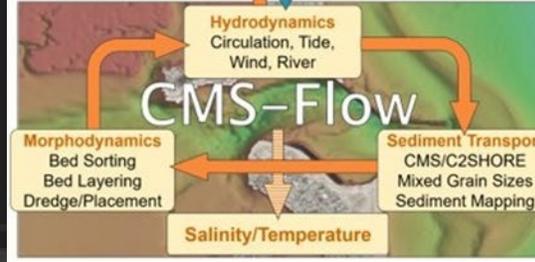
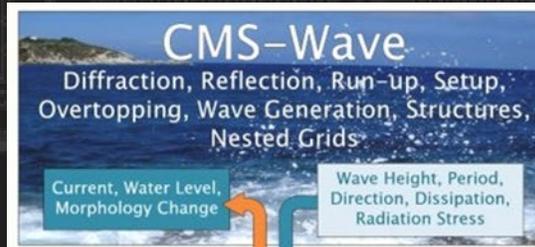
COASTAL MODELING SYSTEM (CMS)

DEVELOPMENT, V&V, TECH TRANSFER, AND USER SUPPORT

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PDT: Rod Moritz, Elizabeth Godsey, Colleen O'Connell, Gerlyn Bice, and Grace Maze

2 Oct 2024



Polygon Properties - Process ID: 39668

- Non-erodible cell
- Specified distance erodible cell
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COASTAL INLETS RESEARCH PROGRAM
FY23 IN PROGRESS REVIEW



U.S. ARMY



US Army Corps of Engineers®



ERDC



CIRP





PROBLEM STATEMENT

Users rely heavily on the calculations of waves, hydrodynamics, sediment transport, and morphodynamics to address problems related to channel shoaling, dredging, and coastal structure modifications. Systematic quality assurance and quality control processes are necessary because the CMS evolves continually, and different versions and updates often produce different solutions.

Statements of Need:

2019-N-1509: Morphodynamic Modeling of Navigation Designs

2021-N-1538: Nearshore Processes Research and Development

2022-N-1726: Nearshore Nourishment Best Management Practices

2024-N-1970: Multi-scale analyses of BUDM impacts on long-term navigation channel maintenance

2025-N-2183: Tools for comprehensive sediment transport analysis to support Dredged Material Management Plans and estuary management

2025-N-2103: Predictive Capability in Coastal Sediment Transport



CAPABILITY AND STRATEGIC IMPACT



The CMS gives users the capability to perform 2D simulations of project alternatives using advanced, integrated models complete with coastal hydrodynamic, wave, sediment transport, and morphodynamic process, including surf zone processes.

User-friendly, computationally inexpensive framework has enabled hundreds of projects by Districts, ERDC, and consultants, in all coastal areas around the United States and internationally.



TECHNICAL APPLICATIONS



Scopes of Work (SOWs)

- NAP – Desktop analysis and CMS modeling of channel shoaling and jetty scour at [Cold Spring Inlet](#)
- NAO – CMS modeling of breakwater and BUDM placement at [Tangier Island](#)
- SAW – [Oak Island](#) Sediment Transport Modeling
- NWS – [Tacoma Harbor](#), channel dredge/placement

Ongoing Work from previous Scopes

- NAP – CMS and GenCade evaluation of coastal structure performance and impacts at [Indian River Inlet, DE](#)
- NAO – [Hampton Roads](#), bird island design and evaluation
- LRC – [Crescent Beach](#) rubble ridge design and evaluation
- EWN – [Deer Island](#) modeling
- NAN – [Stoney Creek](#) and [Passaic River Tidal Basin](#)

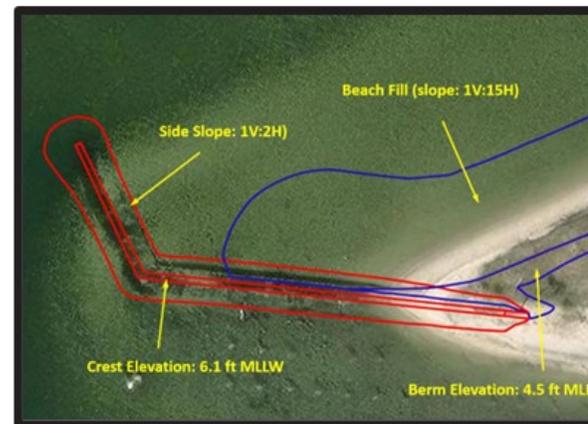
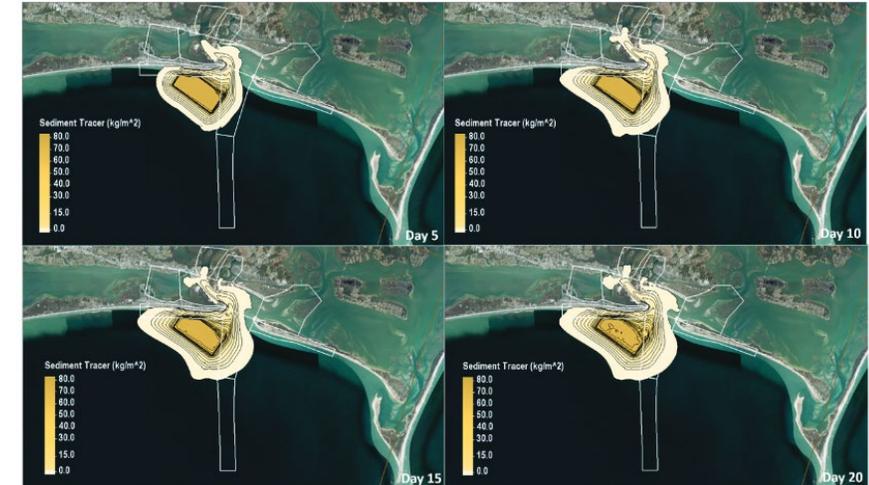
Reports

- Sediment tracer modeling at [Beaufort Inlet and Cape Fear River Inlet](#)
- Sediment transport modeling at [Milford Haven](#) (LT)
- Coastal Modeling System User's Manual

Transferability/transparency

- Webinar training (42 participants)
- Update of Wiki/Website for ongoing SMS changes to CMS interface
- CW Weekly (Sep 2024)

Figure 4-26. Temporal evolution of a sediment plume originating from the Bogue Banks site in the 5-day interval for December 2018.





BAA – Clarkson University

(Weiming Wu / 1 Student)



Awarded! Kick-off meeting planned for October. In Year 1 of 3, scoped for important technical advancements and expedite internal R&D:

~149 K
incl. burdens

1. Clean up existing implicit code in collaboration with explicit code developer (Aquaveo/Chris Reed).
 - Implicit/explicit codes not developed in tandem. Separate development lines over 15+ years with permutations with each physical process added (hydro, sediment, waves)
 - As mentioned, streamlined code will increase efficiency of in-house R&D, AND
 - Streamlined code will also facilitate open-source publication of QAQC'ed code
2. Test current implementation of morphologic acceleration factor (morph-fac) and localized diffusive wave solution to enable multi-decadal simulations.
 - Morph-fac capability currently exists, but not well tested in a range of environments (important for large tidal ranges and wave-dominated tidal inlets)
 - Locally diffusive waves can improve numeric stability in very shallow reaches where wetting/drying can require large time steps (~30 sec), reducing total run time



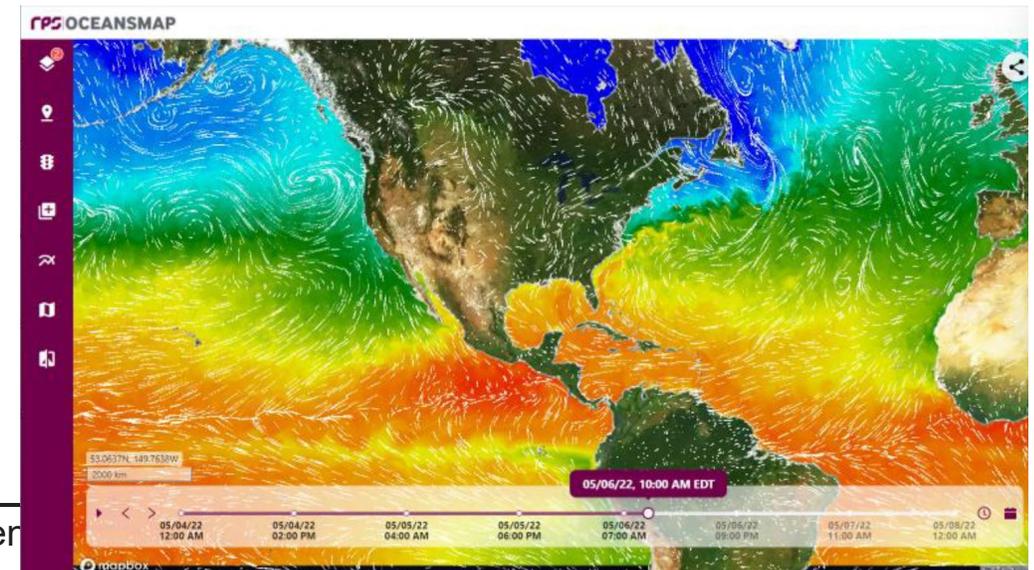
CONTRACT – RPS/TetraTech



Continued work with CODS/WIS team to update the existing WIS Data Portal to bring more tools and capabilities to end users

- Update WIS Portal underlying architecture so other additions can be made.
 - New platform allows for faster generation of plots, tables, and data requests.
 - Eventual inclusion of field data instead of only point data.
 - Will allow for roaming points (drifter buoys)
- Allow end users and tools (such as the SMS) to better interact with the WIS portal to obtain information and forcing for CIRP tools but introducing a new capability for the WIS Portal API to provide a list of stations contained within a bounding box.
- Update the existing capabilities for extracting 2d Spectral information from the WIS Portal.
 - Currently only WIS Stations have been implemented.
 - The changes will allow the CMS-Wave Tool to work with buoy data (NDBC and MEDS).

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incl. burdens





CONTRACT – Aquaveo

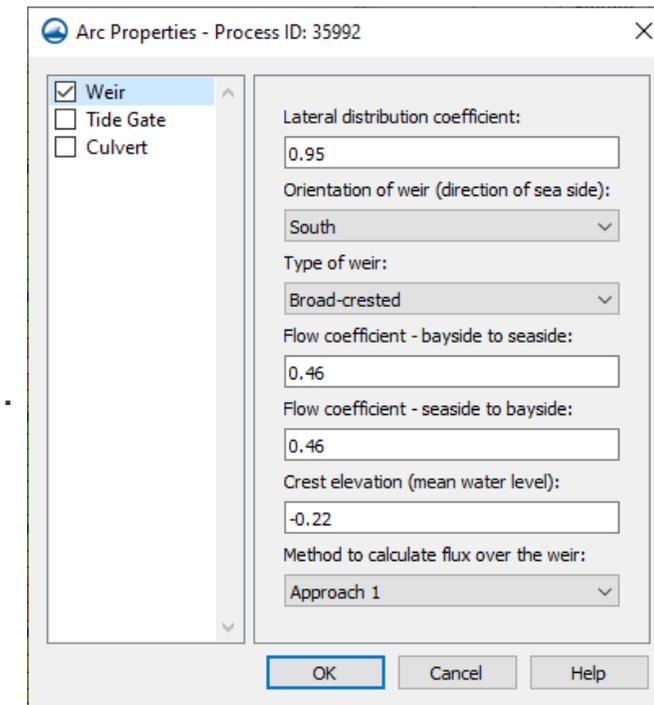


- 1) New Interfaces for the Surface-water Modeling System for CMS-Flow
 - Rubble Mound structures have been implemented for several years.
 - Three additional structure types will be available in SMS 13.4+
 - Culverts, Weirs, Tide Gates
 - Create a new interface and Hard Bottom dataset tools for CMS-Flow in SMS
 - Build out a new model interface for Aeolis

- 2) Add new CMS-Specific tools for the SMS Toolbox
 - Calculate set of statistics - contours of mean/max/min/std. dev of modeled
 - Calculate frequency/return interval for depositional and erosion hotspots
 - Calculate tidal velocity/asymmetry for a given polyline
 - Principle component analysis to determine dominant flow axis
 - Sediment Mapping tool for creating the datasets and setup for running in CMS.

- 3) Implement continuous integration (CI) with GitLab version control for new CMS builds including small- and medium-scale tests for both explicit and implicit codes.

~145 K
incl. burdens





CONTRACT – Aquaveo: Chris Reed subcontractor



- 1) Extensive review explicit code; Coordinate with Weiming Wu (BAA) and adopt same naming convention as implicit.
- 2) Careful merging and cleanup of implicit and explicit code (eliminate duplicate code between two schemes).
- 3) Review and fix all improperly mapped datasets, including mapping between flow and waves (must test every possible orientation of wave grid); possible fix to include logic related to code version

~40 K
incl. burdens



CMS-WORK UNIT OPERATIONS



- CHETN – Guidance for using Tidal Database boundary condition for CMS with SMS.
 - Submitted to EPAS system.
- ~~CHETN~~ – Implementation of Structures in the CMS: An update to Rubble Mound Structures
 - Written but that information will be moved into a Special Report covering SMS implementation of all CMS-Flow structures in FY25
- CMS Webinar Series from 29 July to 2 August 2024 – 42 total participants (25 averaged each day)
 - Participation from 12 USACE Districts, 2 USACE Divisions, 12 participants from academia and industry.
- CMS User Manual (SR) published April 2024
- Support of summer student who helped us prepare for upcoming CMS Sediment Transport V&V.
- Creation of numerous Wiki pages covering the upcoming updates in SMS 13.4.
- New release of CMS v5.3.11 for general availability.



SUMMARY



FY24 Major Advancements in Capability

- Dynamic model interface (DMI) for rubble mound structures and others
- Addition of CMS-Wave tool within the WIS Data Portal
- Code debugging and feature testing
- Sediment Transport V&V test cases prepared

FY24 Major Products & Collaborations

- Release CMS version 5.3.11 [Aug 2024], Push code to Open Source (GitHub)
- Publish CMS User's Guide [Apr 2024]
- User Training and Support to USACE Districts, Workshop Webinar
- Interactivity between CMS and WIS, NMM, and WW3 teams
- 1 journal paper, 6 conf. presentations; several Letter Reports
- 2 USACE Poster Sessions (CWG & RD24)
- 3 Contracts awarded (including one 3-year BAA)

FY25 Products & Advancements

- Implementation of Continuous Integration (CI) QAQC framework to Git version control
- DMIs for three additional structure types (i.e., weirs, tide gates, culverts), Aeolis, sediment mapping, and hard bottom features
- Adding toolboxes to SMS to rapidly calculate meaningful hydro/morpho statistics of interest
- Complete Sediment Transport V&V testing for CMS-Flow and CMS-Wave
- Review of implicit and explicit codes to streamline, standardize nomenclature, and carefully merge
- Update WIS Portal API to allow better access for users and through SMS and scripts
- Continue yearly workshops for USACE District staff and their consultants (November 2024 – Buffalo District)
- Documentation of various features and improvements and tech transfer activities (i.e., training, web dev, conferences, pubs)
- Continue to investigate and implement fixes for known code issues
- Continue tech transfer through Workshop/Webinar & DOTS requests.