Engineering With Nature Project Fact Sheet

Title

Engineering With Nature CSTORM Modeling Toolkit

Background

USACE Districts require a method for predicting the impact that Engineering With Nature (EWN) features may have on the coastal resiliency of communities, quantifying changes to predicted values of storm surge, inundation, and wave attenuation for various storm events (i.e. 1/100, or 1/1000) if these features were implemented. Presently, numerical modeling of EWN features requires manual integration into the bathymetry/mesh, entailing a high level of skill and a significant time commitment. Each time the feature is altered, mesh must be rebuilt. Consequently, a limited set of NNBF measures will be implemented numerically for a subset of storm conditions and those effects will be extrapolated to other study regions, increasing the uncertainty of the study conclusions. The purpose of this project is to include a toolkit to create and permutate EWN features within the Coastal STORM – Modeling System (CSTORM-MS) of numerical models (ADCIRC/STWAVE), allowing Districts to look at variations of design parameters for varying NNBFs without having to modify model bathymetry every time, leading to a significant time and cost savings.

Objectives

The objective of this research task is to develop a EWN CSTORM-MS toolkit that can be implemented to streamline the inclusion of NNBF designs into the USACE numerical modeling process. Accompanying the toolkit will be a Graphical User Interface (GUI) and suggested methods that will allow the user to include EWN feature based designs with the CSTORM suite of numerical models.

Approach

The approach to developing the toolkit consist of four elements: 1) Development of a GUI that allows for rapid representation of EWN features within a coastal numerical model background, 2) Proper numerical representation of the EWN features within the CSTORM mesh through automated mesh editing, 3) Automated assignment of model properties associated with EWN features upon generation such as friction coefficients and elevations, and 4) Sub-domain modeling of EWN features within the large-scale CSTORM-MS system, which will keep the computational time and resource demand low.

Outcomes

The toolkit will aid District users in two primary ways: by streamlining model setup and by reducing model computation time. The model setup will be streamlined through a GUI that will allow the user to create and vary EWN features (i.e. adjust the density of mangroves in a marsh, or dune grass during dune creation) quickly before running them with the CSTORM-MS. The GUI will allow users to access automated discretization, or re-meshing of the area where an EWN feature is to be added based on the spatial constraints of the feature and to quickly parameterize those EWN features in the CSTORM-MS. The use of sub-domain modeling will allow users to consider multiple design configurations in addition to varying EWN feature types without using as many computational resources. Research task deliverables include documentation on how to use the EWN toolkit in the form of a user manual, a technical note describing the development of the EWN toolkit, a conference presentation, and a journal article.

The toolkit will reduce computational and personnel resources associated with EWN and NNBF feature analysis, allowing users the ability to manipulate multiple aspects of NNBF design, ultimately reducing uncertainty related to coastal engineering reliability and resiliency benefit. Additionally this toolkit can be used to advance the beneficial use of dredged sediments by allowing different placement scenarios such as marsh restoration and island creation to be easily modeled, reducing uncertainty of a given design's resiliency benefit, potential adverse impacts, and coastal engineering reliability.

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