Quantifying the benefits of natural and nature-based features in Maryland's Chesapeake and Atlantic Coastal bays to inform conservation and management under future sea level rise scenarios

NOAA EESLR 2019

George Mason University
Maryland Department of Natural Resources
The Nature Conservancy

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Background

As climate change impacts the state of Maryland, communities require a better understanding of how natural features like wetlands and submerged aquatic vegetation (SAV) can contribute to community resilience. This study builds off previous research in Maryland's lower eastern shore to better understand hydrodynamics at natural marsh sites (see Project Video). George Mason University and The Nature Conservancy monitored water levels, waves and currents at a natural eroding marsh in Deal Island, MD (Figure 1). Preliminary results indicated up to 90% reduction in wave height in the first 20 meters of the marsh. Expansion of this research will support statewide modeling of the coastal protection benefits of wetlands, SAV, and other nature-based features. This work will help direct conservation, restoration, and management of the state's natural resources to enhance community resilience. A better understanding of wave attenuation thresholds under different storm conditions and sea level rise scenarios can also inform buffer management and restoration guidelines at site-level and state scales.

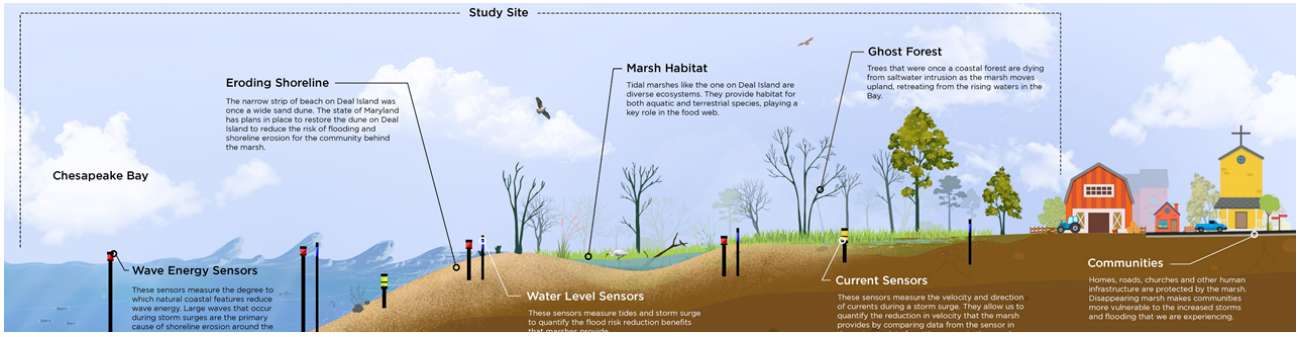

Figure 1. Infographic depicting the study design for the Deal Island wave attenuation study.

NOAA EESLR Project Objectives

1. **MONITOR:** Enhance understanding of the wave attenuation and flood protection capacity and performance of marshes, SAV and other natural and nature-based features (NNBF) under extreme and chronic events.
2. **MODEL:** Increase understanding of statewide flood protection capacity of NNBF under current conditions and future SLR scenarios.
3. **VALUE:** Quantify NNBF ecosystem services for current and future SLR scenarios and integrate into Maryland's natural resource management.
4. **MANAGEMENT:** Work with regional, state and local stakeholders to develop conservation and management recommendations to preserve or elevate the protective benefits of NNBF and enhance resiliency of Maryland's vulnerable communities.

Field Data Collection

Site Selection

The project team is collecting data from 3-9 field sites over the course of this three-year study. Sites are being selected across four regional landscapes: Maryland's Western Shore, upper Eastern Shore, lower Eastern Shore, and Coastal Bays. In addition, sites are selected based on:

- Accessibility to the project team
- Limited accessibility to the public
- Sufficient wave energy
- Presence of marsh
- Presence of SAV
- Presence of a living shoreline
- Adjacency to a vulnerable community
- Existence of on-going monitoring
- Relevance to the project team's conservation efforts

Evaluated sites are documented in the EESLR Site Identification Story Map.

In year 1, the project team selected three study sites that represent three of Maryland's regional landscapes and habitat types (Table 1).

Table 1. Year 1 study sites.

Site Name	**Regional Location**	**Description**
Assateague Island	Coastal Bays	Marsh and SAV present
Franklin Point State Park	Western Shore	Phragmites representation
Blackwater NWR/Karen Noonan Center	Lower Eastern Shore	Marsh and SAV present

In future study years, the project team will seek sites that represent additional natural marsh and SAV habitat, in addition to a 1) freshwater site to understand the wave attenuation benefits provided by vegetation in less saline environments, and 2) living shoreline site to understand the wave attenuation benefits provided by nature-based features.

Data Collection

At each site, the team is collecting hydrodynamic, vegetation, and topo-bathymetric data, which will be integrated into the hydrodynamic model. Specifically, the team is gathering:

A. Time-series hydrodynamic data (water level, current velocity, wave properties) throughout various seasonal and tidal cycles
B. Marsh vegetation characteristics (species, vegetation height, diameter, stem spacing) four-times per year
C. SAV characteristics (species, percent cover, canopy height, epiphyte presence, water depth) twice per year
D. Topo-bathymetric surveys

Model Development and Outputs

The project team is implementing a numerical hydrodynamic modeling framework to extrapolate site-level data across Maryland and evaluate the buffering capacity of unmonitored natural and nature based feature (NNBF) sites to future storms and conditions (Figure 2).

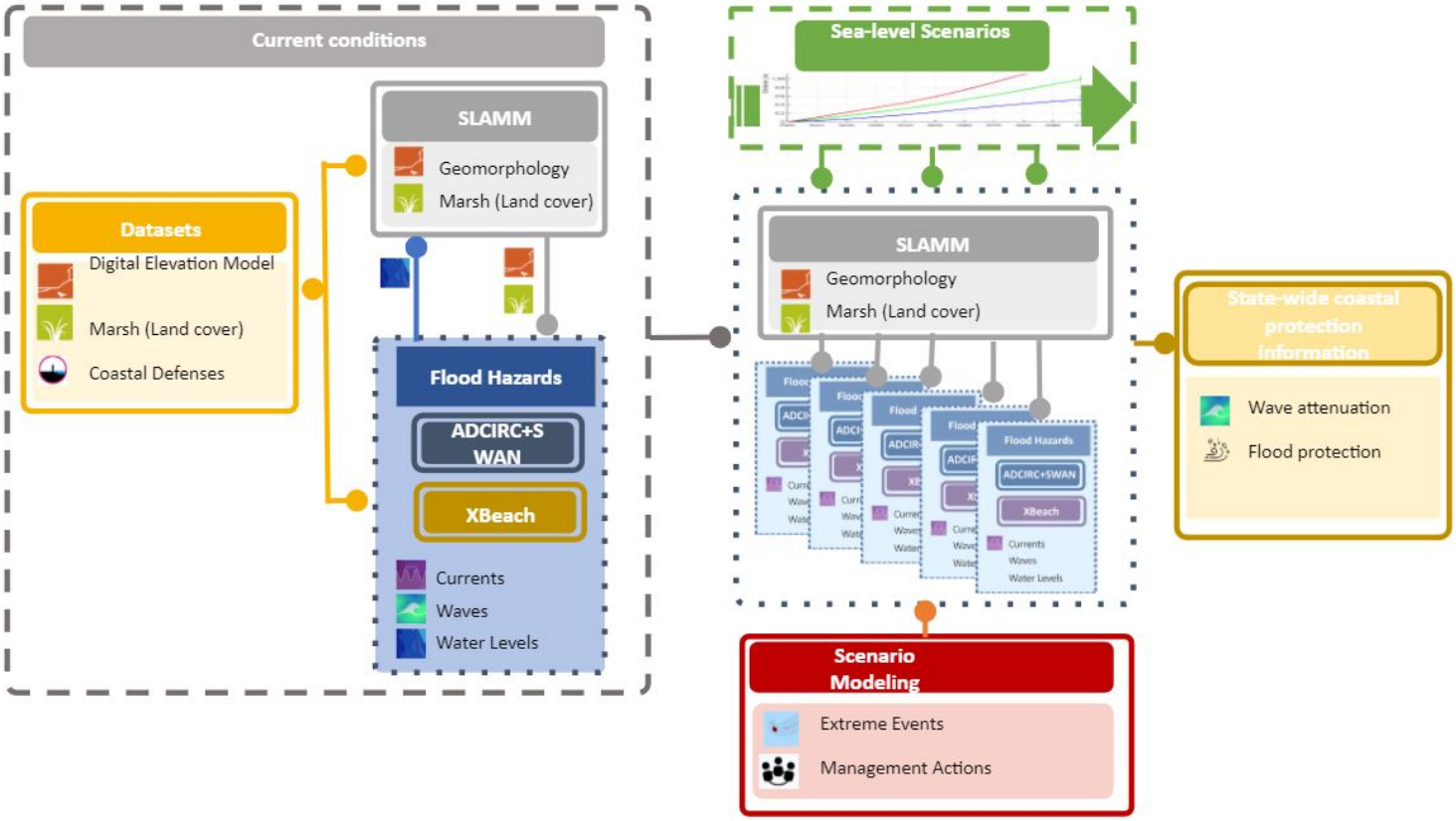

Figure 2. Depiction of the modeling framework being used to estimate the wave attenuation capacity of natural and nature-based features across Maryland.

Additionally, the project team is working with Warren Pinnacle Consulting Inc. to rerun SLAMM (Sea Level Affecting Marshes Model). SLAMM models the future location and extent of marshes and submerged aquatic vegetation (SAV) due to sea level rise (SLR). SLR projections were chosen in consultation with the Management Transition Advisory Group (MTAG) (Figure 3). SLAMM model results are being integrated into the hydrodynamic model to demonstrate the predicted site-level and statewide buffering capacity of NNBF under current and future SLR conditions.

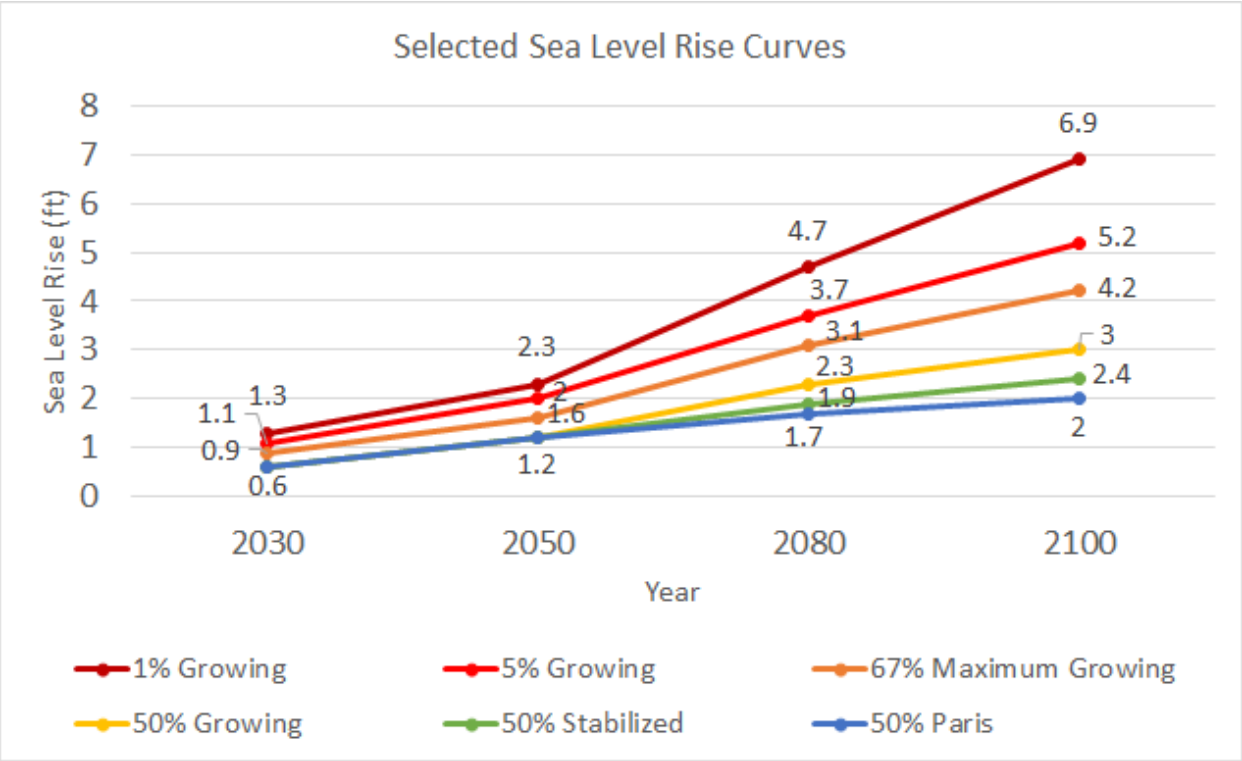

Figure 3. Sea level rise curves recommended by the Sea Level Rise Workgroup and MTAG that will be used in the SLAMM re-run[1].

The project team is also implementing site-level scenario modeling to demonstrate the wave attenuation benefits of varying nature-based adaptation solutions. The MTAG is selecting 1-3 sites and nature-based adaptation strategies to model the wave attenuation benefits provided by the shorelines with and without the NNBF.

Model results will be used to update conservation and restoration targeting tools, highlighting areas across Maryland where resource management may become necessary given SLR.

[1] Boesch, D.F., W.C. Boicourt, R.I. Cullather, T. Ezer, G.E. Galloway, Jr., Z.P. Johnson, K.H. Kilbourne, M.L. Kirwan, R.E. Kopp, S. Land, M. Li, W. Nardin, C.K. Sommerfield, W.V. Sweet. 2018. Sea-level Rise: Projections for Maryland 2018, 27 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

Ecosystem Service Evaluation

Over the long-term, project results will inform documentation and modeling of the ecosystem services of natural and nature-based features (NNBF). Towards this end goal, the project team will explore methodologies for evaluating the coastal flood protection services provided by NNBF. For example, site level hydrodynamics and NNBF conditions may be translated into how NNBF reduce the risk of coastal flooding. This work will support quantification of the full suite of ecosystem services that NNBF provide. We will consider the scenarios of wetland migration and land-use change being generated through the SLAMM model and how those changes impact estimates of ecosystem services such as carbon sequestration, nitrogen processing, air quality benefits and wildlife habitat.

MTAG and Working Groups

A Management Transition Advisory Group (MTAG) of federal, state and local partners and end users is advising the project team to ensure products are relevant and can be applied to natural resource management at regional, state and community scales. The MTAG has initiated the following Workgroups to provide in-depth review, feedback and expertise at different stages of the project:

- **Sea Level Rise Workgroup:** Advise on appropriate sea level rise scenarios.
- **Marsh Model Workgroup:** Review Sea Level Affecting Marshes Model (SLAMM) inputs/outputs.
- **SAV Model Workgroup:** Inform SAV module of SLAMM, review inputs/outputs.
- **Living Shoreline Workgroup:** Identify living shoreline priorities for monitoring.
- **Risk Reduction Workgroup:** Support translation of model results into a statewide data layer depicting ecosystem services, or risk reduction value.
- **Management Actions Workgroup:** Recommend nature-based management actions for scenario modeling.
- **Communications/Scenario Modeling Workgroup:** Support outreach and scenario modeling for 2-3 Focus Areas.

Throughout hydrodynamic model development, MTAG decisions will inform the data being integrated into the model (Figure 4).

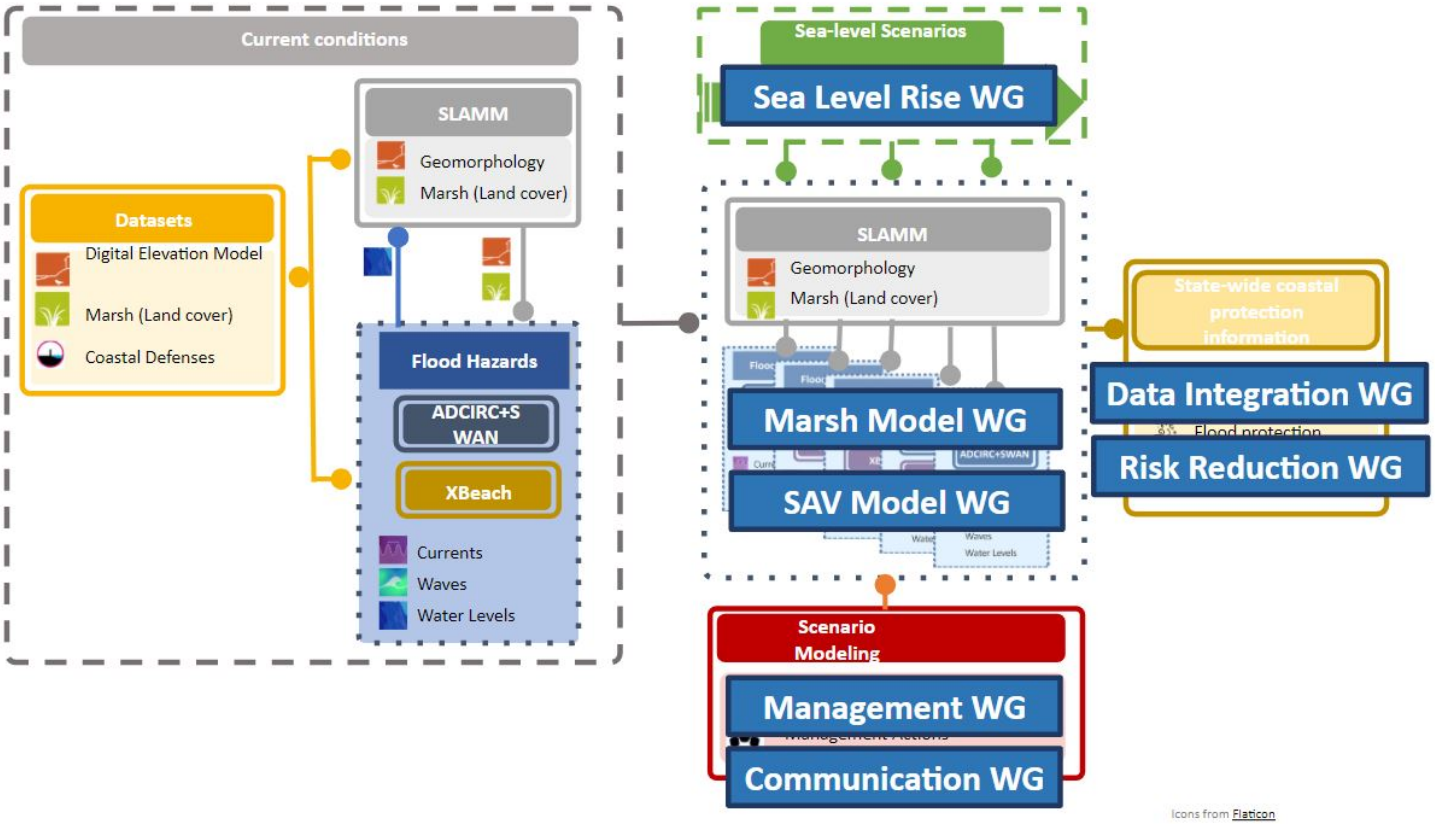

Figure 4. Depiction of where in the hydrodynamic model development MTAG decisions will inform data integrated into the model.

Project Deliverables

1. Site-level vegetation, hydrologic and topo-bathymetric data for marshes, SAV and living shorelines.
2. Spatial datasets representing current and future extent and buffering capacity of coastal habitats.
3. Updated statewide conservation and restoration targeting tools with management recommendations.
4. Community outreach and scenario modeling for up to 3 Focus Areas to understand community needs and compare various management actions at the site scale.

To Learn More

Visit our project webpage (nature.org/MDEESLRstudy), available through The Nature Conservancy's Conservation Gateway, or contact:

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