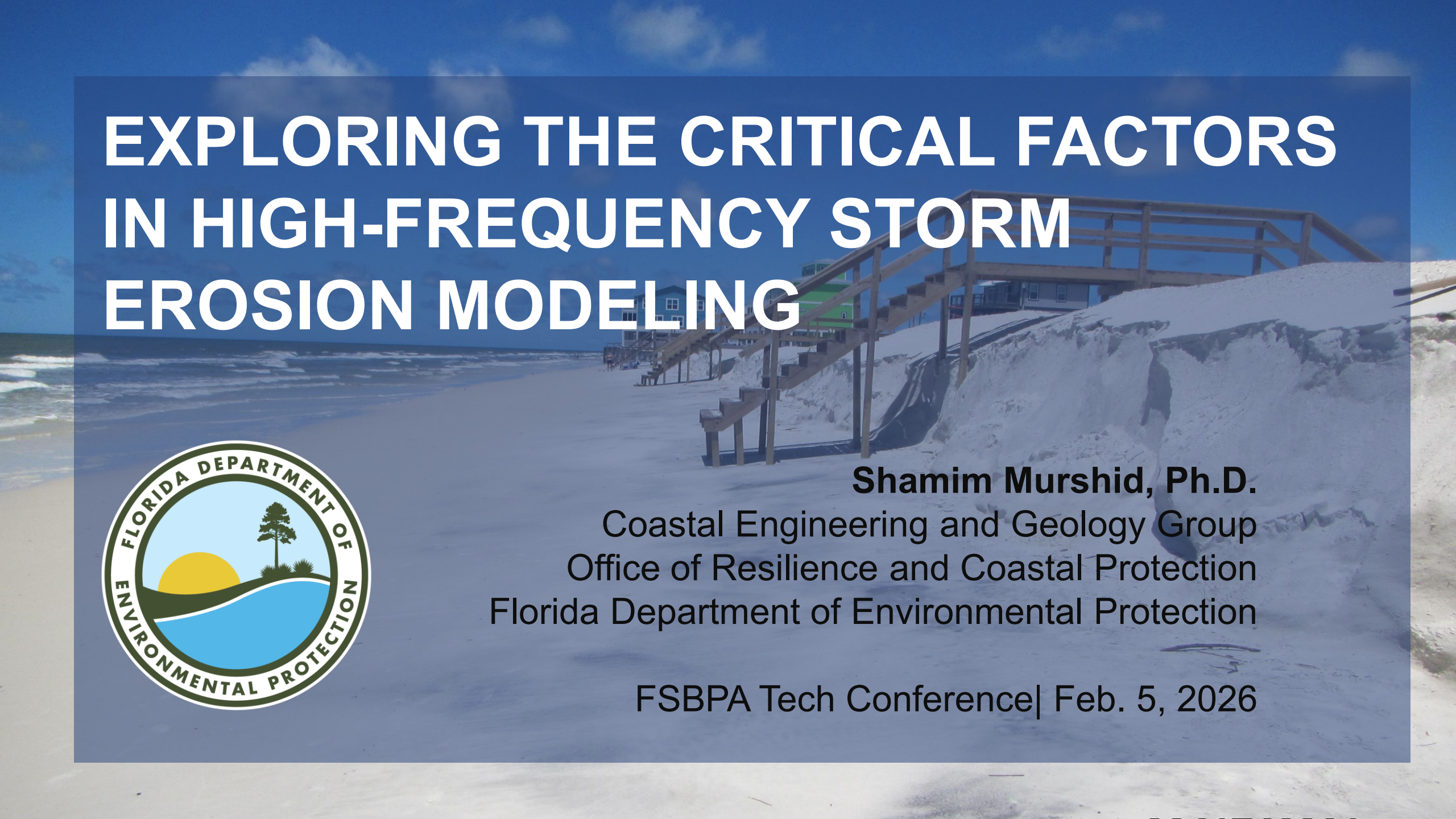
# EXPLORING THE CRITICAL FACTORS IN HIGH-FREQUENCY STORM EROSION MODELING



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# HIGH-FREQUENCY STORM EROSION MODELING

## Background

- Florida Department of Environmental Protection (DEP, also referred as Department) conducts high-frequency storm erosion modeling mostly for
  - Vulnerability assessment of eligible structures seaward of the Coastal Construction Control Line (CCCL) [*Rule 62B-33.0051, F.A.C.*].
  - Critically eroded designation of a shoreline segment.[*section 161.101, 161.161, and rule 62B-36.002(5), F.A.C.].*
- High-frequency storm: 15-year and 25-year return periods.
- Coastal Engineering and Geology (CEG) staff mostly uses **SBEACH** for high-frequency storm erosion modeling.

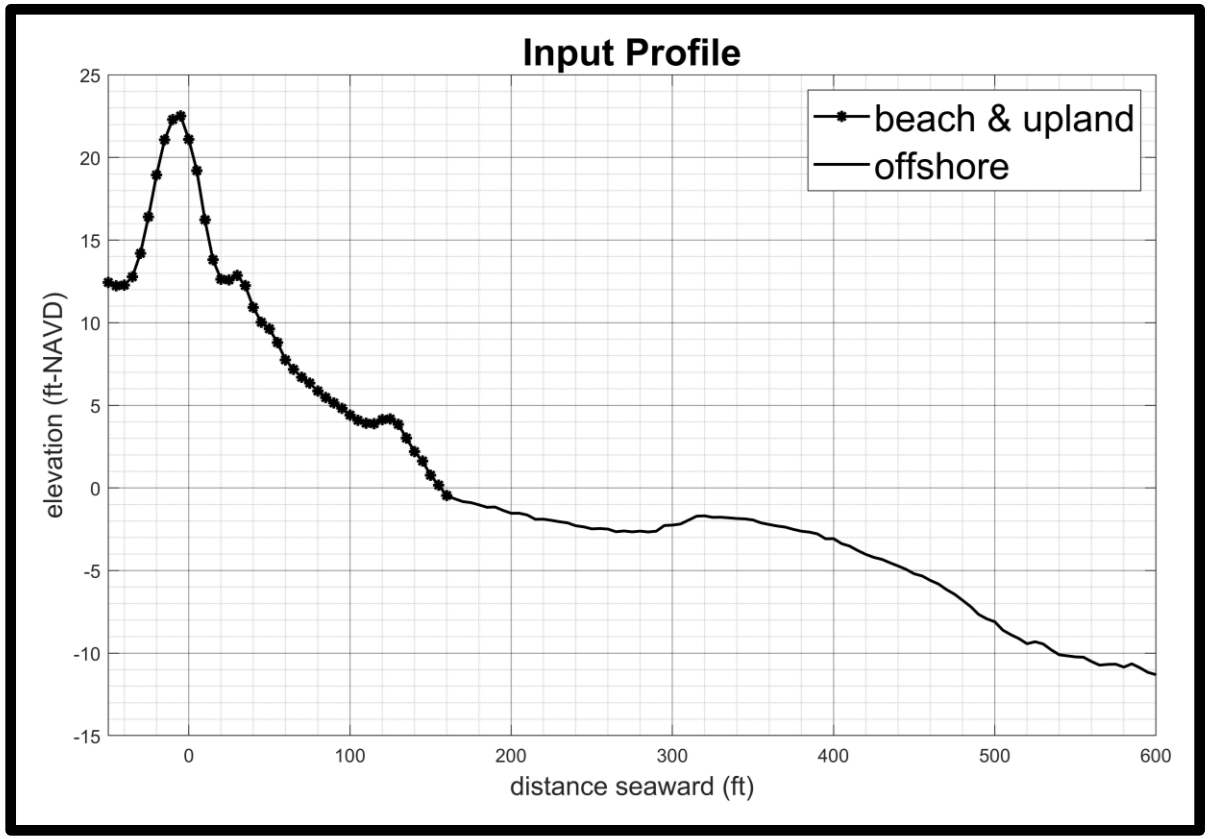
# HIGH-FREQUENCY STORM EROSION MODELING

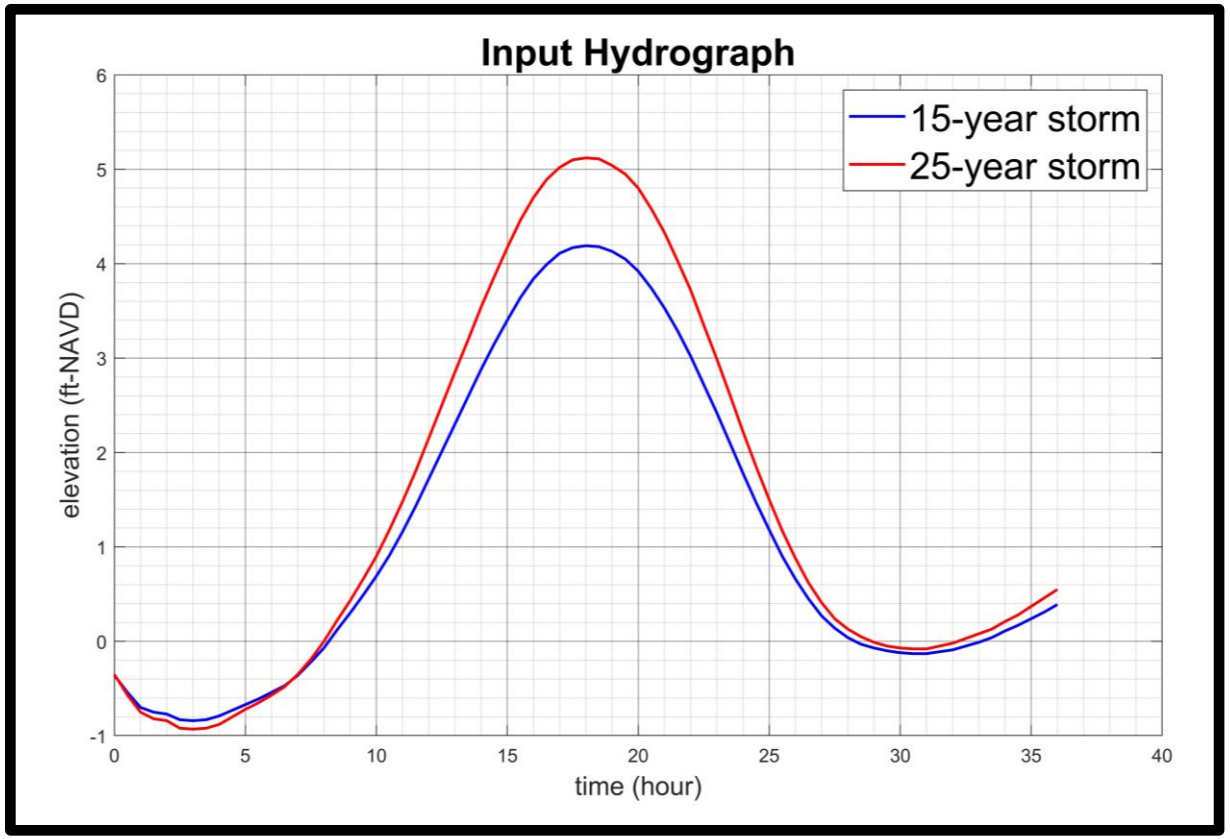
## SBEACH: **S**torm Induced **Bea**ch **Ch**ange Model

- SBEACH, developed by the USACE, is an empirically based cross-shore sediment transport model.
- It estimates beach profile changes with the emphasis on beach and dune erosion and bar formation and movement.
- Input profile with elevations that extends landward enough to ensure calculation of storm erosion limit, and far enough offshore as practical to obtain.
- Landward extent of storm erosion is determined from the eroded beach profile.
- SBEACH is calibrated for most of the coastal counties in Florida.

# HIGH-FREQUENCY STORM EROSION MODELING

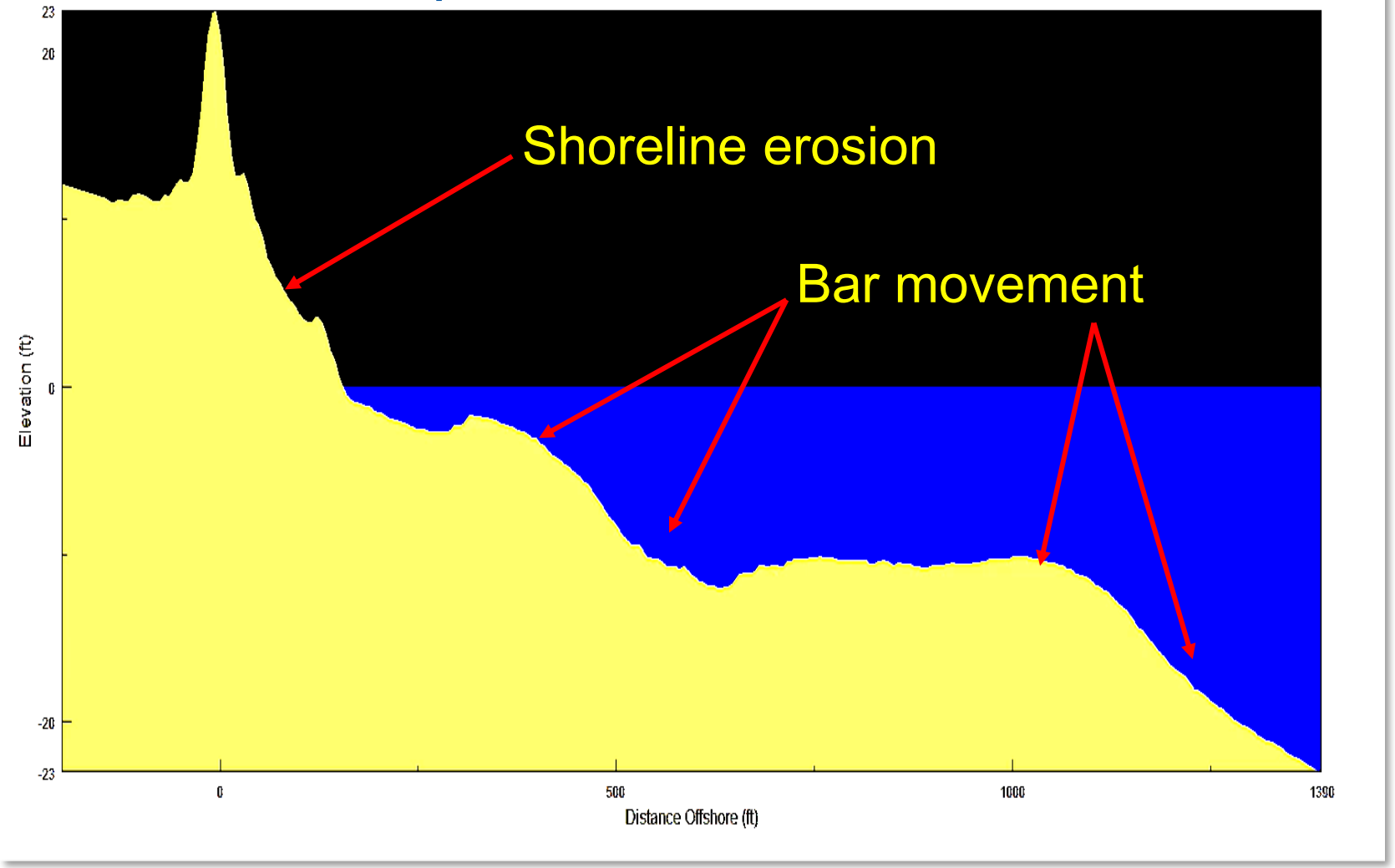
## SBEACH: Model Input



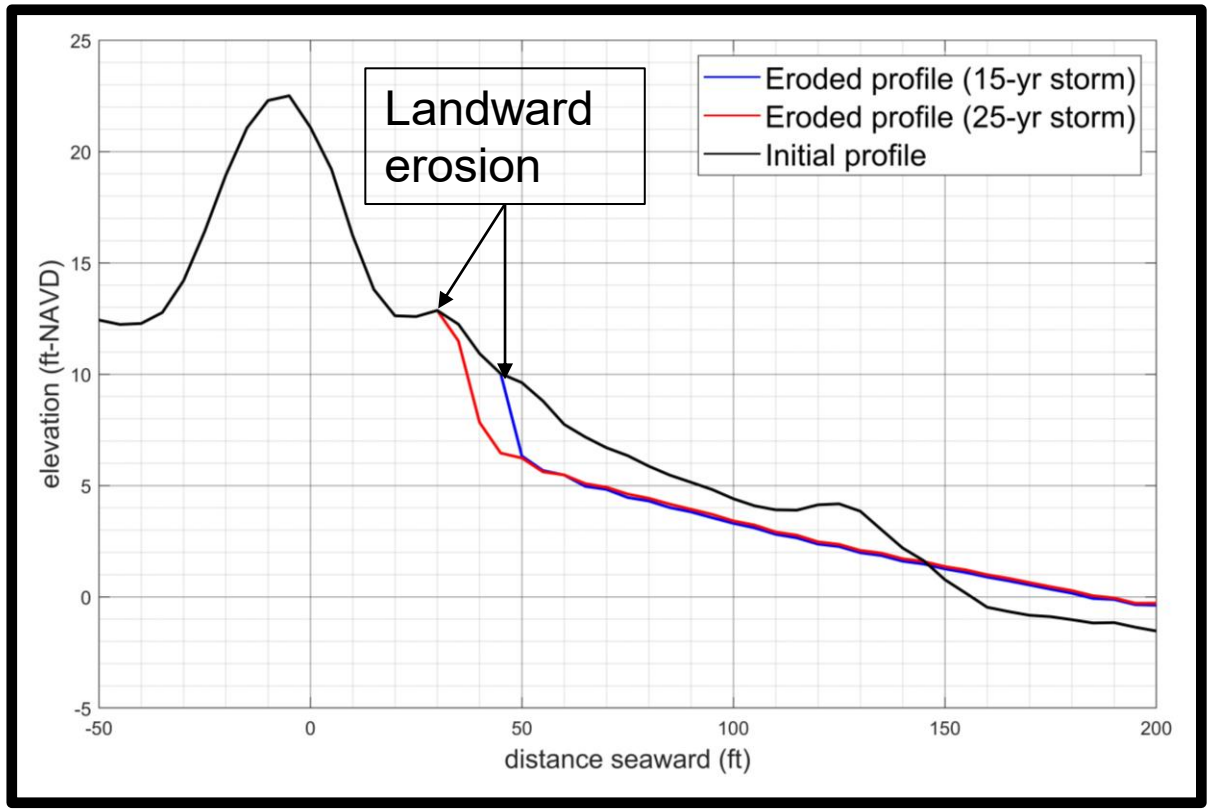
# HIGH-FREQUENCY STORM EROSION MODELING

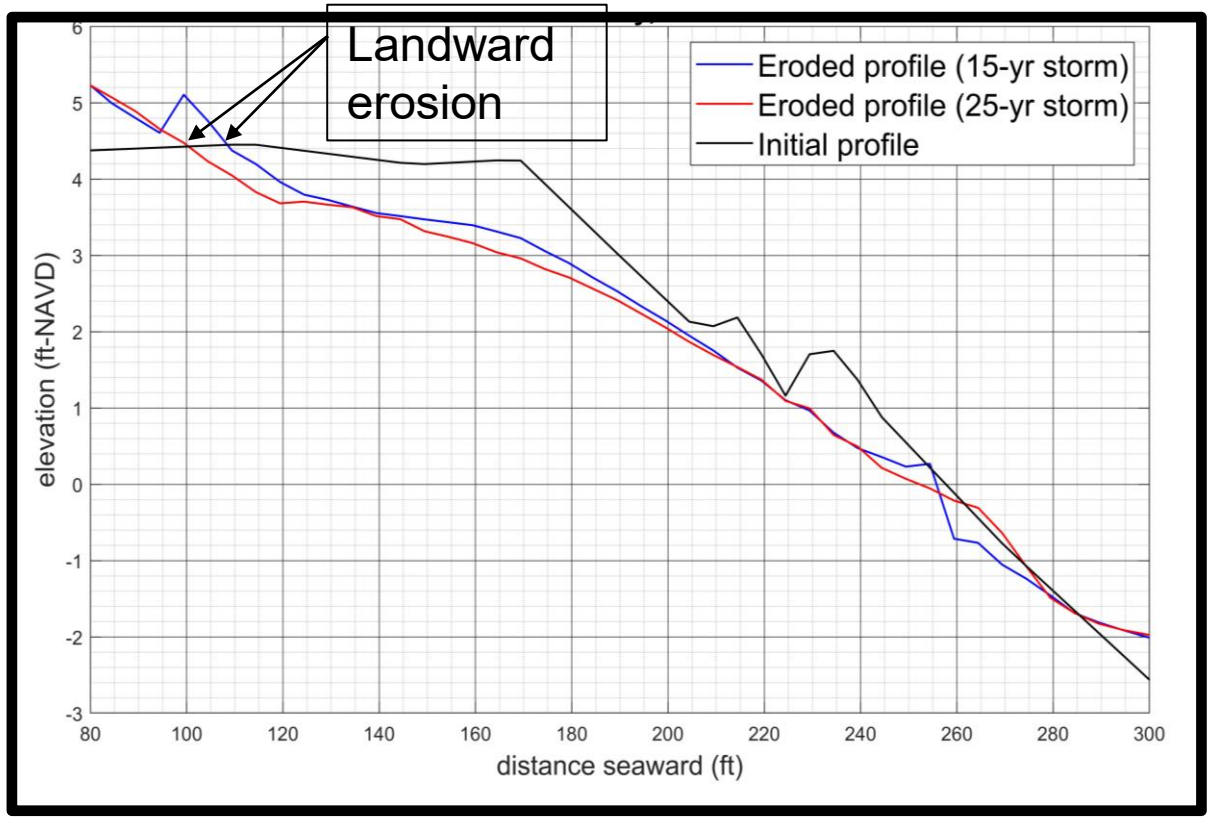
## SBEACH Simulation Example



# HIGH-FREQUENCY STORM EROSION MODELING

## SBEACH: Model Output



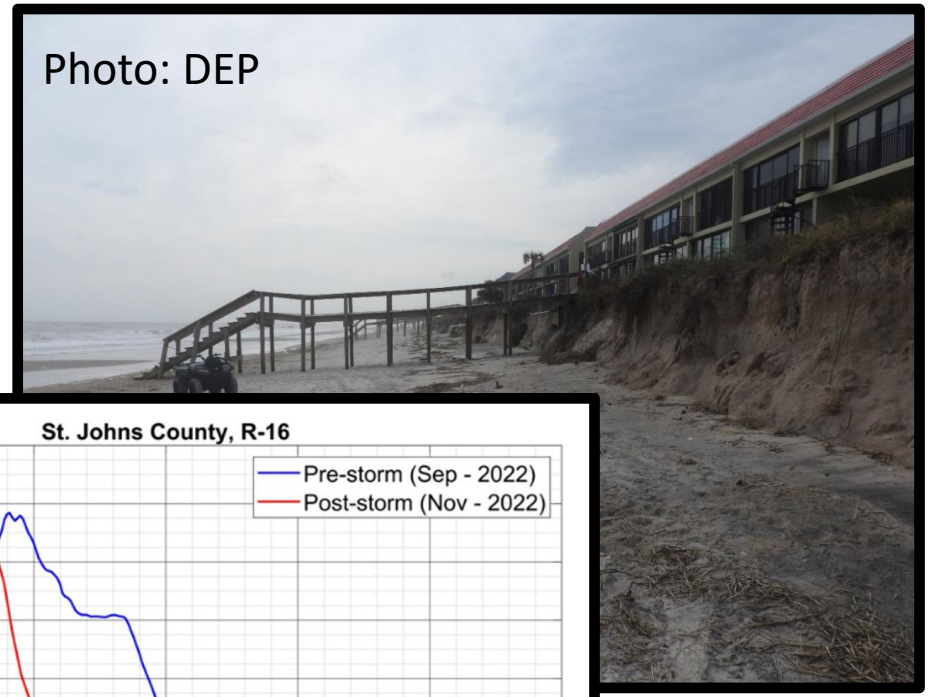
# CRITICAL FACTORS

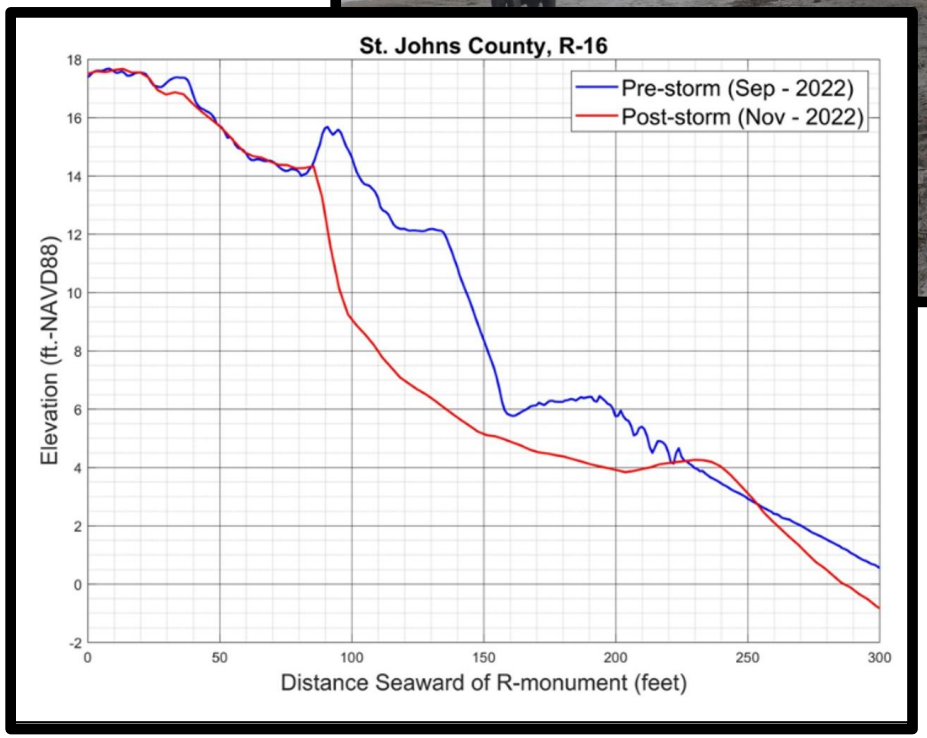
## Hydrologic and Morphologic Factors

- Wave characteristics.
- Peak storm surge & storm duration.
- Dune height.
- Beach and shoreface slope.
- Dry beach width.
- Presence of coastal armoring.
- Geological factors: nearshore hardbottom.

# BEACH & SHOREFACE CONDITION

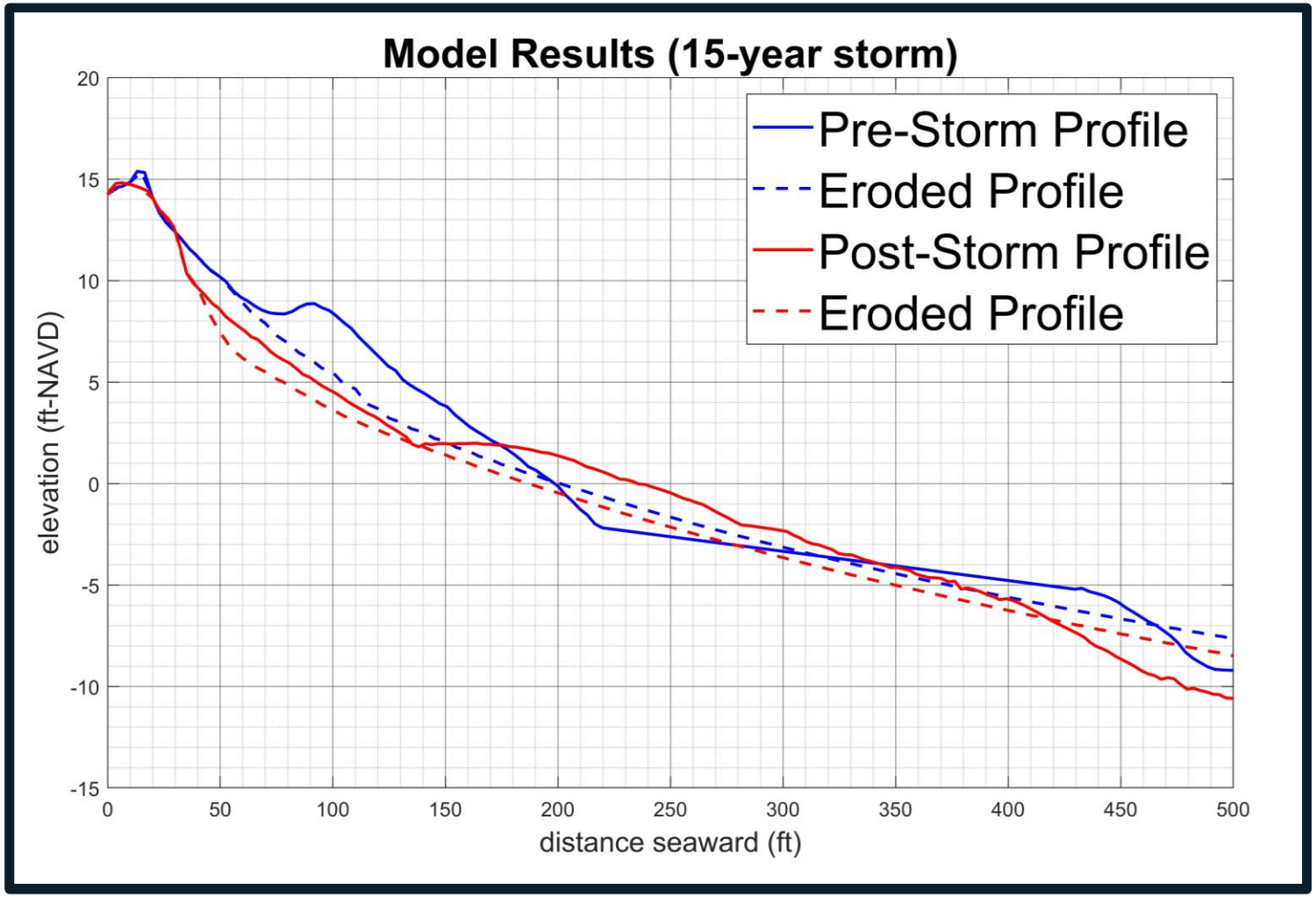
- Beach and shoreface morphology varies geographically.
- In a specific location, temporal variation persists due to
  - Storm erosion.
  - Beach nourishment.
  - Erosion control structures.
  - Inlet effects.



# BEACH & SHOREFACE CONDITION

- Site-specific evaluation of storm erosion.
- Timing of application is important.



# COASTAL ARMORING - SEAWALL

- Inclusion of seawall presence in the modeling.
- Constrains beach profile evolution landward of seawall.
- Scouring at the toe of seawall.
- Seawall failure at certain hydrological condition can also be modelled.

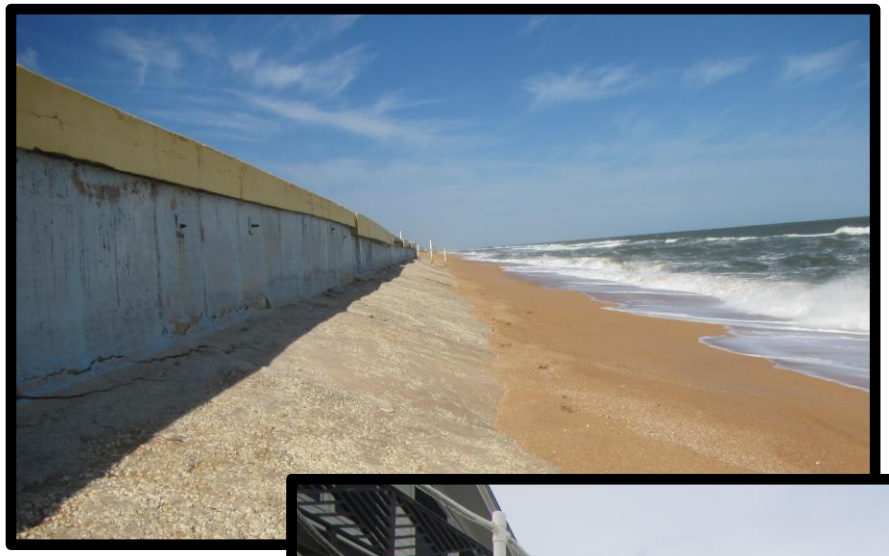
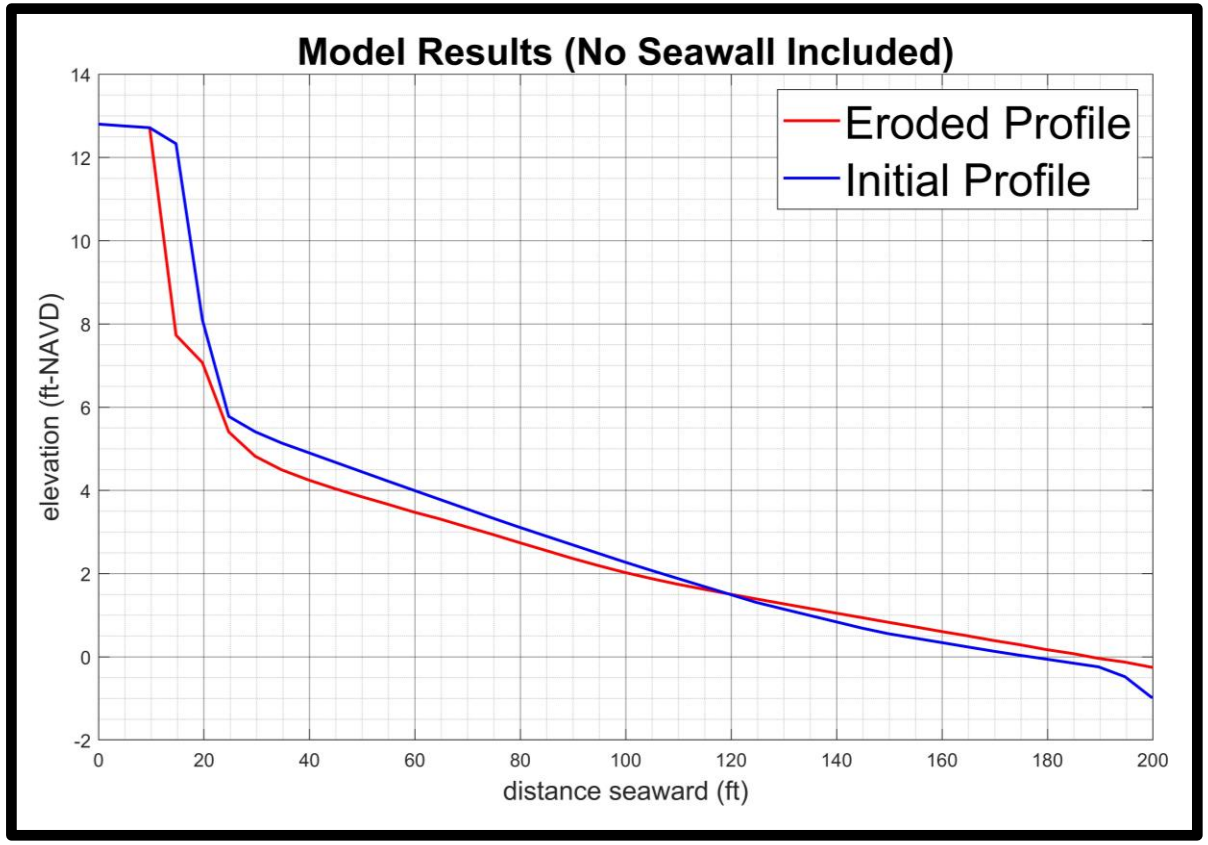
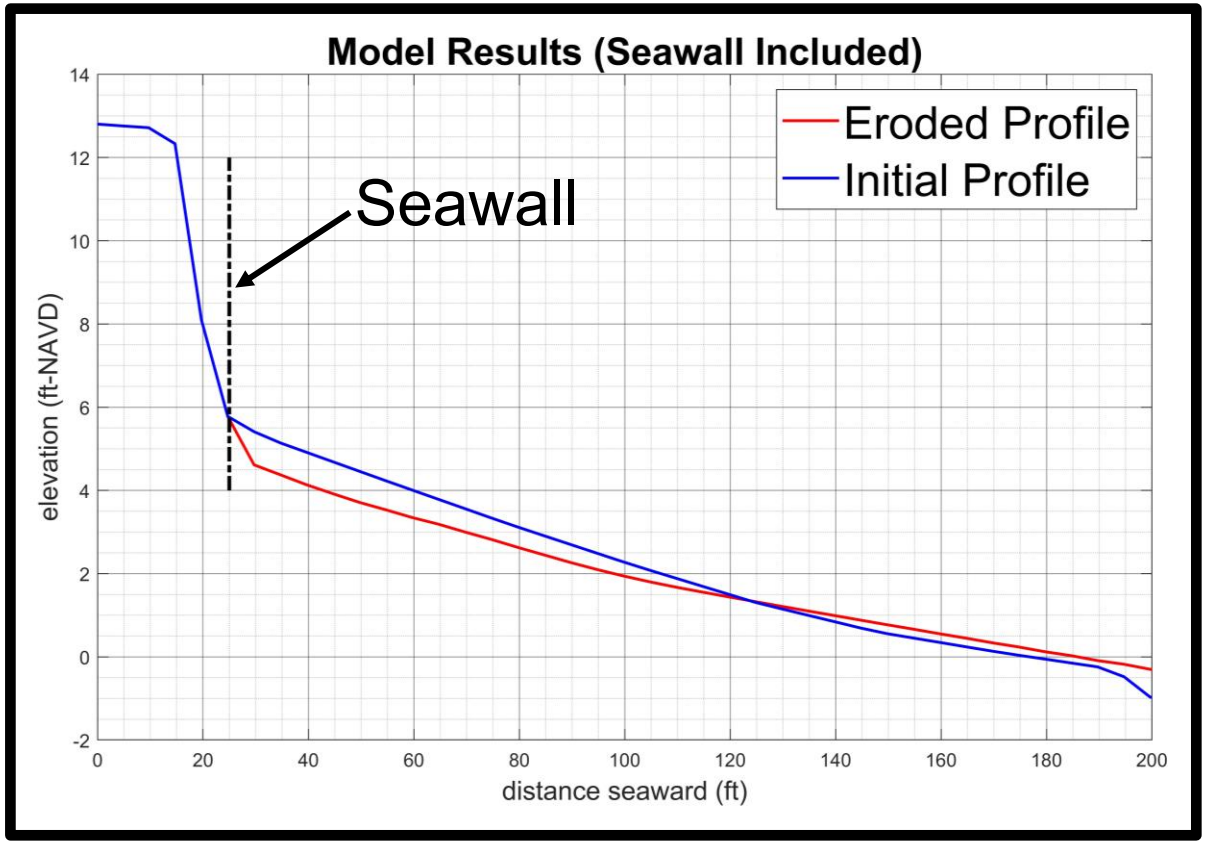


Photo: DEP

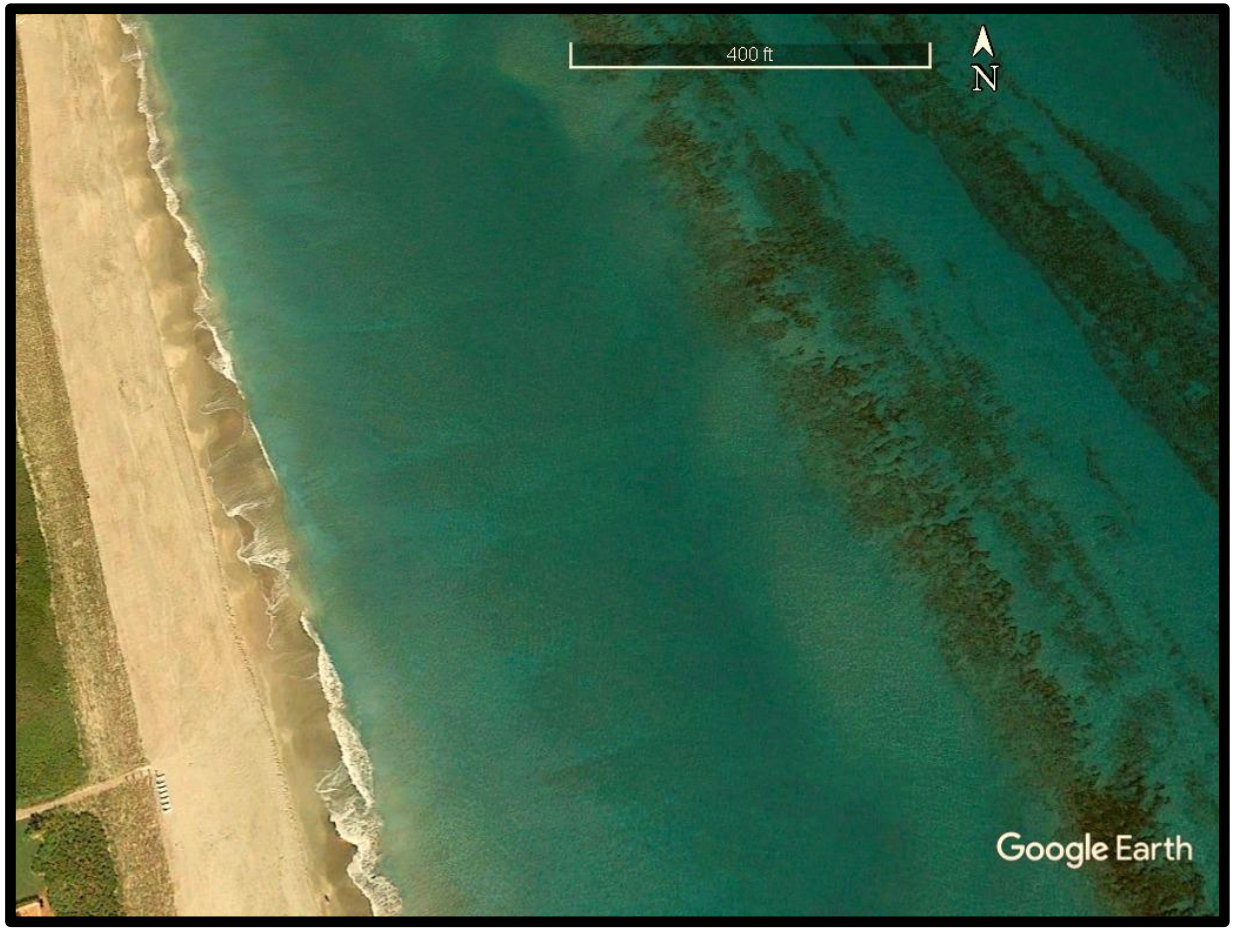
# COASTAL ARMORING - SEAWALL

## Including Seawall in Modeling



# NEARSHORE HARDBOTTOM



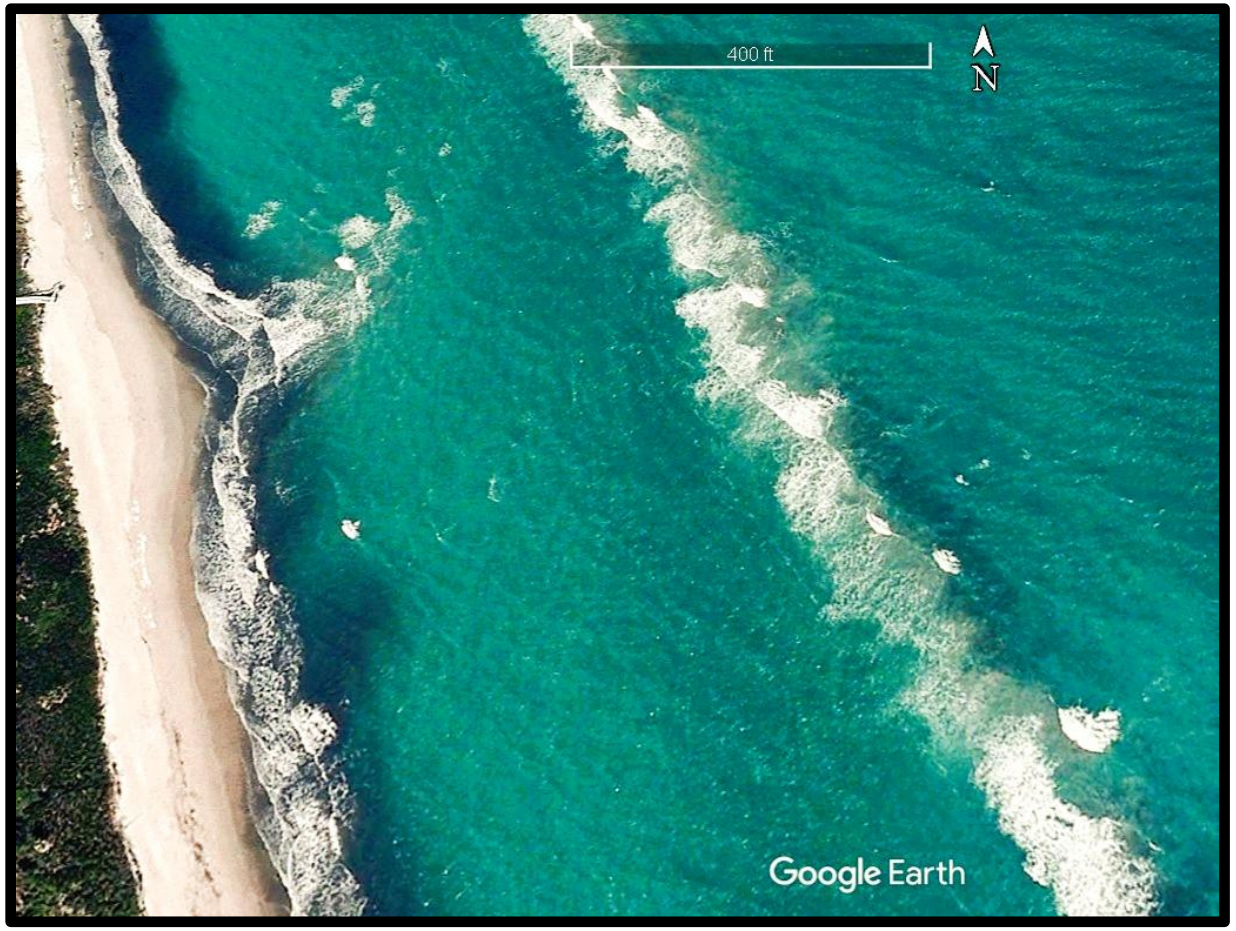




Image: Google Earth

# NEARSHORE HARDBOTTOM

## Hardbottom exposed on the beach

Photo: DEP

# NEARSHORE HARDBOTTOM

## Including hardbottom in the modeling

- Non-erodible bottom feature.
- Sand accumulates on the hardbottom, but erosion is restricted upon exposure.
- Adjustment of transport rate calculation is incorporated in the algorithm.
- Scour attenuation coefficient.

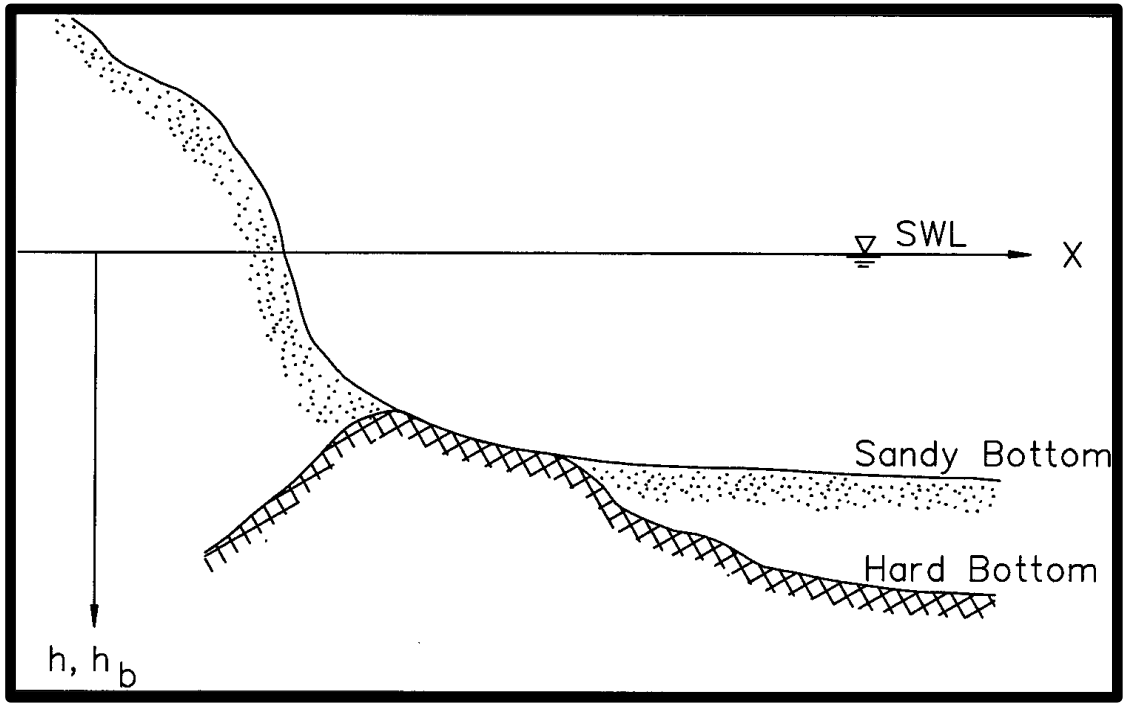
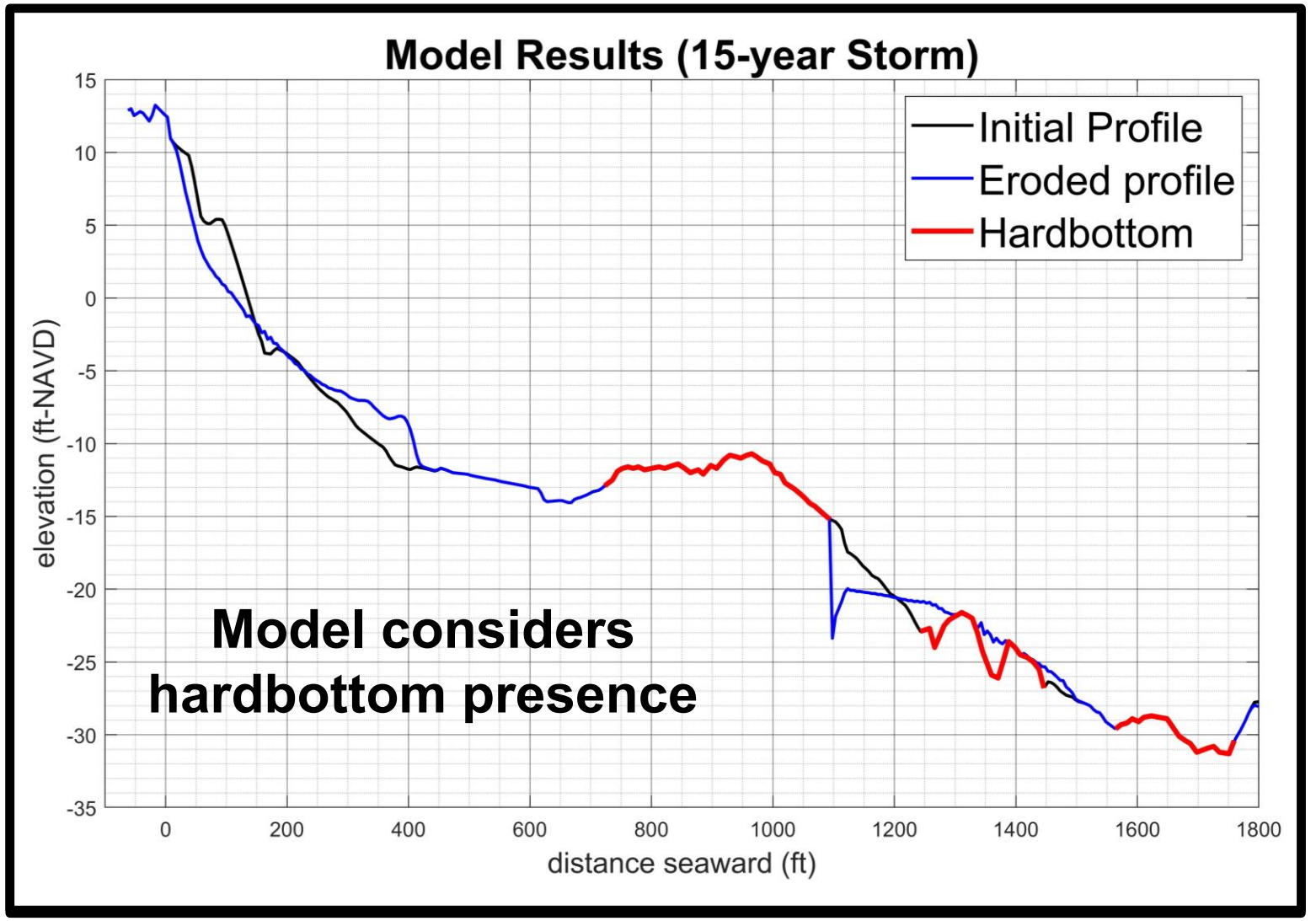
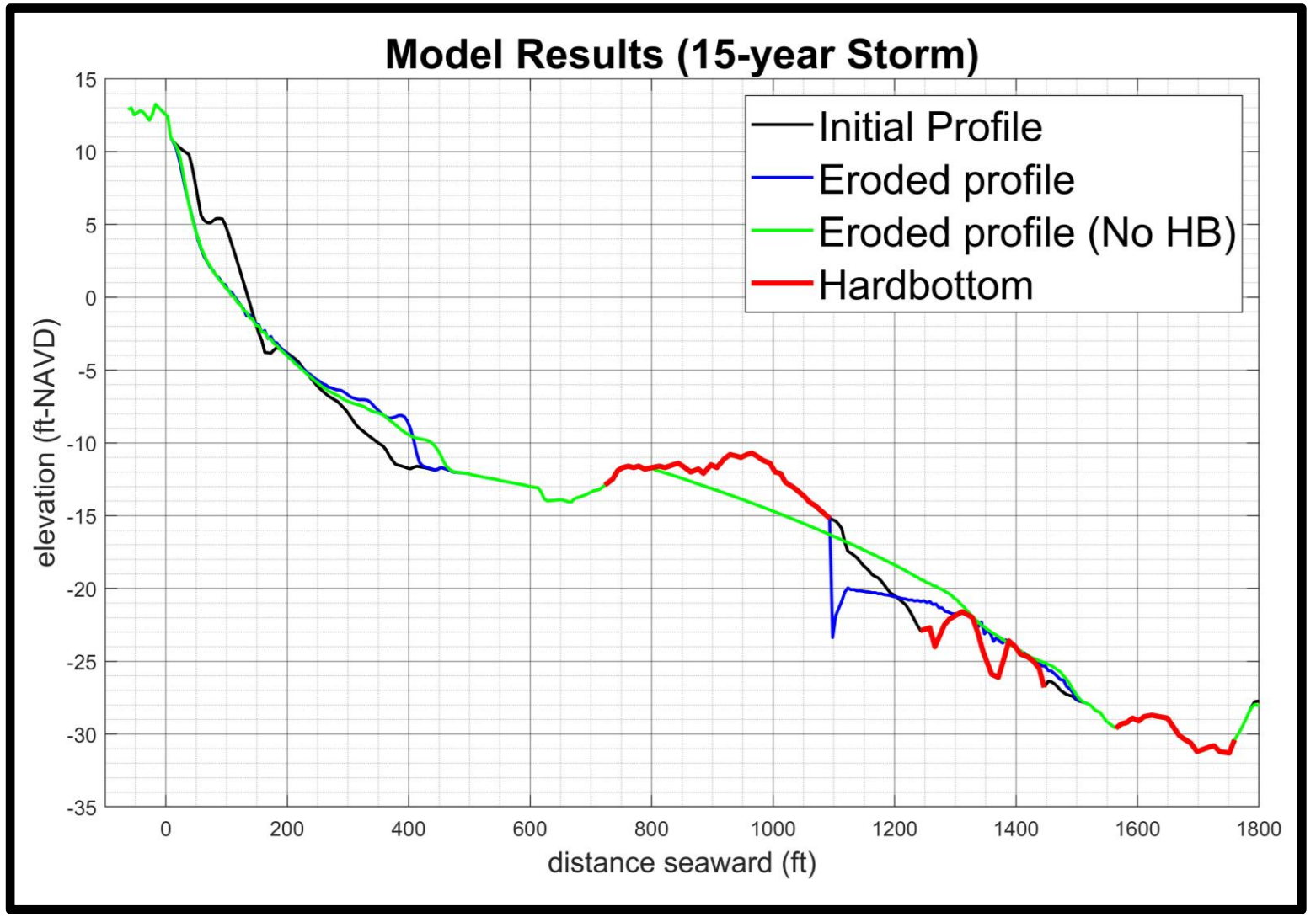



**Figure:** Definition sketch for algorithm to calculate the effect of hard bottoms on the profile evolution.
Source: USACE technical report (https://apps.dtic.mil/sti/pdfs/ADA354783.pdf)

# Nearshore Hardbottom



# Nearshore Hardbottom



# CONCLUSION

- High-frequency storm erosion modeling is frequently conducted for vulnerability assessment and critically eroded designation.
- Landward erosion extent of the eroded profile is the key information.
- The modeling results are site-specific.
- Different hydrologic and morphologic factors are critical in such modeling.
- Inclusion of hardbottom feature in the modeling is practical for some stretches of shoreline to improve site-specific accuracy.
  - This requires combining data from biological and physical monitoring.

# THANK YOU

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