

## Introduction

NC12 is the only route connecting Hatteras Island to mainland North Carolina.

Dunes are the only barriers between NC12 and the ocean.

This study focuses on prediction of highway vulnerability to dune overwash.

**Overwash:** when water begins to flow over the dune crest

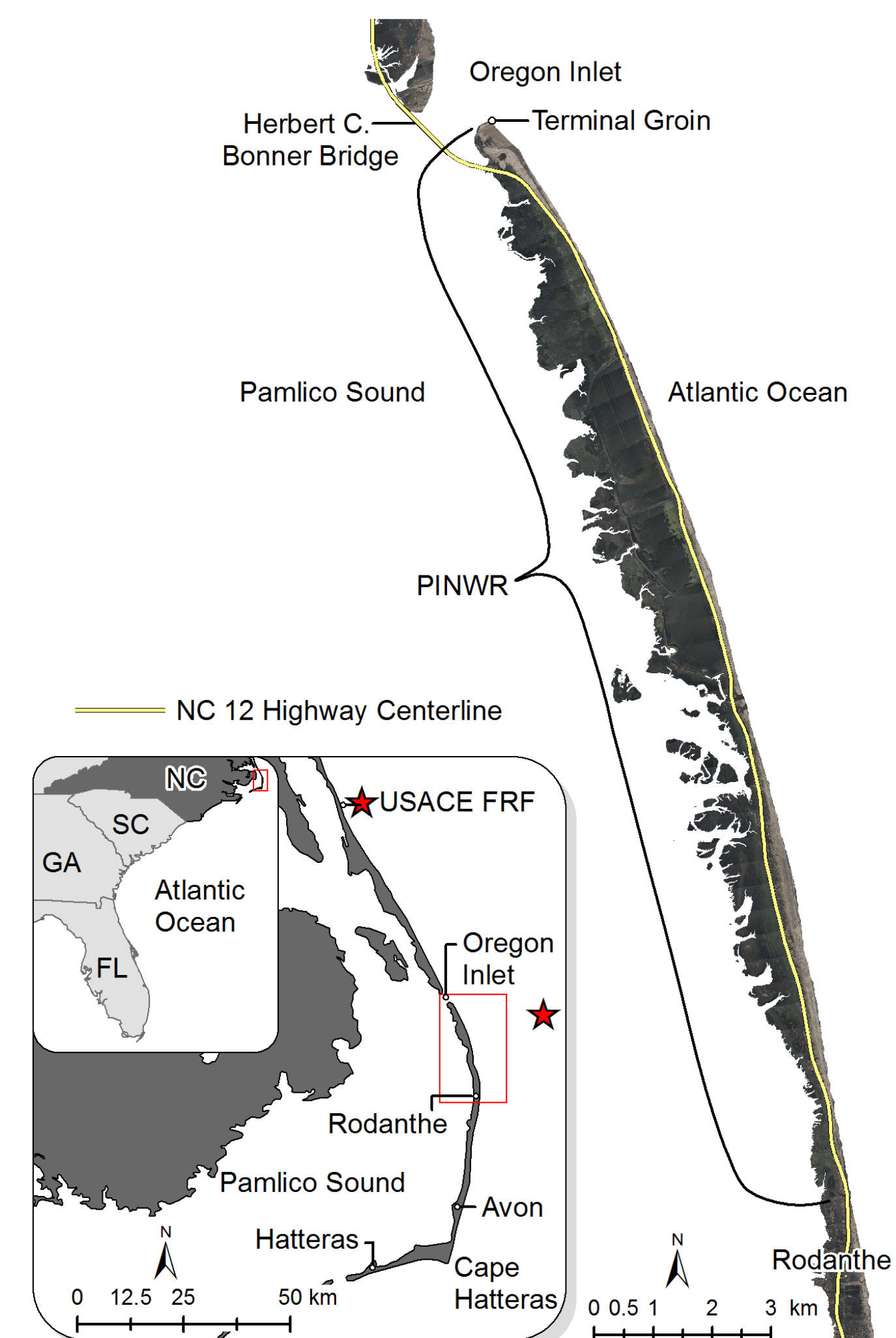
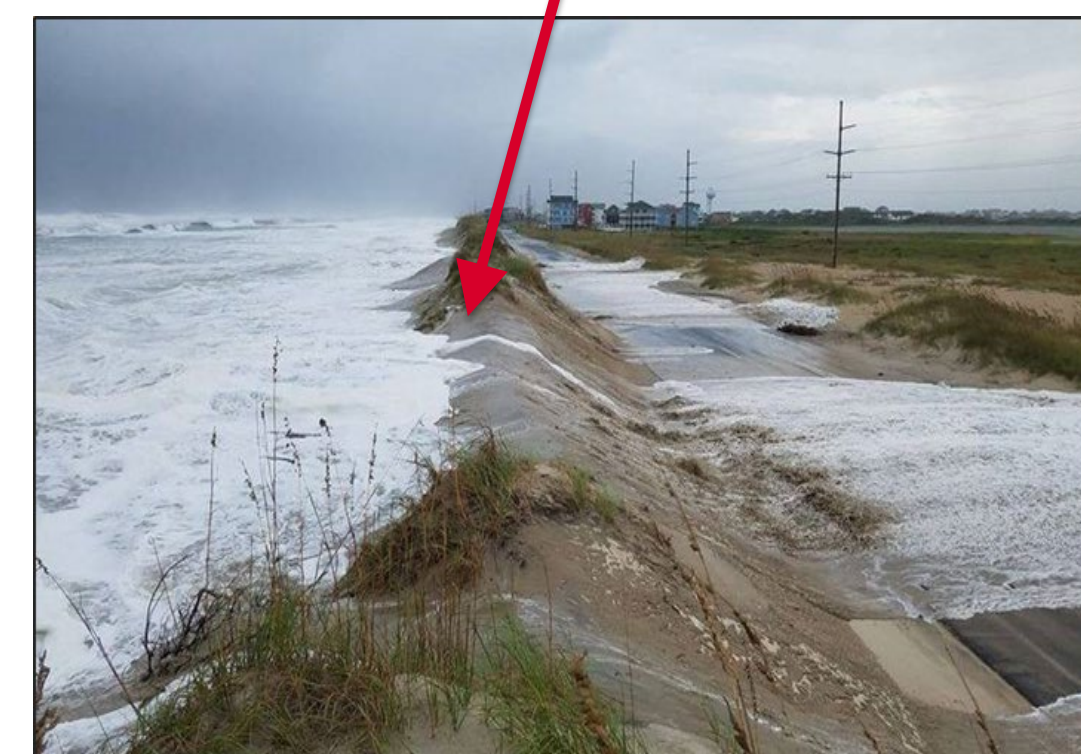
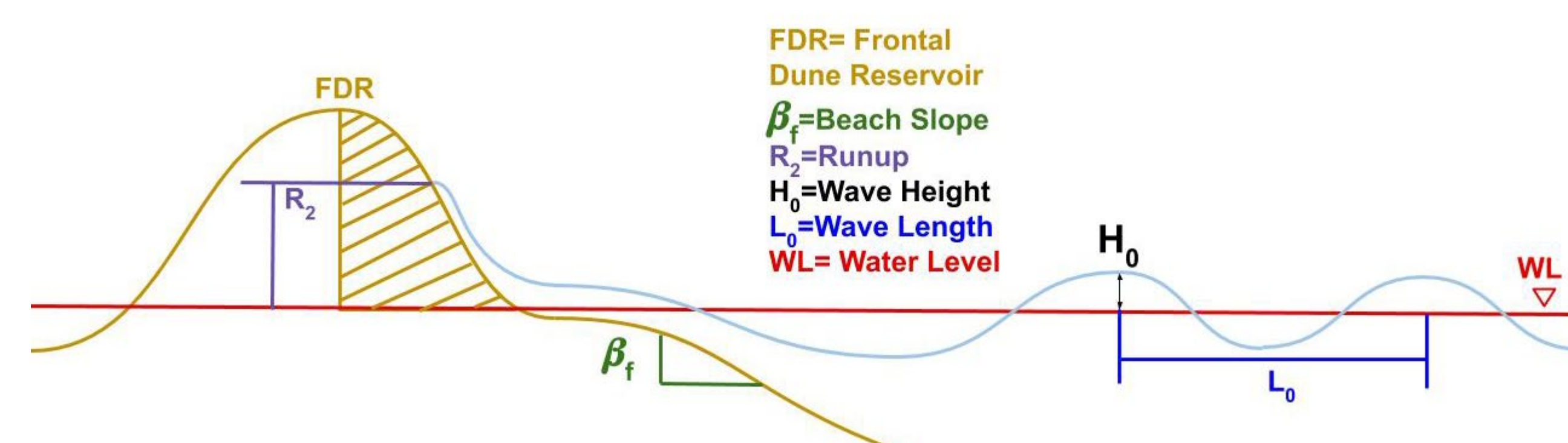


Figure 1: (above) Location map for study area  
Figure 2: (left) Hurricane Florence dune overwash

## Methods

Figure 3: Diagram of dune and water variables required in calculations.



Runup:

$$R_2 = 1.1(0.35\beta_f(H_0L_0)^{\frac{1}{2}} + \frac{[H_0L_0(0.563\beta_f^2 + 0.004)]^{\frac{1}{2}}}{2}) \quad (2)$$

Erosion:

$$Erosion [m^2] = 8(Recurrence Interval [yr])^{0.4} \quad (1)$$

Compute runup & erosion

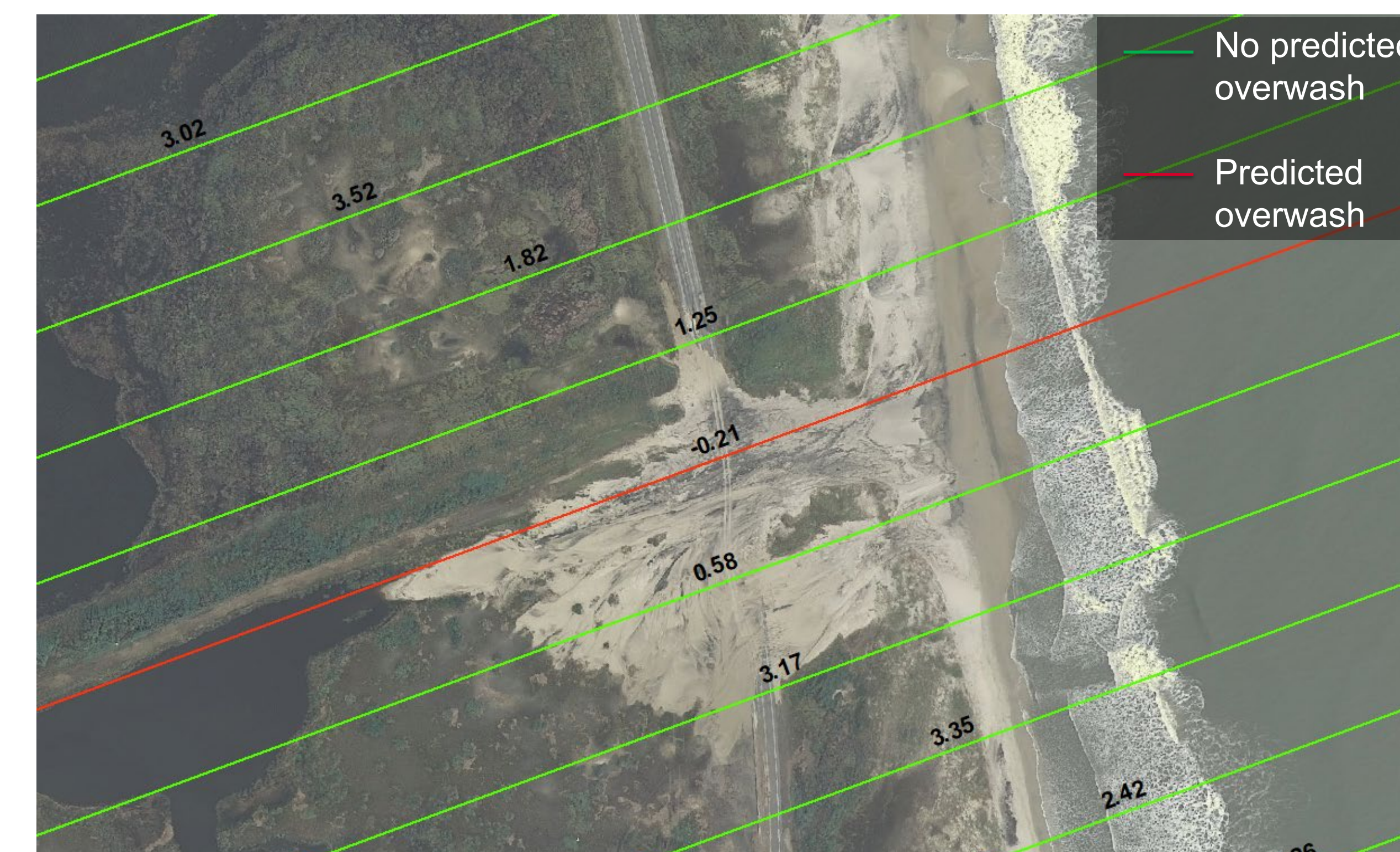
Compare to dune characteristics

Assess accuracy of predictors

Evaluate current vulnerability

## Evaluation of Prediction Methods

Figure 4: Post Hurricane Sandy Oct. 2012 transects 374-383. Red and green transects indicate runup predicted dune vulnerability. The transects are labelled with the calculated difference between the dune crest and predicted runup. Some overwash wasn't predicted due to transect spacing.



### Hurricane Sandy

- Wave Height: 7.9 m
- Wave Storm Event ~ 20 yr
- Water Level: 1.08 m
- Water Level Event ~ 10 yr

	Runup	Erosion
Correctly Predicted Vulnerable	44.3%	4.5%
Correctly Predicted Non-Vulnerable	94.8%	100%
Overall Accuracy	83.9%	79.8%

Figure 5: Percentages of accurately predicted transects

## Findings

- Runup was more successful than erosion in the prediction of overwash along the study area
- Since runup was more successful in predicting vulnerability, it was used to evaluate the current vulnerability of the study area based on the February 2019 digital elevation model
- As of now, the dunes would be able to protect the highway from a 1-year wave event with up to a 2 meter water level. however, any 10-year storm or larger with a 1.5 meter water level or higher would overwash the majority of the transects along NC12

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## Results

### Application: Current Vulnerability

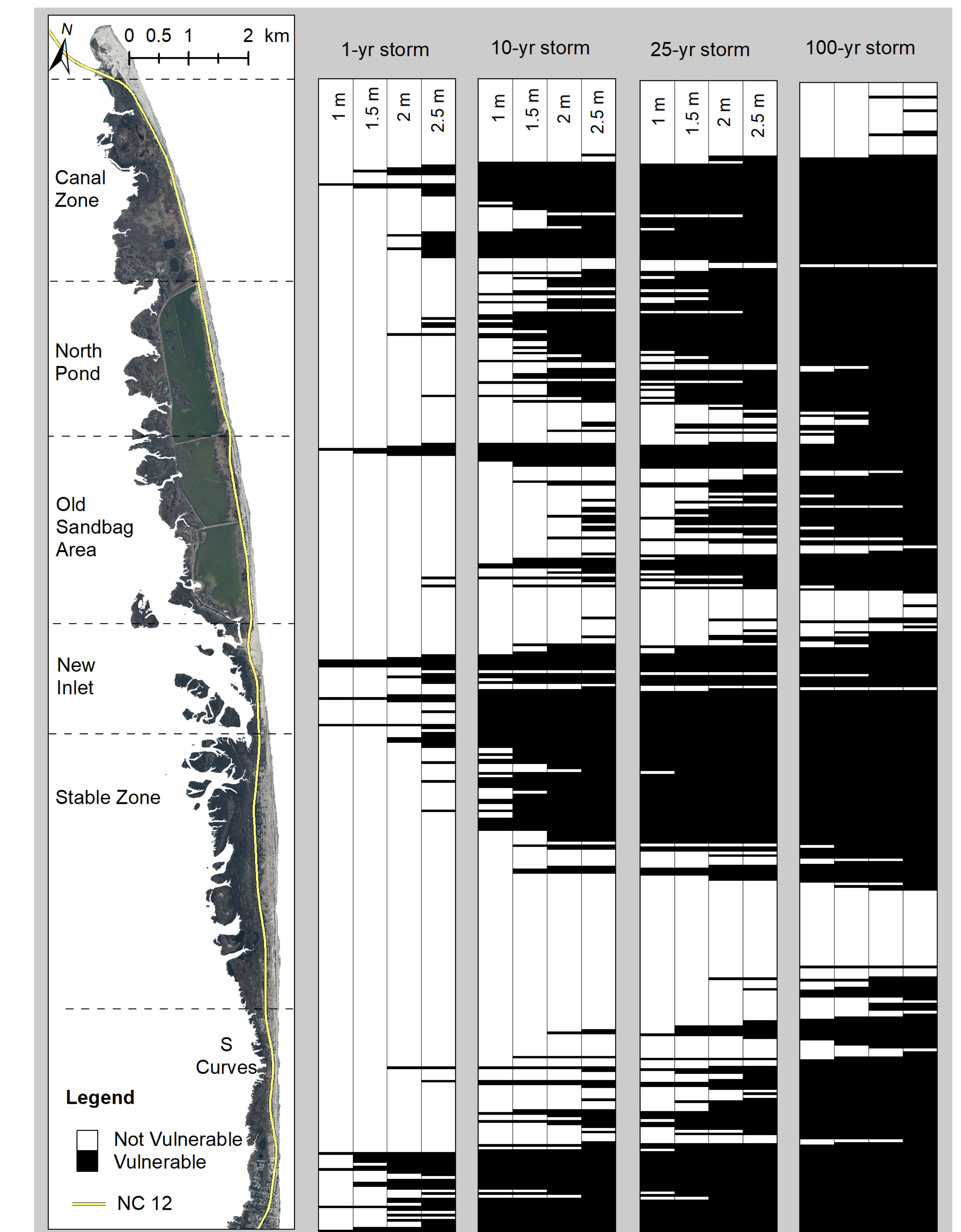


Figure 6: Current overwash vulnerability based on runup calculated from wave recurrence intervals for 1-year, 10-year, 25-year, and 100-year storms with four different potential water levels.

## References

- [1] Hallermeier, Robert J., and Perry E. Rhodes. "Generic Treatment Of Dune Erosion For 100-Year Event." Coastal Engineering Proceedings, vol. 1, no. 21, 1988, p. 89., doi:10.9753/icce.v21.89.
- [2] Stockdon, Hilary F., et al. "Empirical Parameterization of Setup, Swash, and Runup." Coastal Engineering, vol. 53, no. 7, 2006, pp. 573–588., doi:10.1016/j.coastaleng.2005.12.005.

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