A process-based model to predict wave attenuation across marshes

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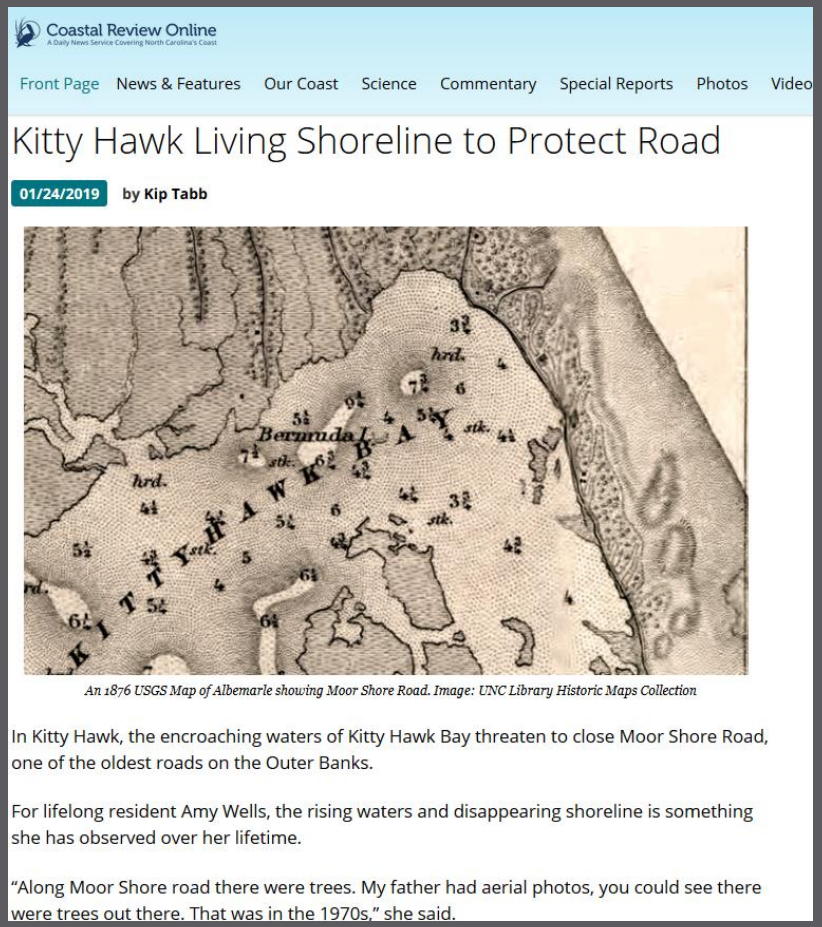
As coastal flooding surges, 'living shorelines' seen as the answer

Salt marshes and oyster reefs prove more resilient than seawalls when big storms hit

By Rowan Jacobsen, March 19, 2019
Photography by John Althouse

On August 27, 2011, Hurricane Irene crashed into North Carolina, eviscerating the Outer Banks. The storm dumped rain shin-high and hurled three-meter storm surges against the barrier island shores that faced the mainland, destroying roads and 1,100 homes.

https://thefern.org/2019/03/as-coastal-flooding-surges-living-shorelines-seen-as-savior/



Kitty Hawk Living Shoreline to Protect Road

01/24/2019 by **Kip Tabb**

An 1876 USGS Map of Albemarle showing Moor Shore Road. Image: UNC Library Historic Maps Collection

In Kitty Hawk, the encroaching waters of Kitty Hawk Bay threaten to close Moor Shore Road, one of the oldest roads on the Outer Banks.

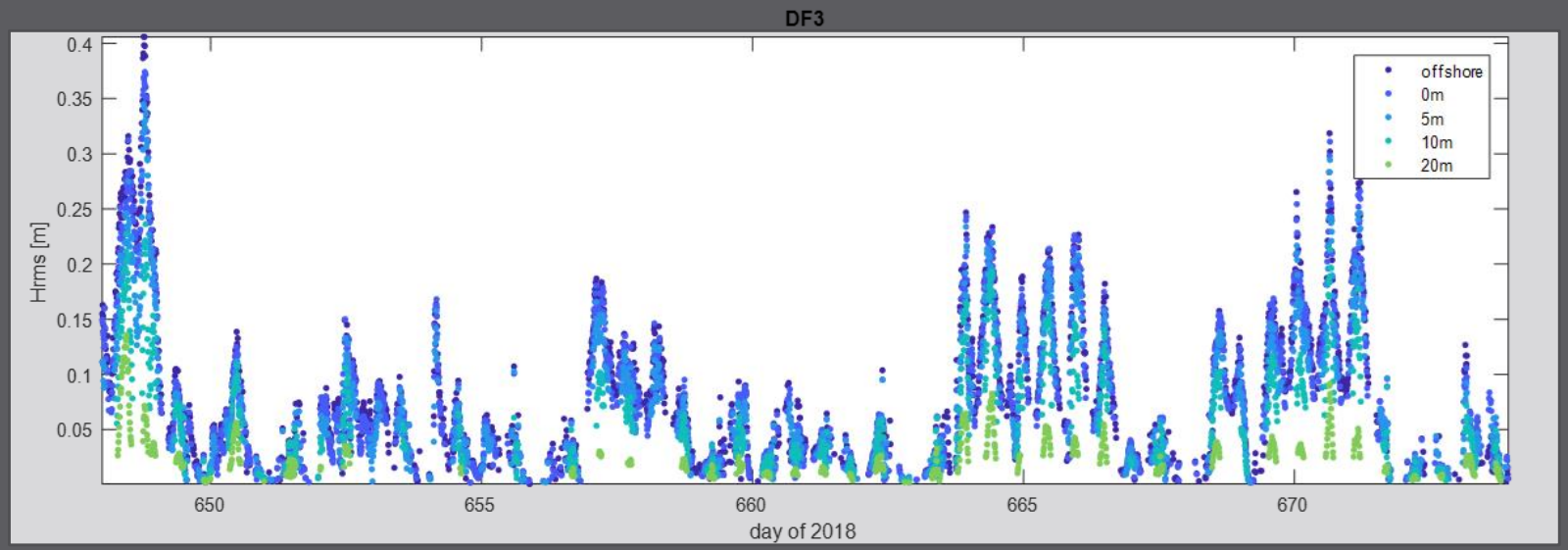
For lifelong resident Amy Wells, the rising waters and disappearing shoreline is something she has observed over her lifetime.

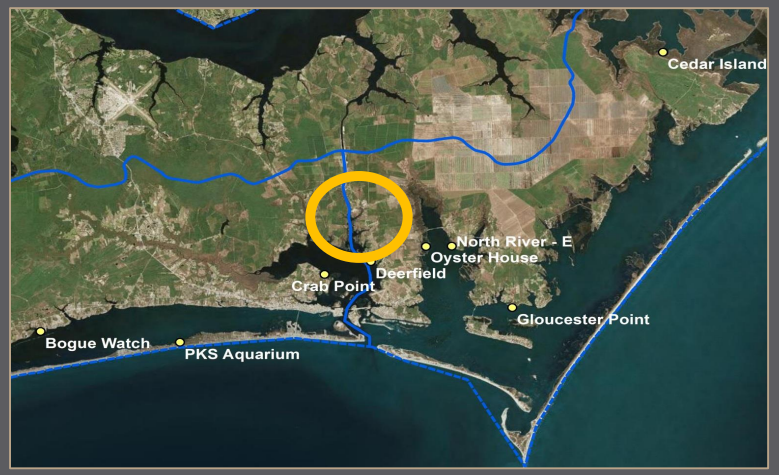
"Along Moor Shore road there were trees. My father had aerial photos, you could see there were trees out there. That was in the 1970s," she said.

https://www.coastalreview.org/2019/01/kitty-hawk-living-shoreline-to-protect-road/


Cedar Island
North River - E
Oyster House
Deerfield
Crab Point
IMS
Gloucester Point
Bogue Watch
PKS Aquarium

Wave measurements





Deerfield
H. Michael, Oct. 2018

Wave damping model

Conservation of wave energy flux:

Wave energy flux

$$\frac{\partial(EC_g)}{\partial x} = \underbrace{-\langle\varepsilon_b\rangle - \langle\varepsilon_v\rangle - \langle\varepsilon_f\rangle}_{\text{Dissipation of wave energy}}$$

EC_g = (wave energy density) x (wave group speed)

$\langle\varepsilon_b\rangle$ = dissipation by wave breaking

$\langle\varepsilon_v\rangle$ = dissipation by vegetation drag

$\langle\varepsilon_f\rangle$ = dissipation by bottom friction

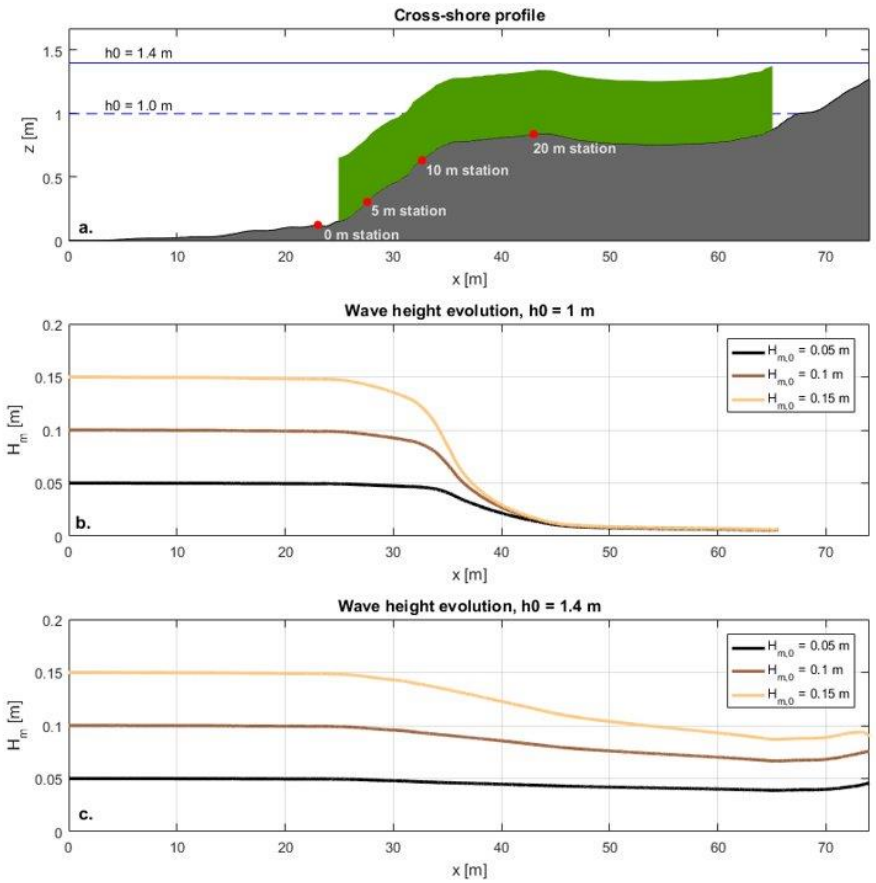
Wave damping model

$$\frac{\partial(EC_g)}{\partial x} = -\langle \varepsilon_b \rangle - \langle \varepsilon_v \rangle - \langle \varepsilon_f \rangle$$

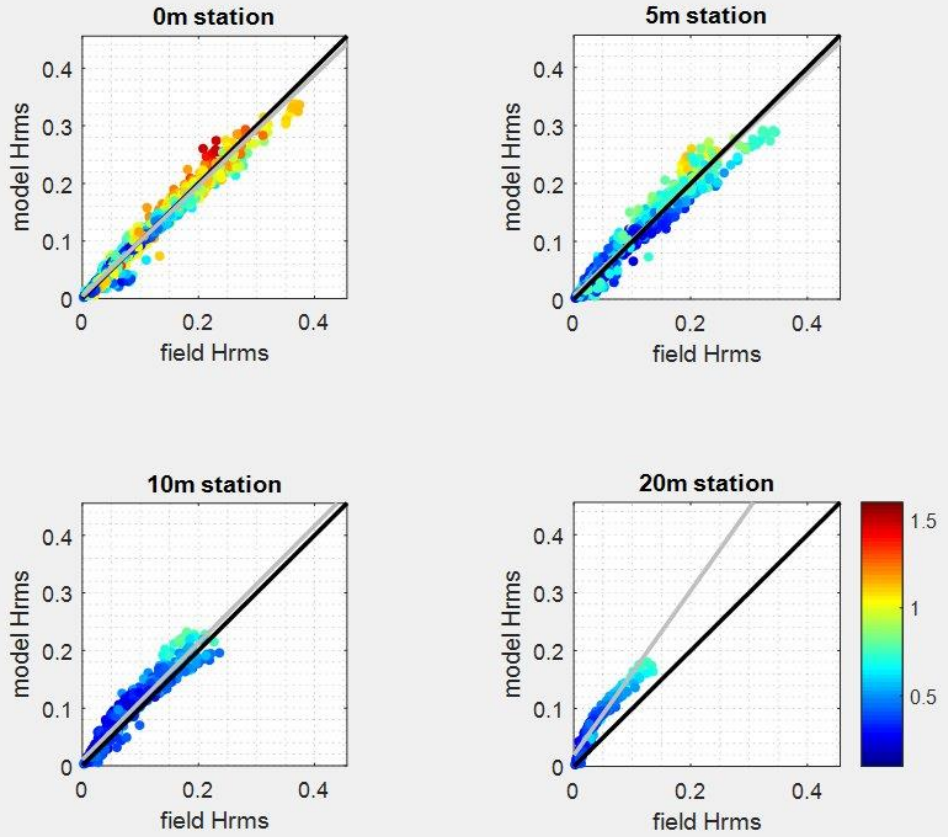
EC_g = (wave energy density) x (wave group speed)

Dissipation term:	Function of:
$\langle \varepsilon_b \rangle$ = dissipation by wave breaking	Water depth, wave height
$\langle \varepsilon_f \rangle$ = dissipation by bottom friction	Water depth, wave height, wave length, wave period, friction coefficient
$\langle \varepsilon_v \rangle$ = dissipation by vegetation drag	Water depth, wave length, wave period, wave height, vegetation parameters

Model at Deerfield for different water levels and incident wave heights, with constant veg. values:

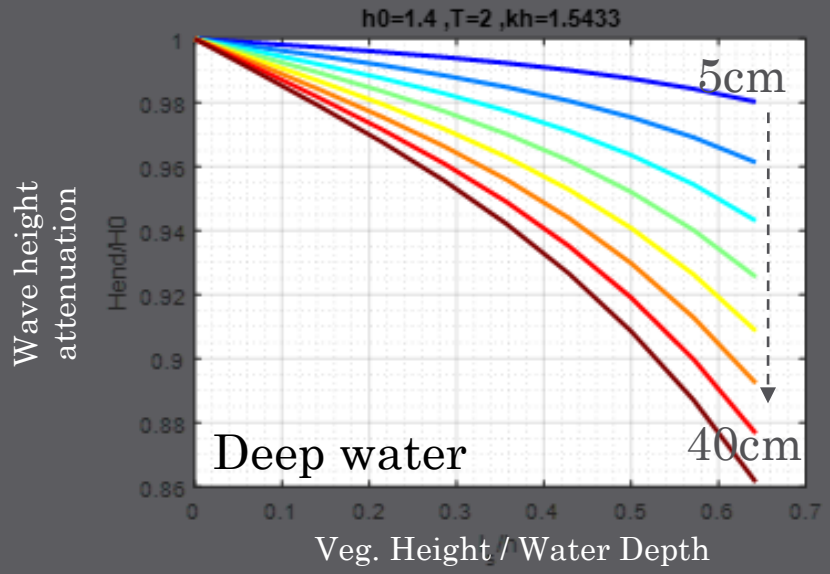


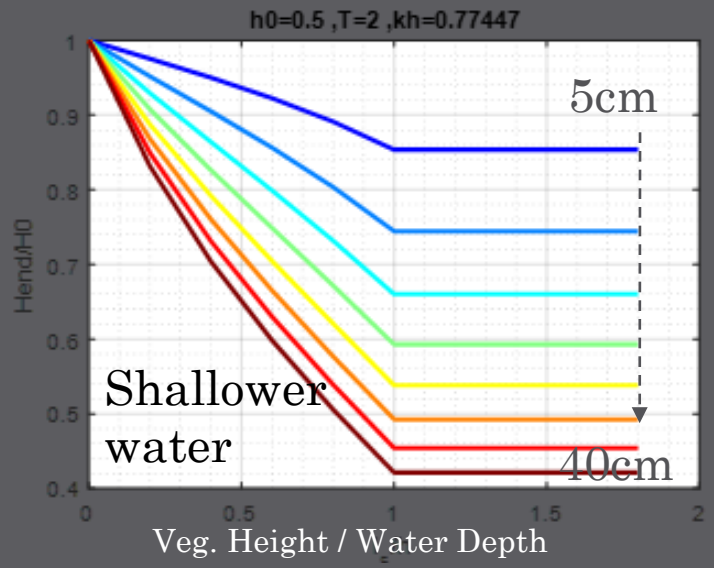
Model validation with Deerfield H_{rms} field data (H. Michael):

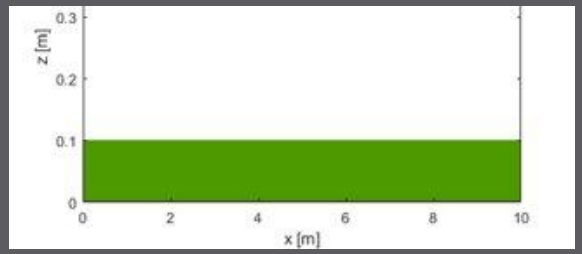


Sensitivity to Veg. Characteristics

Change in attenuation with varying vegetation height in water column







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