Progress report on wave-driven dynamics simulation of shoreline erosion - Testbeds Corsica and Choptank Rivers

Richard Tian and CBPO modeling team

Modeling Quarterly Review
June 20-21, 2023
Annapolis

Context

Phase 6 shoreline erosion

- **Observed(?) long-term shoreline erosion**
- **Partitioned in time based on hydrology**
- **Kilometer spatial resolution of CH3D grid**

Phase 7 recommendation from Larry Sanford

Wave-driven time dependent dynamics simulation of shoreline erosion (Quarterly review 01/11/2023)

$$Eh\rho_{dry} = \alpha'(P - P_{crit}) f(\frac{D}{h}) \quad (1)$$

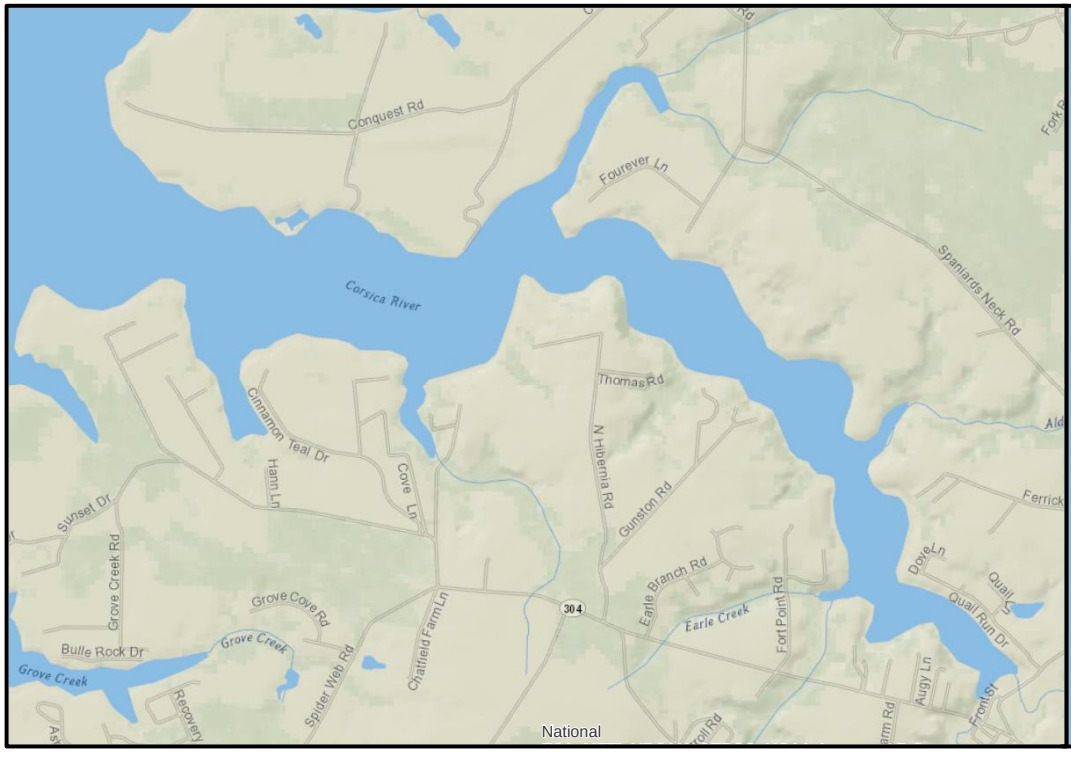
$$P = \frac{1}{8}\rho g H_s^2 c_g \cos(\alpha) \quad (2)$$

Significance

- **Coastline erosion is a challenge, particularly under climate change and sea level rise.**
- **A new piece of best available science**

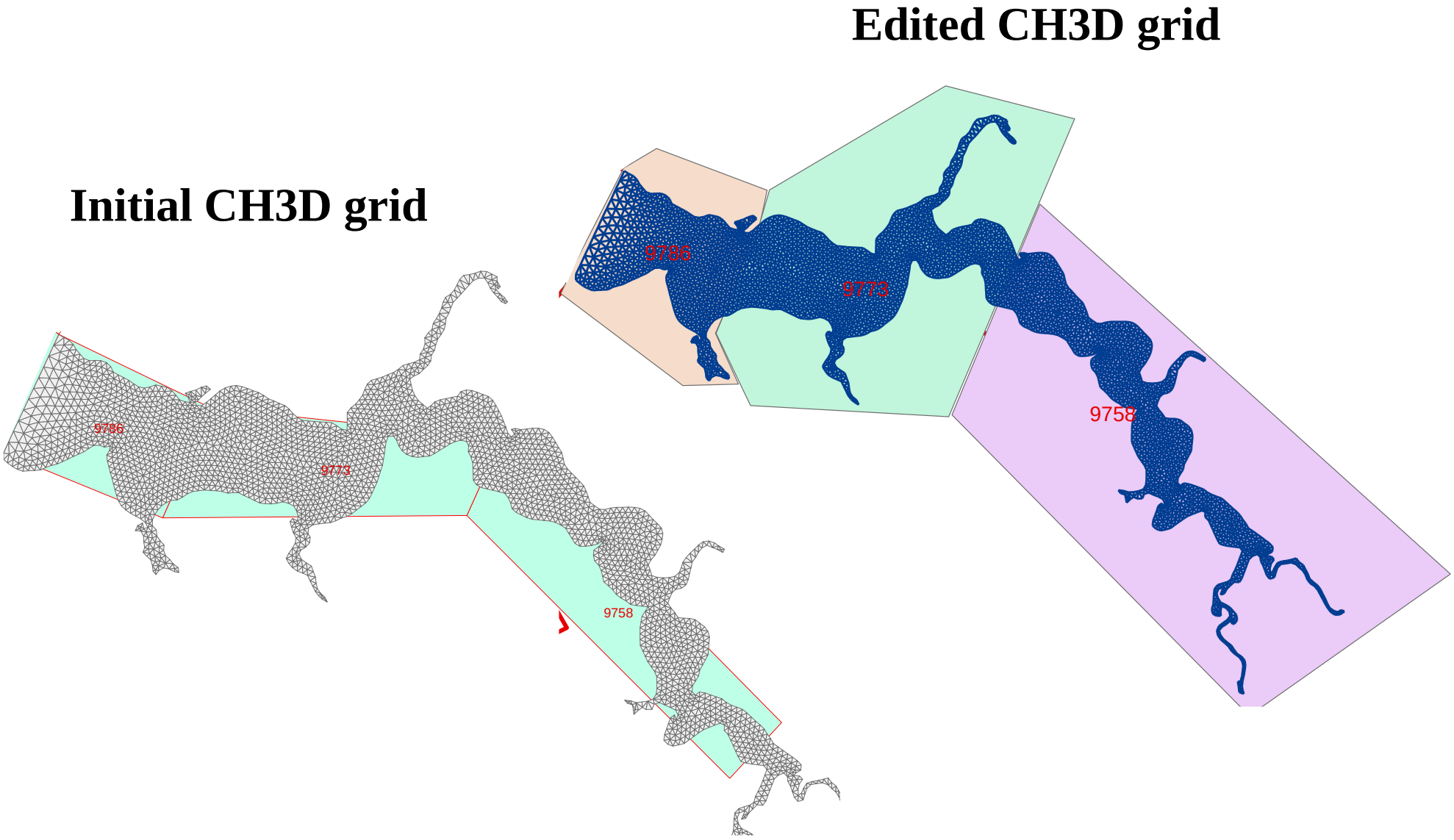
Testbeds

Corsica River

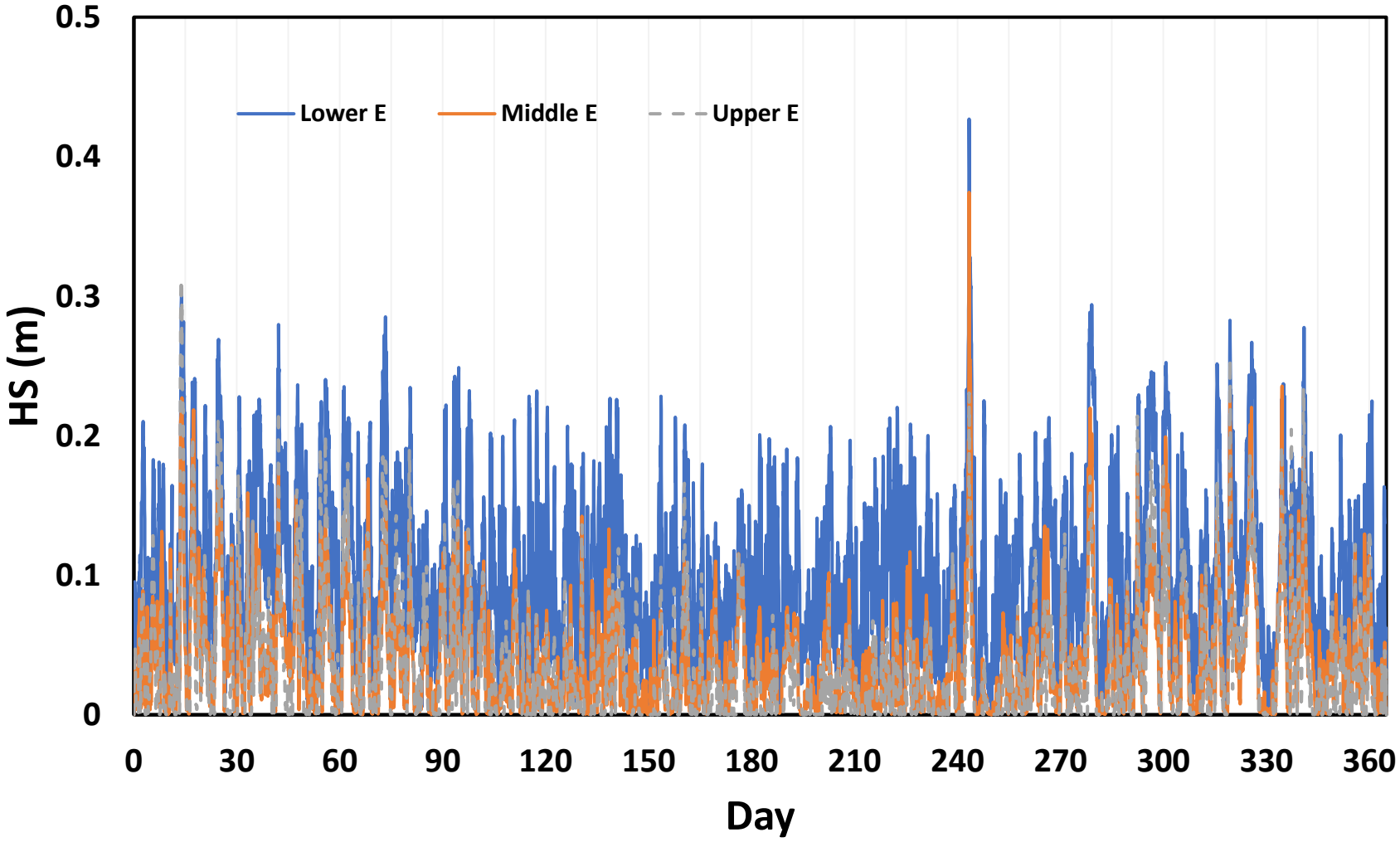


Choptank

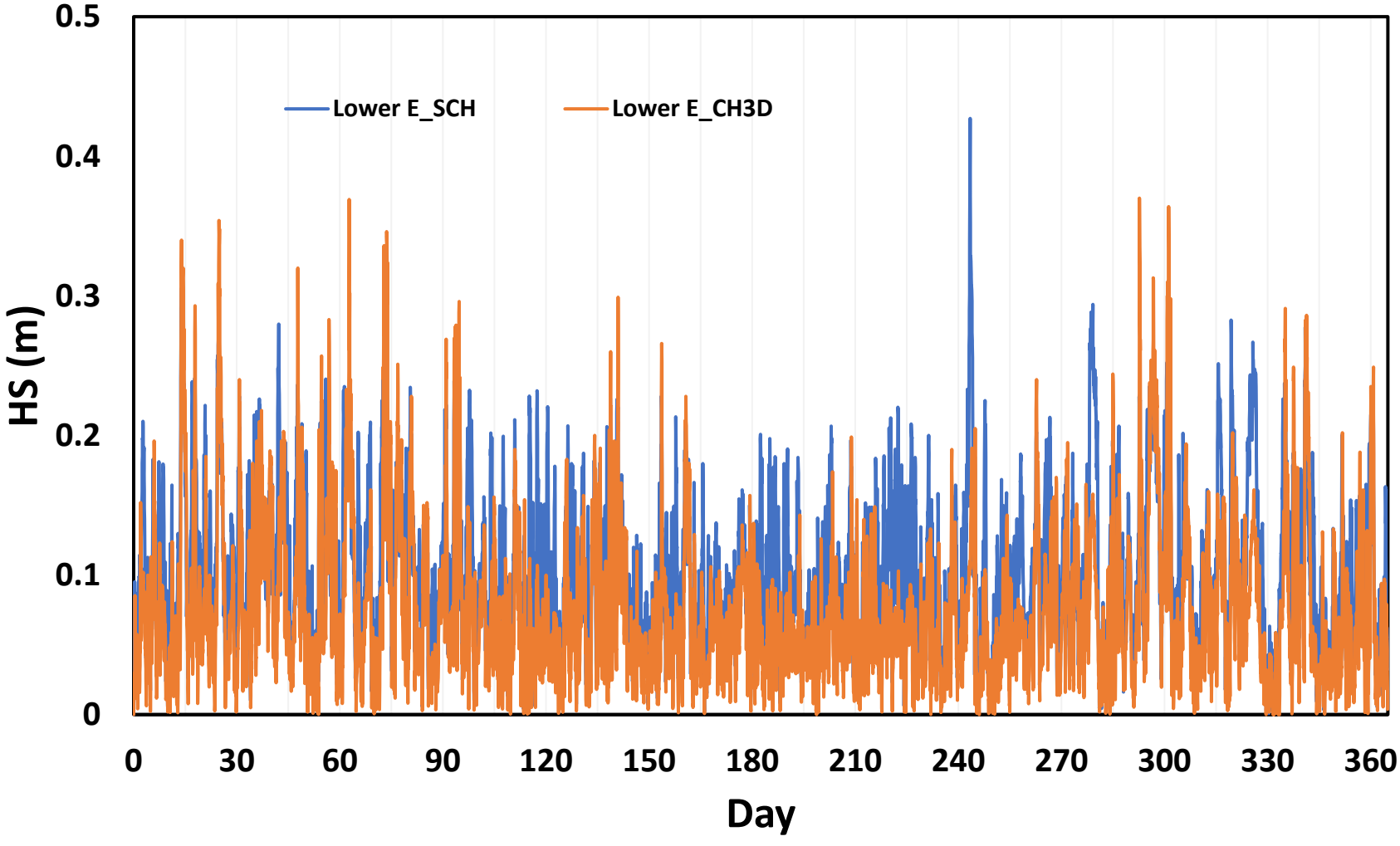
Mapping coastal cells to CH3D grid



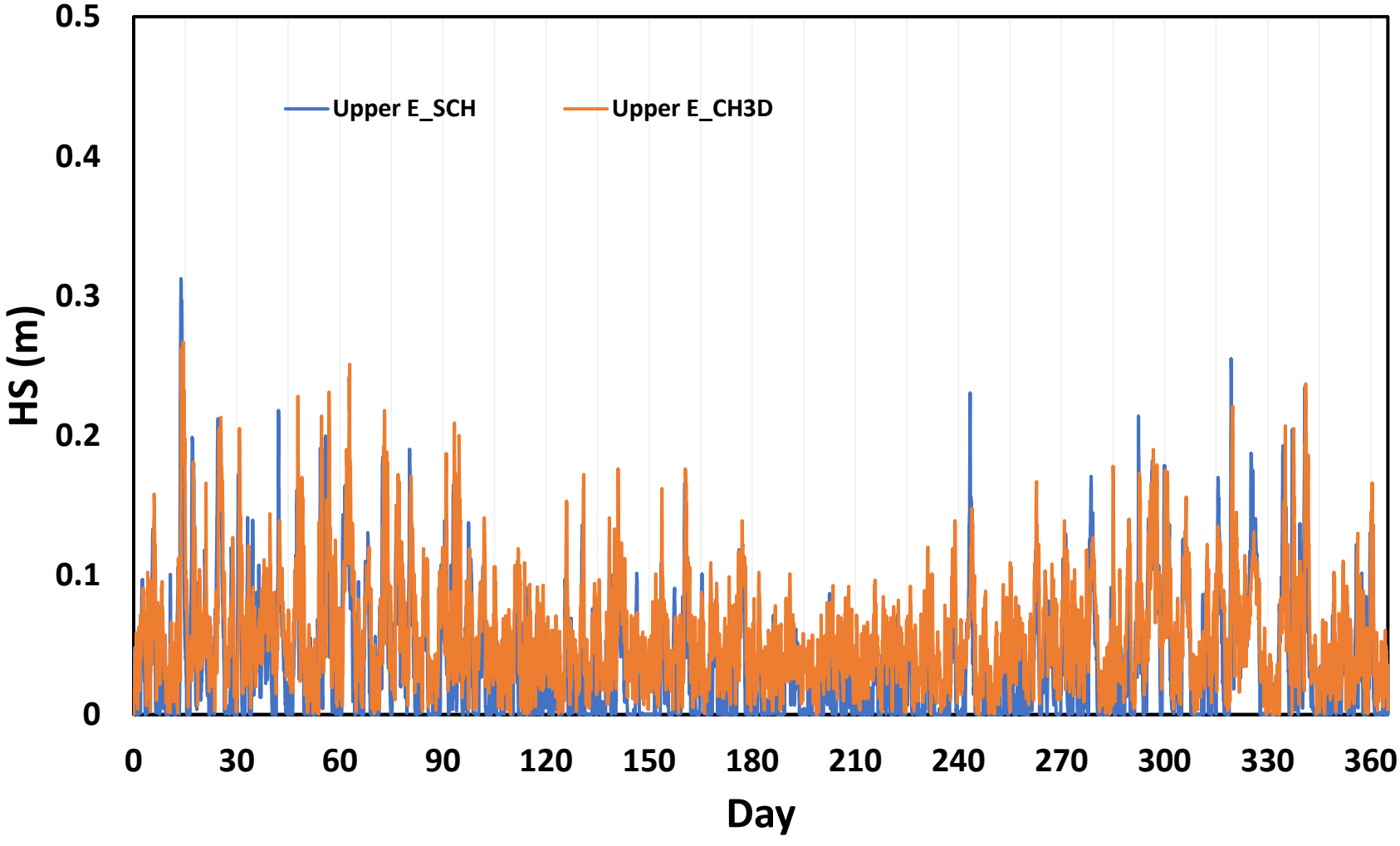
Significant wave height at the lower, middle and upper estuary stations in the Corsica River



Comparison between schism (blue) and CH3D (red) at the lower estuary station



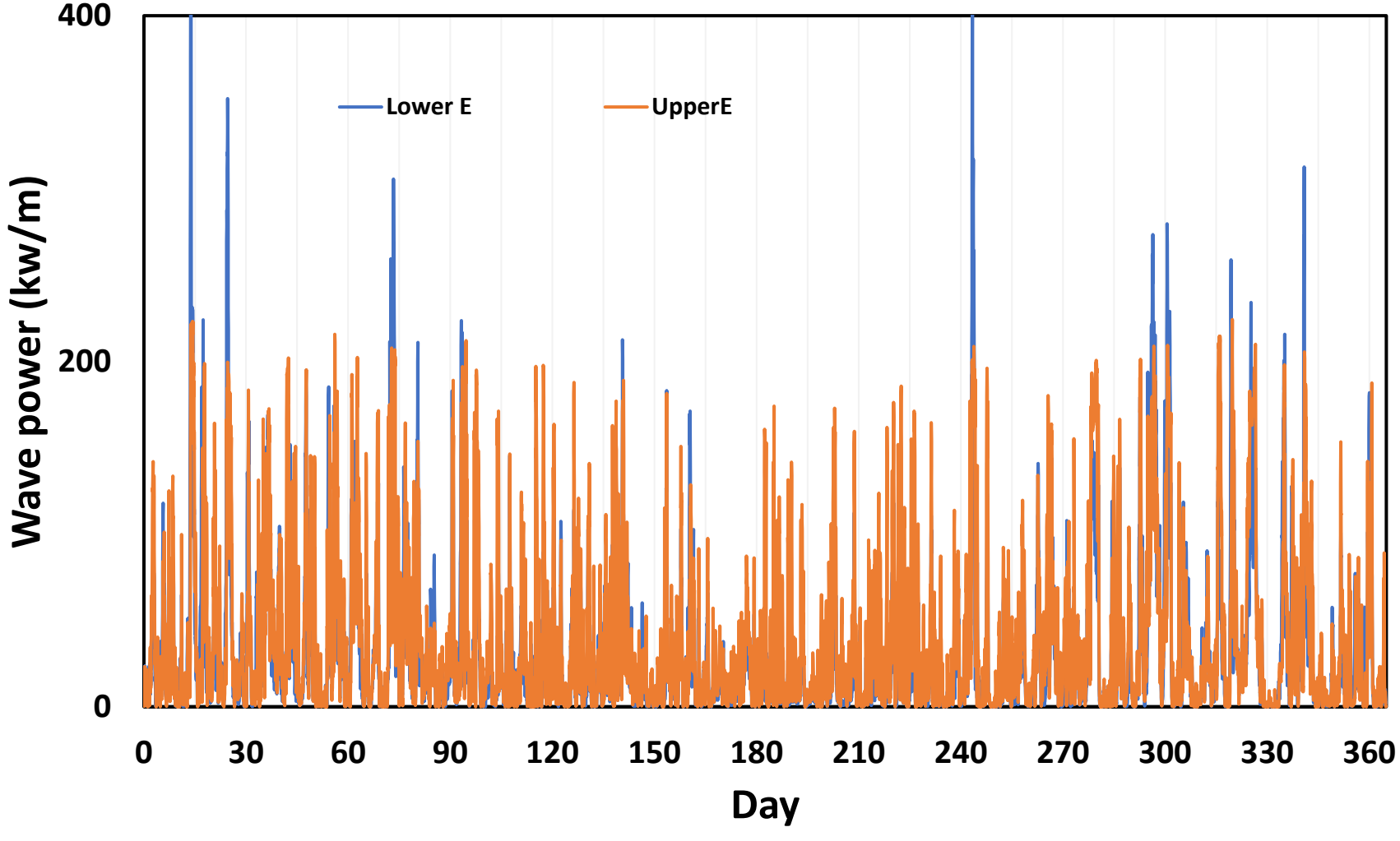
Comparison between schism (blue) and CH3D (red) at the upper estuary station



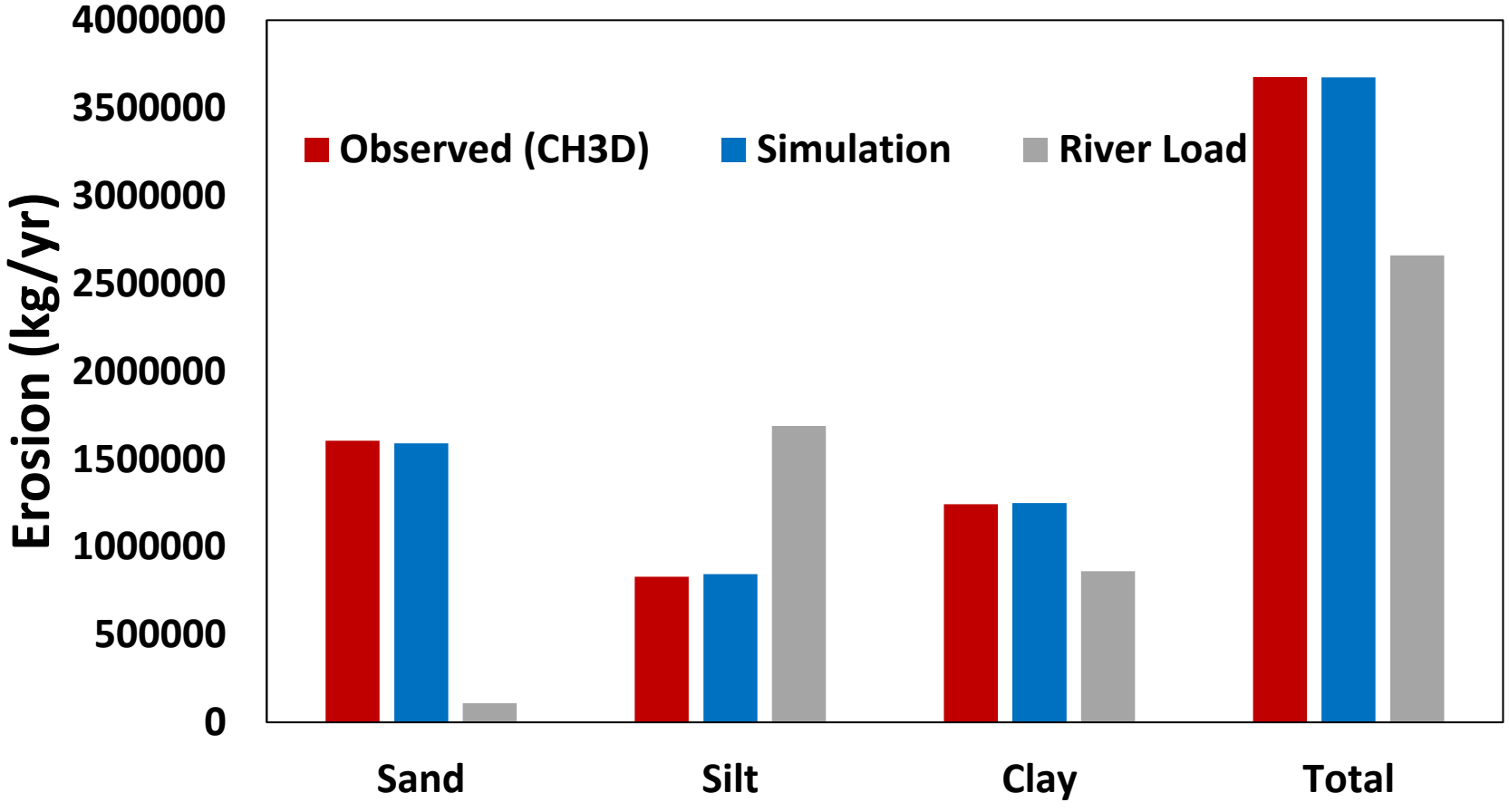
Wave Power

$$P = \frac{1}{8}\rho g H_s^2 c_g \cos(\alpha) \quad (2)$$

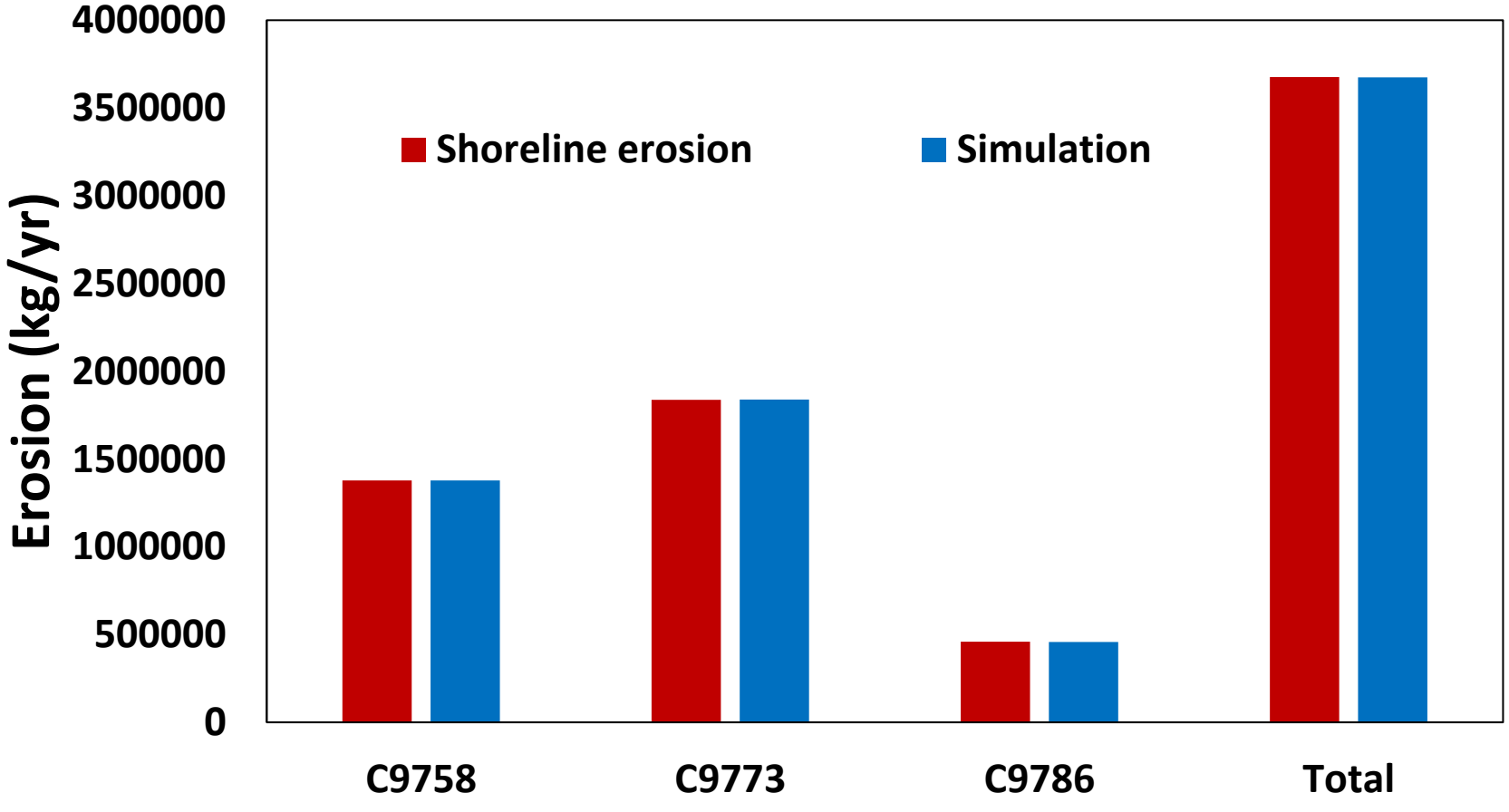
Where H_s is significant wave height, c_g is wave group velocity, and α is the angle of wave approach.



Simulated versus observed shoreline erosion in the whole estuary

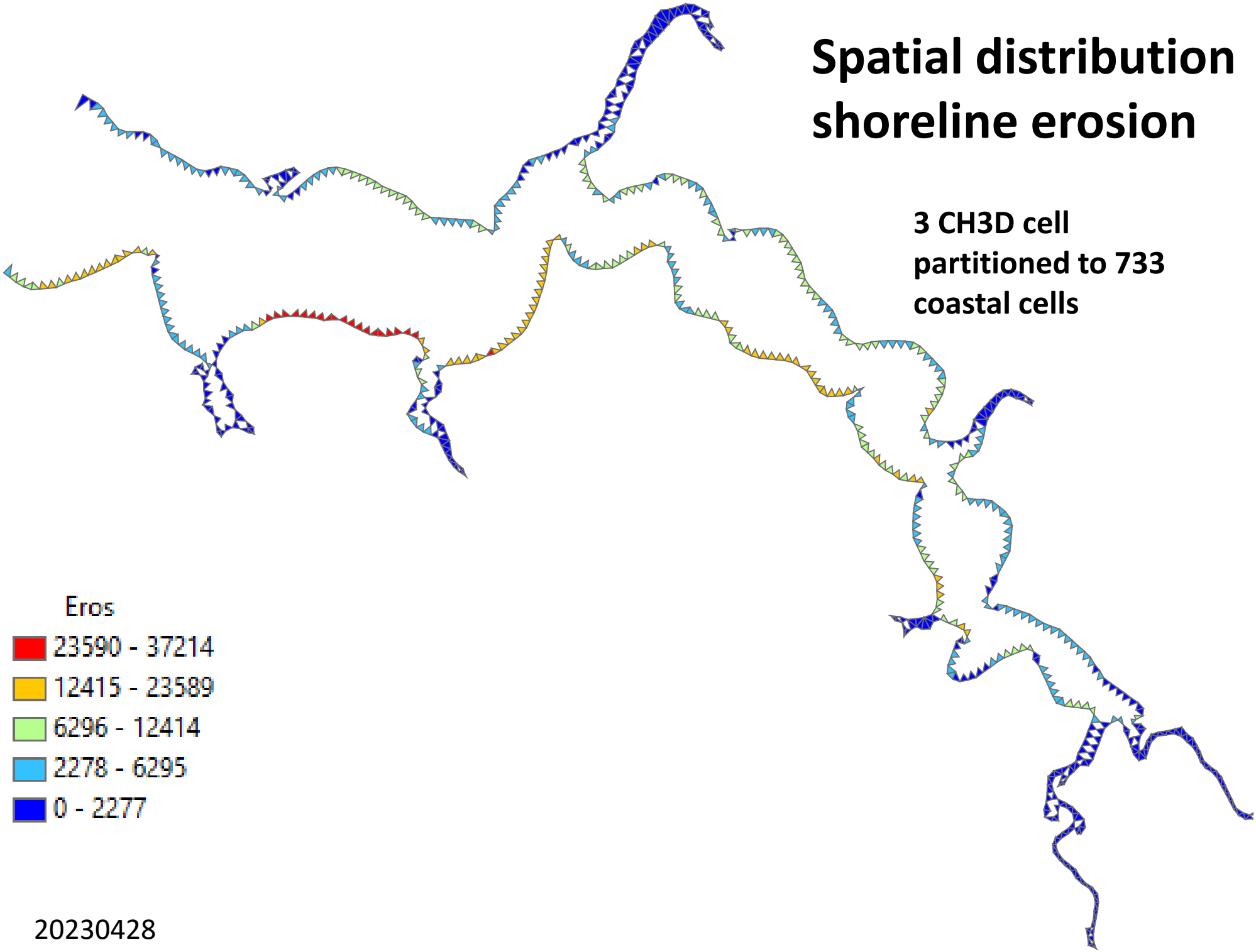


Simulated versus observed shoreline erosion at each calibration cell



Spatial distribution shoreline erosion

3 CH3D cell partitioned to 733 coastal cells



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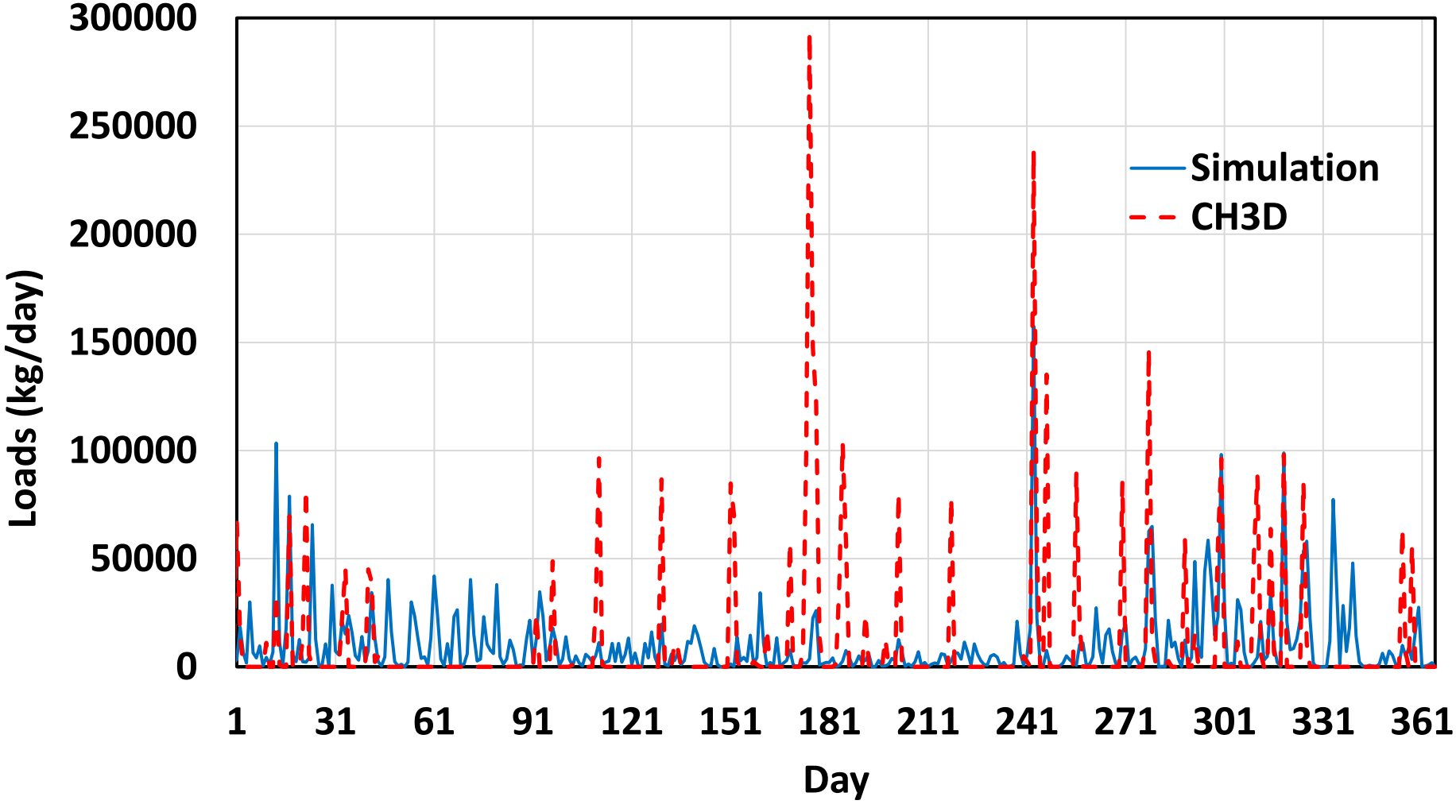
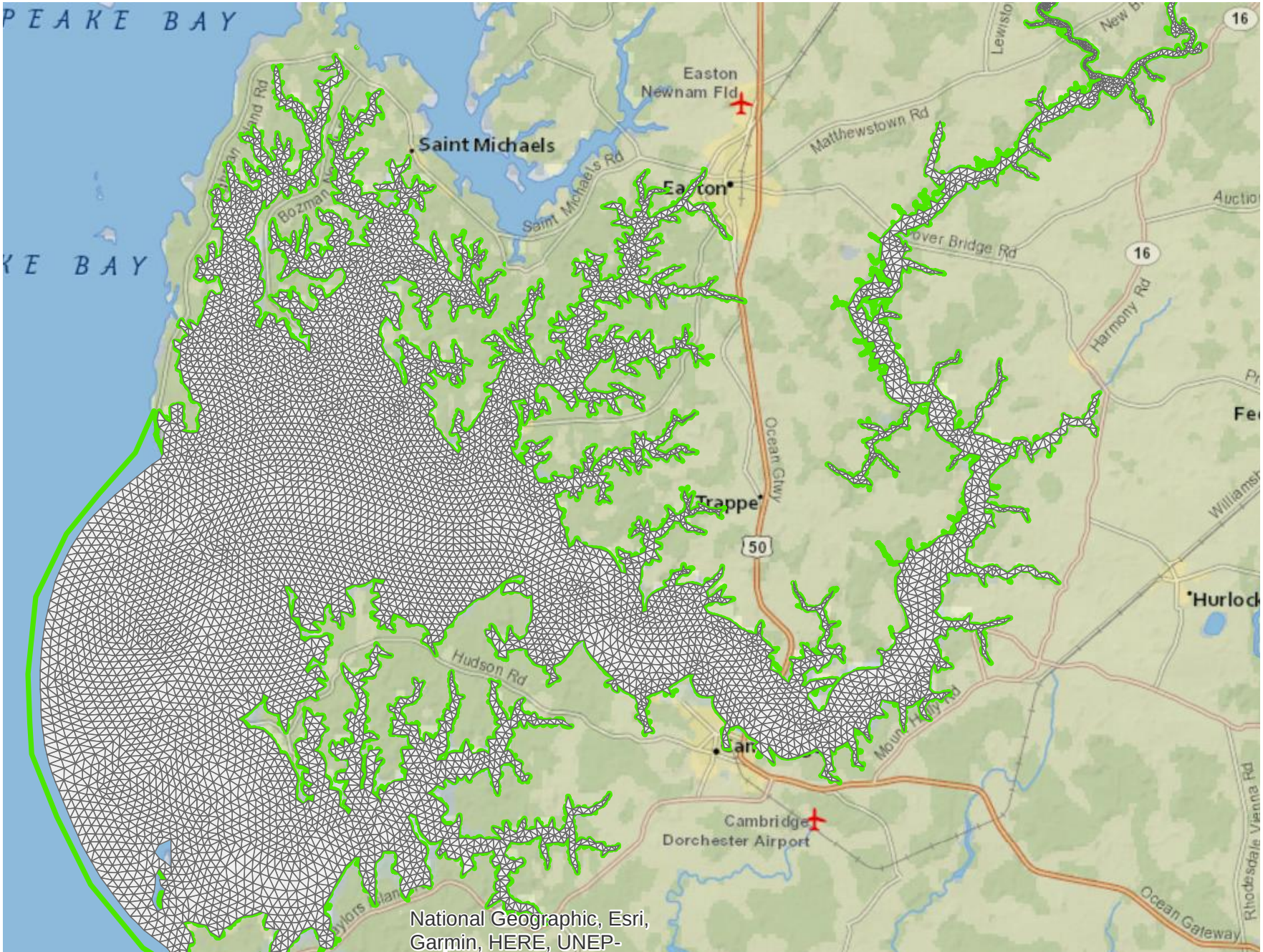
Wave-driven versus hydrology-driven time series of shoreline erosion



Choptank

New grid with the new coastline

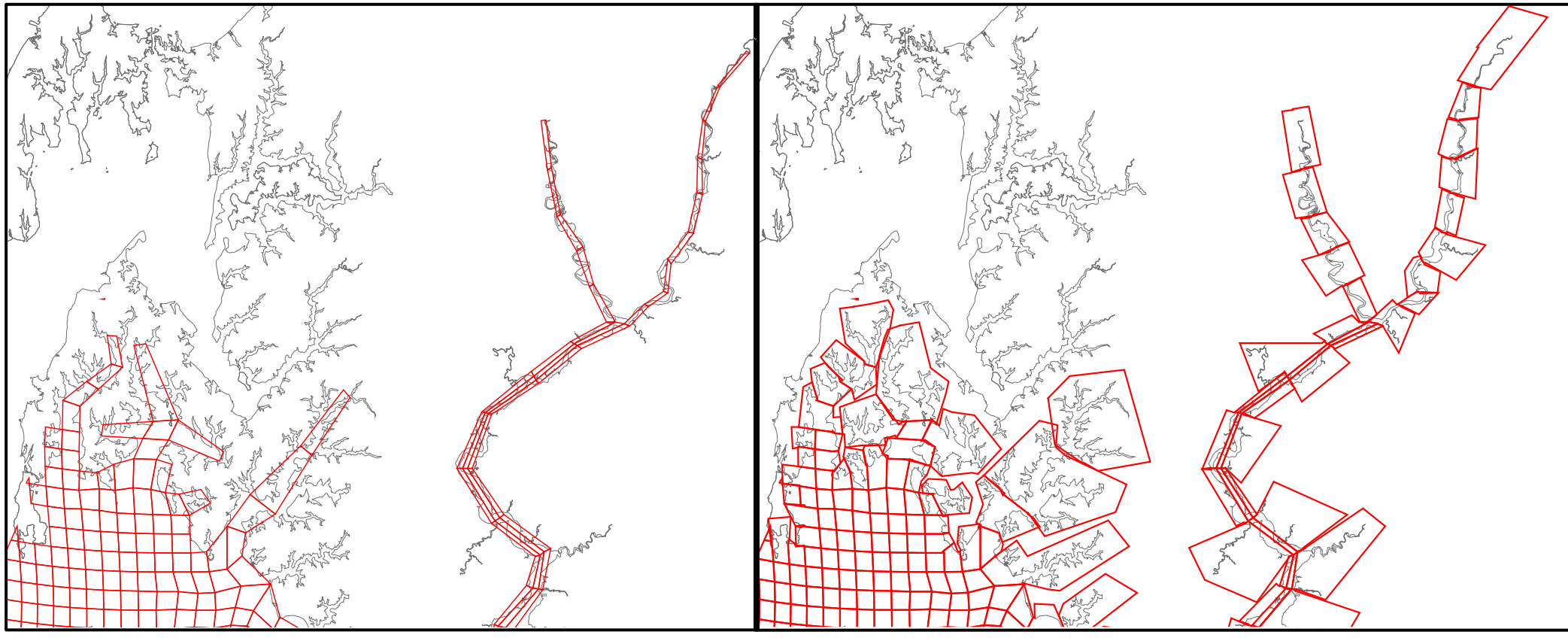


Edited CH3D grid for cell mapping

(135 Coastal CH3D cells)

Initial CH3D grid

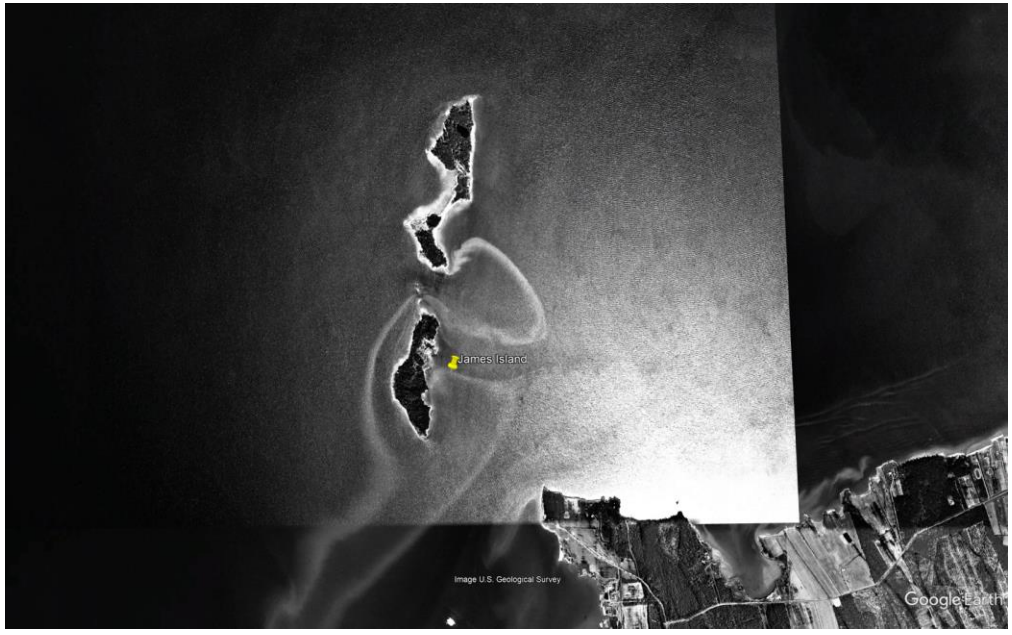
Edited CH3D grid



The poor James Island

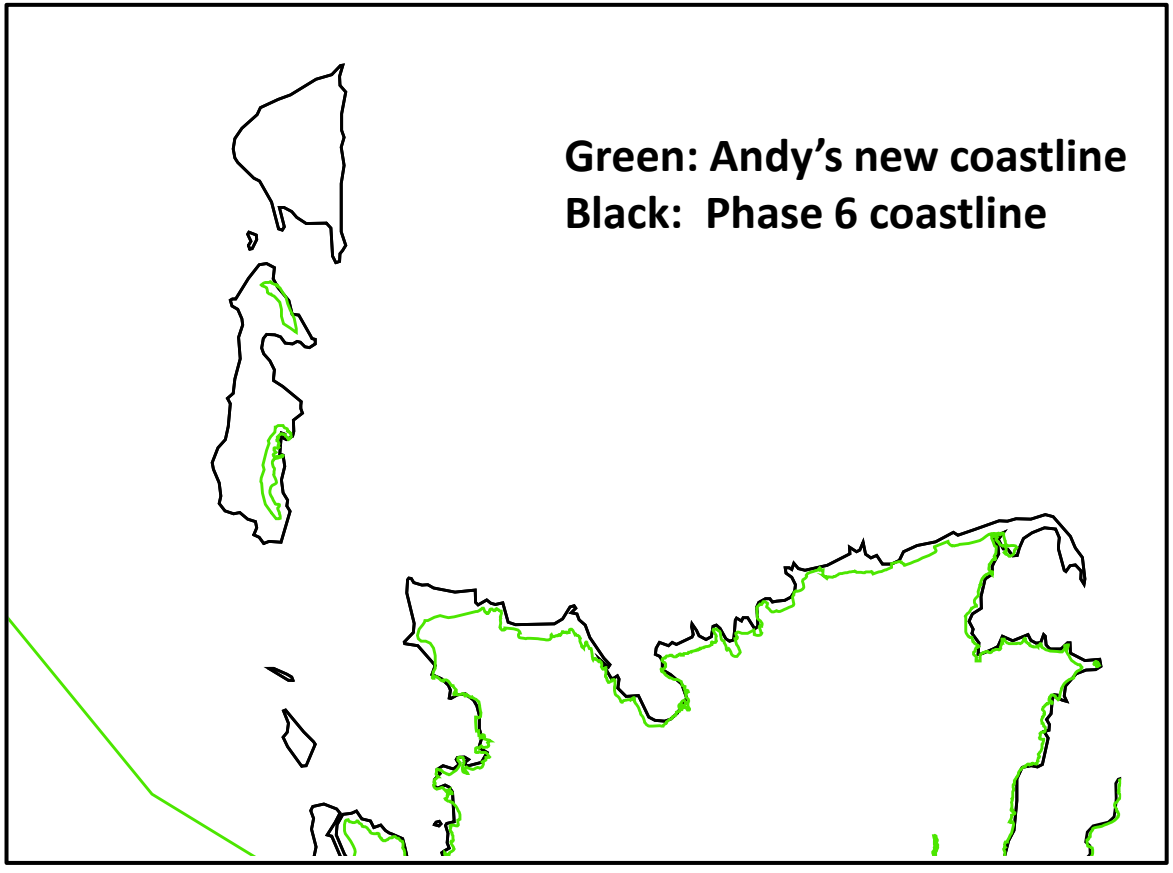
The Bay Journal

Google earth 1994 (Larry Sanford)

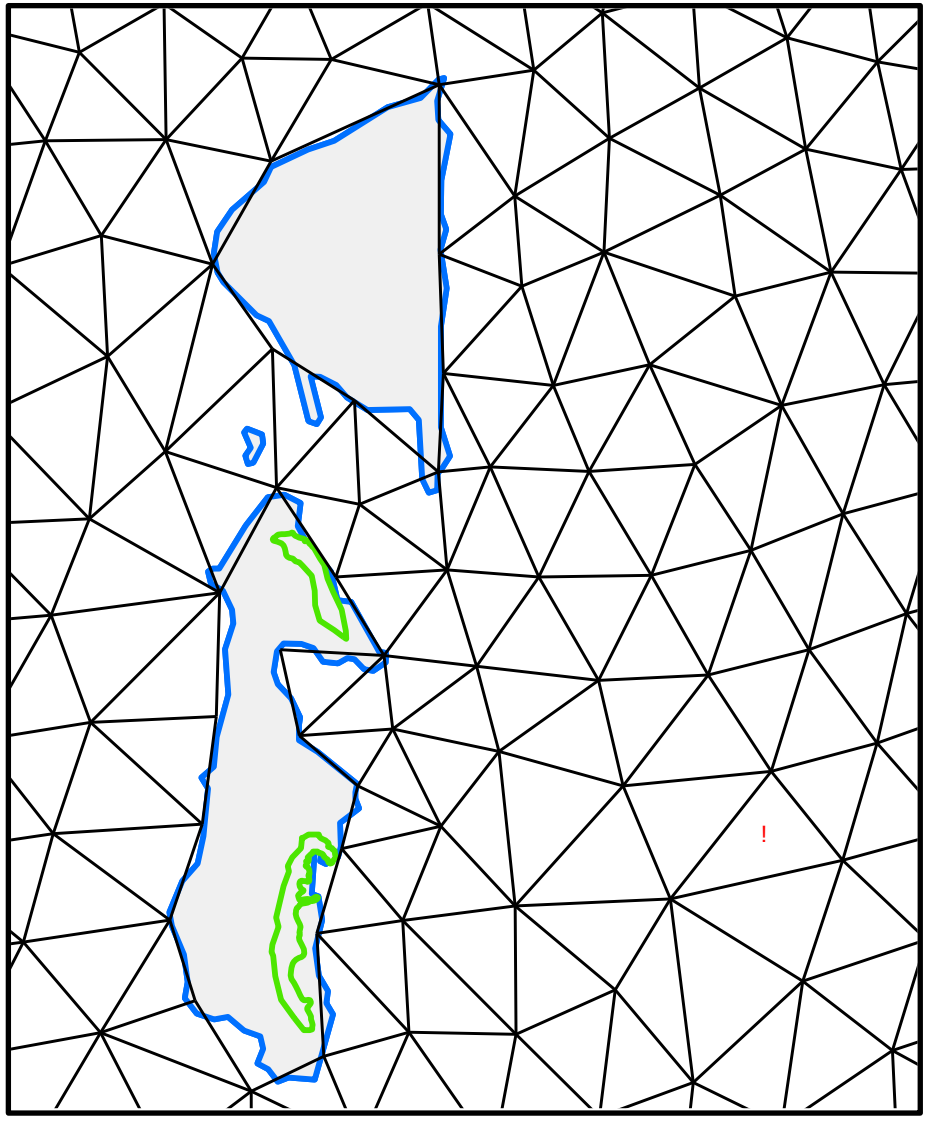


- The James and Taylors islands were once connected.
- When it was settled in the 1660s it was called St. James Island and totaled 1,350 acres.
- By 1877 James Island had split into two land masses with a total acreage of 1,134. It then had about a dozen homes, a school and a store.
- In 1892 twenty families lived there.
- Byy 1910 all but seven residents moved to the mainland.

James Island's fate in the CBPO's record

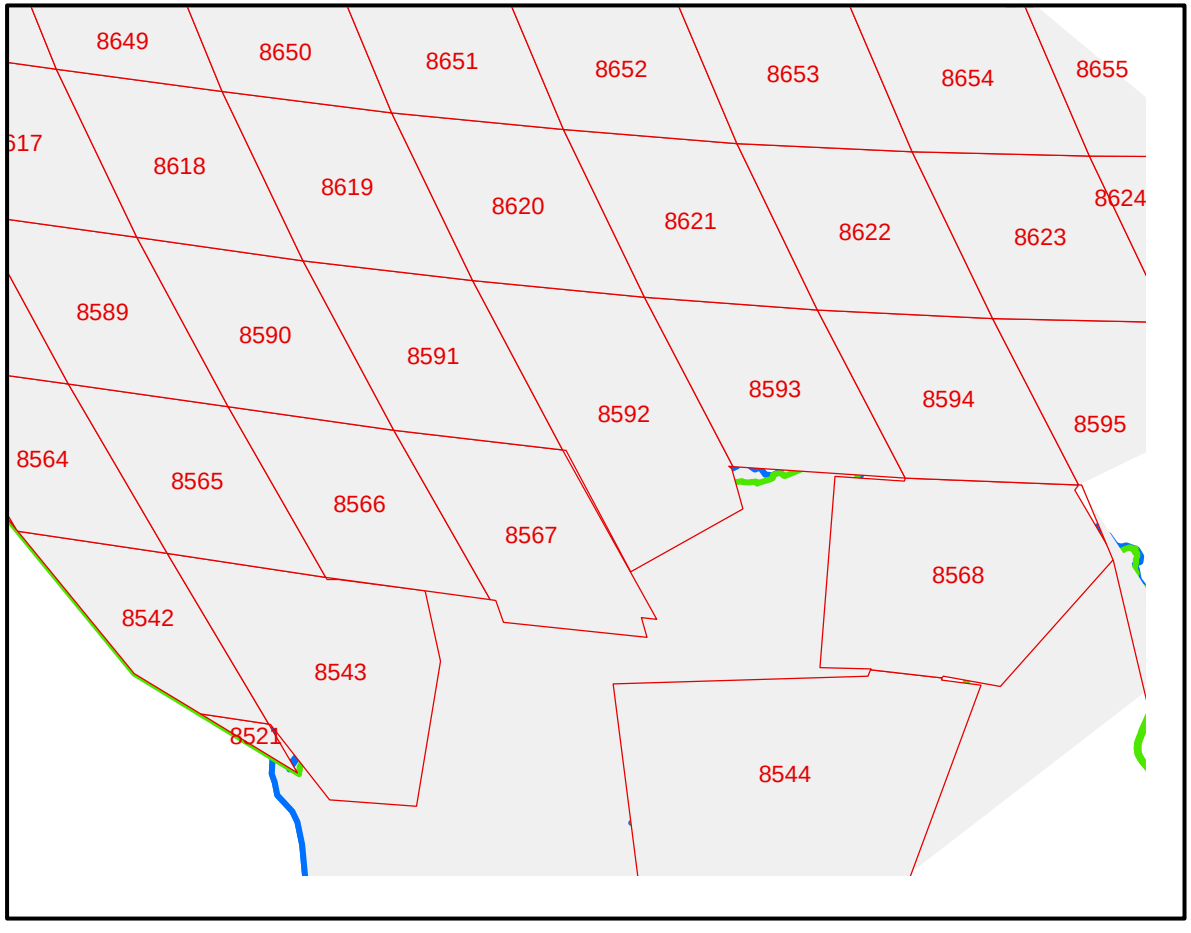


Grid based on the Phase 6 shoreline

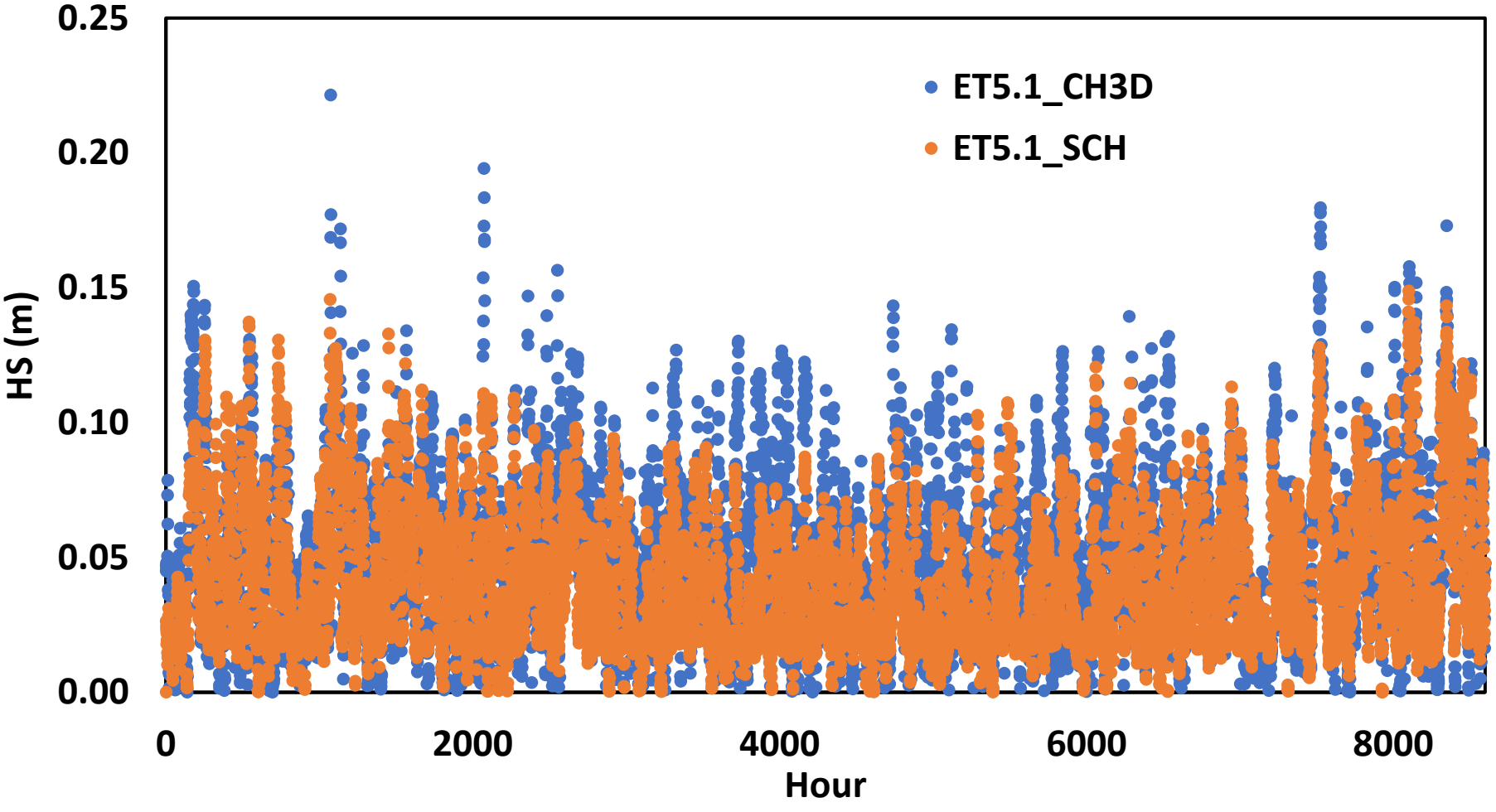


James Island shoreline erosion rate

Eroded area (m2)
8566 (cape): 100,698
8565: 82739
8589: 49119
8590: 314002
8618: 144833 (=43785+2966+98082)
8619: 246895



Significant wave height at Station ET5.1



Message

- **Dynamics simulation redistributes shoreline erosion in time and space based on wave power.**

- **Work in progress in the Choptank**