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

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Modeling Quarterly Review
October 18, 2023
Annapolis

Phase 6 shoreline erosion

- Digitally measured 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

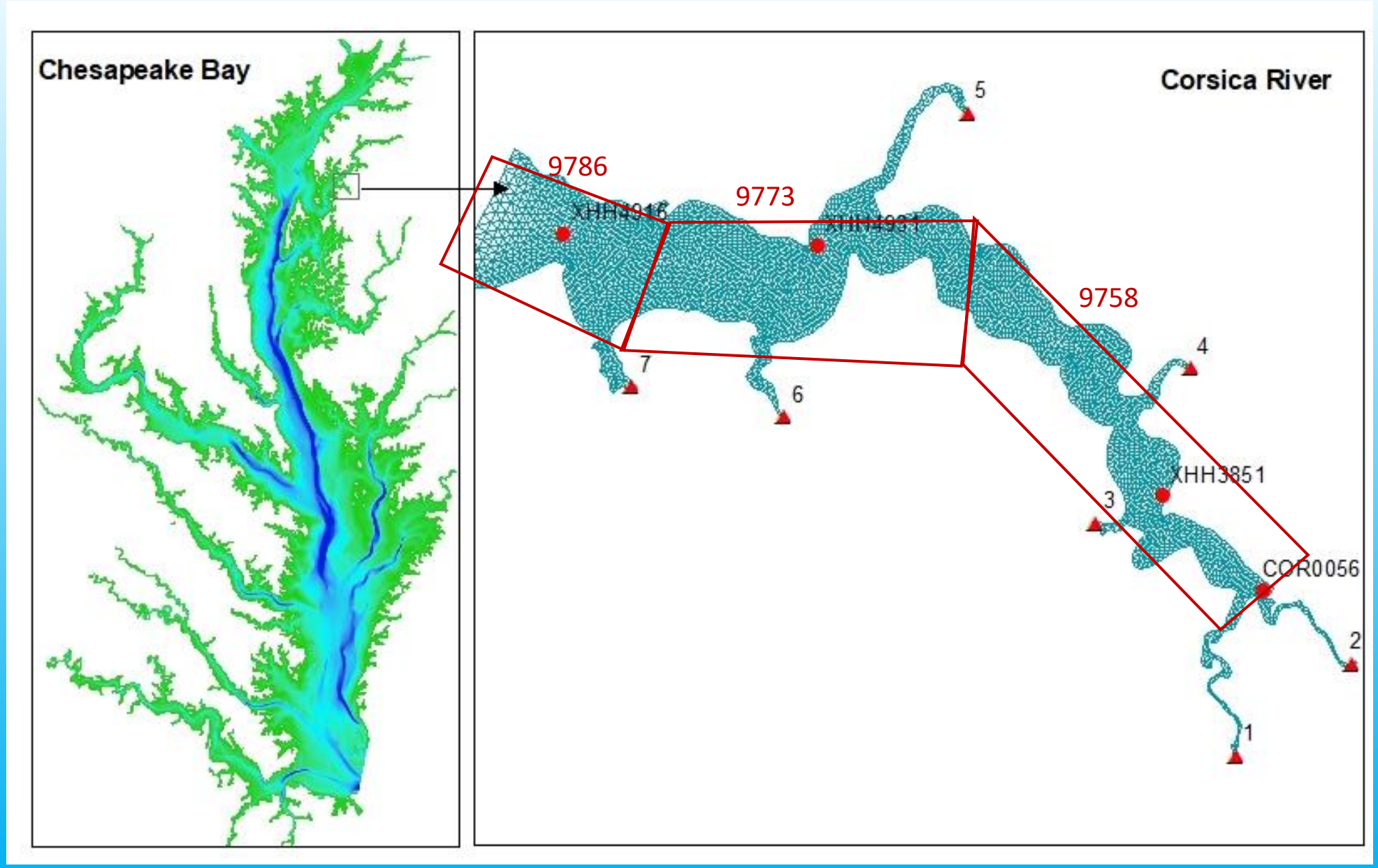
$$Eh\rho_{dry} = \alpha'(P - P_{crit}) f(\frac{D}{h}) \quad (1)$$

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

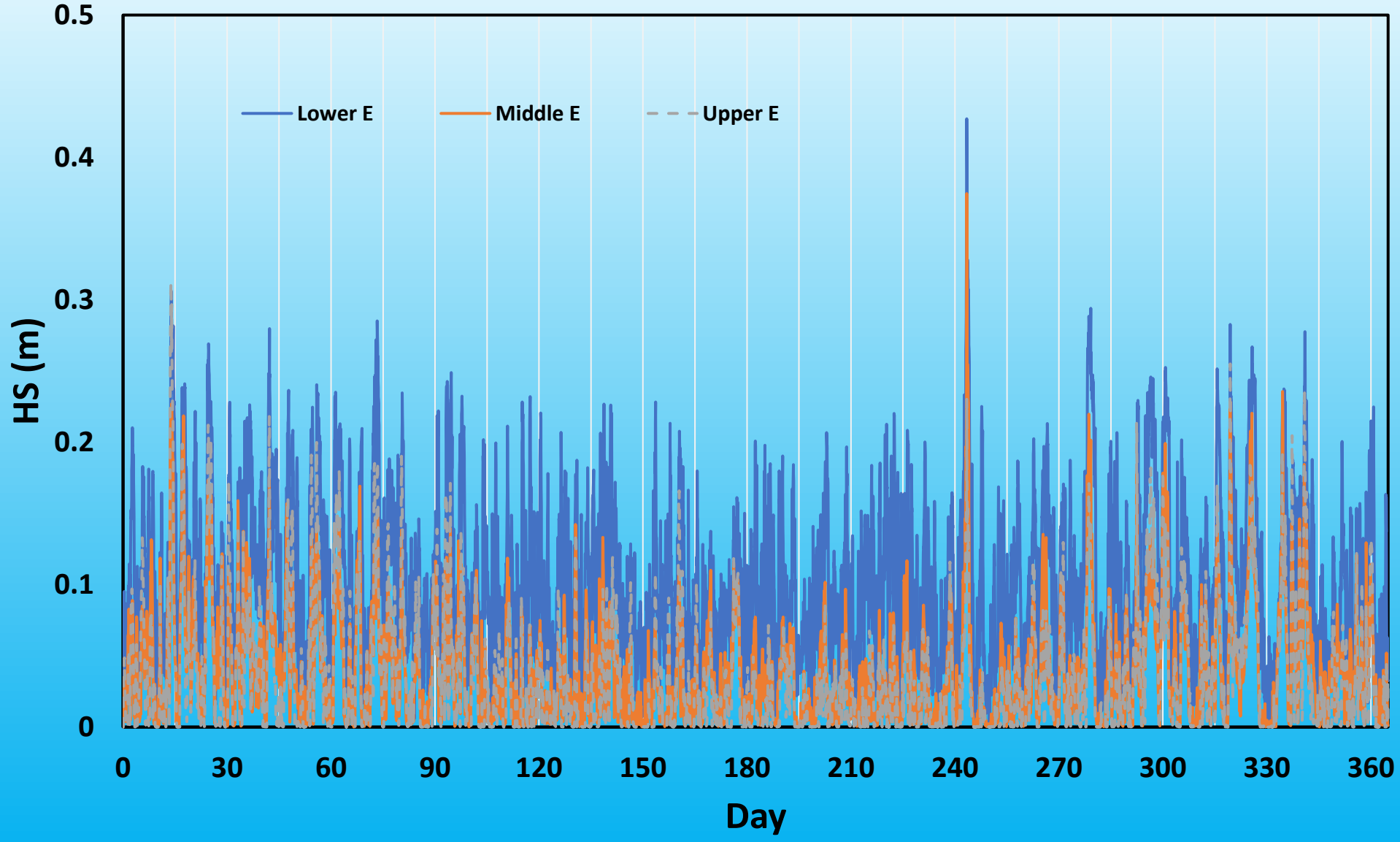
Significance

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

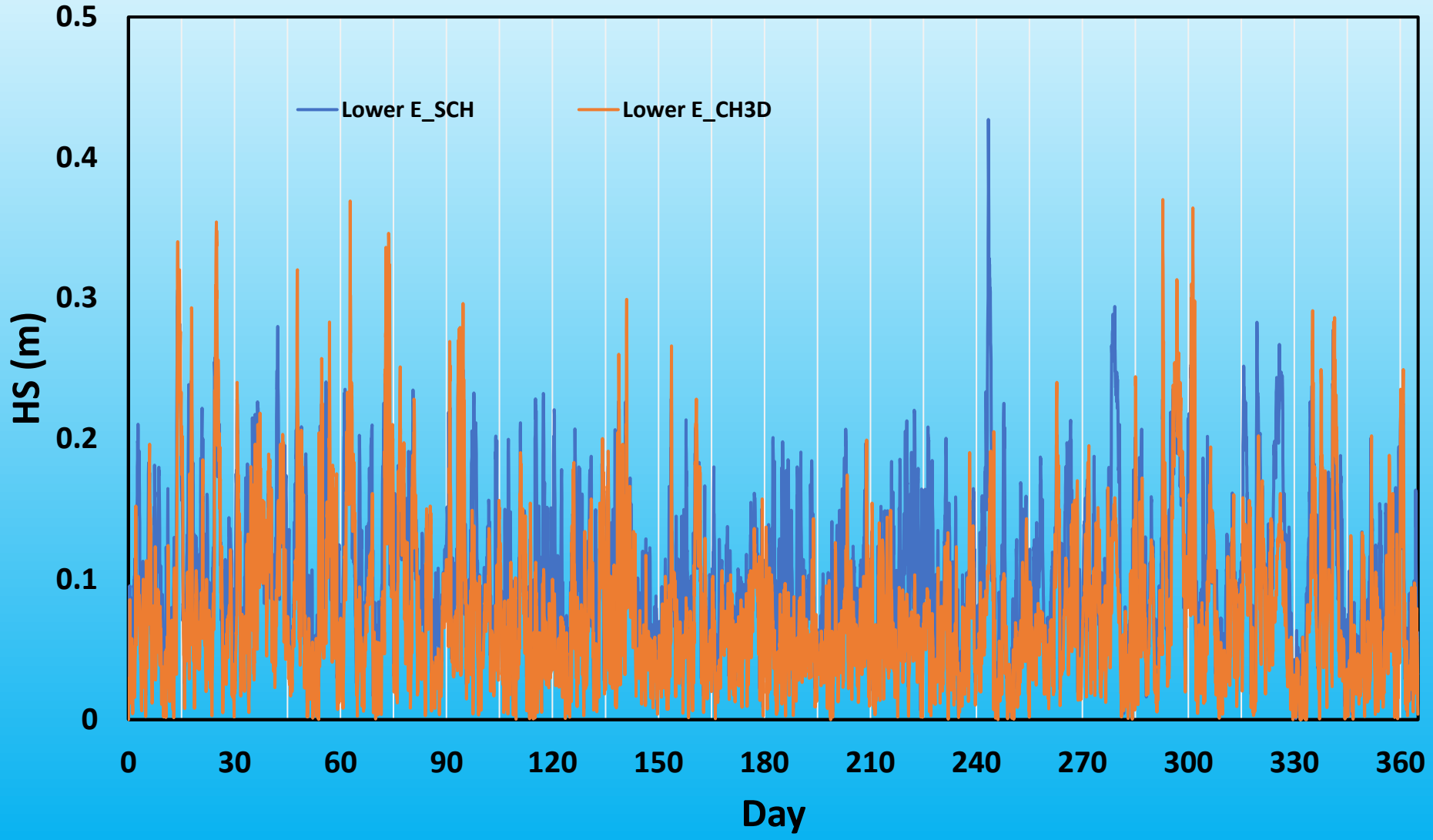
Corsica river grid



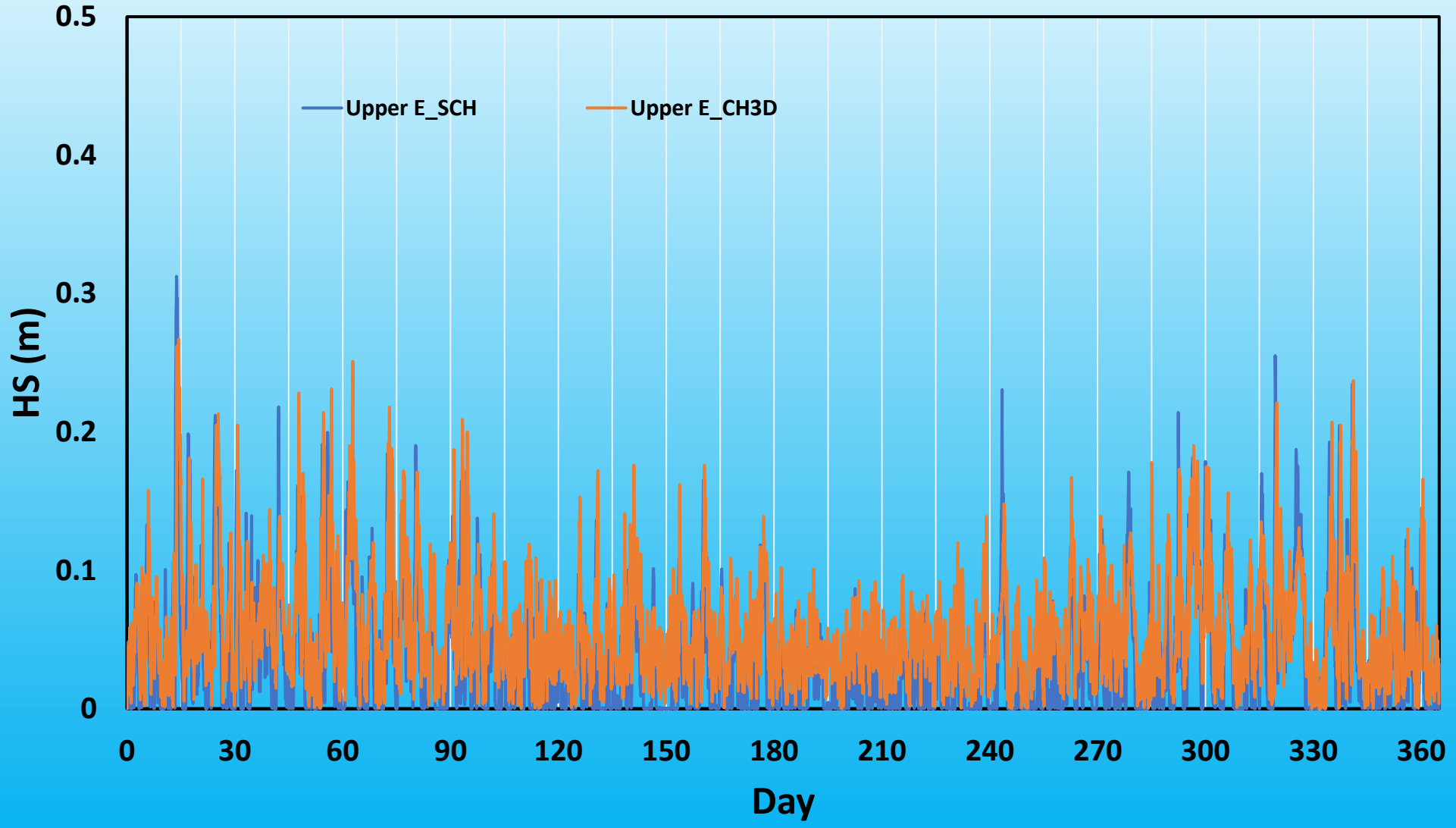
Significant wave height at the lower, middle and upper estuary stations in the Corsica River



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



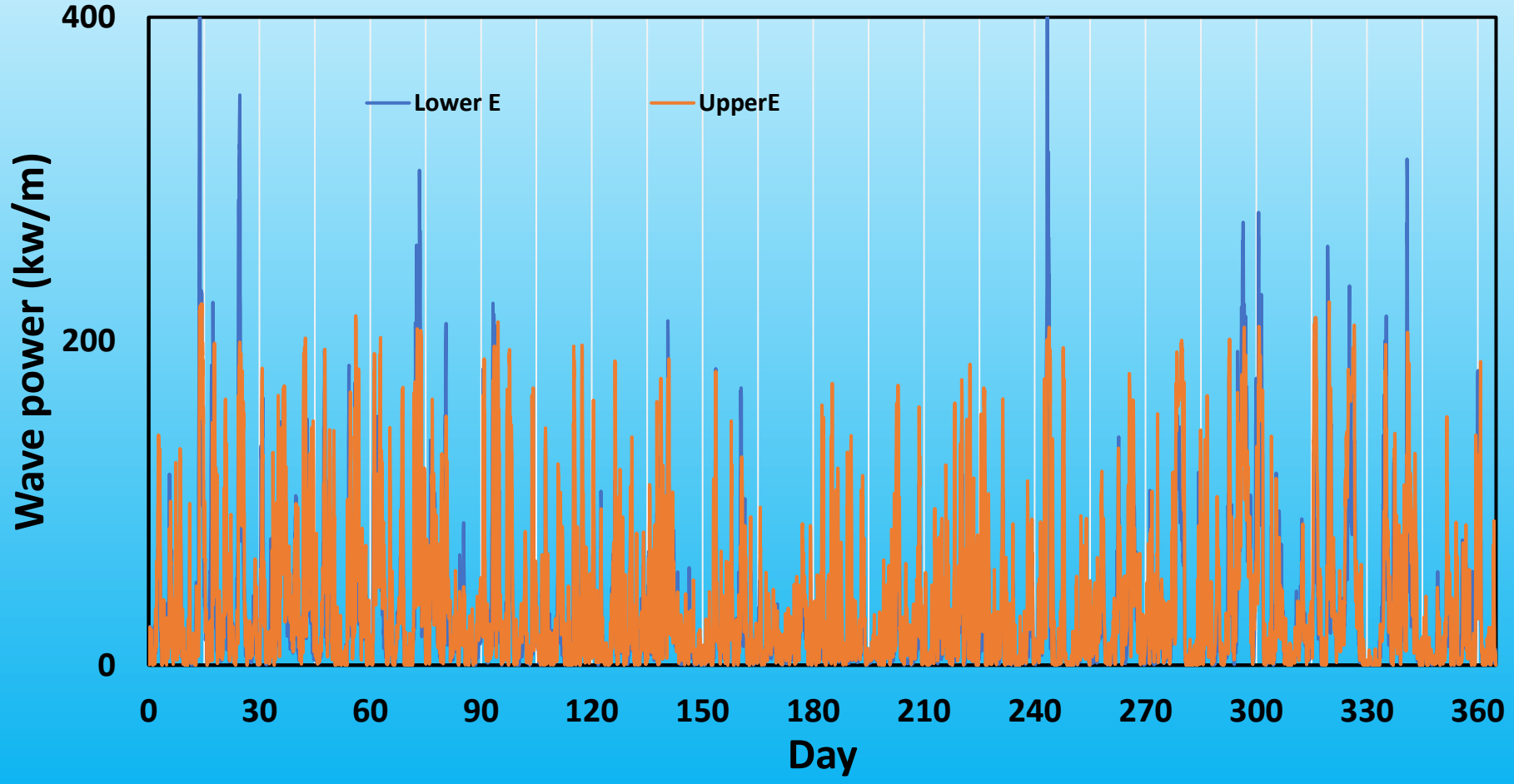
Comparison between schism (blue) and CH3D (red) at the upper estuary station



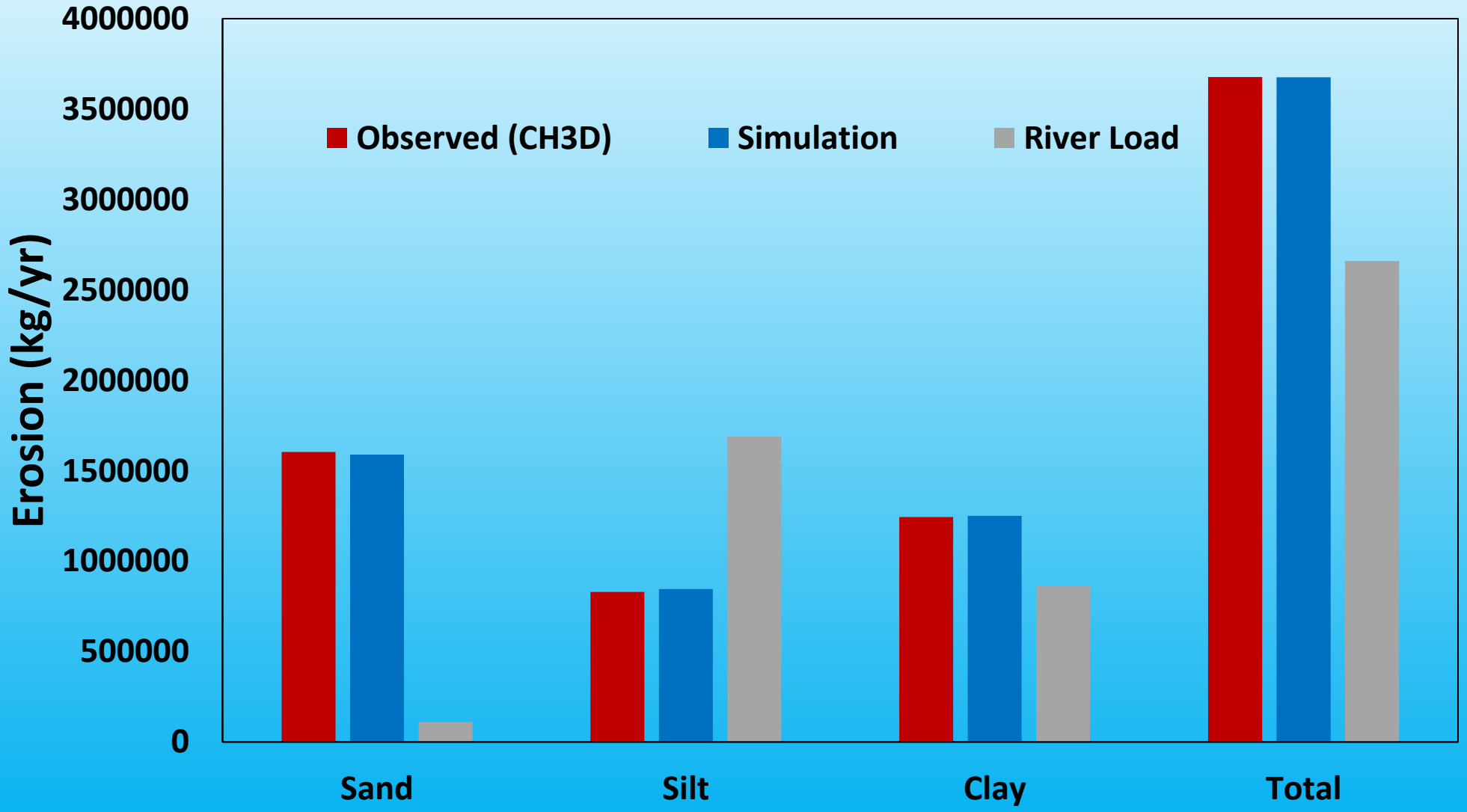
Wave Power

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

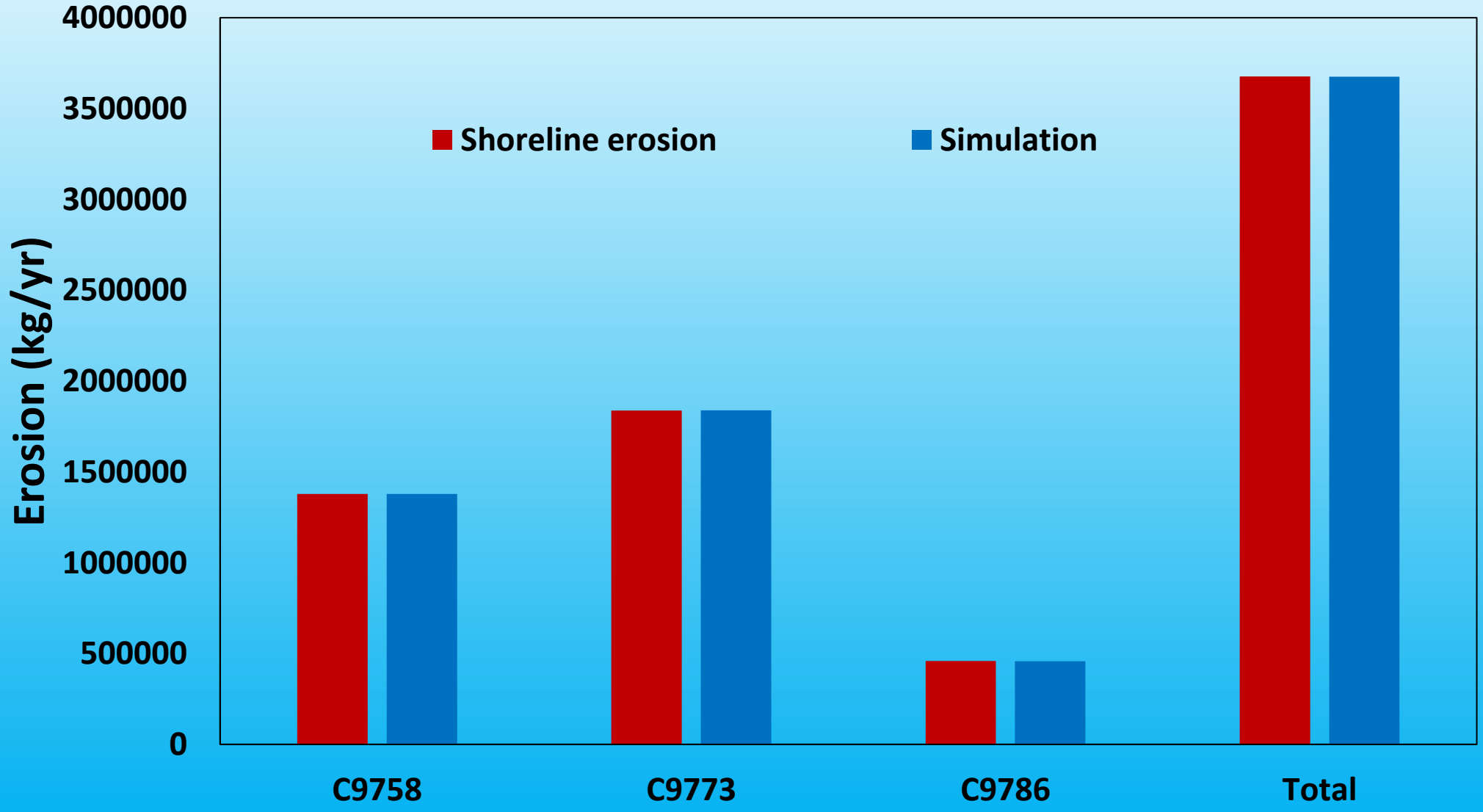
Where H_s is significant wave height, c_g is wave group velocity, and α is the angle of wave approach.



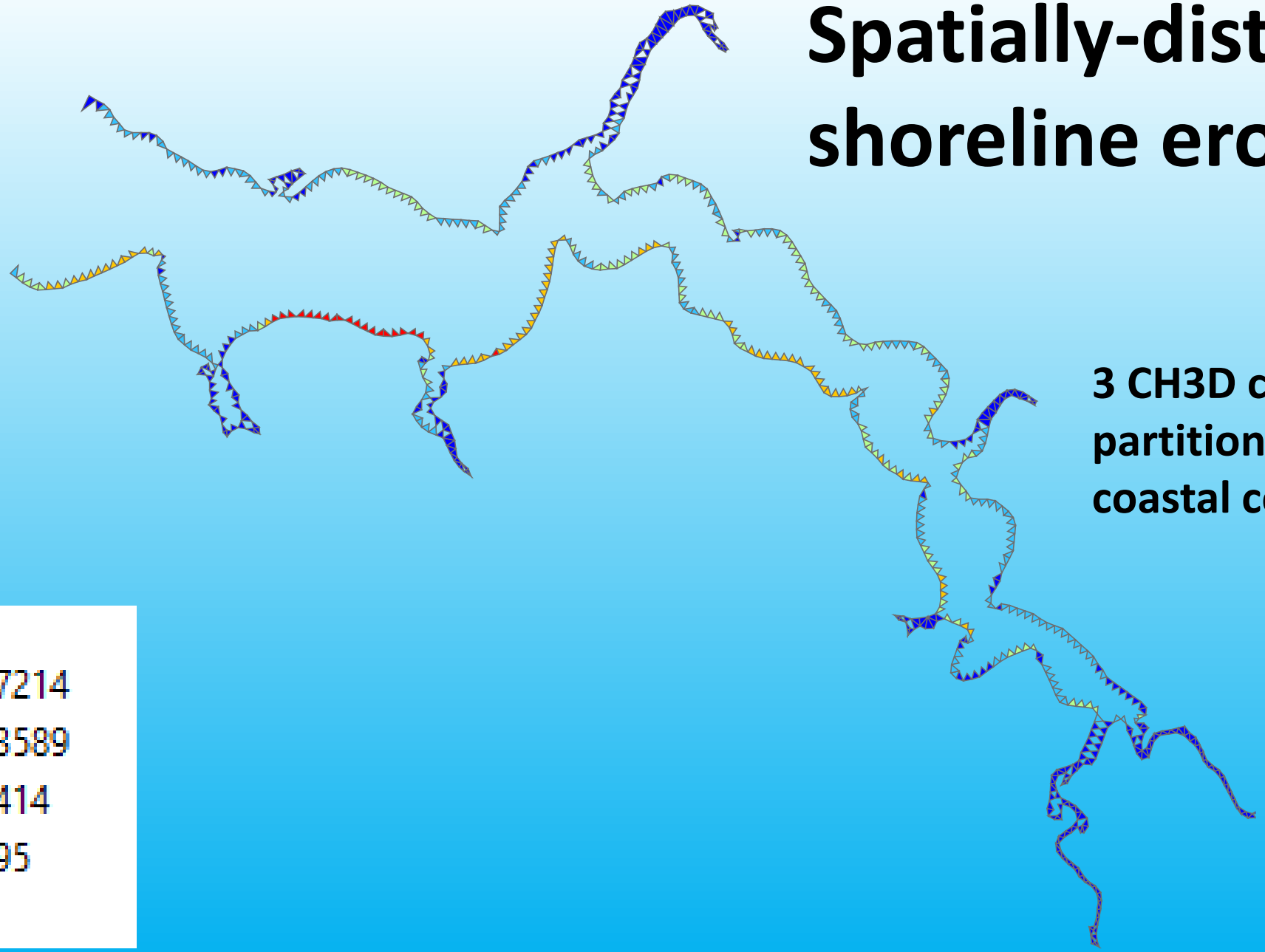
Simulated versus observed shoreline erosion in the whole estuary



Simulated versus observed shoreline erosion at each calibration cell (20230428)

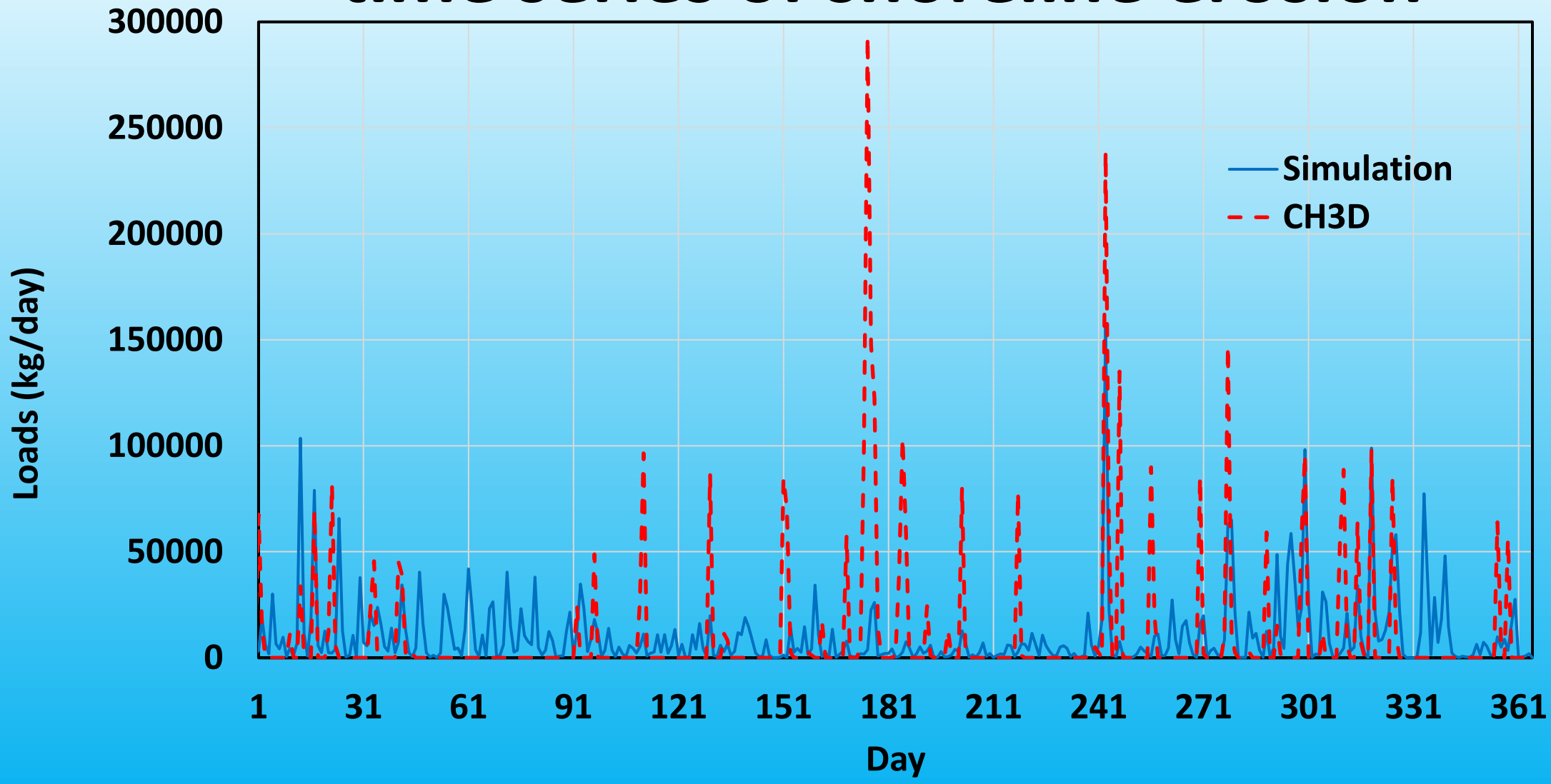


Spatially-distributed shoreline erosion

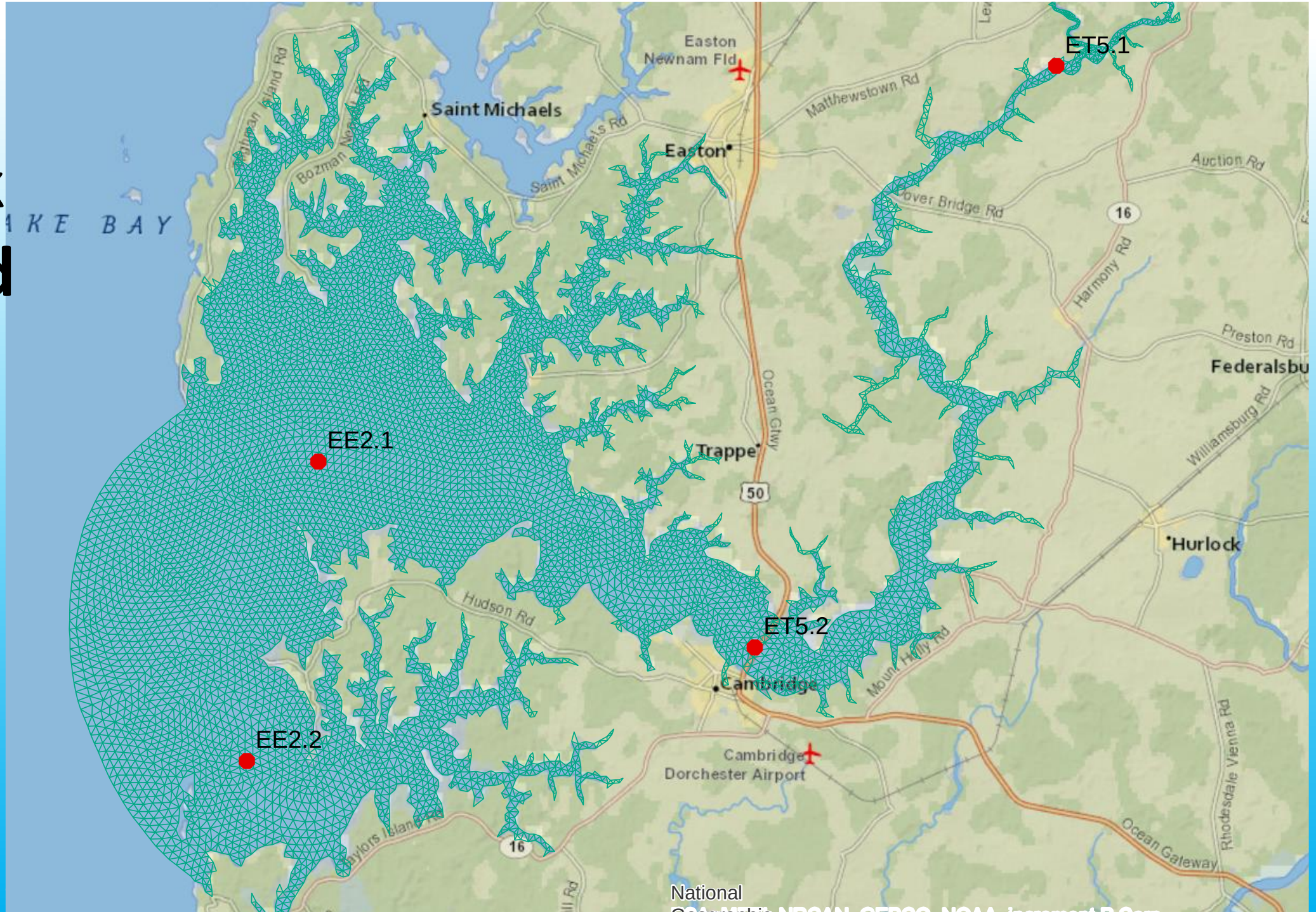


3 CH3D cell partitioned to 733 coastal cells

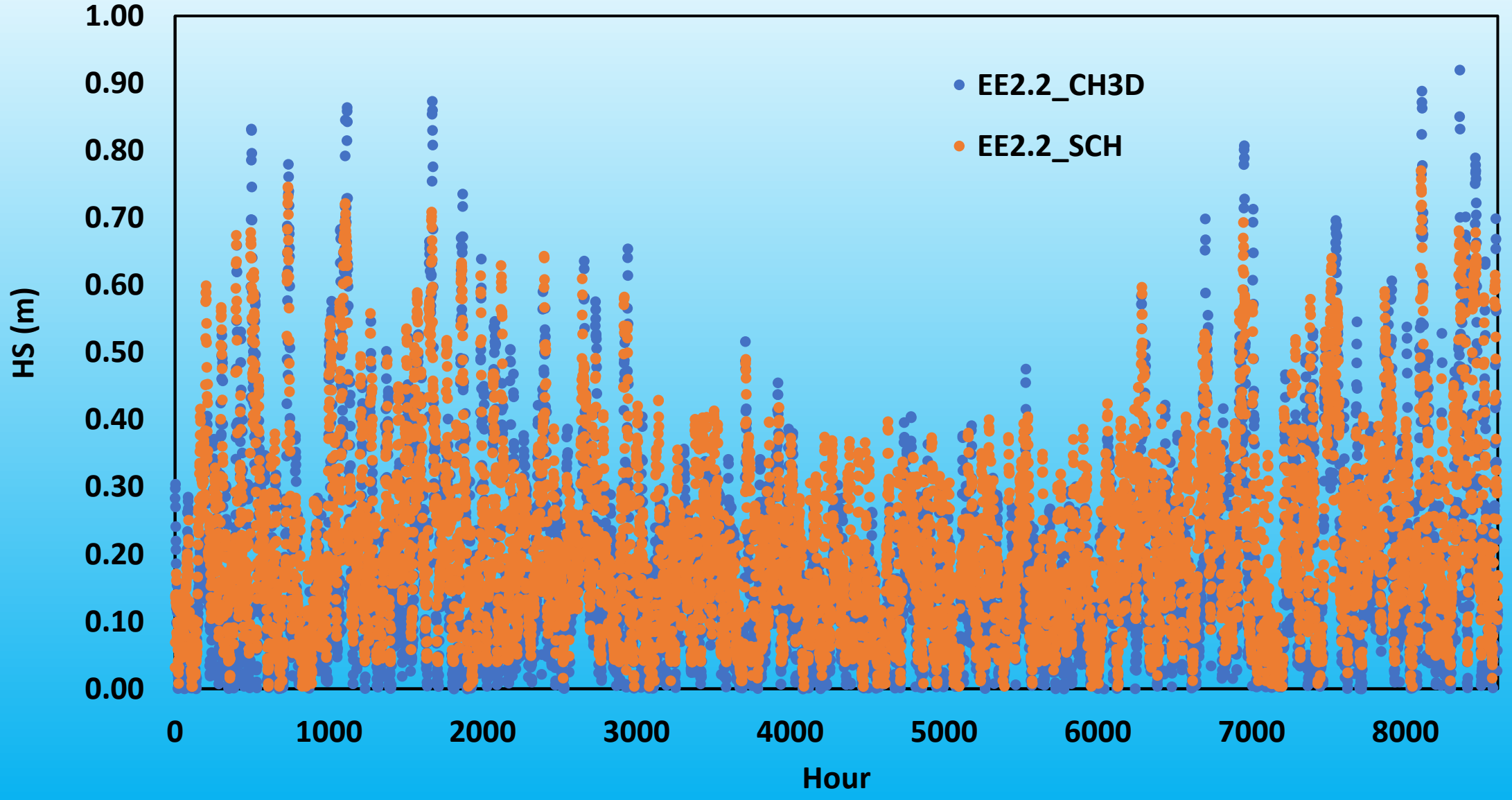
Wave-driven versus hydrology-driven time series of shoreline erosion



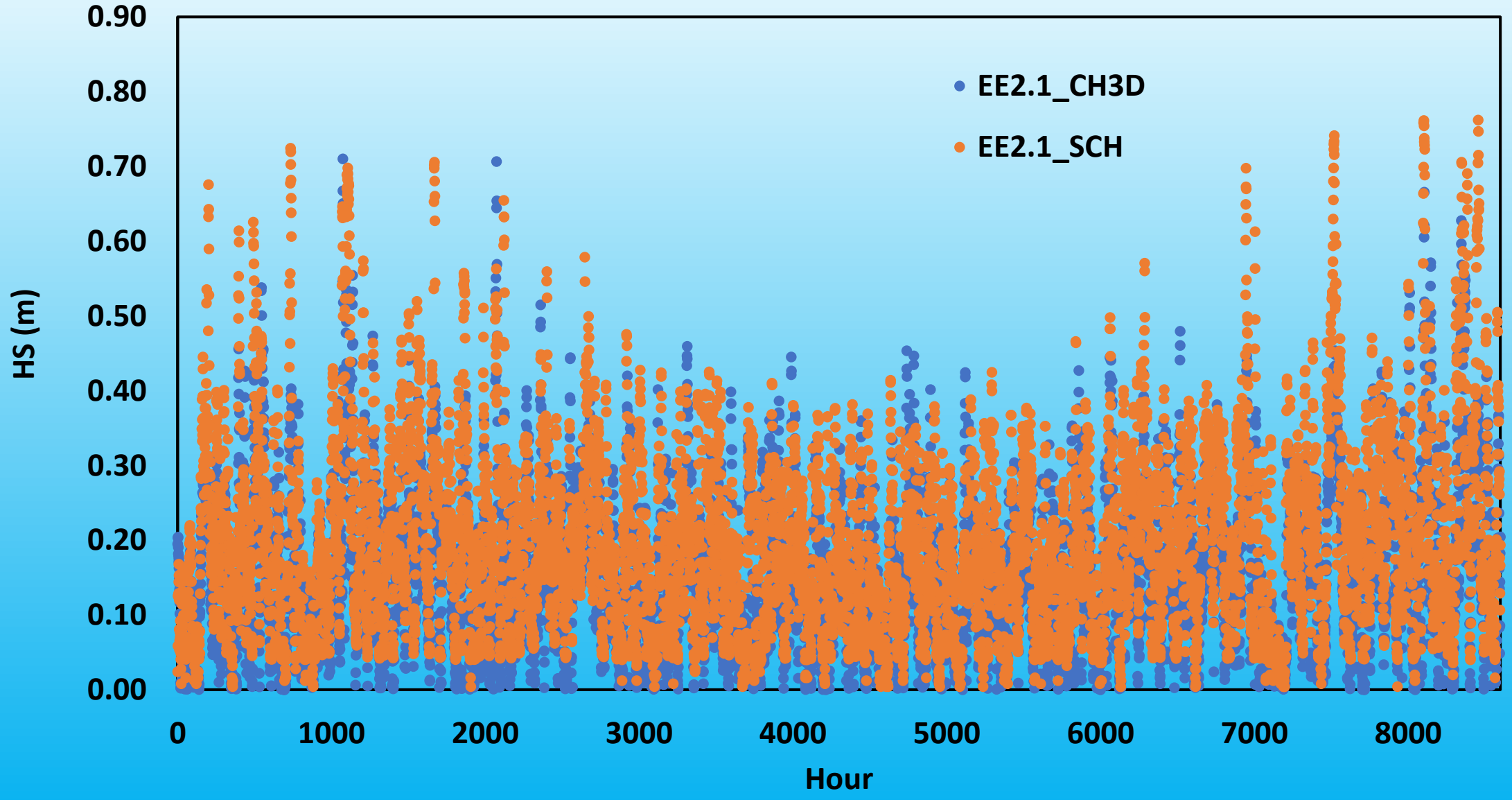
Choptank River Grid



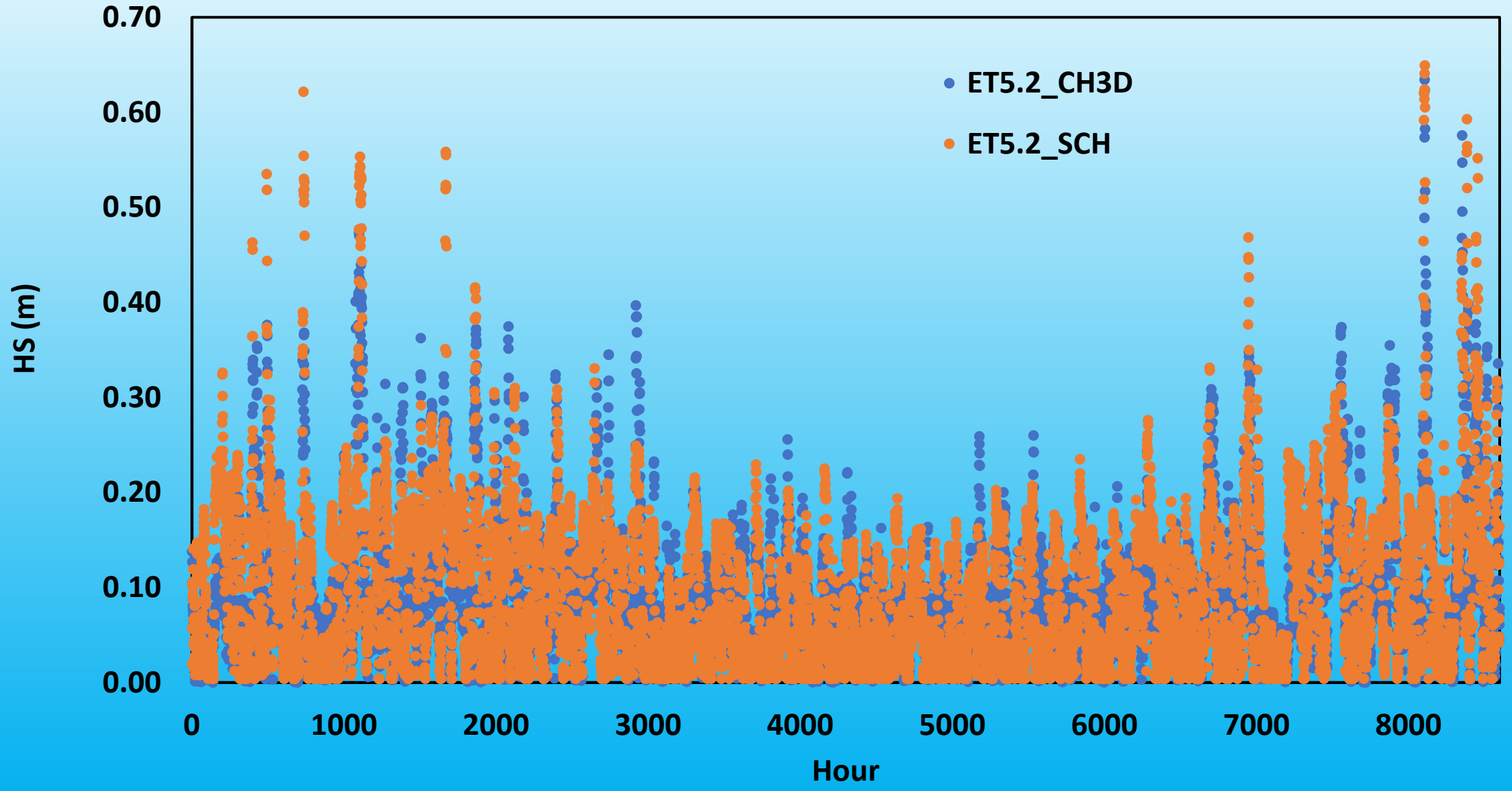
Significant wave height at Station EE2.2



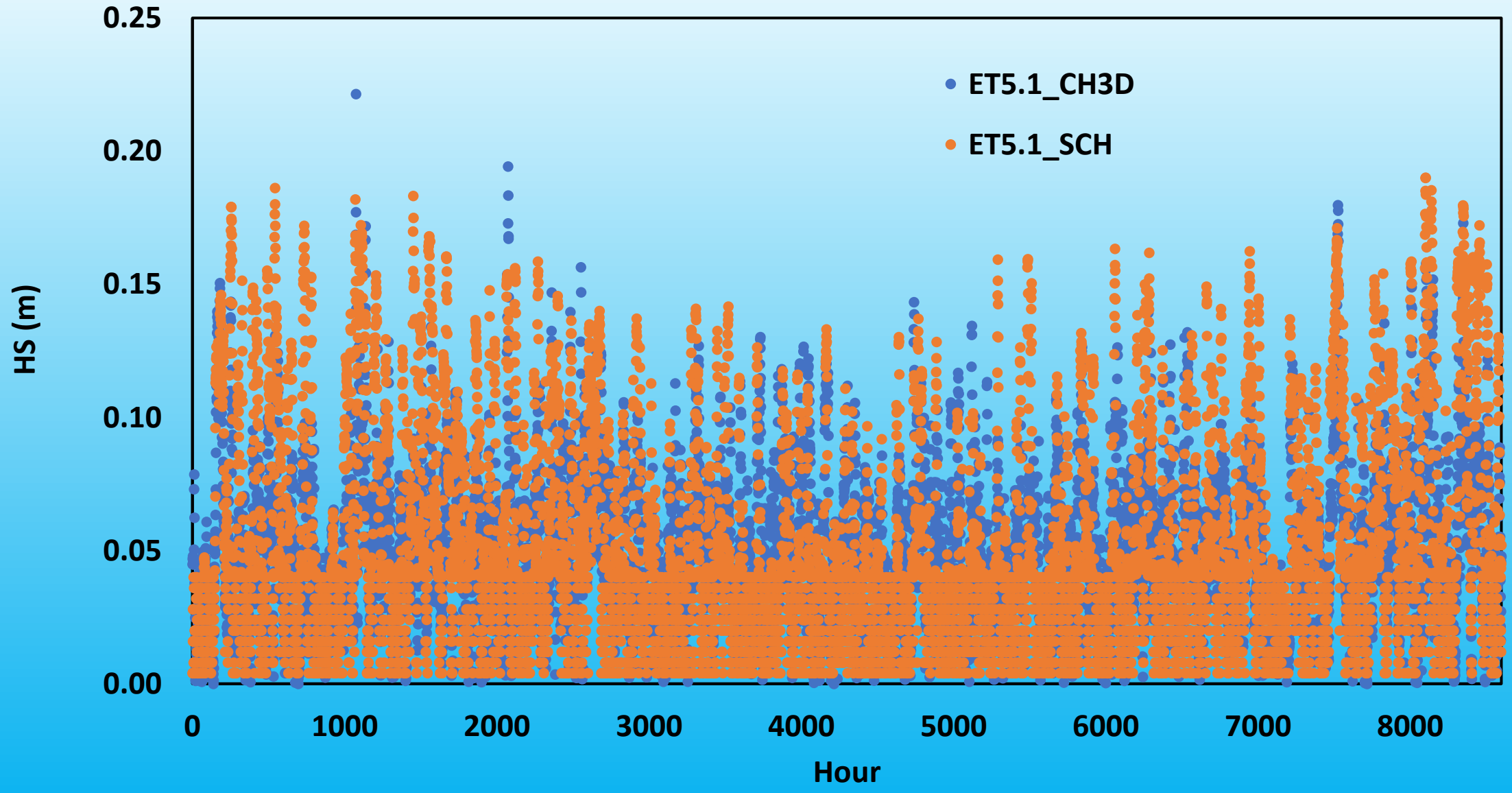
Significant wave height at Station EE2.1



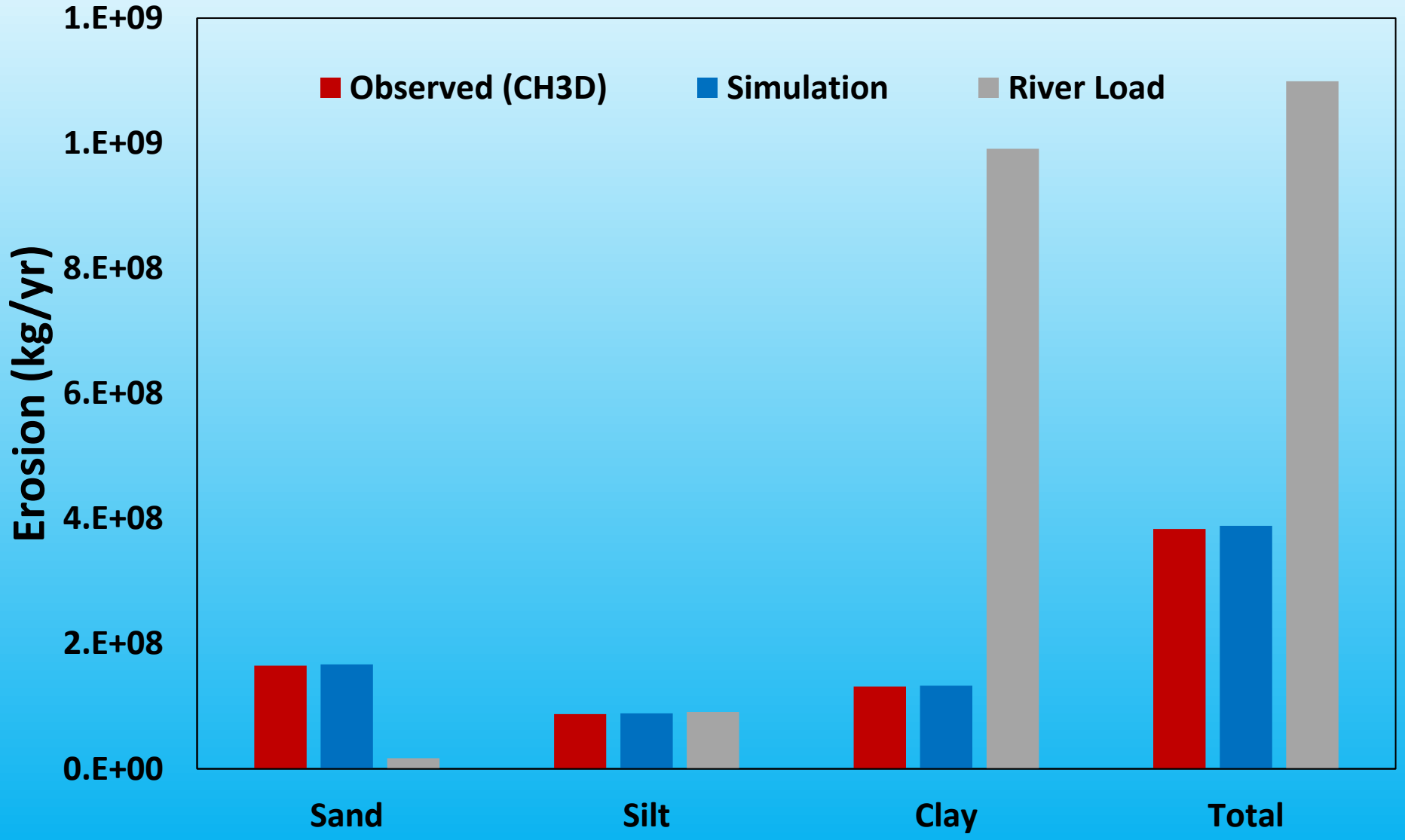
Significant wave height at Station ET5.2



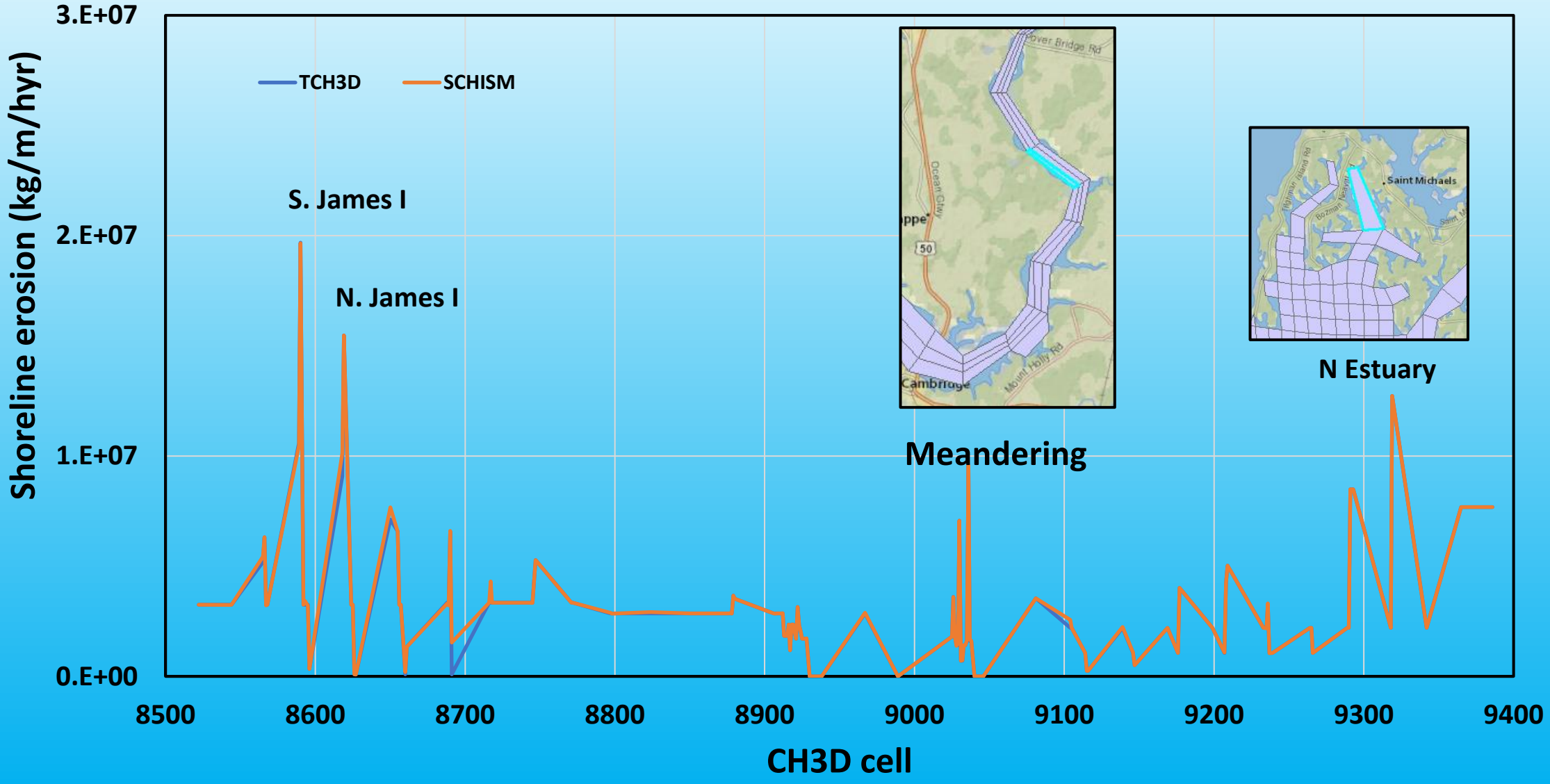
Significant wave height at Station ET5.1



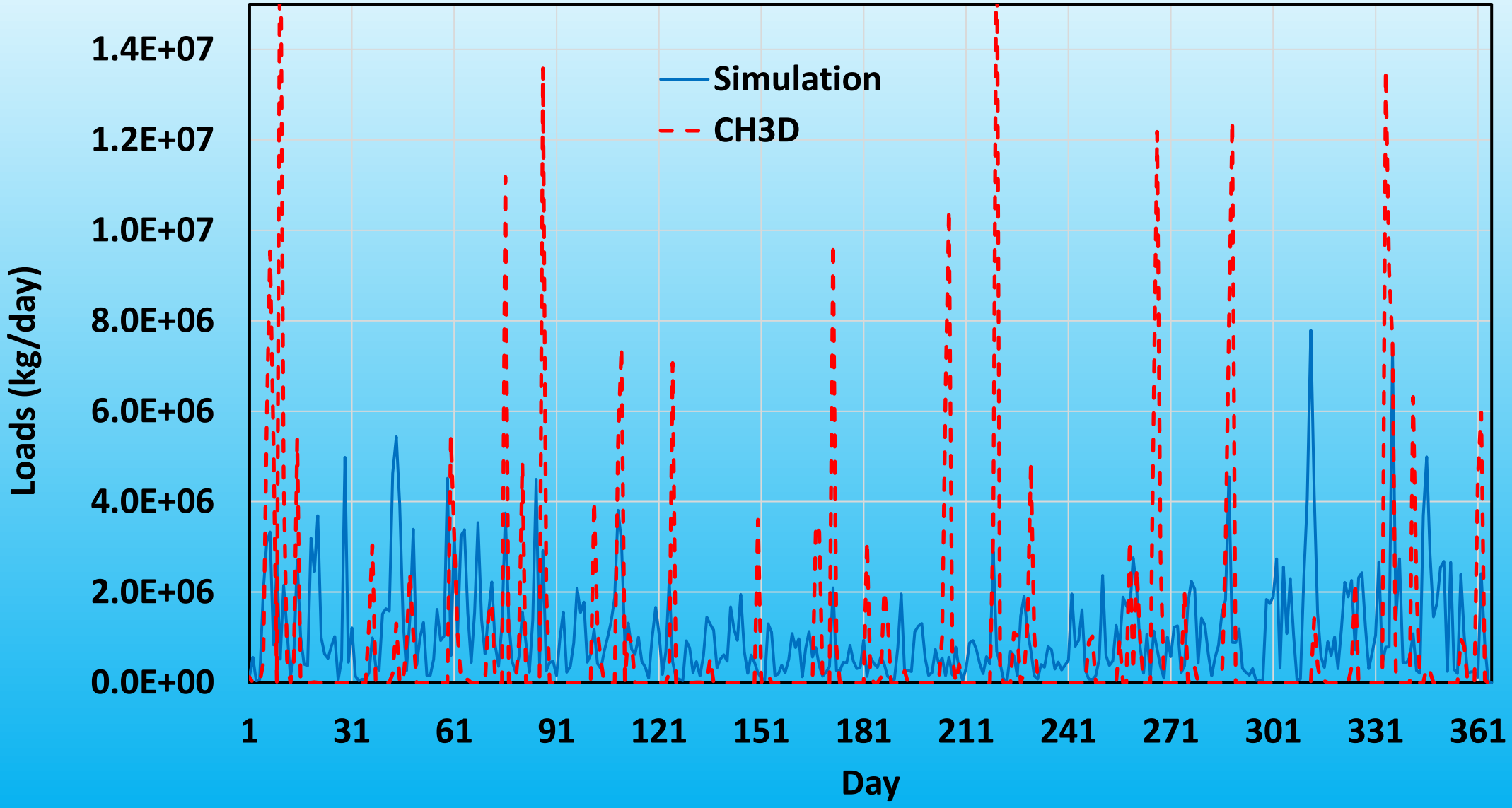
Simulated versus observed shoreline erosion in the whole estuary



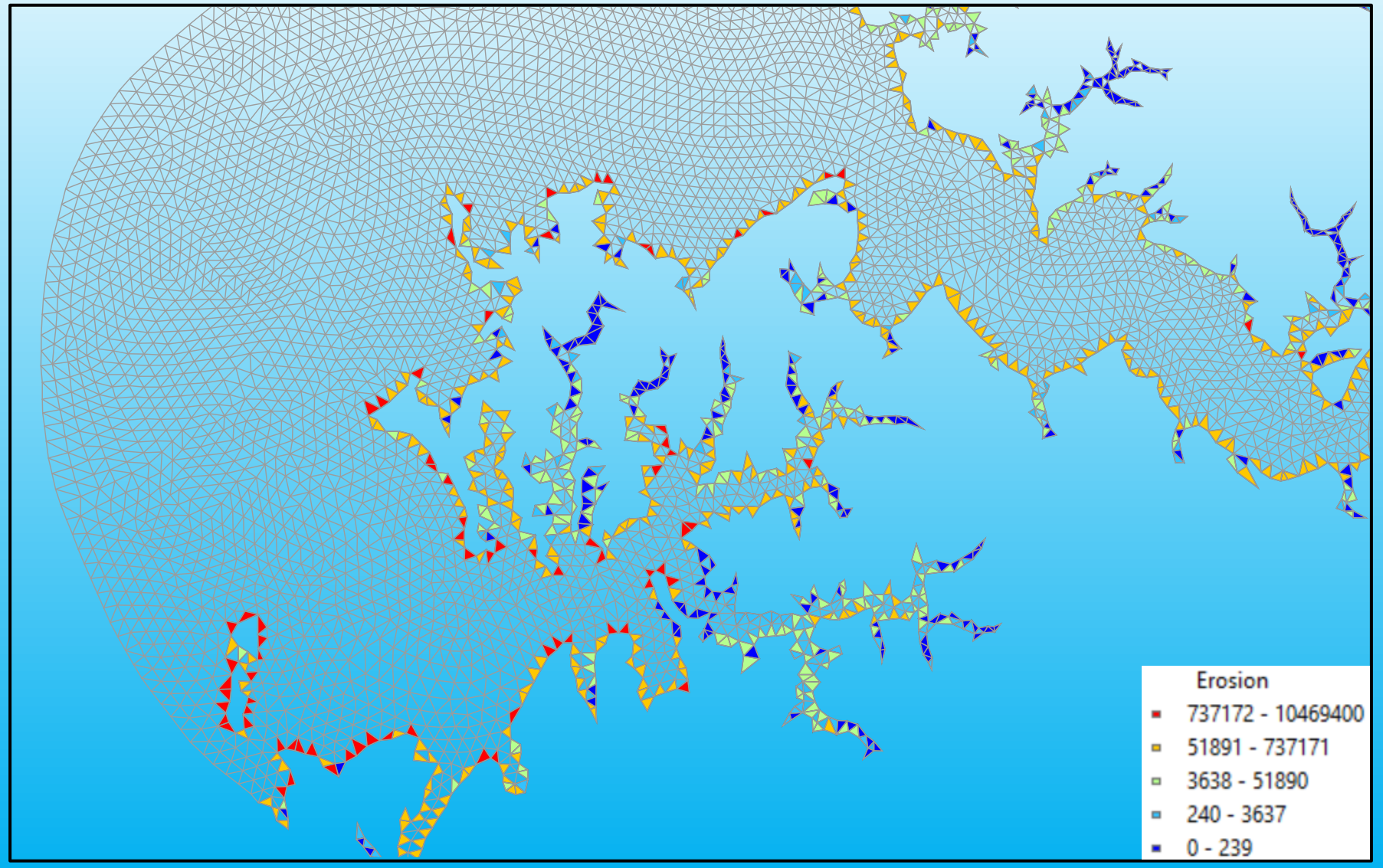
Comparison of wave-driven versus measured shoreline erosion at each coastal CH3D cell



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



Spatial distribution of wave-driven shoreline erosion in the Choptank River



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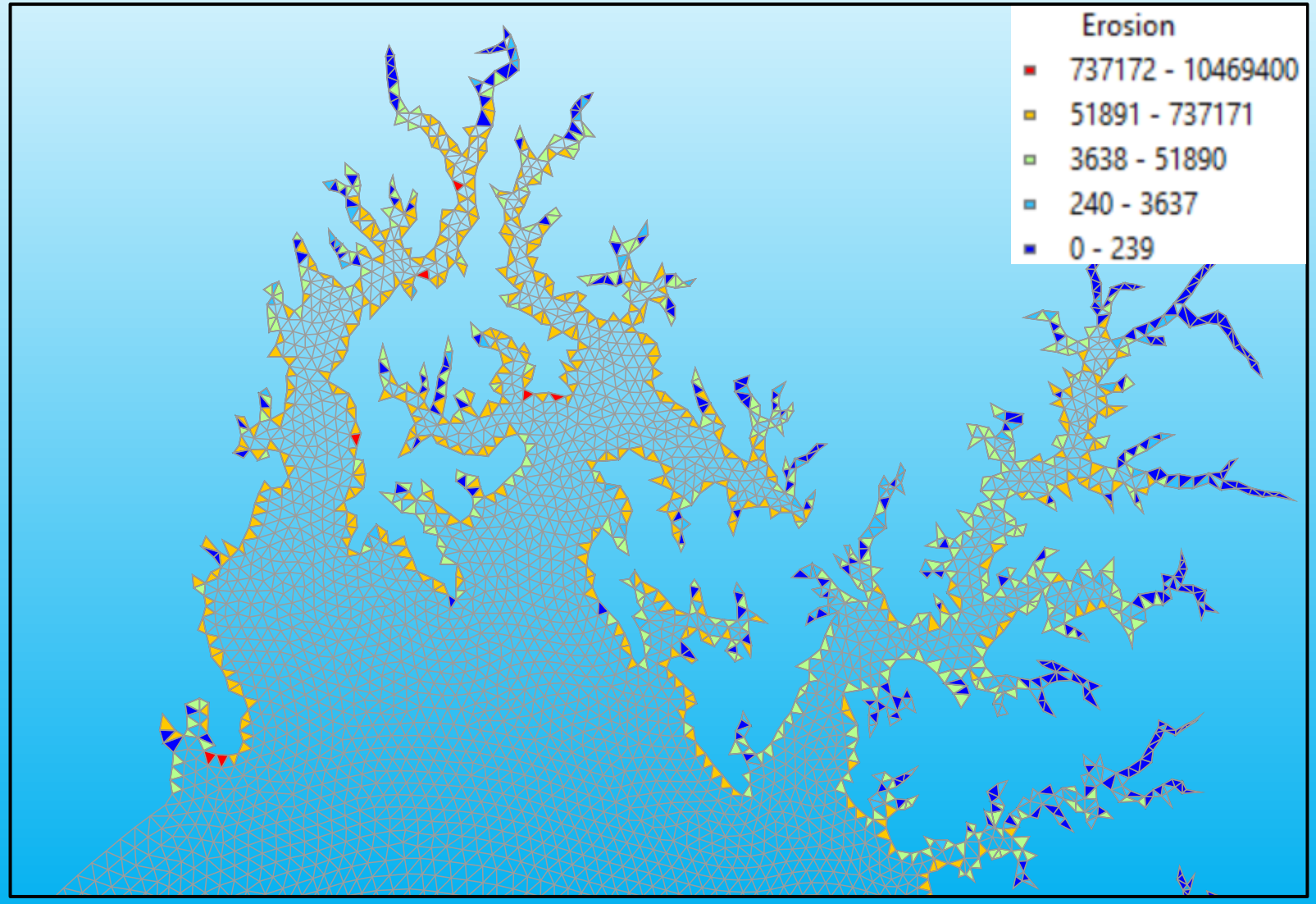
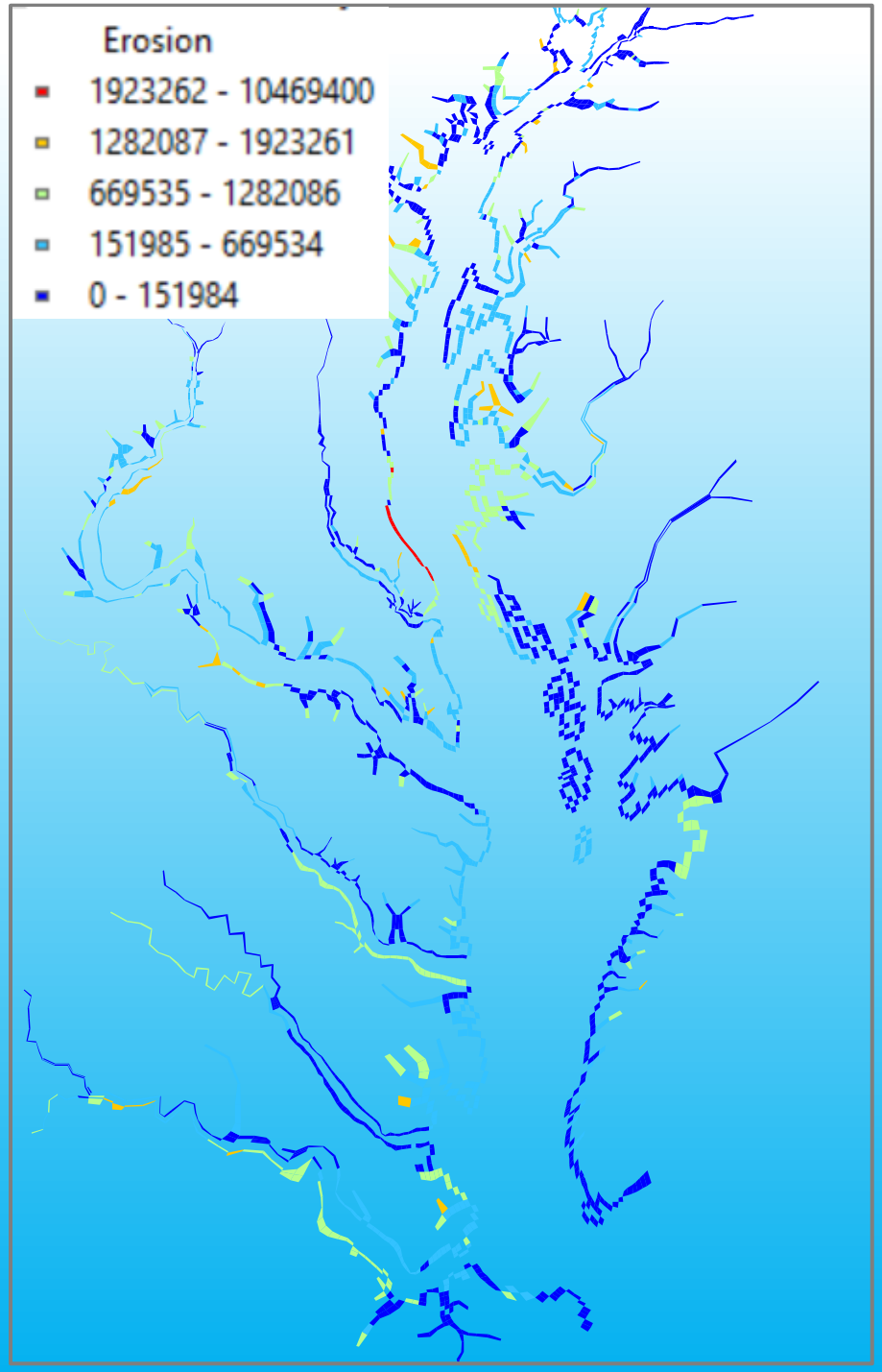


Measured annual shoreline erosion in the whole bay



Message

- The wave model functioned properly.
- Wave-driven shoreline erosion reproduced the measured erosion.
- Wave power redistributed shoreline erosion in space time.

Question

- Should be applied bay-wide?
- Interannual variability?