

Shallow-water model for Chester River: Hydrodynamics and Water Quality

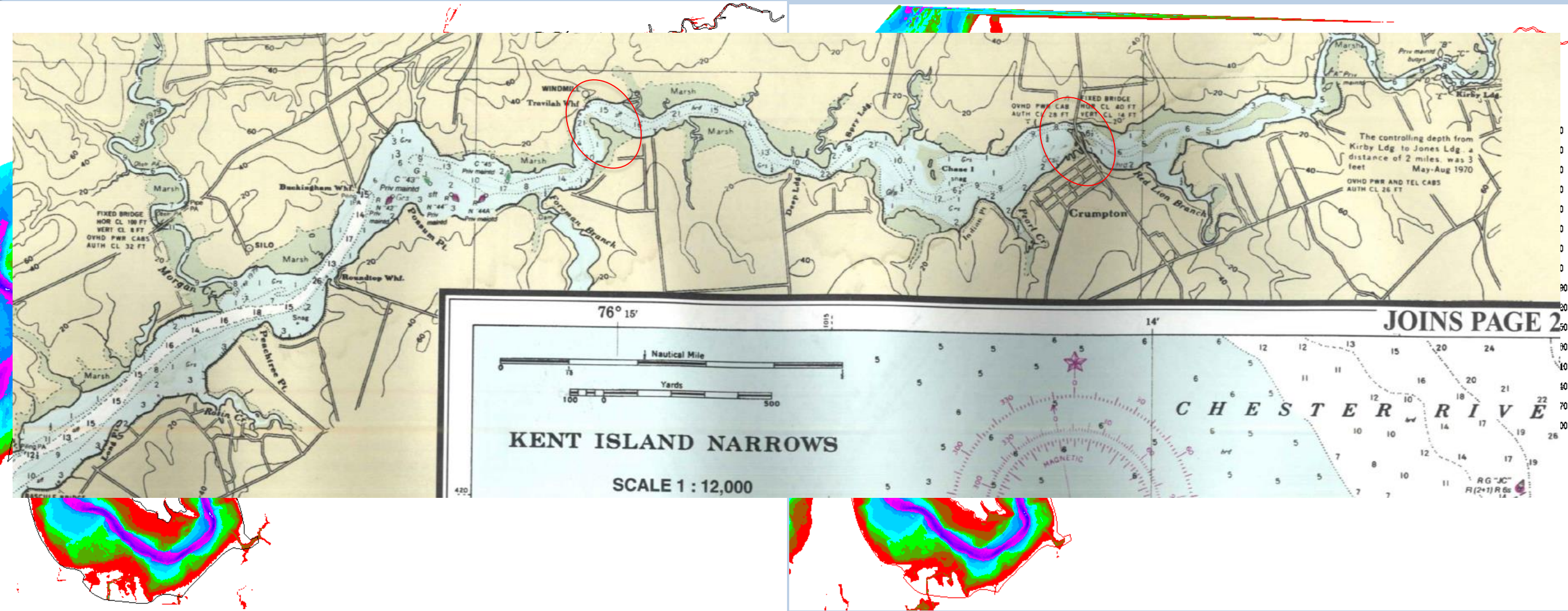
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April 20, 2016 Workshop

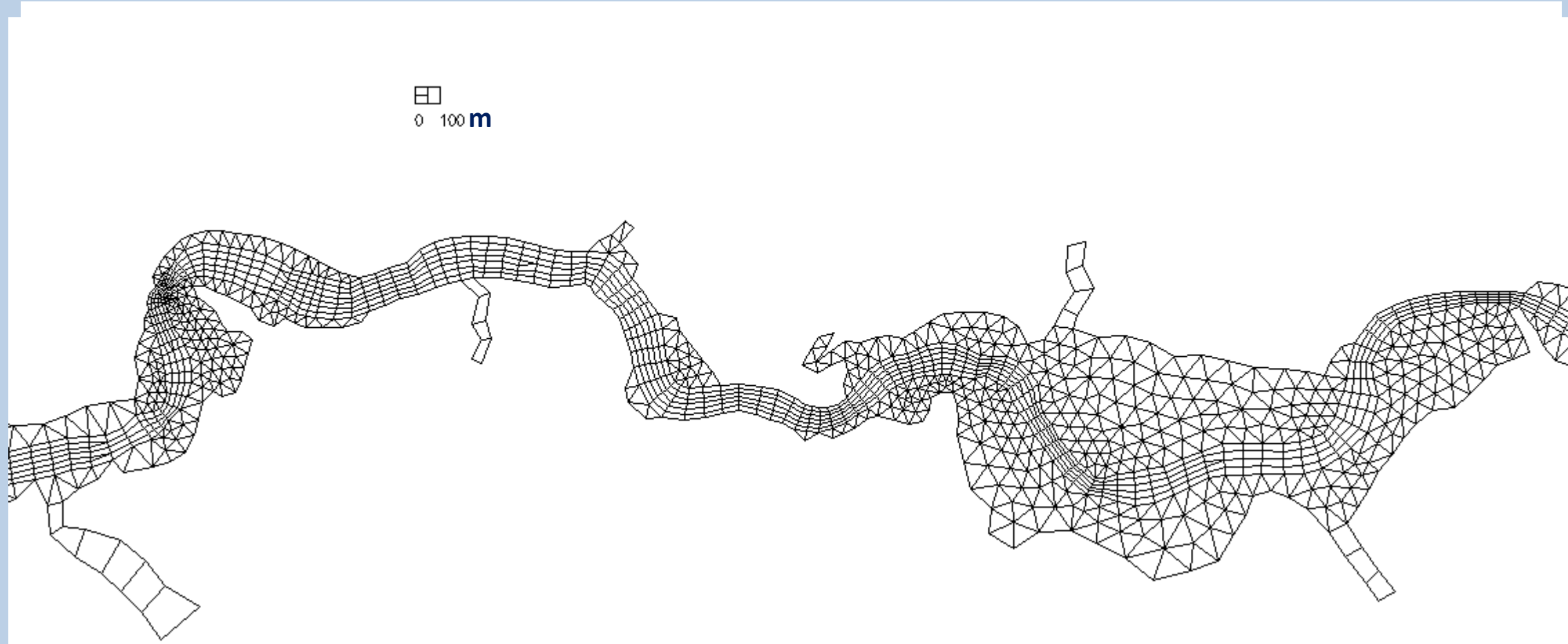
Outline

- I. Hydrodynamics from SCHISM: implication for WQ (Joseph)
- II. TSM from SCHISM-WWM-SED3D (Joseph)
- III. Water quality with SCHISM-ICM (Harry)

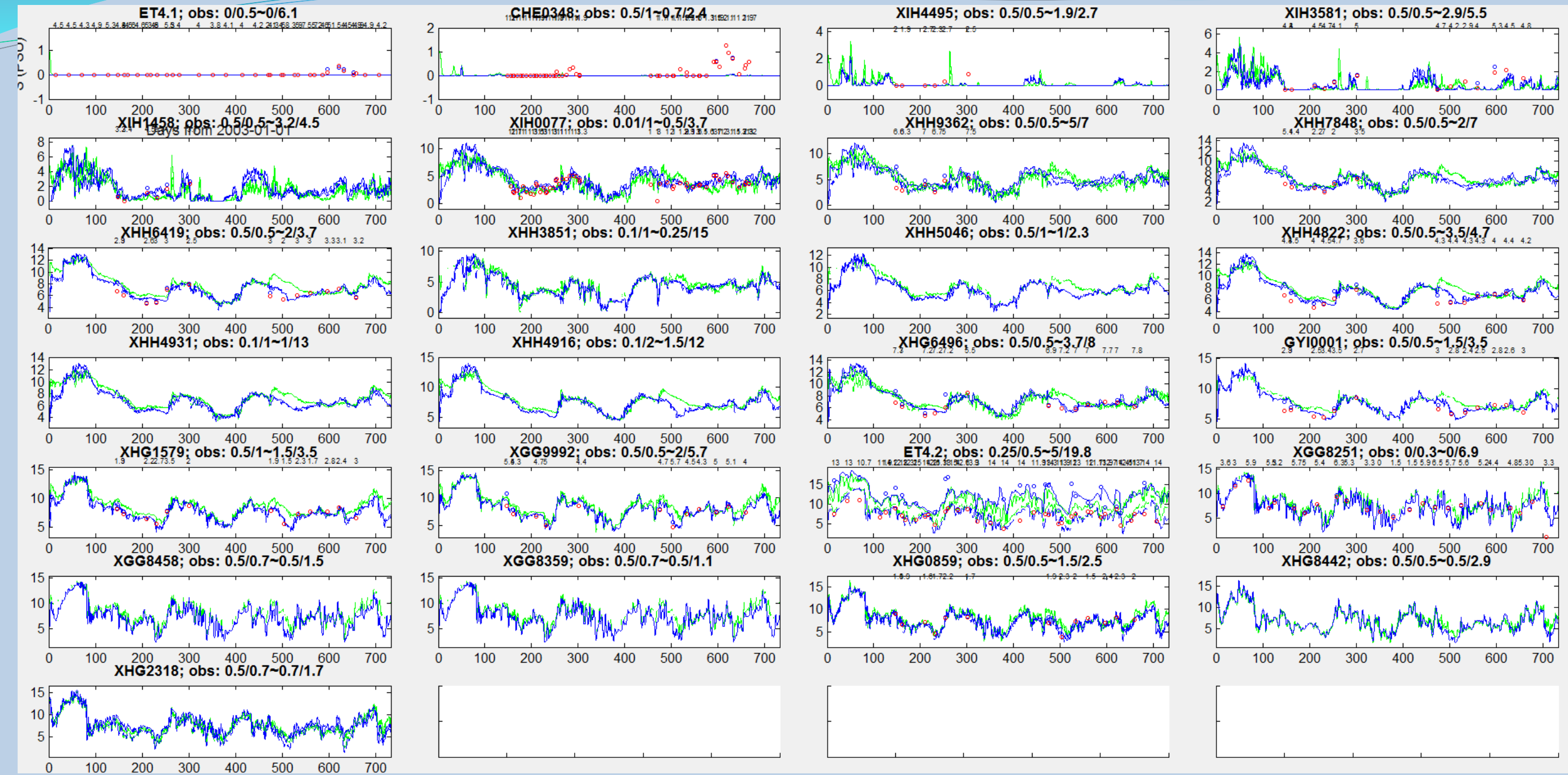
Sensitivity of salt intrusion to DEM and grid



Sensitivity of Salt intrusion to DEM and grid

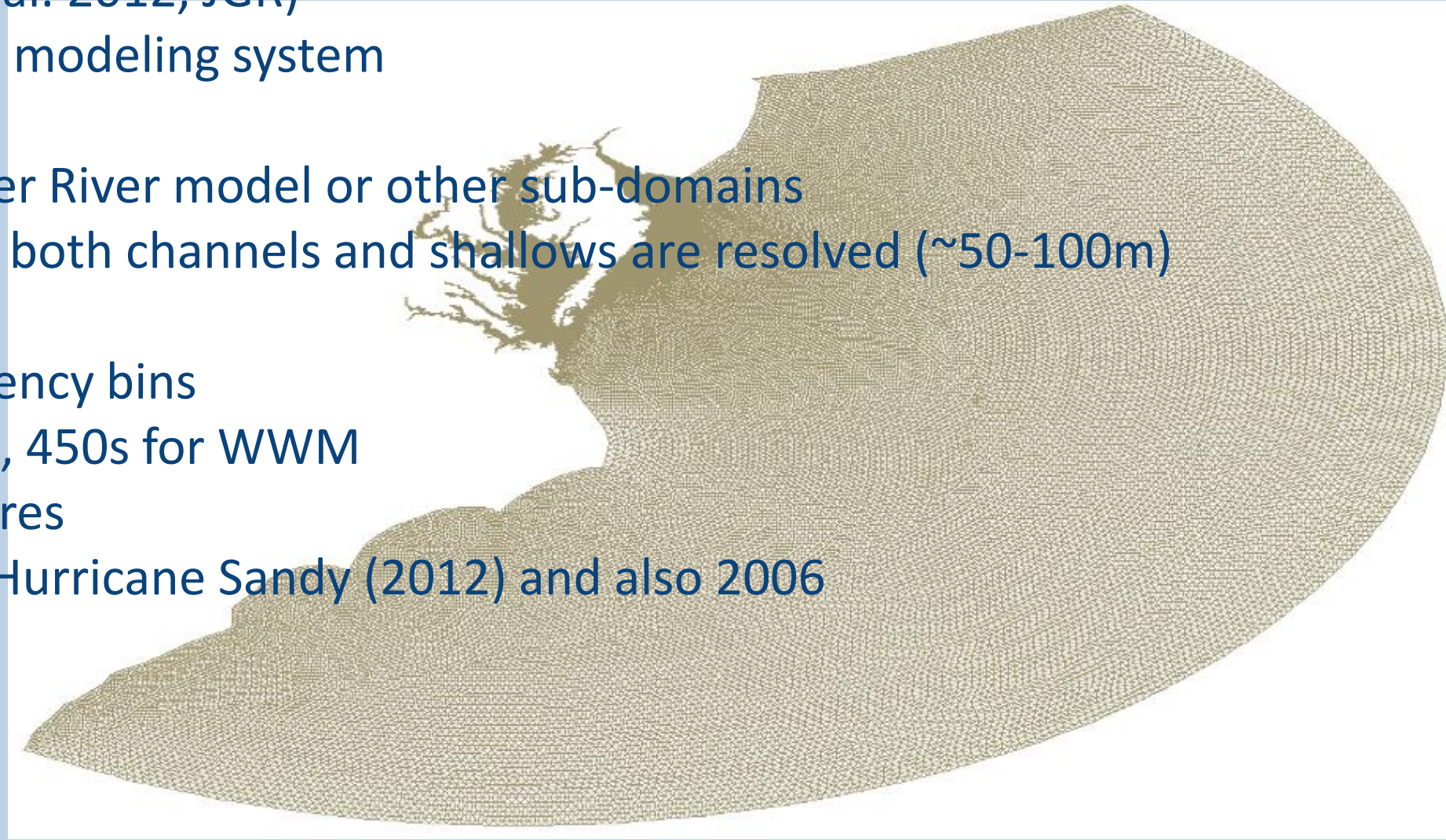


Sensitivity of Salt intrusion to DEM and grid (SCHISM b.c.)



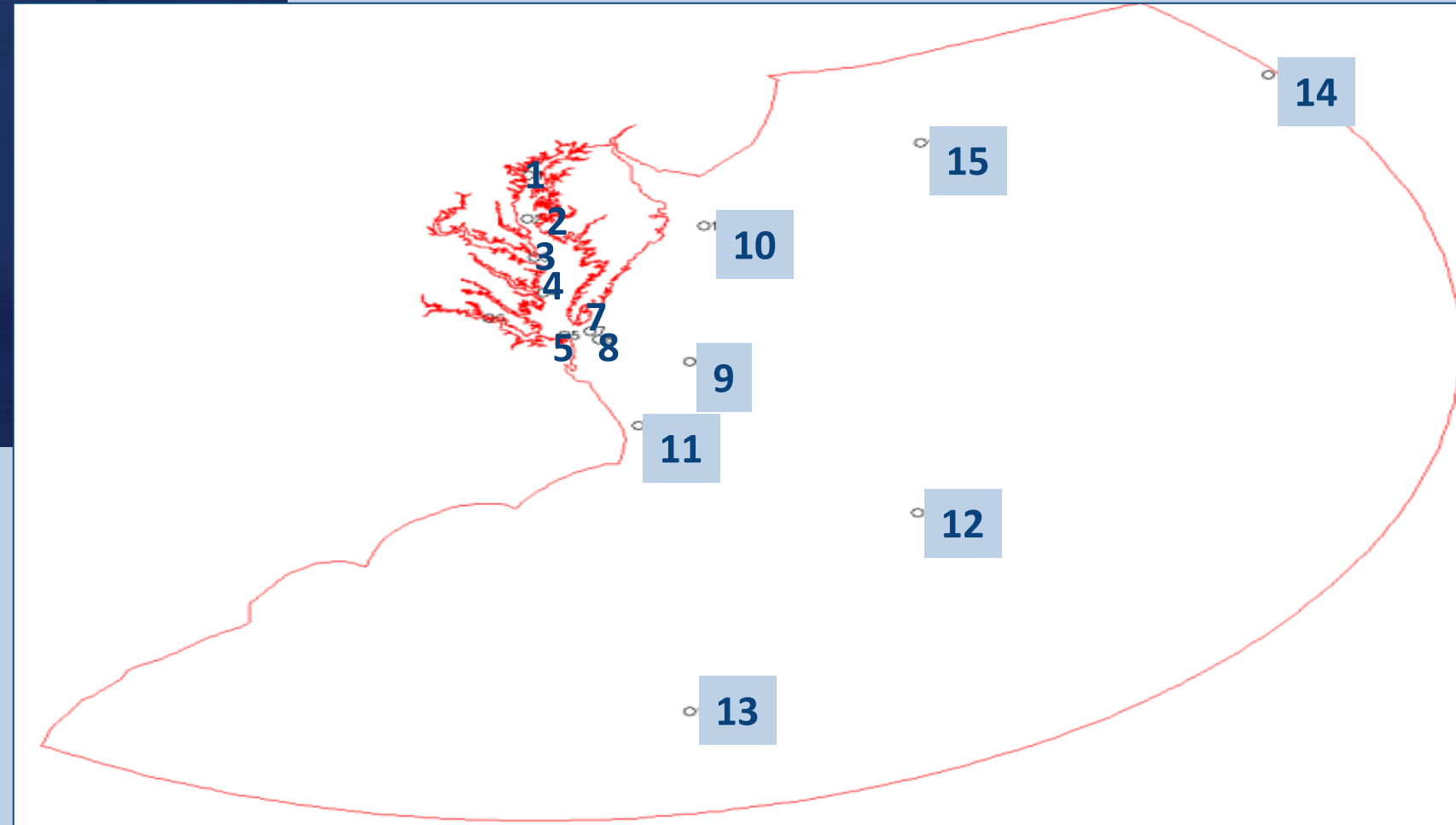
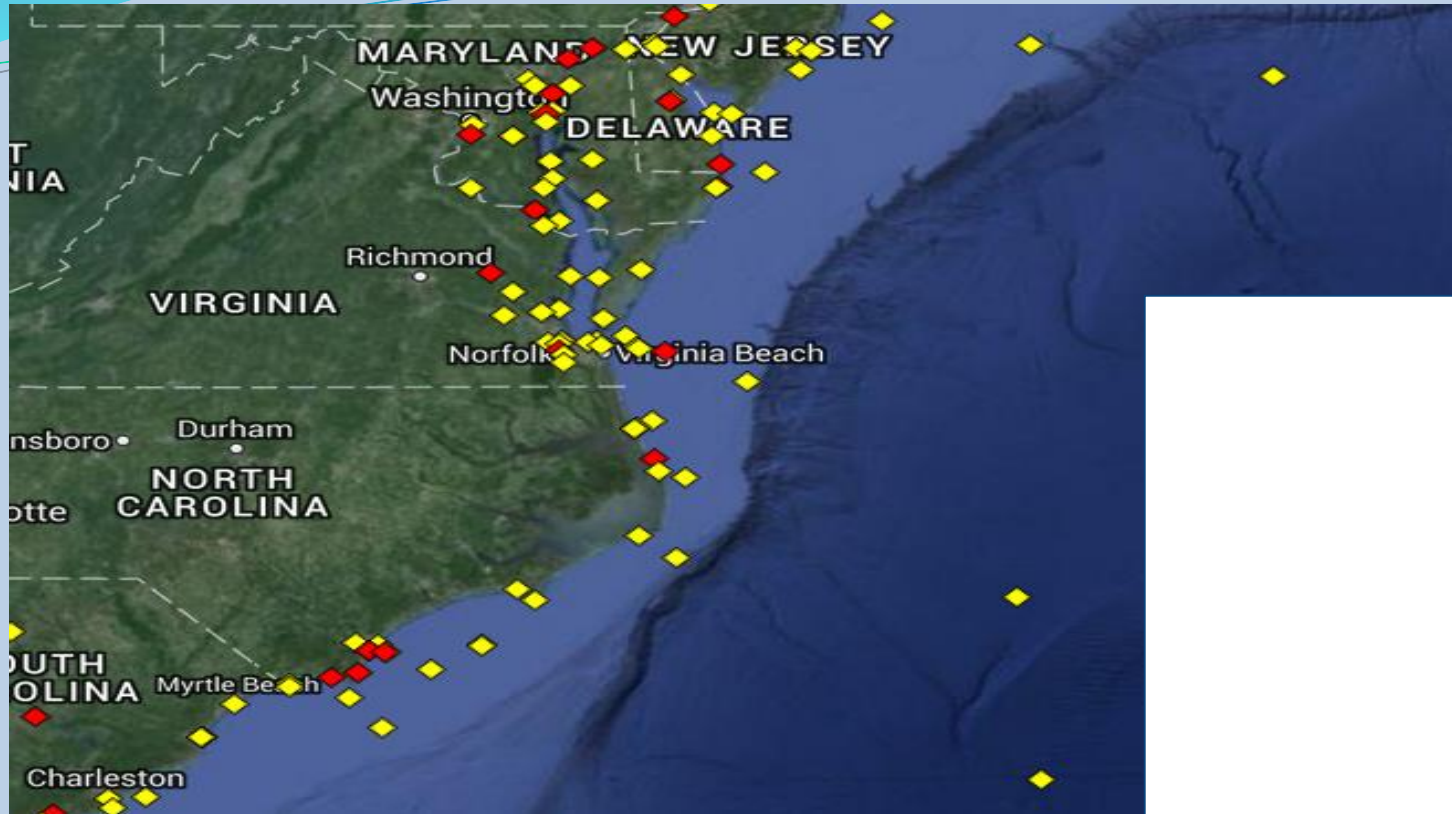
Wave model set-up: whole Bay

- Wind Wave Model III (Roland et al. 2012, JGR)
 - Fully integrated into SCHISM modeling system
- Set up for whole Bay + shelf
 - Provides wave b.c. for Chester River model or other sub-domains
 - 308K nodes, 559K elements; both channels and shallows are resolved (~50-100m)
 - B.c. from Wave Watch III
 - 30 directional bins, 24 frequency bins
 - Time steps: 150s for SCHISM, 450s for WWM
 - 90x faster than RT on 160 cores
- Validation: NDBC buoys, during Hurricane Sandy (2012) and also 2006



NDBC buoys

- Many buoys are inside the model domain
- But many have missing data

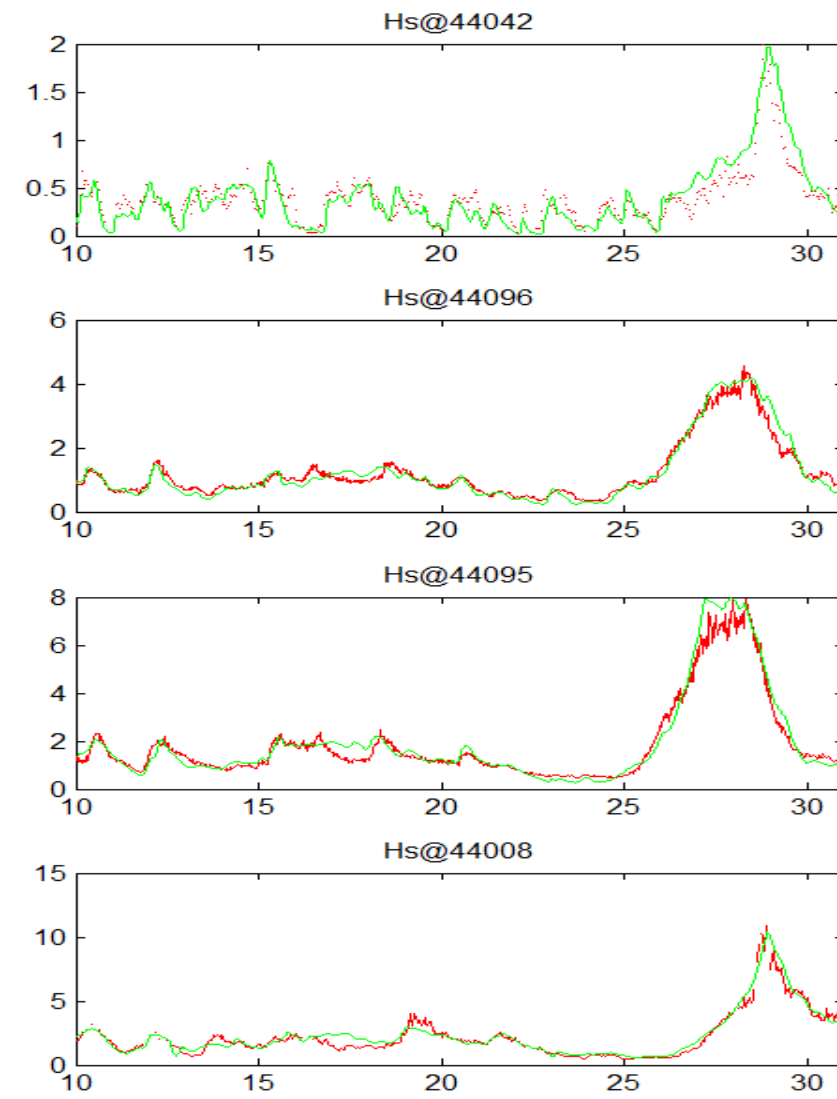
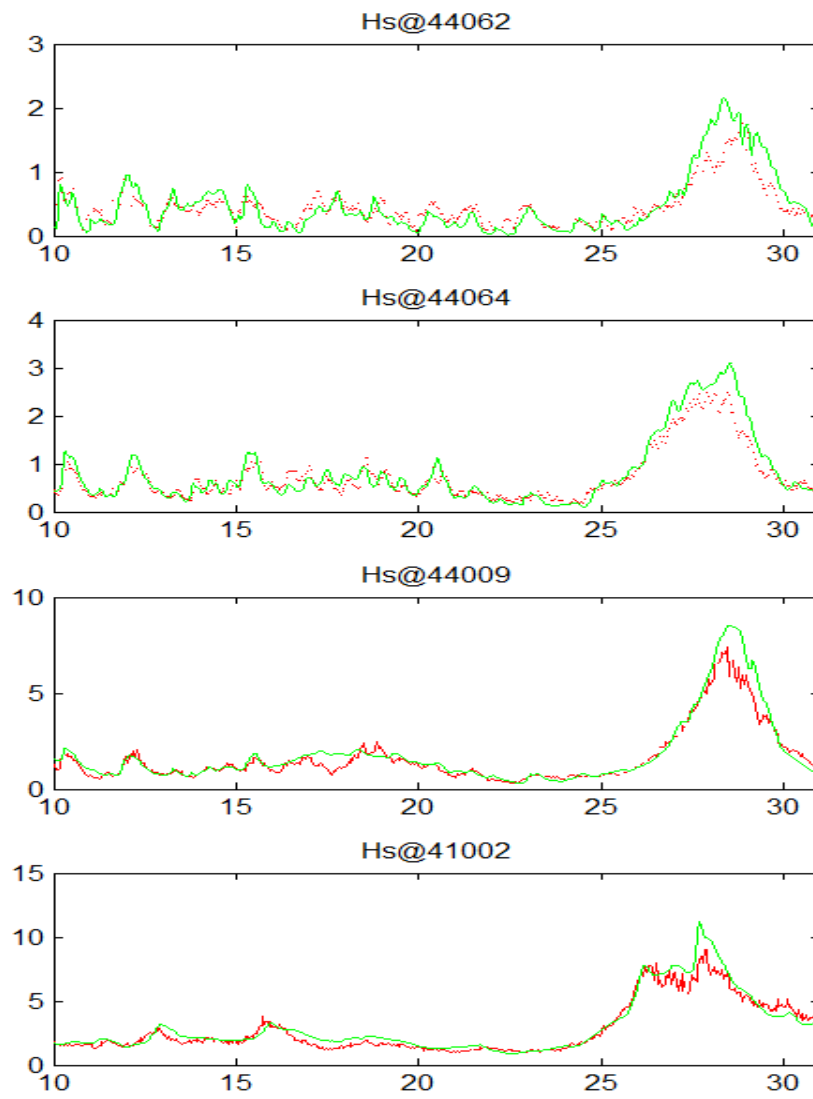
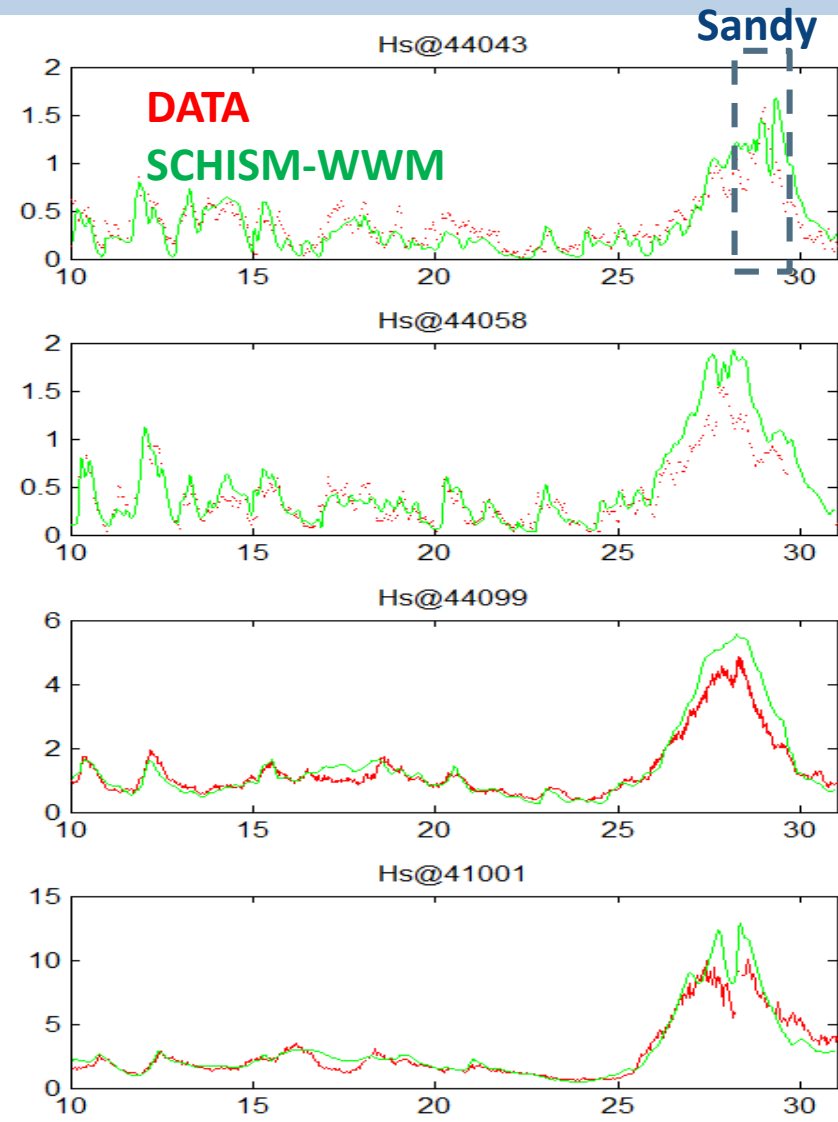


Wave model validation (Sandy)

Upper Bay

Coastal ocean

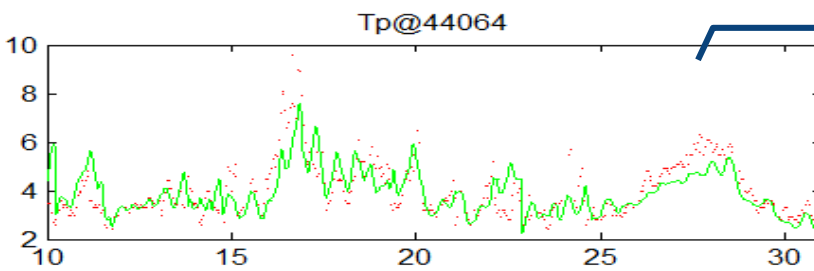
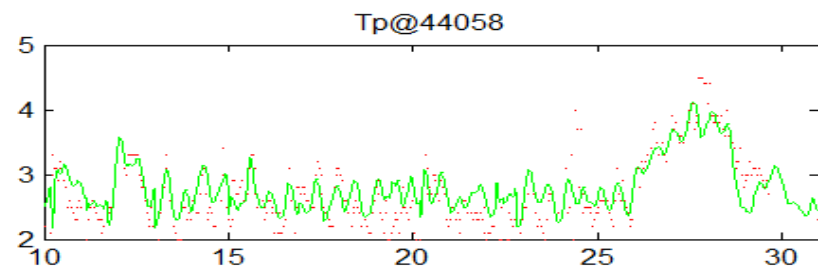
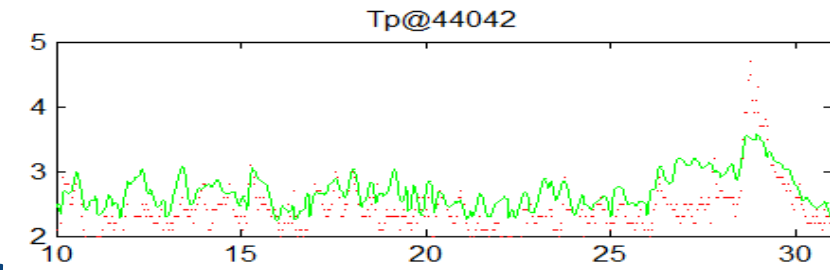
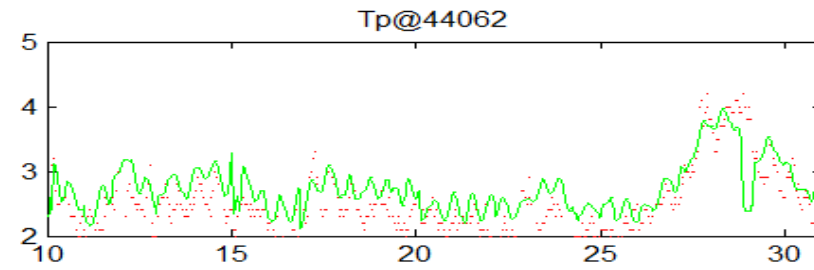
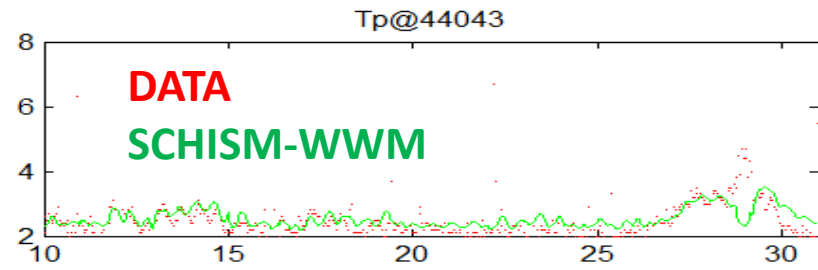
Significant Wave Height (m)



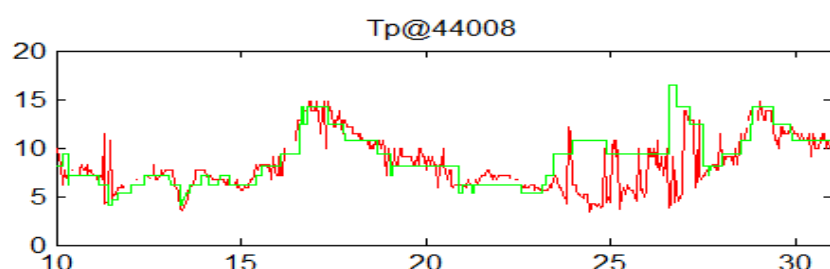
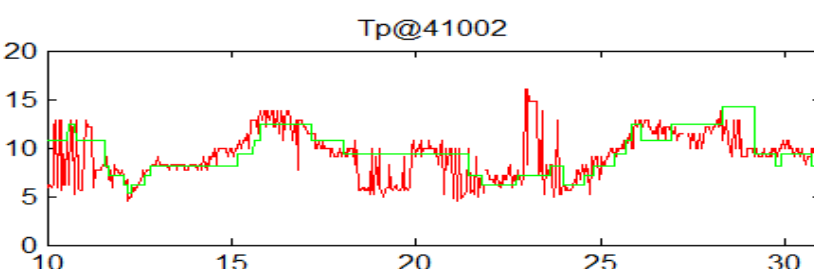
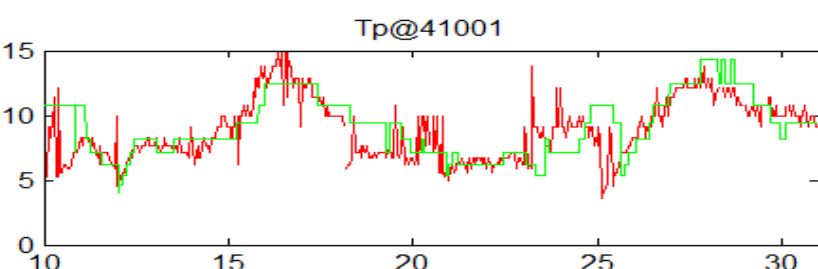
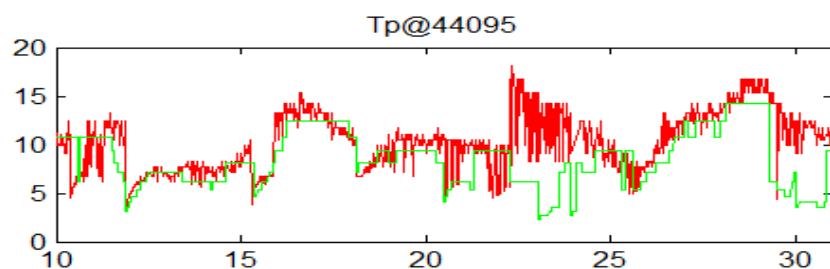
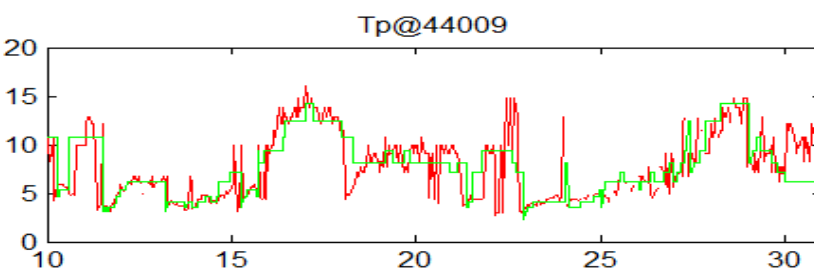
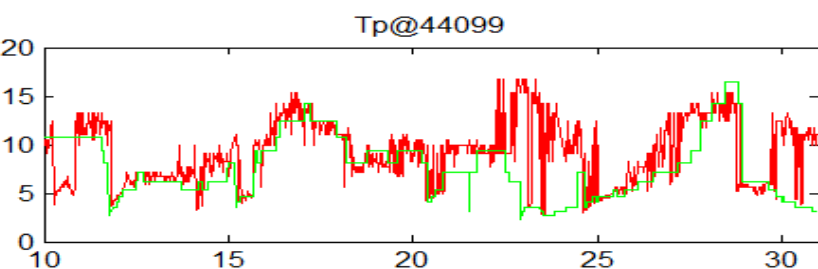
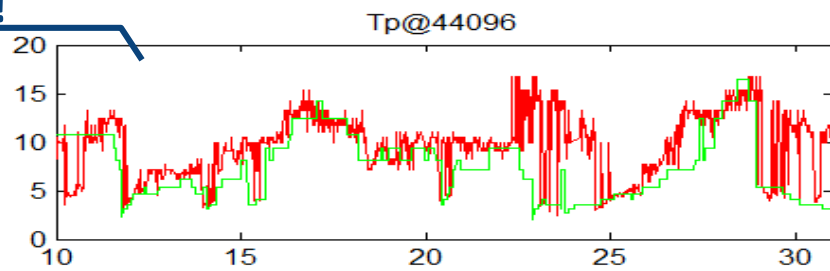
Days from Oct. 1, 2012

Peak period

Peak period (sec)



change!

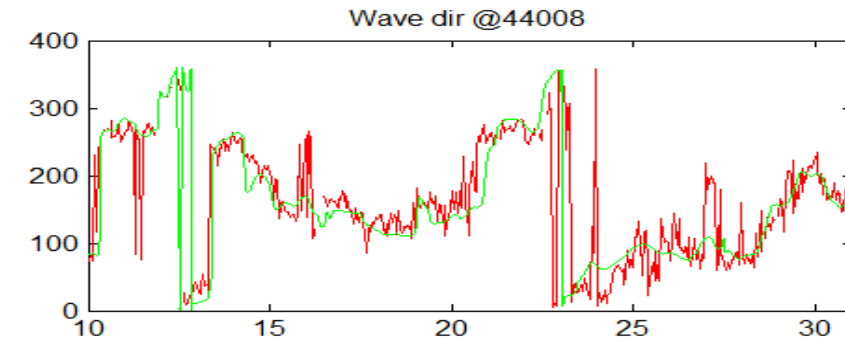
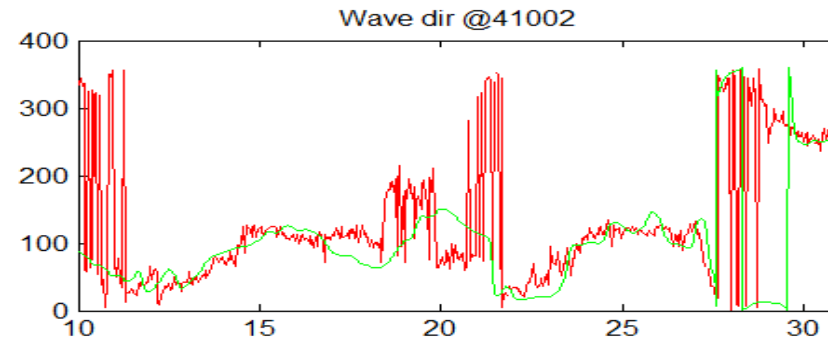
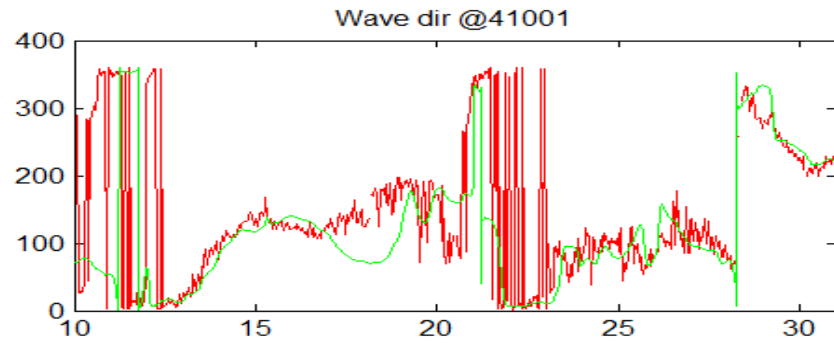
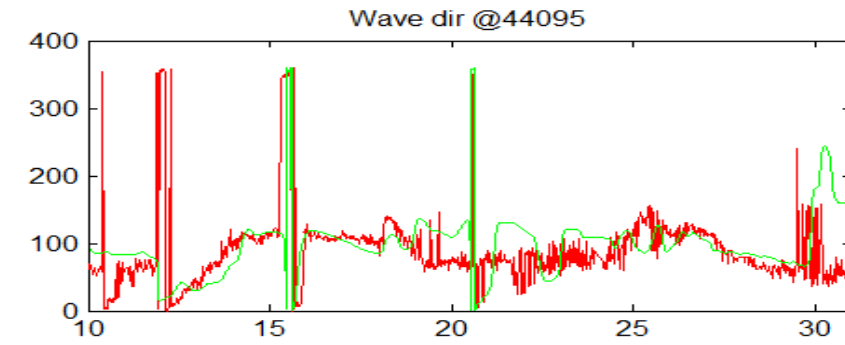
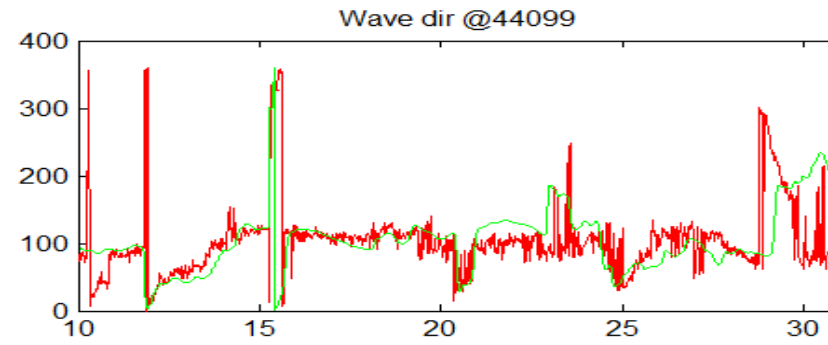
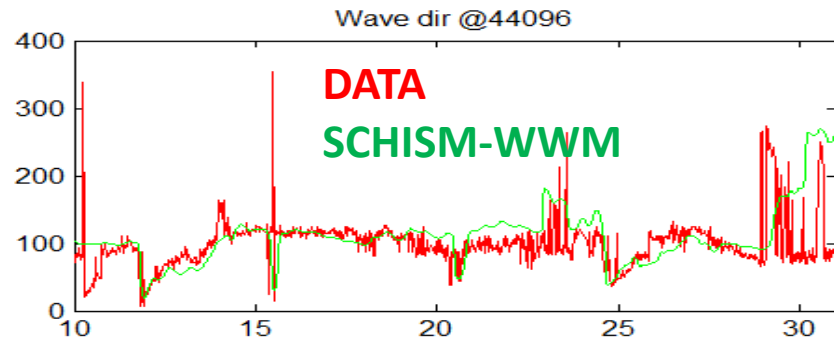


*cut-off frequency in buoys important for comparison

Error in b.c.

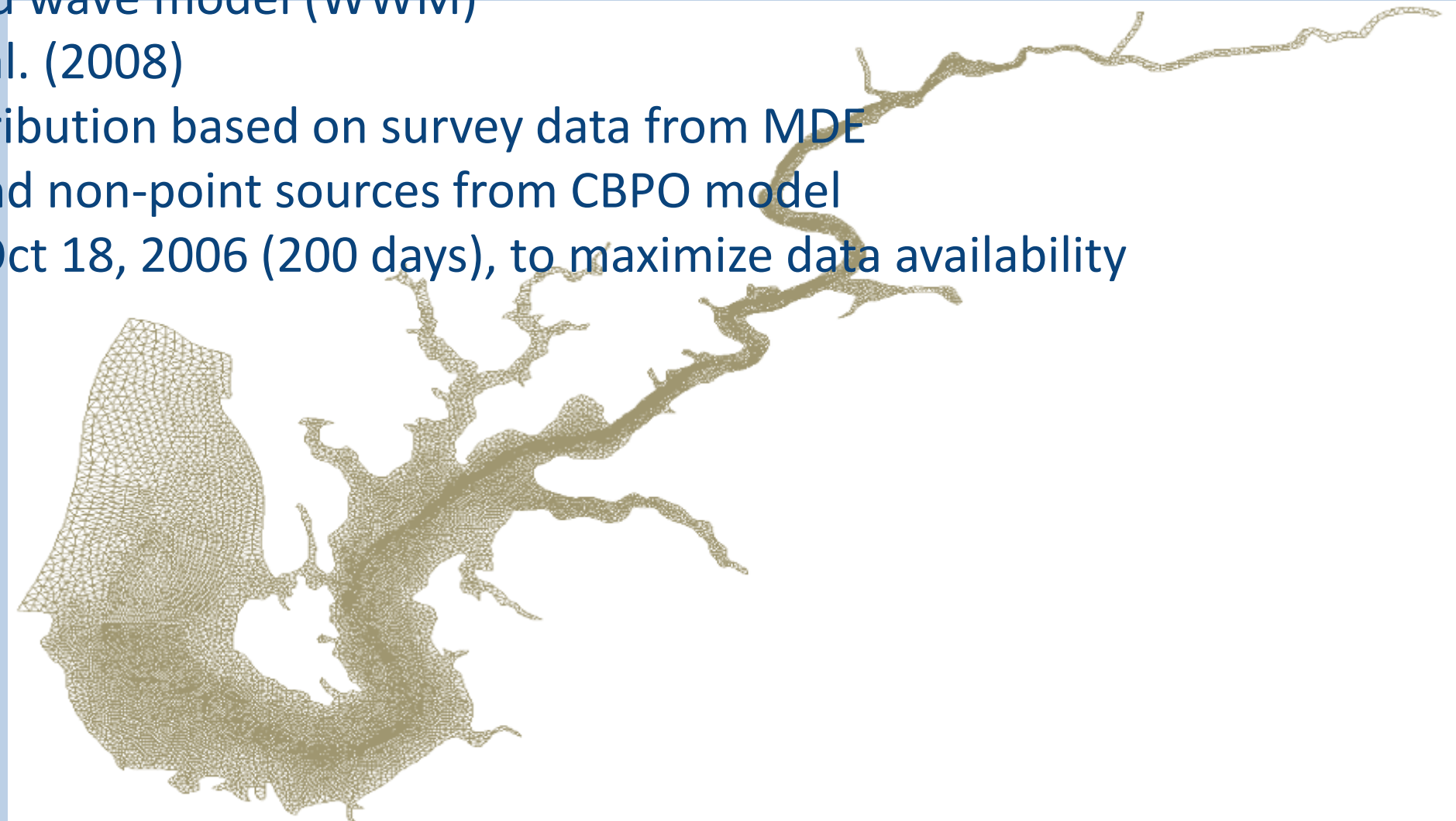
Wave model validation (Sandy)

Mean Wave Direction (degrees)



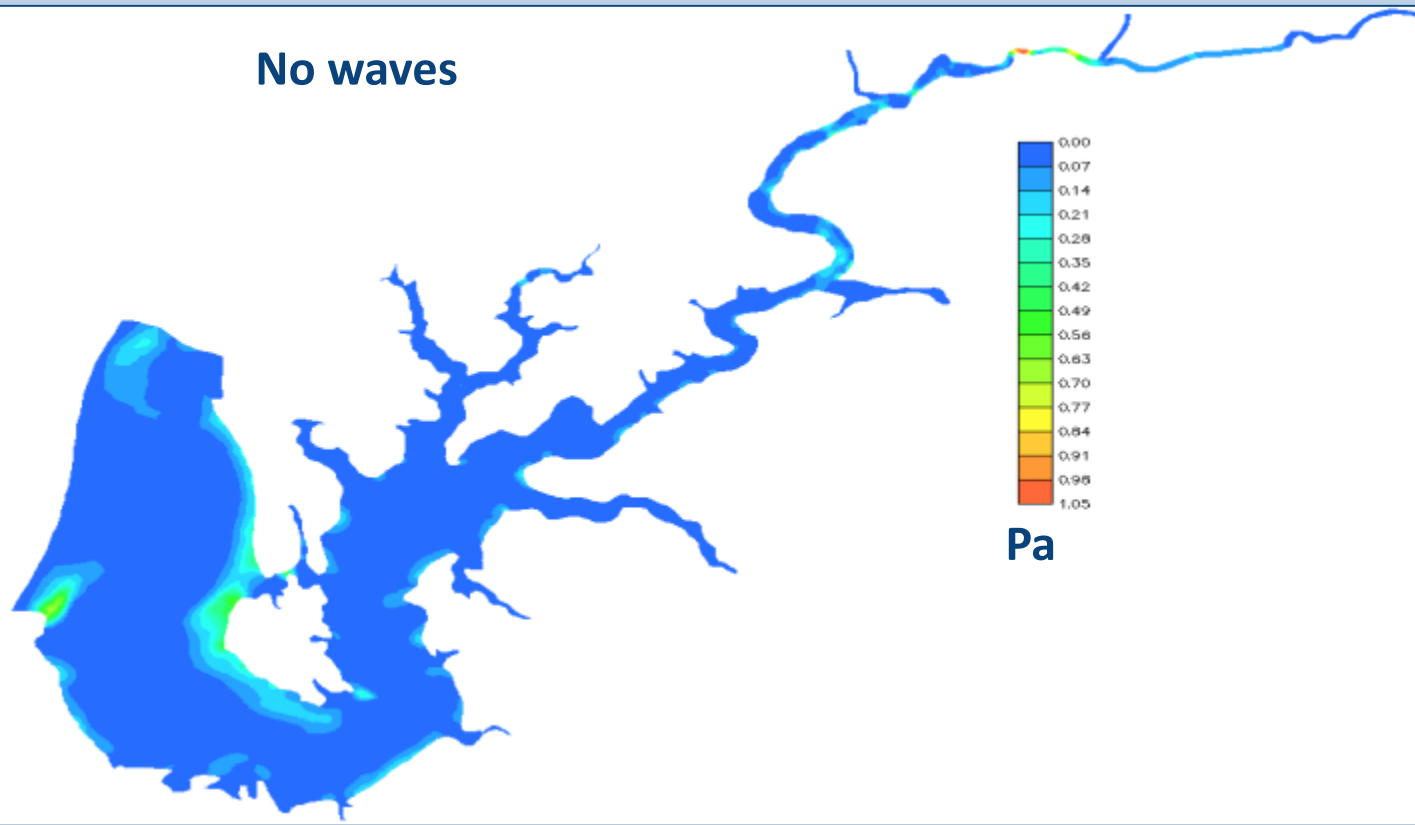
Sediment model set-up

- Chester River domain only (28790 triangles)
- Fully coupled with SCHISM and wave model (WWM)
- Based on CSTM of Warner et al. (2008)
- Initial sediment grain size distribution based on survey data from MDE
- Sediment inputs from point and non-point sources from CBPO model
- Calibration period: April 1 to Oct 18, 2006 (200 days), to maximize data availability
- 223xRT on 60 cores

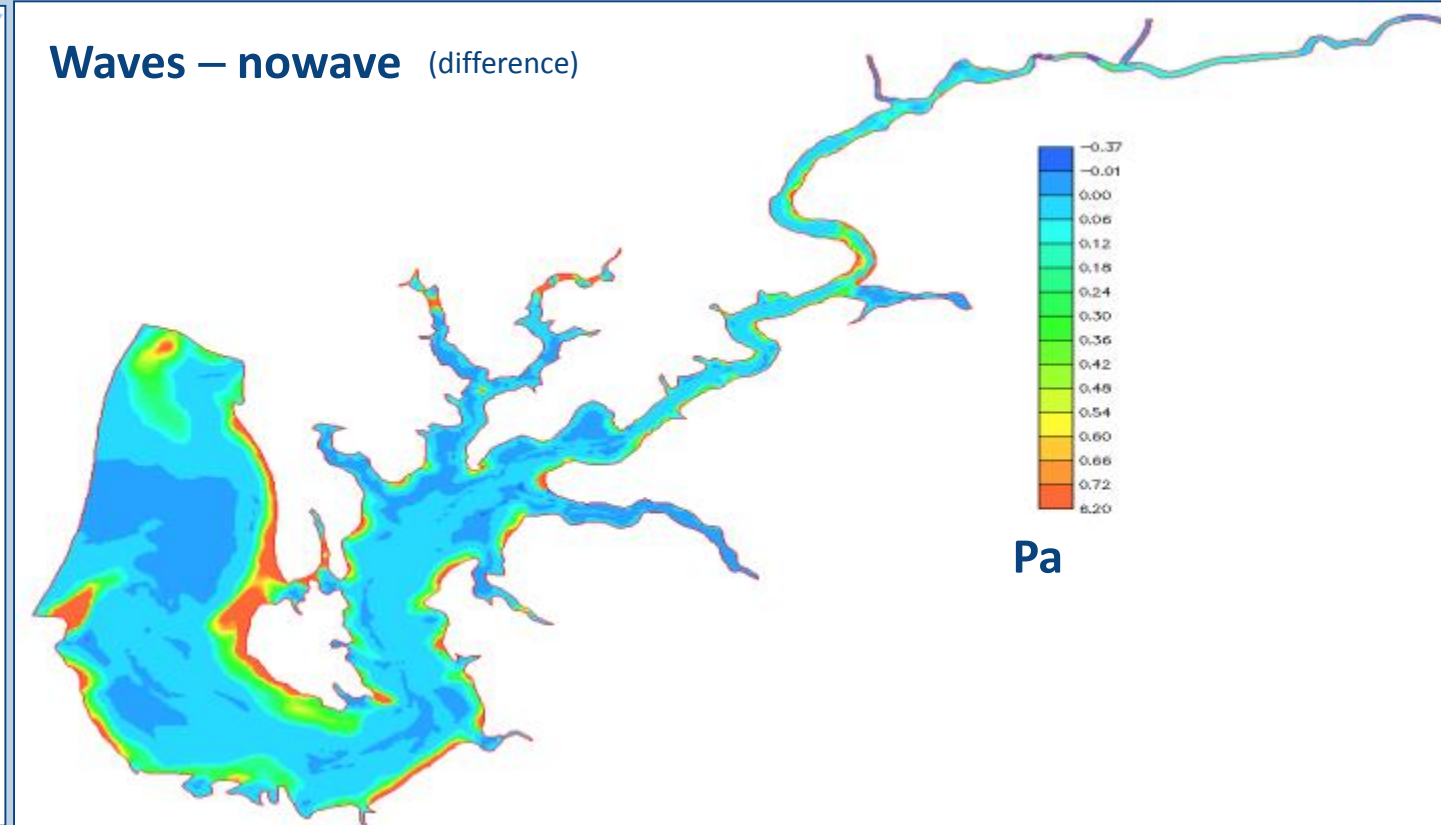


Bottom stress

No waves



Waves – nowave (difference)

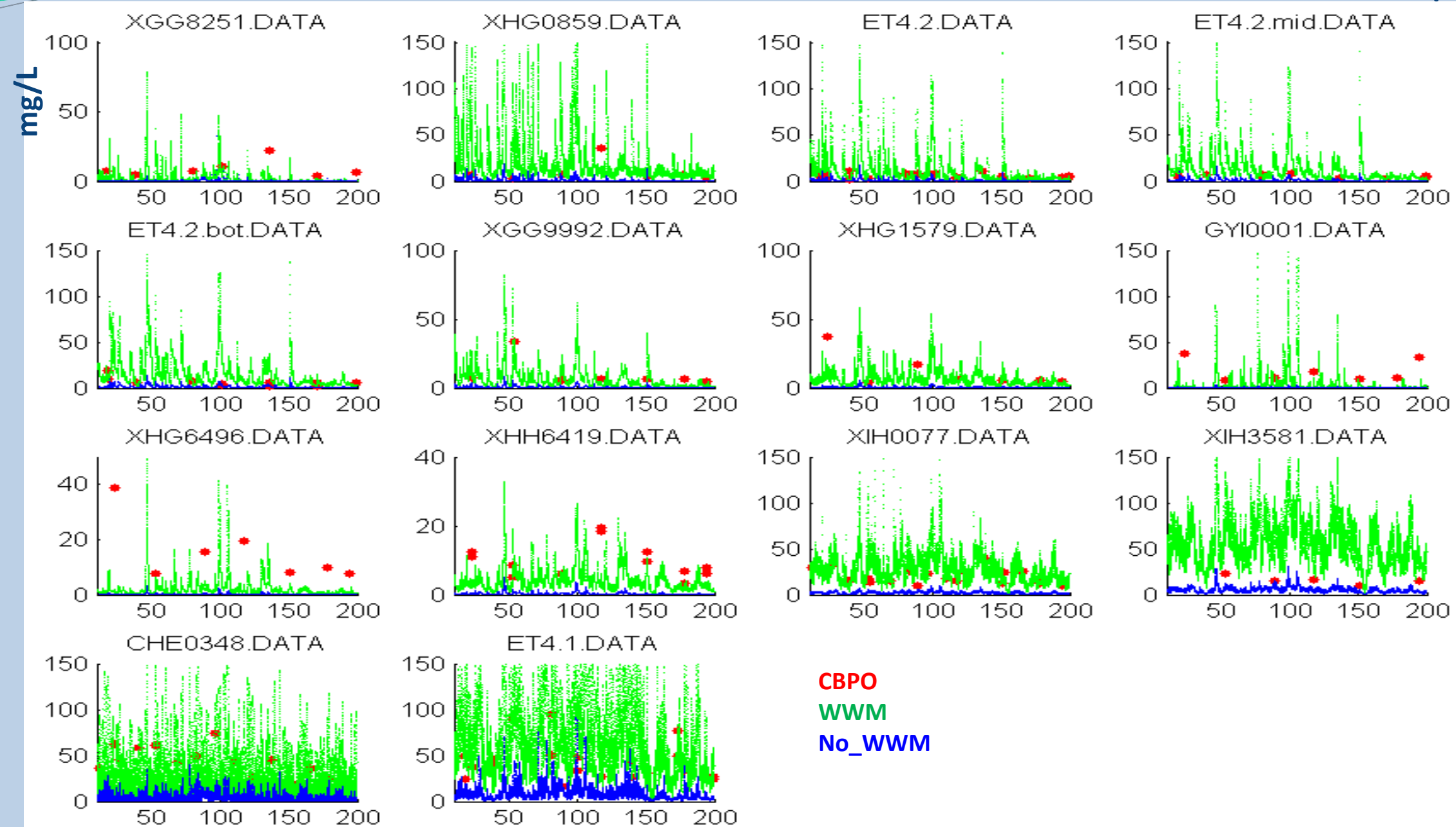


- Averaged from May to Oct 2006
- Waves enhance bottom stress especially in the shallows

Sediment: mainstem

Downstream

→ upstream



CBPO
WWM
No_WWM

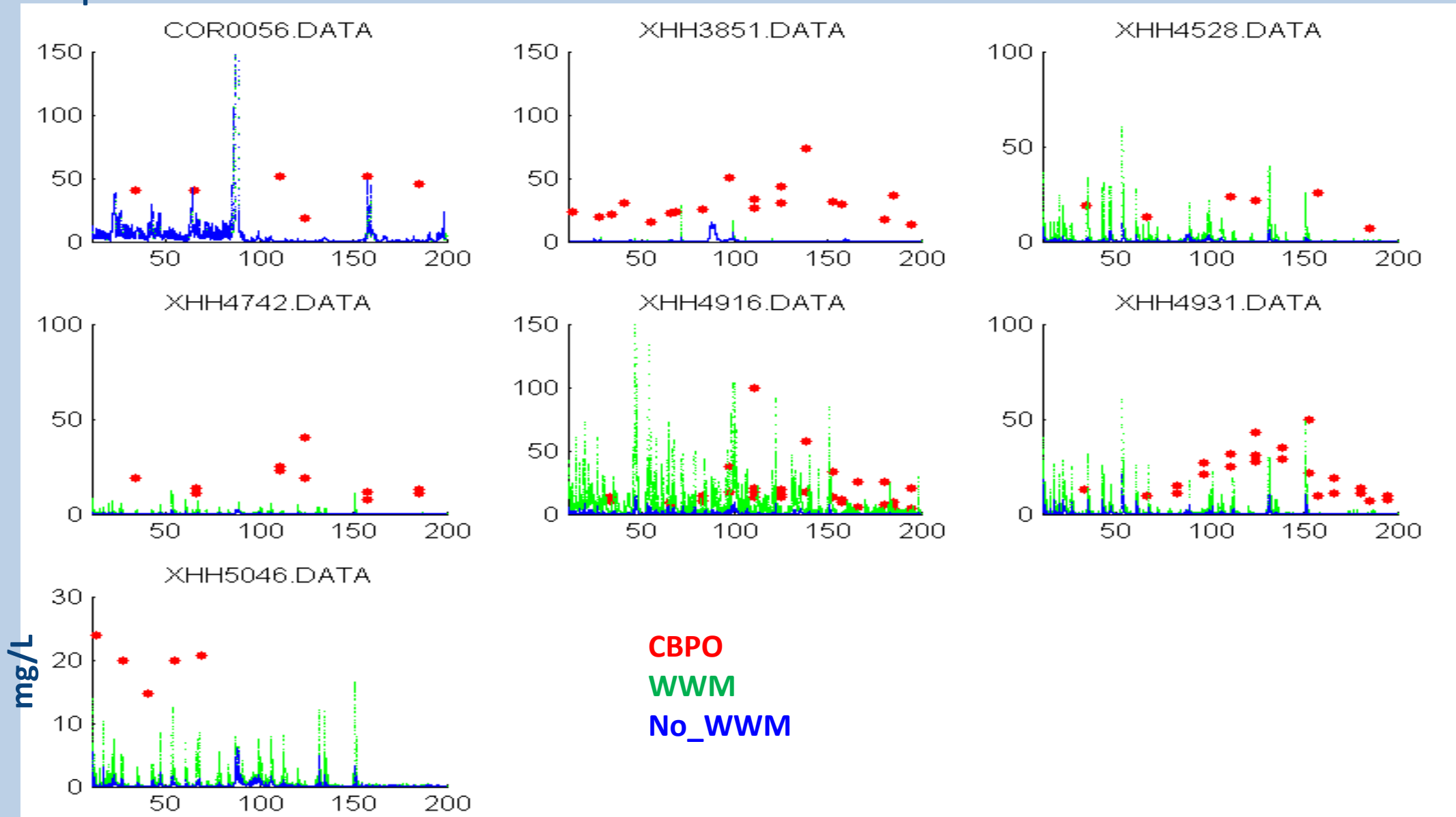
*The high-frequency signal in No_WWM results in upstream is due to watershed inflow, sediment inputs and high velocity locally

Days from April 1, 2006

Sediment: Corsica River

Upstream

→ downstream



Days from April 1, 2006

Conclusions

- Salt intrusion is improved with new work on horizontal grid and SCHISM b.c.; this proves important for WQ simulations (Harry's talk). Will merge to a single grid soon.
- Fully coupled SCHISM-WWM-SED3D has been applied to Chester River, to explain the hydrodynamic, wave and sediment responses
- Results from waves are good and the model is able to resolve the sharp transition of wave period near the Bay mouth
- Results from sediment transport model are reasonable and capture some high-frequency oscillations observed in the field; waves are found to be important for resuspension process
- Sediment inputs from watershed model are important as well