

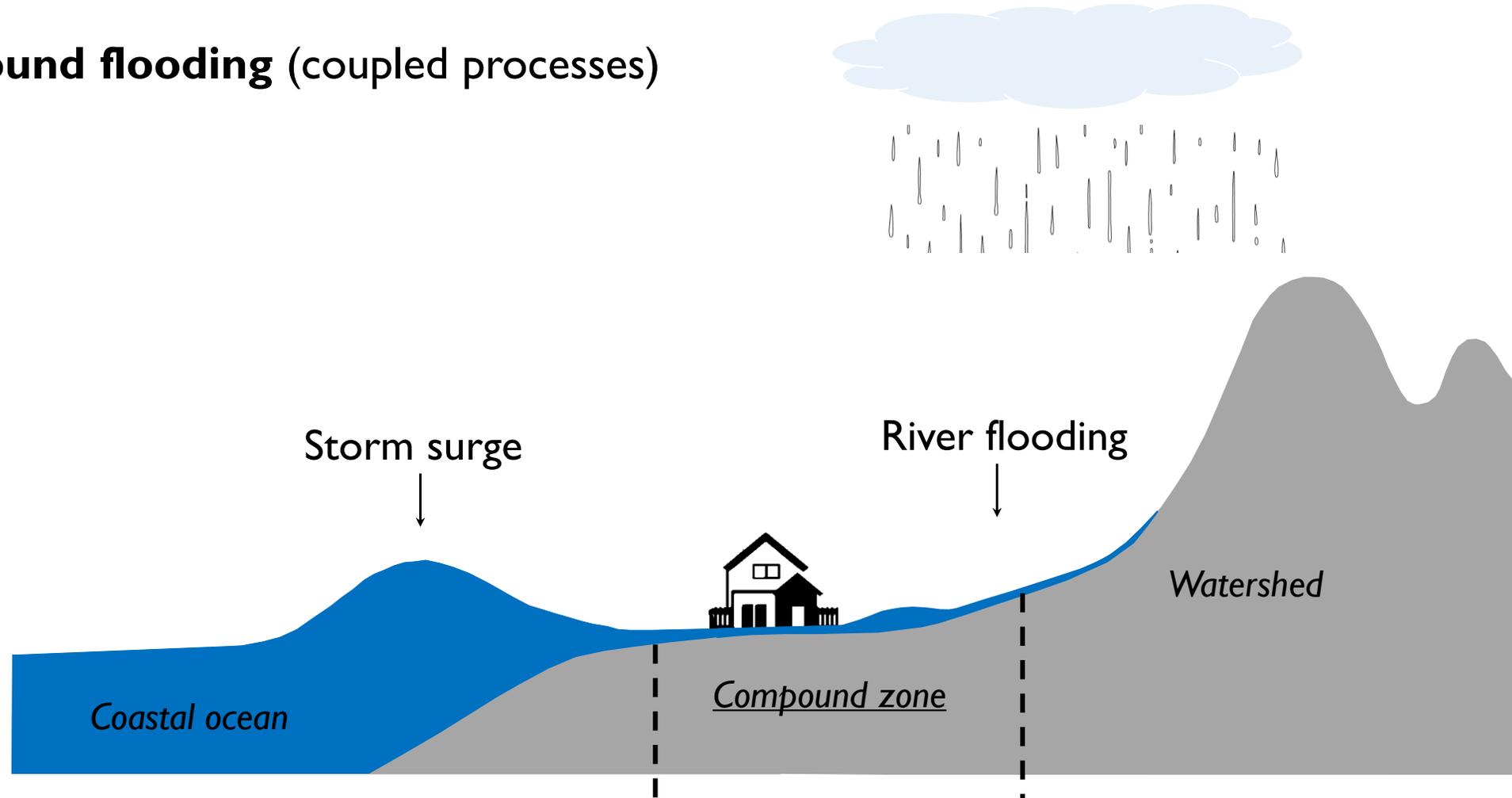
Model setup for 2D compound flooding

Fei Ye

Motivation

concurrency of high water levels at the coast and in the rivers

- **Compound flooding** (coupled processes)



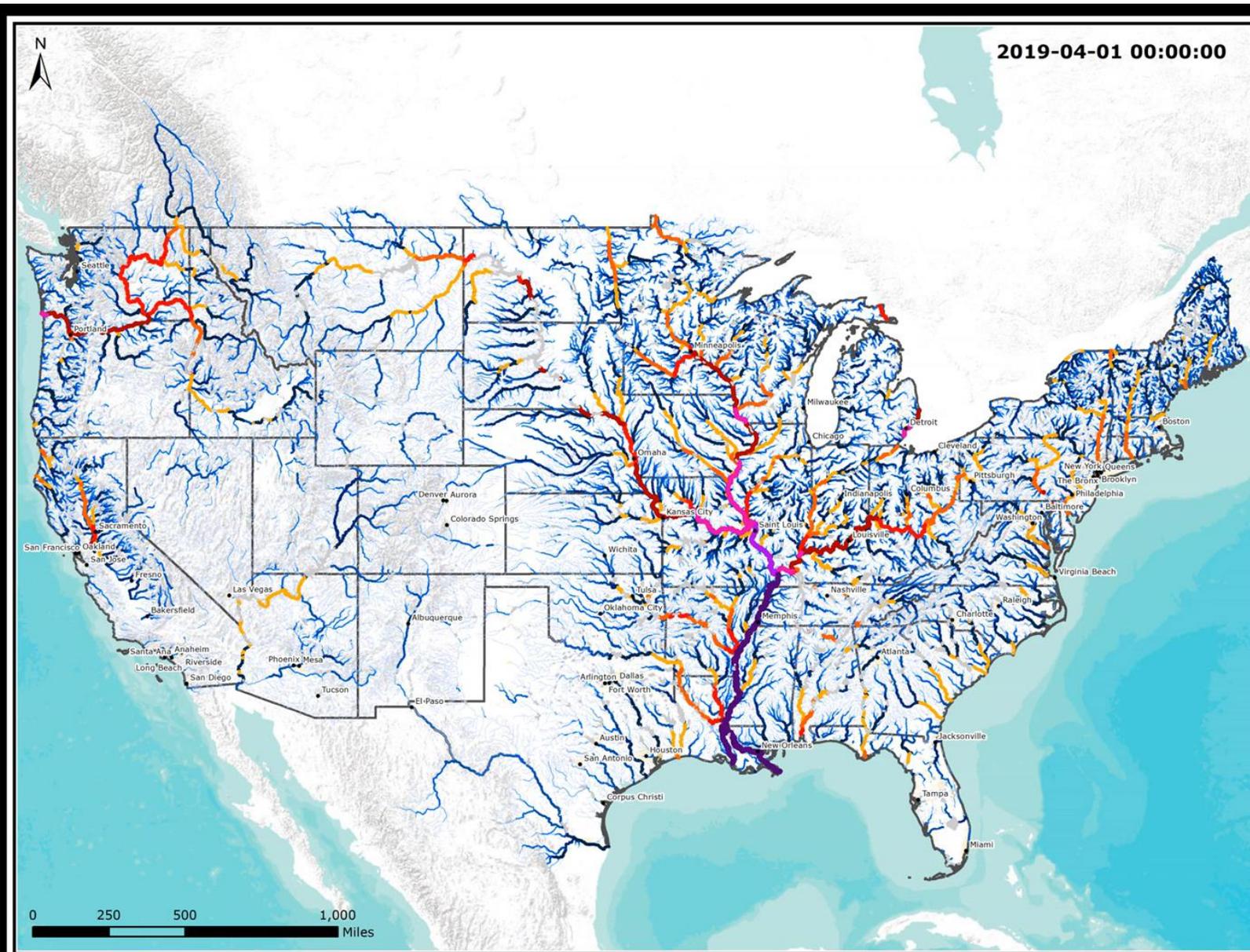
- **Simulation with coupled model**

Where should the multiple models meet?

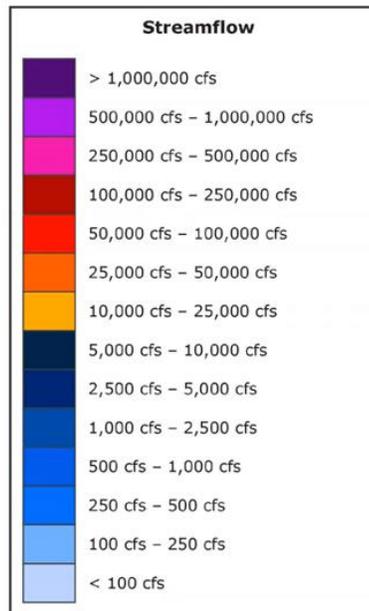
Hydrodynamic model



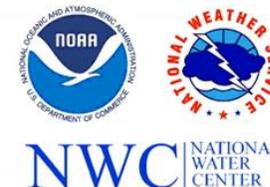
Hydrologic model



National Water Model Streamflow

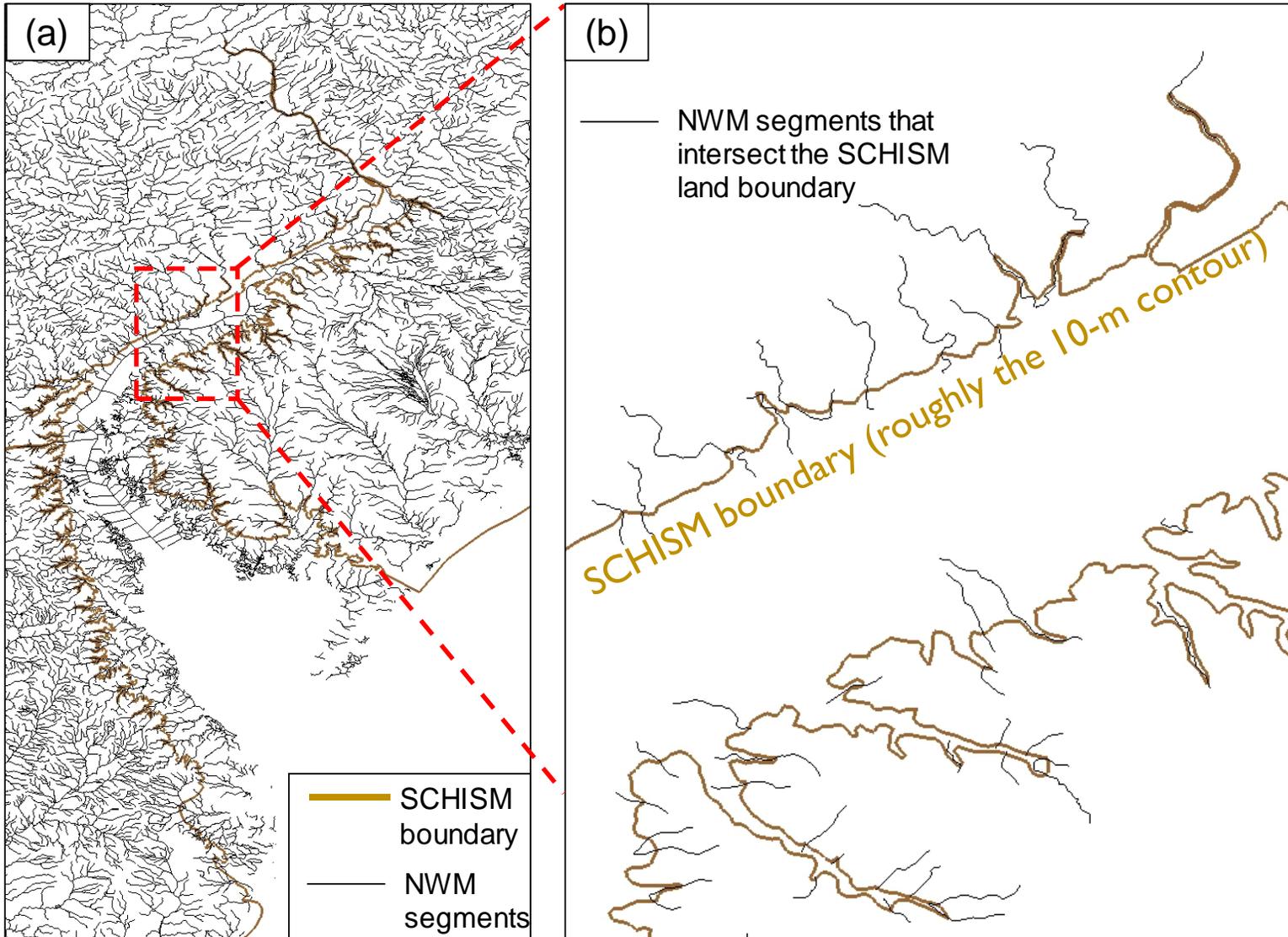


Provisional, for guidance use only. May not reflect the official forecast. For the official forecast visit: <https://water.weather.gov>



A hydrologic modelling framework that simulates observed and forecast streamflow over the entire continental United States (CONUS) (2.7 million streams).

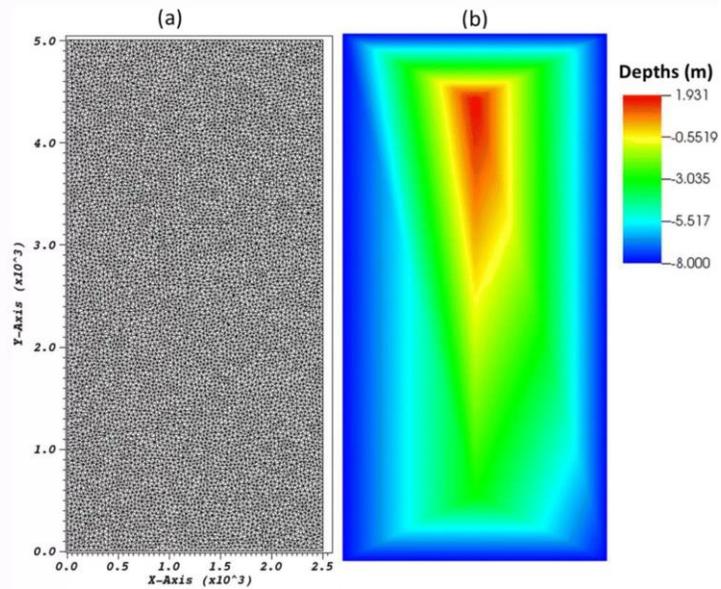
The practical question: where should the two models meet?



- Hydrological model cannot simulate estuarine circulations
- Hydrodynamic model faces great challenge on robustness/efficiency when including watershed above MSL
- The **intersection** between NWM Segments and the SCHISM land boundary occurs at **10 m above MSL**
- SCHISM seamlessly handles
 - (1) the **flood routing** inside the domain
 - (2) 3D estuarine and coastal dynamics
 - (3) 3D processes in the large-scale eddy regime(Ye et al., 2020; Zhang et al., 2020)

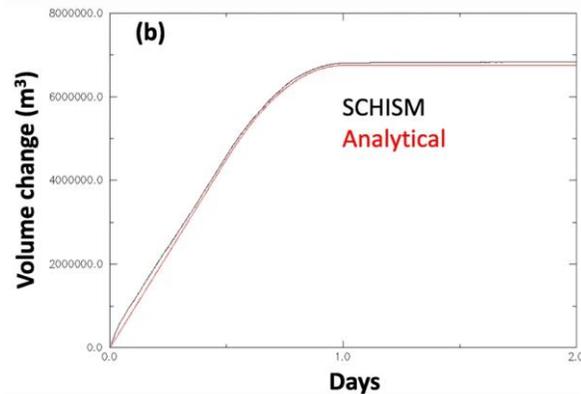
Reservoir Test: Heavy rainfall over a basin

Domain and bathymetry

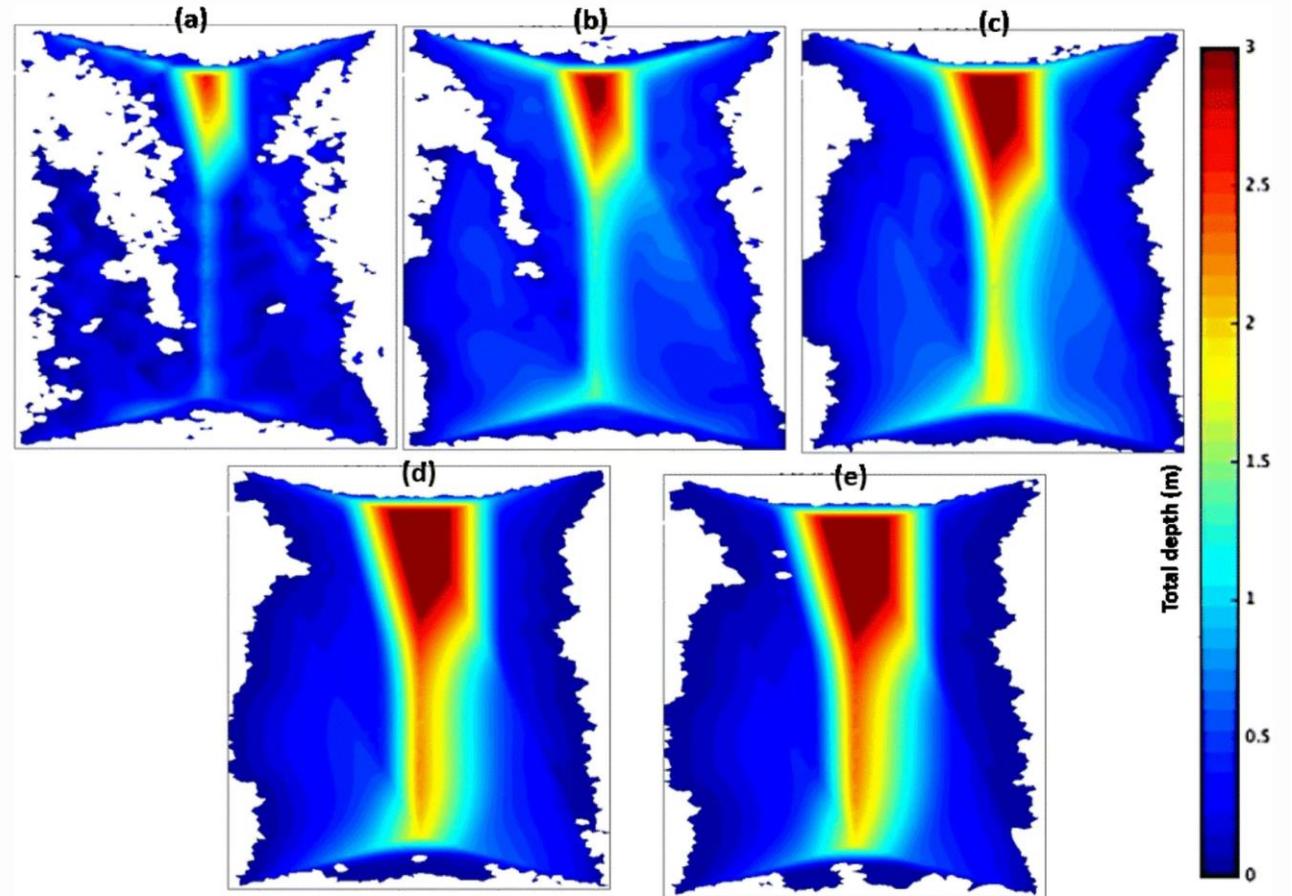


Domain and grid for the reservoir test. **a** Horizontal grid; **b** bathymetry; **c**

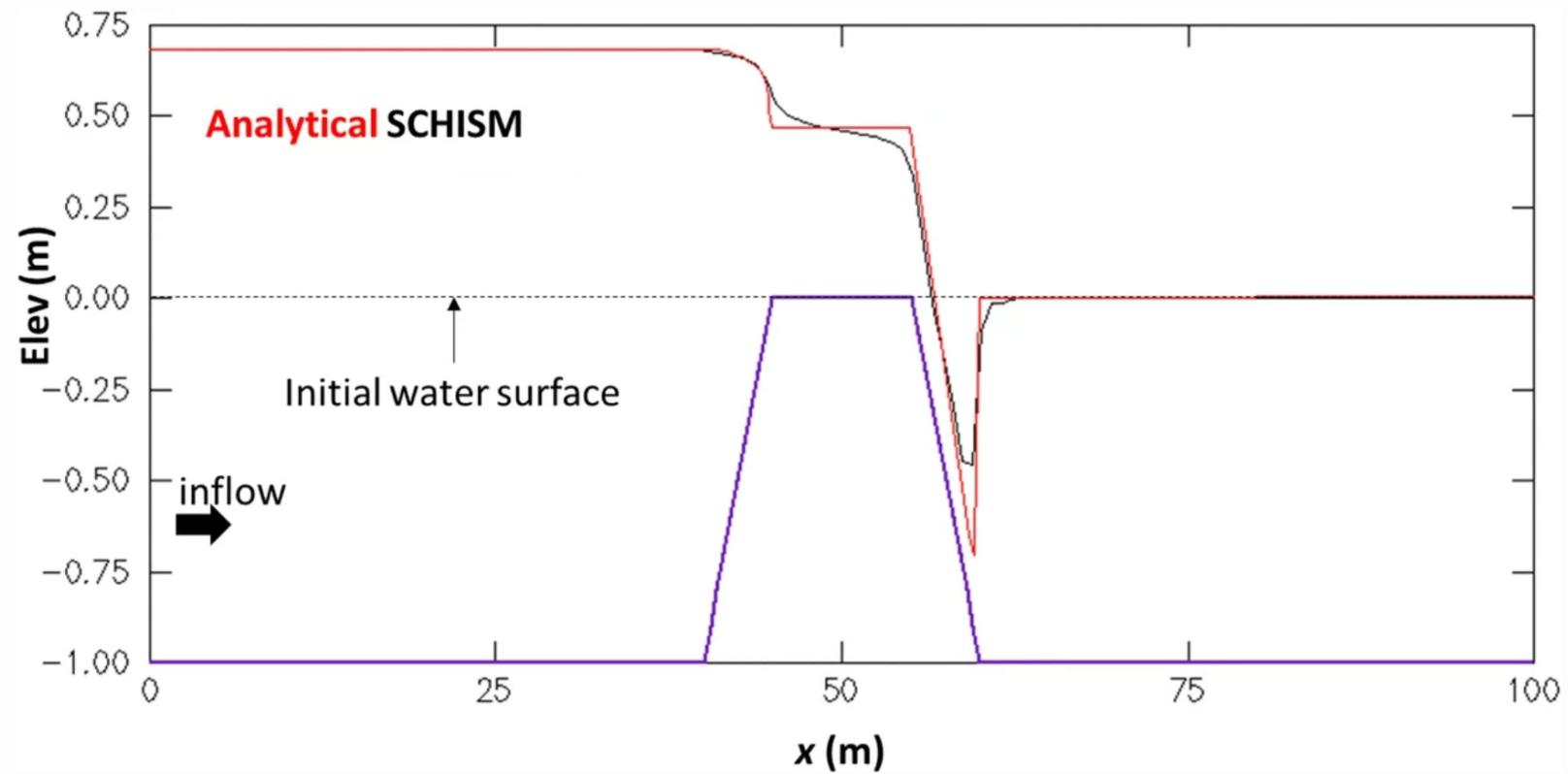
✓ Mass conservation

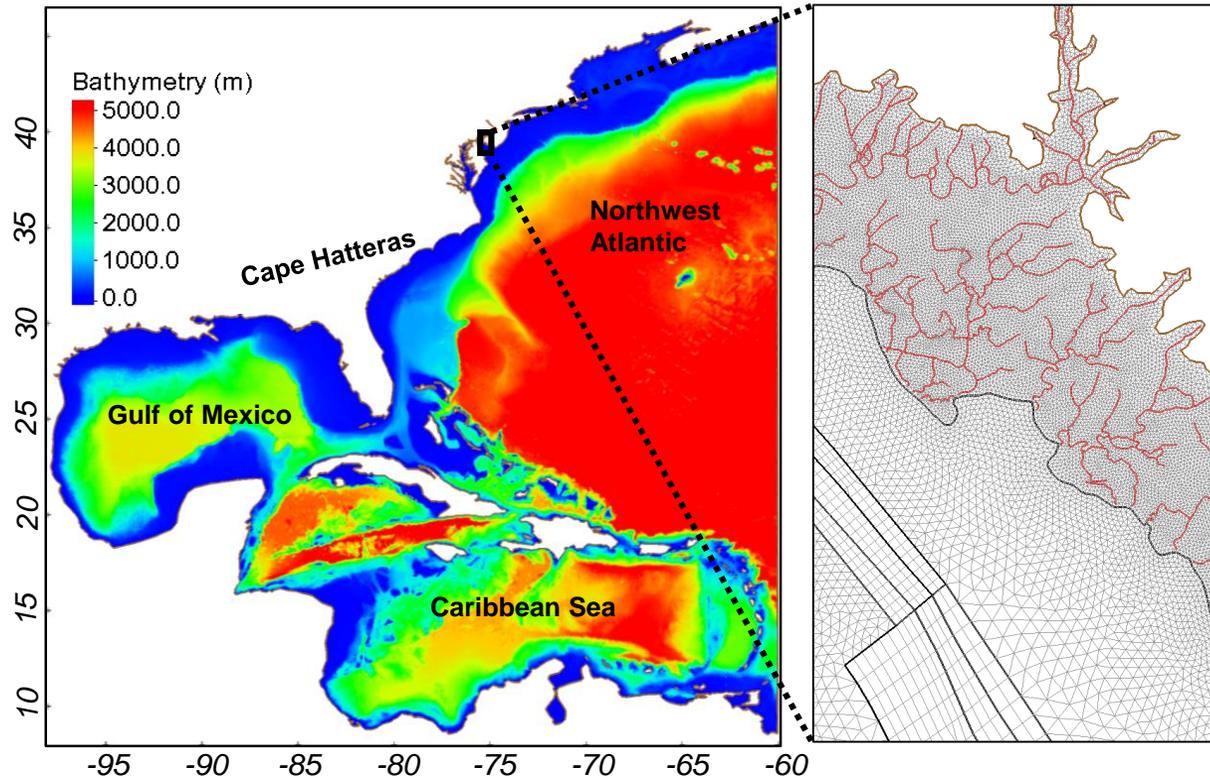


Inundation through time



Snapshots of inundation depths at DD:HH:MM = **a** 00:04:50; **b** 00:13:50; **c** 01:00:24; **d** 01:15:00; **e** 02:00:00





Mixed triangle-quadrangle

horizontal grid:

- 2.2 million nodes and 4.4 million elements
 - 40% of the elements have resolution finer than 220m
 - 2~7 km resolution in the ocean; 50-200 m in rivers and bays; down to ~3m in small streams
 - 9 layers on average, 1 layer in the watershed (above MSL)
 - 0.3 million NWM segments explicitly incorporated inside our grid
 - $\Delta t = 150$ s
 - Baseline (3D baroclinic): 80x faster than Real Time on 1440 cores of Pleiades (NASA)
 - The 2D model runs approximately 57 times faster than the baseline
- (Ye et al., 2020; Zhang et al., 2020; Huang et al., 2021)

[Simulating storm surge and compound flooding events with a creek-to-ocean model: Importance of baroclinic effects](#) F Ye, YJ Zhang, H Yu, W Sun, S Moghimi, E Myers, K Nunez, R Zhang, ...

Ocean Modelling 145, 101526

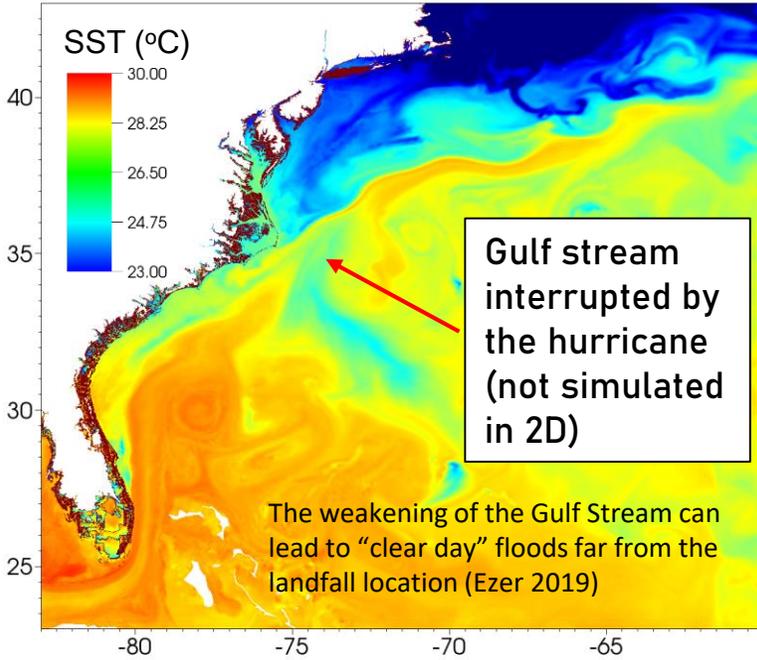
[Compounding factors for extreme flooding around Galveston Bay during Hurricane Harvey](#) W Huang, F Ye, YJ Zhang, K Park, J Du, S Moghimi, E Myers, S Pe'eri, ...

Ocean Modelling 158, 101735

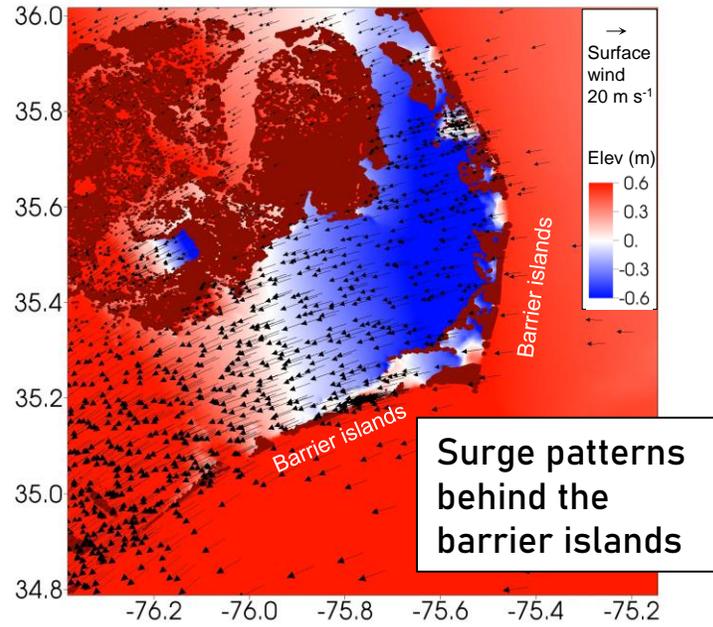
[Simulating compound flooding events in a hurricane](#) YJ Zhang, F Ye, H Yu, W Sun, S Moghimi, E Myers, K Nunez, R Zhang, ...

Ocean Dynamics 70 (5), 621-640

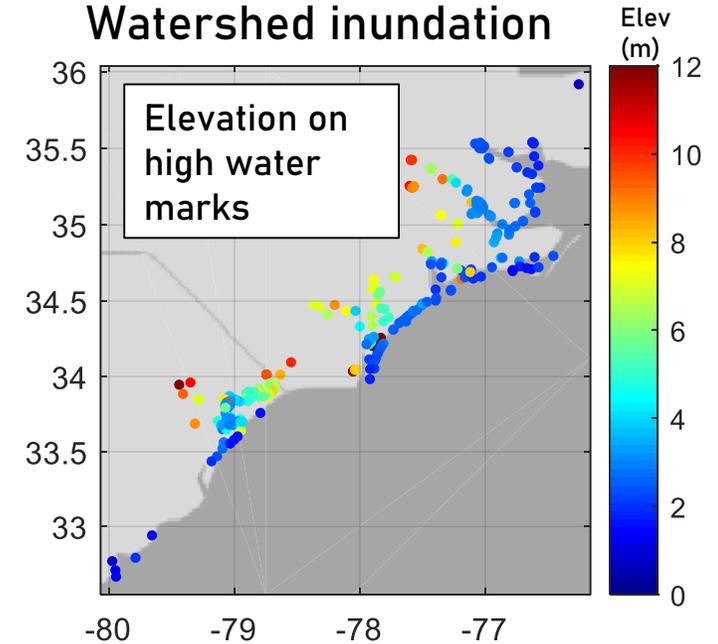
Ocean



Coastal zone

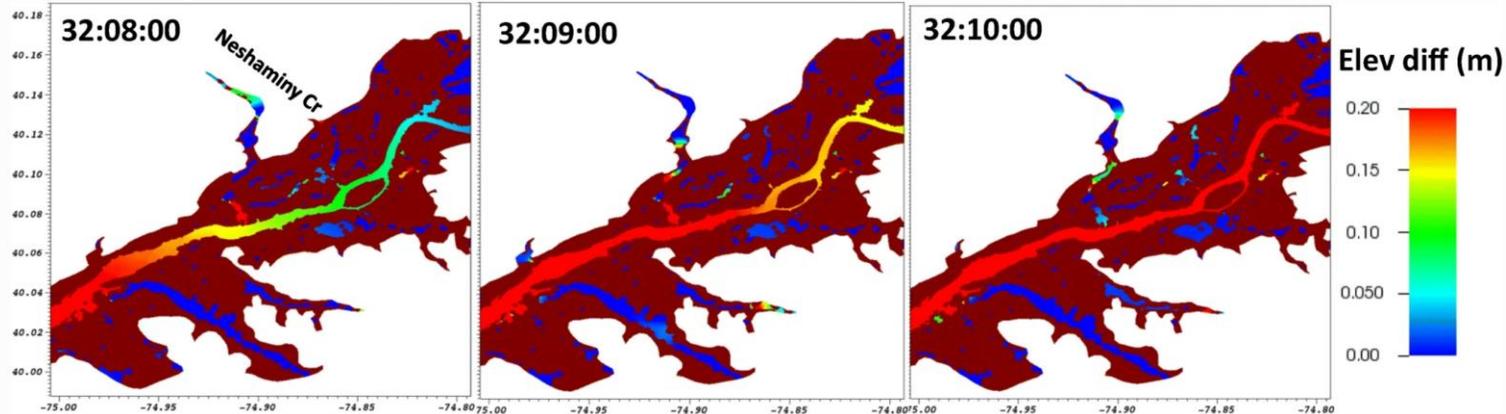


Watershed inundation



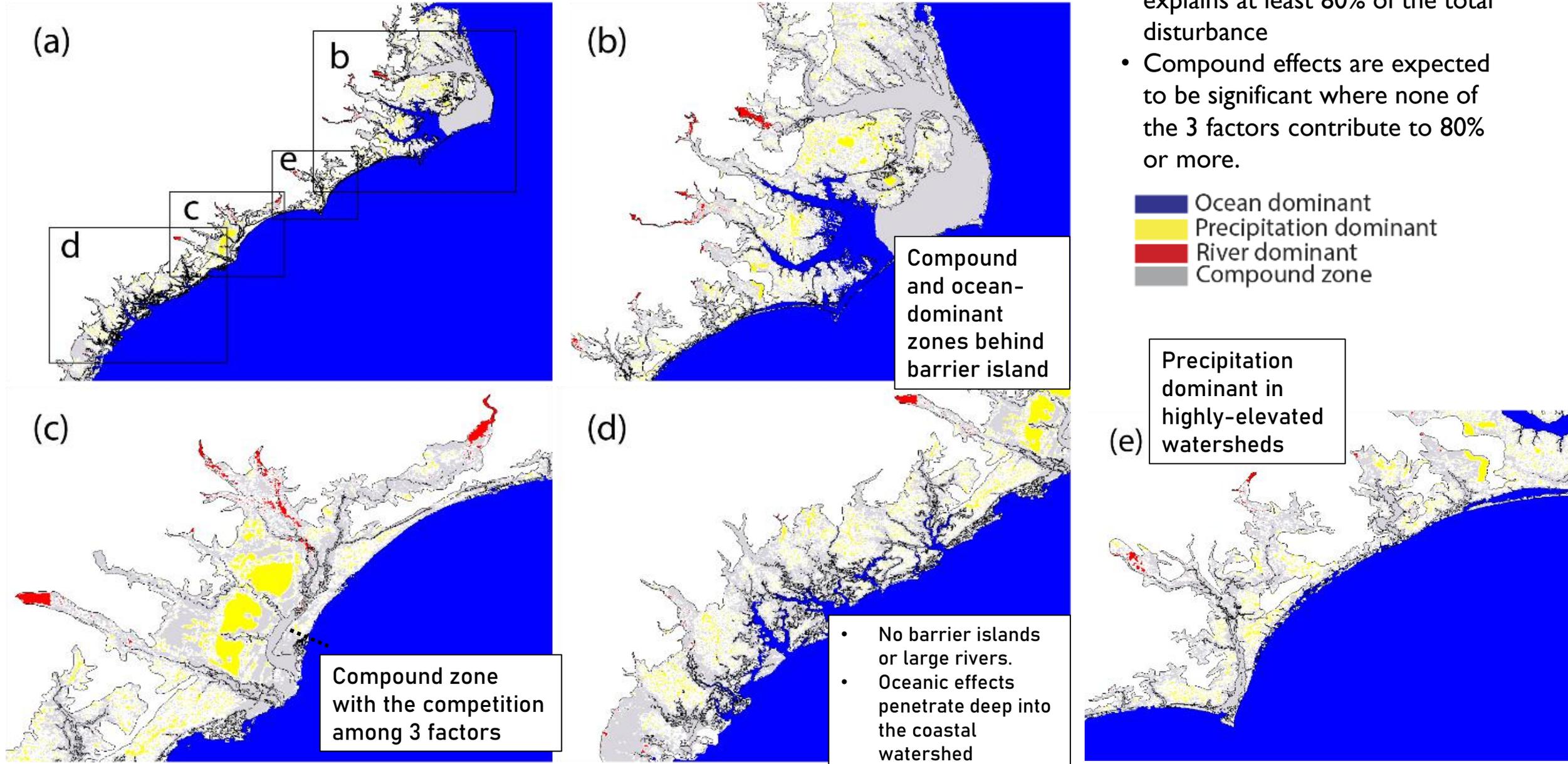
Backwater effect

(outflowing river water is partially blocked the incoming surge)



Snapshots of differences of elevation (baseline—reduced), suggesting a sequence of propagation of backwater effect into upstream Neshaminy Creek

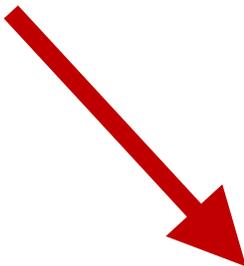
Dominance map showing the competition among 3 forcing factors



Small domain cut from the baseline grid:

- Elements: 500 K
- Nodes: 142 K
- North Carolina and South Carolina

Link to the online doc
provided in the agenda:



Day 2: SCHISM 2D for compound flooding studies

****ON GOTOWEBINAR****

Recording session

10:00-13:00

1. Introduction to SCHISM [Joseph; 1 hr]
2. Mesh generation for compound flooding study [Joseph, Wei; 2 hr]

Lunch break (30 min)

13:30-13:50

3. Building SCHISM, pre-processing (ACE tools etc); post-processing, visualization [Joseph; 20 min]

Break (10 min)

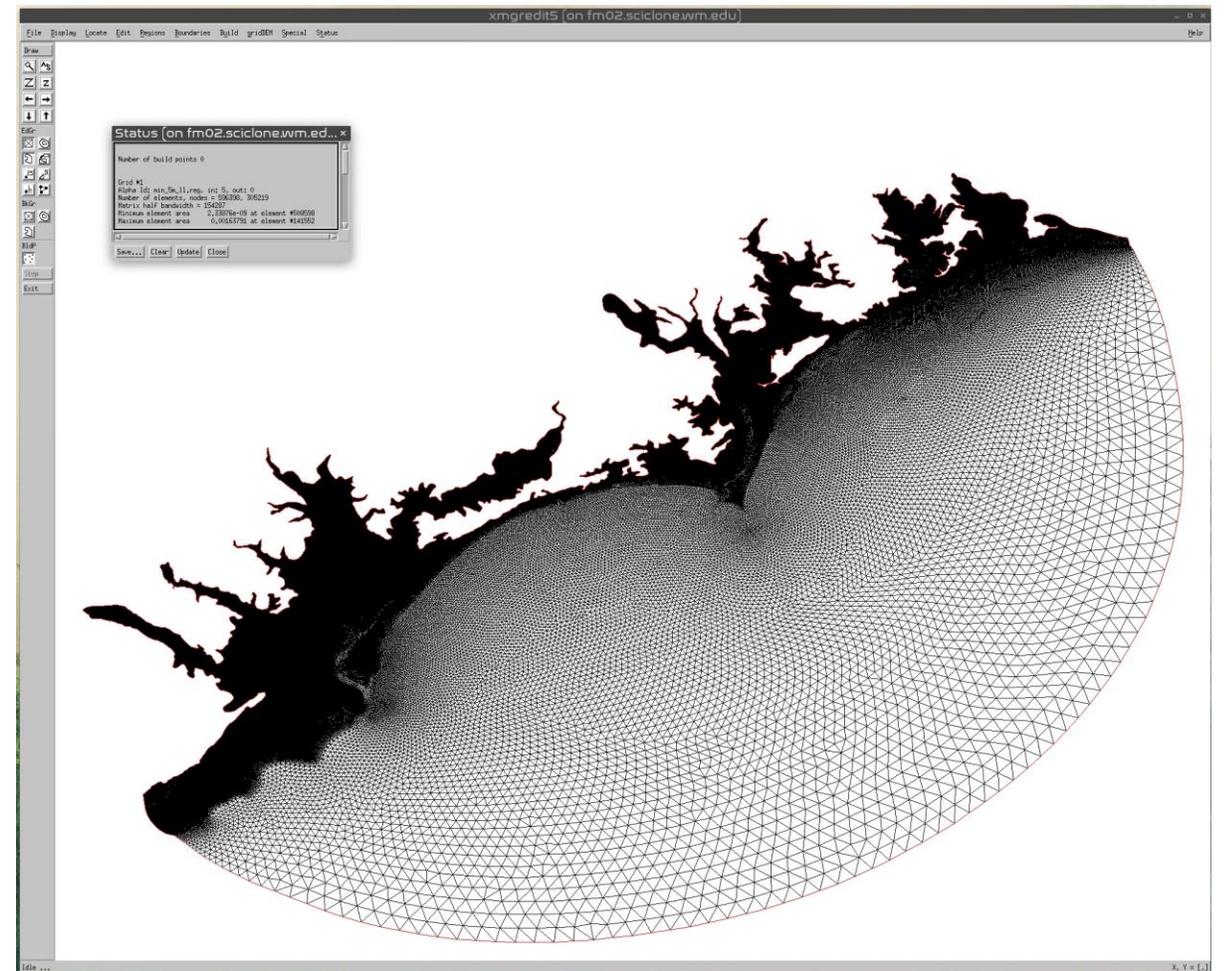
14:00-15:00

4. Model setup for 2D compound flooding [Fei Ye; 1 hr]

useful document to refer to:

http://ccrm.vims.edu/yinglong/feiye/Workshop_20190701/TEMP/Doc/ECGC2D.html

****END OF GOTOWEBINAR****



- ✓ **Mandatory Inputs**
- ✓ **Additional inputs for 2D compound flooding**

The scripts are inside schism-dev on Github:

[git@github.com:schism-dev/schism.git](https://github.com/schism-dev/schism.git)

, under the "Utility" folder:

`$your_schism_git_dir/src/Utility/Pre-Processing/NWM/`

Please get the latest code before starting the tutorial. If you're using Femto for the tutorial, you can also copy from Fei's folder:

`/sciclone/data10/feiye/NOAA_BOOT_CAMP/NWM/`

Purpose:

- ❑ Not asking you to exactly follow this procedure, which is by no means optimal and is under revamping by my colleague Dr. Linlin Cui.
- ✓ Provide enough background information so that you can set up the compound flooding model using your preferred tools.

