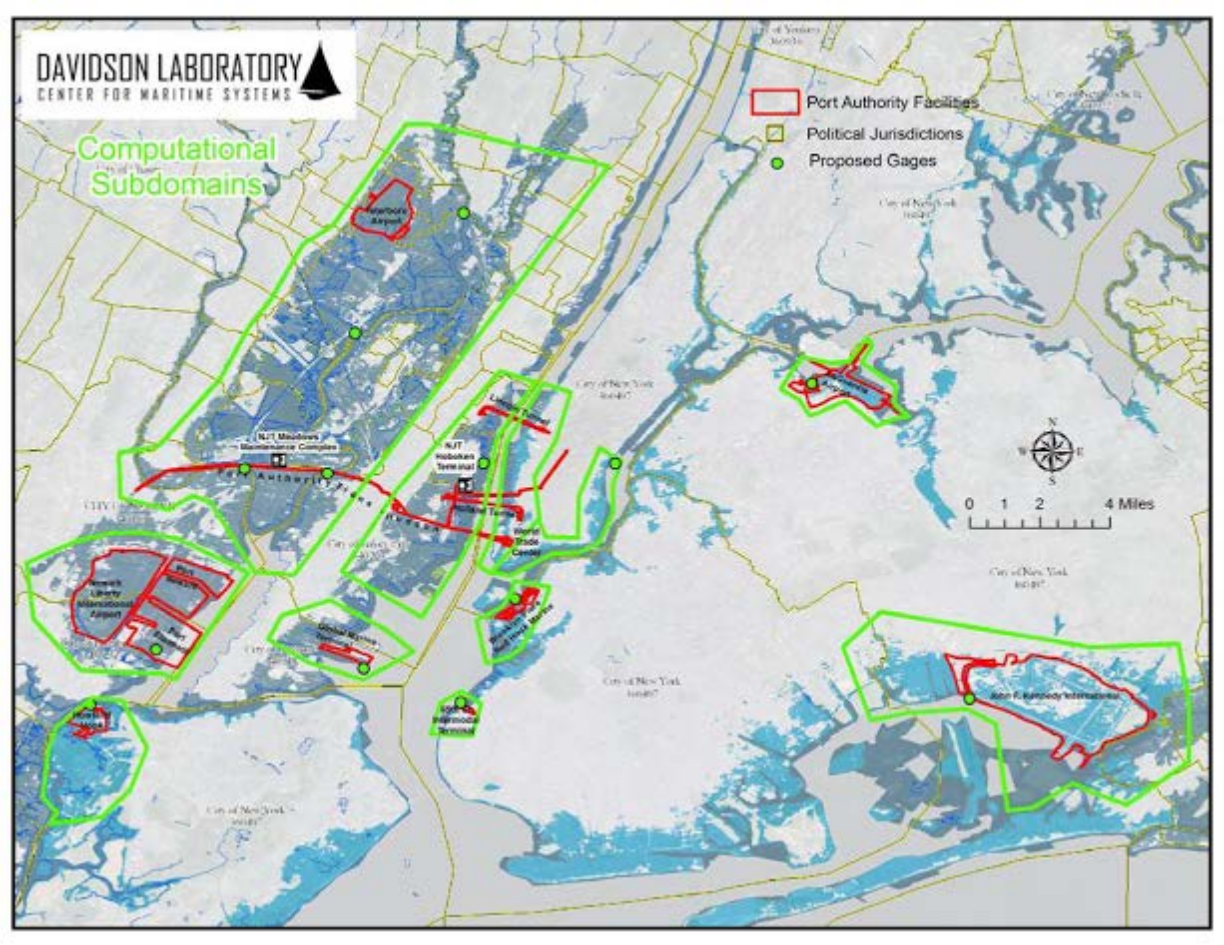
Rain and Storm Surge Integrated Hydrodynamic Modeling system for overland flood forecasting in the NJ Meadowlands region

Nickitas Georgas, Davidson Laboratory, Stevens Institute of Technology

The overall objective is to predict inundation occurring from a storm surge|rainfall event.

- **-New Sensors**
- **-New Surge/Rain Forecasts**
- **-Street-Scale 2D Dynamics**
- **-Ensemble Met Predictions**
- **-Web Maps and Time Series**
- **-Automatic Alert Triggers**



Co-authors

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The Port Authority of New York and New Jersey
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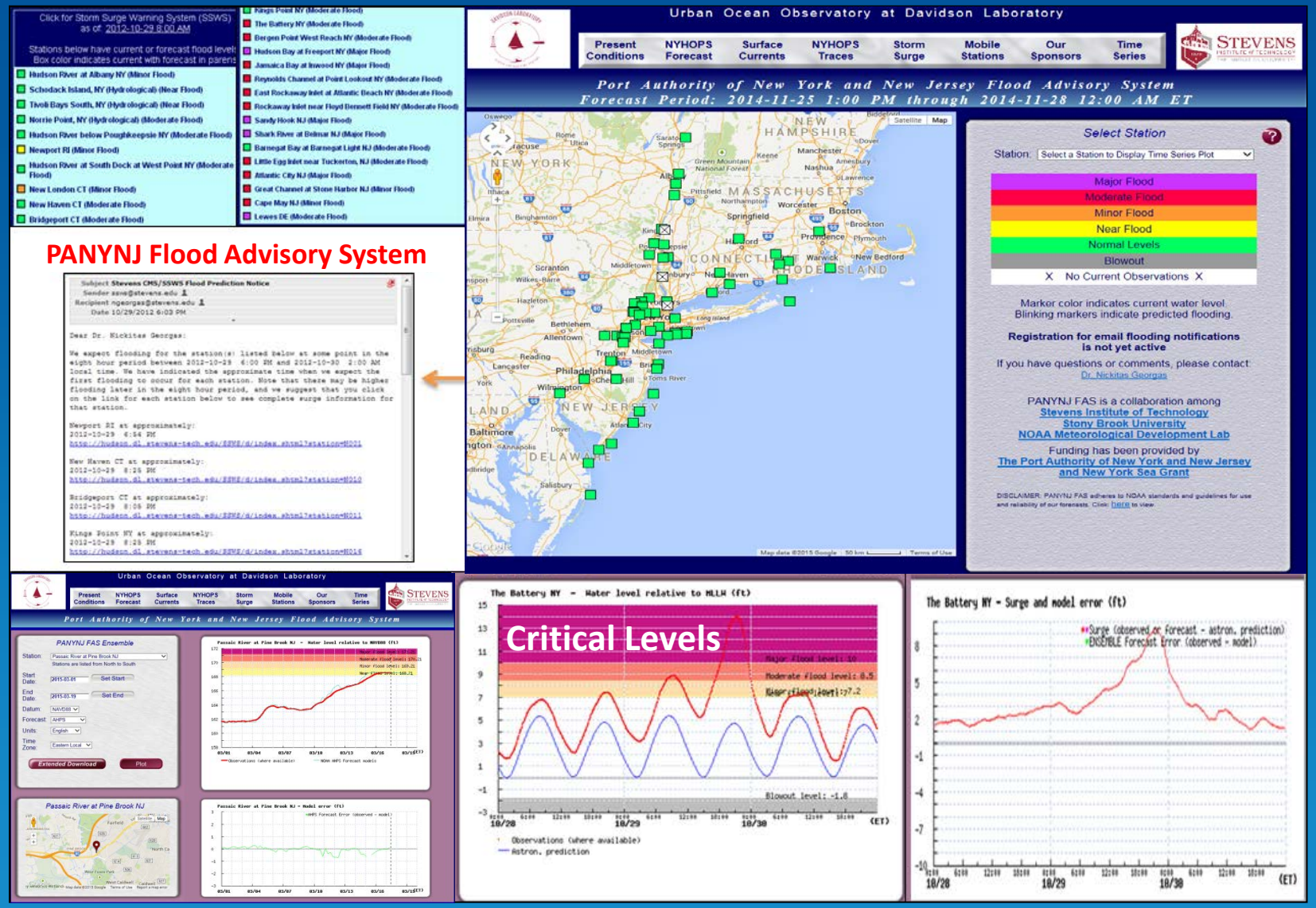
NJ Meadowlands Environmental Research Institute
Dom Elefante, Joe Grzyb and Francisco Artigas

SSWS -> PANYNJ FAS: Combined Flood Advisories, at NAVD88



River floods

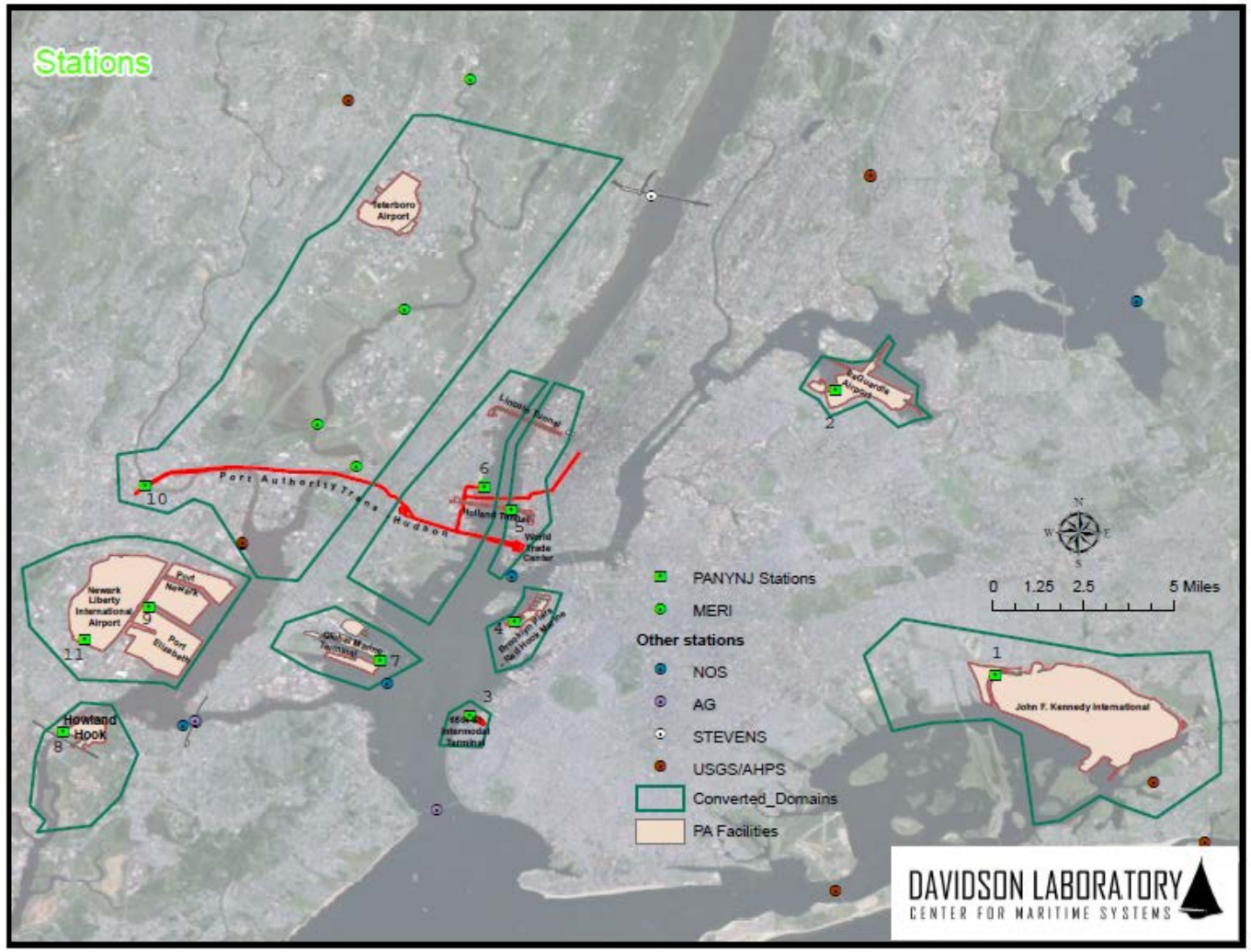
Storm Surges

Real-time Water Level Stations (Virtual and Physical)

Deploy co-located virtual (model-derived) and real-time physical stations on facilities

VIRTUAL STATIONS

- 72hr water level forecasts
- Initialized every 6 hours
- ID critical flood levels
- Trigger flood guidance
- First, from storm surge
- Then, combine rain
- Ensemble predictions



PHYSICAL STATIONS

- 11 dual procured
- Site Visits / Recon
- Approval process
- Installation/Benchmark
- RT communications
- FAS Website Integration
- Routine Maintenance

NOS-standard, Wireless Aquatrak Sensors (Water Level)

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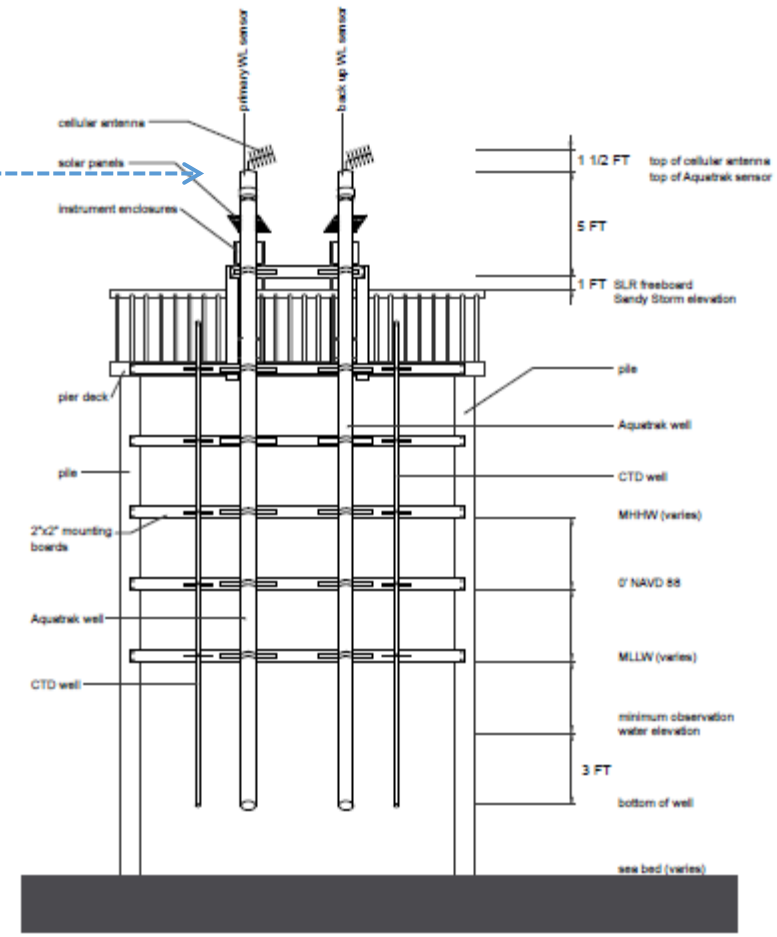
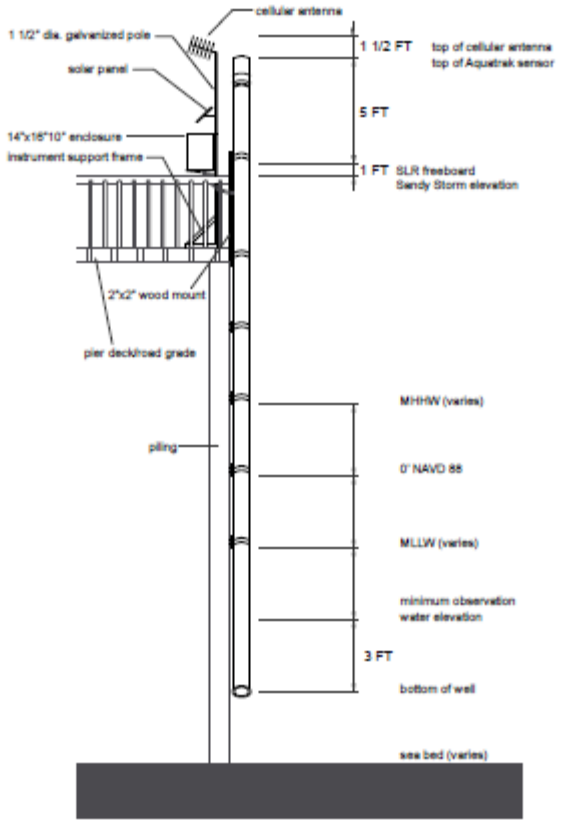
Greenspan

Analytical

EC250 C/T



Front View

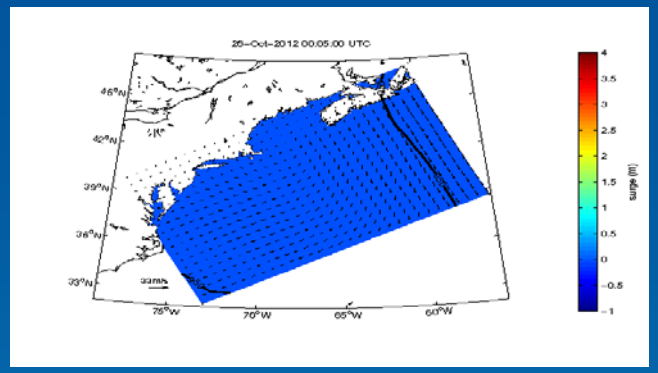


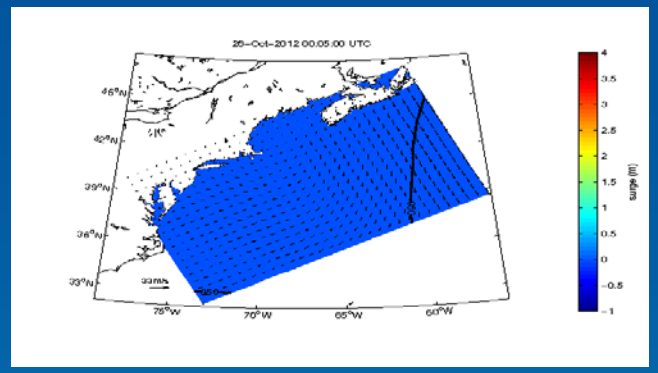
Side View

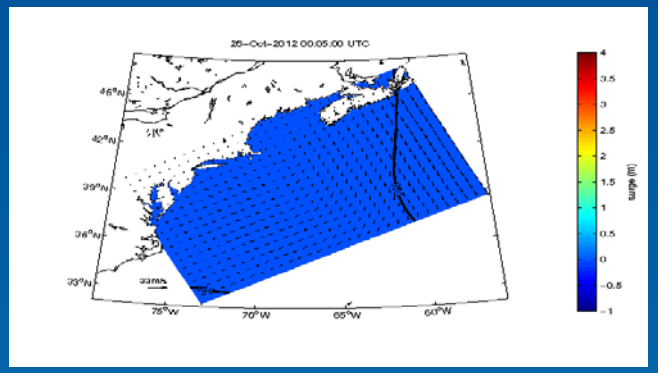
Pharos cluster at the Stevens Hyper-Scale Computing Center

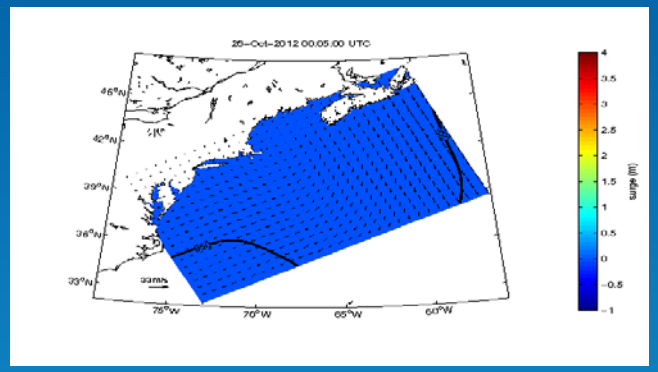
1,280 cores, 2PB+ of RAIDed Xyratex storage, UPS, Generator.
65 ensemble endmembers running, every 6hrs, 72hr forecasts.

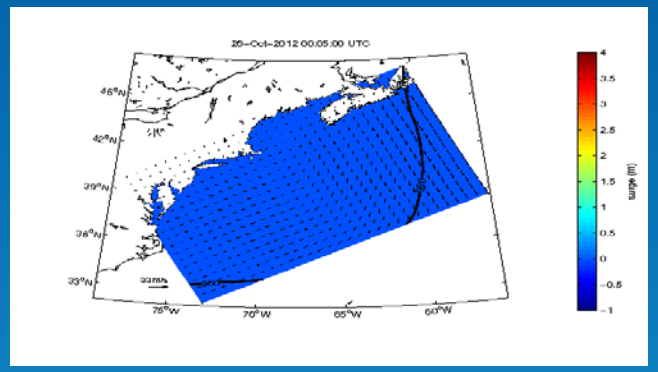
Now: 65 Stevens North Atlantic Predictions (SNAP) forecasts

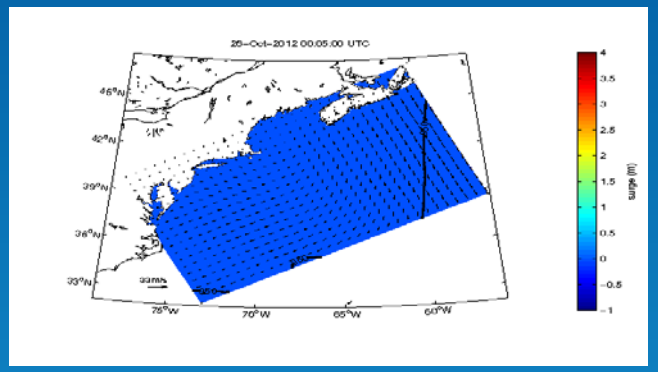


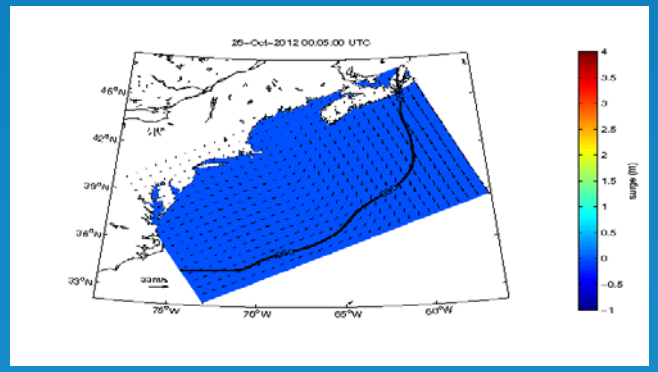


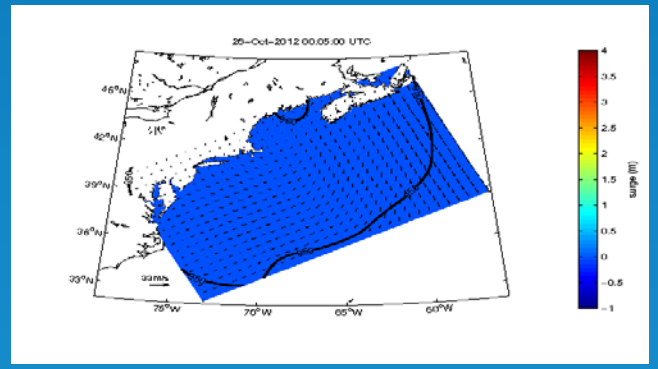


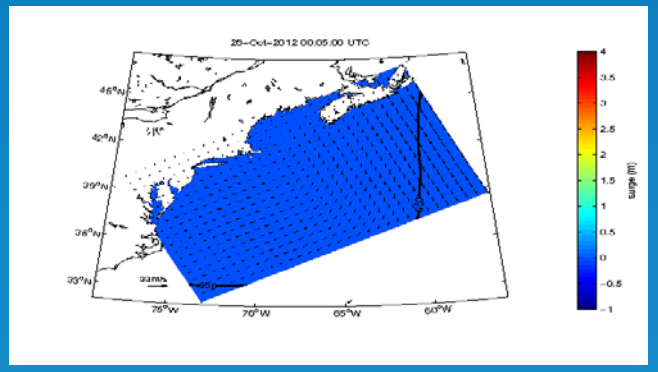












Operational NYHOPS Forecast model
3D General Circulation and Surface Wind-Wave Model

Input forcing:

- ✓ Tides
- ✓ Offshore Surge and Steric
- ✓ Offshore Waves
- ✓ Surface Winds/Pressure
- ✓ Heating and Cooling
- ✓ 239 Rivers and Streams
- ✓ 280 Major Dischargers
- ✓ River Ice

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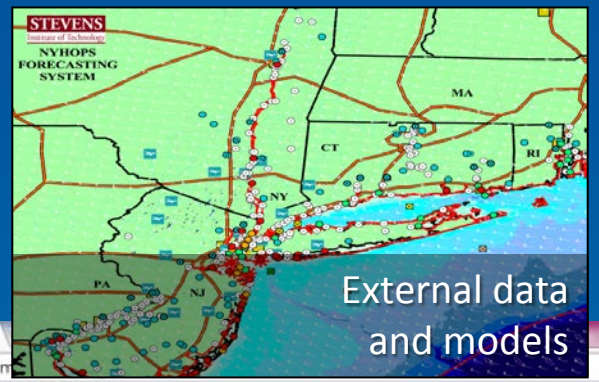

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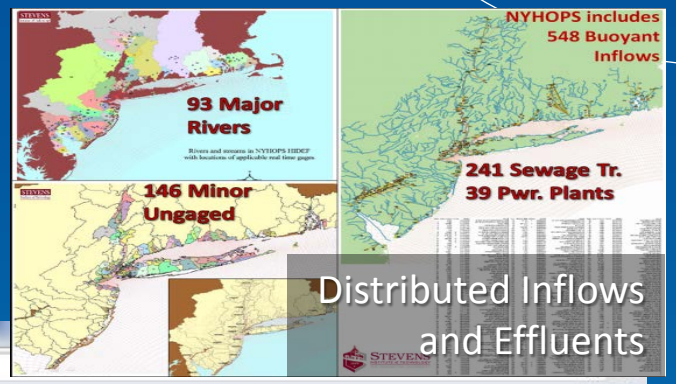


Output:

hindcasts+72-hr forecasts 4x/day

Results every 10min, since 2006.

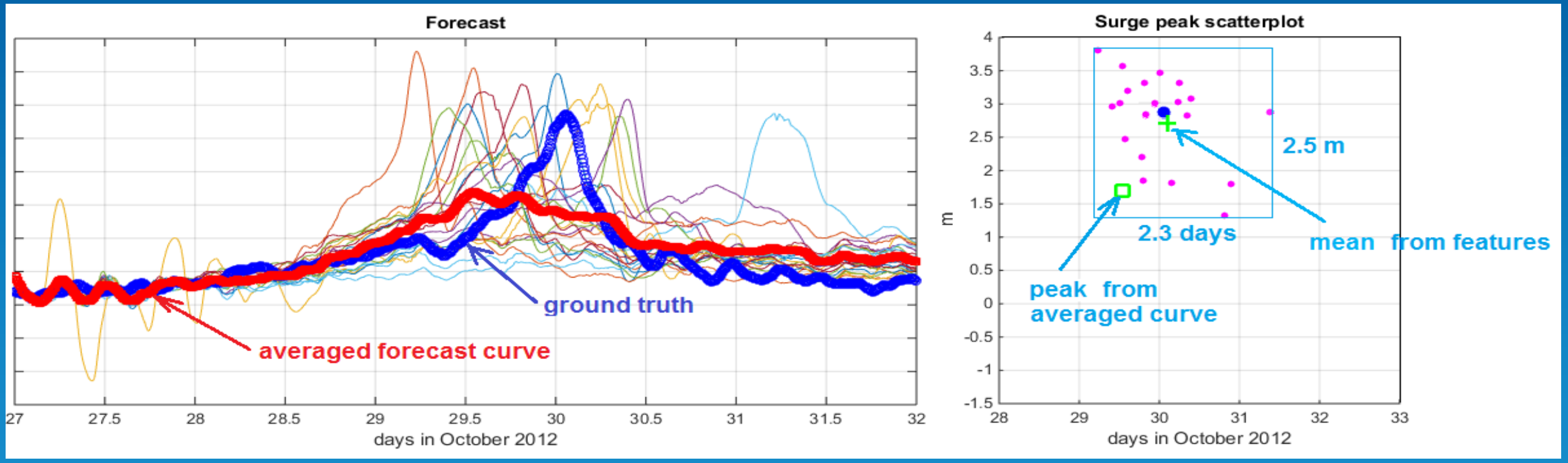
- ➢Total water level.
- ➢3D Currents, Salinity, Temperature.
- ➢Significant wave height and wave period.

STEVENS INSTITUTE of TECHNOLOGY

IOOS INTEGRATED OCEAN OBSERVING SYSTEM

Research on Forecasts and Ensembles

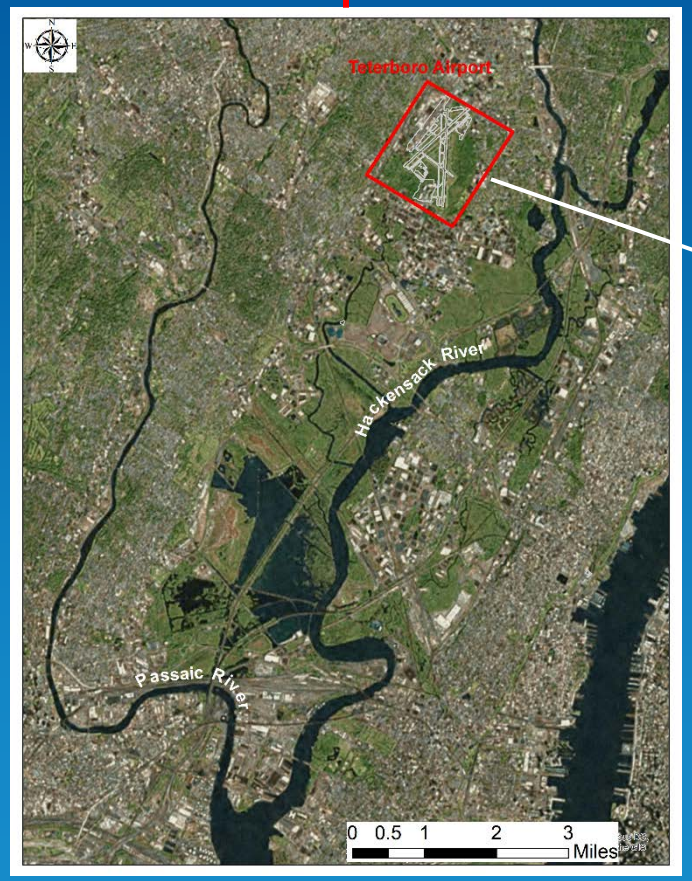
De-bias models -> Ensemble predictions -> Best Forecast, Reasonable Uncertainty Range



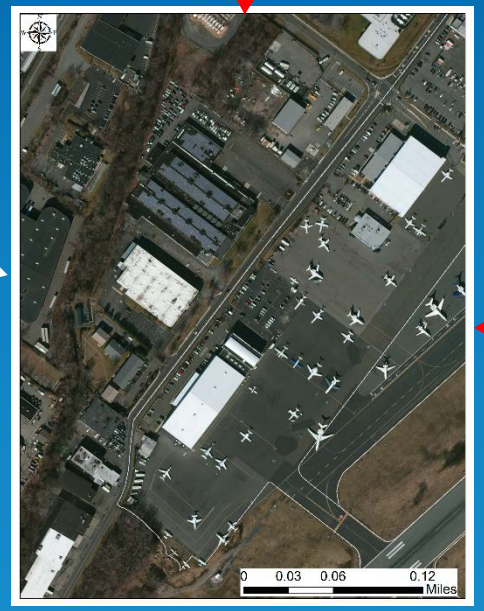
Flood Forecasting Framework in PANYNJ Facilities

The inland forecasting framework is based on a coupled approach

Regional scale rainfall-runoff model generates boundary conditions and external inflows to a local scale model

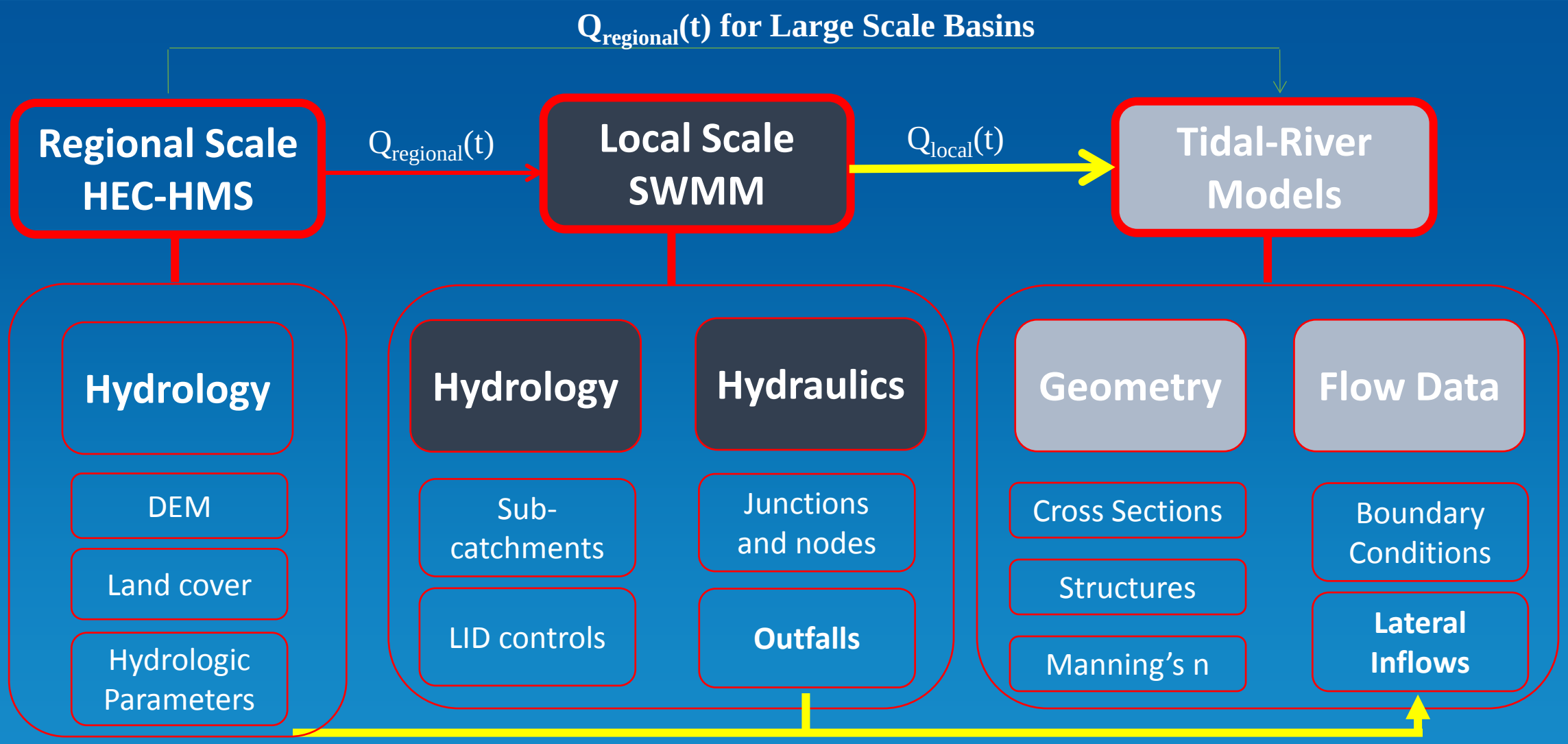


Discharge inflow to a Tidal-River model



Downstream tidal boundary conditions [NYHOPS]

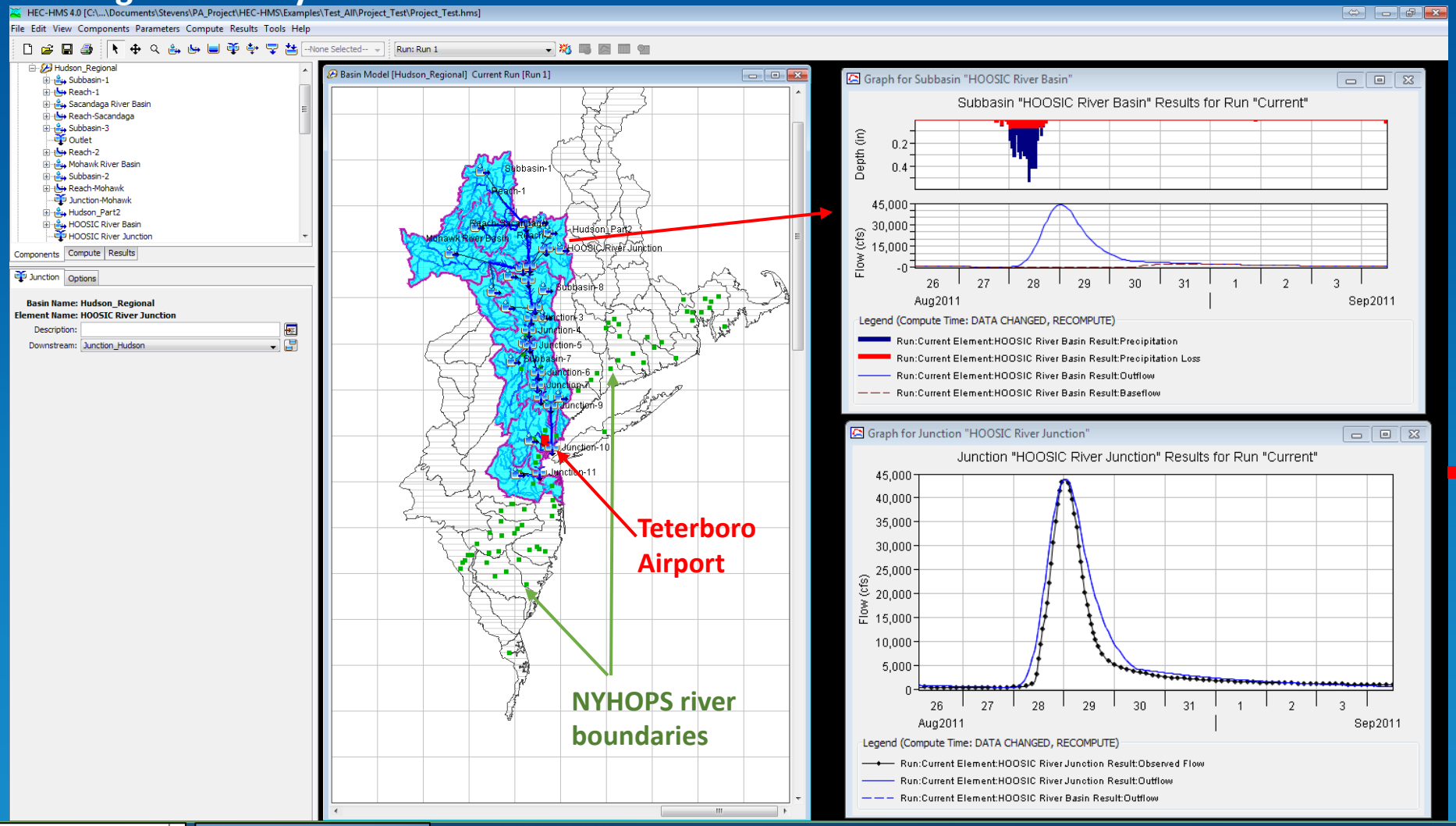
Flood Forecasting Framework in PANYNJ Facilities



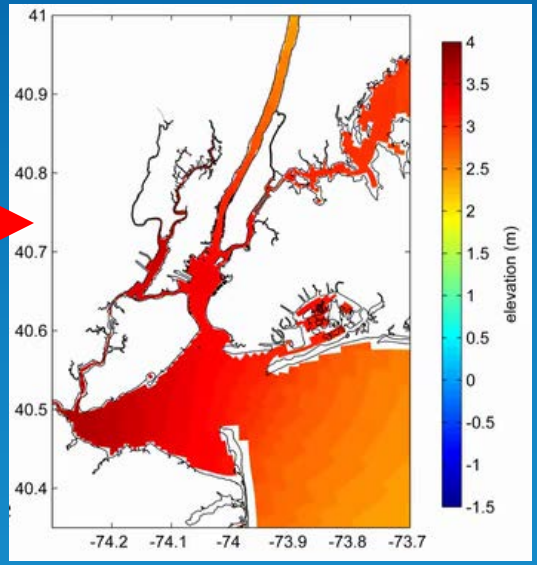
All models are forced with meteorological forecasts

HEC-HMS Coupling with NYHOPS

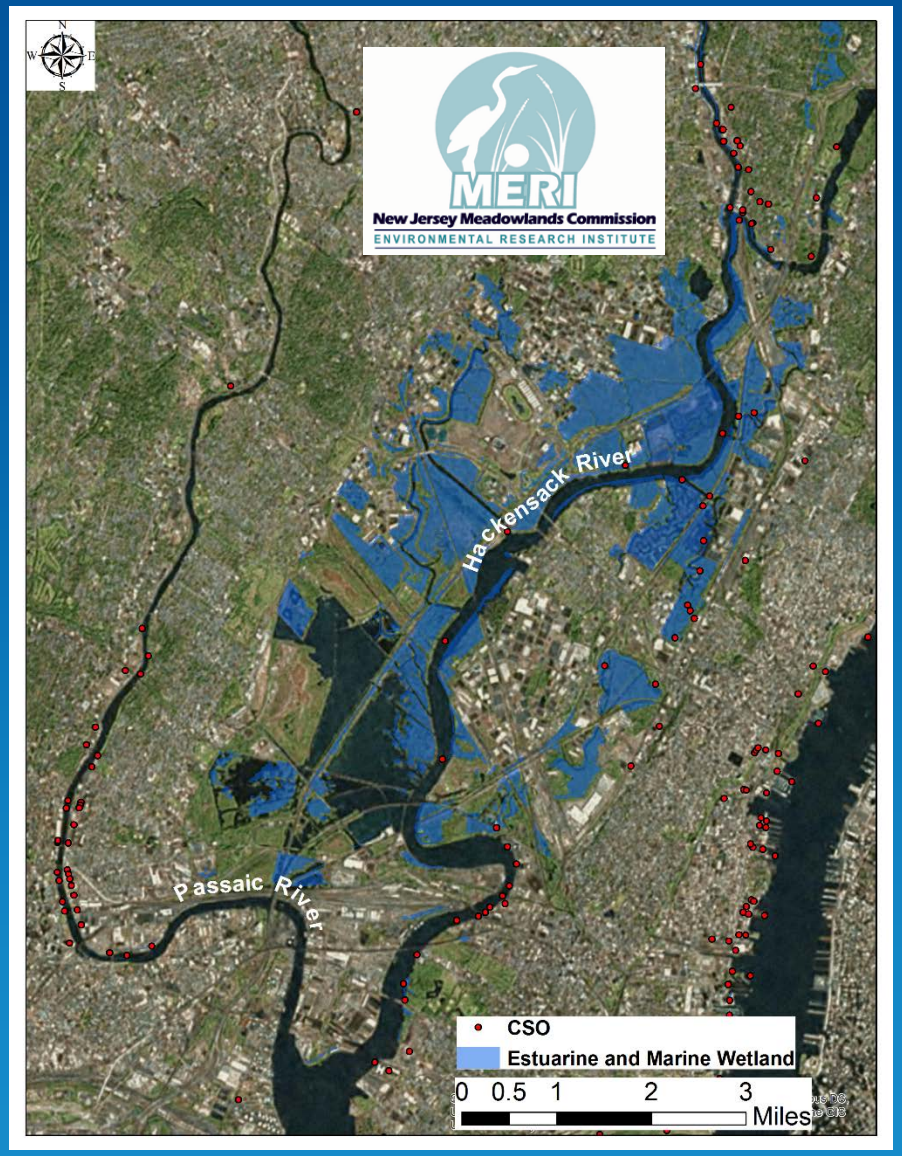
Automatic scripting is being built to convert the forecast precipitation data to HEC-HMS in order to forecast regional discharge boundary conditions for the local scale models as well as NYHOPS.



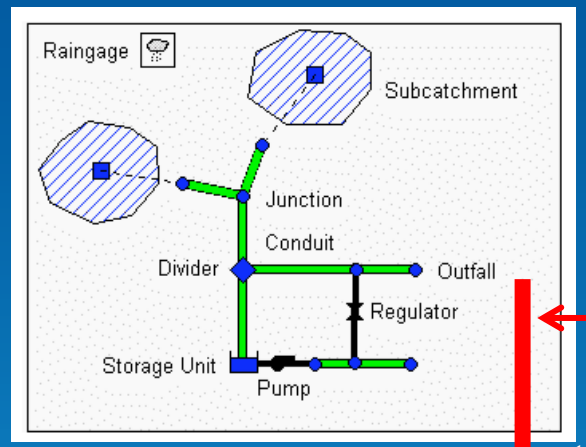
NYHOPS



Local Scale Hydrologic/Hydraulic Modeling and Prediction



Local Scale SWMM



Downstream tidal boundary conditions [NYHOPS]

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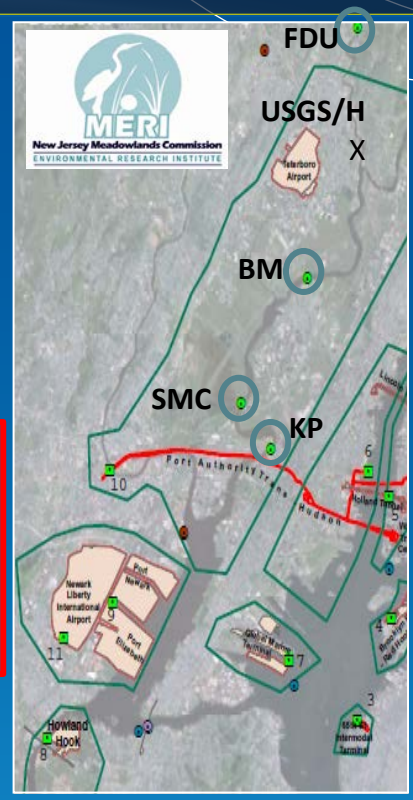
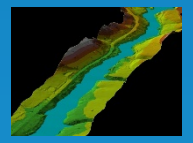
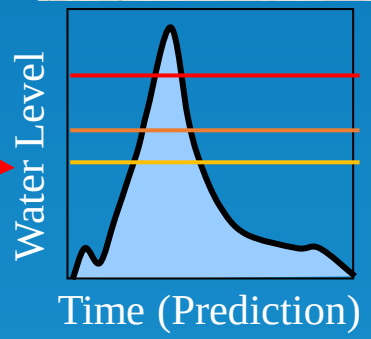


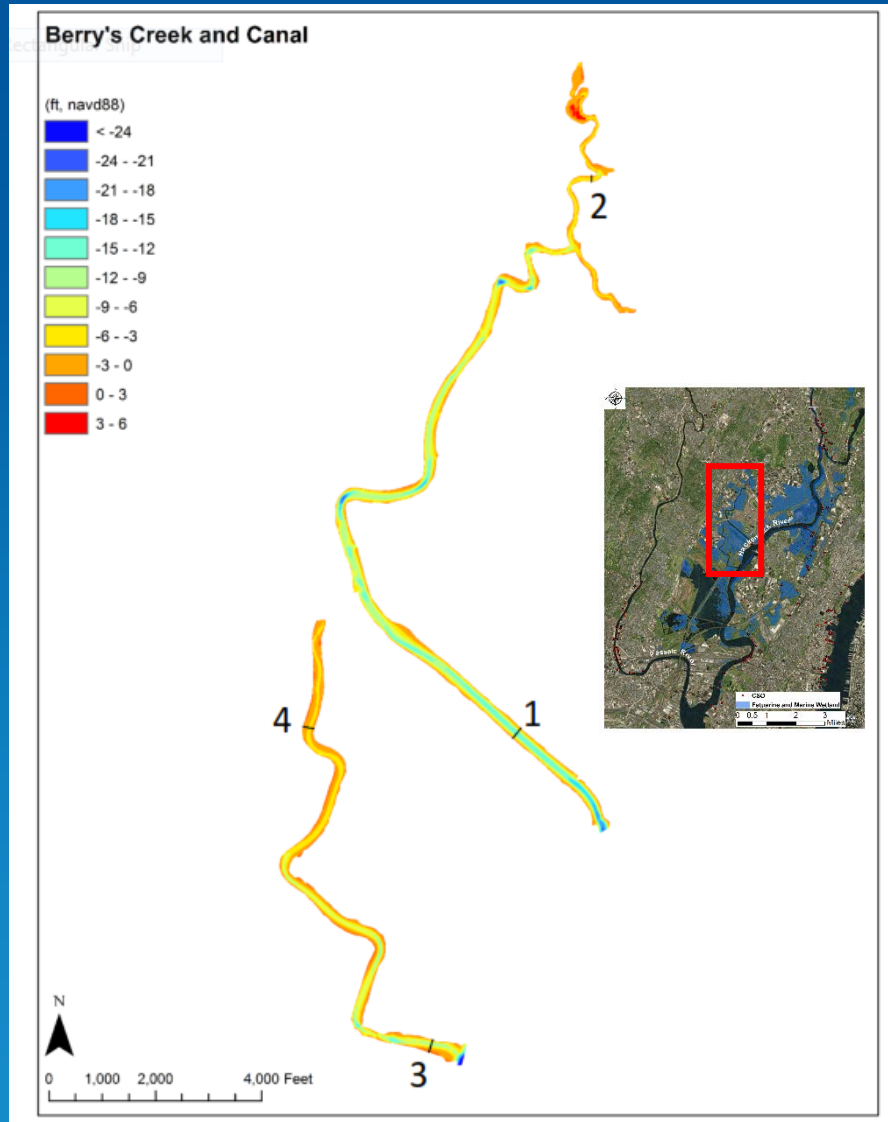
Tidal-River Models

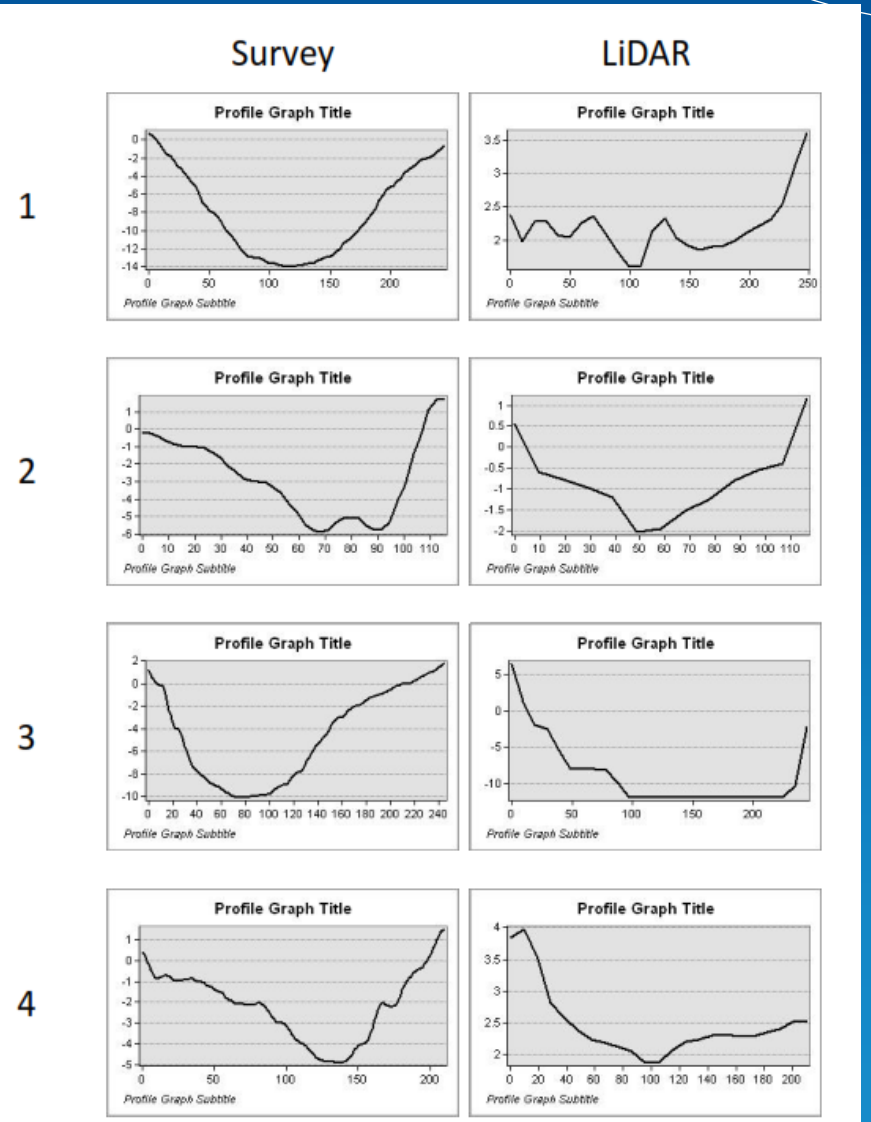




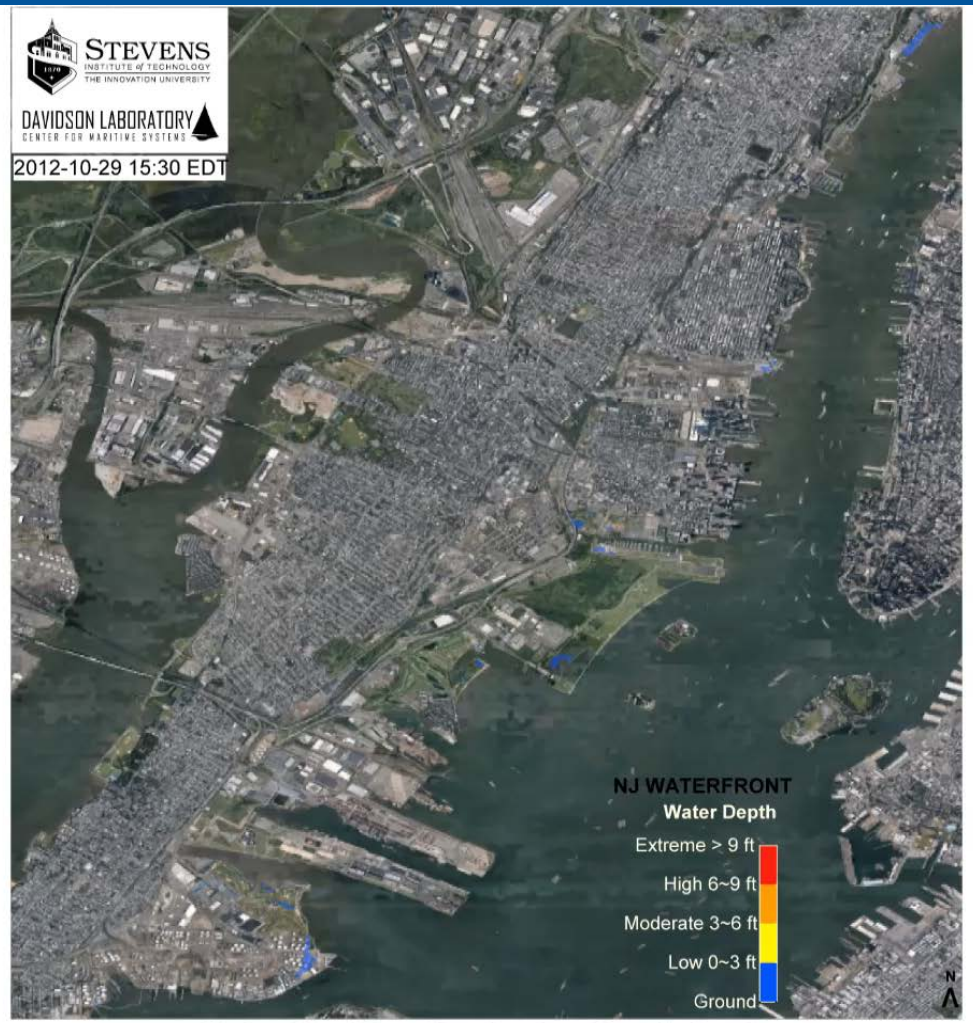
NJ Meadowlands Data provided by MERI (Thank you!)

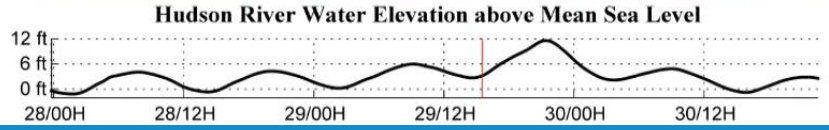
- Bathymetry for Berry's Creek and Canal
- Technical Reports
- CSO outfalls
- Locations of flood control structures within the Meadowland District
- Geometric properties of inline structures
- Hydraulic and hydrologic analysis reports and data (e.g. West Riser Tide Gates System)
- Data for validation



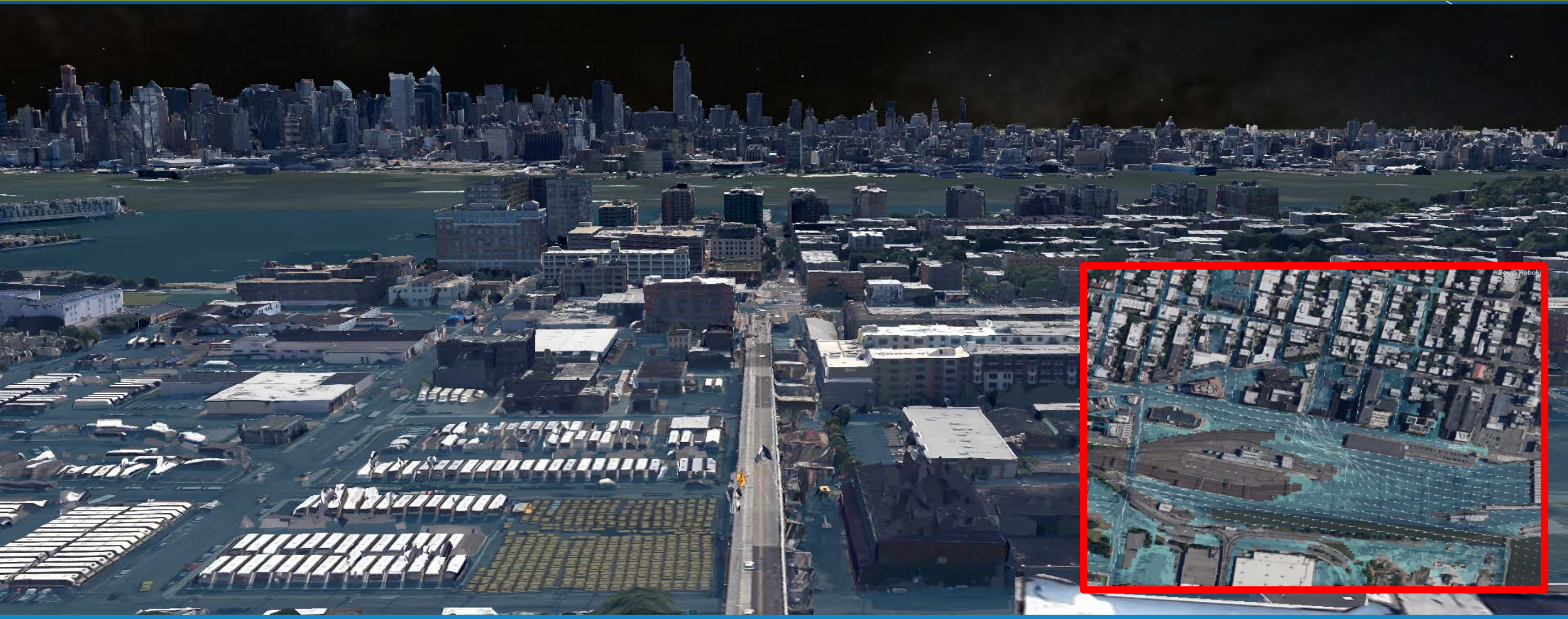


Street Scale Surge Model for NJ Hudson River Waterfront





Street Scale Hoboken ‘Zero Hour’



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Presentation at the New Jersey Geospatial Forum – Trenton, NJ – 2015/03/17