Operational Hydrologic-Hydraulic-Coastal Ensemble Prediction System in Urban Watersheds: Runoff and Combined Sewer Overflow (CSO) Forecasts in the City of Hoboken, New Jersey

F. Saleh*, V. Ramaswamy, N. Georgas,
A. F. Blumberg and J. Pullen

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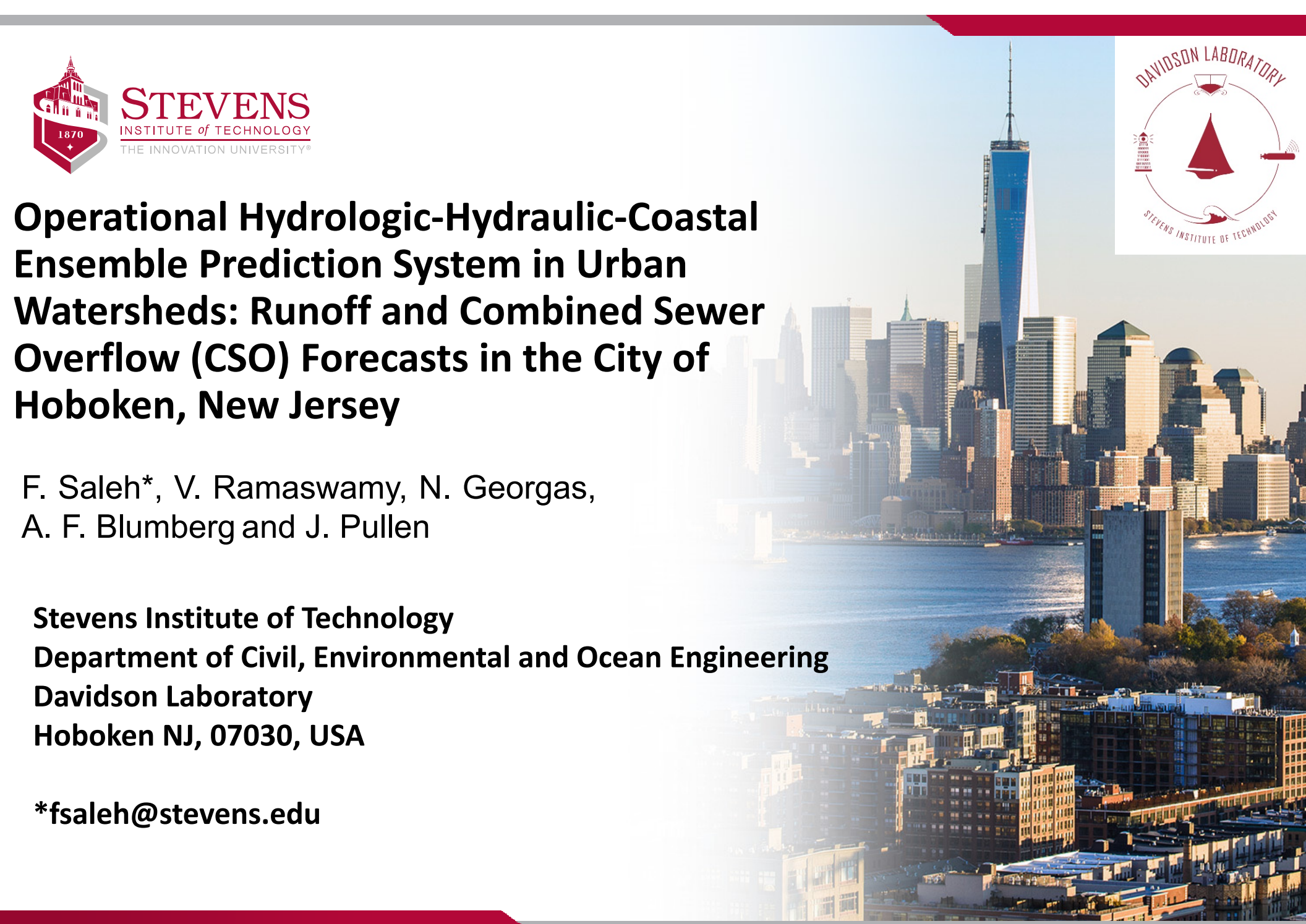
Department of Civil, Environmental and Ocean Engineering
Davidson Laboratory
Hoboken NJ, 07030, USA

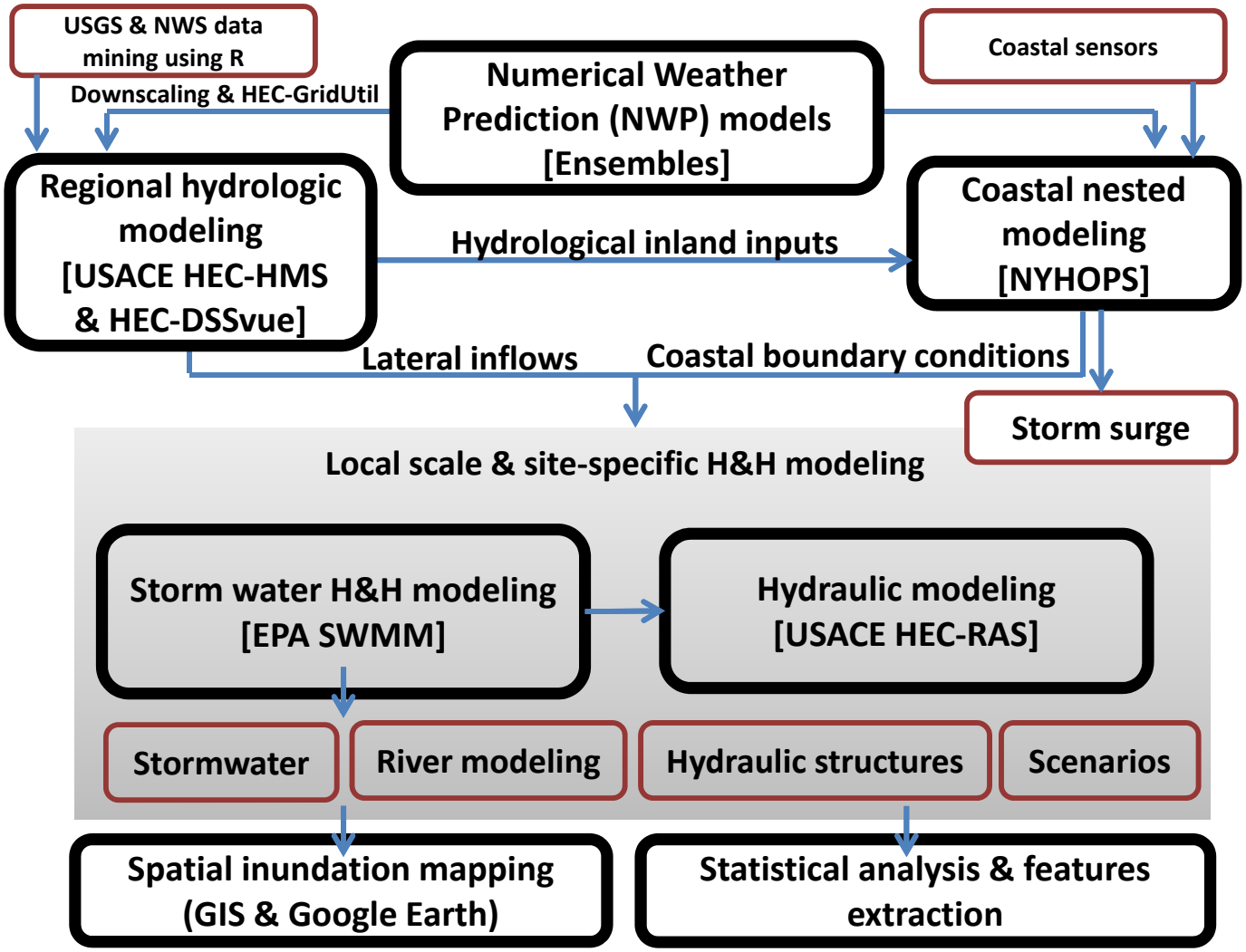
***fsaleh@stevens.edu**



2016 HEPEX Workshop - Ensemble for Better Hydrological Forecasts - 6-8 June 2016, Québec, Canada

Integrated Prediction Framework

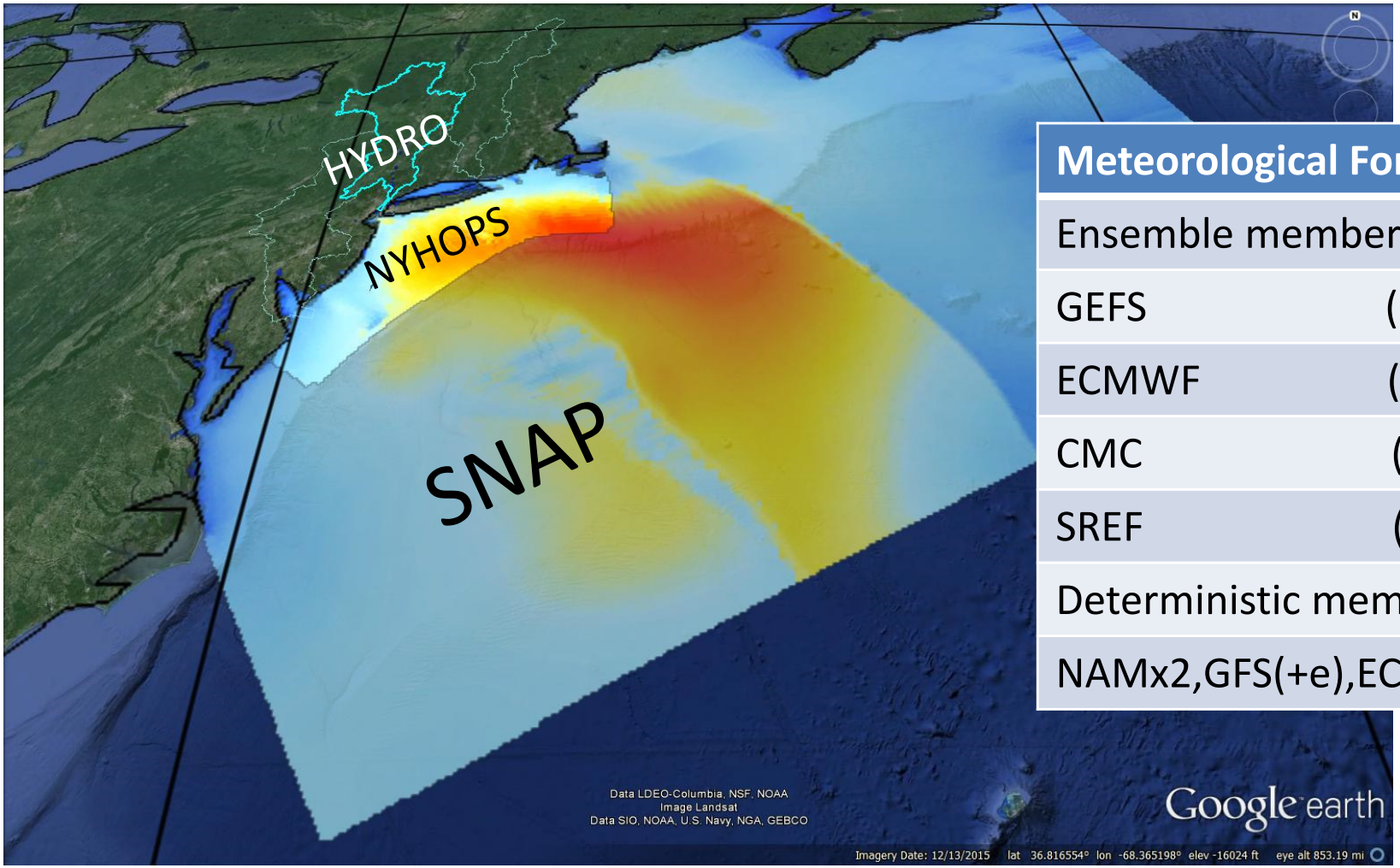
- Operational and fully automated on the Pharos (lighthouse) supercomputer (1,320 cores).
- 72 hours forecast horizon.
- 4 forecast cycles per day.
- 125 ensemble members.



(Saleh et al., 2016; Blumberg et al., 2015; Georgas et al., 2014)

Ensemble Forecasting System [Nested]

Stevens Northwest Atlantic Prediction (SNAP) model domain, the NYHOPS 3D 125-member Ensemble linked to offshore SNAP & HYDRO-river ensembles



Meteorological Forcing	
Ensemble members	
GEFS	(21)
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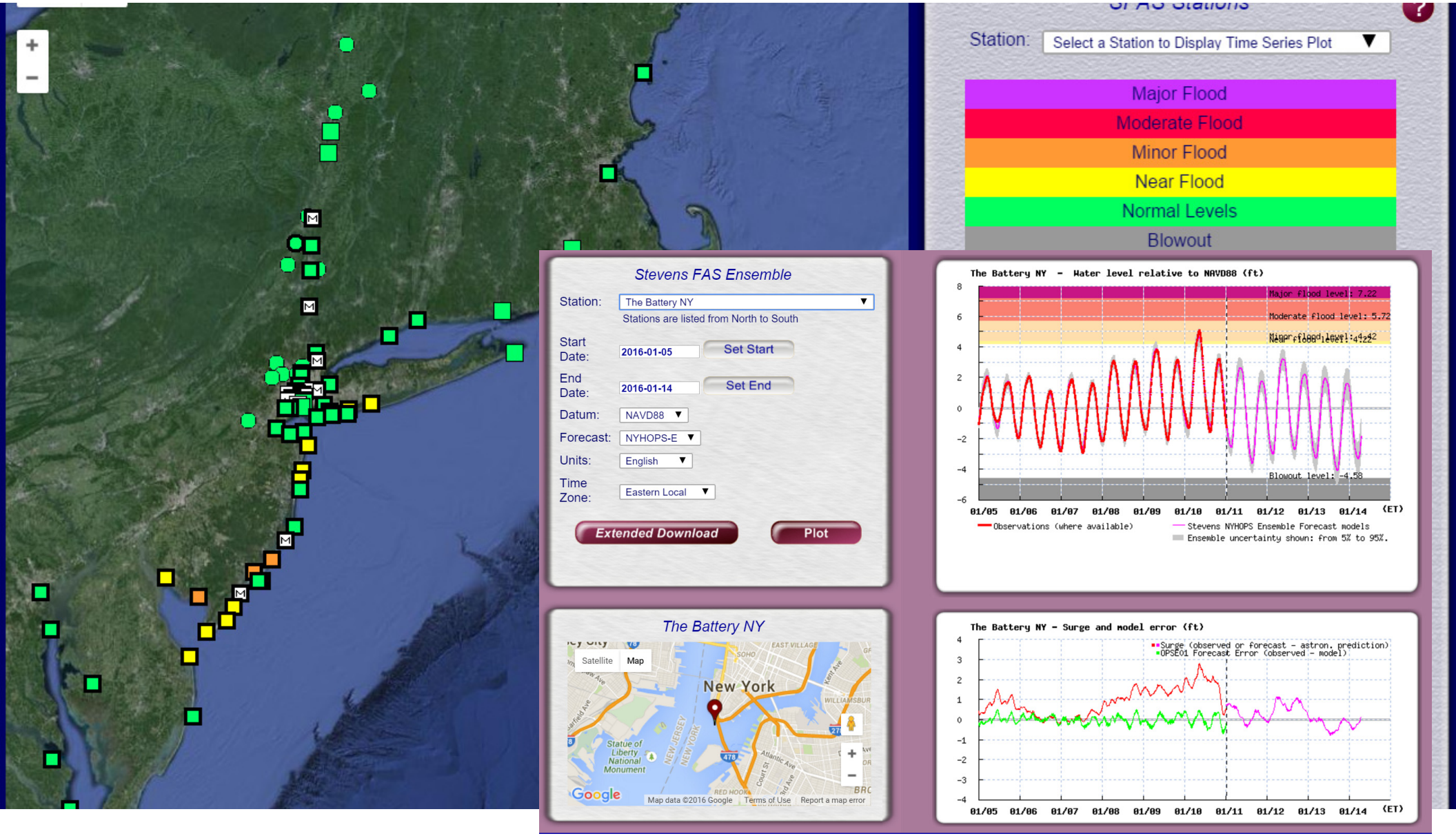
Deterministic members	
NAMx2,GFS(+e),ECMWF.	

Stevens Flood Advisory System

www.stevens.edu/SFAS



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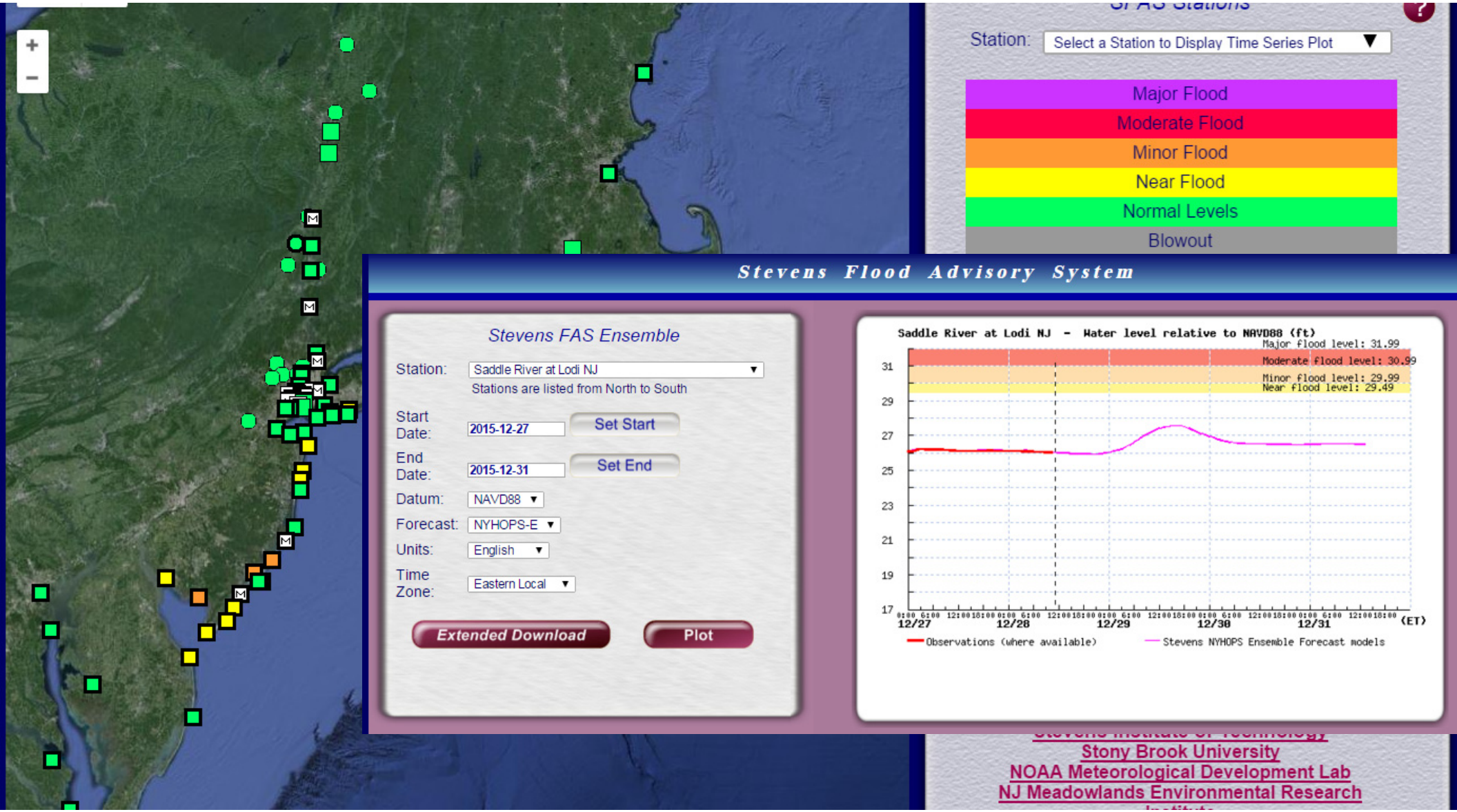

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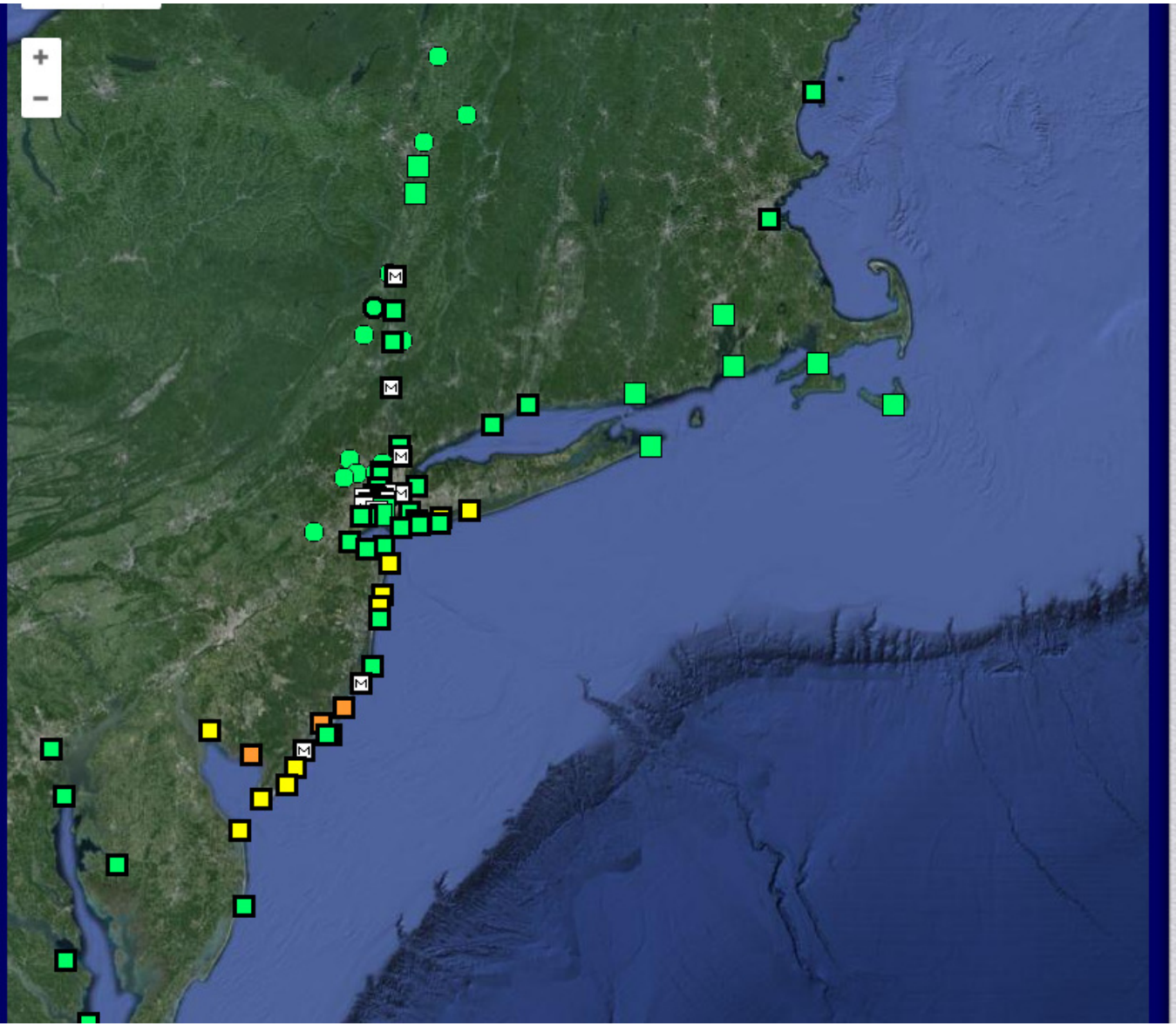


SFAS Stations

Station: Select a Station to Display Time Series Plot

Major Flood
Moderate Flood
Minor Flood
Near Flood
Normal Levels
Blowout
Model Predictions Only, Currently

Marker color indicates current water level.
Blinking markers indicate predicted flooding.

Page auto-refresh in: 4:18

To **register for email flooding notifications**, or to update registration information, enter your primary email and click the Manage... button:

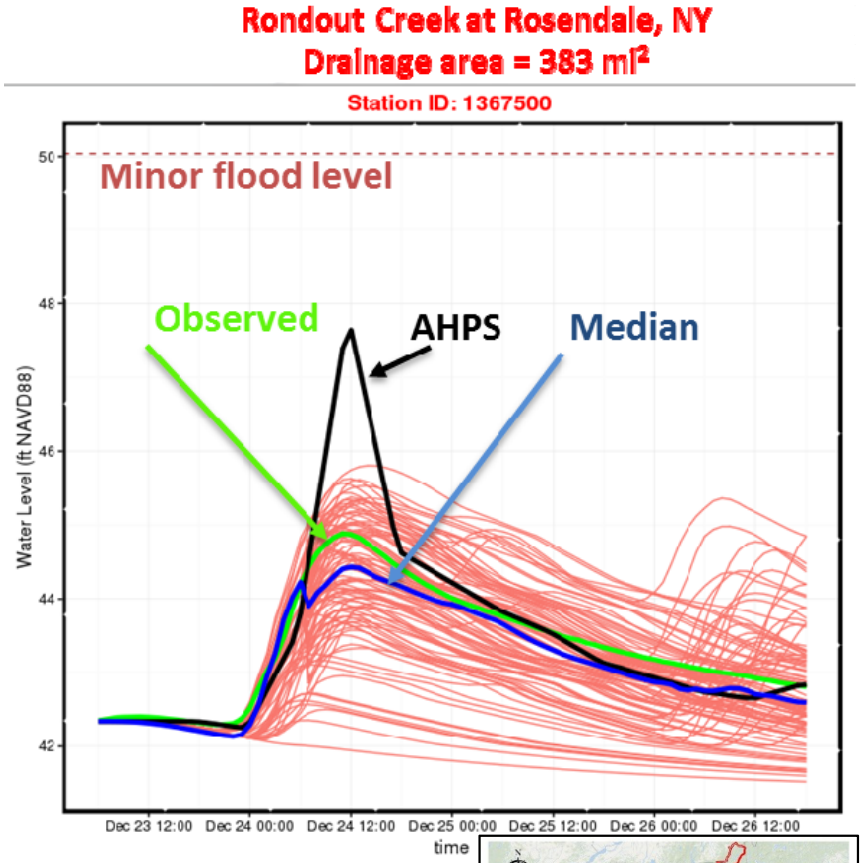
Manage Email Notifications

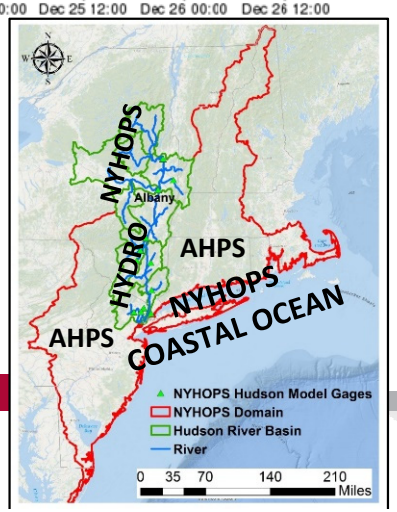
If you have questions or comments, please contact:
Dr. Nickitas Georgas

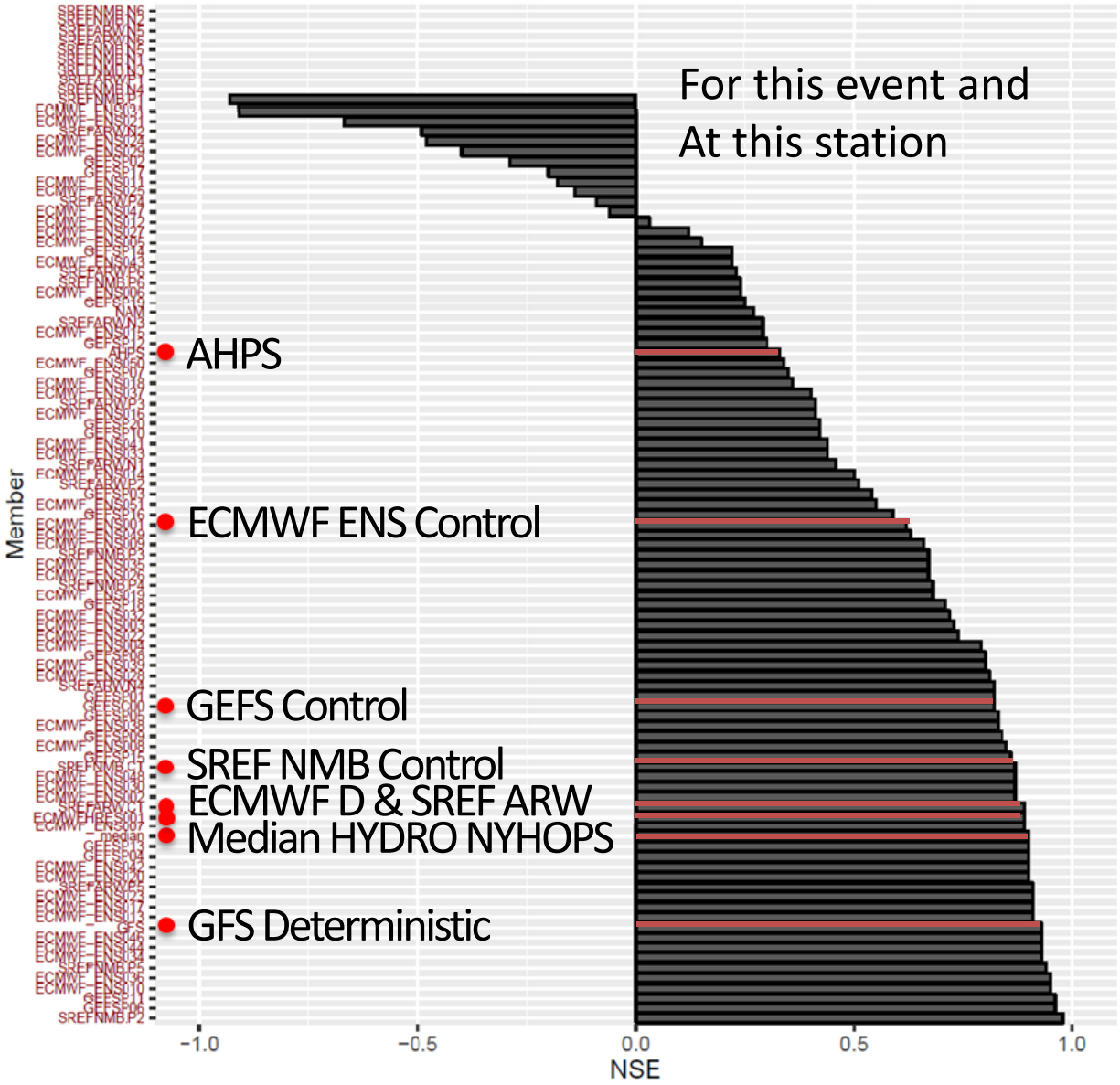
Latest News about SFAS as of:
December 08, 2015

The Stevens FAS is a collaboration among
Stevens Institute of Technology
Stony Brook University
NOAA Meteorological Development Lab
NJ Meadowlands Environmental Research

River Discharge Forecasts
Operational NYHOPS







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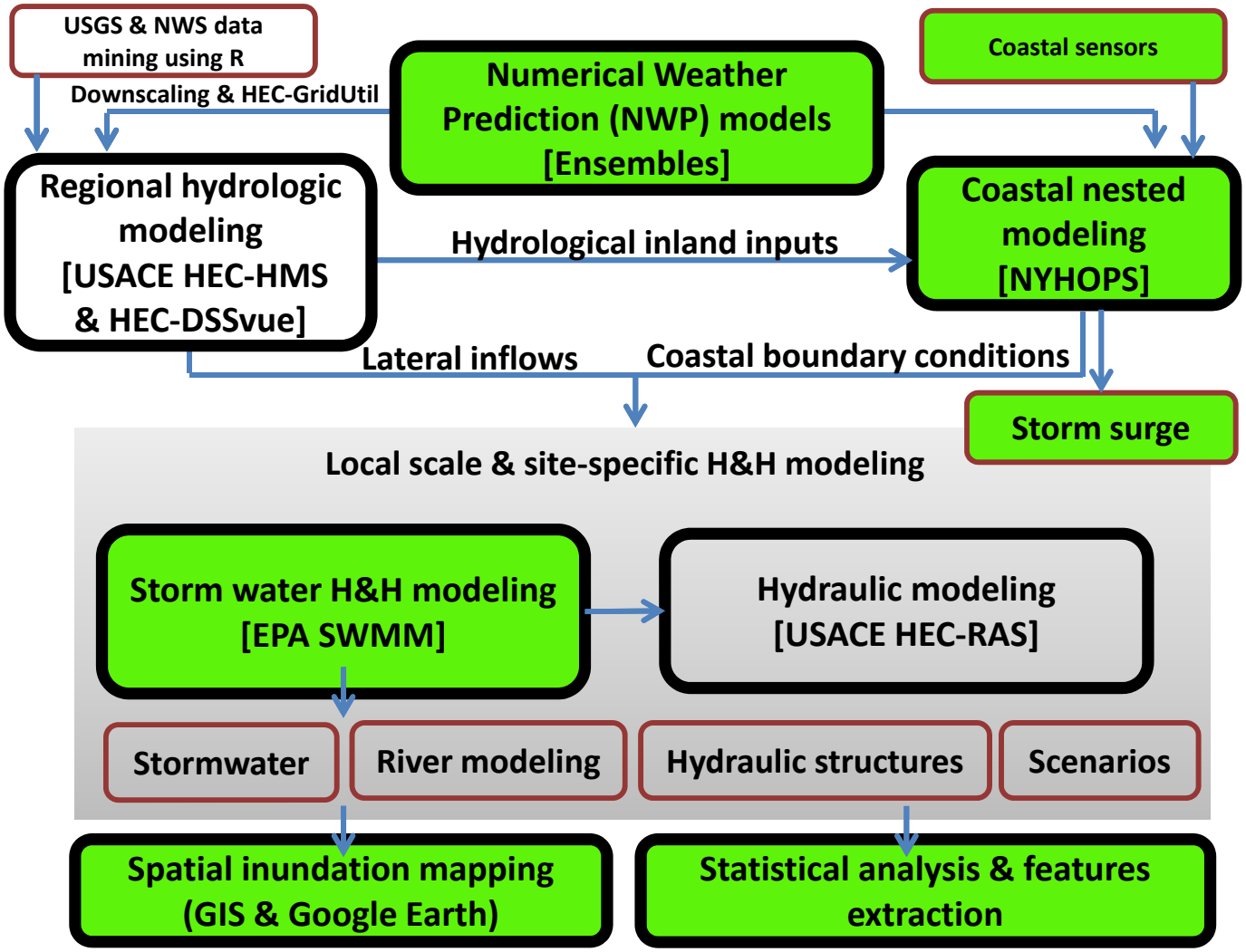
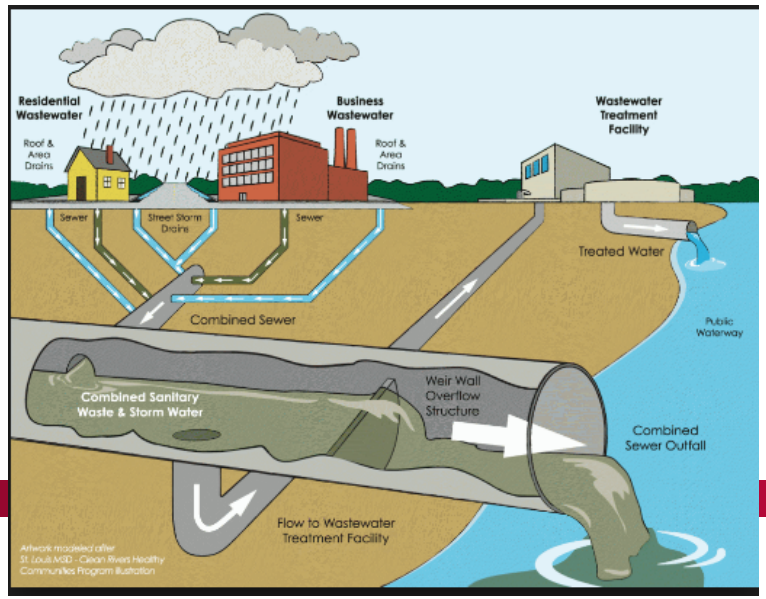


(Saleh et al., 2016; Blumberg et al., 2015; Georgas et al., 2014)

The City of Hoboken

- Population density of 15,140/km^2, increased by 30% between 2000 and 2010.
- 94% impervious coverage.
- Vulnerable to storm surges and frequent flash floods and back water flow.
- Combined sewer overflow.
- Sea level rise.
- Hurricane Irene & Sandy damage.



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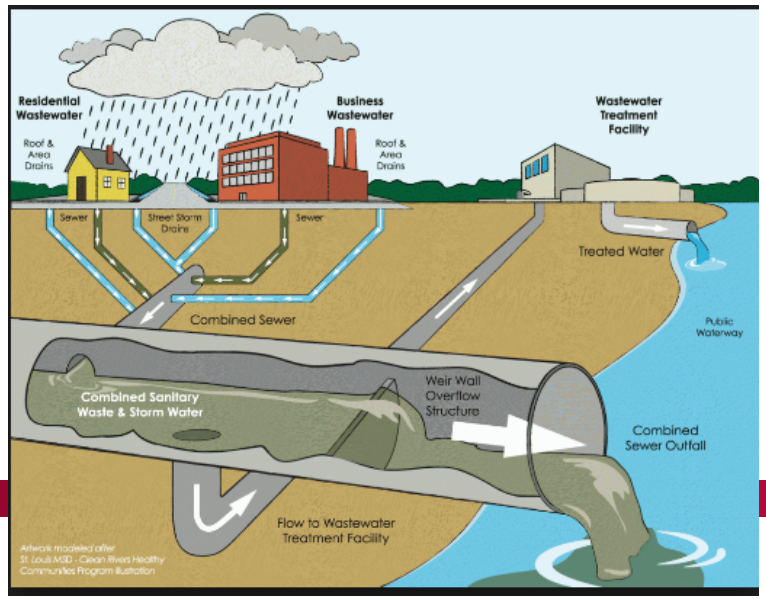
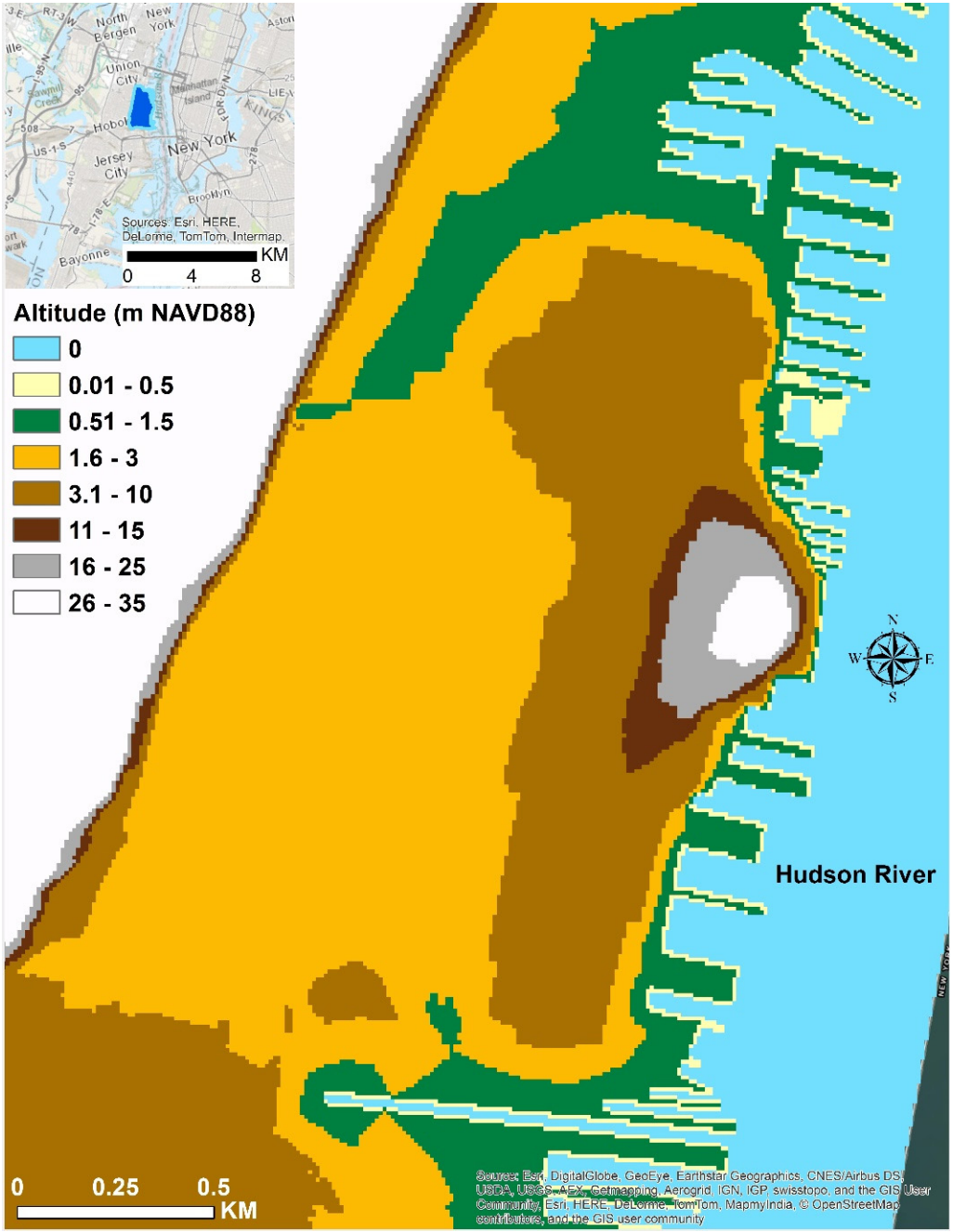
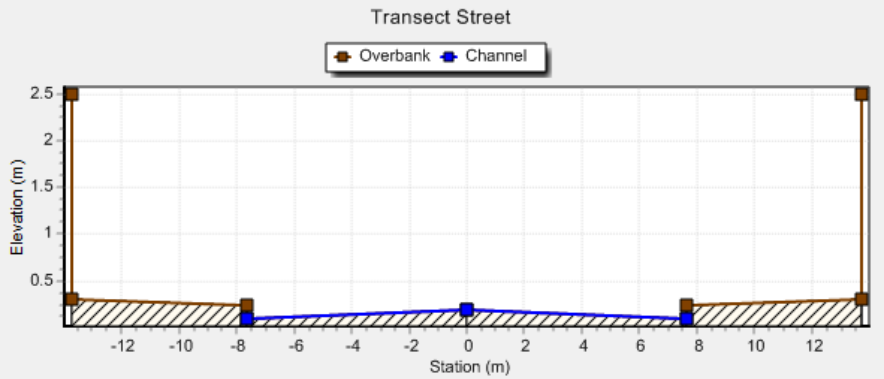
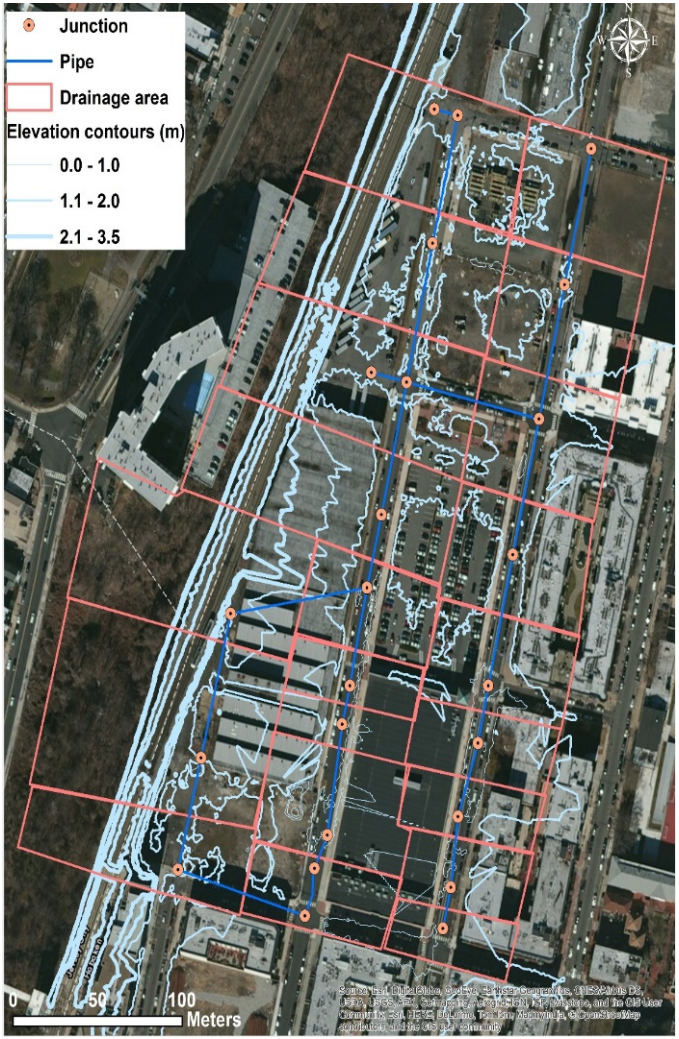




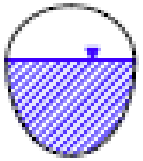
Local Scale Application in Hoboken

- Rainfall-runoff processes.
- Dual drainage system represented by the street network, junctions and pipes.
- Full dynamic wave equations [backwater effects, pressurized flow, flow reversal].





http://www.hobokennj.org



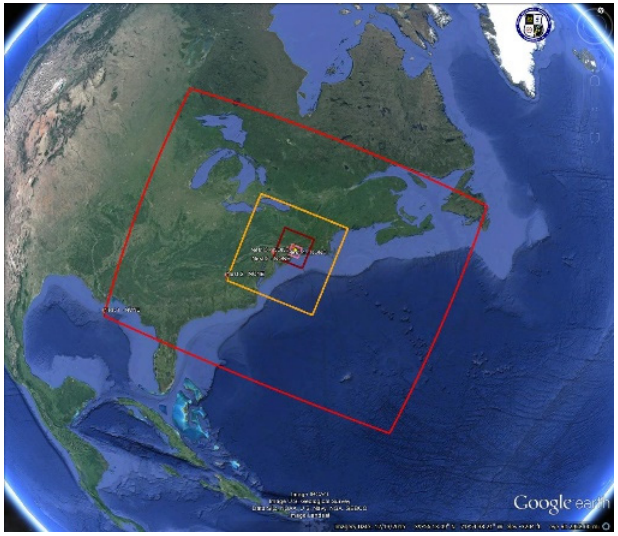
Egg sewer pipe

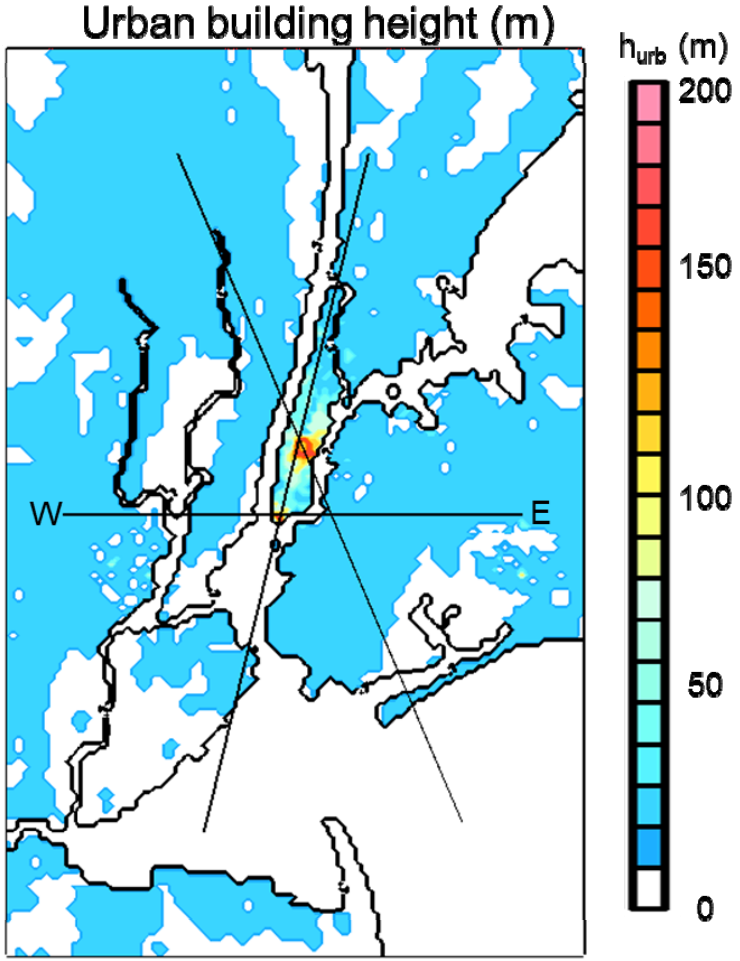
Local Scale Application in Hoboken

Boundary conditions

Meteorological Component

- Three-dimensional Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS®), Naval Research Laboratory (Hodur, 1997).
- Urban Canopy Parameterization.
- 5 nests with horizontal resolutions of 27, 9, 3, 1 and 0.333 km (Pullen et al., 2003; Pullen et al., 2015).





Courtesy of Dr. Teddy Holt
U.S. Naval Research Laboratory

http://www.nrlmry.navy.mil/coamps-web/web/home

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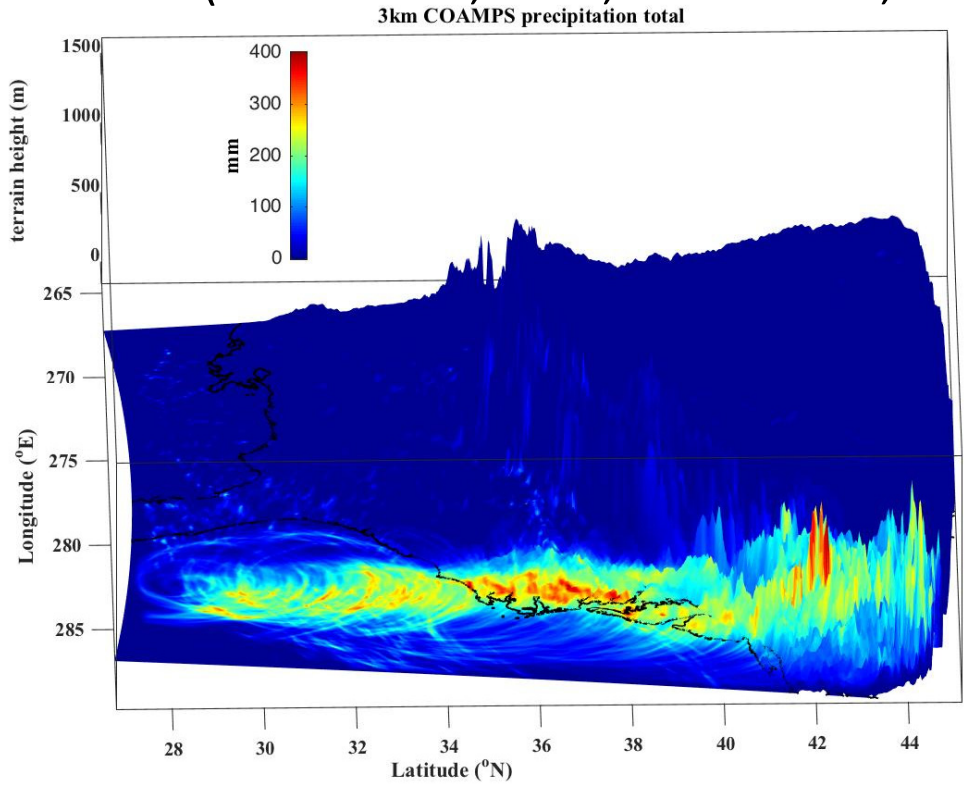
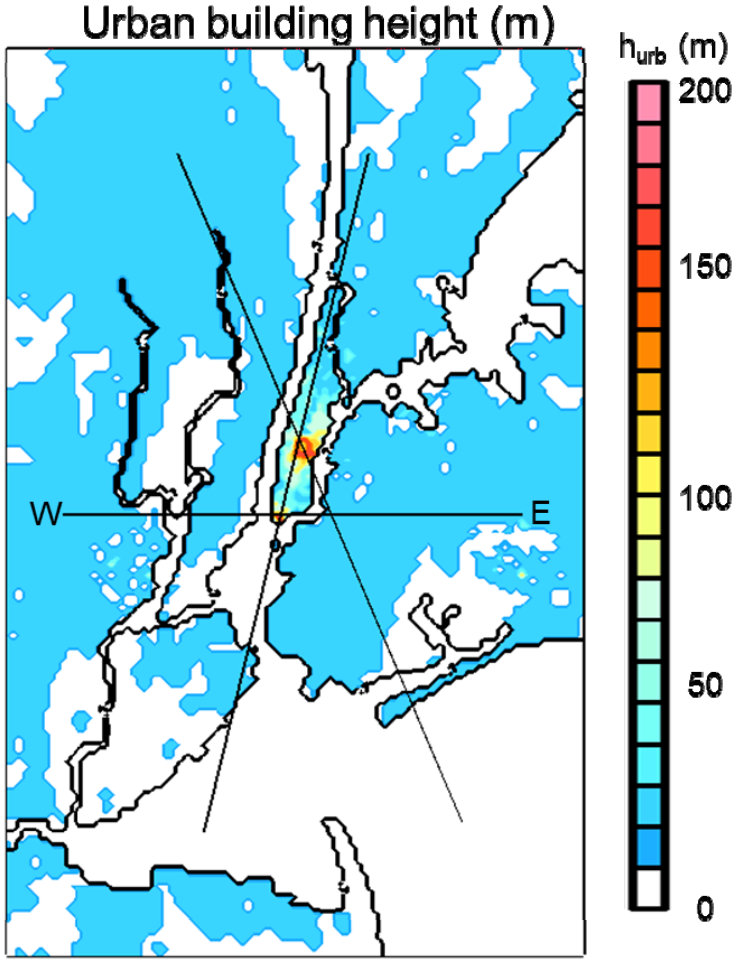




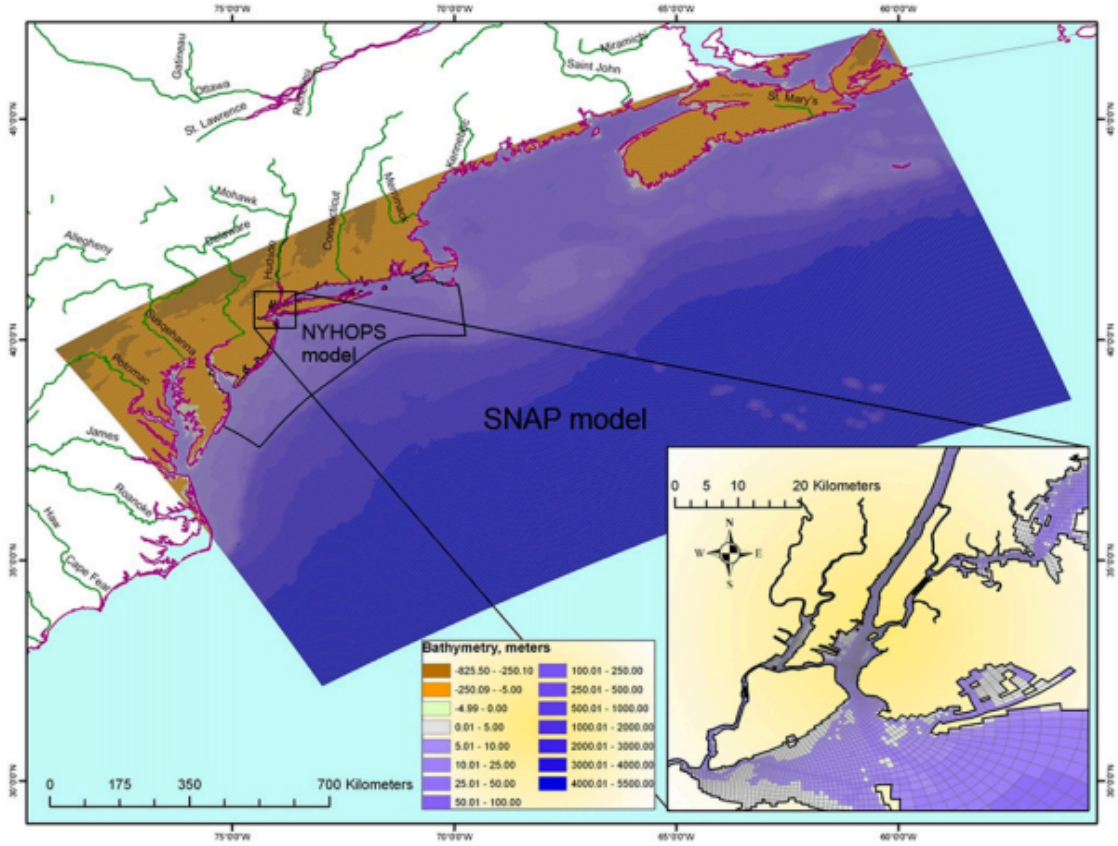
Courtesy of Dr. Teddy Holt
U.S. Naval Research Laboratory

Local Scale Application in Hoboken

Boundary conditions

Coastal Component

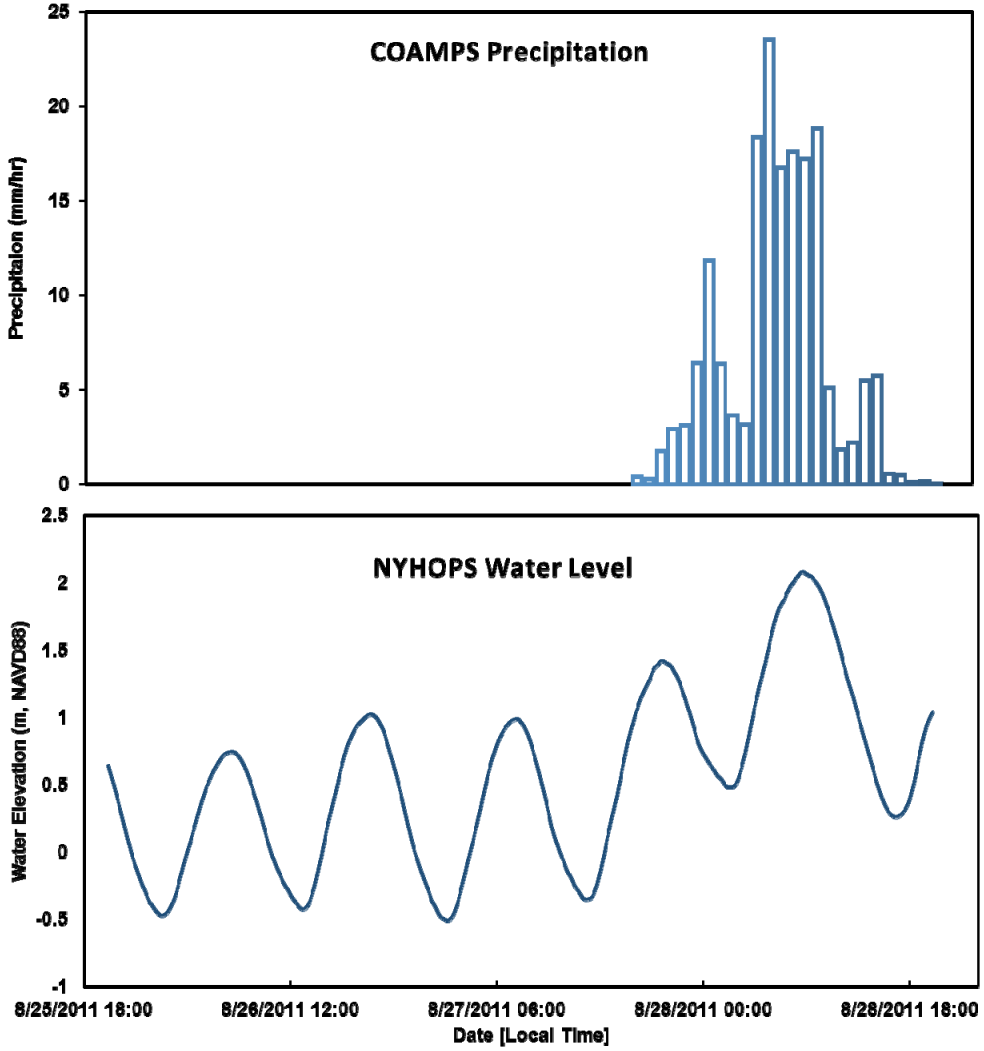
New York Harbor Observing and Prediction System (NYHOPS)

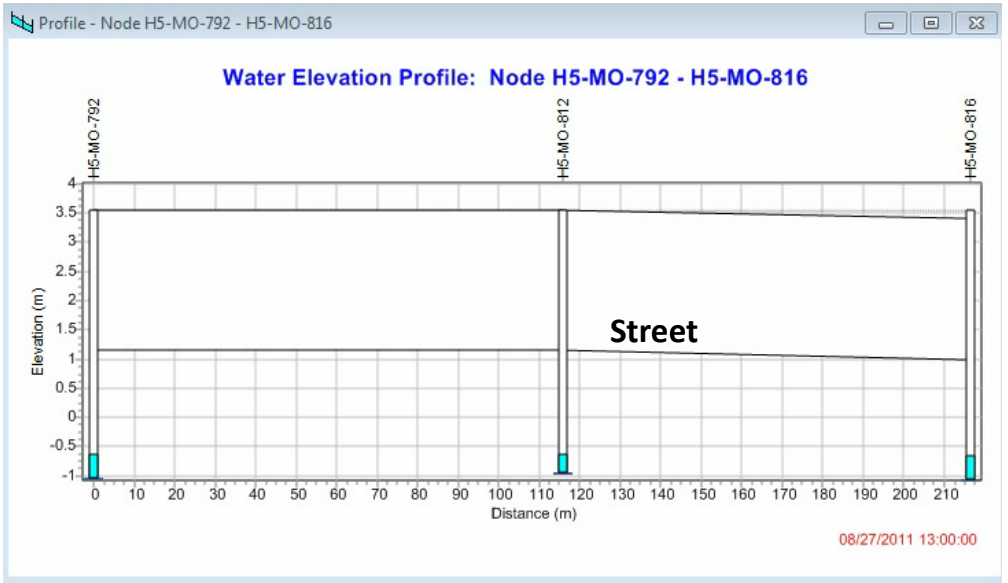


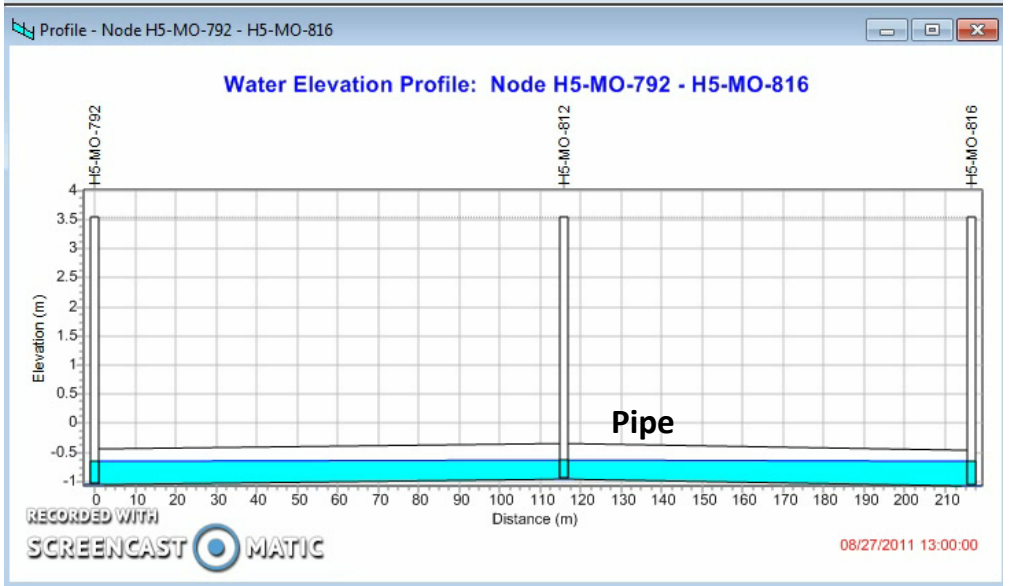
Local Scale Application in Hoboken

[Retrospective forecast of Hurricane Irene issued on August 25, 2011 at 6:00 pm]

Boundary Conditions







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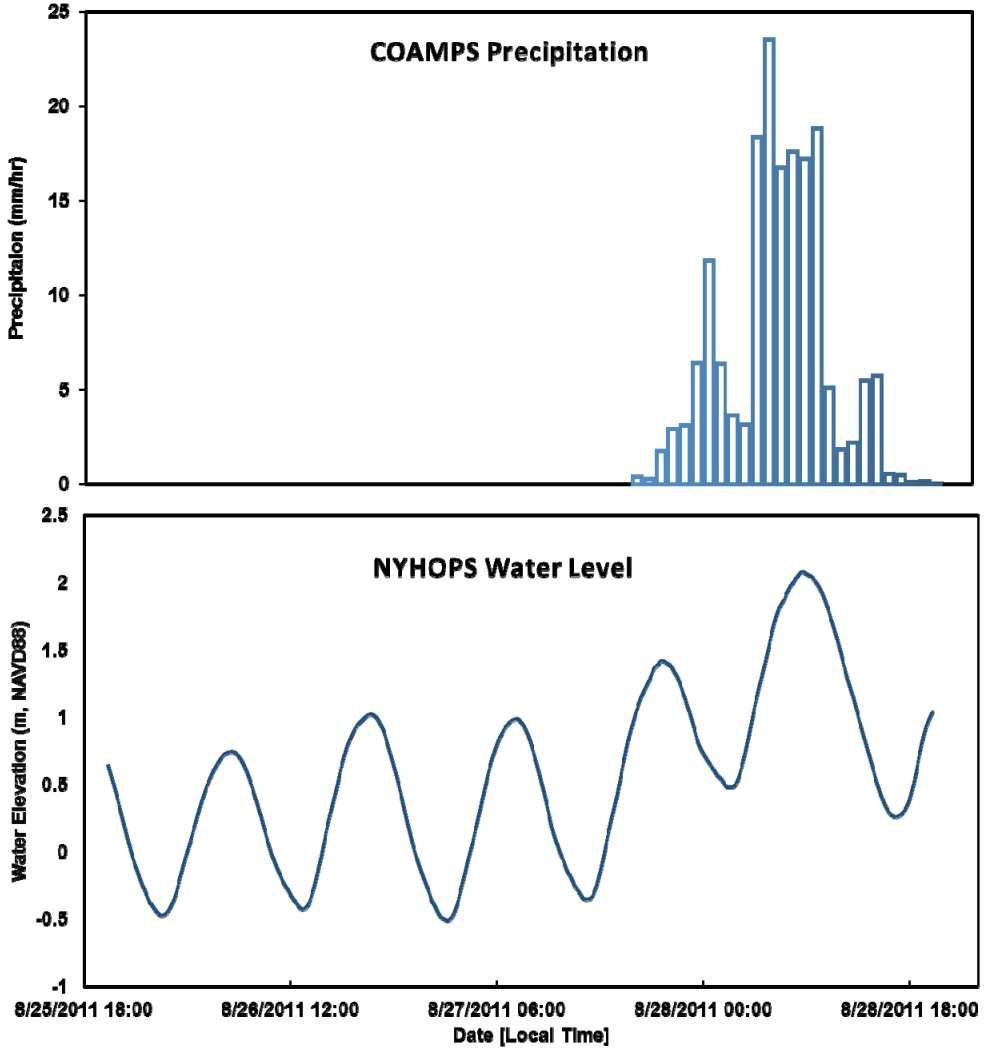

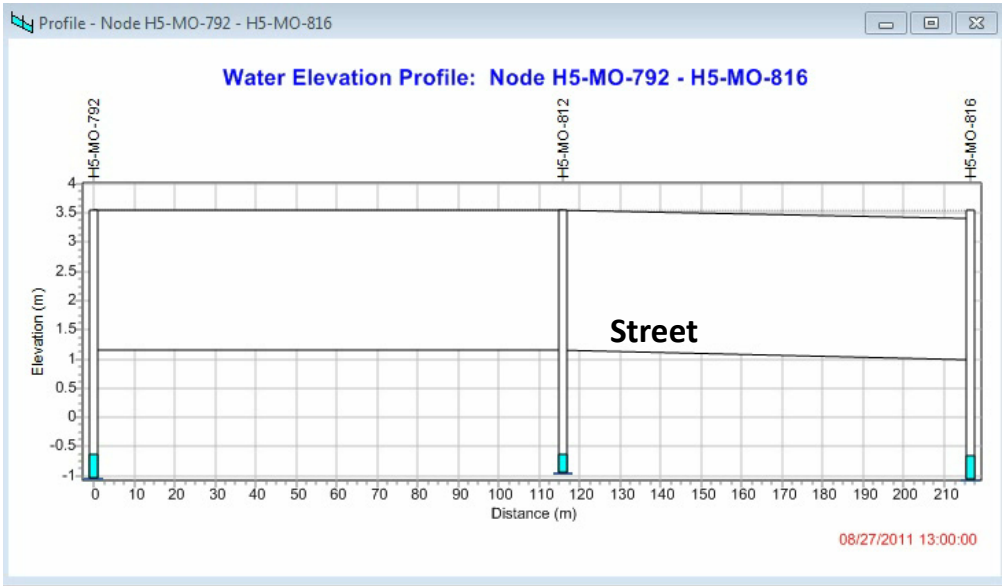

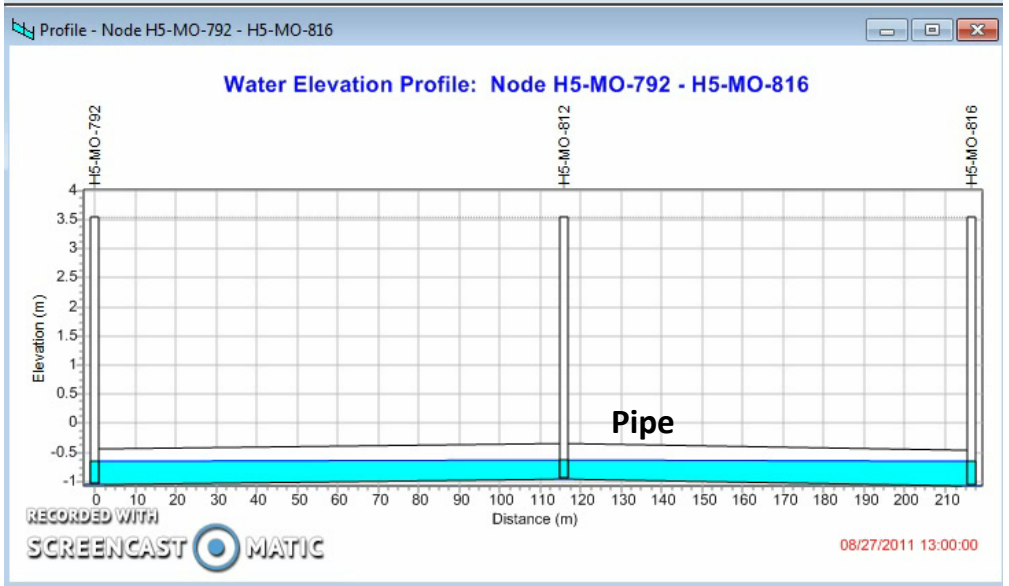

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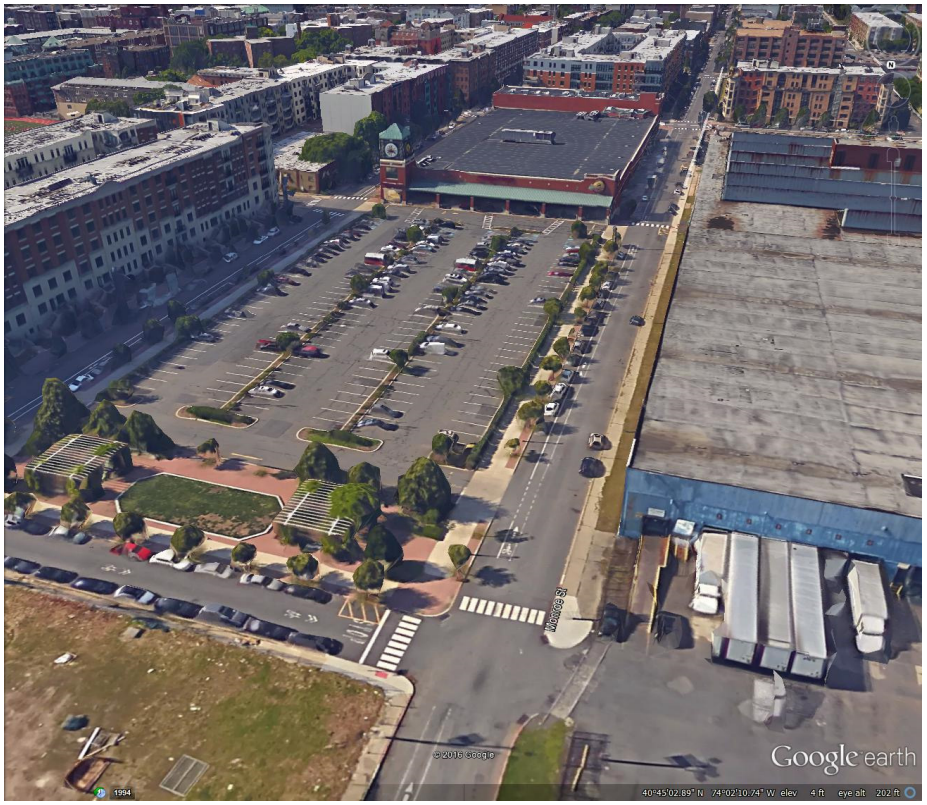

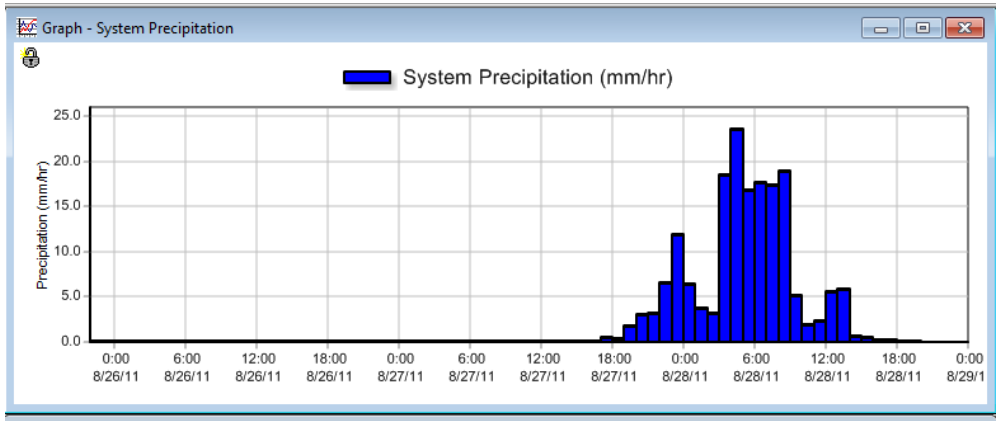

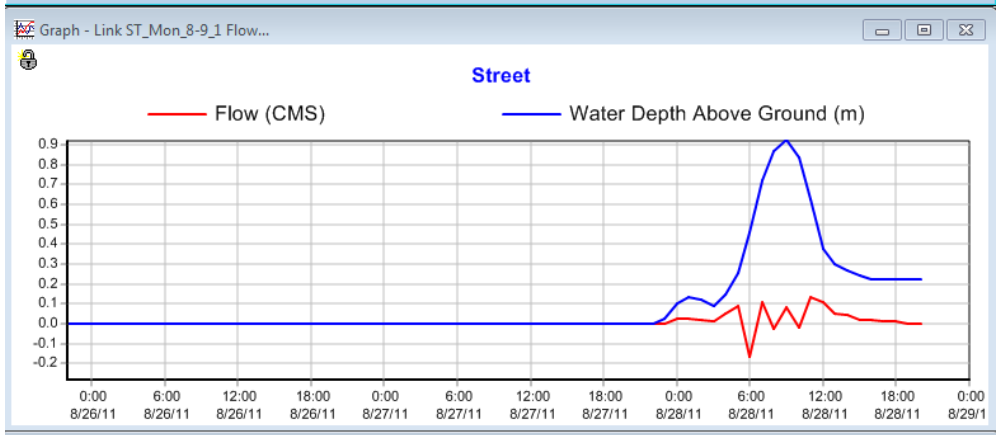

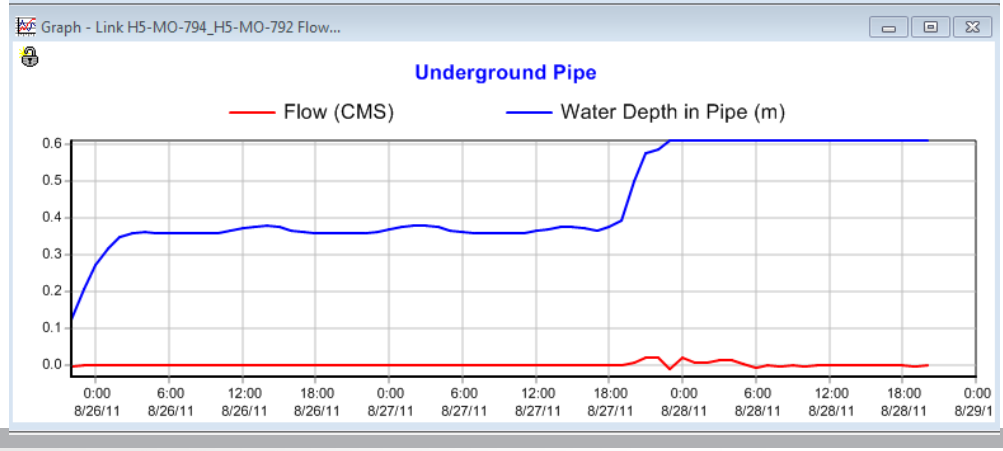

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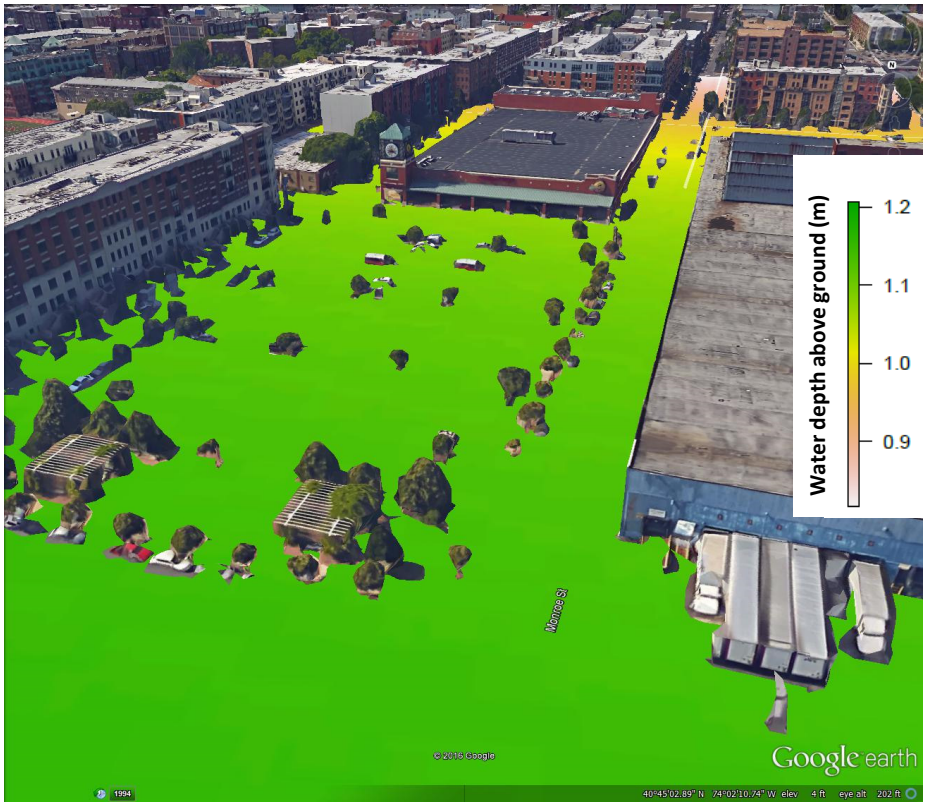
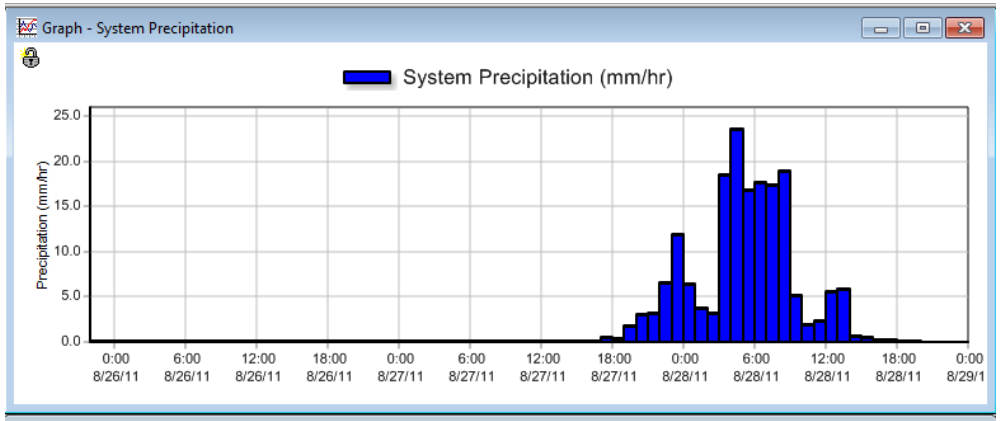
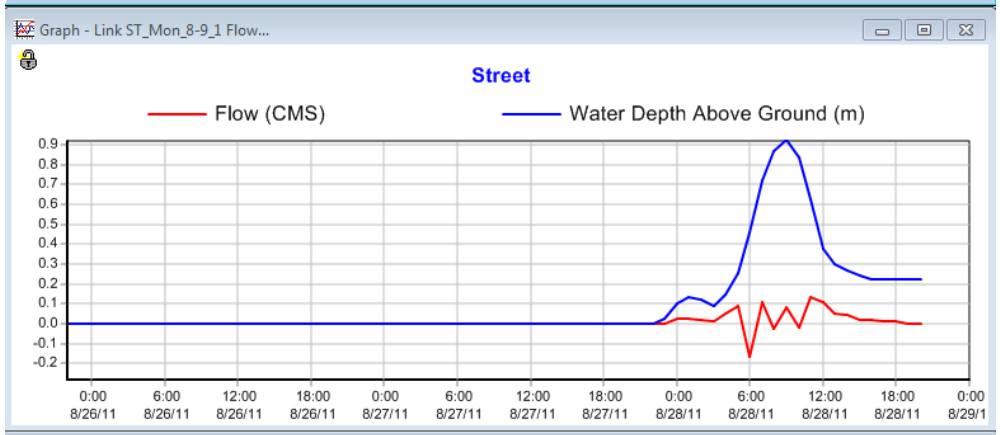
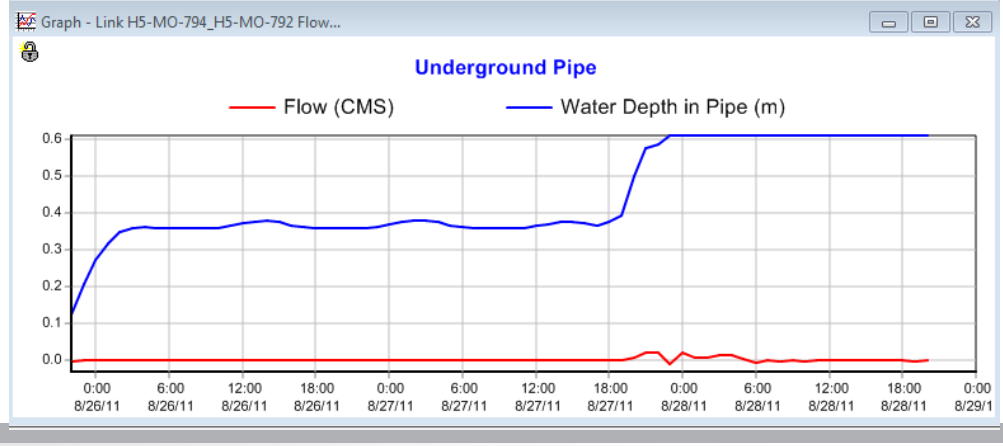
[SWMM2GE module]









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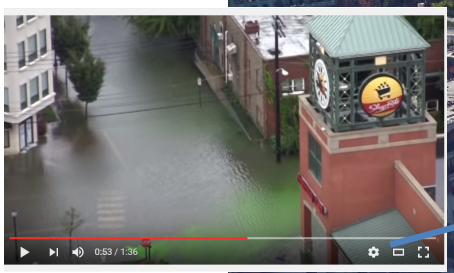

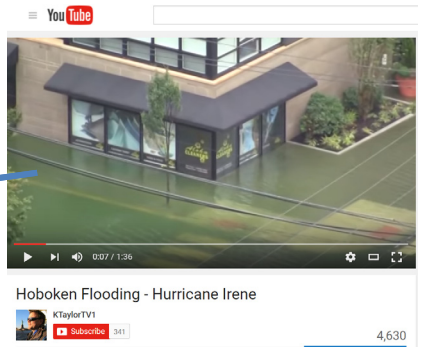

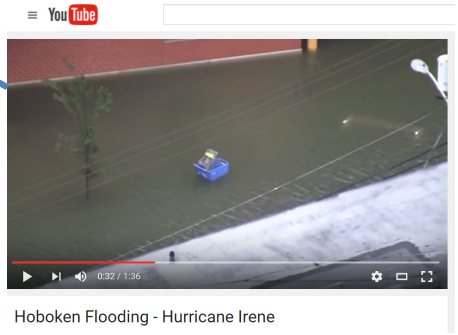

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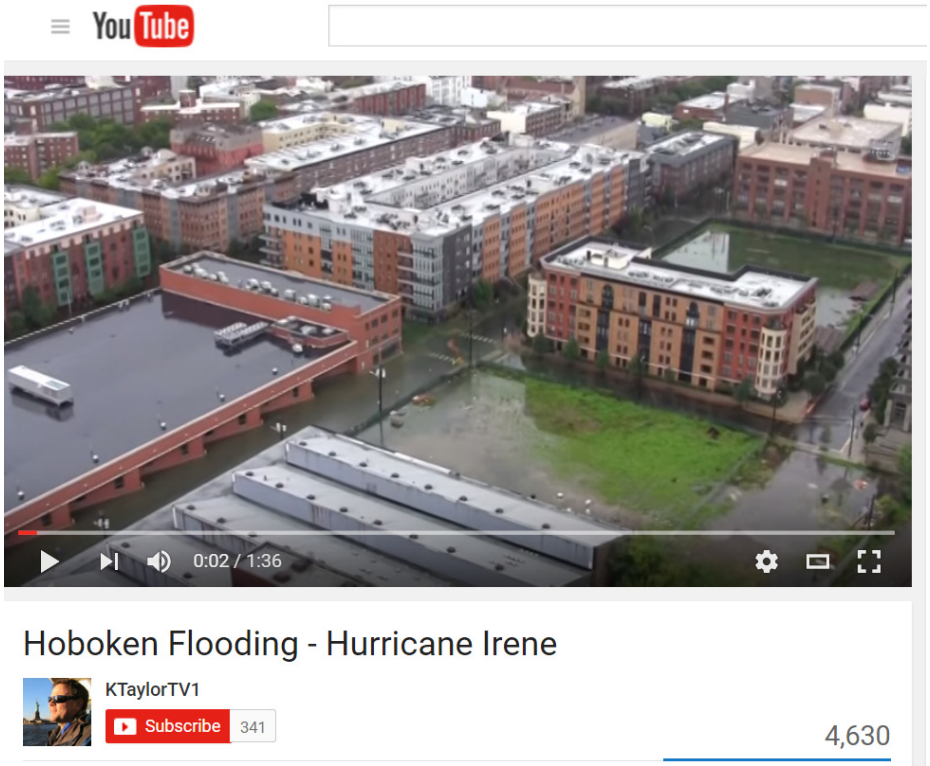

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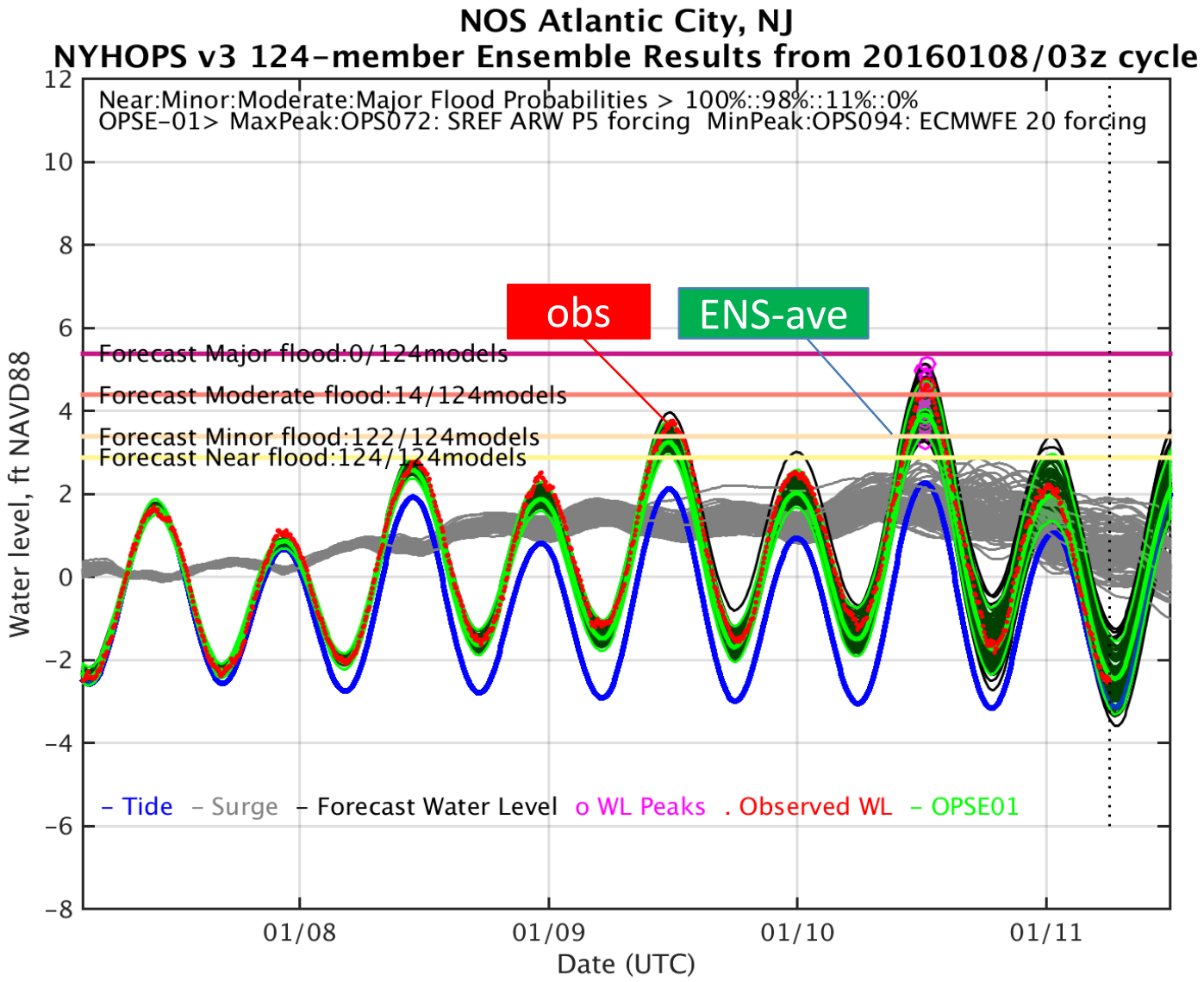
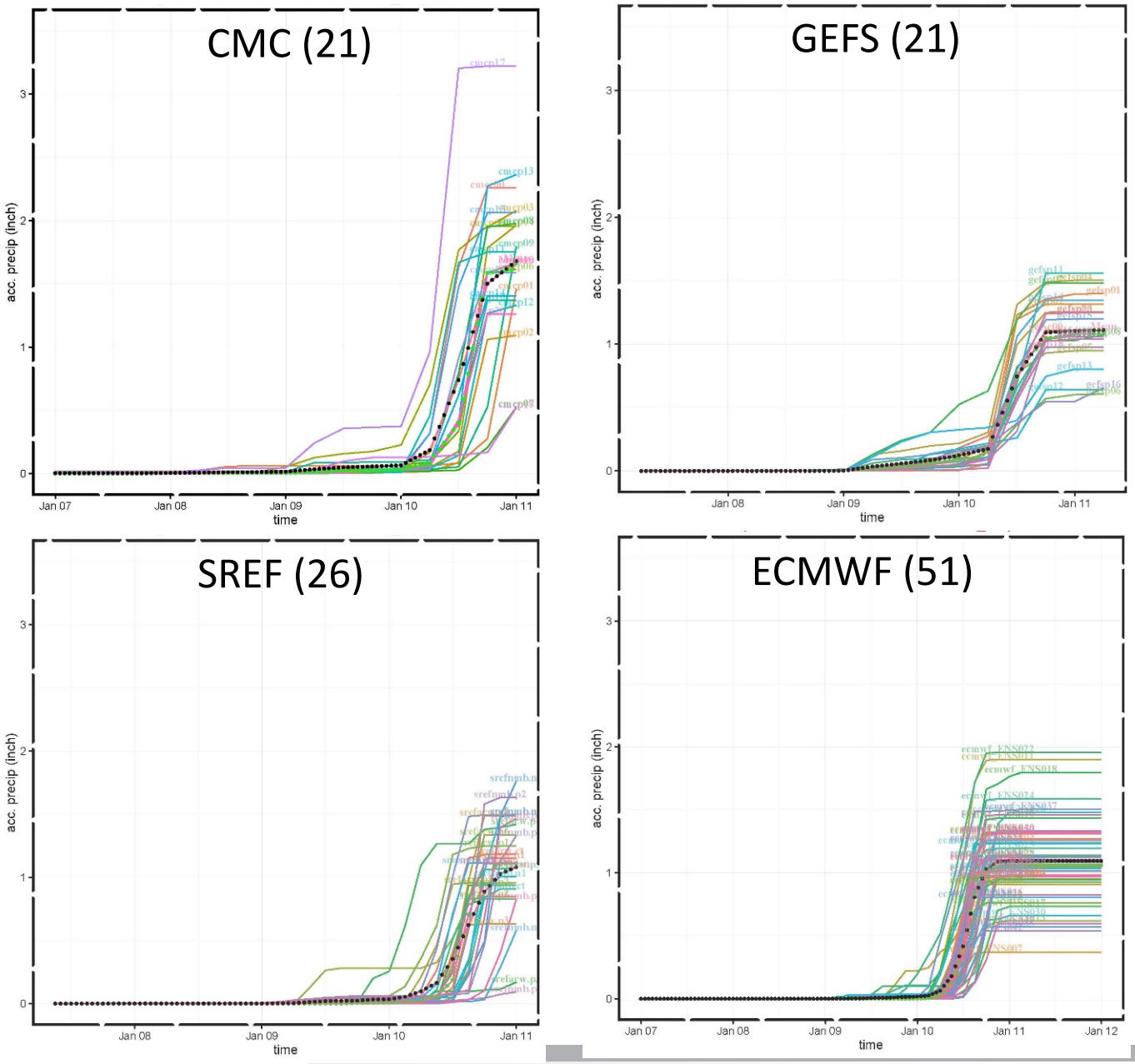
Deterministic members	
NAMx2,GFS(+e),ECMWF.	

- 2016-01-10 Flood Event was Predicted 3 days in advance.
- Ensemble usually envelopes the observations well



Operational Hydrologic-Hydraulic-Coastal Ensemble Prediction System

Example of Precipitation Ensemble Members used as inputs to the framework



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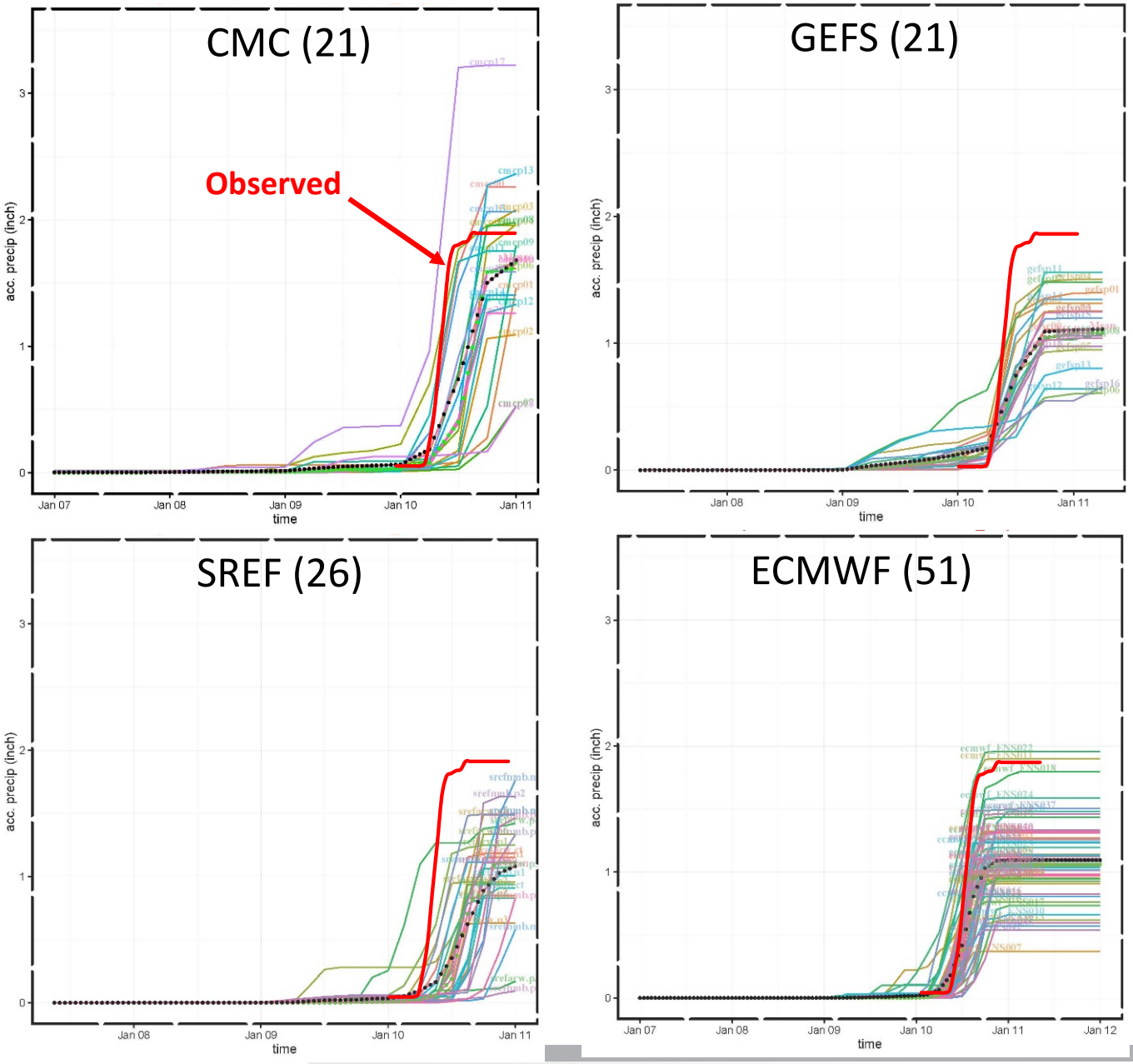
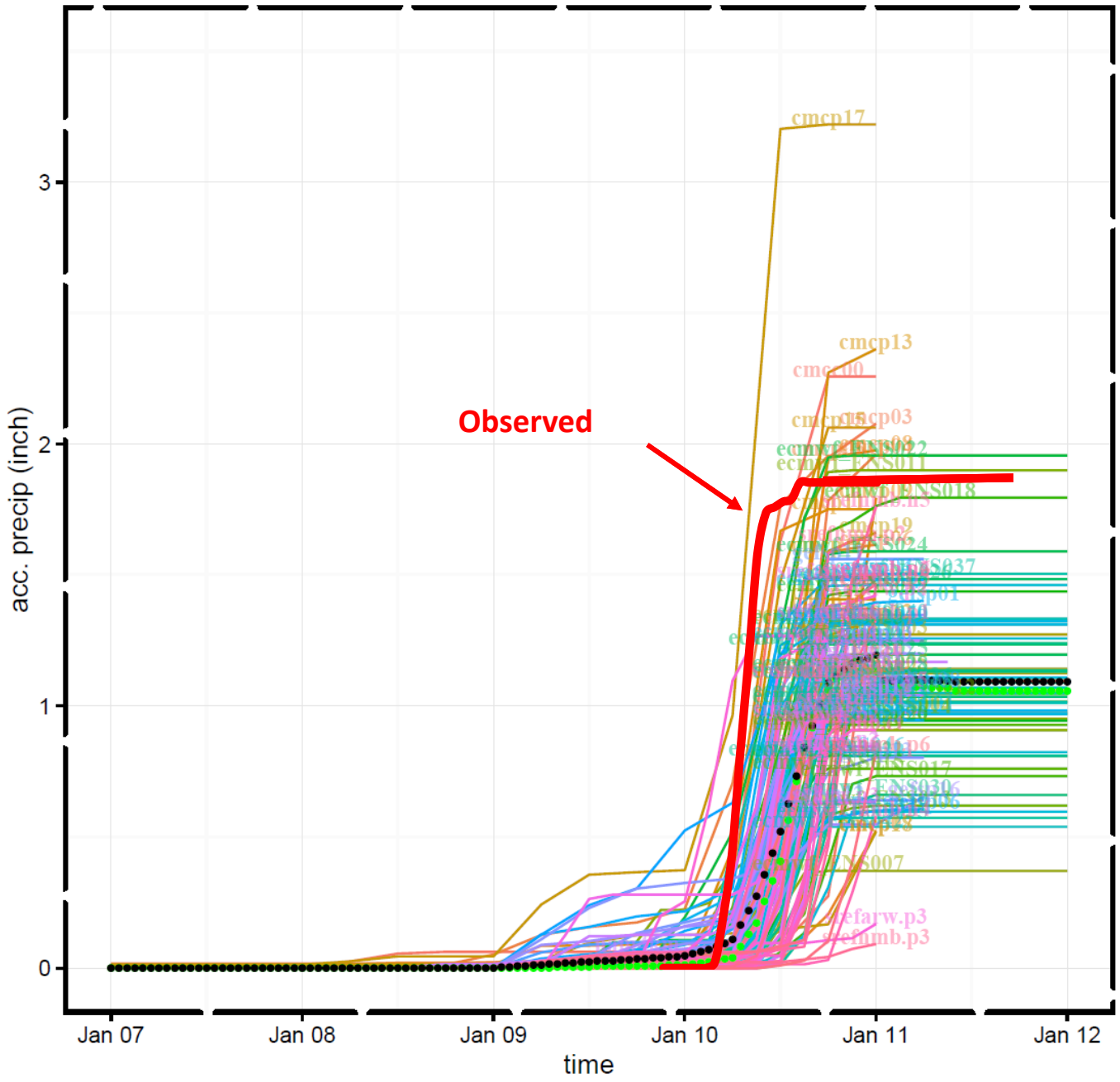
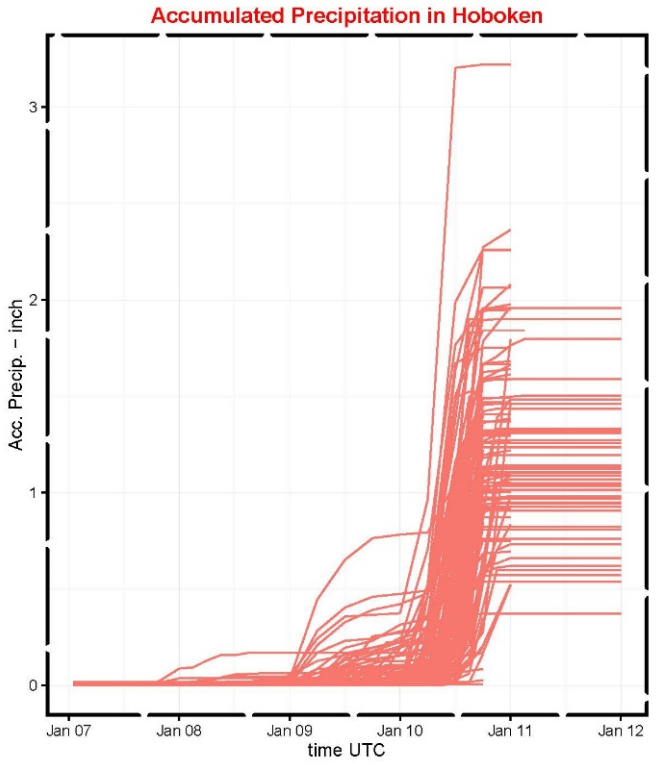


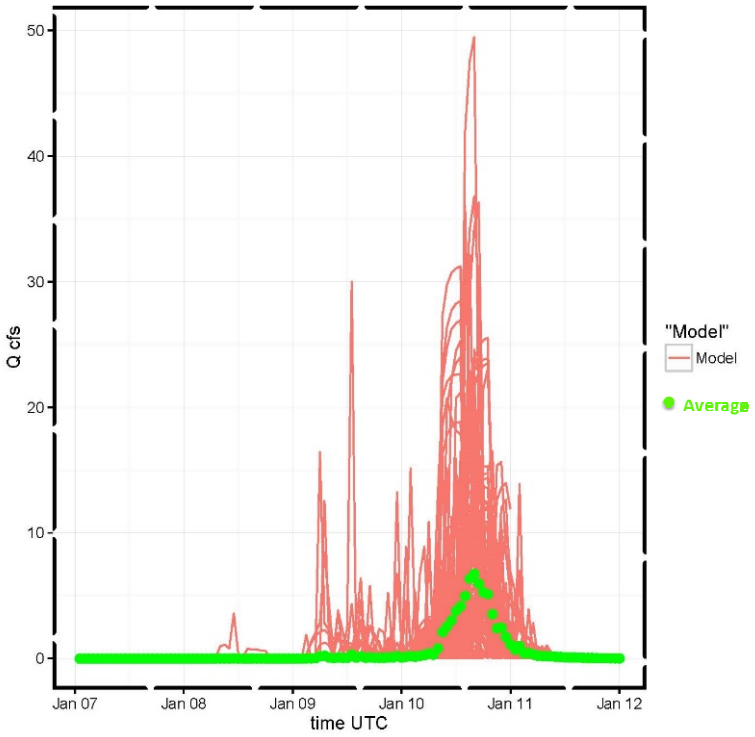
Precipitation from 125 Ensemble Members



Operational Hydrologic-Hydraulic Ensemble Prediction System

Runoff Forecasts in the City of Hoboken, NJ





Summary & Perspectives

- Operational Hydrologic-Hydraulic-Coastal Ensemble Prediction System in Urban Watersheds.
- City of Hoboken Retrospective forecast of Hurricane Irene.
- Monitoring CSO sensors.
- Spread in precipitation inputs and data assimilation.
- Ensemble post-processing techniques.
- Interesting perspectives for efforts focused on integrating the stormwater best management practices, water quality and climate change scenarios.
- Potential of linking traffic flow models to predict potential traffic delays and congestion problems.

AGU FALL MEETING
San Francisco | 12–16 December 2016

Weather and Climate Ensembles for Hydrologic Forecasting and Scenario Analysis

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fsaleh@stevens.edu