ERDC
Engineer Research and Development Center

ERDC Support for Hurricane Sandy

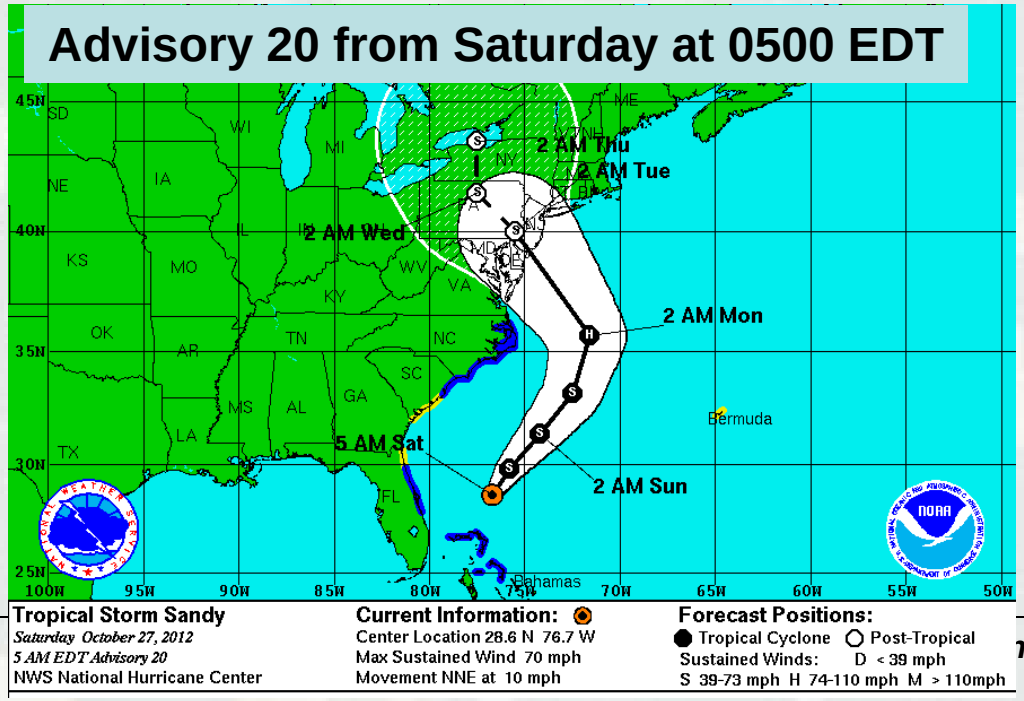
Chris Massey, CHL; Aaron Byrd, CHL; Nawa Pradhan, CHL; Jeff Melby, CHL; Jane Smith, CHL; Robert Walker, ITL; and Jennifer Wozencraft, JALBTCX

ERDC Support for Hurricane Sandy

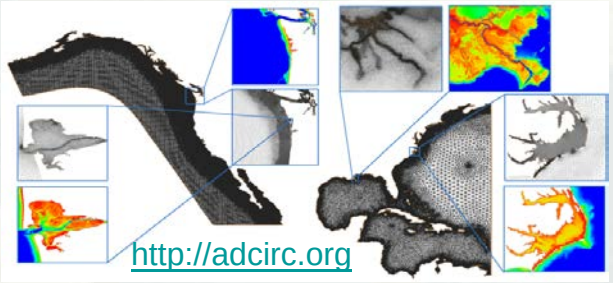
- Pre-landfall
  - Surge and flood modeling
- Post-landfall
  - Questions about flooding of the Brooklyn-Battery Tunnel
  - Deployed **MICA**
  - **JALBTCX** Lidar Surveys
  - Nor'easter Modeling

CHL's Modeling Efforts

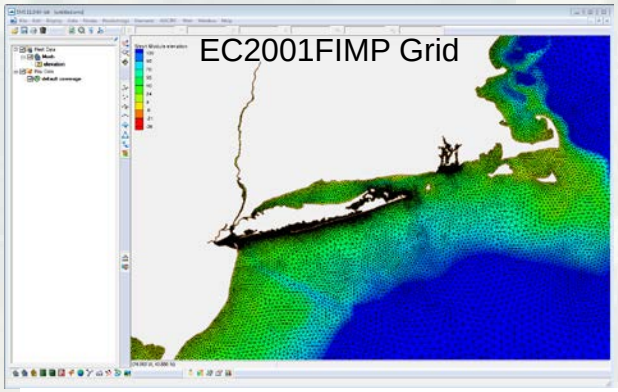
- On Saturday Oct. 27, 2012, ERDC CHL was asked by the New York District (NAN) through the UROC to provide estimates to potential flooding in the New York City area before 1200 EDT on Monday October, 29, 2012.
- Provide potential coastal storm surge estimates using the hydrodynamic model **ADCIRC**
- Provide potential inland flooding estimates using the overland flow model **GSSHA**

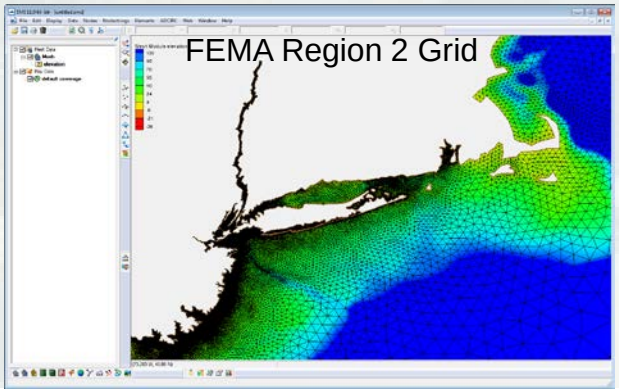


ADCIRC Coastal Circulation and Storm Surge Model



- An unstructured finite element hydrodynamics model
- 2D and 3D simulations
- Wetting/Drying algorithm allows for storm surge inundation over previously dry land
- Highly portable code
- A part of ERDC's Coastal Storm Modeling System



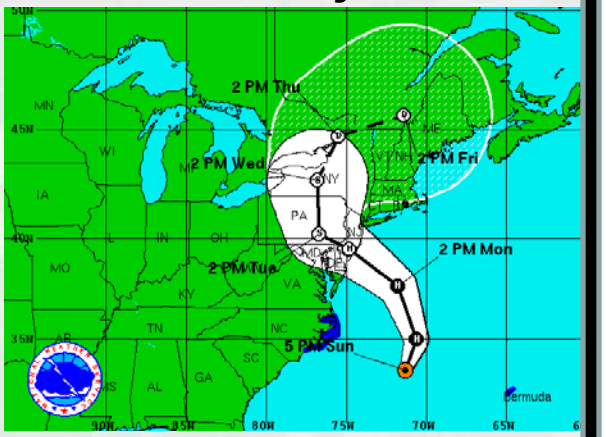


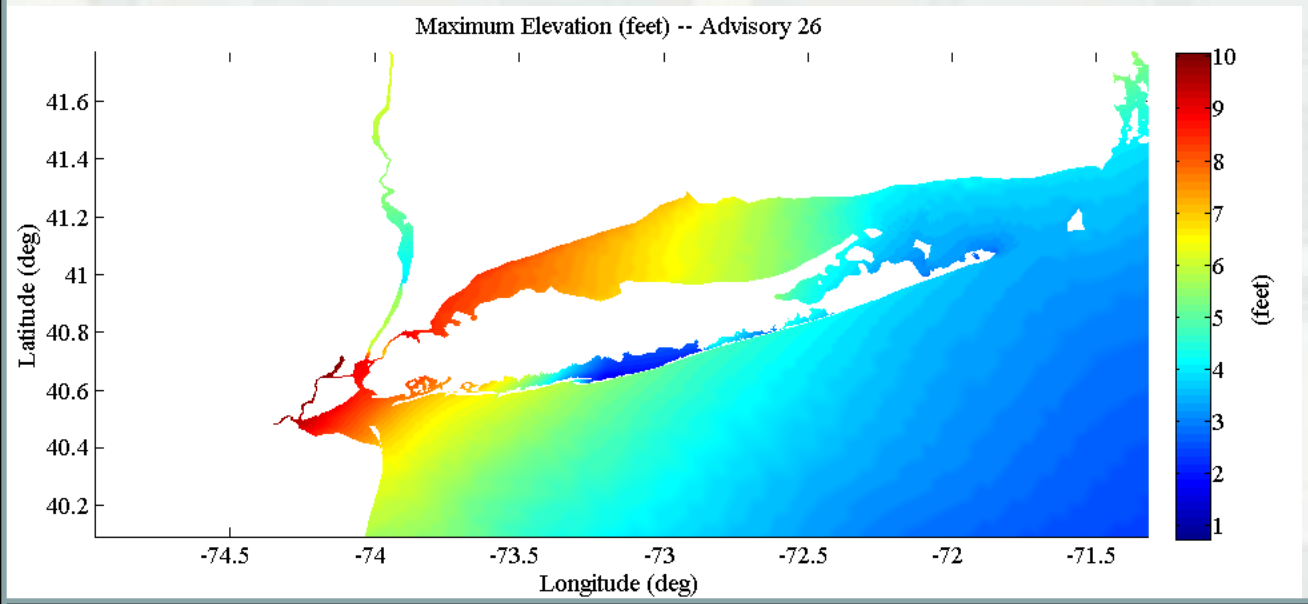
Surge Modeling for Sandy

- Used two meshes
  - EC2001FIMP Grid
  - FEMA Region 2 Grid
- Used tidal forcing and the imbedded asymmetric vortex Holland wind/pressure model
- Wind model inputs derived from the NHC forecast using the ASGS
- Advisories 22 – 31 were simulated
- Advisory 26 results sent to NAN.

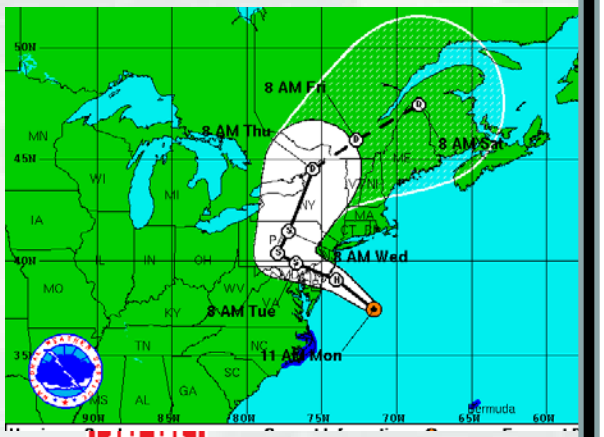
Max Elevation (ft MSL)

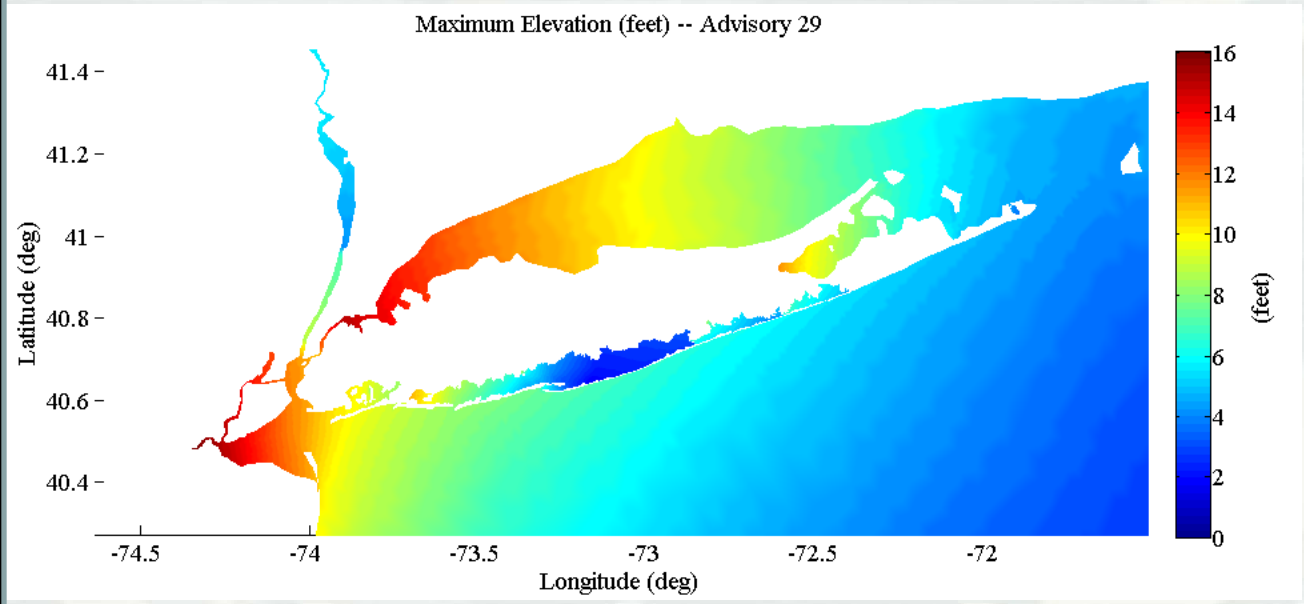
Advisory 26





Advisory 29





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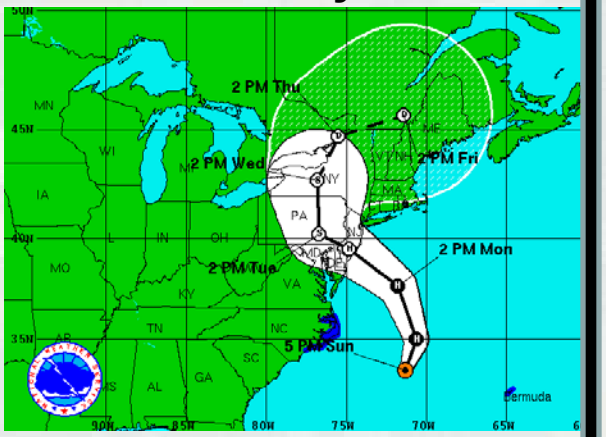
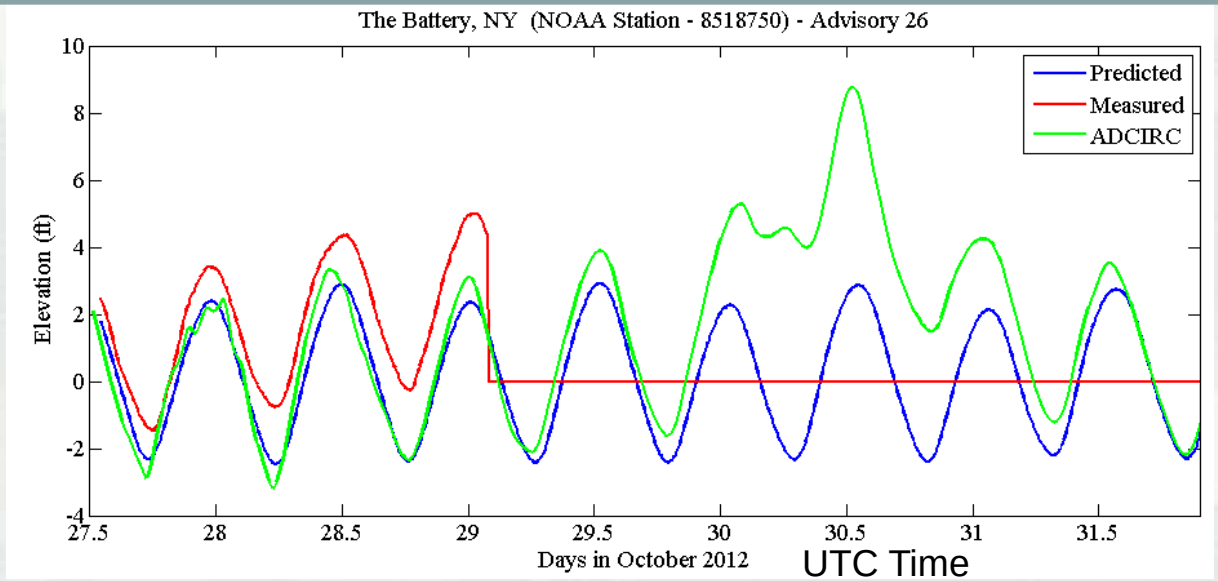
EC2001FIMP Grid

The Battery, NY Elevation (ft MSL)

Advisory 26





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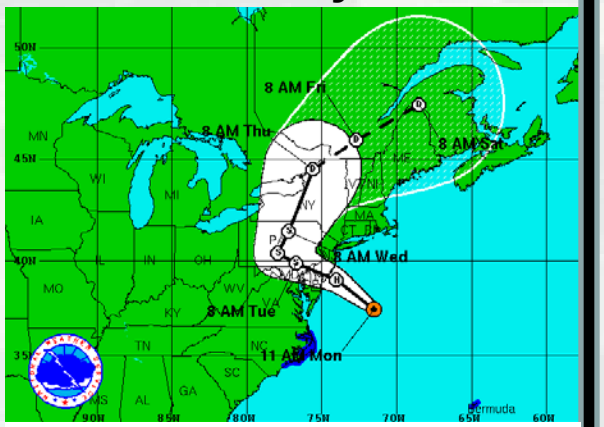

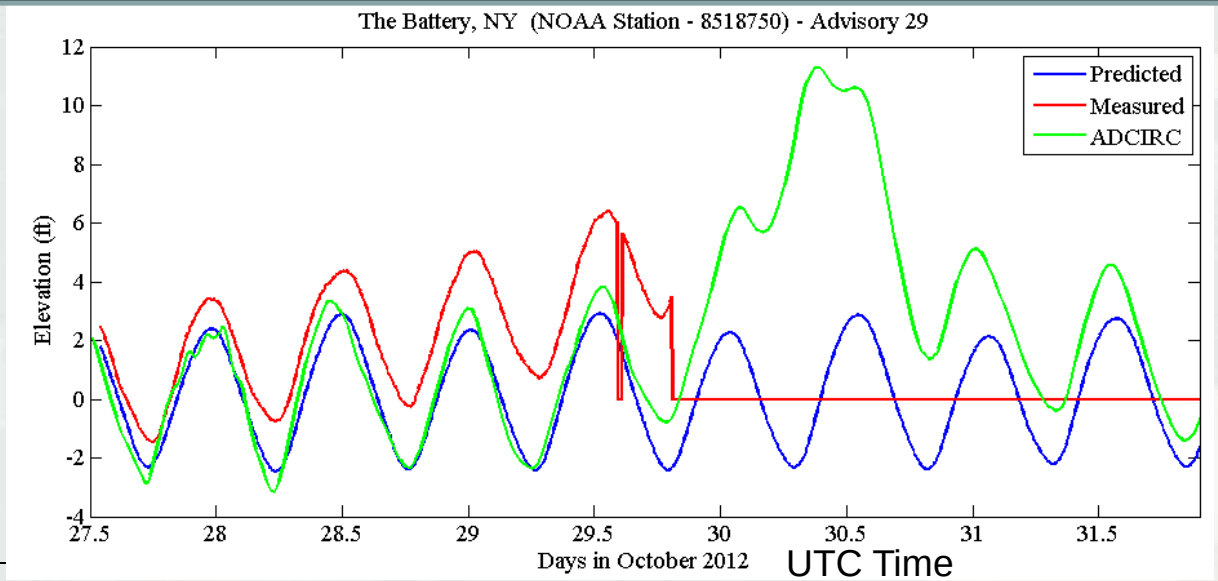

Datum Conversions at this Location
MSL to NAVD88 subtract 0.21 ft
MSL to MLLW add 2.57 ft

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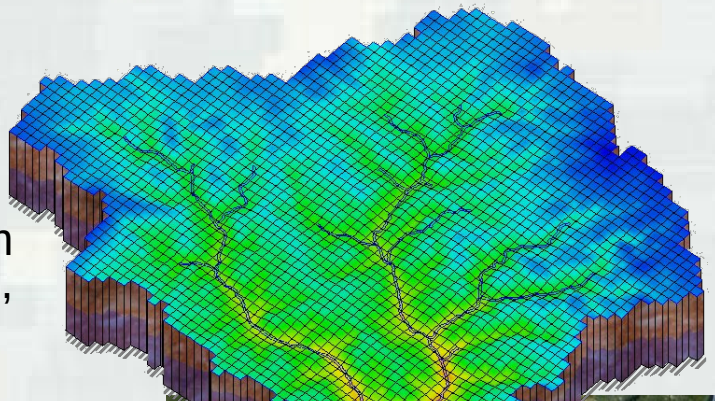
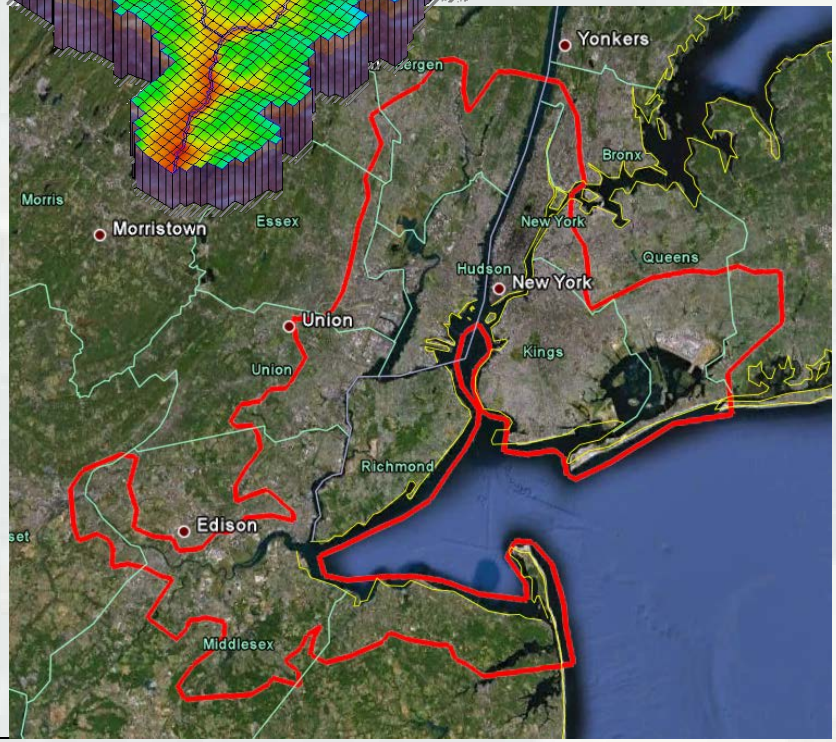
EC2001FIMP Grid

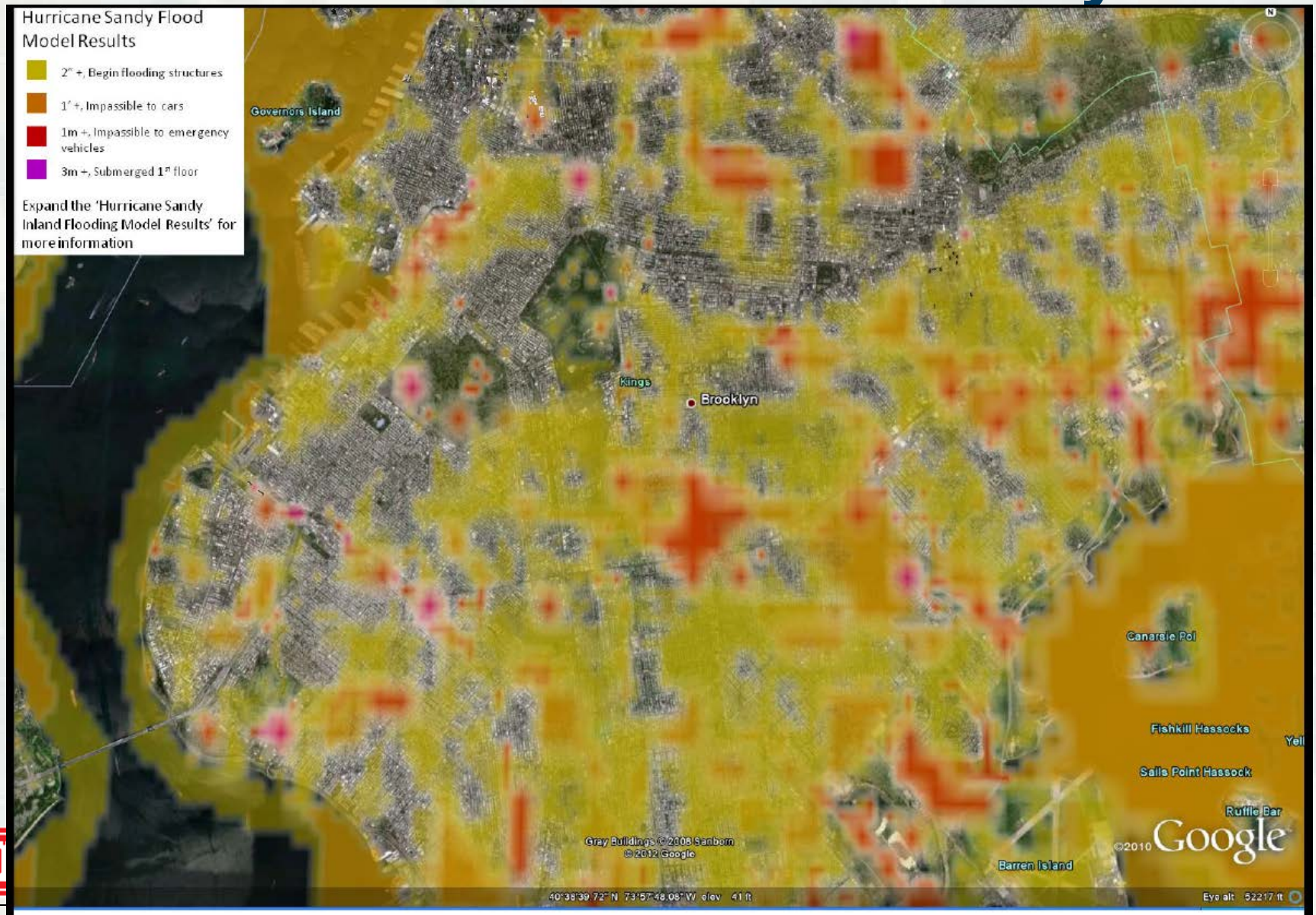
GSSHA New York Models

- GSSHA is a gridded, physics-based full hydrology model
  - Overland flow, stream flow, groundwater, vadose zone, storm and tile drains, wetlands, erosion, constituent transport
- GSSHA 2D Overland Flow Model used to predict inland flood inundation
  - Use time-varying specified head condition for storm surge
- 2 Models:
  - Central NY Model @75m (right)
  - Long Island Model @150m
- Rainfall estimated from NWS plots
- Storm surge from ADCIRC



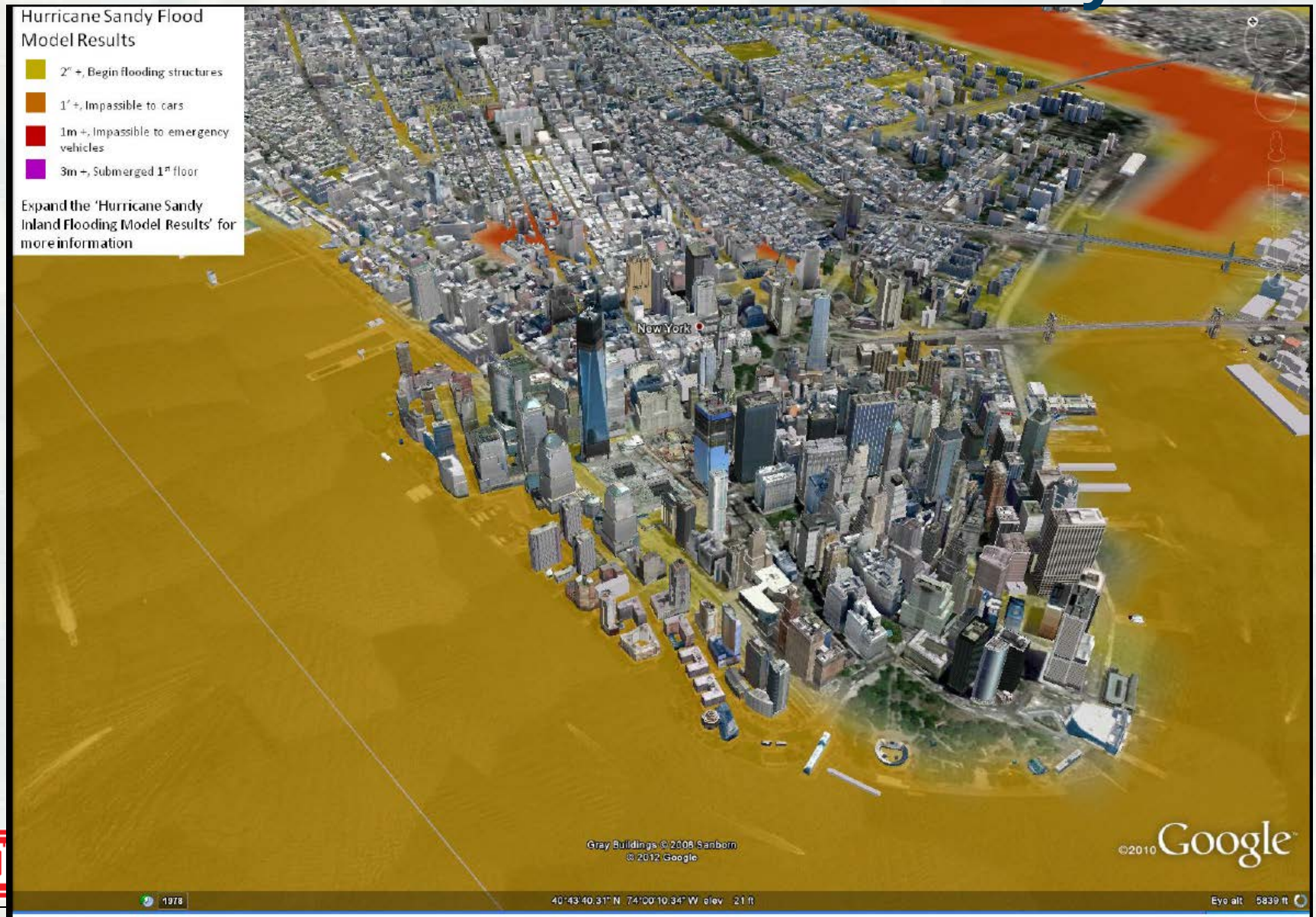


GSSHA Results from Advisory 26



Advisory 26

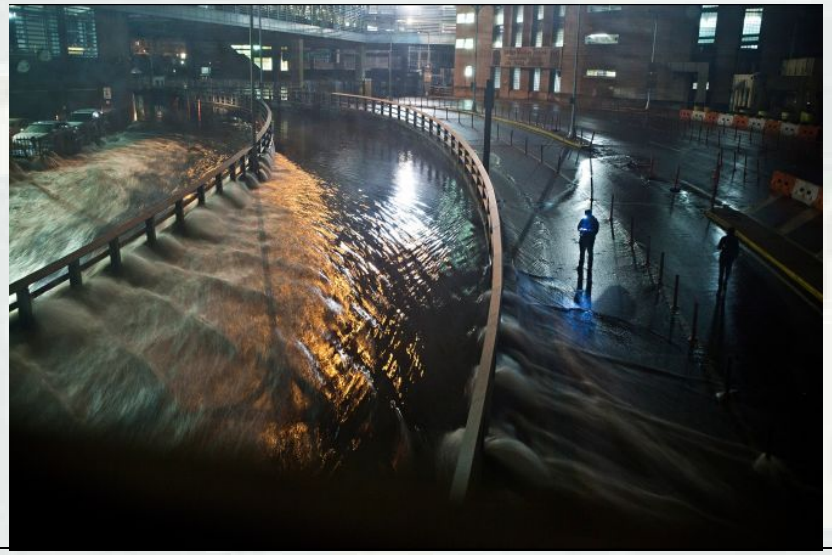
GSSHA Results from Advisory 26



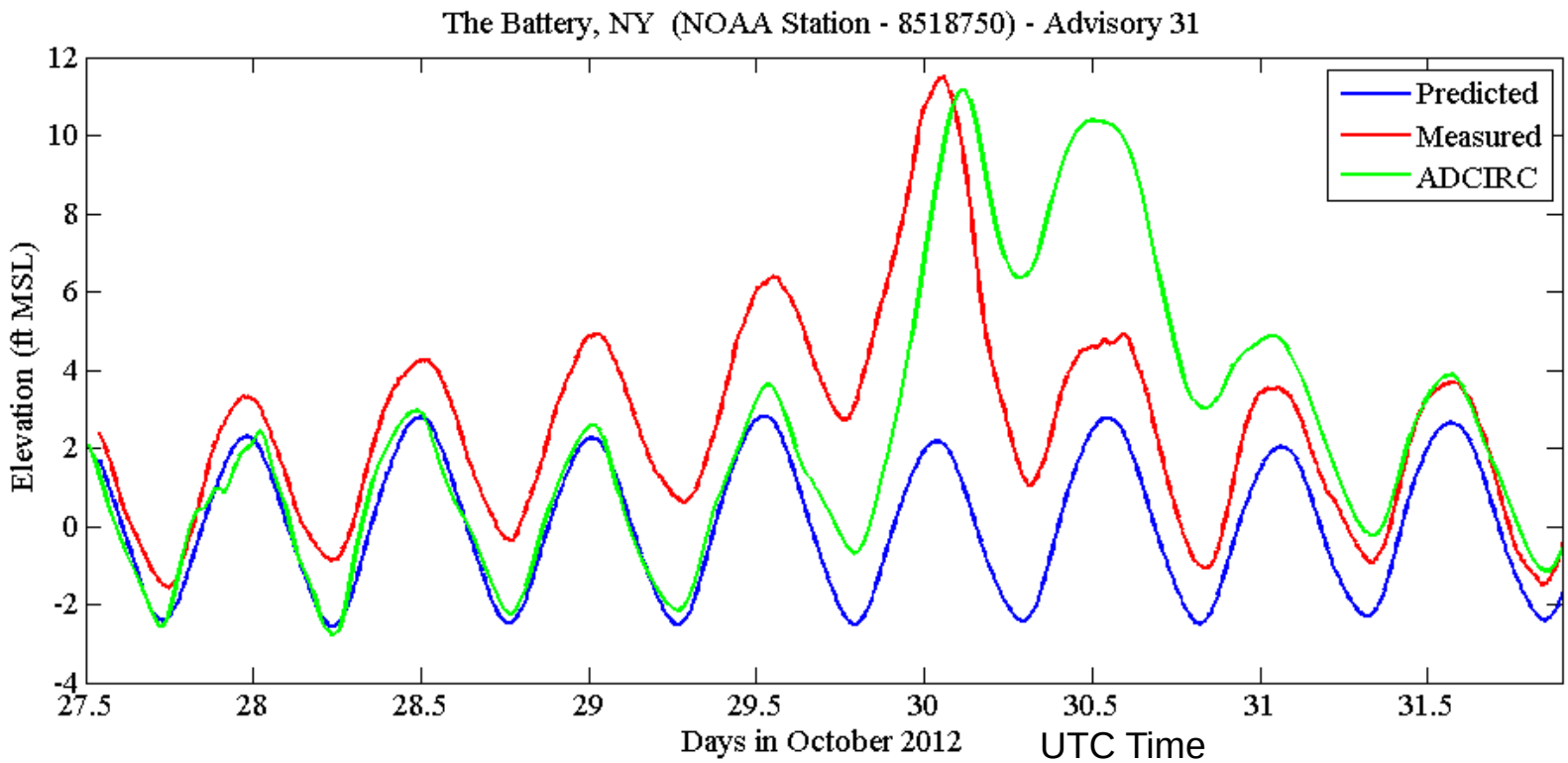
Advisory 26

Post-Sandy

- Questions about flooding of the Brooklyn-Battery Tunnel
- Deployed **MICA**
- **JALBTCX** Lidar Surveys
- Nor'easter Modeling



Comparison of Hurricane Sandy Water Elevations (ft MSL) at the NOAA Gauge at the Battery, NY



Datum Conversions at this Location
MSL to NAVD88 subtract 0.21 ft
MSL to MLLW add 2.57 ft

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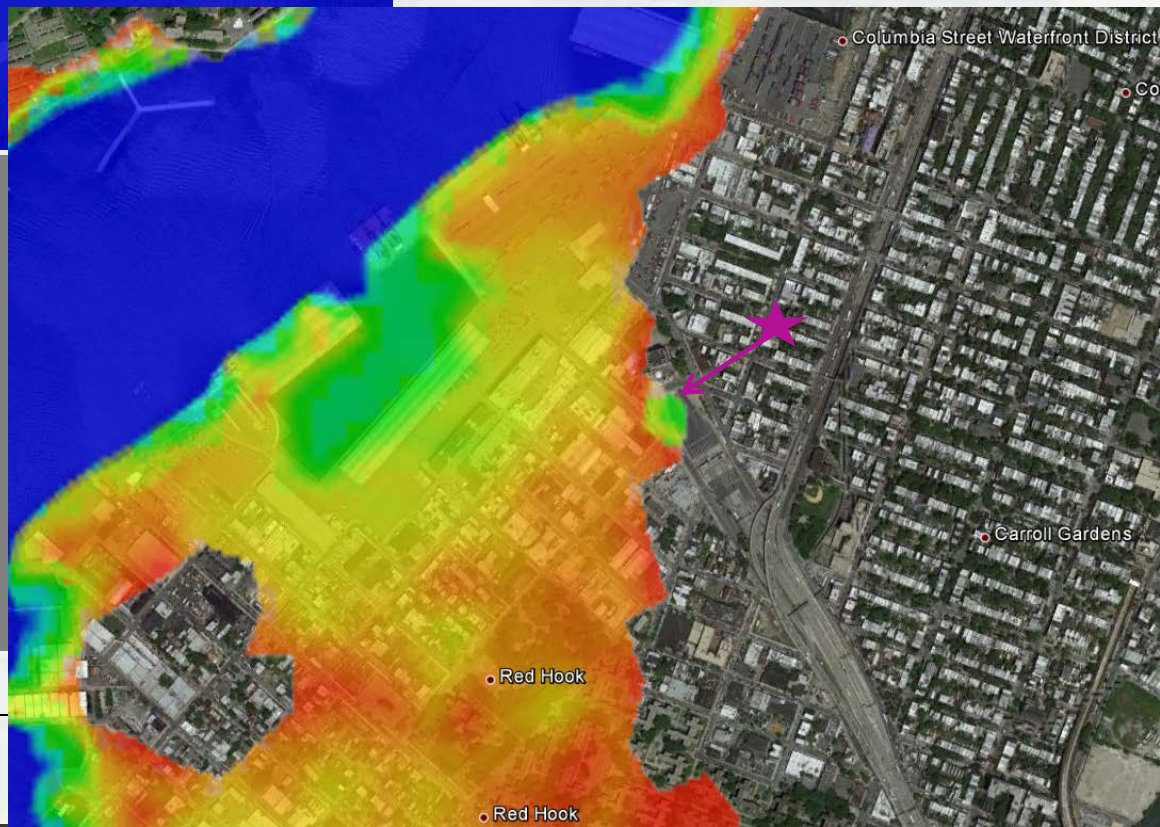
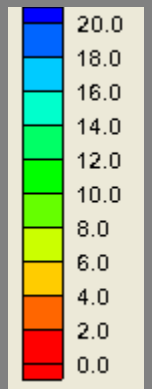
ADCIRC Total Water Depth (feet MSL)

Results from ADCIRC, using the FEMA Region 2 Mesh and NWS Forecast Winds from Advisory 31 of Hurricane Sandy.



Total Water Depth (ft MSL)



★ Location of Tunnel Entrance/Exit

Datum Conversions at this Location
MSL to NAVD88 subtract 0.21 ft
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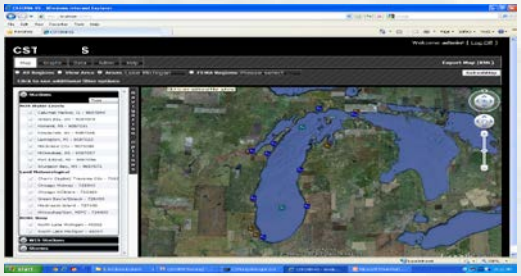
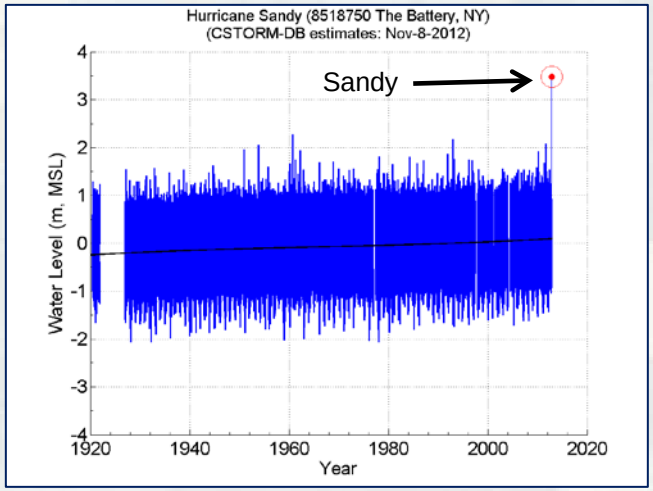
Return Period Estimates for Sandy (CSTORM-DB)

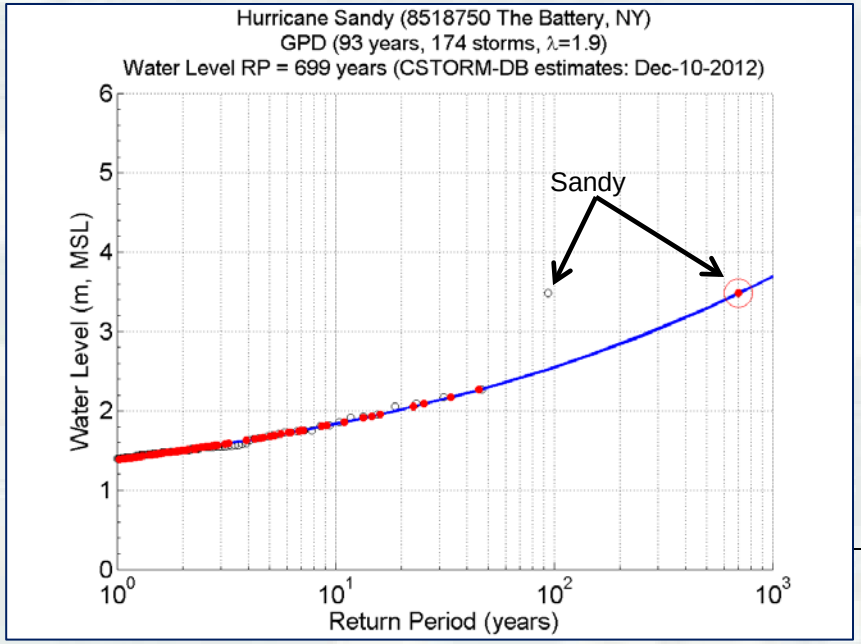


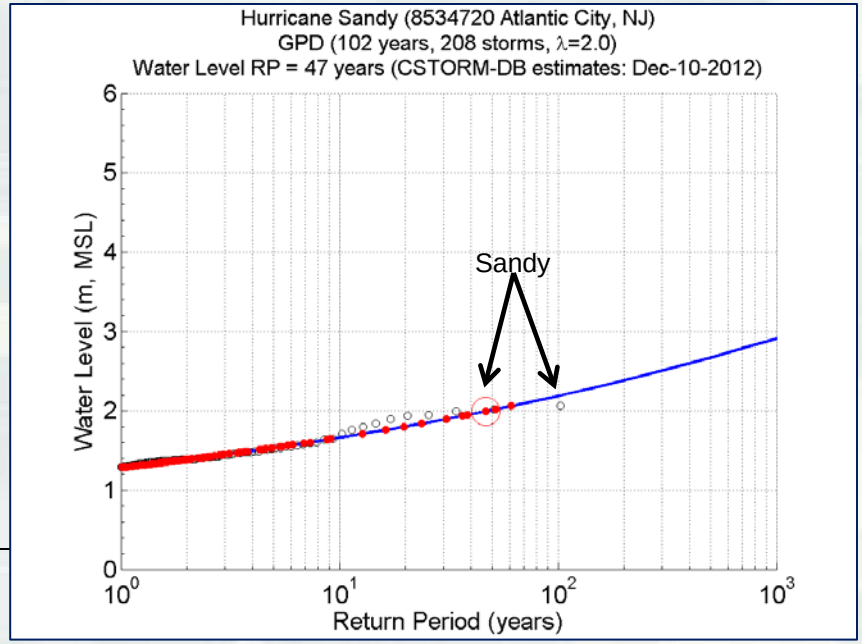
Coastal Storm Database Statistical Products

- Storm screening using peaks-over-threshold
- Extremal analysis
- MLM fit with generalized Pareto distribution
- Quantile-Quantile optimization
- Standard products updated annually and following major storms

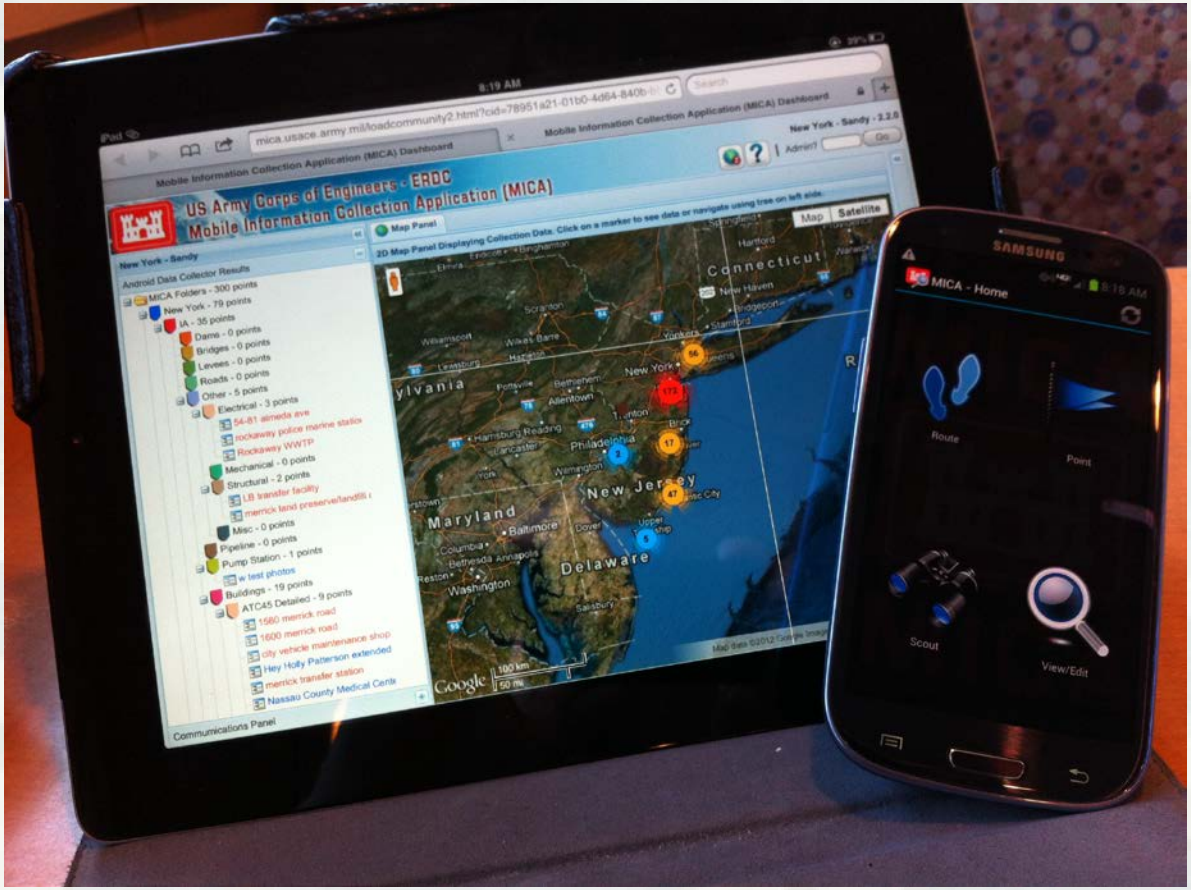


Water level return periods were requested by NAN and subsequently supplied to NAN and other NE Atlantic divisions following Hurricane Sandy.





Mobile Information Collection Application (MICA)

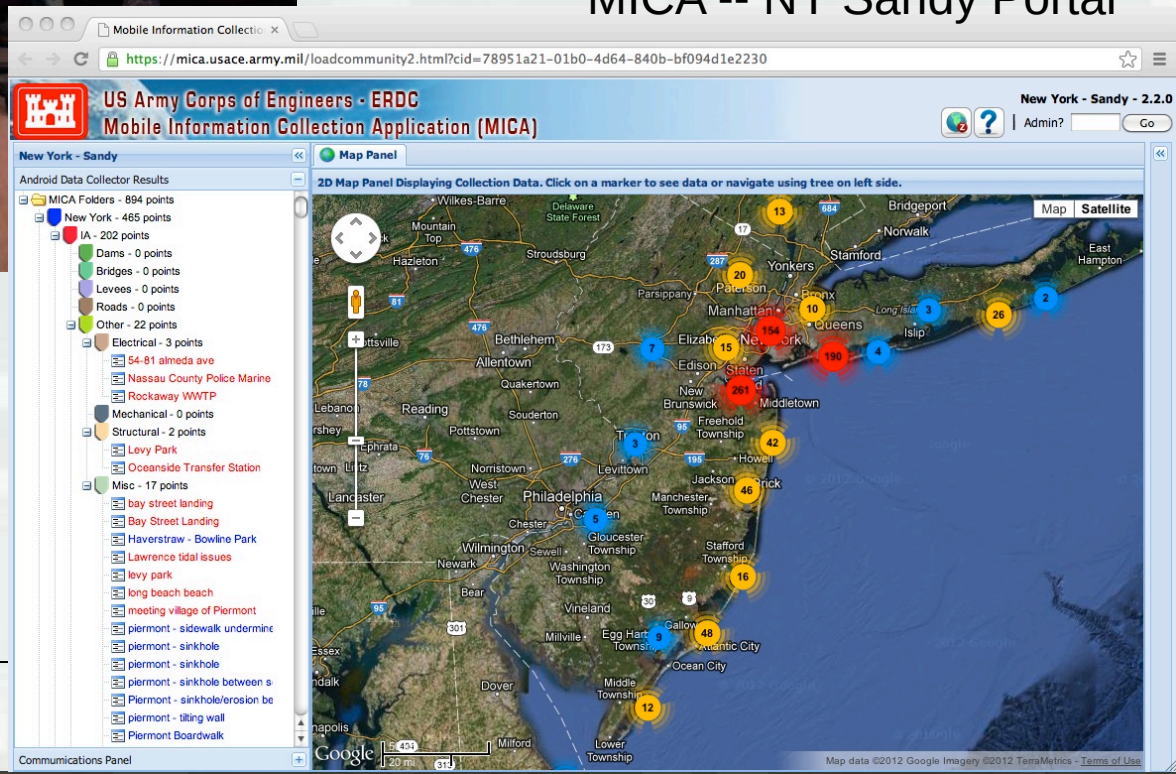


ERDC responded with the MICA system to Hurricane Sandy at the request of Mr. Willam Helms of the USACE North Atlantic Division (NAD) office, initially with 35 devices followed by an additional 95 devices.

Mobile Information Collection Application (MICA)

The NAD Emergency Operations Center

MICA -- NY Sandy Portal



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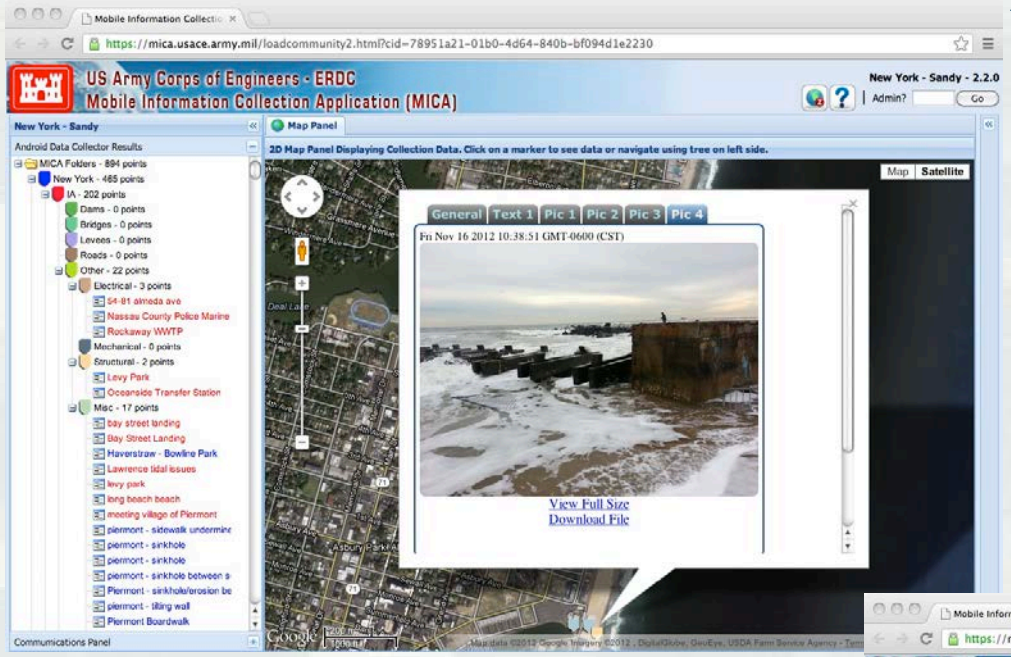
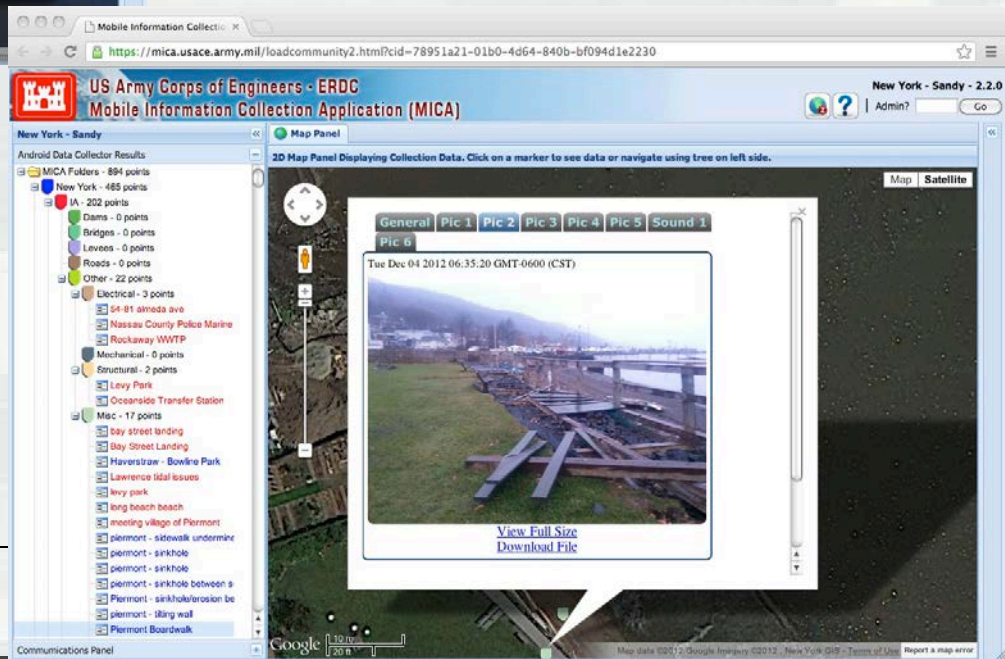
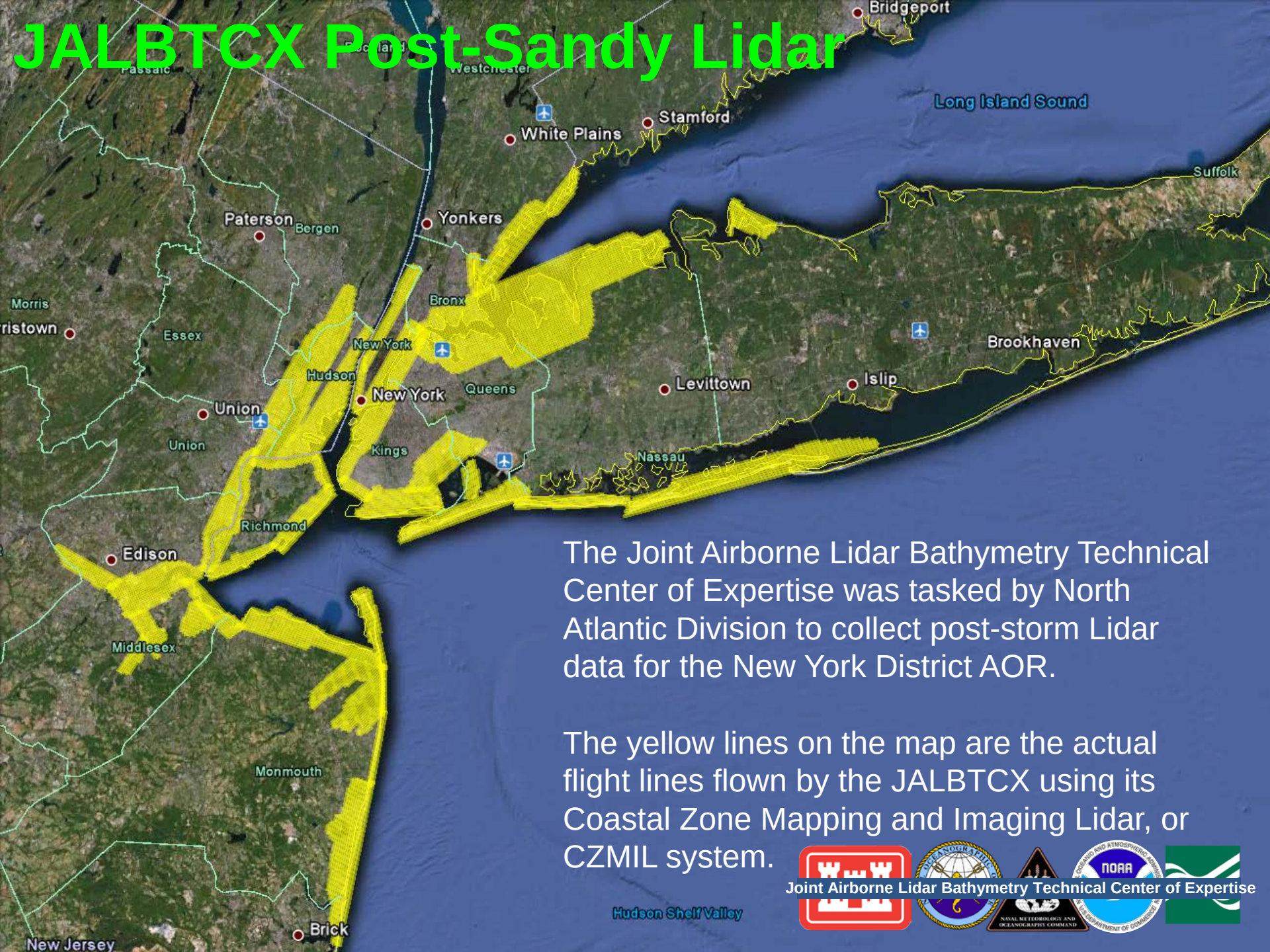
Mobile Information Collection Application (MICA)



- Over 1000 photos and videos have been collected
- ERDC created 11 forms for specific data collection in a variety of missions
    - Power
    - Debris
    - Infrastructure Assessments



JALBTCX Post-Sandy Lidar

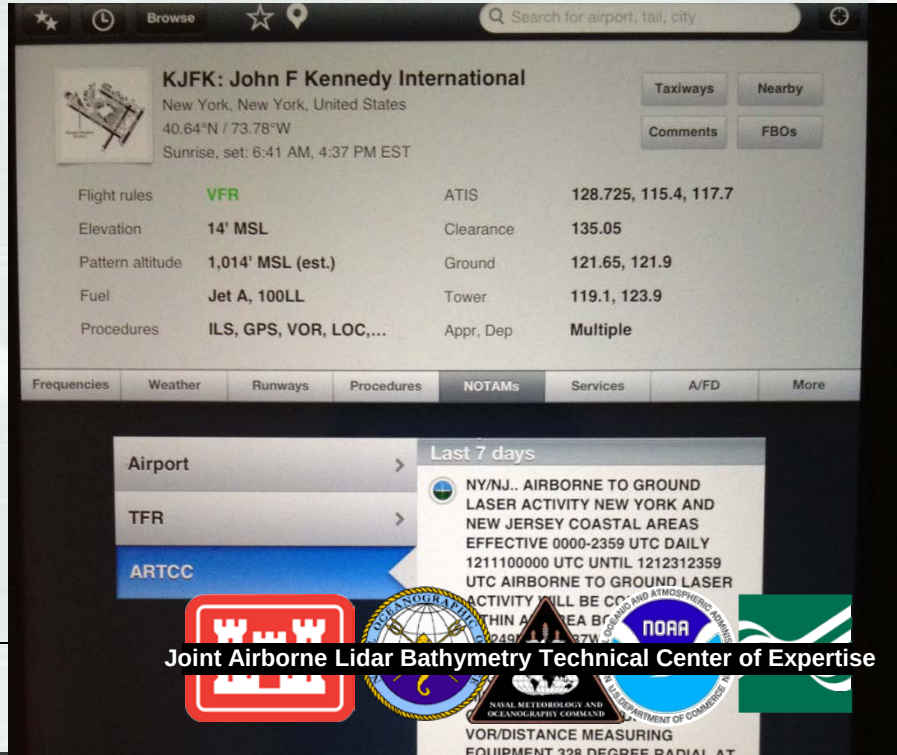


The Joint Airborne Lidar Bathymetry Technical Center of Expertise was tasked by North Atlantic Division to collect post-storm Lidar data for the New York District AOR.

The yellow lines on the map are the actual flight lines flown by the JALBTCX using its Coastal Zone Mapping and Imaging Lidar, or CZMIL system.

Joint Airborne Lidar Bathymetry Technical Center of Expertise

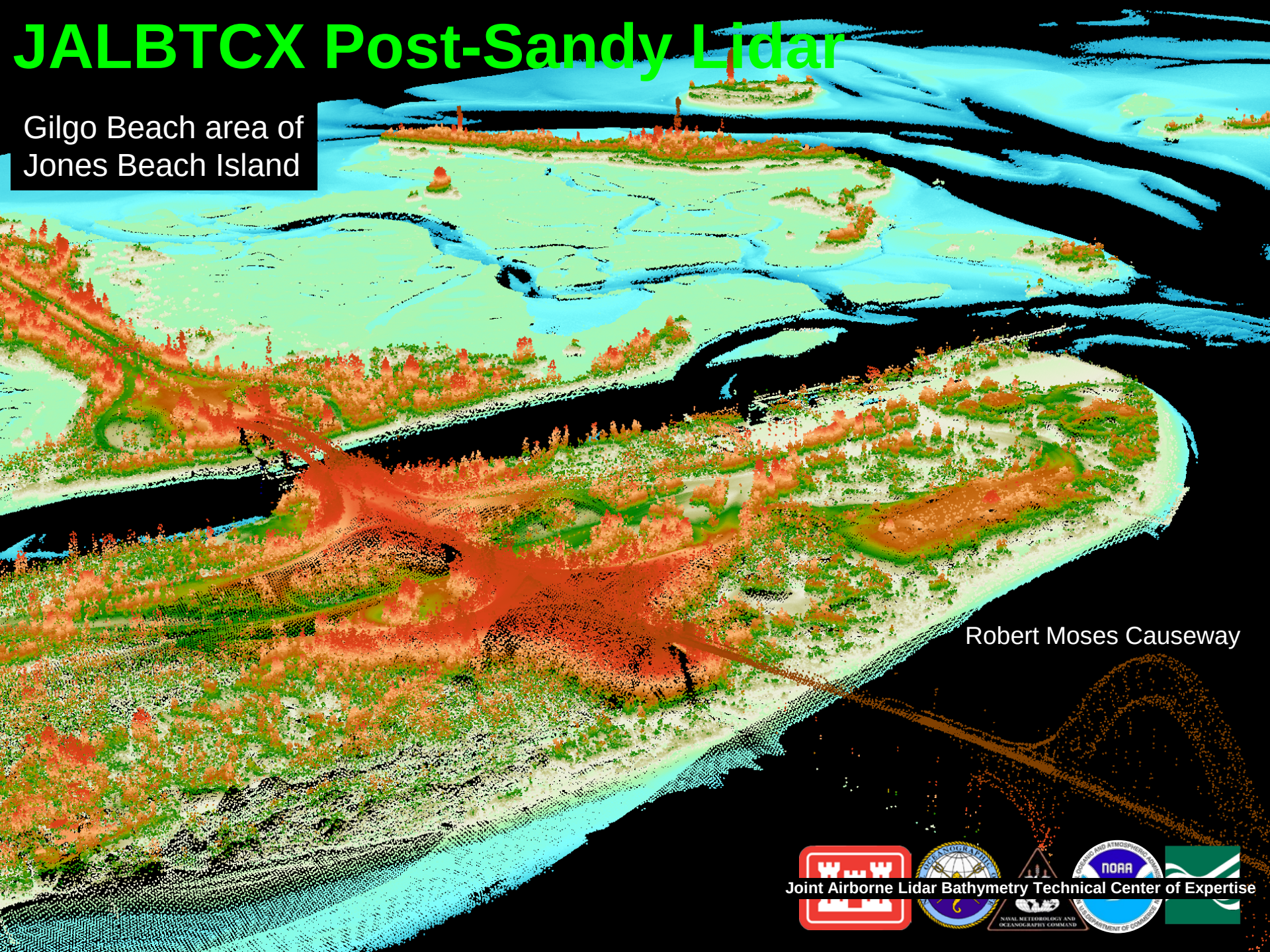
JALBTCX Post-Sandy Lidar



Joint Airborne Lidar Bathymetry Technical Center of Expertise

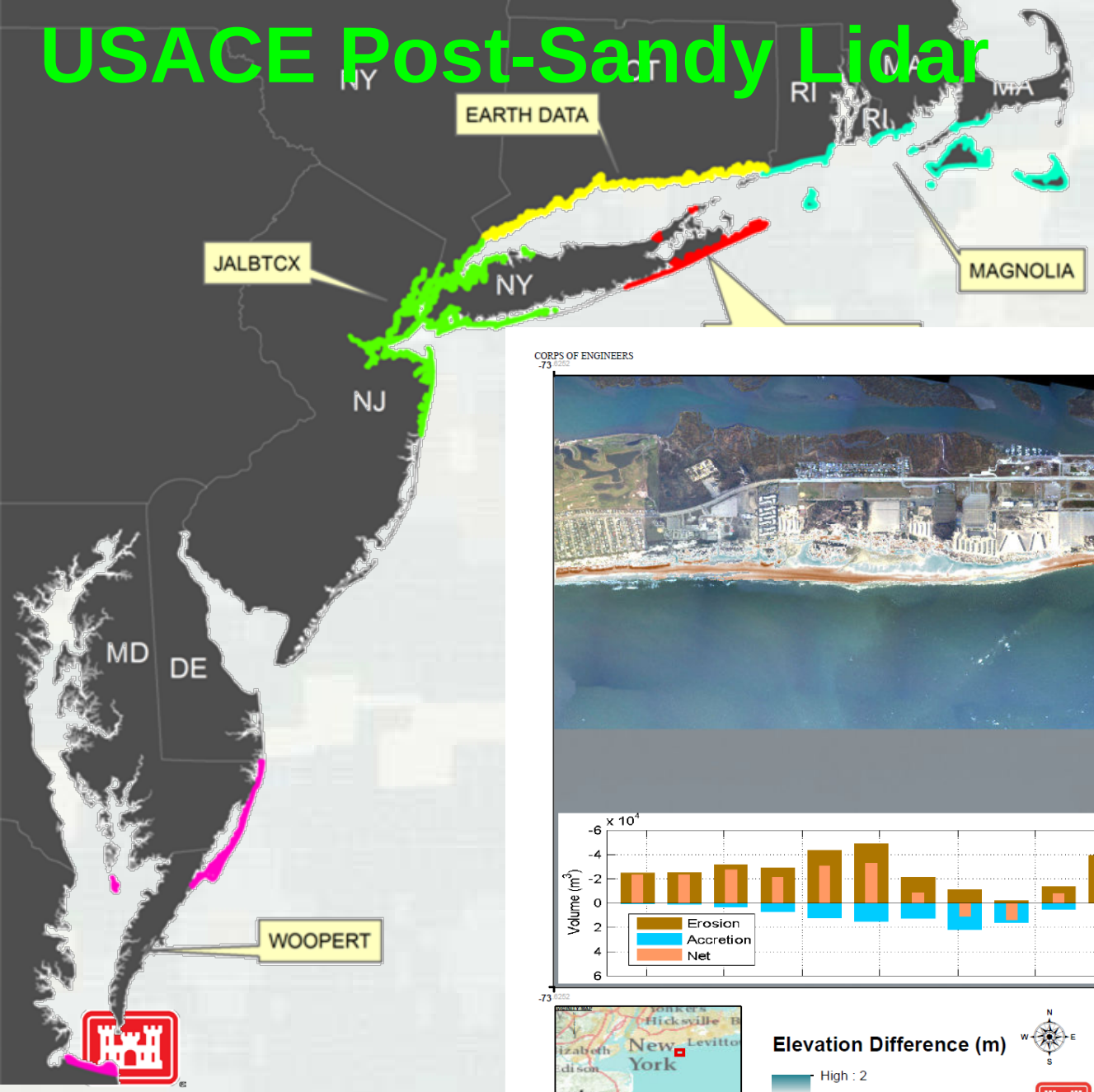
JALBTCX Post-Sandy Lidar

Gilgo Beach area of
Jones Beach Island

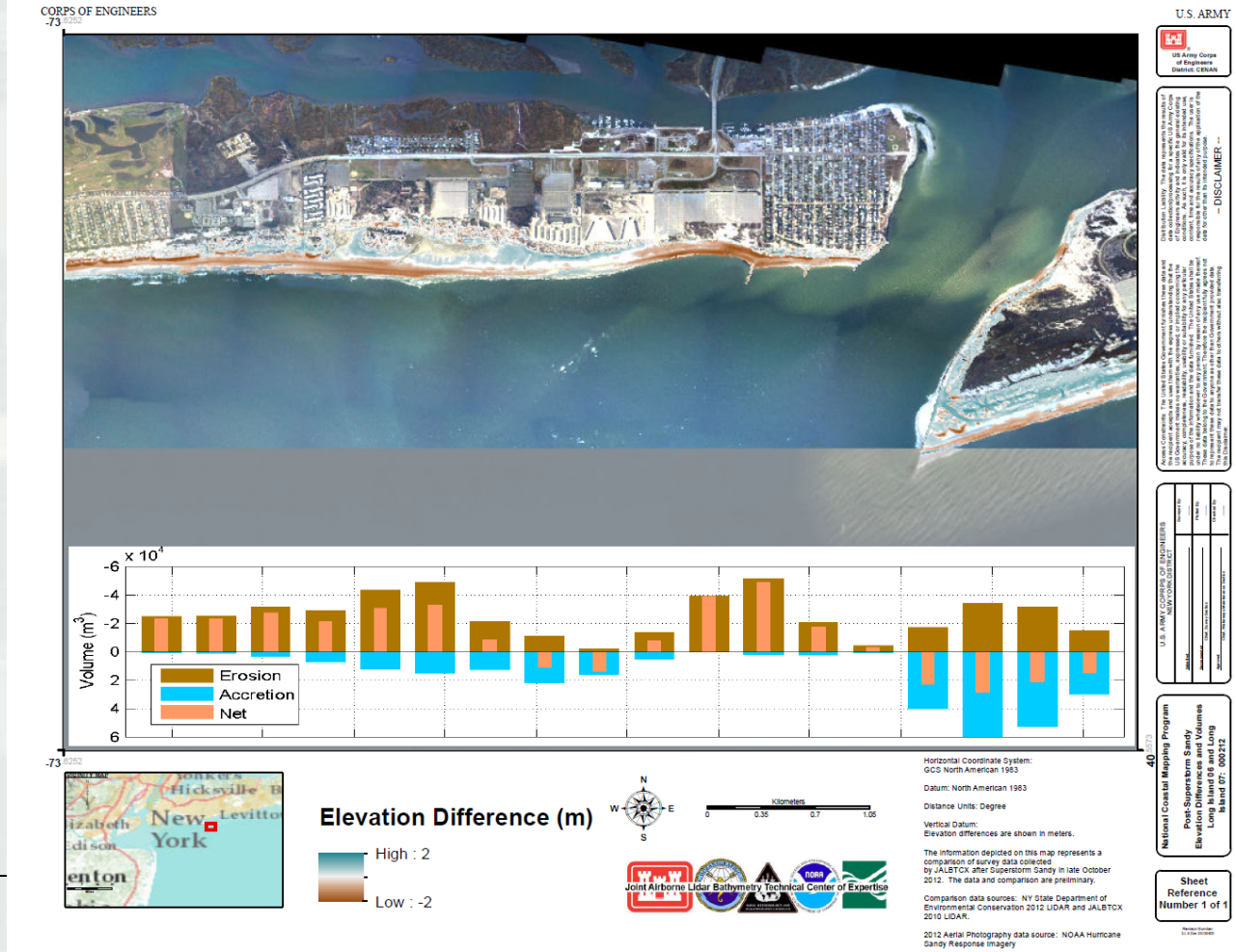


Joint Airborne Lidar Bathymetry Technical Center of Expertise

USACE Post-Sandy Lidar



JALBTCX was also tasked by North Atlantic Division with comparing the pre-event datasets from the USACE National Coastal Mapping Program with the post-event lidar data.



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Surge/Flood Modeling for the Nor'easter Following Sandy

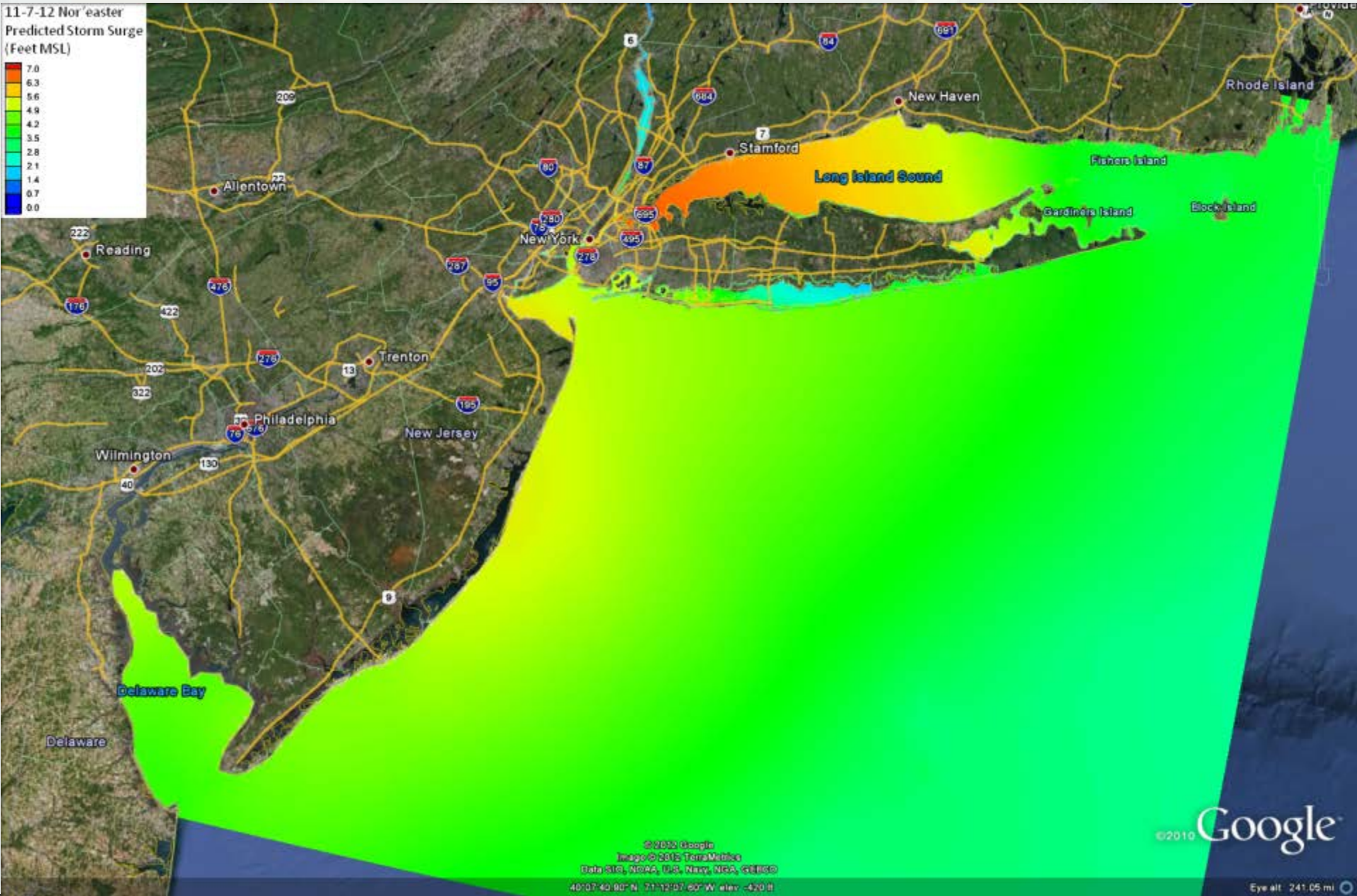
ADCIRC Surge Modeling

- Used two ADCIRC meshes
  - EC2001FIMP Grid
  - FEMA Region 2 Grid
- Used tidal forcing and NAM wind fields
- In collaboration with the ASGS team, used winds derived from the North American Mesoscale Forecast System (NAM) which is part of the NWS's NCEP.
- Two forecast wind sets 2012/11/06 00Z and 2012/11/07 12Z
- 2012/11/07 12Z results sent forward

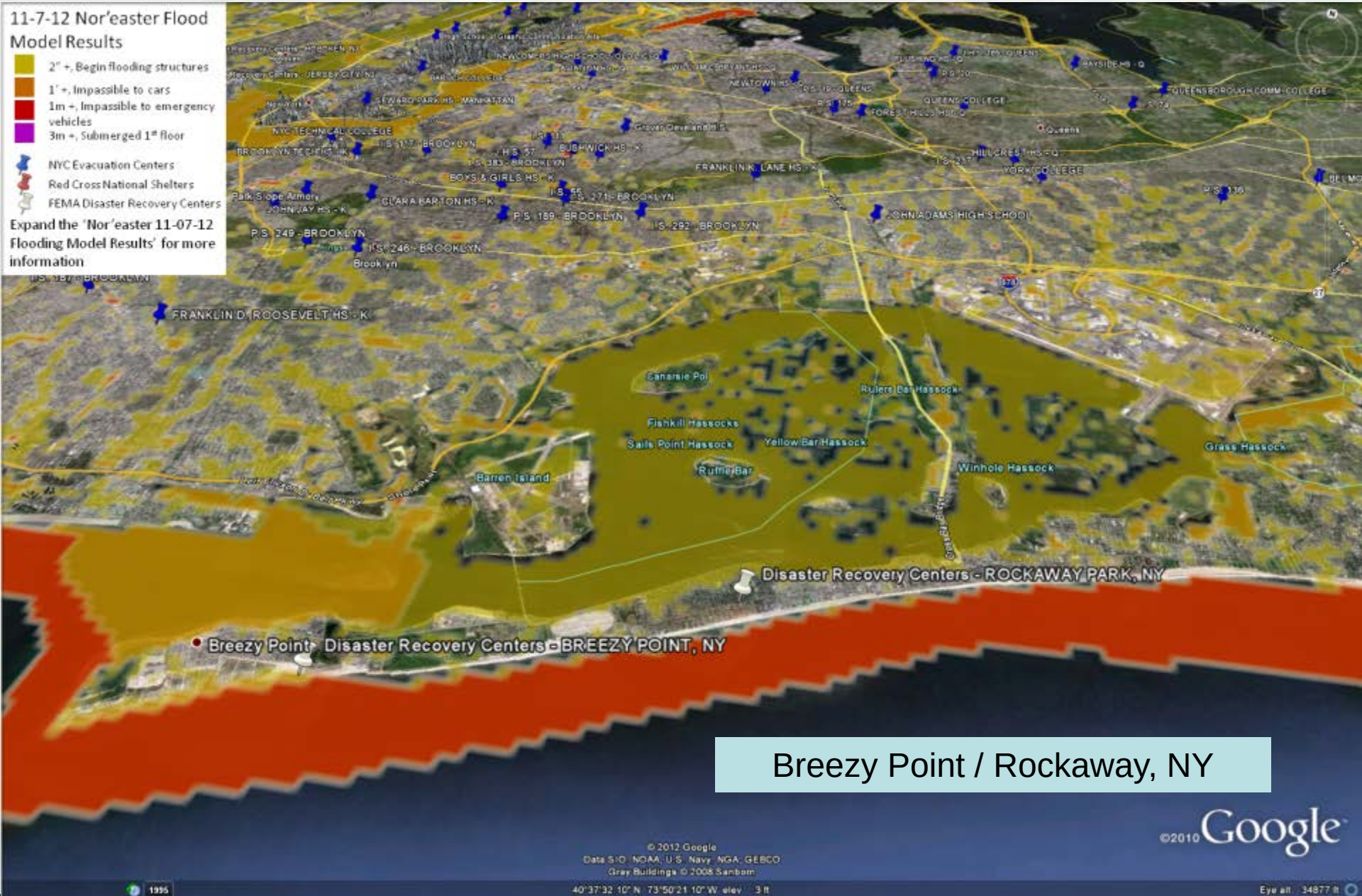
Maximum Storm Surge Predicted Values at Requested Locations

Longitude (deg)	Latitude (deg)		Location Name	Maximum Water Elevation (ft MSL)
-73.8439	40.5728		Rockaway, NY	4.6176
-74.1449	40.5313		South Staten Island NY	5.0079
-74.1786	40.4464		Union Beach, NJ	5.2931
-73.9642	40.3503		Sea Bright, NJ	4.8505
-74.0161	40.1278		Manasquan, NJ	4.9942
-74.0359	40.0461		Mantoloking, NJ	5.0448
-74.0624	39.9261		Seaside Park, NJ	5.1055
-74.1778	39.6318		Long Beach Island, NJ	4.8897
-74.4183	39.355		Atlantic City, NJ	4.4804

Nor’easter Surge Estimates



Inland Flood Model Results (Nor'easter)



Breezy Point / Rockaway, NY