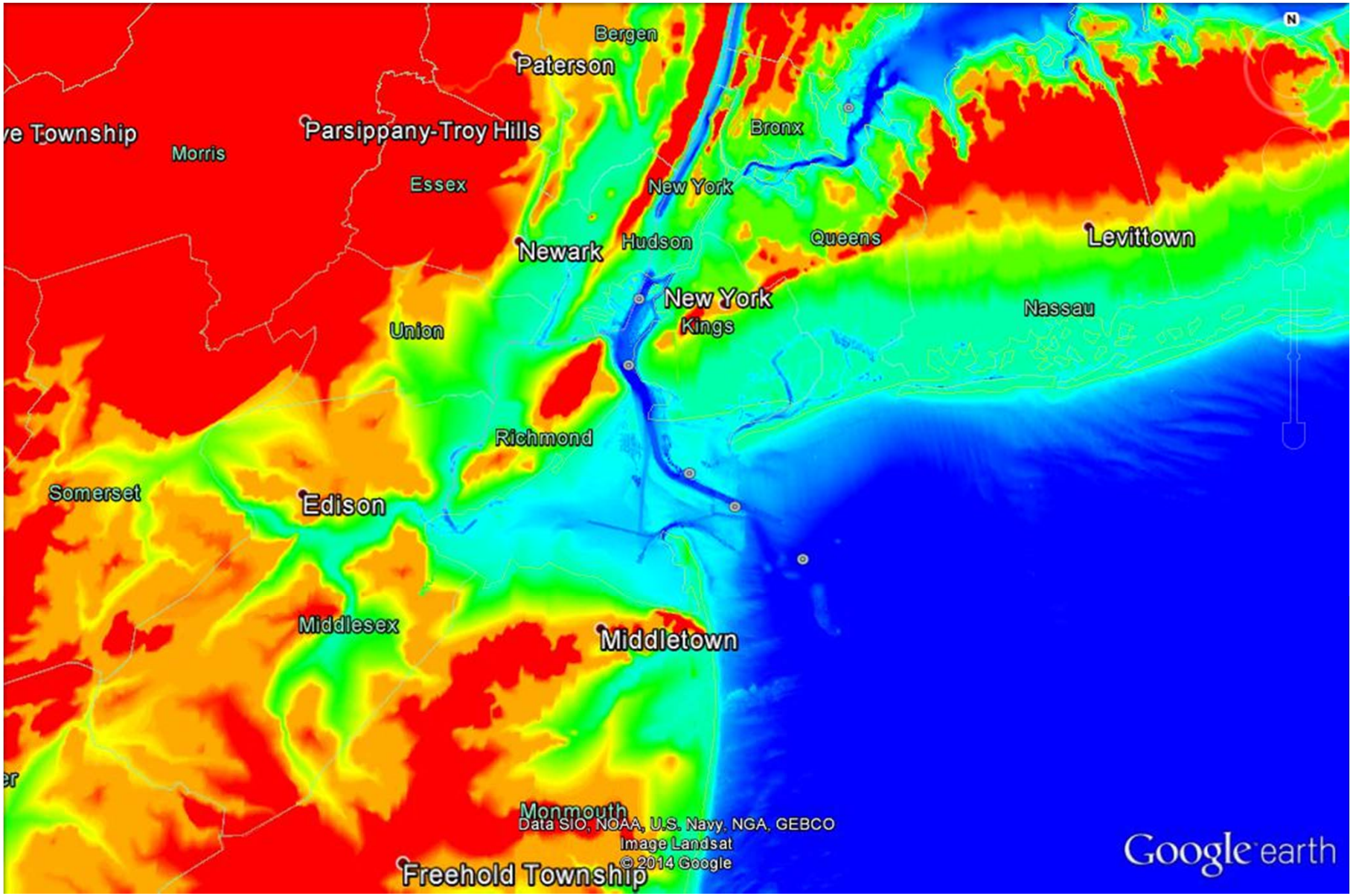
THE CITY UNIVERSITY OF NEW YORK
College of Staten Island

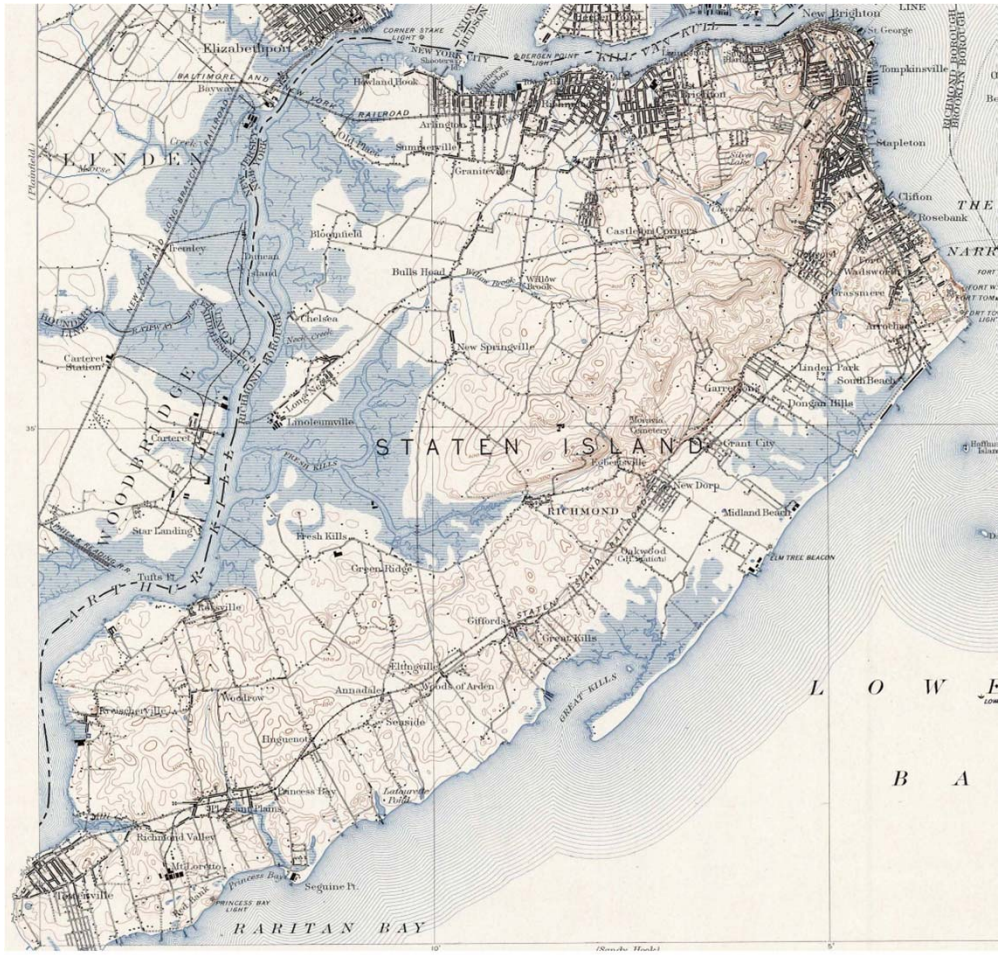
ADCIRC Storm Surge Modeling of The New Artificial Dune System from South Beach to Fox Beach, Staten Island NY

GSA Annual Meeting October 21, 2014

Michael E. Kress
William Fritz
Alan Benimoff
Eugene Dzedzits


Bergen
Paterson
Parsippany-Troy Hills
Morris
Essex
Bronx
New York
Newark
Hudson
Queens
Levittown
New York
Kings
Nassau
Union
Richmond
Somerset
Edison
Middlesex
Middletown
Monmouth
Freehold Township
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2014 Google
Google earth

Historical Perspective



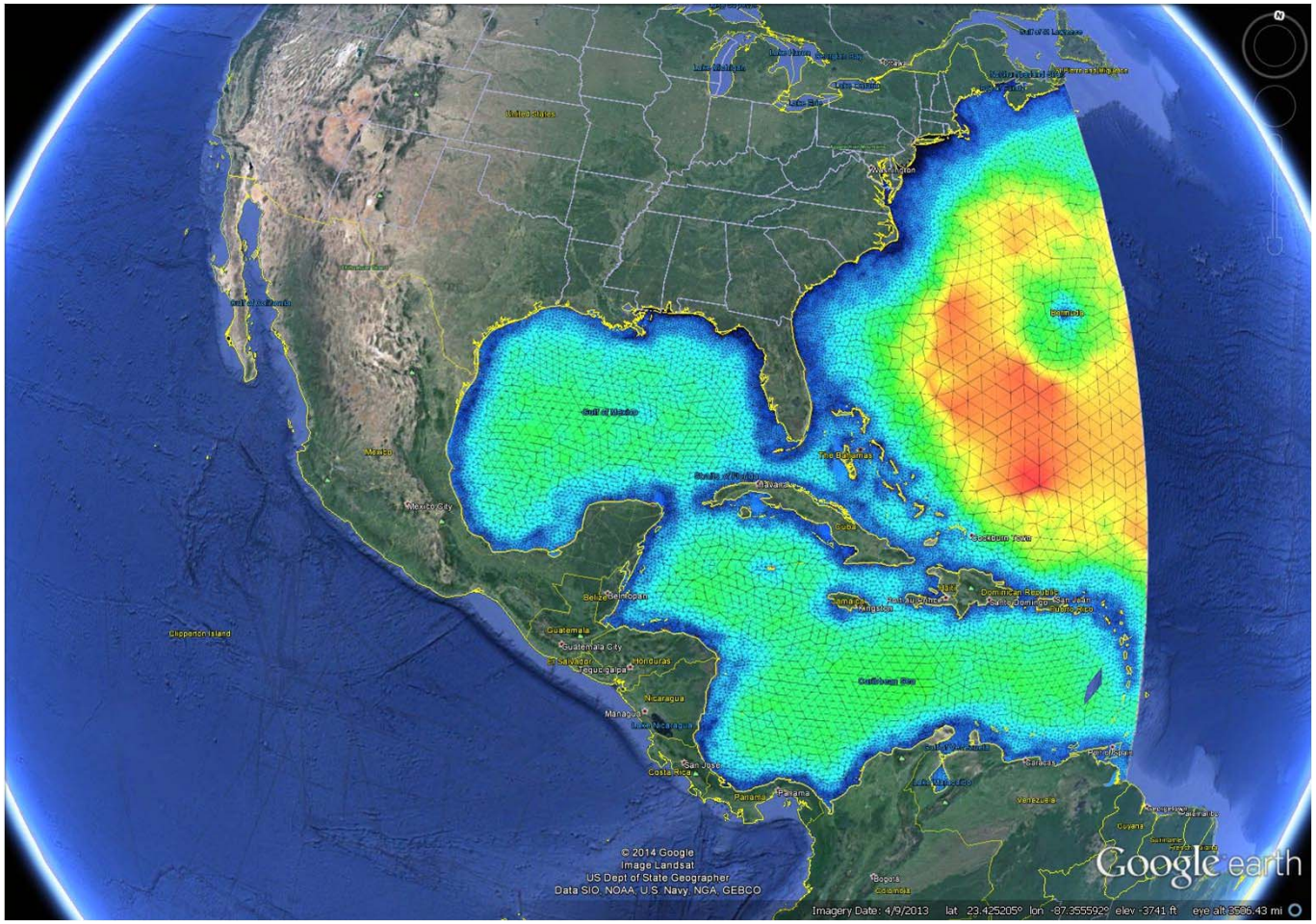
CSI Storm Surge Models - ADCIRC

- Highly vetted and commonly utilized storm surge analysis model. ADCIRC is the standard coastal storm surge model used by the U.S. Army Corps of Engineers (USACE) .
- Used to simulate storm surge flooding for a large number of hurricane scenarios.
- Luettich, R.A., and J.J. Westerink. 2004. “Formulation and Numerical Implementation of the 2D/3D ADCIRC Finite Element Model Version 44.XX.”
- Solves a finite element numerical representation of the Shallow Water Equations.

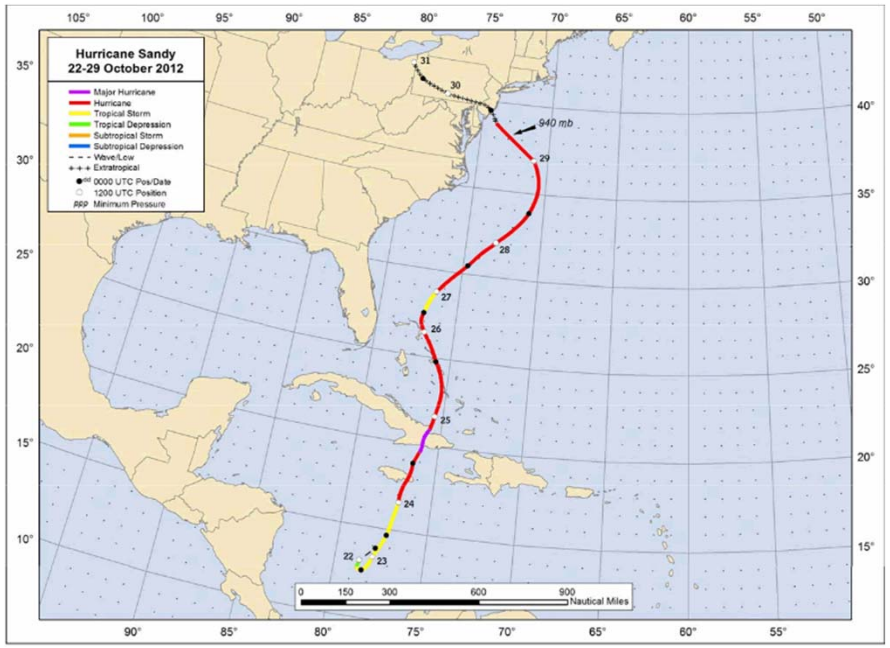
CSI Storm Surge Models - ADCIRC

- Simulates near shore waves and wind with SWAN, J.C. Dietrich, M. Zijlema, et al.
- “Modeling hurricane waves and storm surge using integrally-coupled,
- scalable computations”, Coastal Engineering 58 (2011) 45–65.
- Tides are included as driving forces.
- SSS meteorological Data: Wind field and pressure profiles from National Hurricane Center data are used.

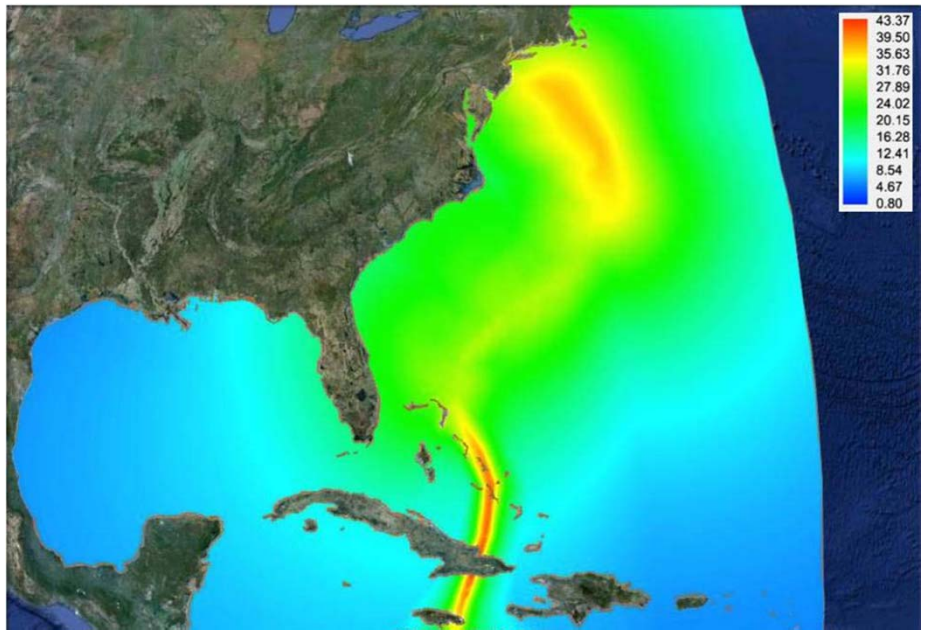
ADCIRC Computational Domain



Superstorm Sandy Track Comparison

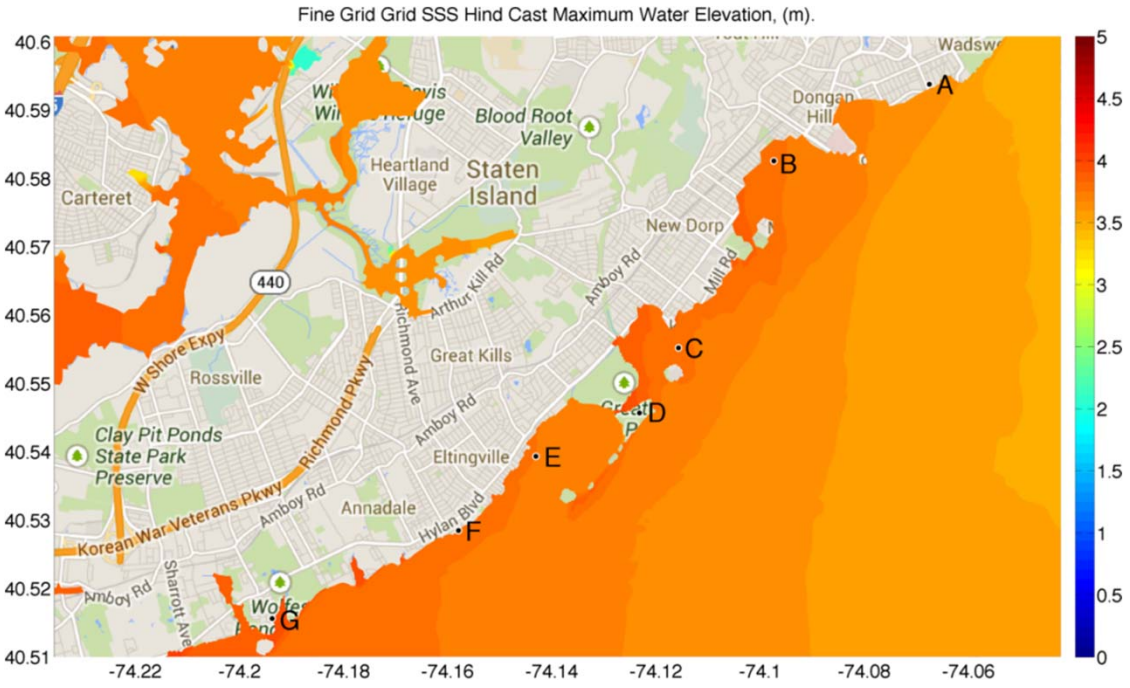


NOAA Reported Track



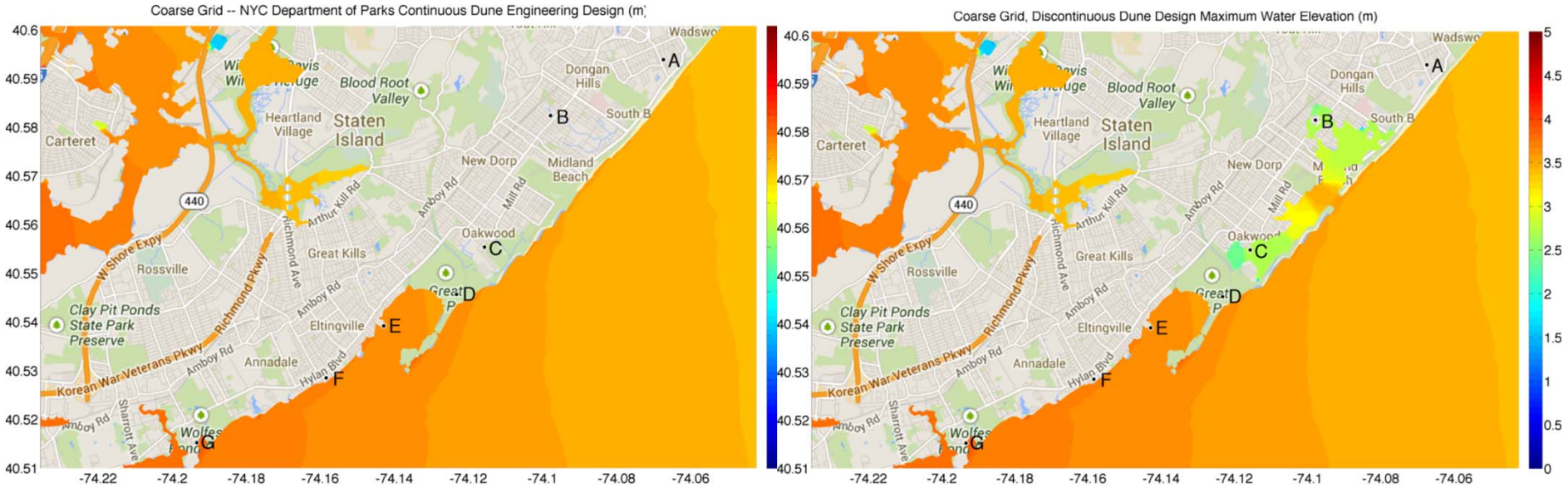
CSI ADCIRC Model

Superstorm Sandy Hindsight Model Comparison Observed Modeled Maximum Water Elevation (m)

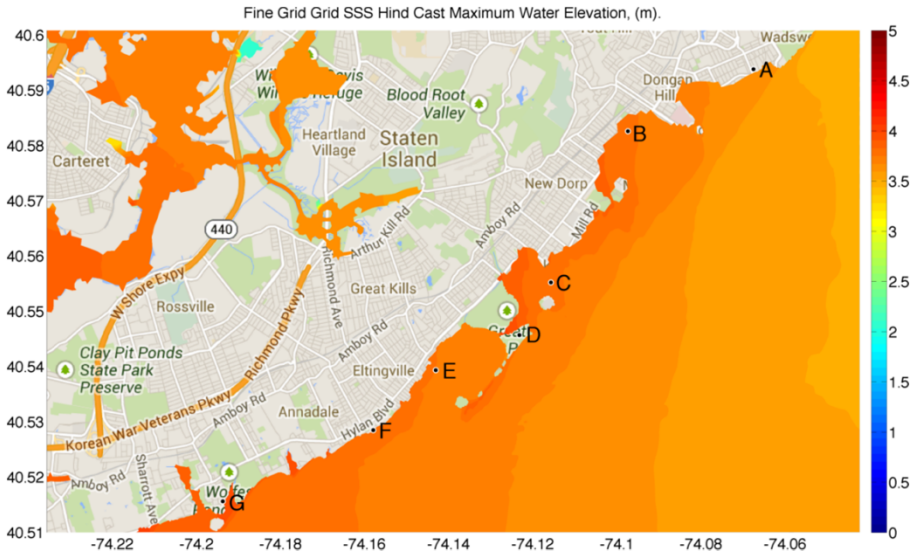


Location Name	Long	Lat	Observed	Modeled
A	-74.068	40.594	3.872	
B	-74.099	40.582	3.811	3.766
C	-74.117	40.555	3.811	3.773
D	-74.124	40.546	4.268	
E	-74.144	40.539	2.988	3.748
F	-74.159	40.528	5.152	3.841
G	-74.194	40.515	3.963	
H	-74.210	40.512	3.994	3.943
I	-74.231	40.502	4.024	3.954
J	-74.241	40.500	4.024	4.017
K	-74.254	40.502	3.994	
L	-74.166	40.592	3.750	3.641
M	-74.136	40.641	3.506	3.438
N	-74.090	40.647	3.567	
O	-74.074	40.638	3.567	3.512
P	-74.063	40.616	4.665	3.479
RootMeanSquareDeviation				0.583

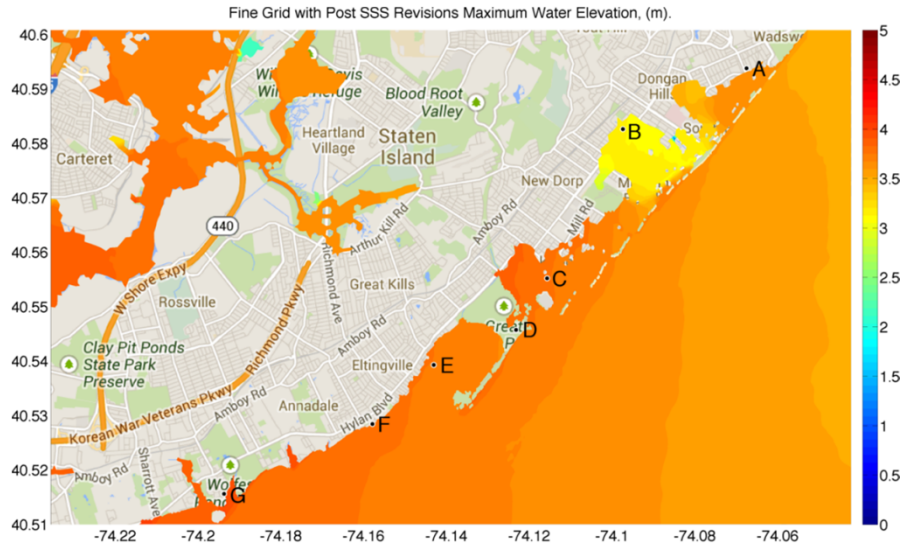
Inundation Prevention Dunes and Berms: As Planned, Assuming No Erosion of the Dunes



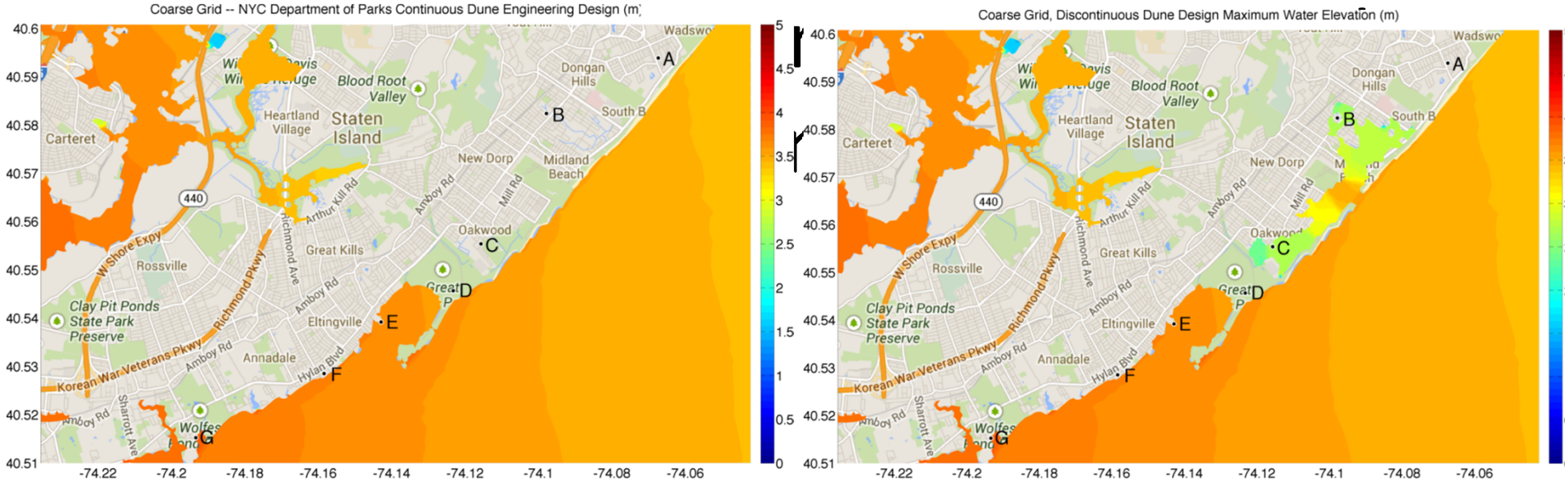
Pre – Post Superstorm Sandy Comparison
Maximum Water Elevation (m): As Built



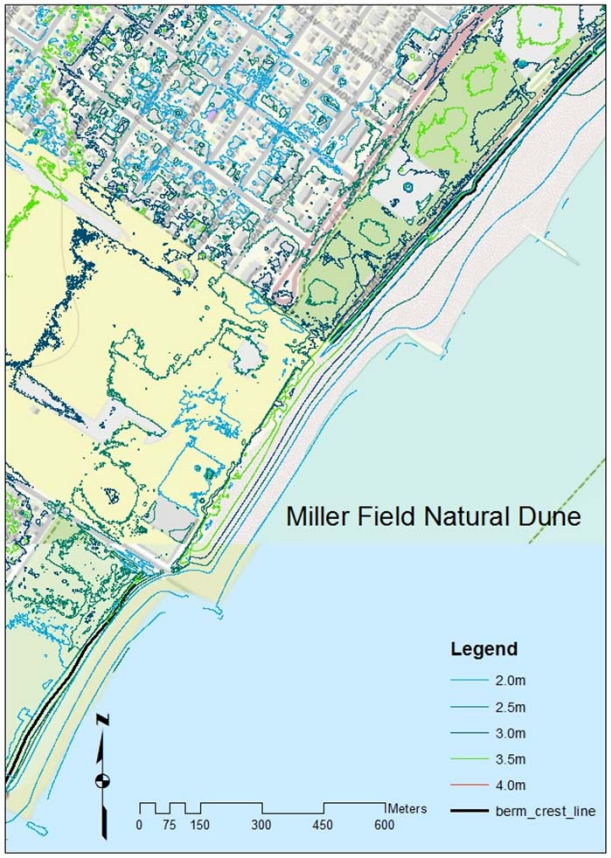
Pre-Superstorm Sandy



Post-Superstorm Sandy


Coarse Grid -- NYC Department of Parks Continuous Dune Engineering Design (m)
Coarse Grid, Discontinuous Dune Design Maximum Water Elevation (m)
Fine Grid with Post SSS Revisions Maximum Water Elevation, (m).
Staten Island
Carteret
Heartland Village
Blood Root Valley
Dongan Hills
South B
New Dorp
Midland Beach
Oakwood
Great Kills
Rossville
Clay Pit Ponds State Park Preserve
Eltingville
Annadale
Arthur Kill Rd
Richmond Ave
Amboy Rd
Mill Rd
Hylan Blvd
Sharrott Ave
W Shore Expy
Richmond Pkwy
Korean War Veterans Pkwy
440
A
B
C
D
E
F
G
40.6
40.59
40.58
40.57
40.56
40.55
40.54
40.53
40.52
40.51
-74.22
-74.2
-74.18
-74.16
-74.14
-74.12
-74.1
-74.08
-74.06
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

Miller Field Coastline



Inundation Prevention Dunes and Berm on Staten Island South East Coastline

Ground Truth

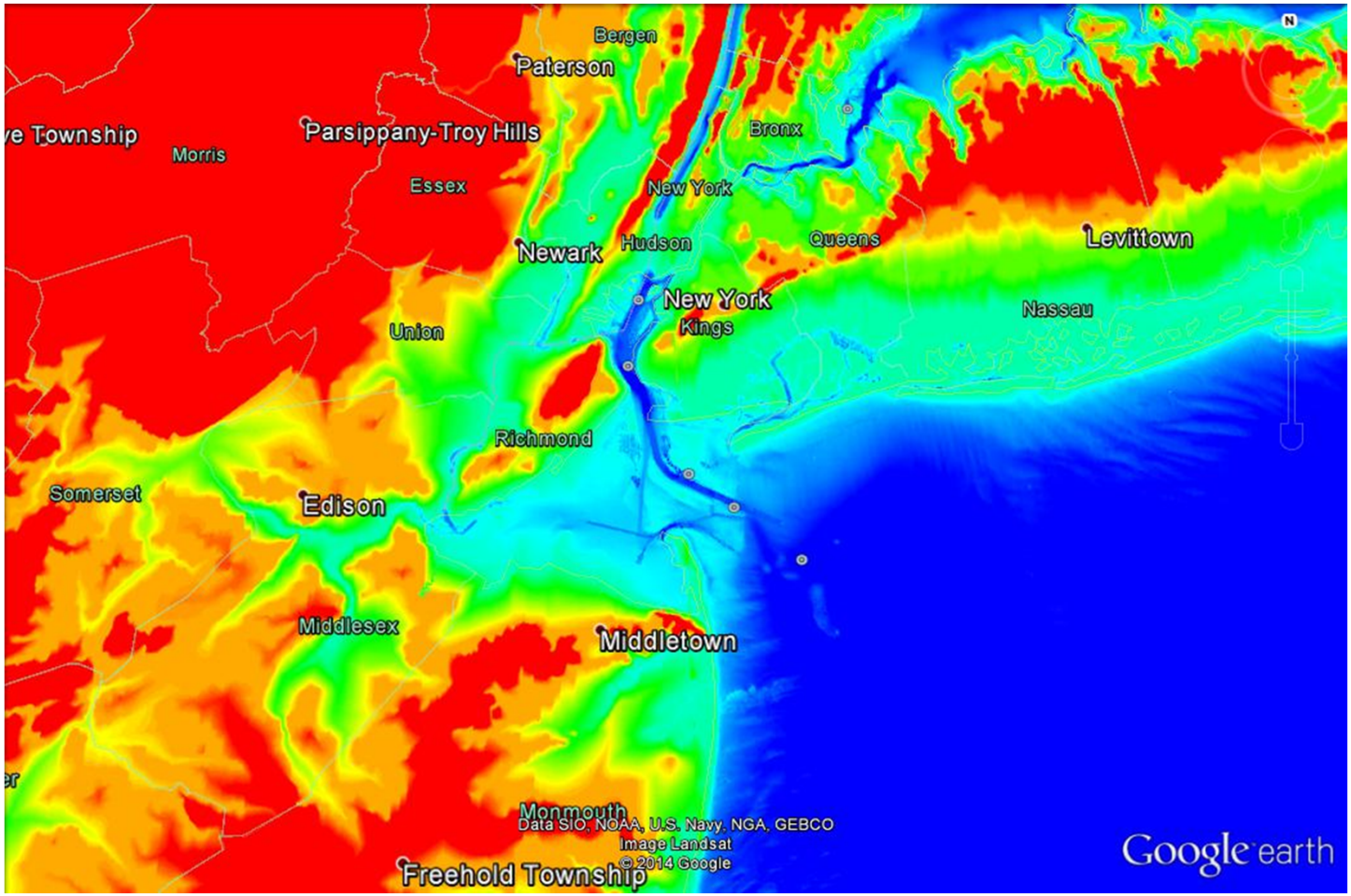
Results

- Validated three ADCIRC grid by comparing results of numerical simulation to observed HWM data and seeing good agreement, in some location .
- Performed numerical simulations based tests of engineering design of a protective dune constructed by NYC Department of Parks and Recreation and found potential flaws.

Results

- Integrated coastal elevation data collected by the USGS after SSS into existing grids and performed SSS simulation with updated grids.
- Simulations demonstrated that engineering design of the protective dune built along has critical flaws that need to be addressed. Suggested modifications include closing gaps in the dune structure. It was demonstrated that a continuous dune provides much stronger protection.

Thank You


Bergen
Paterson
Parsippany-Troy Hills
Morris
Essex
Bronx
New York
Hudson
Queens
Levittown
Newark
New York
Kings
Nassau
Union
Richmond
Somerset
Edison
Middlesex
Middletown
Monmouth
Freehold Township
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2014 Google
Google earth