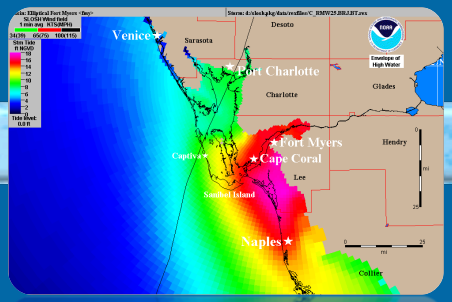



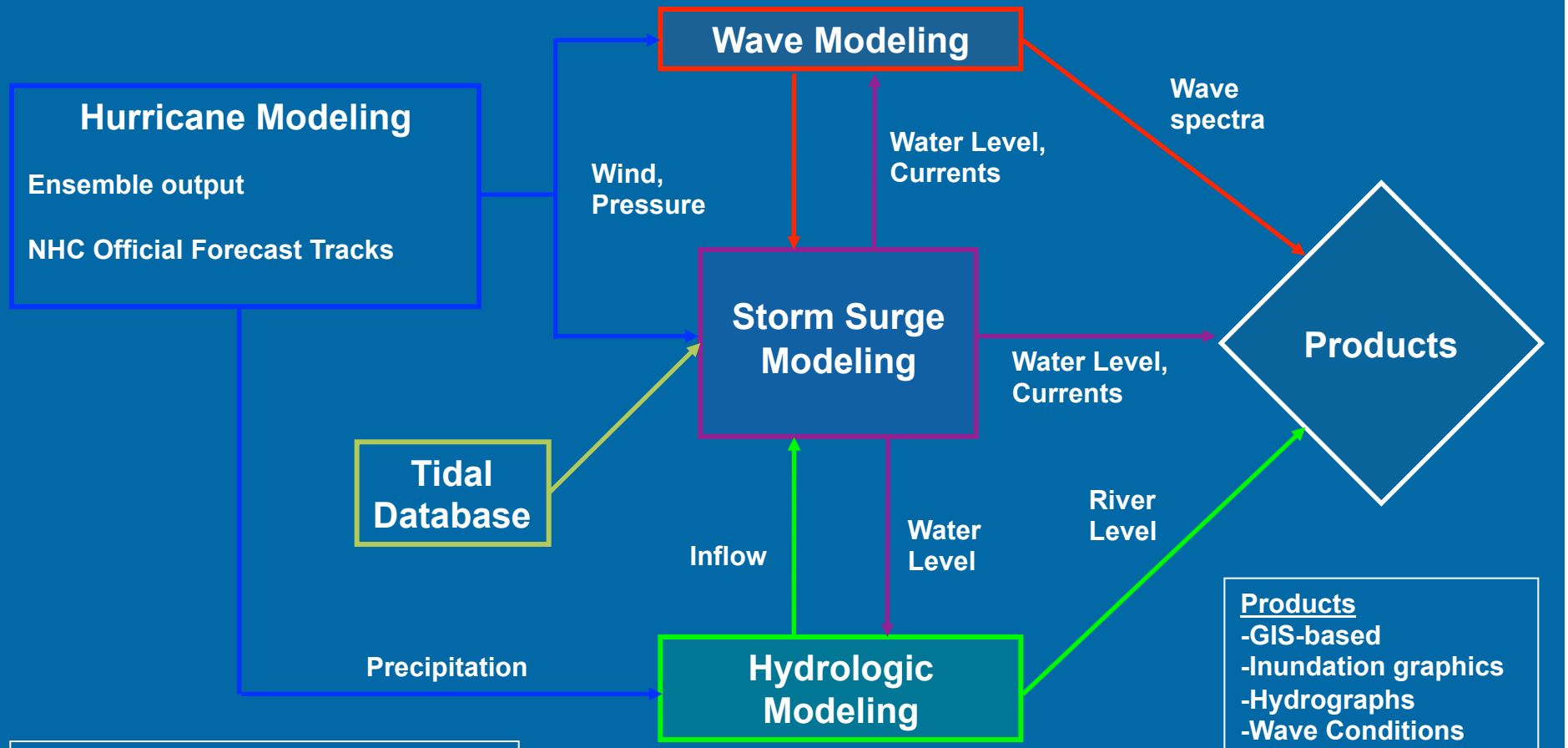
HFIP-Supported Improvements to Storm Surge Forecasting in 2012

Jesse C. Feyen (NOS/OCS), Jamie Rhome (NWS/NHC), Rick Luettich (UNC-CH), Jason Fleming (Seahorse Consulting), Brian Blanton (RENCI), Yuji Funakoshi (UCAR)

Model Improvements Prioritized by NOAA's Storm Surge Roadmap

- Roadmap is NOAA's plan for improving models, products and services
- Highlights need for NOAA to establish storm surge model ensembles that are:
  - High resolution
  - Able to capture large scale storms
  - Capture effects of tides, waves, and river inflow
  - Community based to leverage multi-agency investments

Concept of a Next Generation Storm Surge System



Products
-GIS-based
-Inundation graphics
-Hydrographs
-Wave Conditions
-Ensembles

Coastal hazards modeling
-Flexible grids that combine large regions with locally high resolution
-Combine effects of surge + tide + waves + rivers to assess flooding

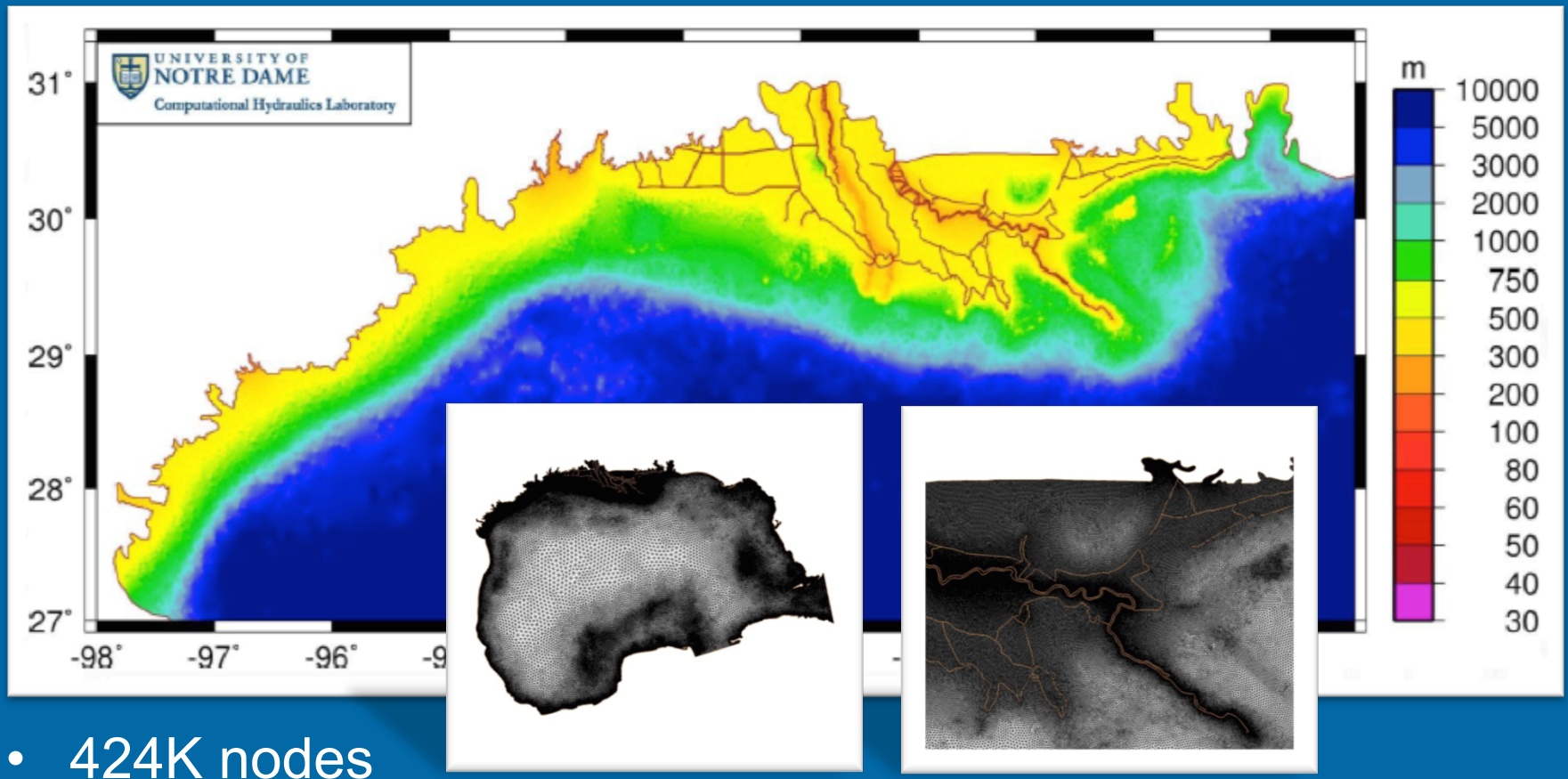
High Res Total Water Level Modeling

- ADCIRC
  - Community-based model being actively developed by academia; routinely used by USACE, FEMA
  - Runs on 10K+ CPUs
  - Unstructured grids combine basins with local resolution down to tens of meters
  - Includes tides, river inflows, waves (via internal SWAN model)
  - Supports forcing from gridded windfields or track forecast files (via asymmetric Holland parametric hurricane wind model)

High Res Surge Ensembles

- ADCIRC Surge Guidance System (ASGS)
  - Provides automated software system for running ADCIRC + SWAN
  - Forced by NAM or driven by NHC Forecast Advisories
  - Utilizes growing library of ADCIRC grids
  - Developed via support from USACE and DHS; maintained by researchers at UNC-CH and partners
- Perturbs official NHC forecast
  - Official forecast track, wind speed increase, veer halfway/fully to edges of cone, slower forward speed, change in Rmax

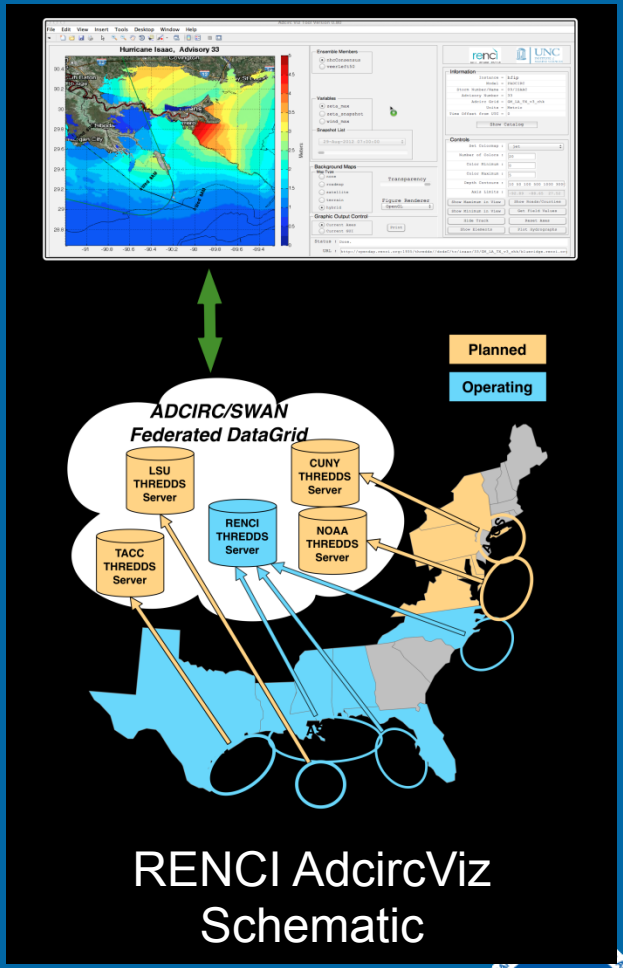
Gulf Coast Test Grid Resolution



- 424K nodes
- From Westerink et al., 2012 AMS Conference session on IOOS Coastal Modeling Testbed

Dissemination of Surge Predictions

- ADCIRC generates standard NetCDF output
- RENCI has developed MATLAB-based viz tool "AdcircViz" to display results
- Accesses runs from NOAA and elsewhere
- NOAA relied upon RENCI THREDDS server in 2012



RENCI AdcircViz Schematic

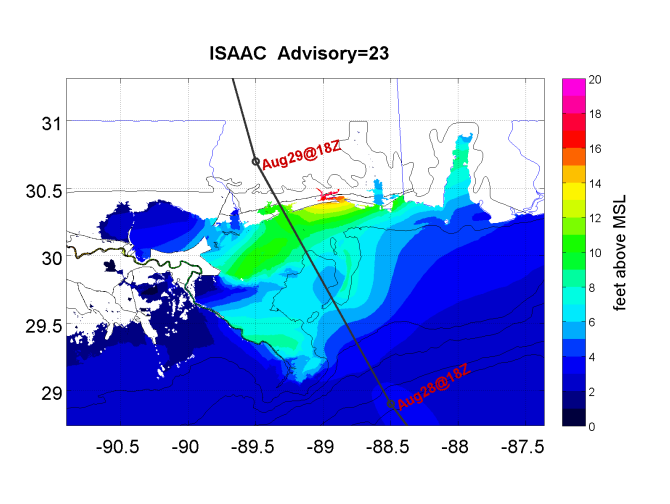
2012 Storm Surge Forecast Guidance

- Opportunity to provide proof of concept
  - Focused on Gulf Coast due to grid availability
- Used by NHC Storm Surge Unit to augment official guidance for Isaac and Sandy
- Helps fill gaps in operational guidance
  - Captures large storms (e.g., Sandy)
  - Higher resolution
  - Includes tide contributions
  - Some external runs included wave effects

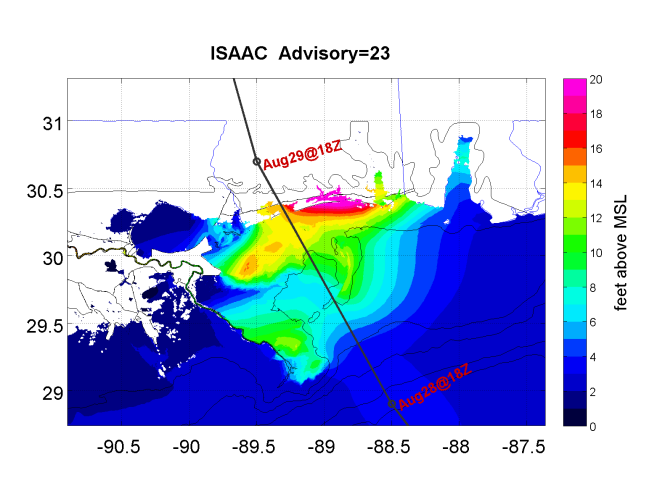
Hurricane Isaac

- Provided output for most advisories from 21 (early Sunday) to 34 (Wednesday morning near landfall)
- Generally provided 5 ensemble members
  - Official, left, right, 20% more intense, slower, softer left
- Also was able to provide access to USACE high resolution results in Louisiana

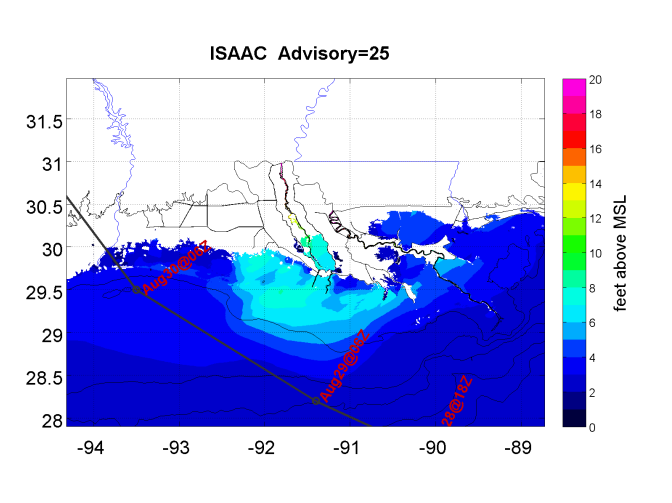
ASGS Ensemble – Sandy Adv 23



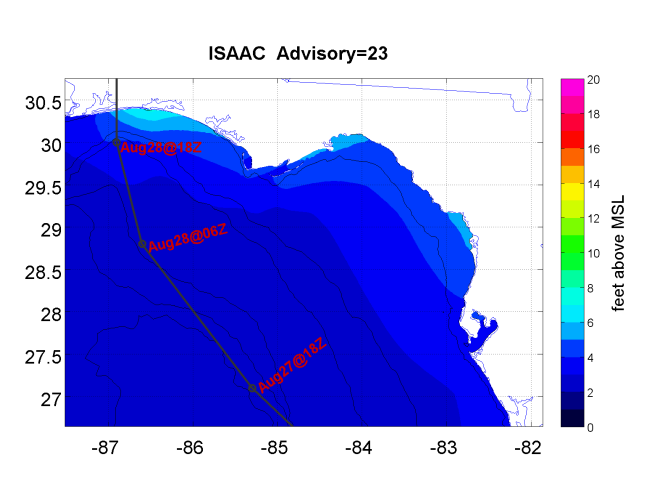
Official Track



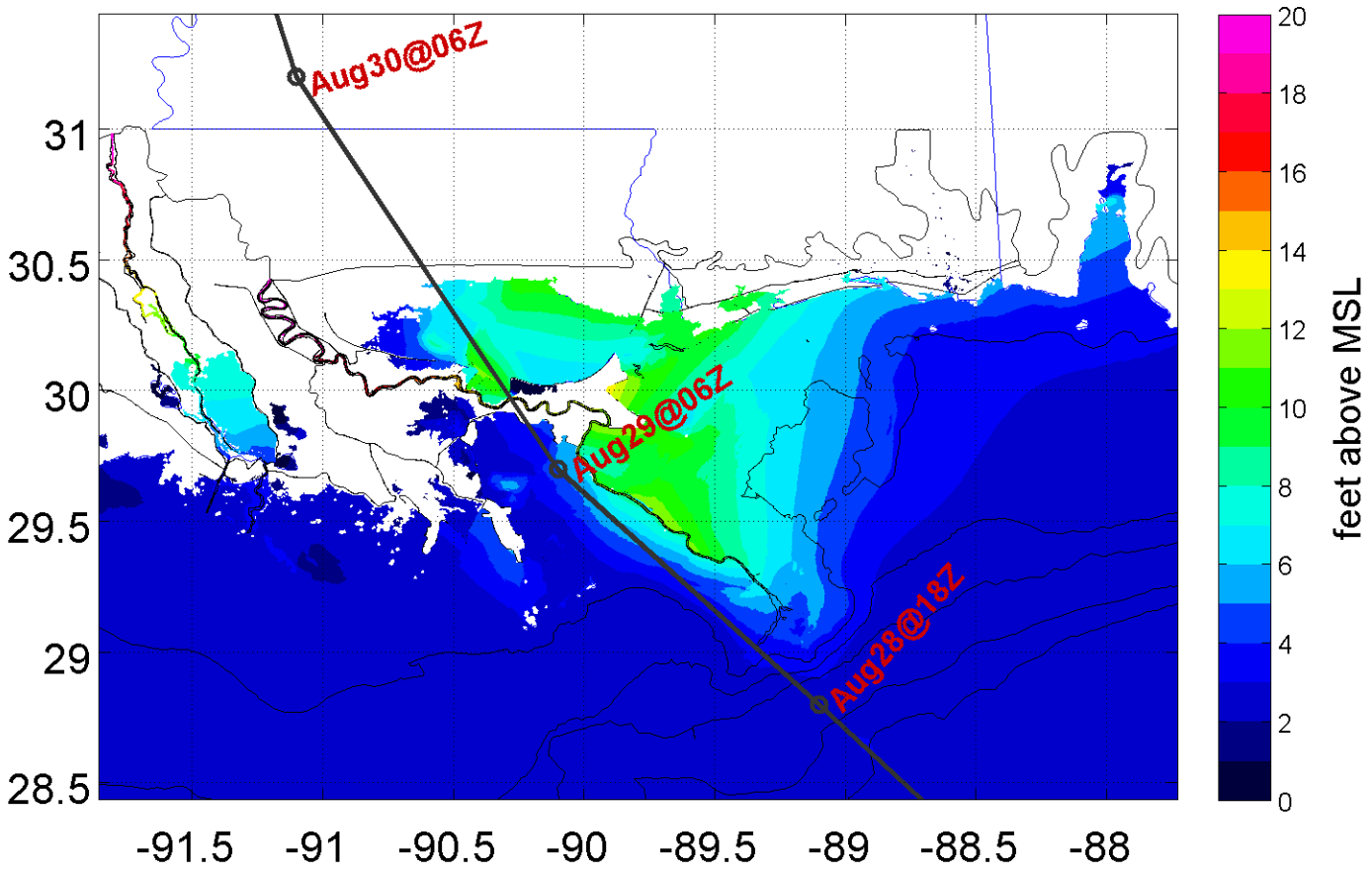
20% More Intense



Left shift



Right Shift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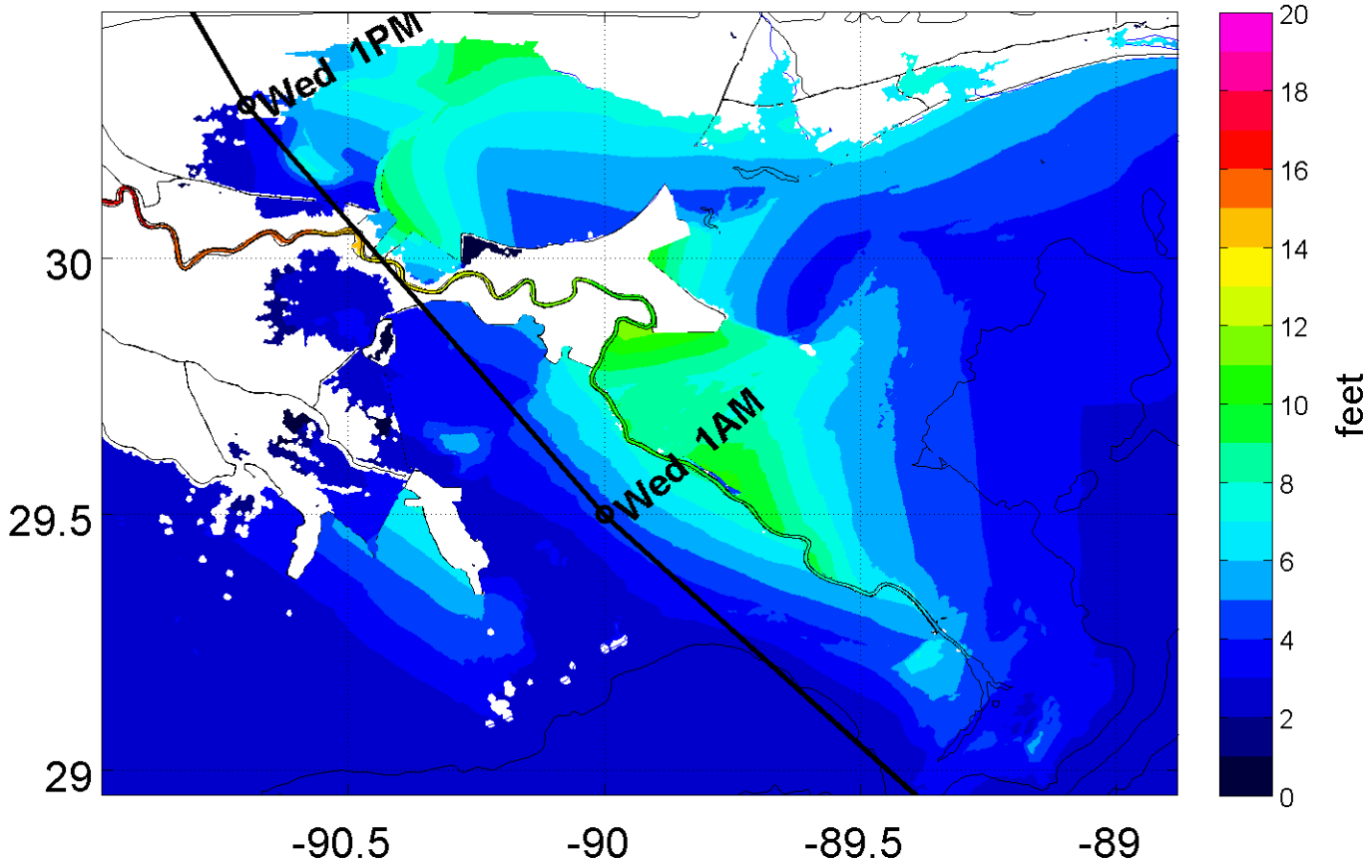
Aug30@06Z
Aug29@06Z
Aug28@18Z
31
30.5
30
29.5
29
28.5
-91.5
-91
-90.5
-90
-89.5
-89
-88.5
-88
20
18
16
14
12
10
8
6
4
2
0
feet above MSL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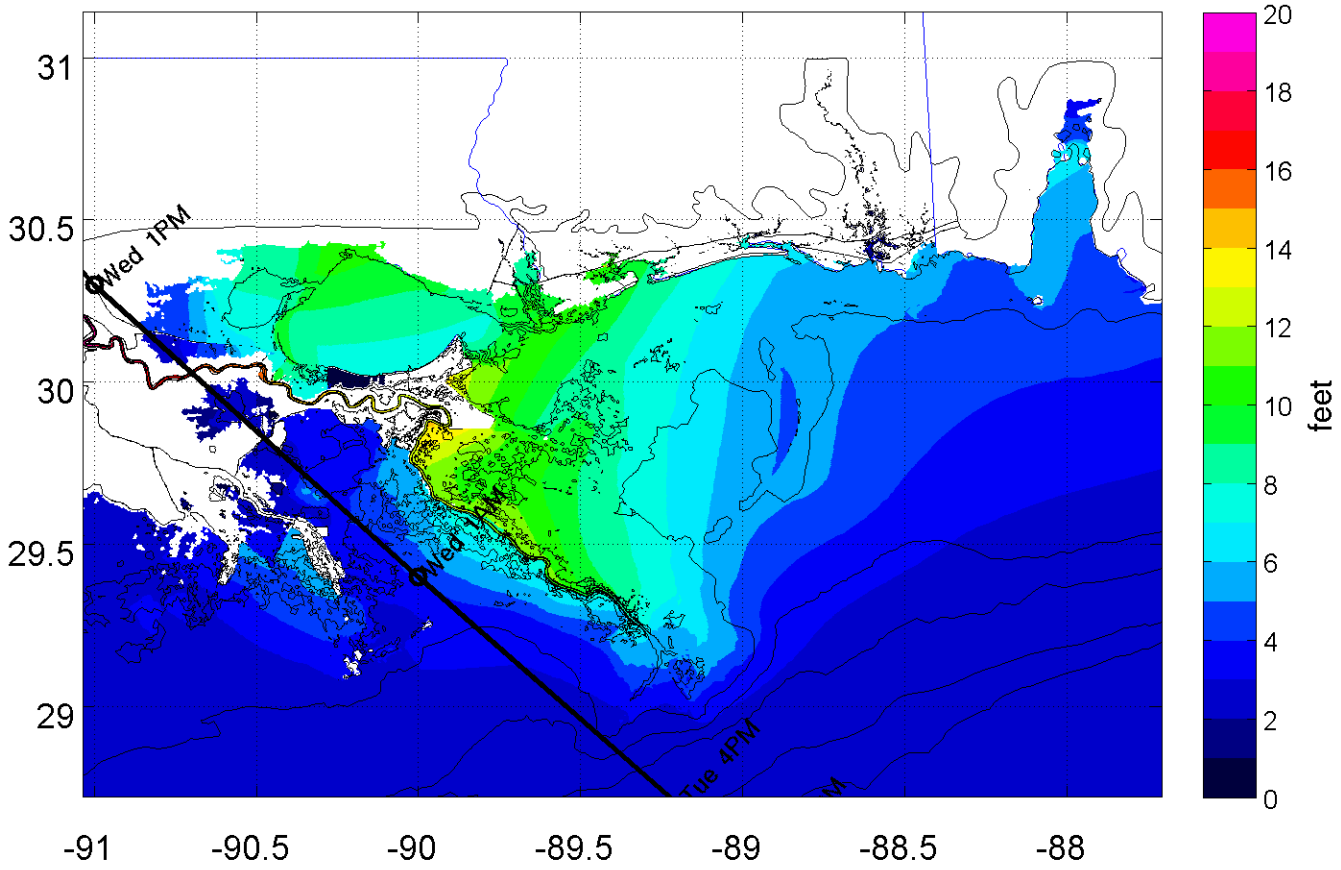
Mon, 27 Aug, 4 PM
Wed 1PM
Wed 1AM
30
29.5
29
-90.5
-90
-89.5
-89
20
18
16
14
12
10
8
6
4
2
0
feet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31
30.5
30
29.5
29
-91
-90.5
-90
-89.5
-89
-88.5
-88
Wed 1PM
Wed 1AM
Tue 4PM
20
18
16
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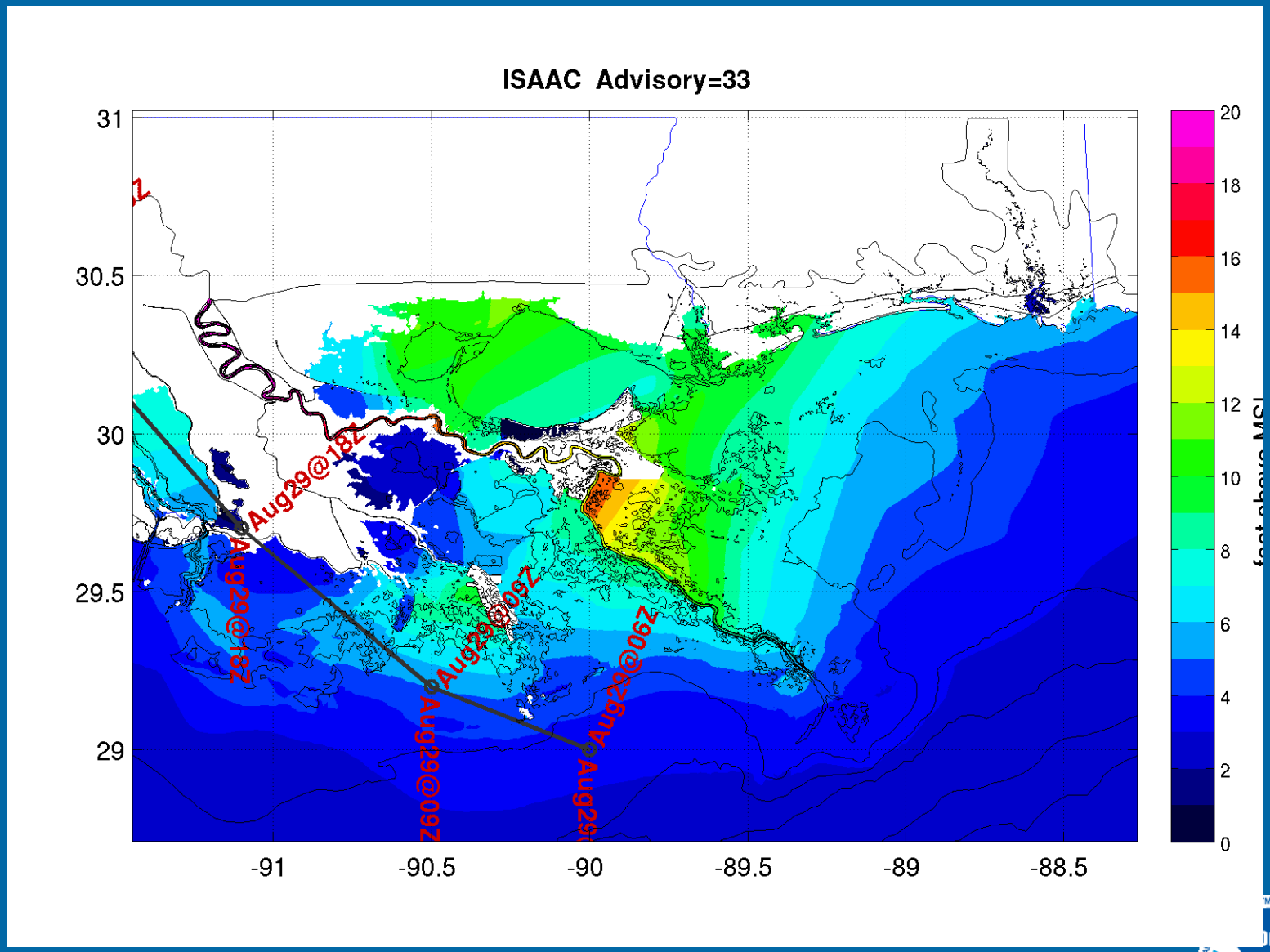
feet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30.5
30
29.5
29
-91
-90.5
-90
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-89
-88.5
Aug29@18Z
Aug29@09Z
Aug29@00Z
20
18
16
14
12
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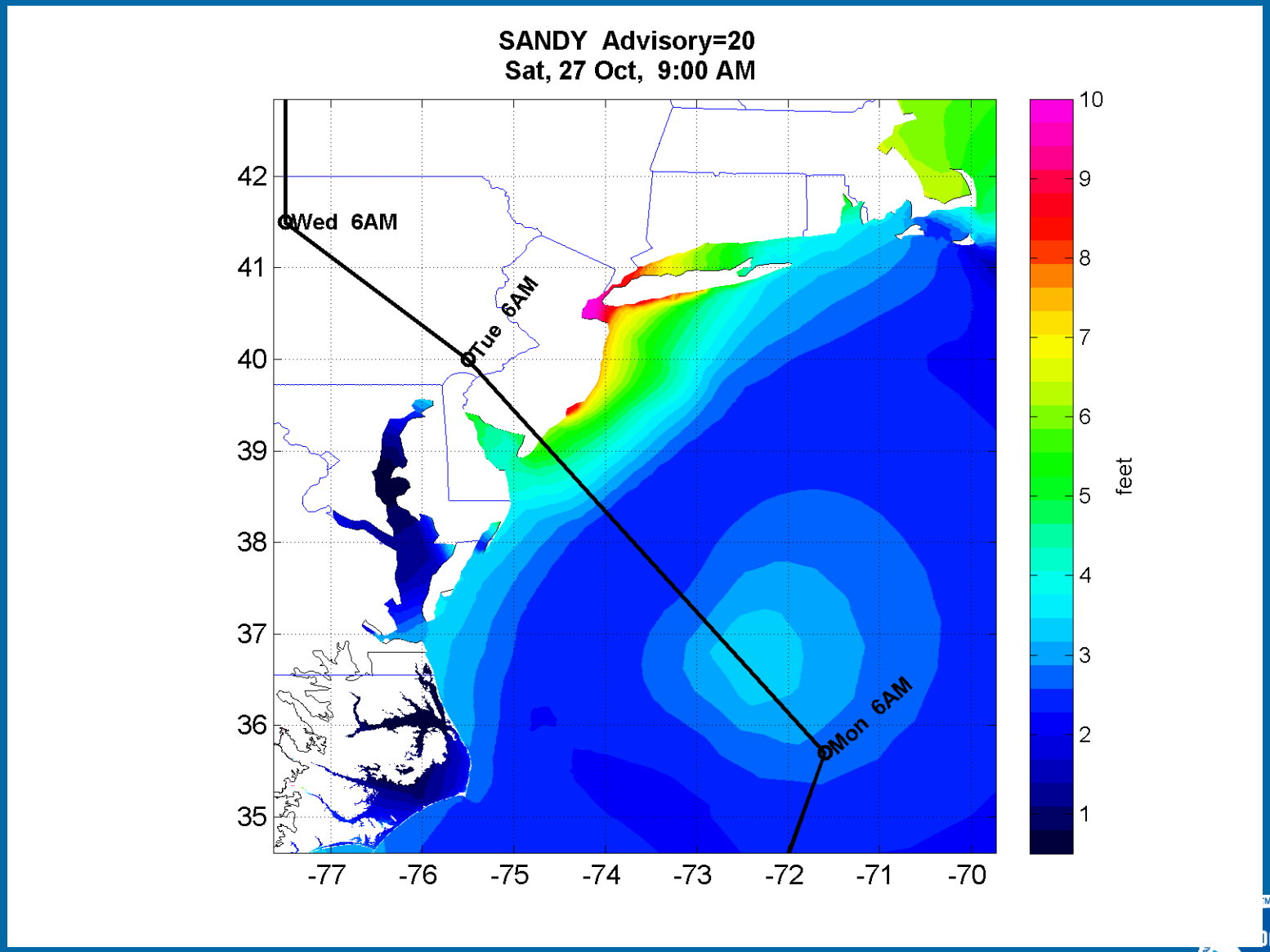
4
2
0

Hurricane Sandy

- Provided output for most NHC advisories from 20 (Sunday) through 29 (Monday afternoon right before landfall)
- Grids in NY area were limited in resolution, so fewer ensemble members were used; higher resolution in NC did help there
- Also provided a few results from NAM-forced runs as Sandy transitioned to post-tropical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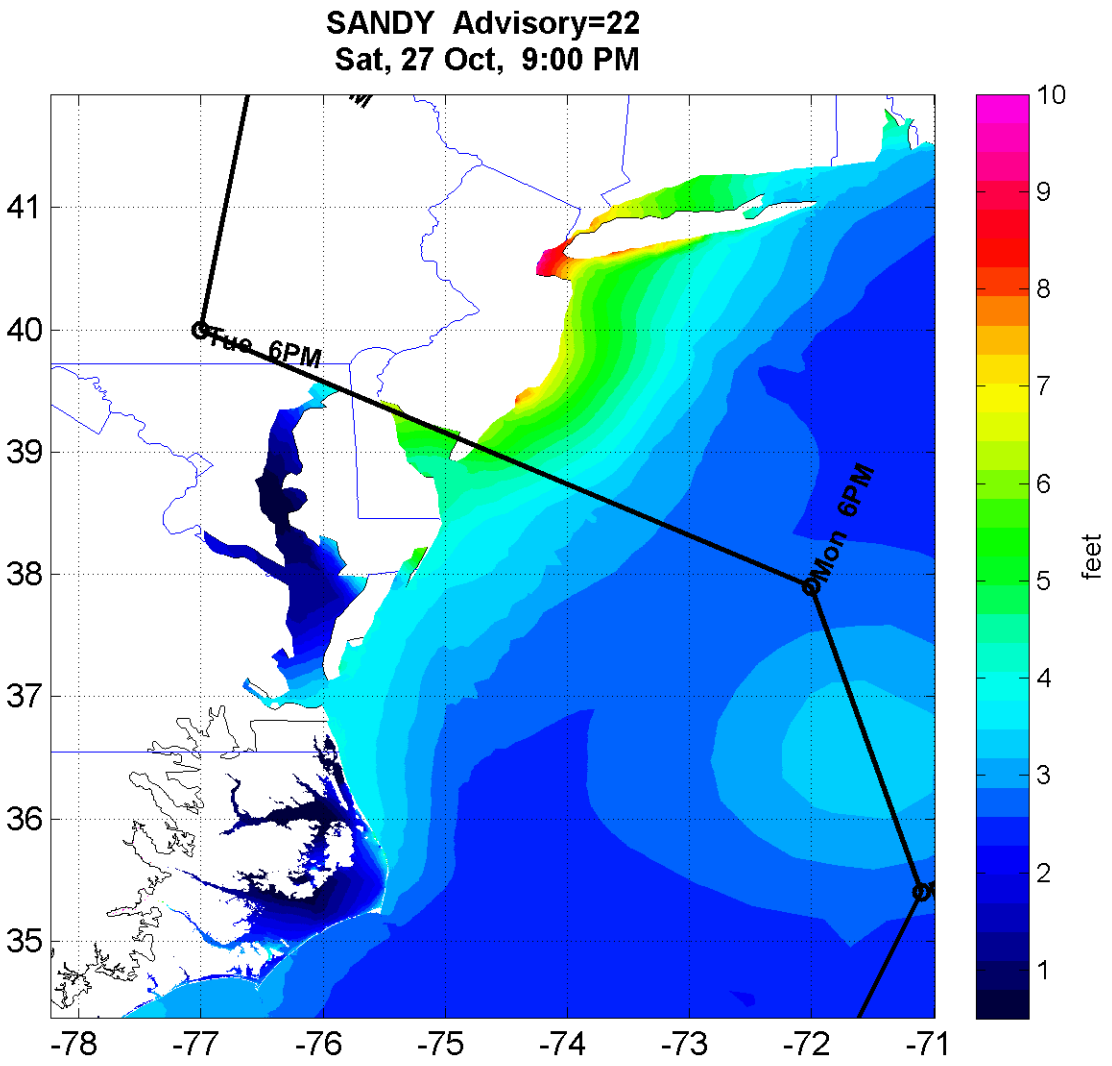
Wed 6AM
Tue 6AM
Mon 6AM
42
41
40
39
38
37
36
35
-77
-76
-75
-74
-73
-72
-71
-70
10
9
8
7
6
5
4
3
2
1
feet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Tue 6PM
Mon 6PM
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35
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-71
10
9
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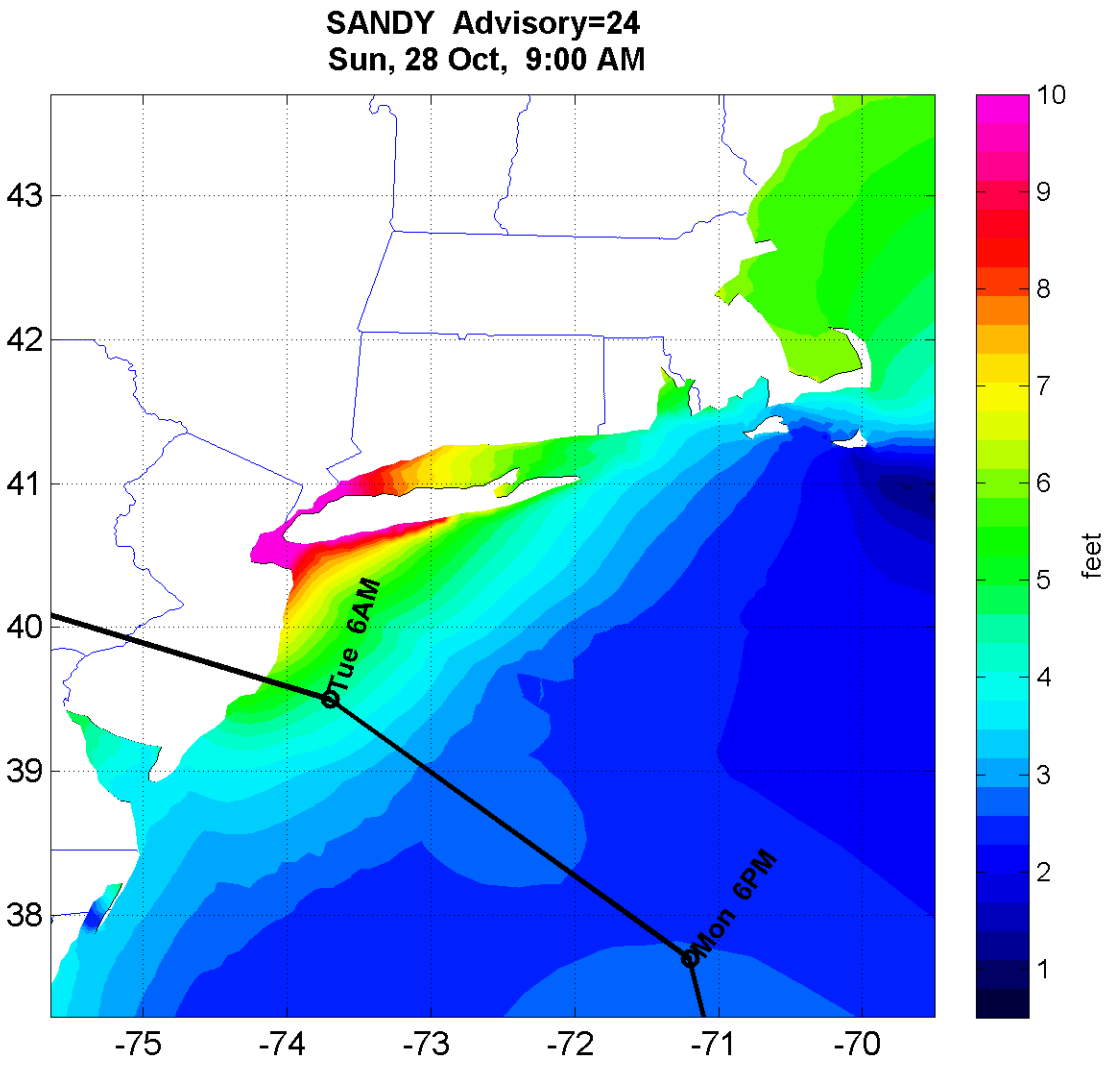
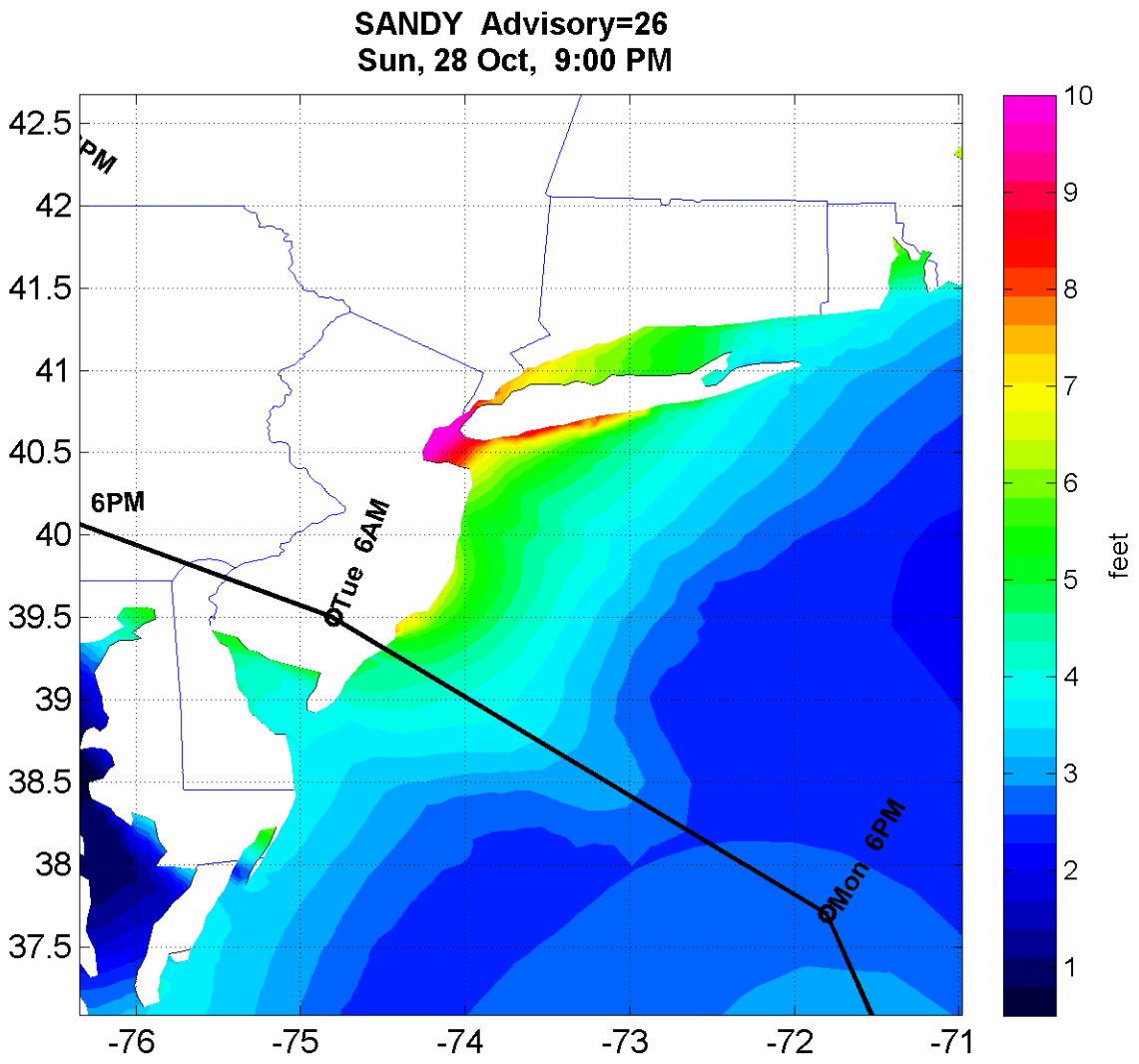
7
6
5
4
3
2
1
feet


SANDY Advisory=24
Sun, 28 Oct, 9:00 AM
43
42
41
40
39
38
-75
-74
-73
-72
-71
-70
Tue 6AM
Mon 6PM
10
9
8
7
6
5
4
3
2
1
feet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Sun, 28 Oct, 9:00 PM
42.5
42
41.5
41
40.5
40
39.5
39
38.5
38
37.5
-76
-75
-74
-73
-72
-71
6PM
Tue 6AM
Mon 6PM
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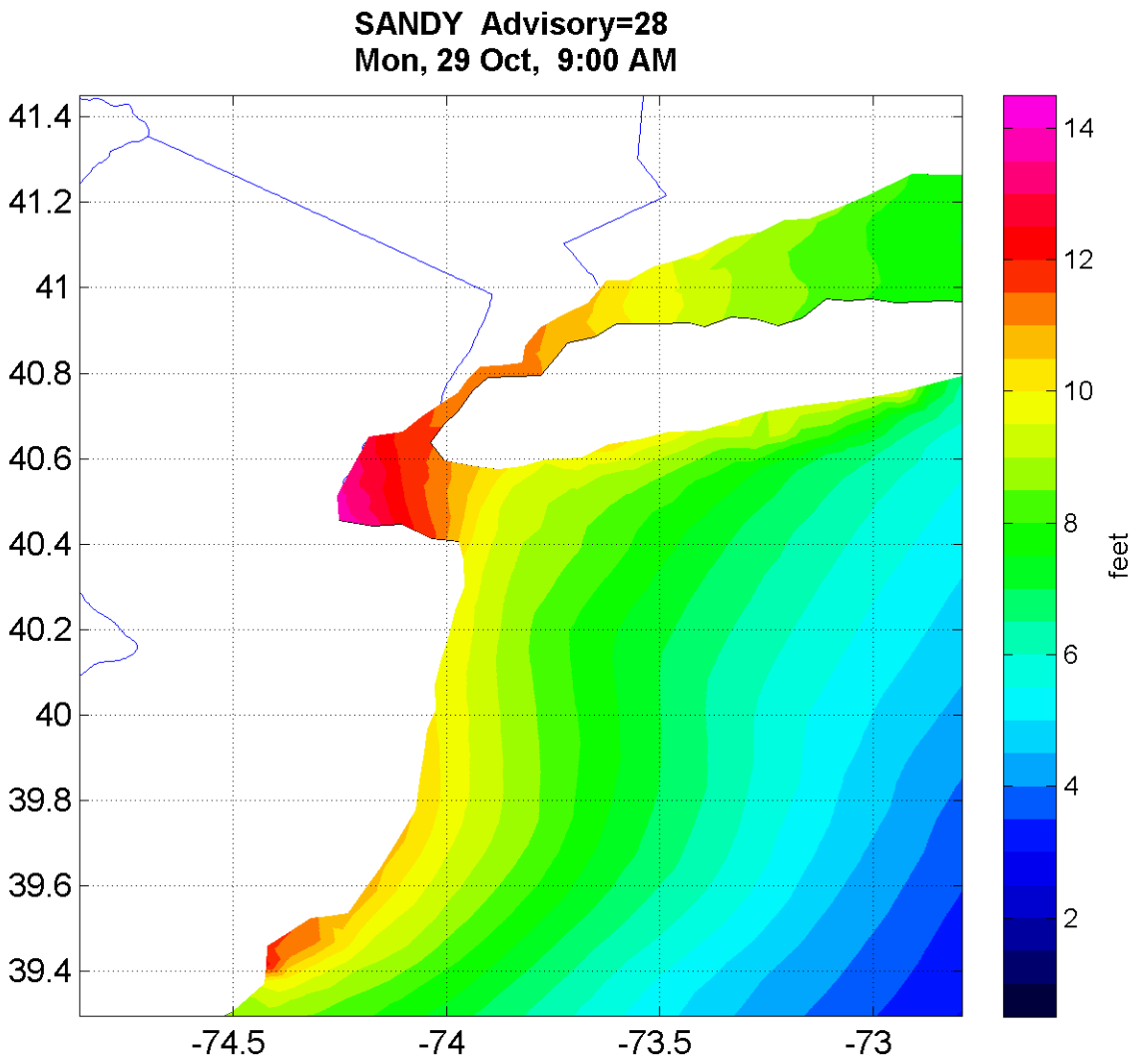
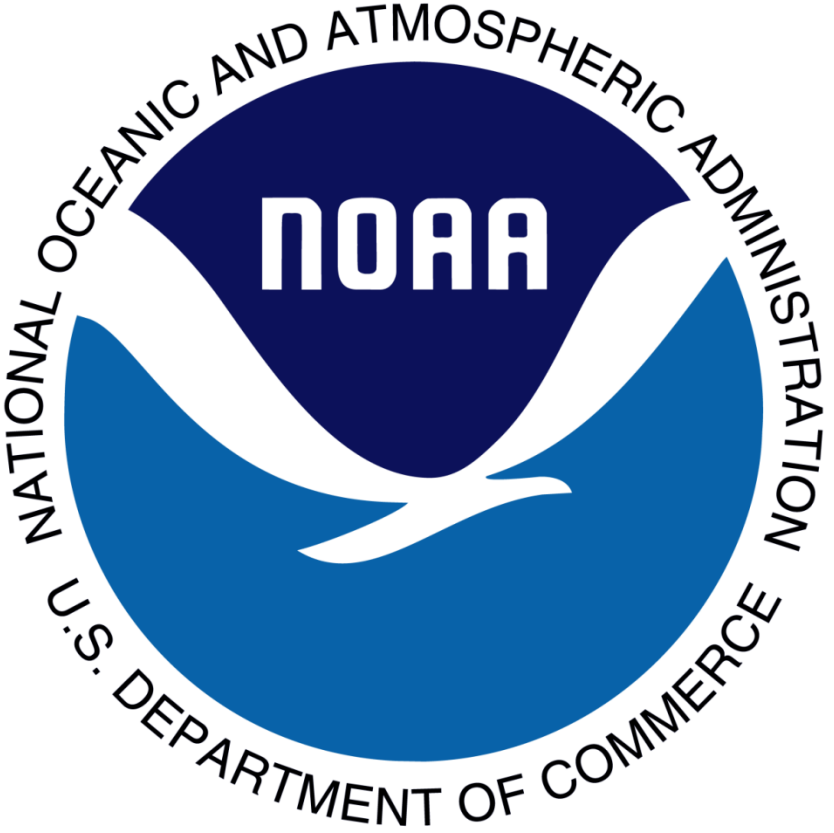
3
2
1
feet


SANDY Advisory=28
Mon, 29 Oct, 9:00 AM
41.4
41.2
41
40.8
40.6
40.4
40.2
40
39.8
39.6
39.4
-74.5
-74
-73.5
-73
14
12
10
8
6
4
2
feet

Challenges and Future Work

- Improved grid coverage needed
  - Full Gulf and East coast at efficient 500 m resolution
- Need OPeNDAP/THREDDS for data delivery
  - Enables use of community tools; CSDL investigating
- Install viz tool at operational center
- Further testing of real-time scripting
- Coupled surge+wave predictions
- Evaluation of HWRF forecasts for surge
  - Surge prediction improvements with HWRF track forecasts and gridded wind fields


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE