

IOOS Summit Special Session: Mid-Atlantic Responds to Hurricane Sandy

Scott Glenn (+ Many)



Hurricane Sandy Damage Statistics

>113 U.S. Deaths (CNN)

After Sandy: 8.6 Million Meters without Power (DoE)

As of Sunday: 160,000 Meters without Power (DoE)

FEMA Assistance: \$1.5 B dedicated over the last 2 weeks.

Damage Cost Estimate: \$50 B - \$60 B;

Second costliest natural disaster in U.S. History (after Katrina) (NWS).



MIDDLE
ATLANTIC
REGIONAL
ASSOCIATION
COASTAL
OCEAN
OBSERVING
SYSTEM

>40 PIs
>20 Institutions
>50 Members
>2000 Contacts

1000 km
Cape to Cape

CT

RI

MA

Cape
Cod

NY

10 States

111 Congressional Districts

76 Million People

PA

NJ

MD

DE

VA

NC

Cape
Hatteras

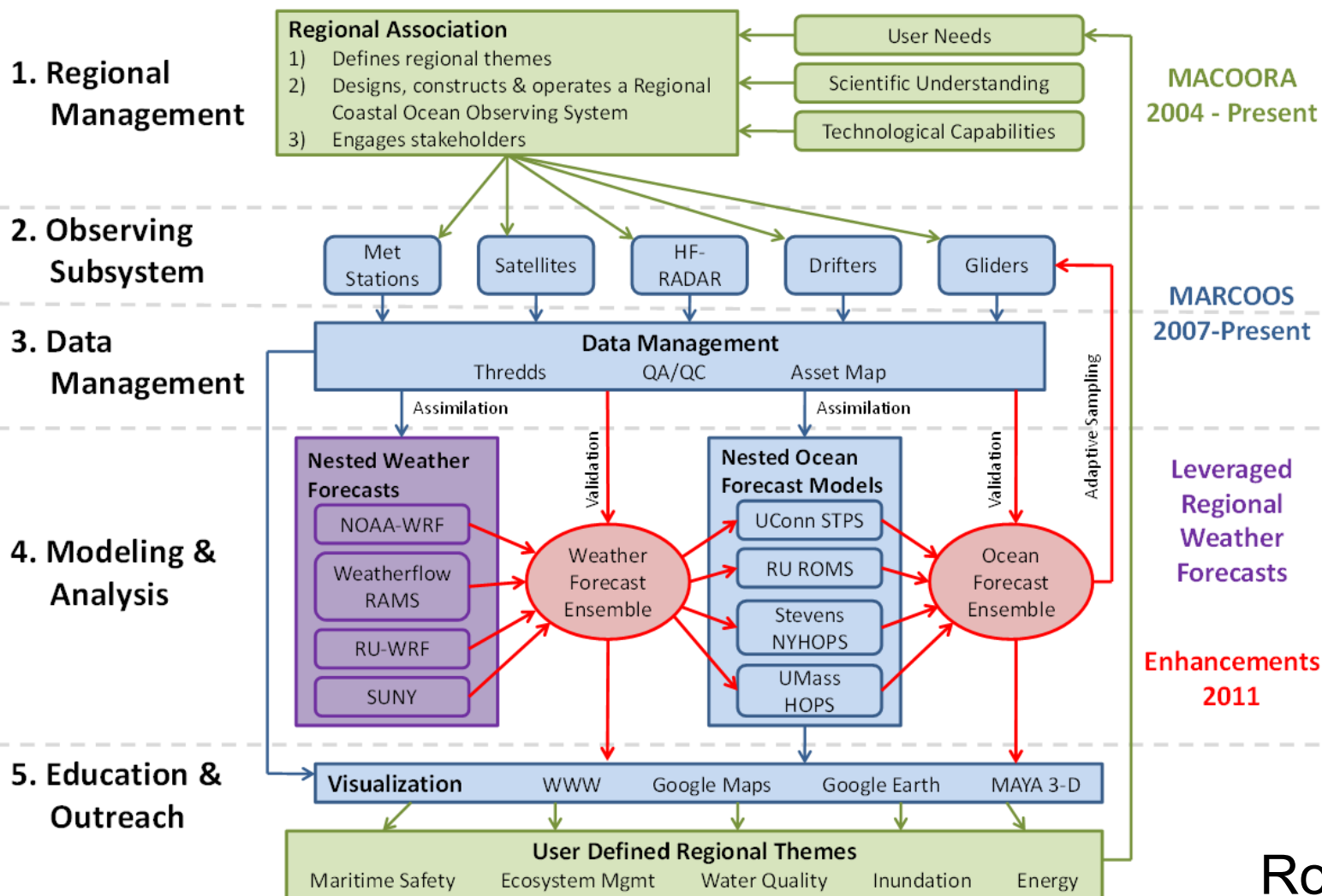
Mid-Atlantic Responds to Hurricane Sandy



MARACOOS Approach

MARACOOS = MACOORA + MARCOOS + Enhancements

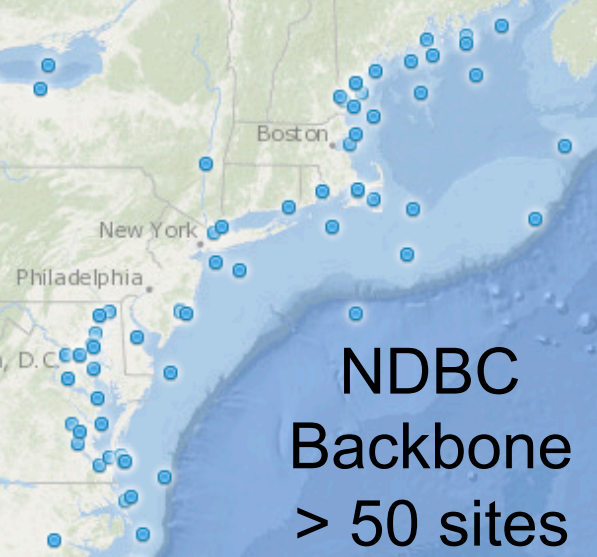
IOOS Subsystems



MARACOOS
Ocean Information for a Changing World

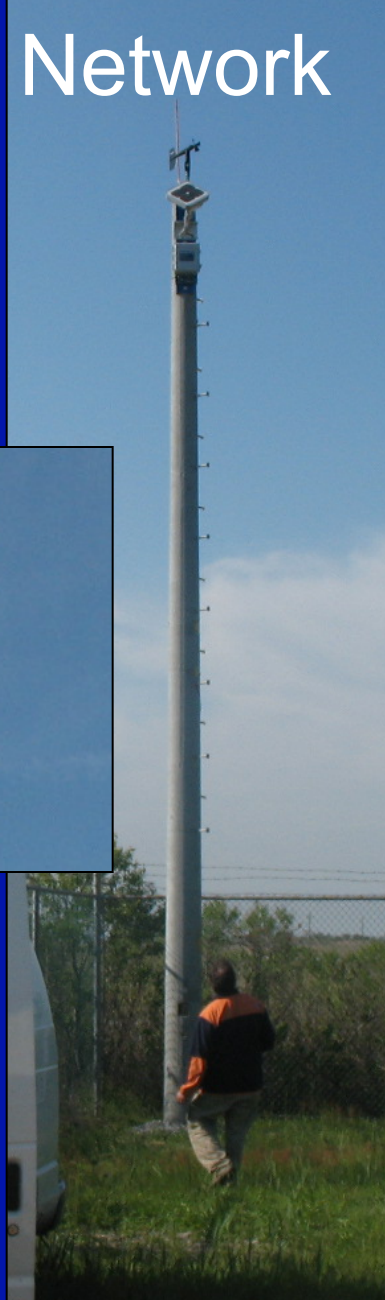


MARACOOS Weather Network



Regional Industry
Enhancement
> 100 sites

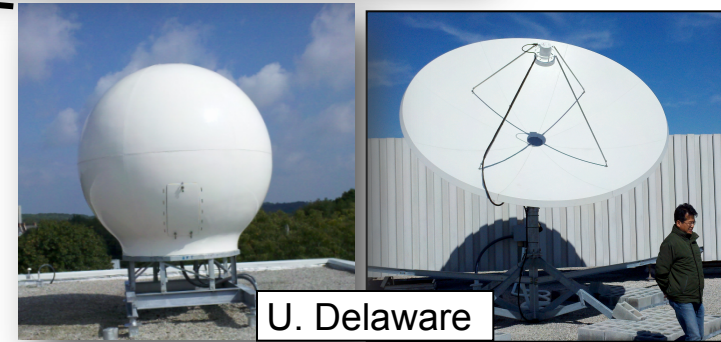
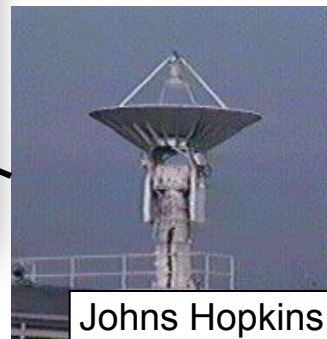
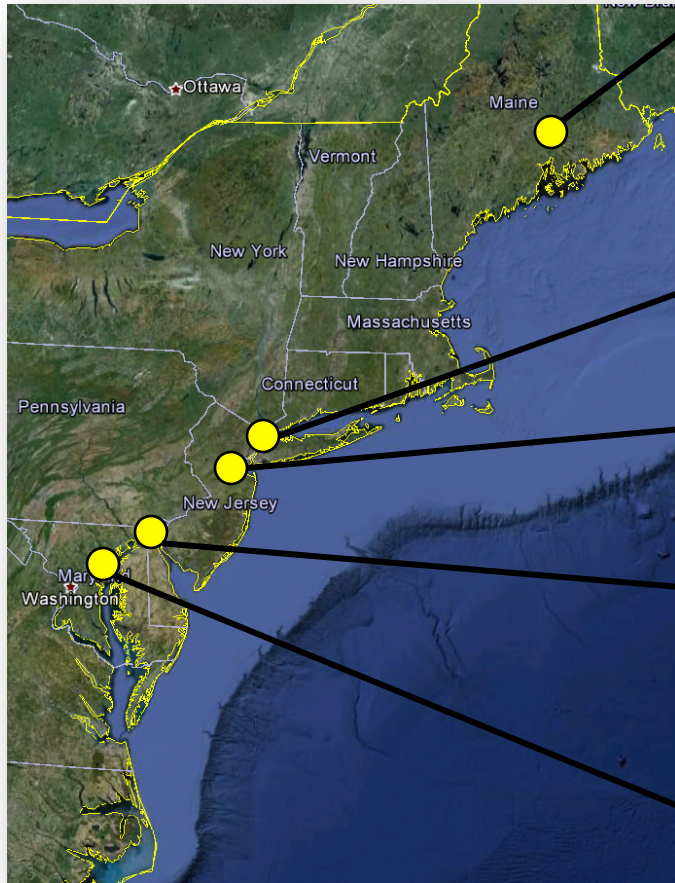
- WeatherFlow Station
- Hurricane Network Station



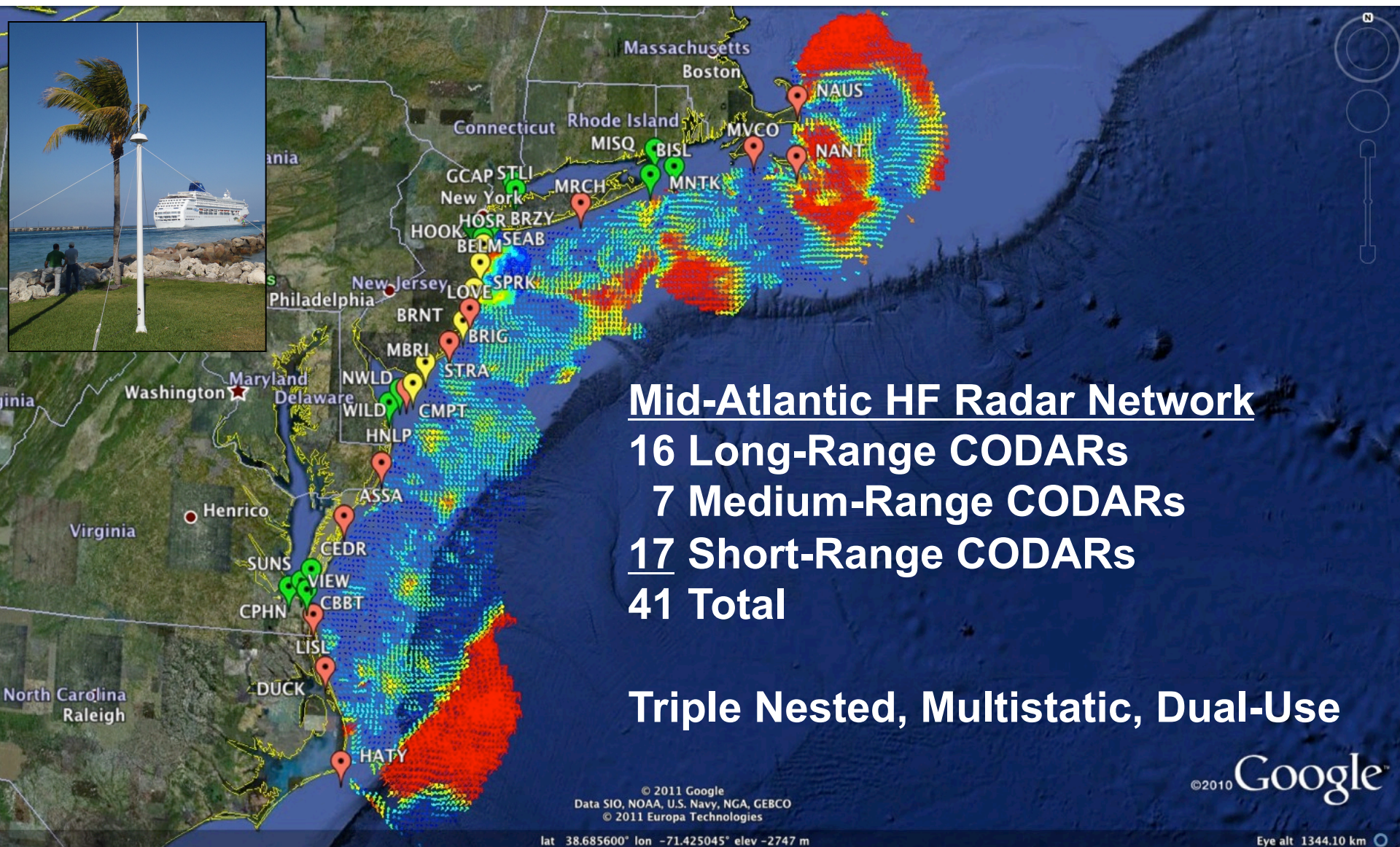
WeatherFlow
Better Data. Better Decisions.

Real-Time Satellite Ground Stations in the Northeast U.S.

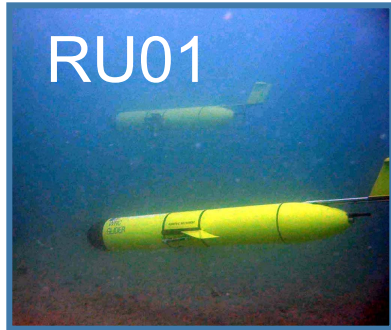
Satellites: NPP, Terra, Aqua,
NOAA Polar Orbiters, Metop &
GOES



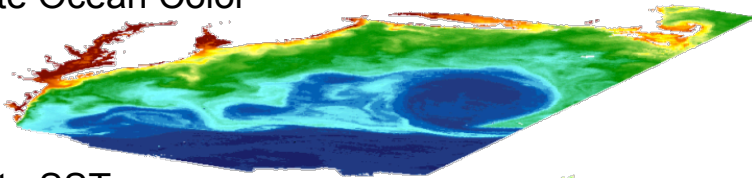
MARACOOOS HF Radar Network



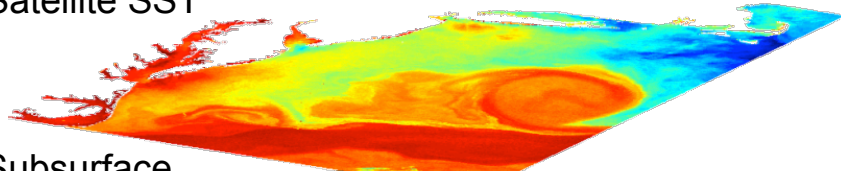
MARACOOS Glider Network



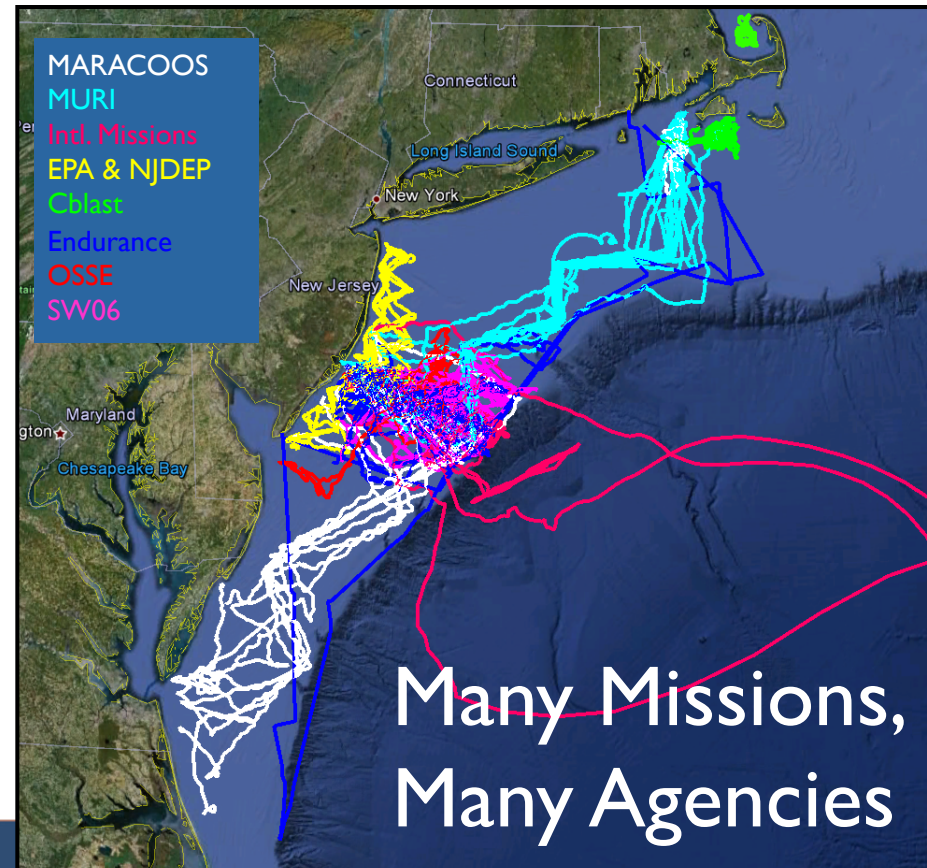
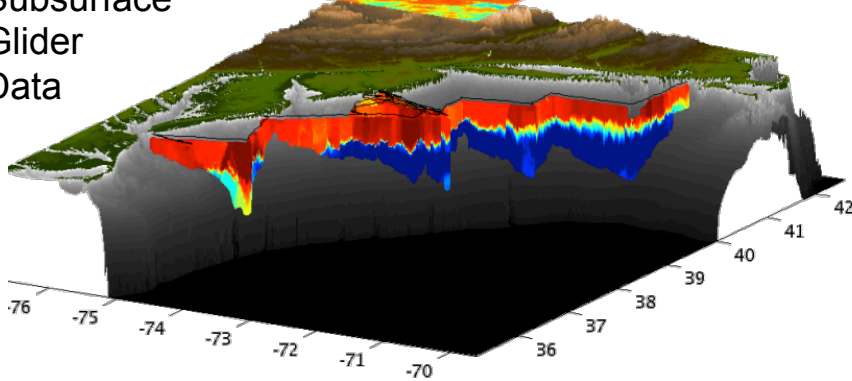
Satellite Ocean Color



Satellite SST

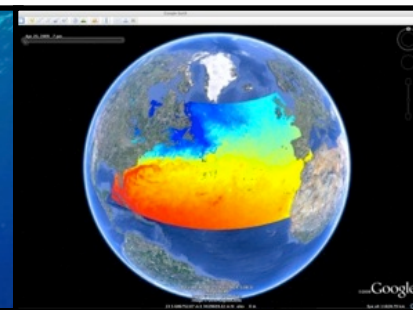
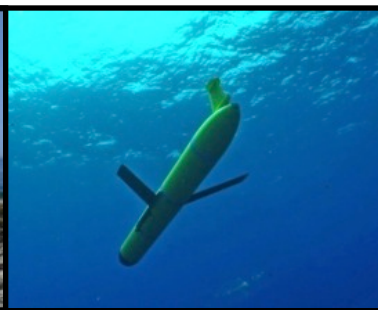


Subsurface
Glider
Data



MARACOOS Operations Center

Rutgers University - Coastal Ocean Observation Lab



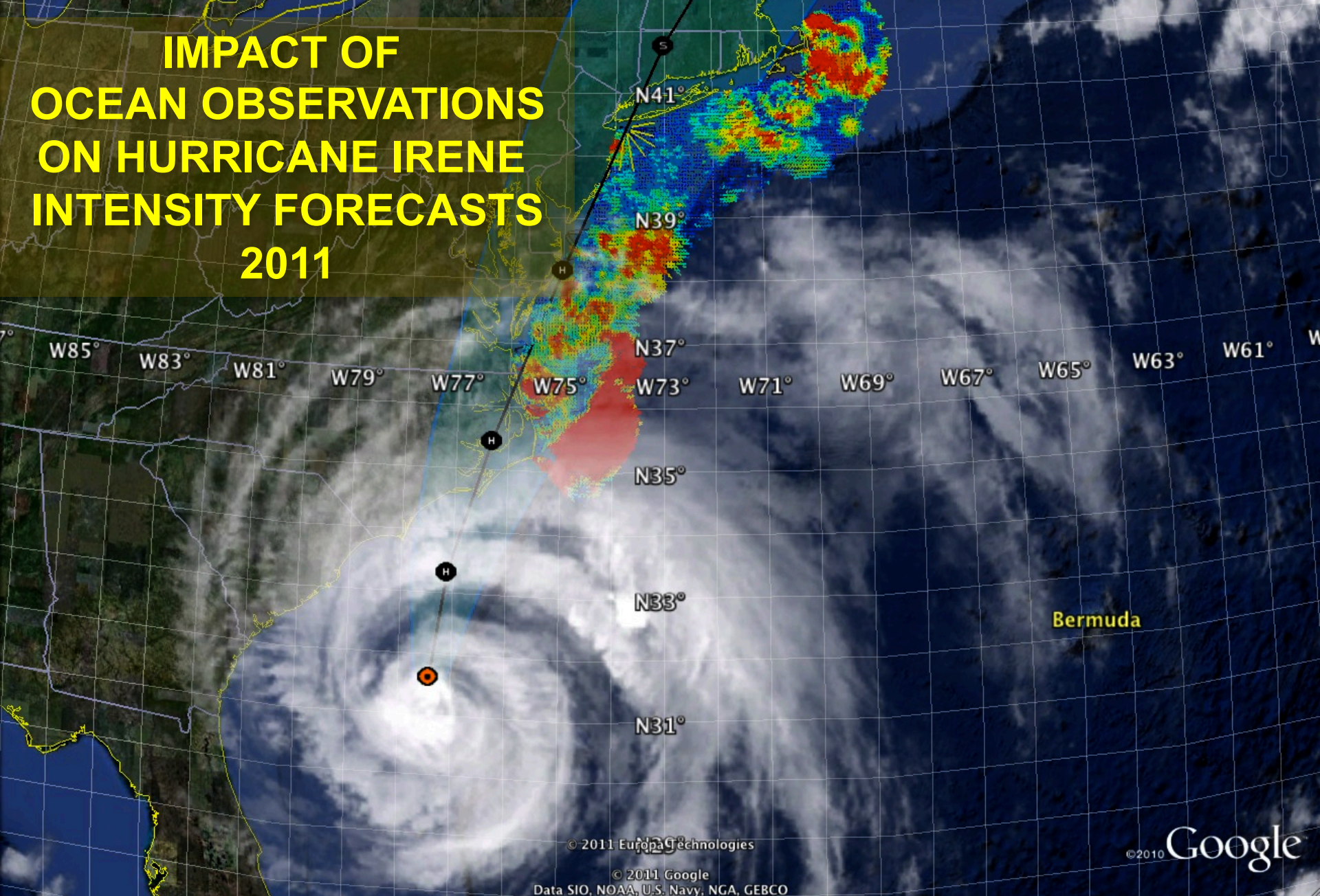
Satellite Data Acquisition Stations

CODAR Network

Glider Fleet

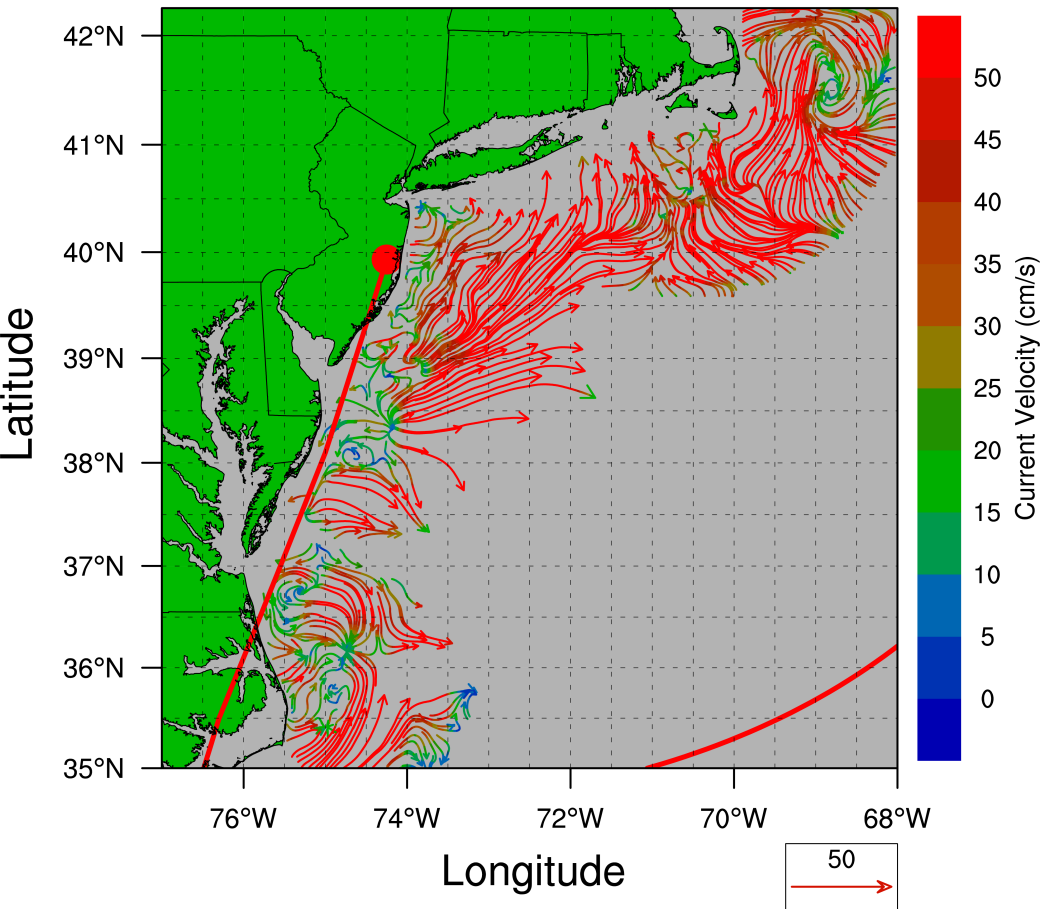
3-D Forecasts

IMPACT OF OCEAN OBSERVATIONS ON HURRICANE IRENE INTENSITY FORECASTS 2011



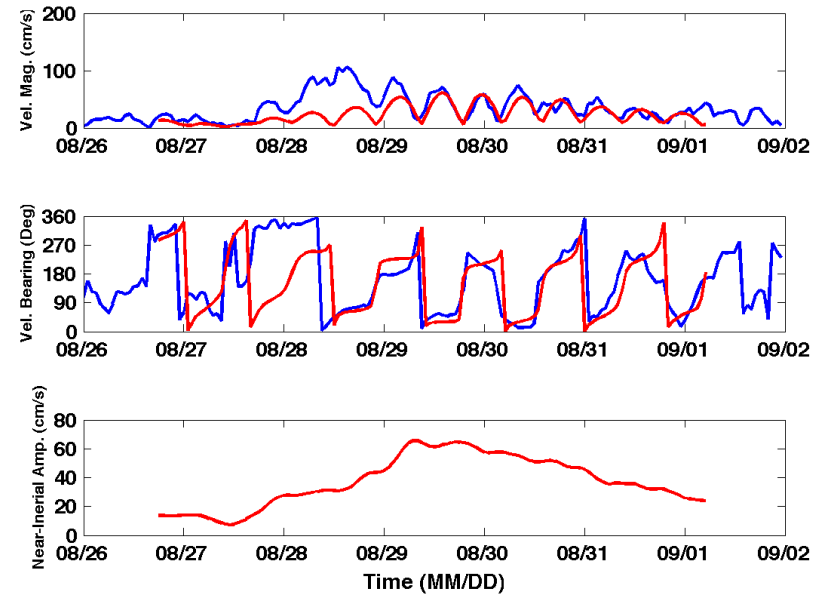
Hurricane Irene

Long Range Radar Network
Sea Surface Currents
2011082812 GMT

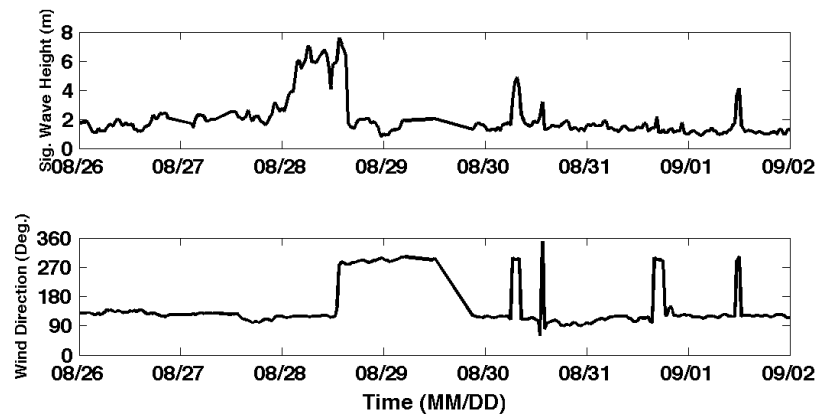


39.5N 73W Surface Current Time Series

Total Current Near-Inertial Current



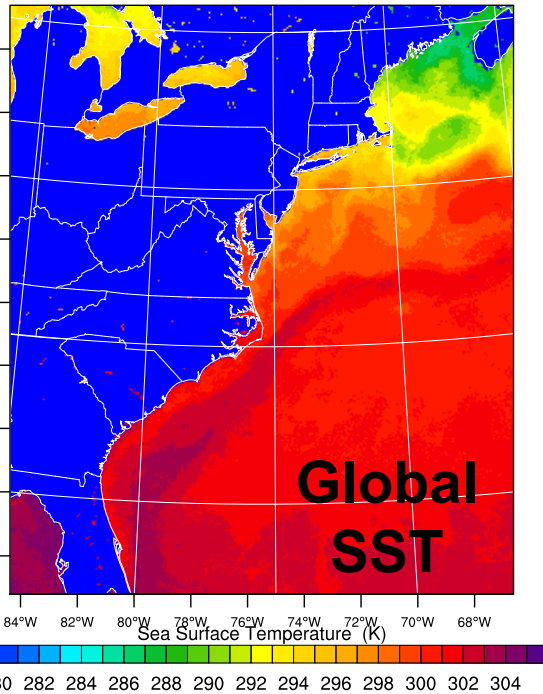
Wave & Wind Direction Time Series



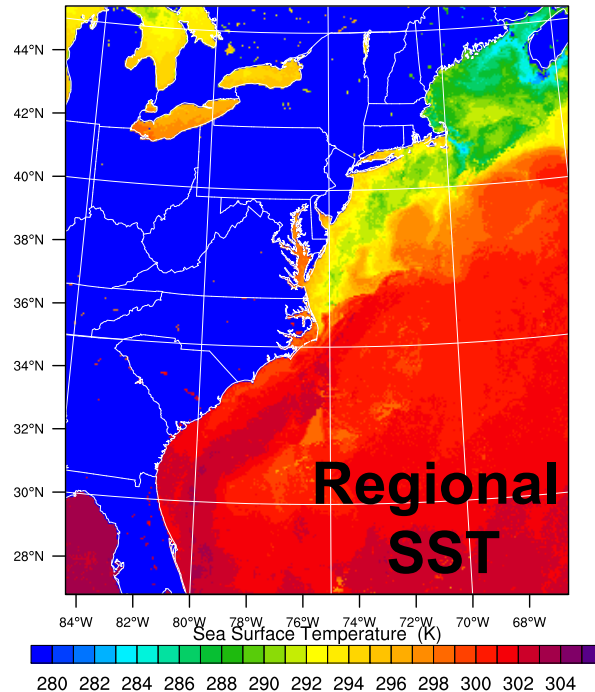
Eye crosses NJ mid-day on Aug 28

Post-Hurricane Irene Sea Surface Temperatures

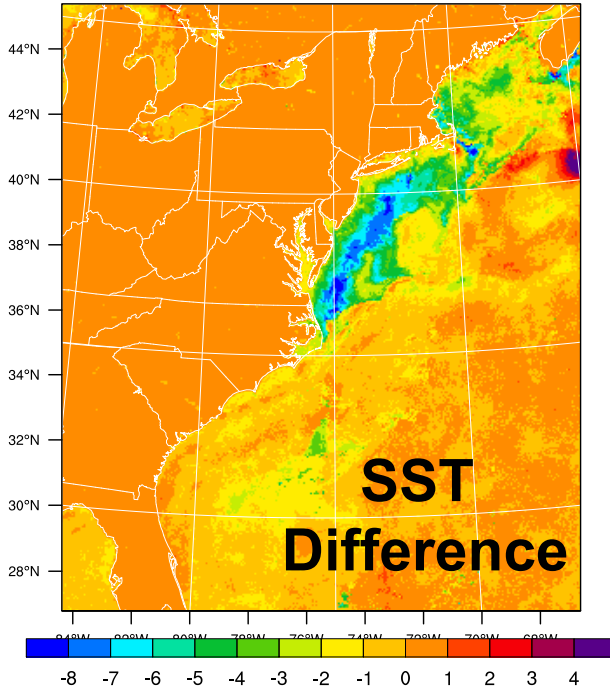
Sea Surface Temperature (K)



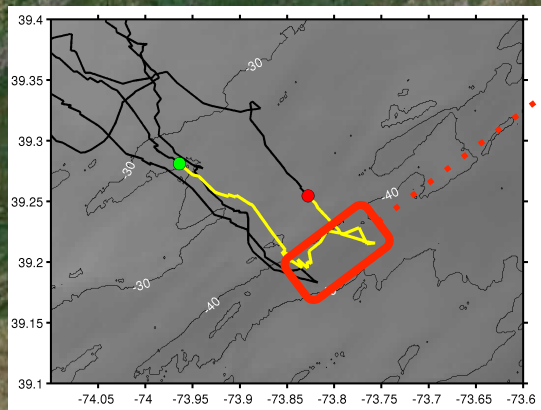
Sea Surface Temperature (K)



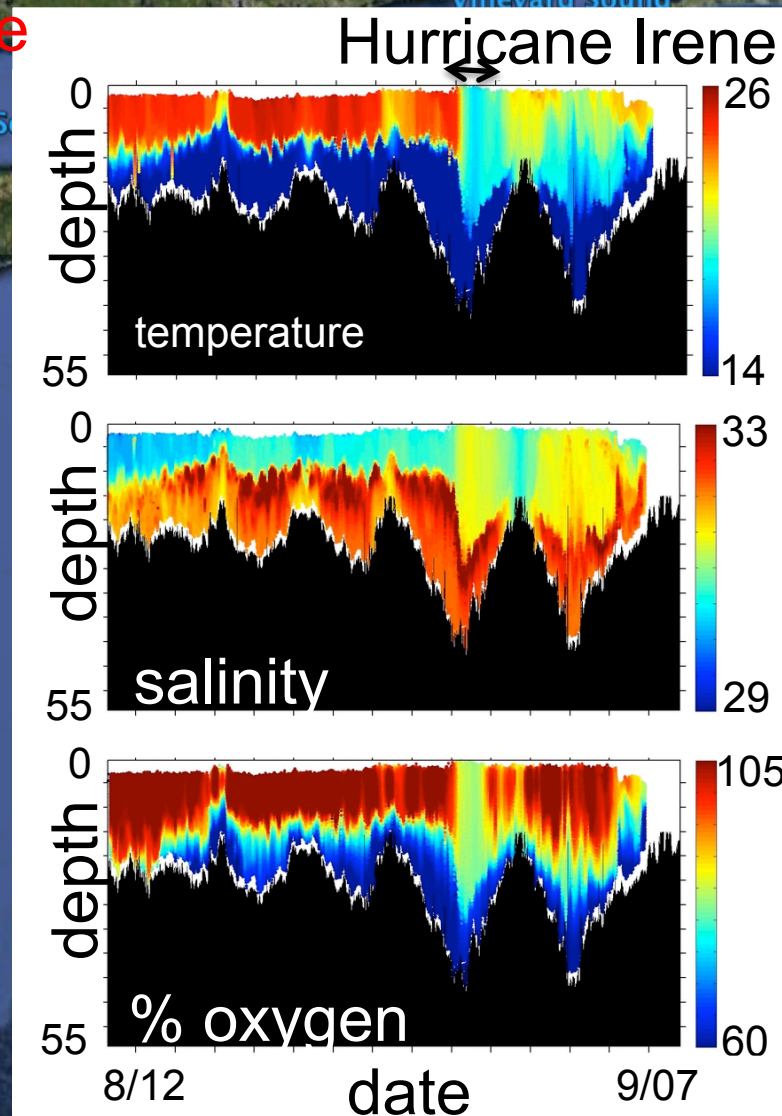
Unknown



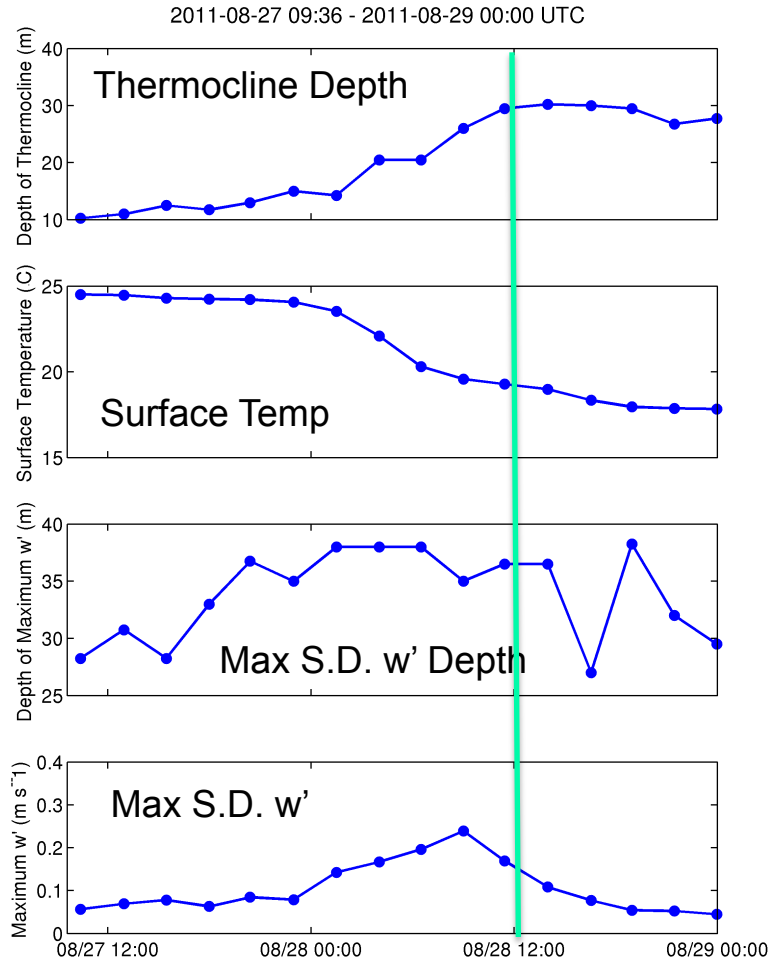
But when did the 6C - 8C Cooling occur?



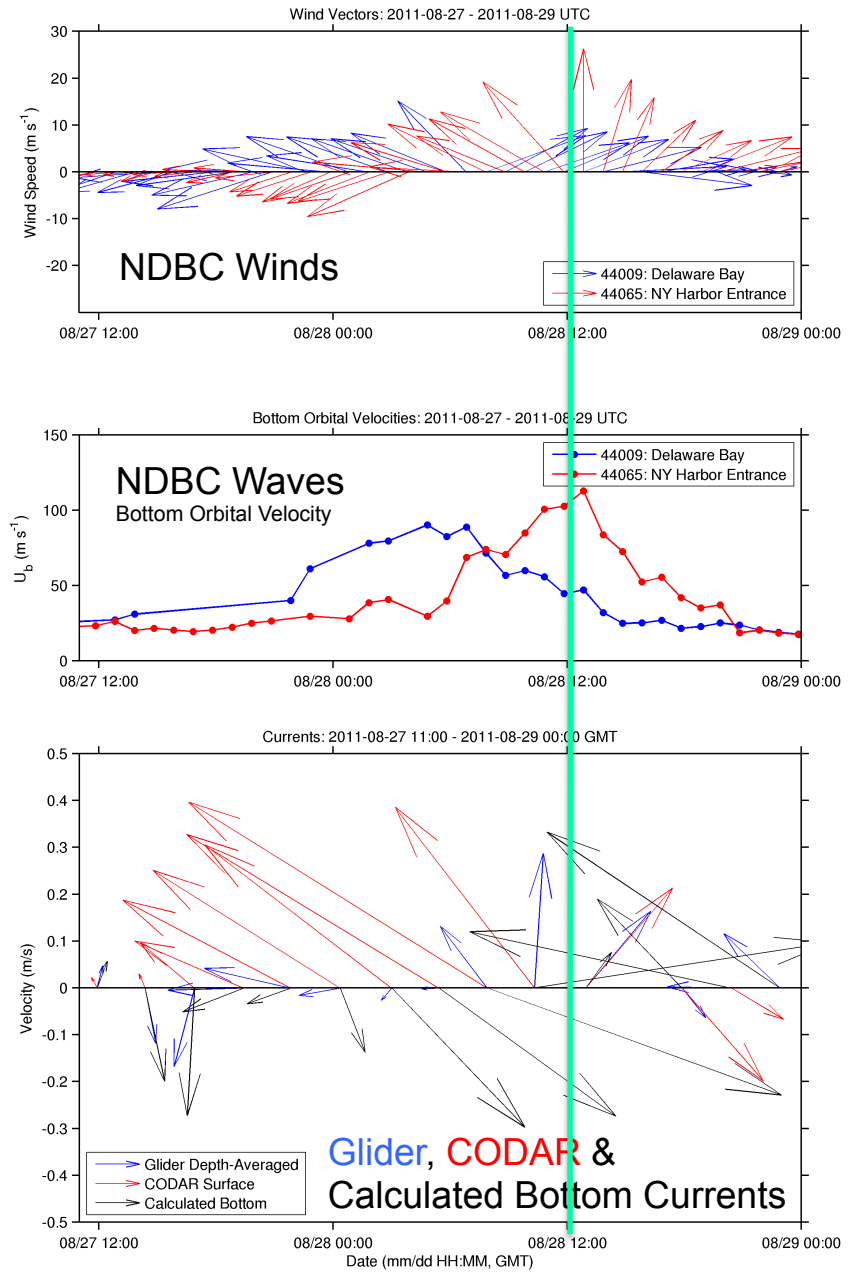
Hurricane Irene



MARACOOS Network Observations: Hurricane Irene

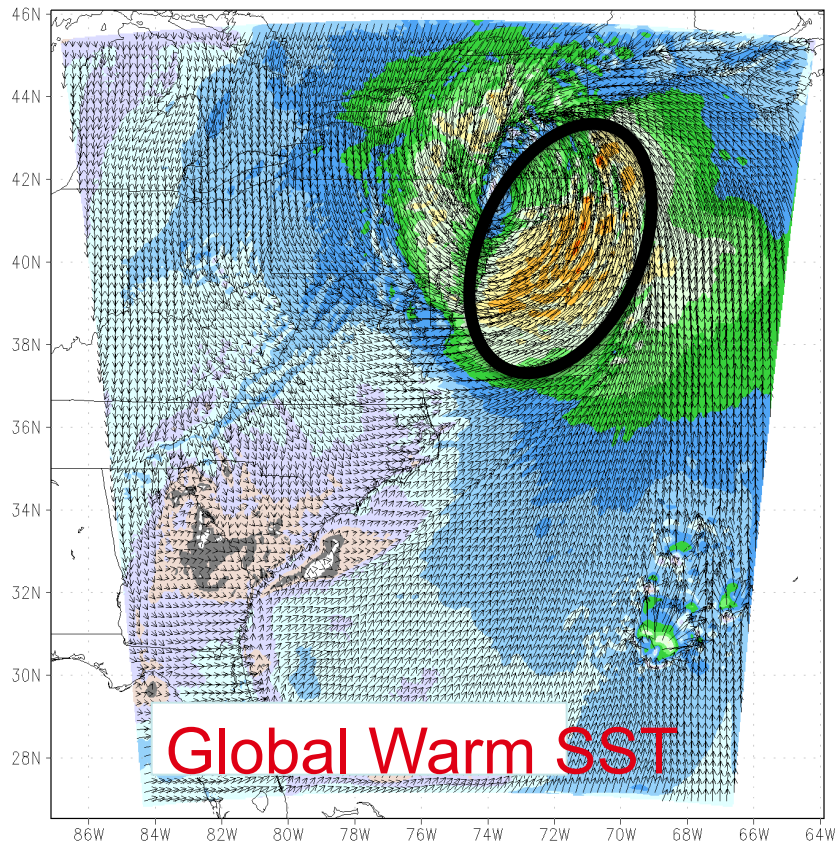


Glider RU16

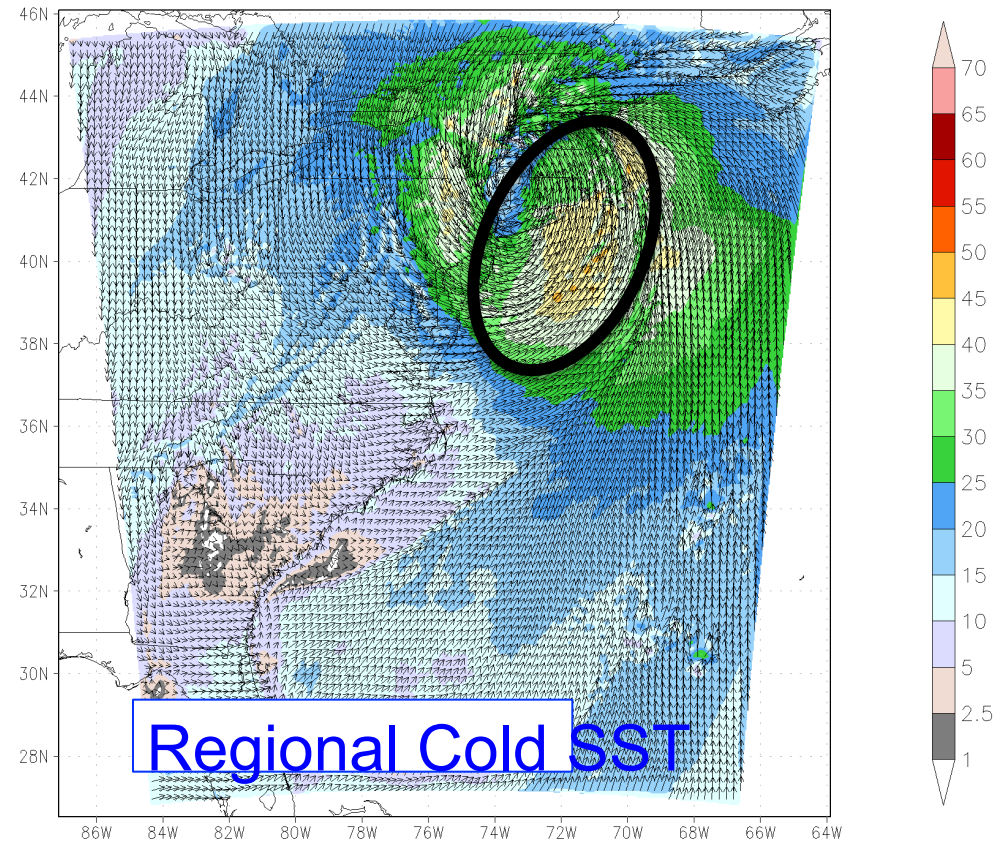


Hurricane Irene SST Sensitivity Hindcast

Wind Speed at 10 m [kts]



Wind Speed at 10 m [kts]



Maximum Wind Speed Skill Score	Official Forecast	Warm SST Hindcast	Warm SST + OML Model Hindcast	Cold SST Hindcast
RMS Error (knots)	9.43	7.13	7.09	3.61

First Warning of Potential 2012 Storm: Monday, Oct 22, 1-week prior to landfall

----- Original Message -----

Subject: Re: [hfiip-telecon] Telecon this week

Date: Mon, 22 Oct 2012 15:18:18 -0400

From: Louis Bowers <bowers@marine.rutgers.edu>

To: Scott Glenn <glenn@marine.rutgers.edu>

CC:

If you take the medium range models at face value, 30th thru 1st, historic storm, starting from to-be Sandy. Winds hurricane force, 6" + of rain, extreme coastal flooding. Or, it could miss completely.

Louis Bowers

Sent from my iPhone

On Oct 22, 2012, at 3:11 PM, Scott Glenn <glenn@marine.rutgers.edu> wrote:

Big storm coming.

Sent from my iPhone

On Oct 22, 2012, at 2:59 PM, Louis Bowers <bowers@marine.rutgers.edu> wrote:

Might get a chance to test out our forecasting early next week, could be a whopper of a coastal storm.

Louis Bowers

Sent from my iPhone



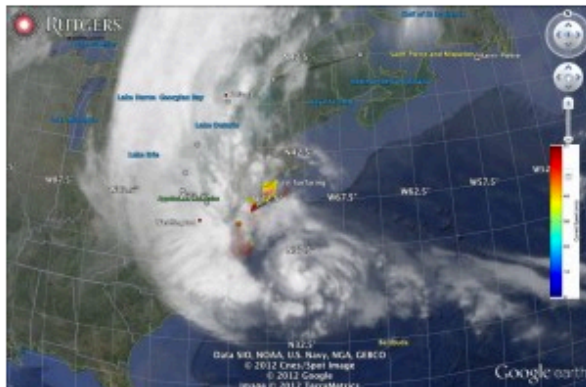
MARACOOS Blog

[Home](#)

Hurricane Sandy approaches the shore

Posted on [October 29, 2012](#) by [scott](#)

Just lost power, so this will be my final post until the power comes back on.



Above are the clouds and the updated advisory (#30) for Hurricane Sandy. Its just offshore southern New Jersey.

Recent Comments

- Andrew Quaid on [Morning Sandy Update](#)
- Donglai Gong on [Hurricane Sandy approaches the shore](#)
- Hugh on [HF Radar Update](#)
- Donglai Gong on [HF Radar Update](#)
- Donglai Gong on [Sandy intensifies further, down to 940 mb](#)

Archives

- [October 2012](#)
- [April 2012](#)

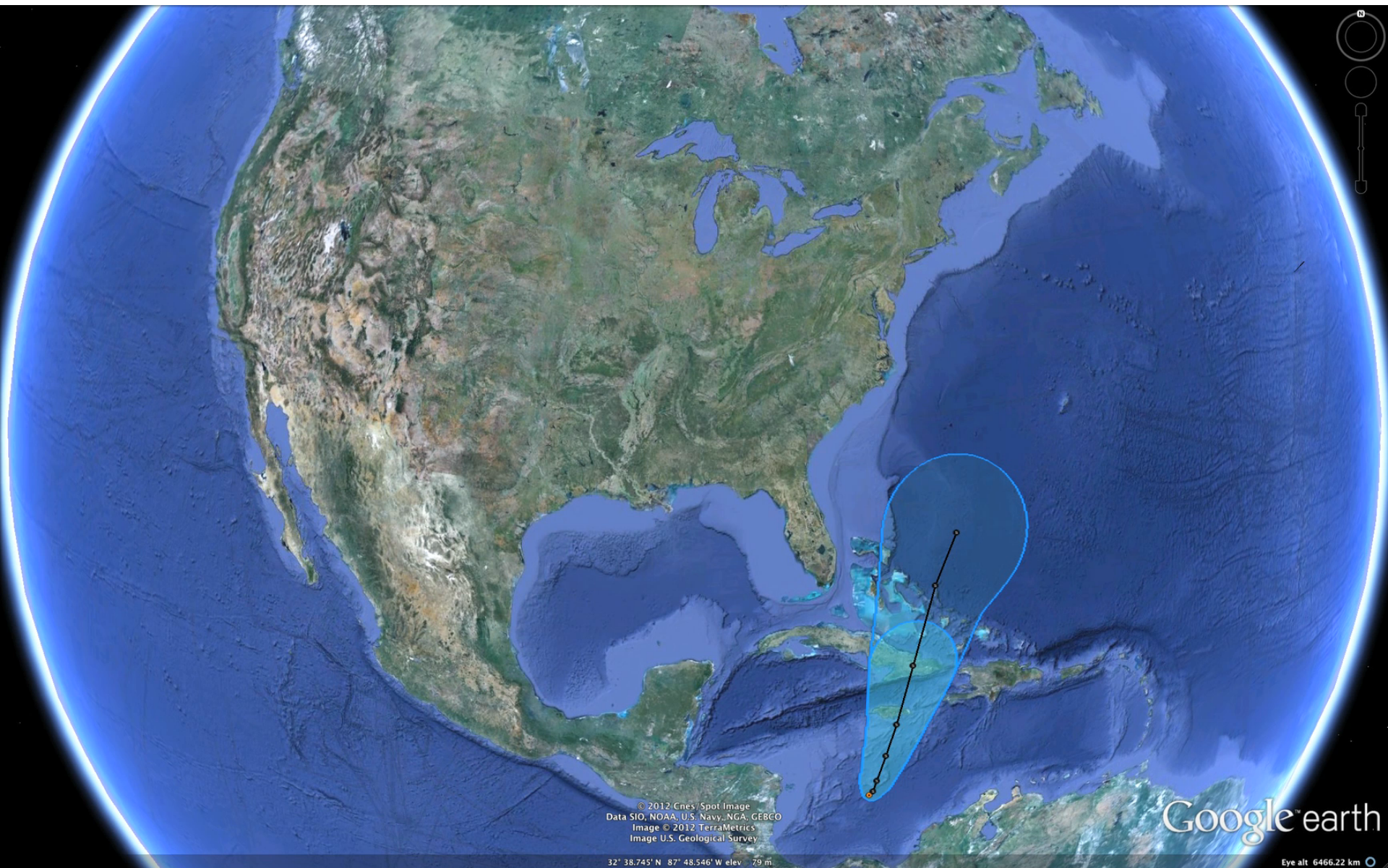
Categories

- [Uncategorized](#)

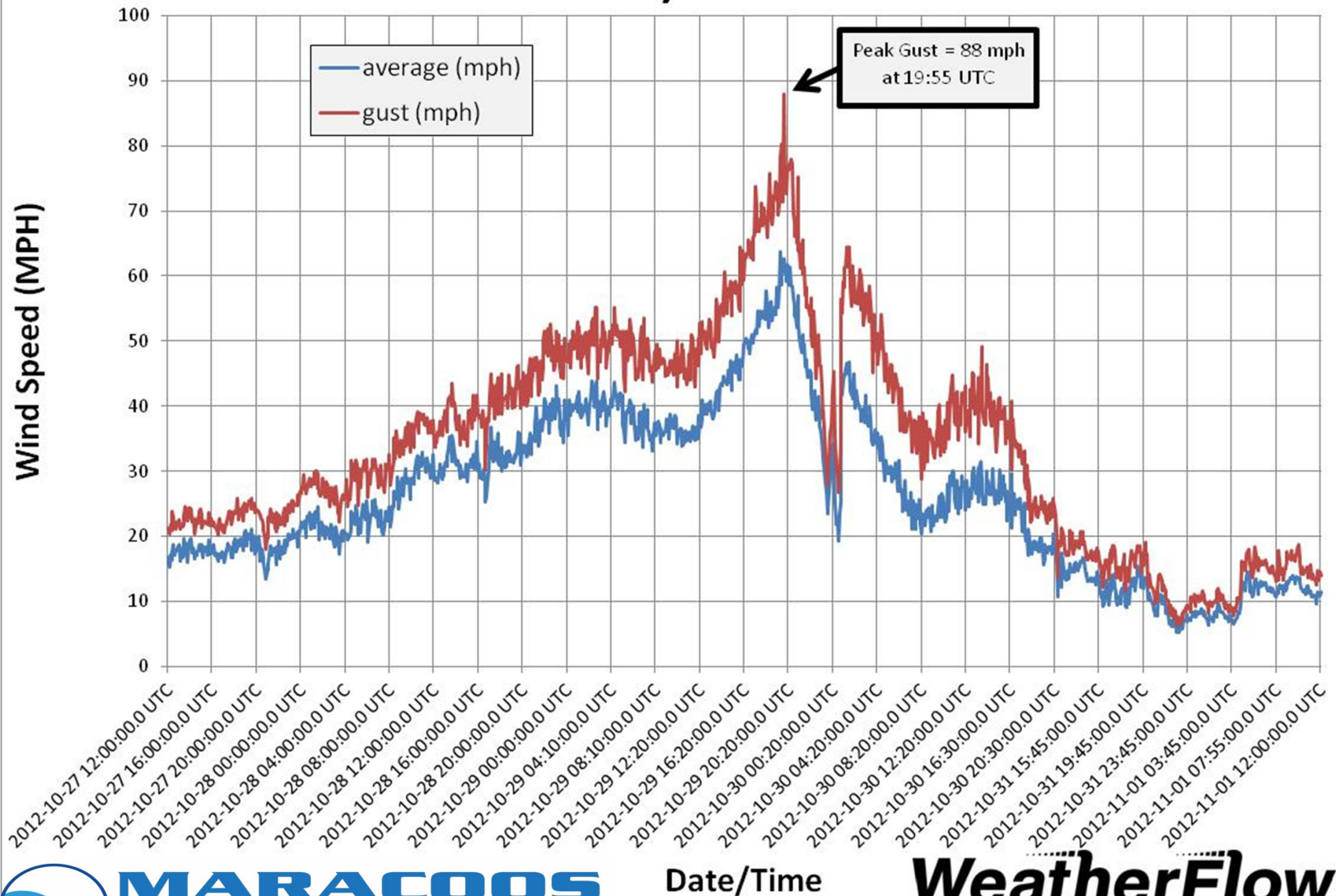
Meta

- [Register](#)
- [Log in](#)
- [Entries RSS](#)

Hurricane Sandy: 5 Day Track Uncertainty Cone



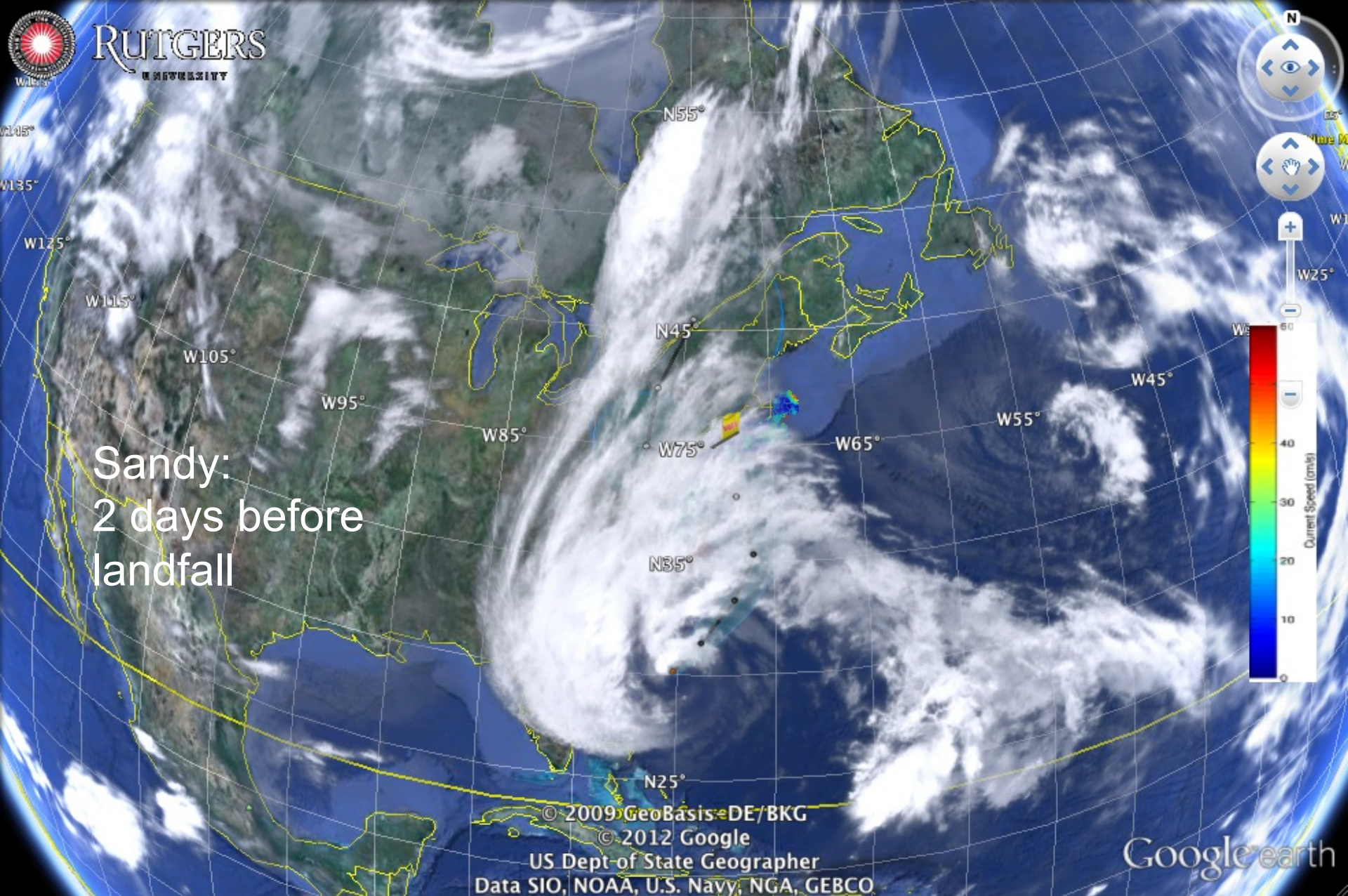
Hurricane Sandy at Tuckerton NJ



MARACOOS
Ocean Information for a Changing World

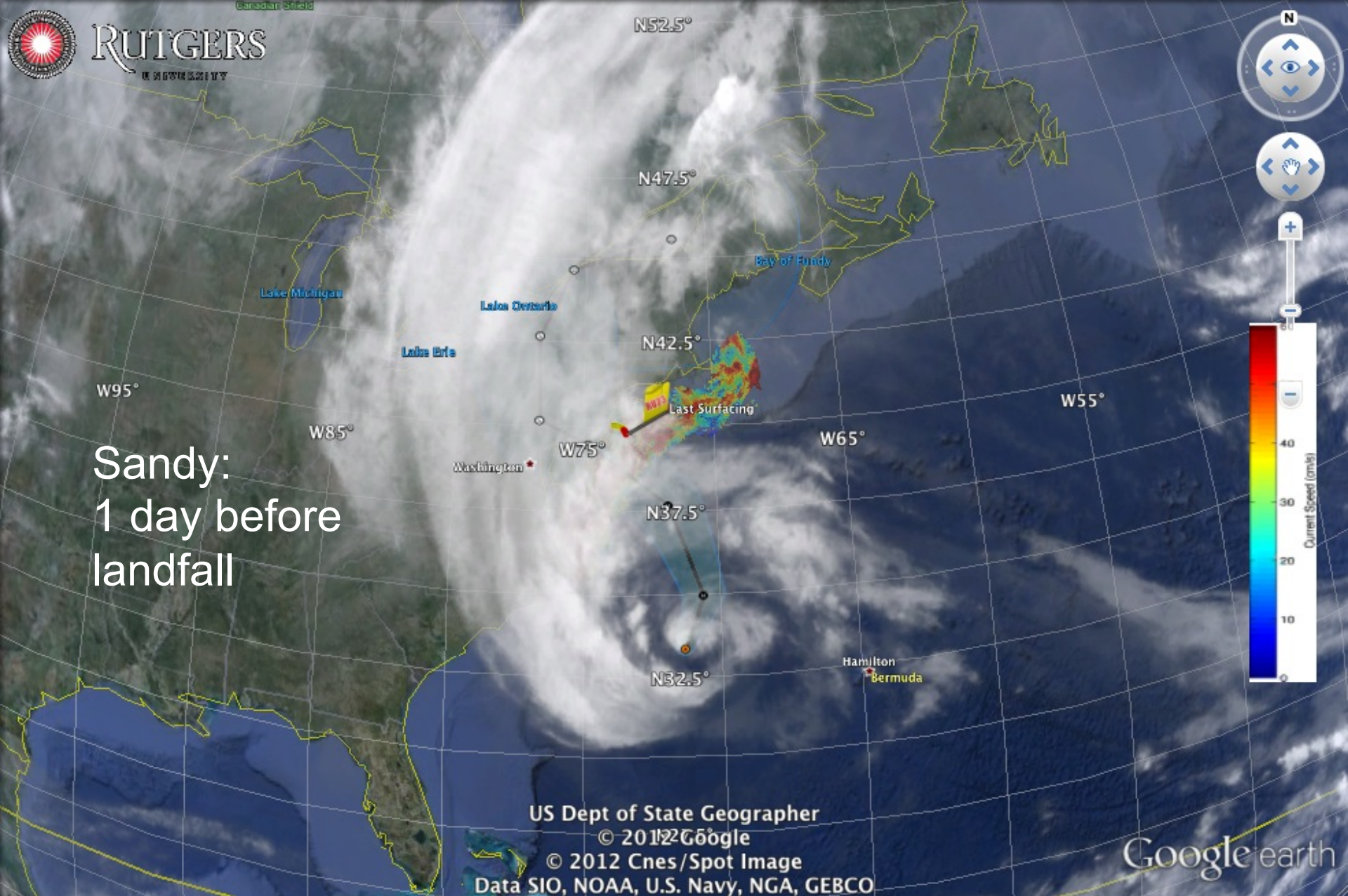
Date/Time

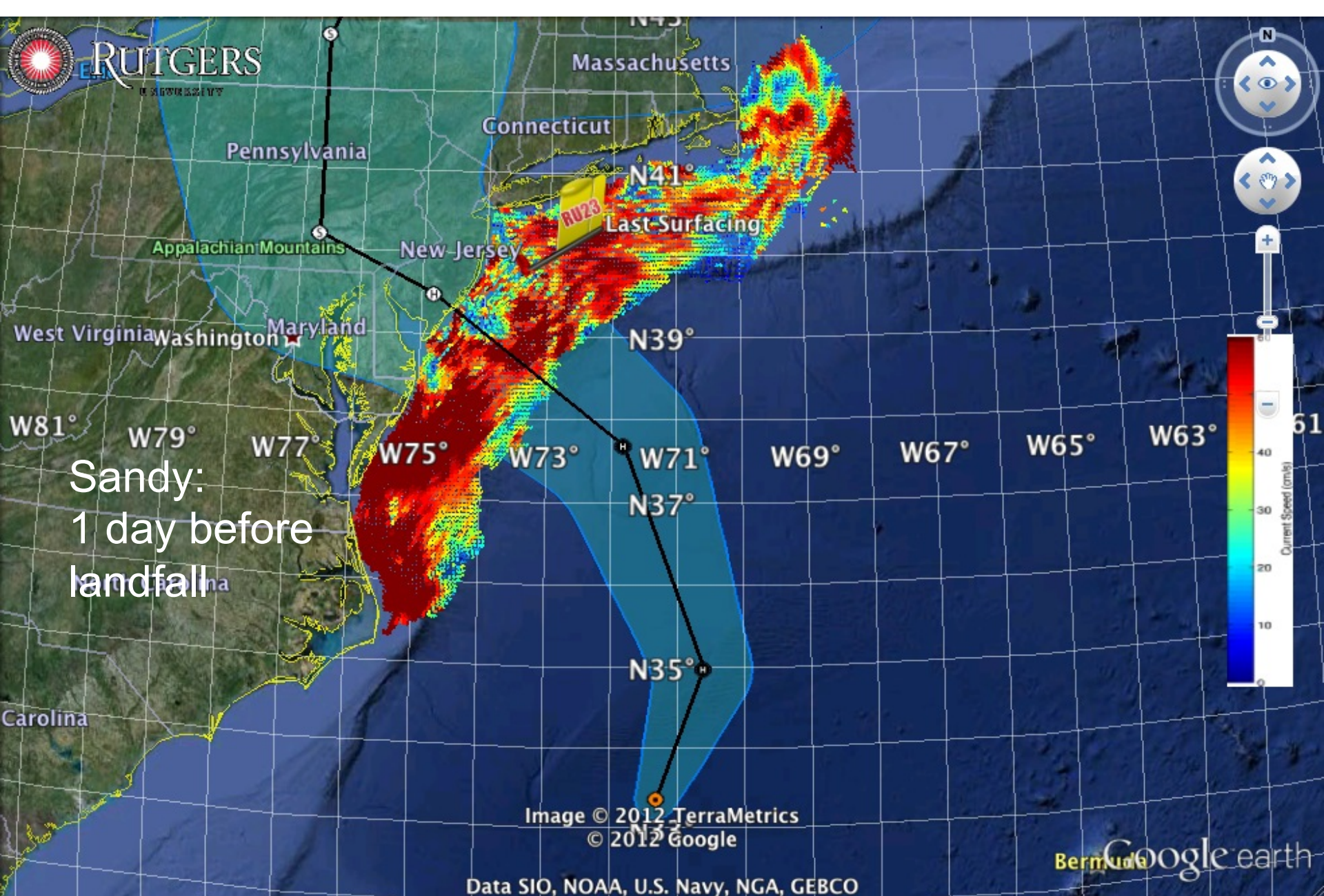
WeatherFlow

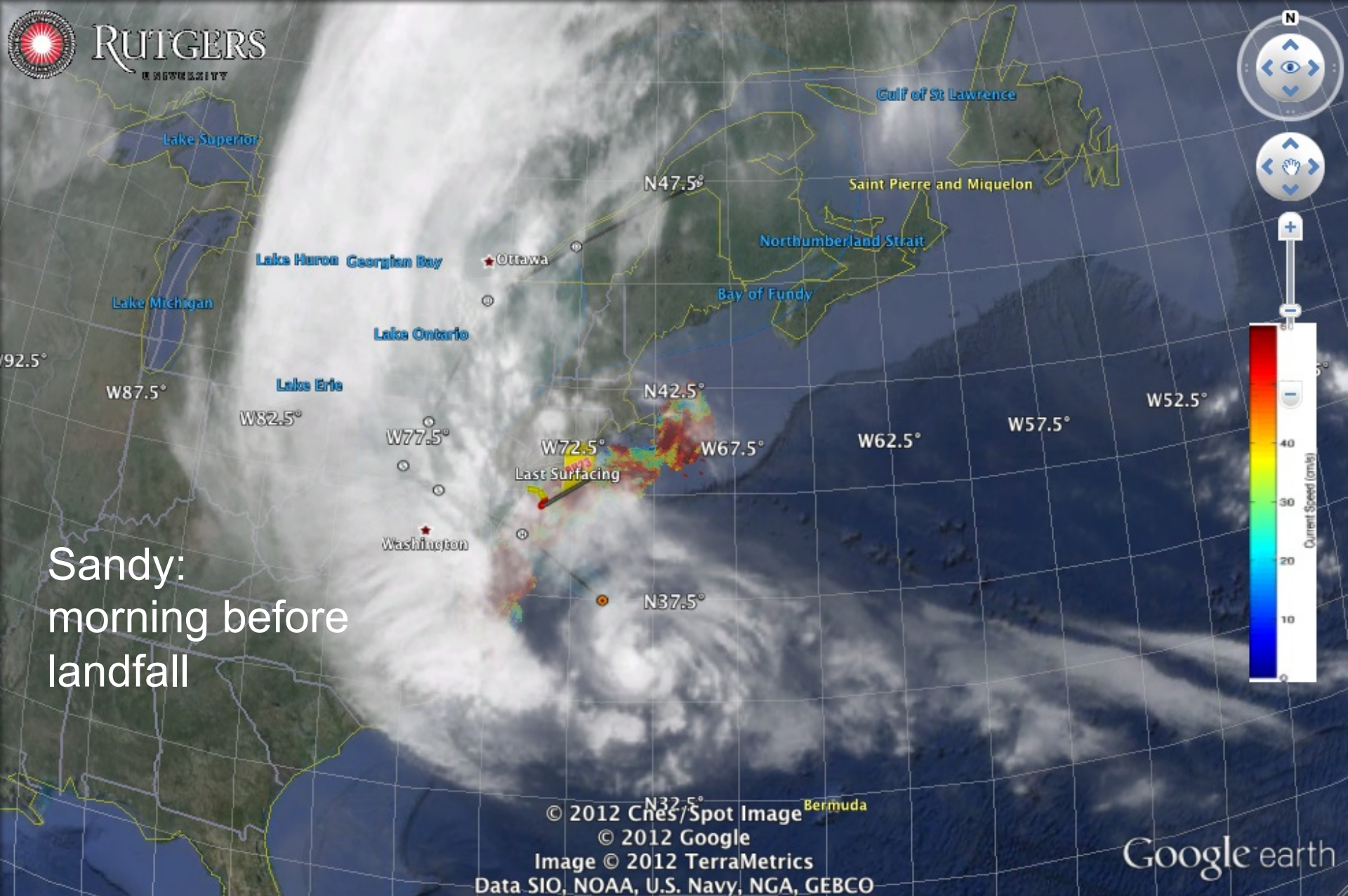


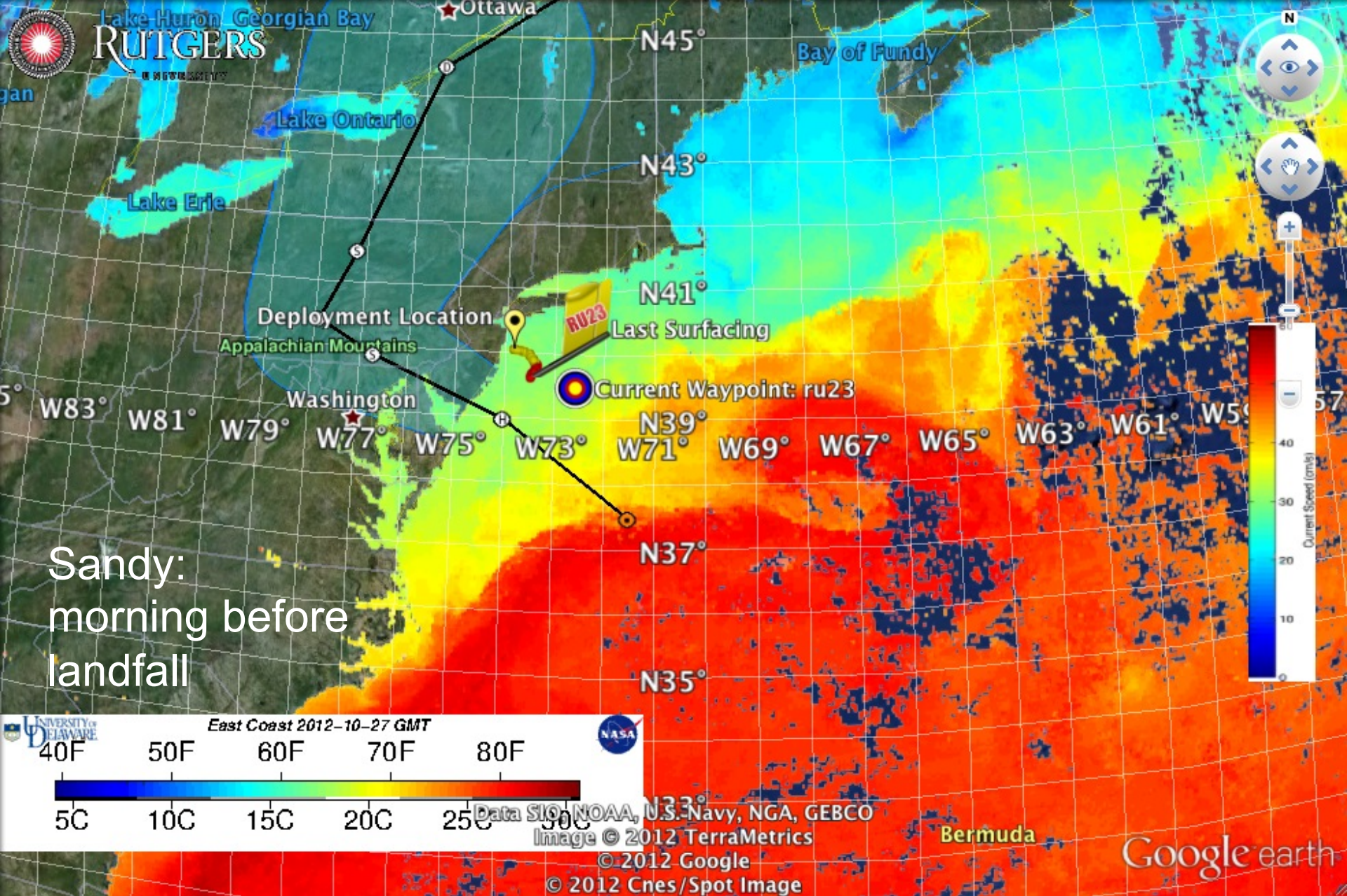


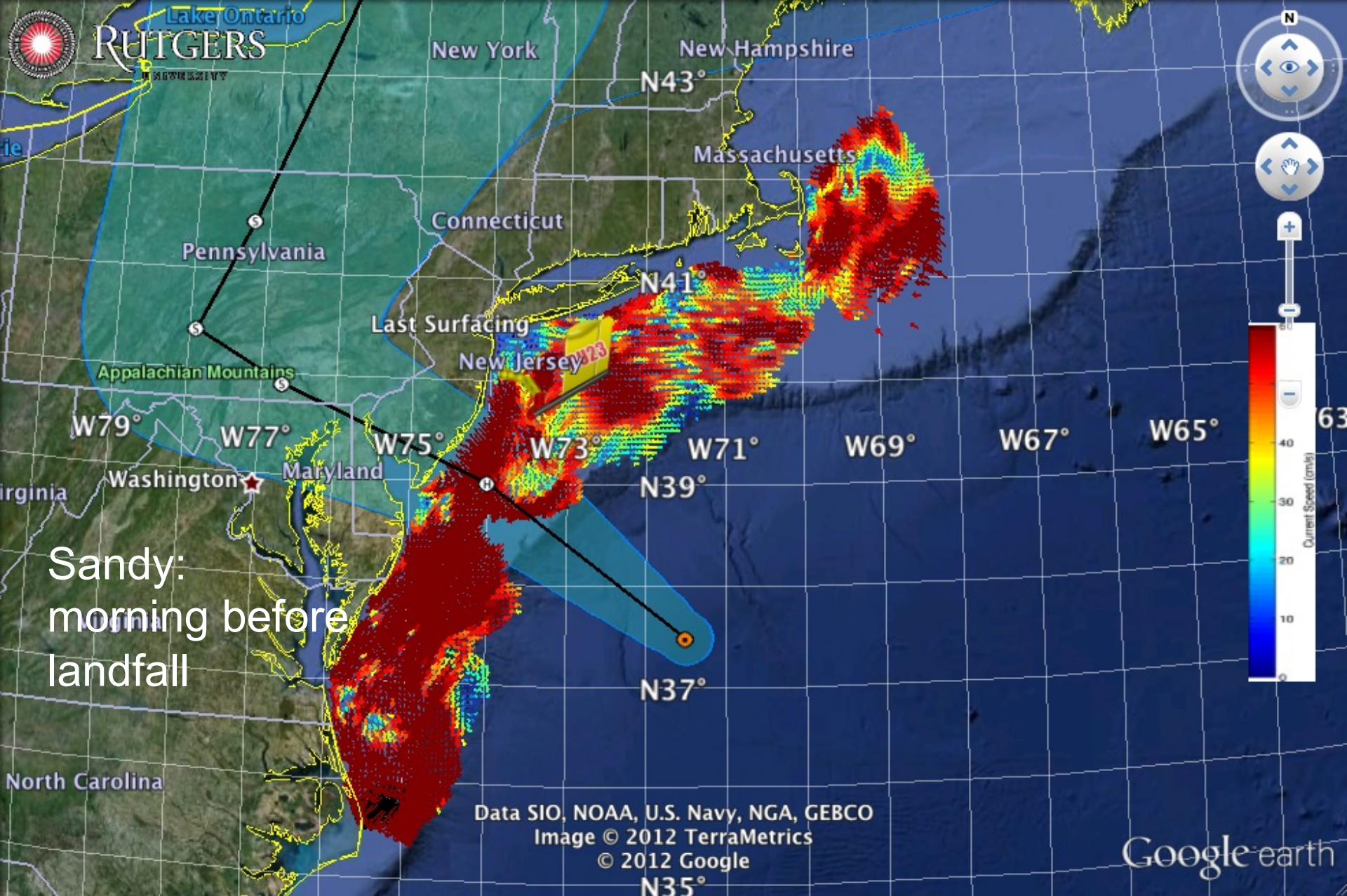
Sandy:
2 days before
landfall

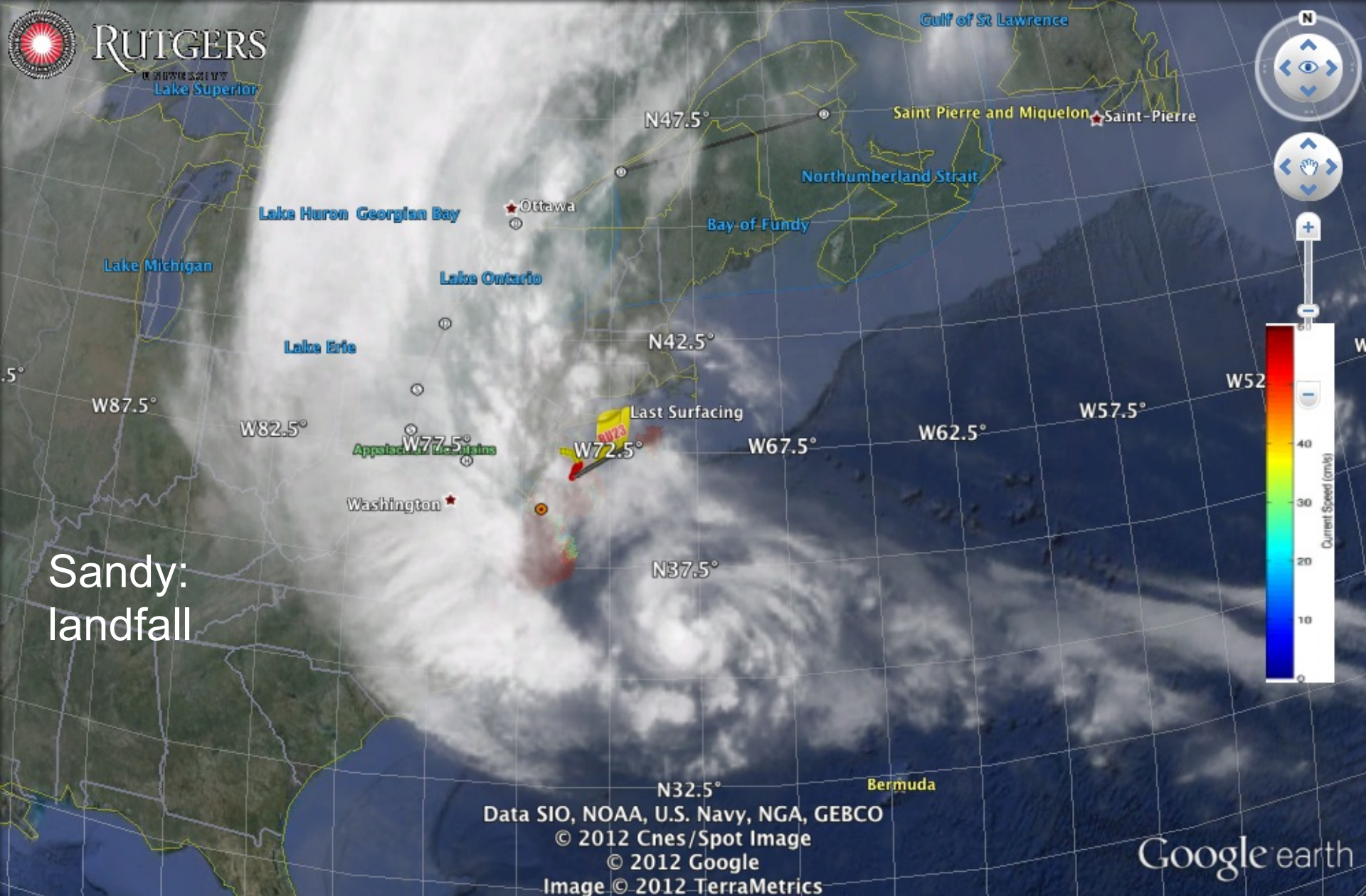


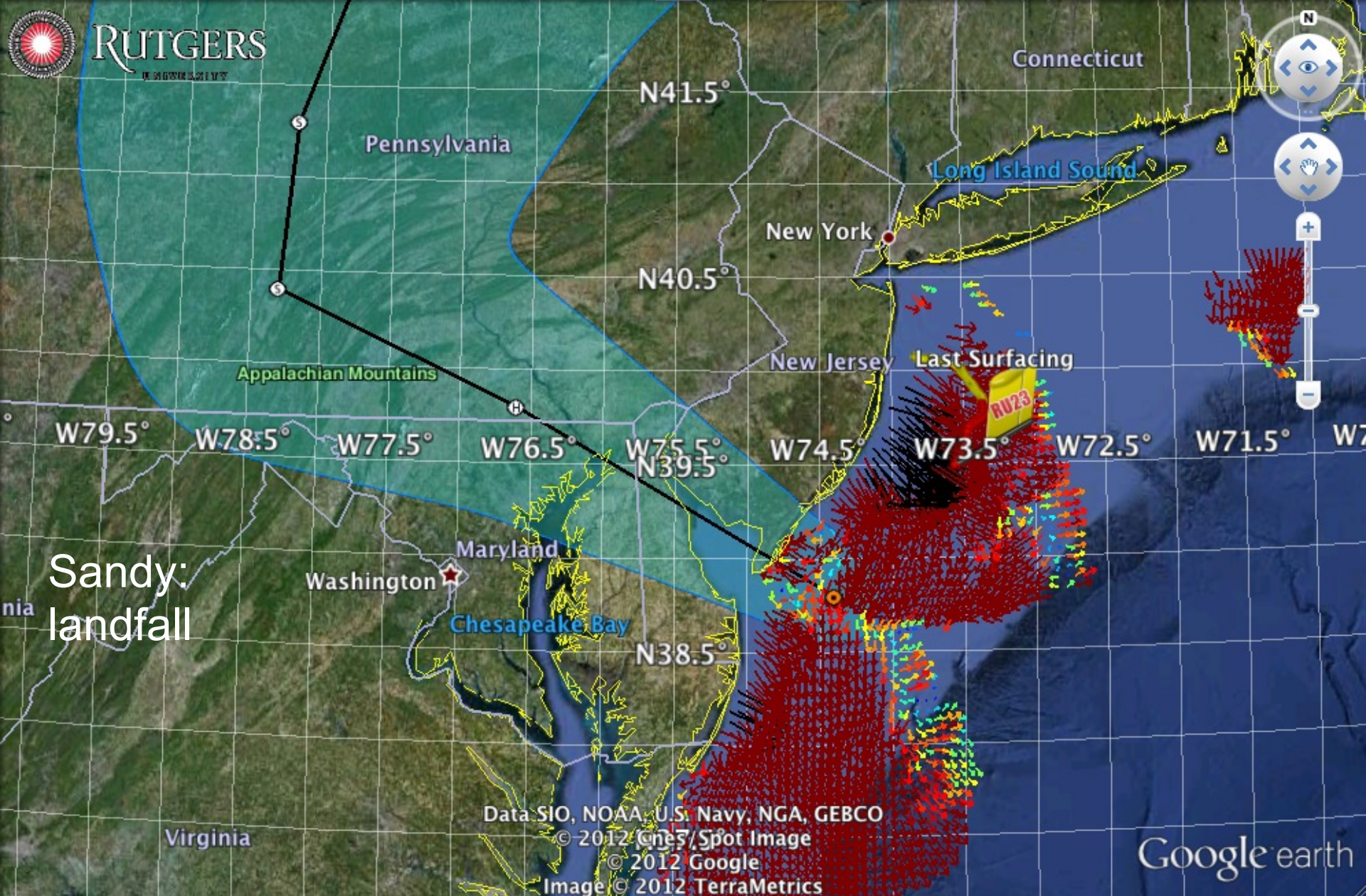








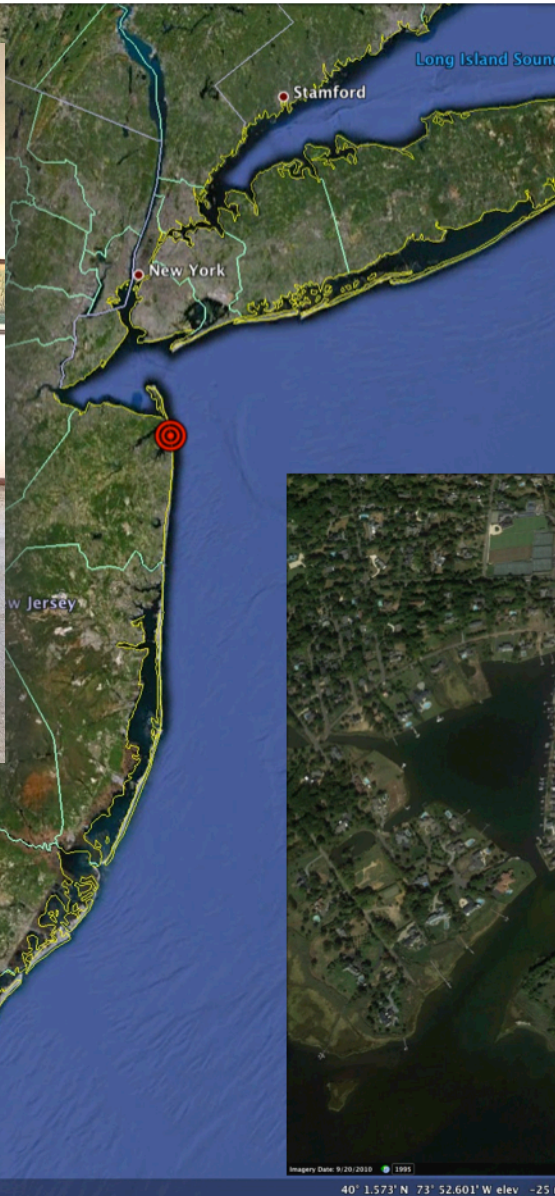




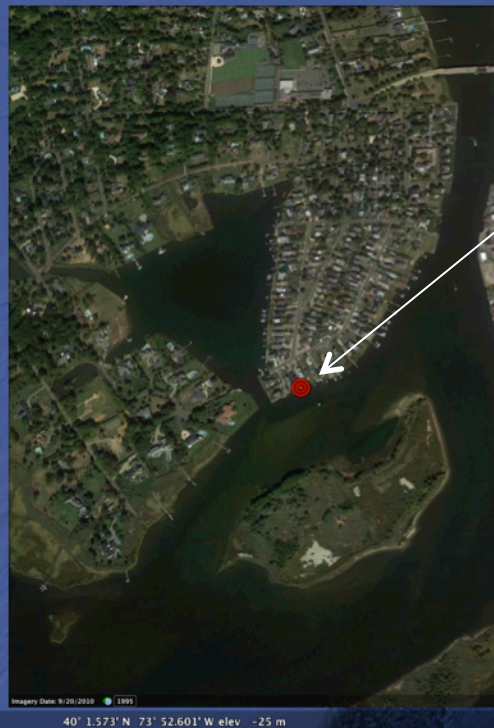
HF Radar Storm Damage



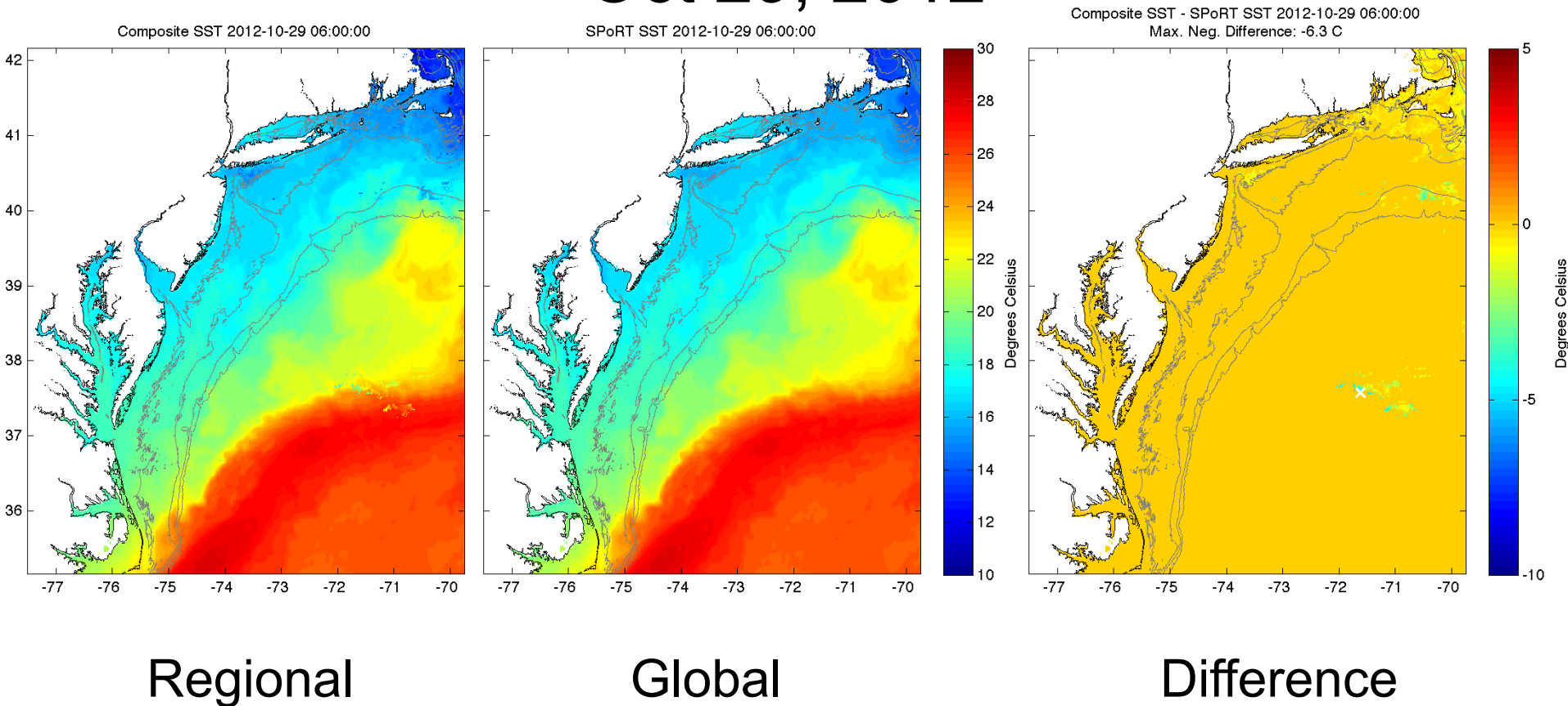
Keyport



HF Radar
Shed floats
0.85 km
across barrier
island & river

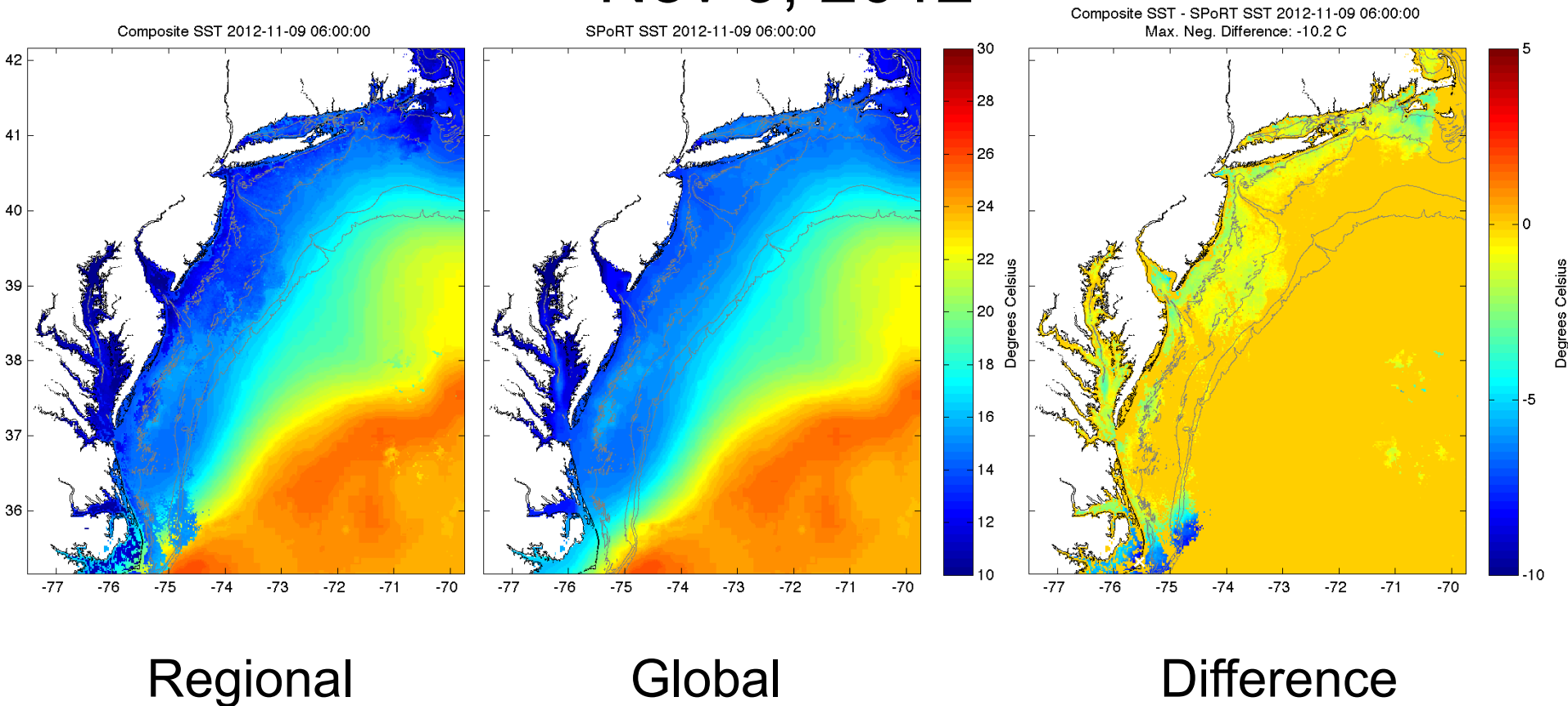


Sea Surface Temperature Products used for Atmospheric Forecasts Oct 29, 2012

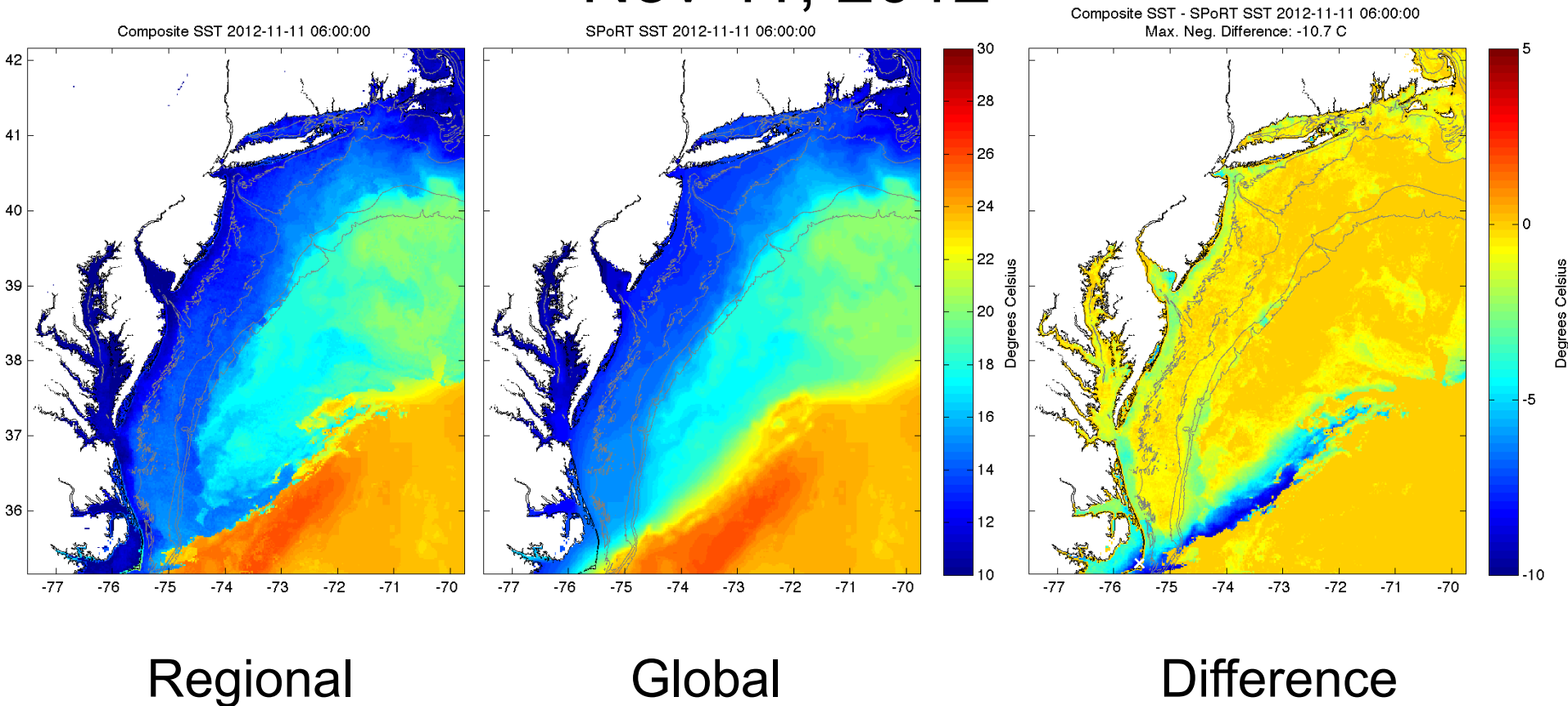


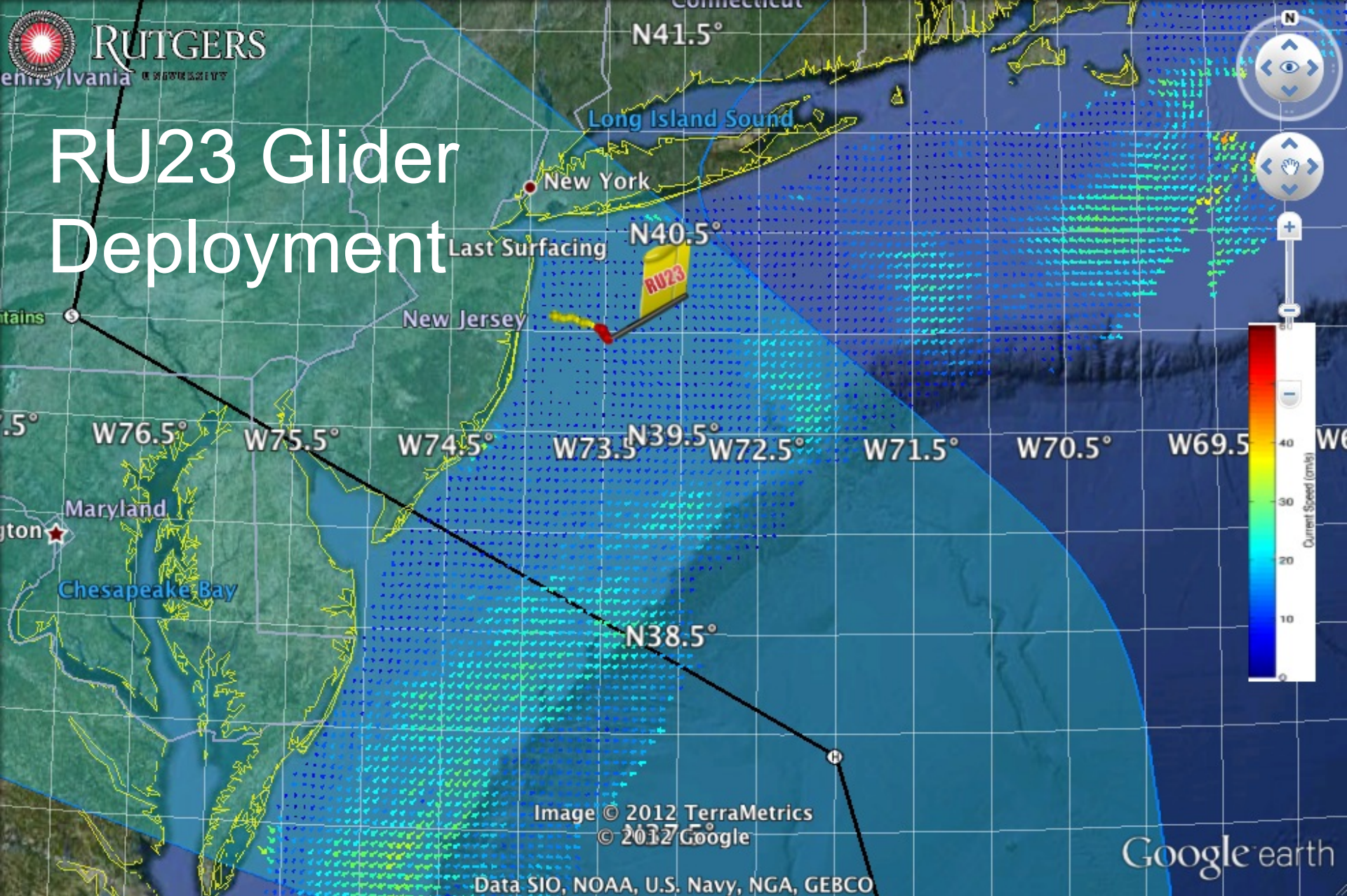
Sea Surface Temperature Products used for Atmospheric Forecasts

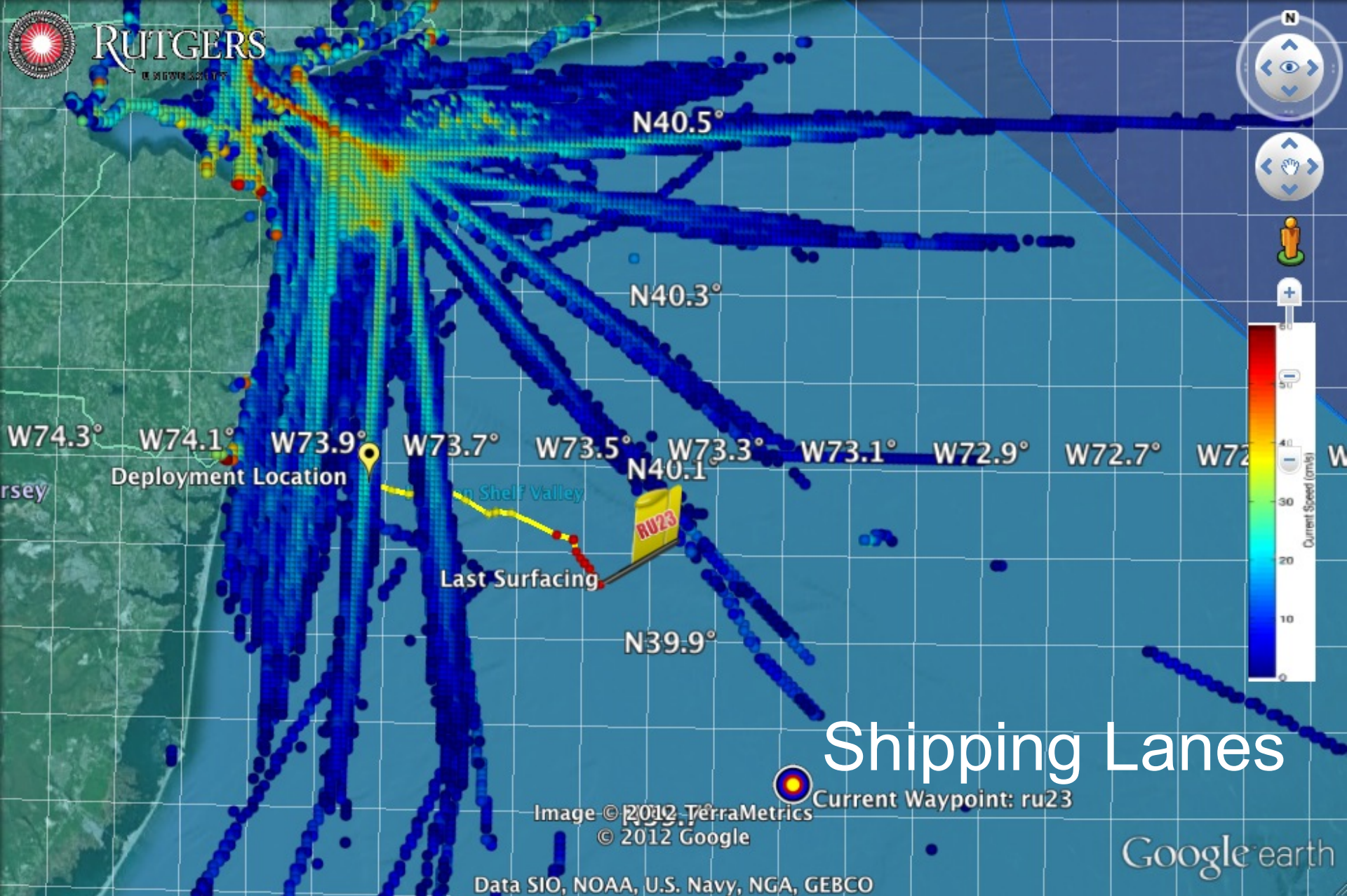
Nov 9, 2012



Sea Surface Temperature Products used for Atmospheric Forecasts Nov 11, 2012

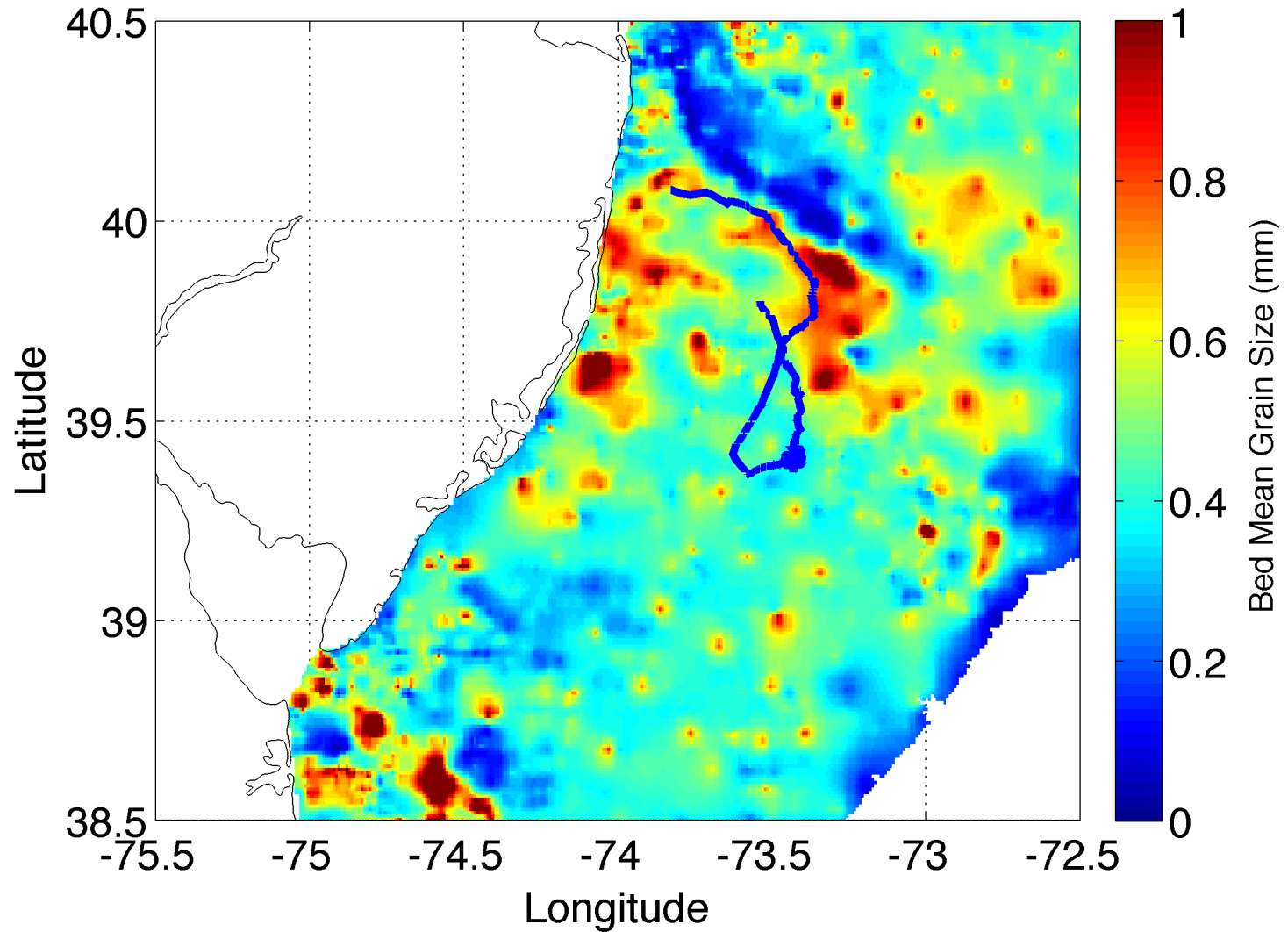




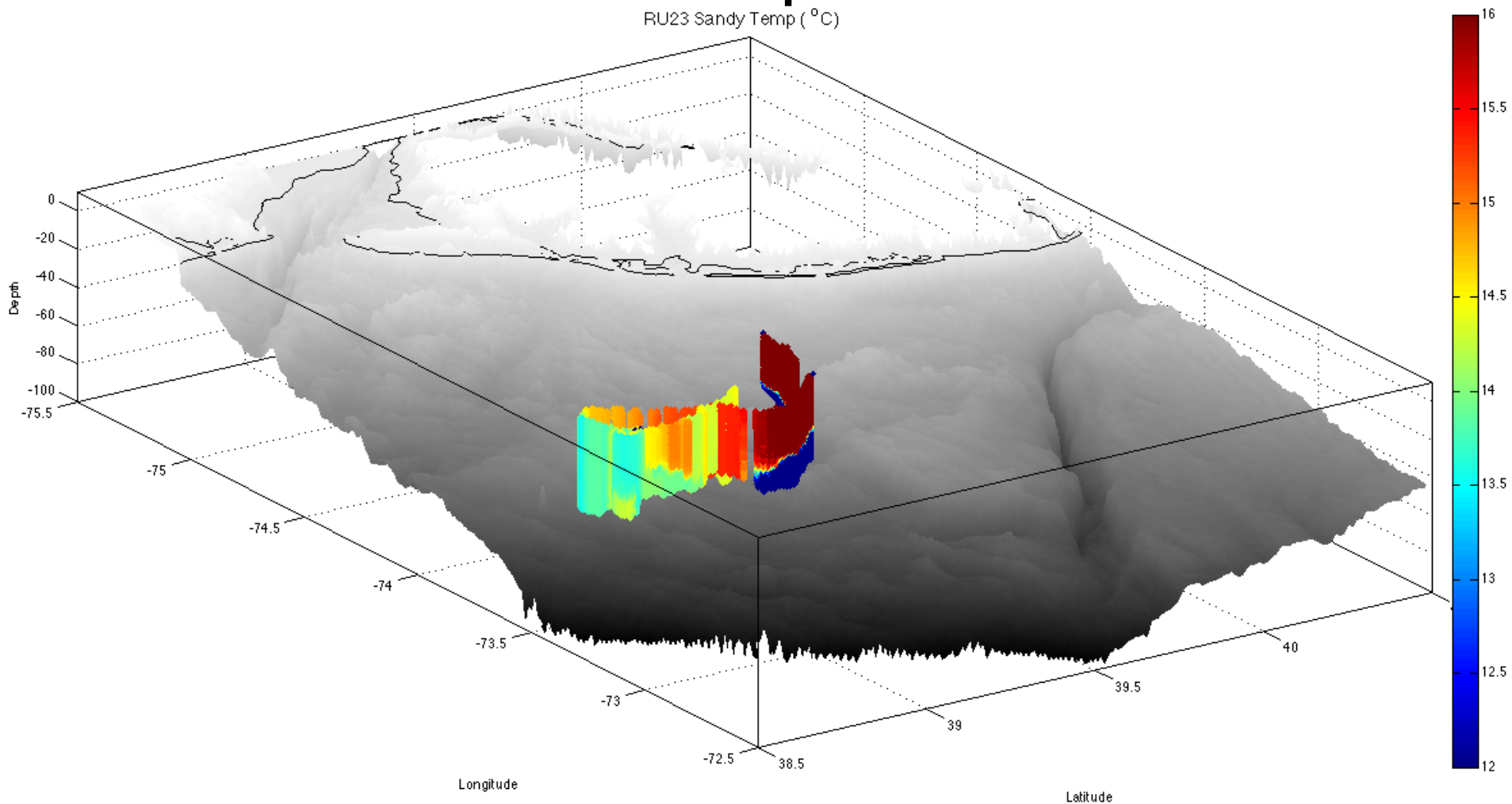


Bottom Sediment

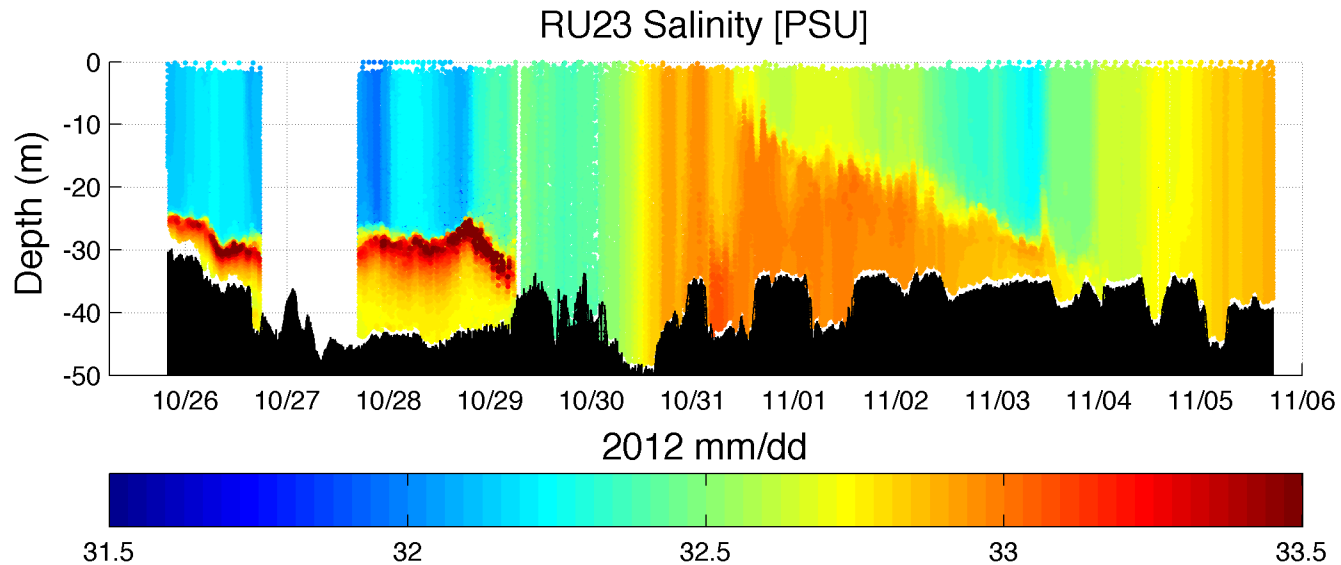
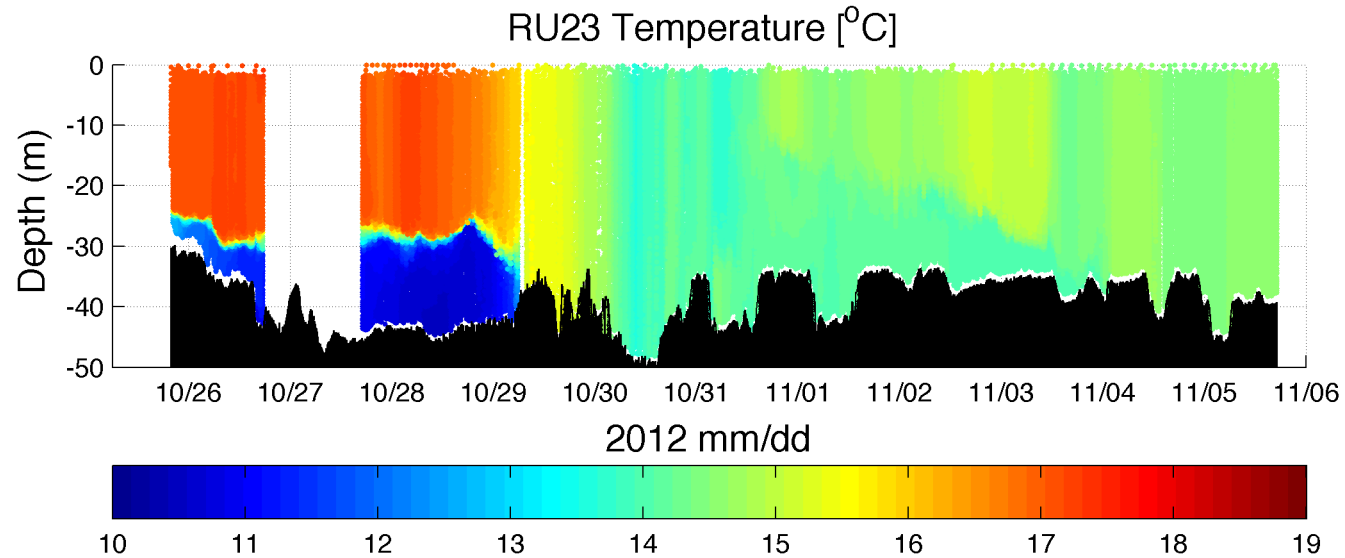
NJ Shelf Sediment Map



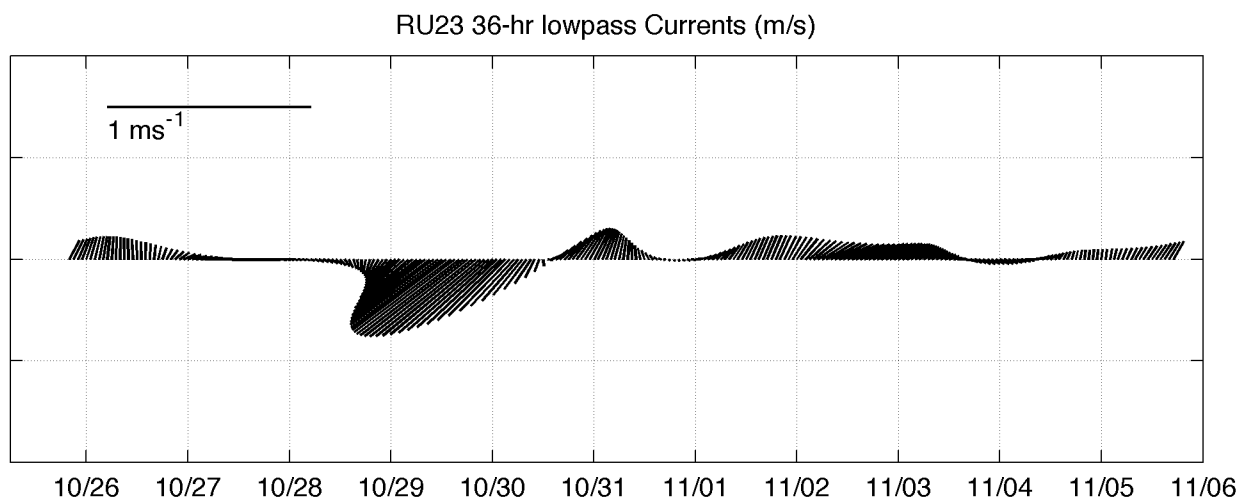
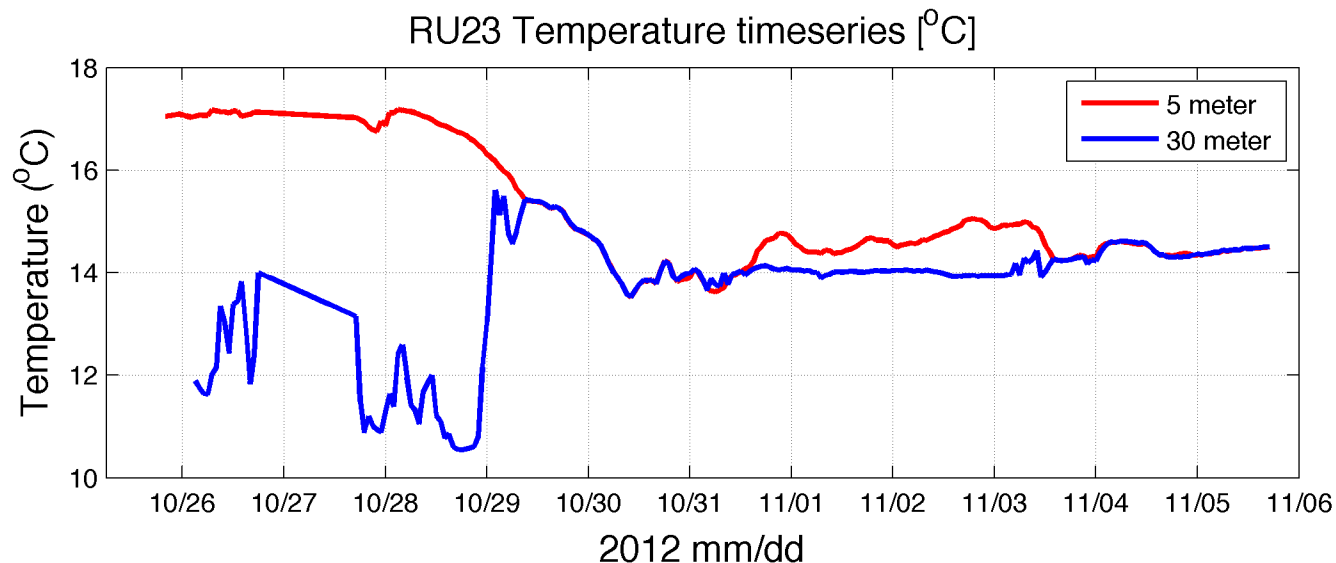
Glider RU23 Temperature Ribbon



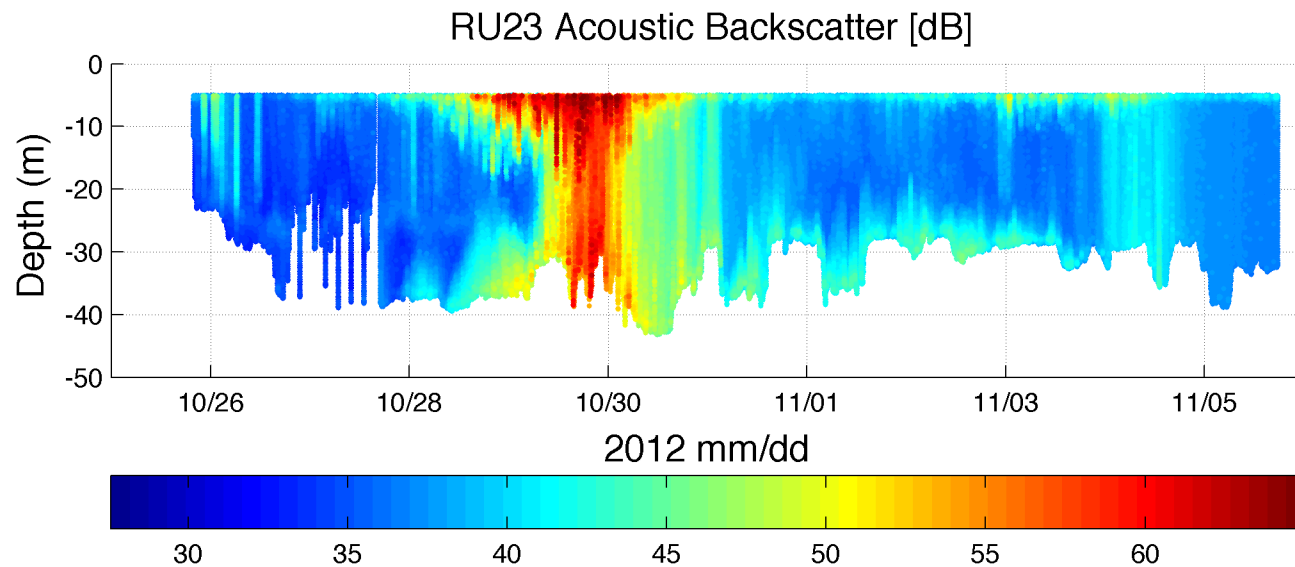
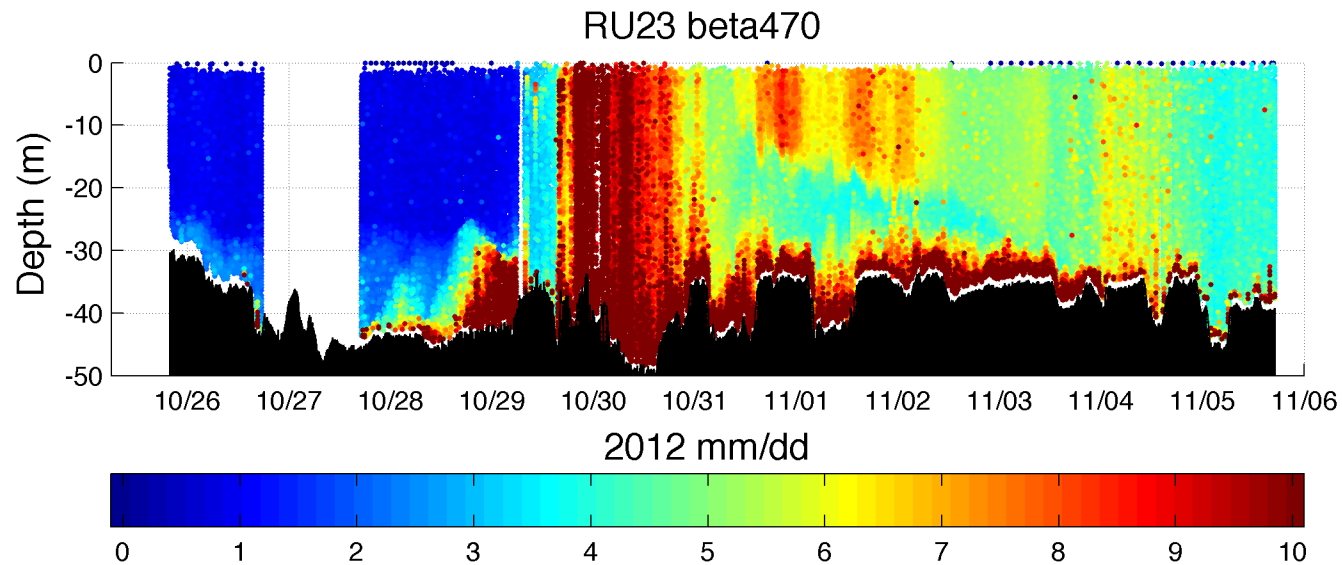
Glider RU23 Temperature and Salinity Section



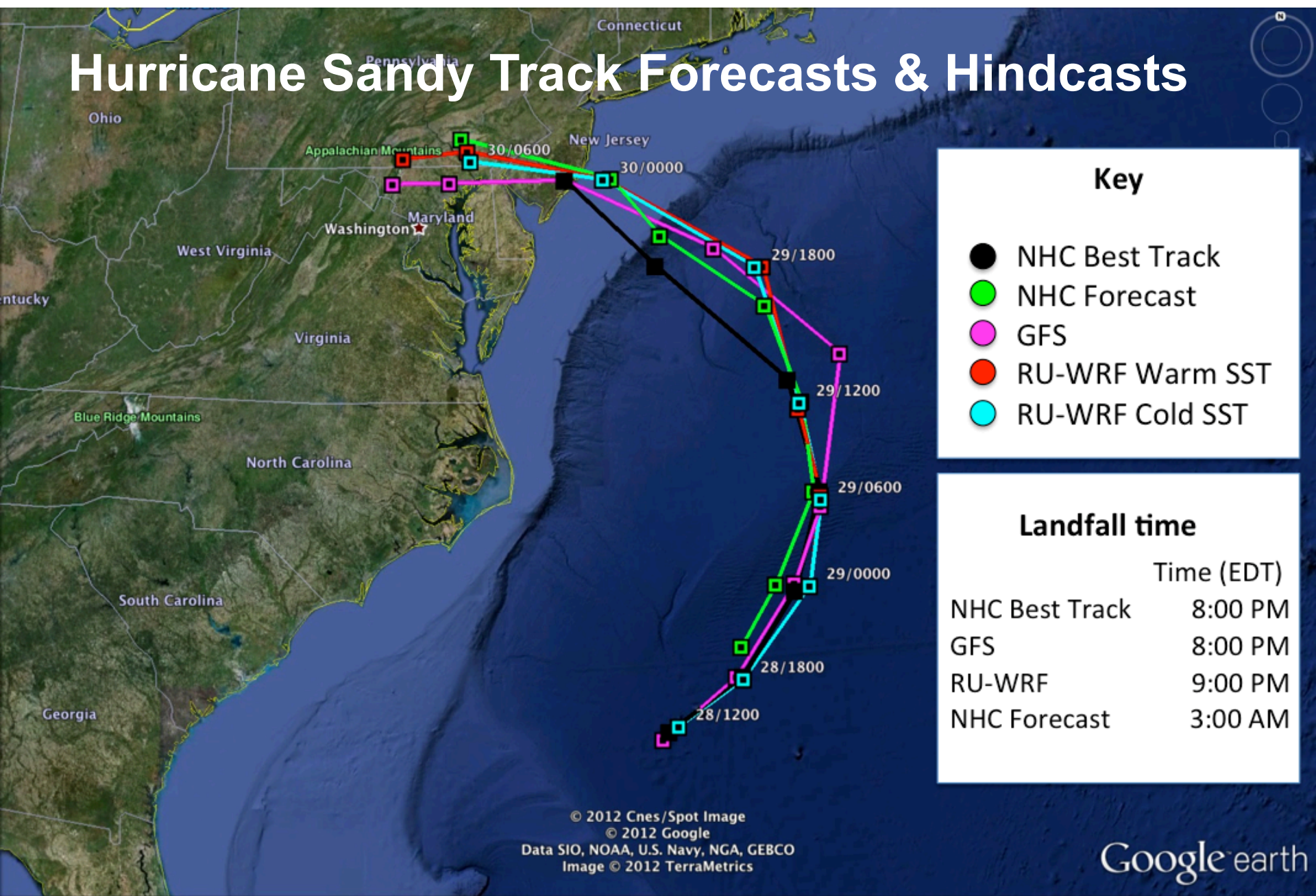
Glider RU23 Top & Bottom Temperature, Currents



Glider RU23 Optical and Acoustic Backscatter



Hurricane Sandy Track Forecasts & Hindcasts



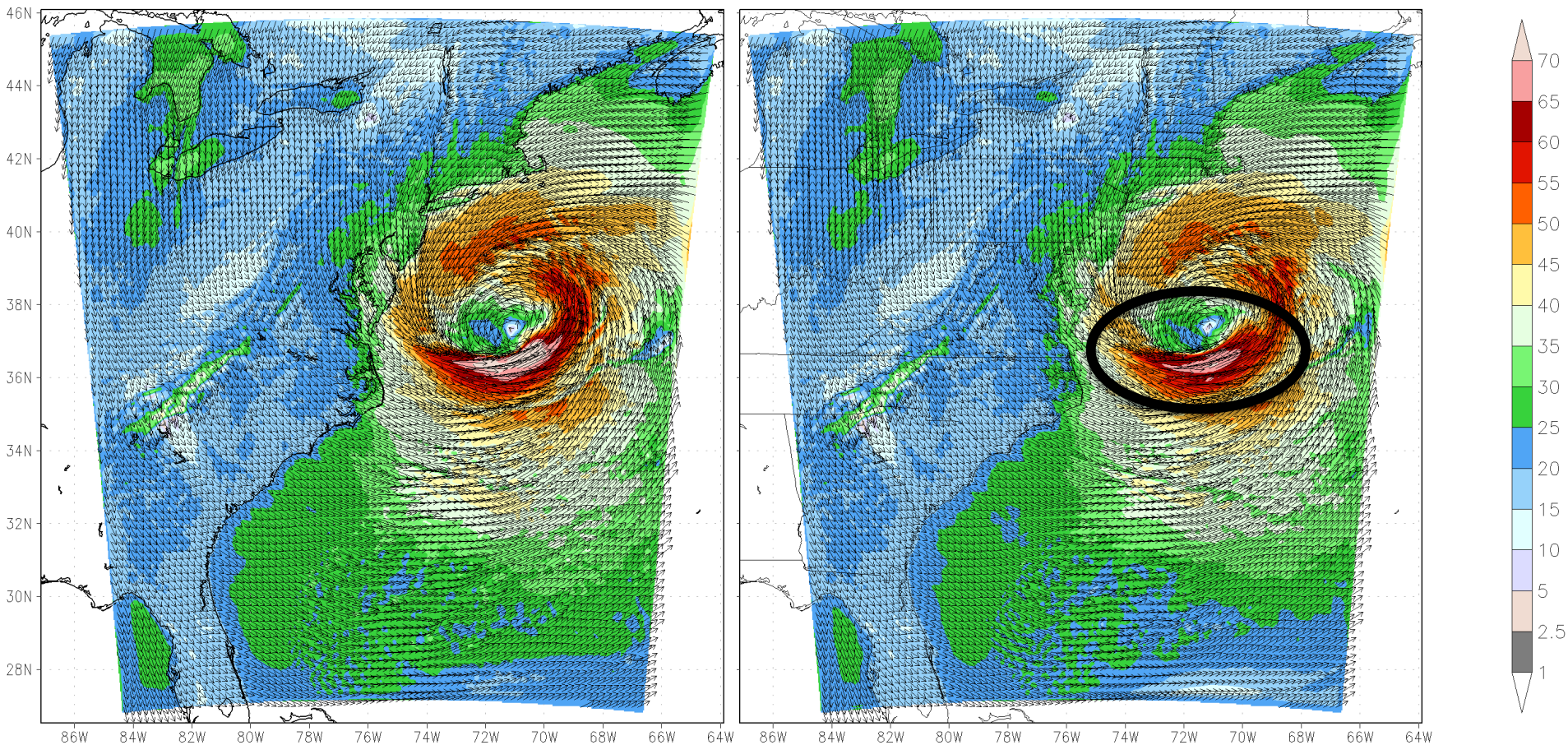
Hurricane Sandy Hindcast: SST Sensitivity

Warm SST

Cold SST

Wind Speed at 10 m [kts]

Wind Speed at 10 m [kts]



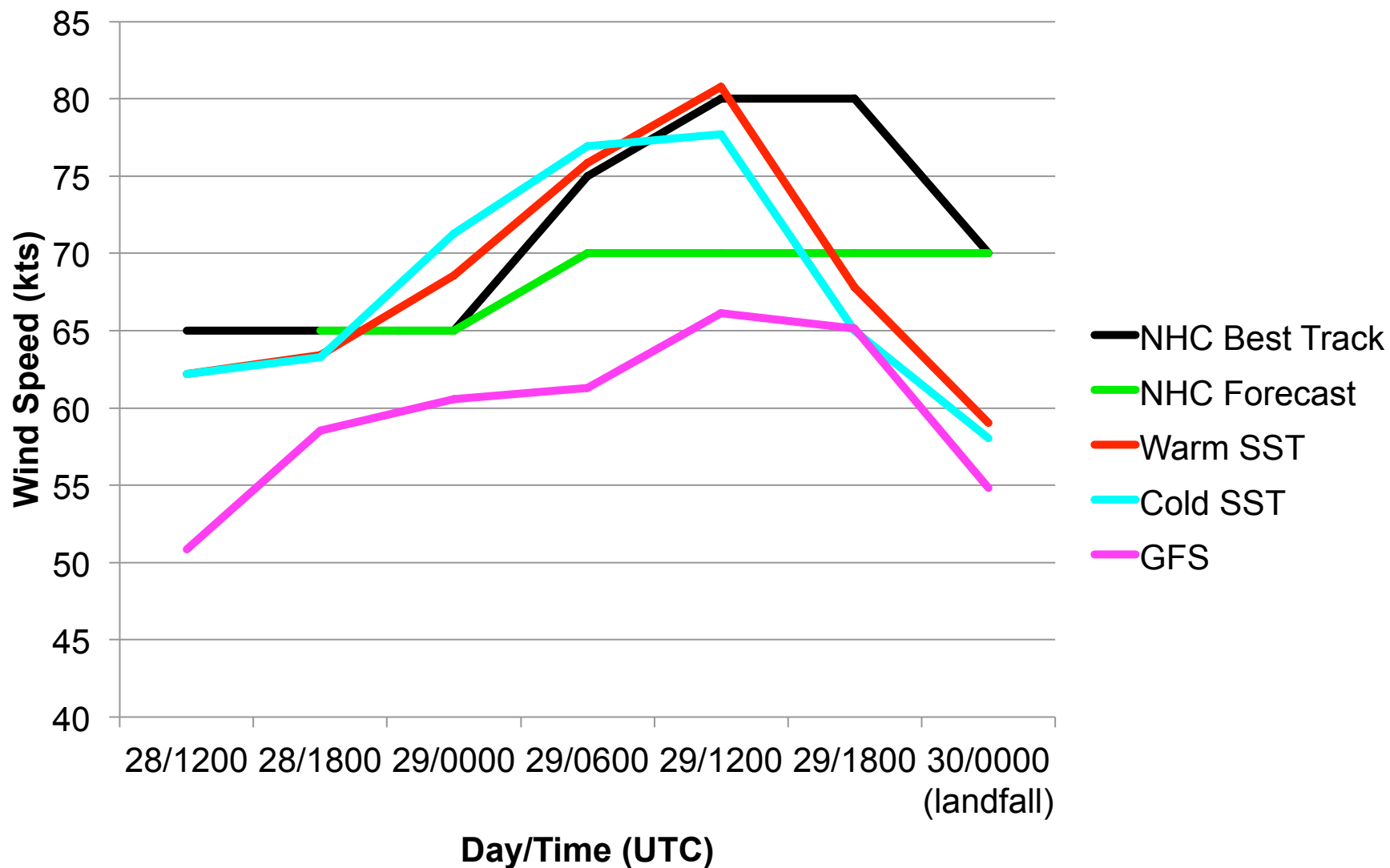
J Coastal Ocean Observation Lab: WRF-ARW 6 KM
tp://marine.rutgers.edu/cool/weather

Model Initialized 12Z28OCT2012
Valid 16Z29OCT2012 (Mon) | Forecast

Model Initialized 12Z28OCT2012
Valid 16Z29OCT2012 (Mon) | Forecast Hour 28

Hurricane Sandy Hindcast: Intensity

Maximum Sustained 10m Wind Speed (kts)



New York Harbor Observing and Prediction System



Urban Ocean Observatory at the Center for Maritime Systems

Present
Conditions

NYHOPS
Forecast

NJ Coast
(CMN)

Storm
Surge

Mobile
Stations

CMS
Partners

Data &
Time Series

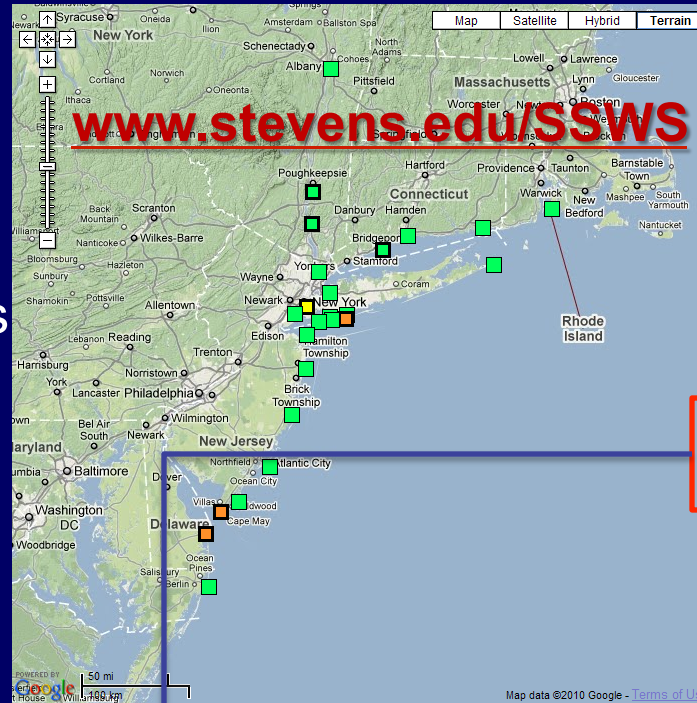


Click for Storm Surge Warning System (SSWS)
as of: 2010-11-05 9:00 AM

Stations below have current or forecast flood levels.
Box color indicates current with forecast in parens

- Hudson River below Poughkeepsie NY (Near Flood)
- Hudson River at South Dock at West Point NY (Near Flood)
- Bridgeport CT (Minor Flood)
- The Battery NY (Near Flood)
- Reynolds Channel at Point Lookout NY (Normal)
- Cape May NJ (Minor Flood)
- Lewes DE (Minor Flood)

CMS Storm Surge Warning System
Forecast Period: 2010-11-05 9:00 AM through 2010-11-07 12:00 AM ET



Select Station

Station:

- Major Flood
- Moderate Flood
- Minor Flood
- Near Flood
- Normal Levels
- Blowout

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

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

Manage Email Notifications

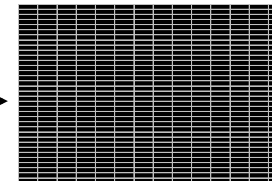
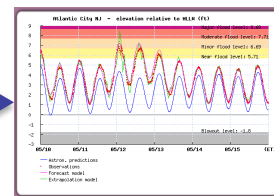
If you have questions or comments, please contact:
[Dr. Nickitas Georgas](mailto:Dr_Nickitas_Georgas@stevens.edu)

[Latest News about SSWS as of: August 12, 2010](#)

[SSWS: A Presentation of How it Works!](#)

- Color Coded Flood Levels
- Vertical datum selection
- Units selection
- Download data option
- Surge, prediction error

Storm Surge Warning System



Event

Phonebook Warning



NYC's Preparations



... Some Were Not High Enough



Storm Surge Forecast at Peak



Urban Ocean Observatory at the Center for Maritime Systems

Present
Conditions

NYHOPS
Forecast

NJ Coast
(CMN)

Storm
Surge

Mobile
Stations

CMS
Partners

Data &
Time Series



Storm Surge Warning System

Plot Series or Download Data

Station:
Stations are listed from North to South

Start Date:

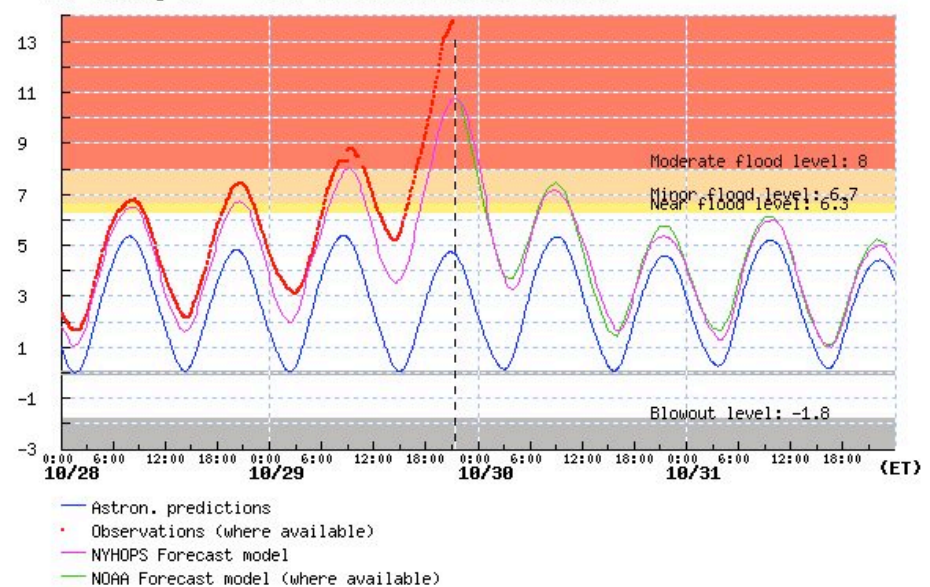
End Date:

Datum:

Units:

Time Zone:

The Battery NY - Water level relative to MLLW (ft)

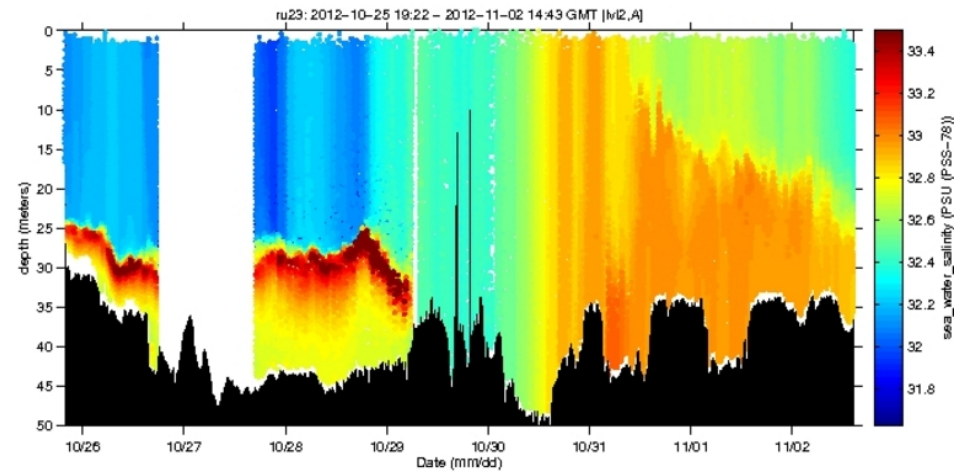
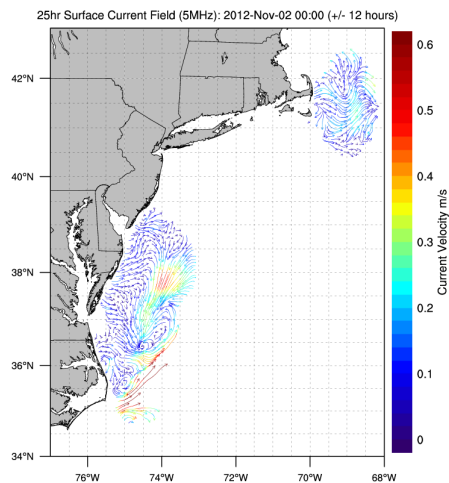
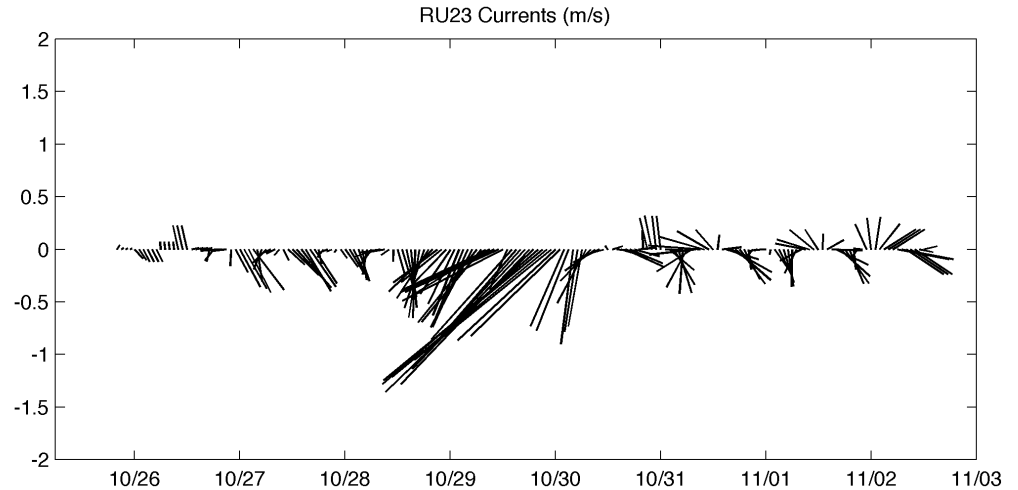
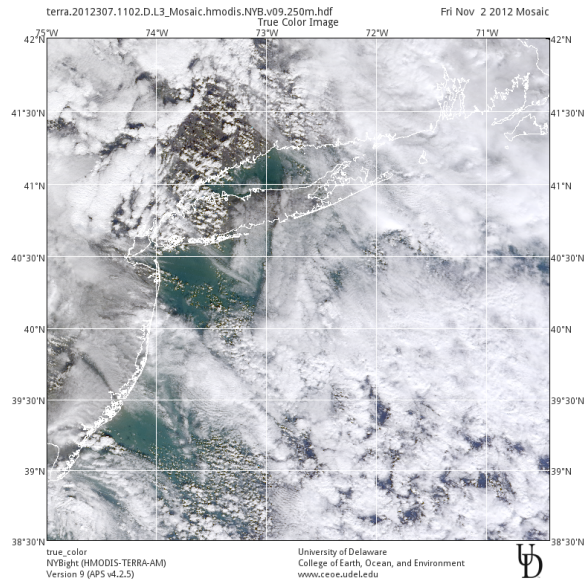


Email Message & Response to NJDEP 4 days after landfall

NJDEP Question – Urgent, time Sensitive!

Buchanan, Gary

11/2/12 10:08 AM





Conclusions:

- 1) Sandy was a disruptive event.
- 2) IOOS was there before, during and after.
- 3) IOOS made a difference.

