



A Review of Sandy Operations

NWS Weather Forecast Office

New York, NY



The 14th Annual
Southern New England
Weather Conference

Presented by Gary Conte, Meteorologist
National Weather Service



A Review of Sandy Operations



Outline of Presentation

- Overview
- Impacts caused by Sandy
- NWS Forecast Services
- NWS Decision Support Services
- Forecast Accuracy
- How we will Improve our Service



Weather Forecast Office New York, NY



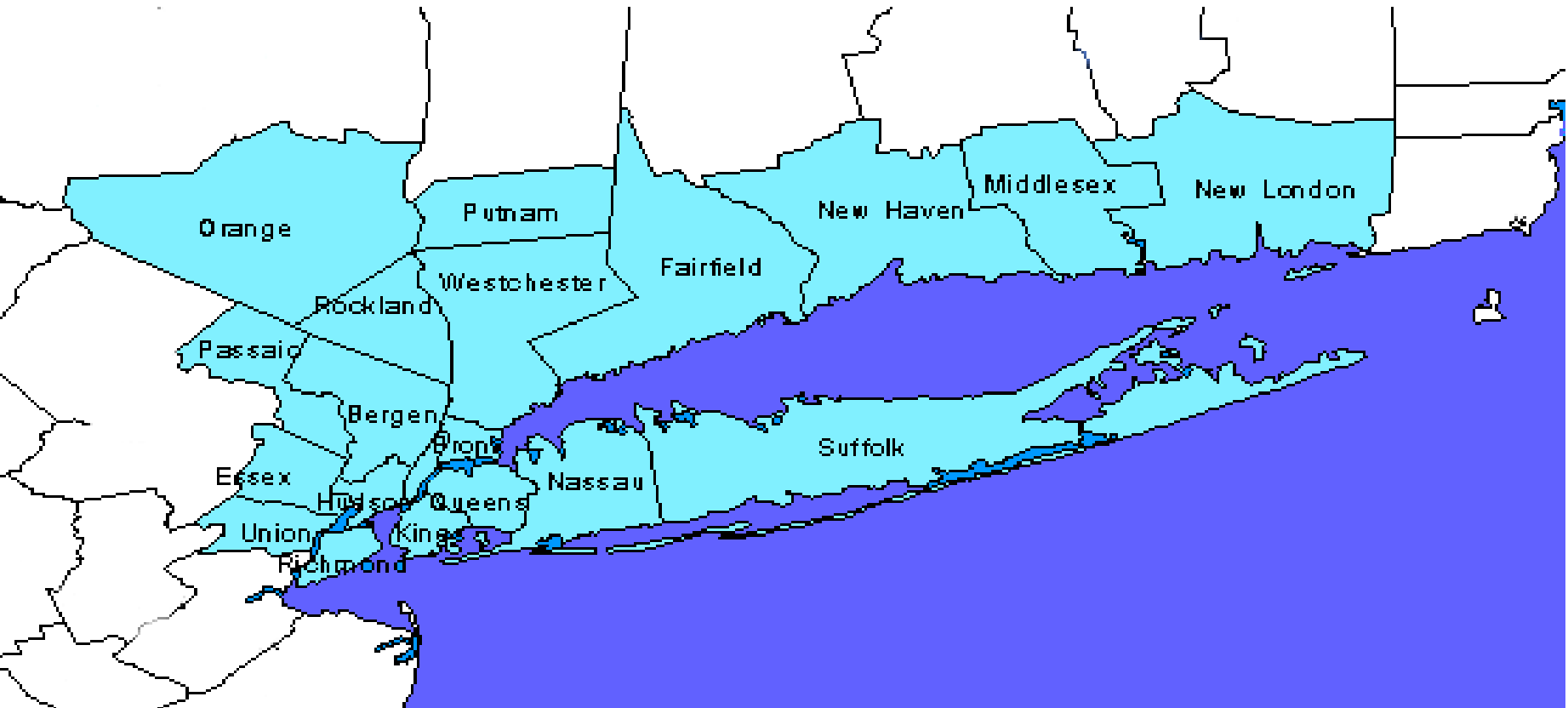
- Located at Brookhaven National Laboratory
- Open 24 hours a day, 365 days a year
- 30 Meteorologists and Technicians





Service Area

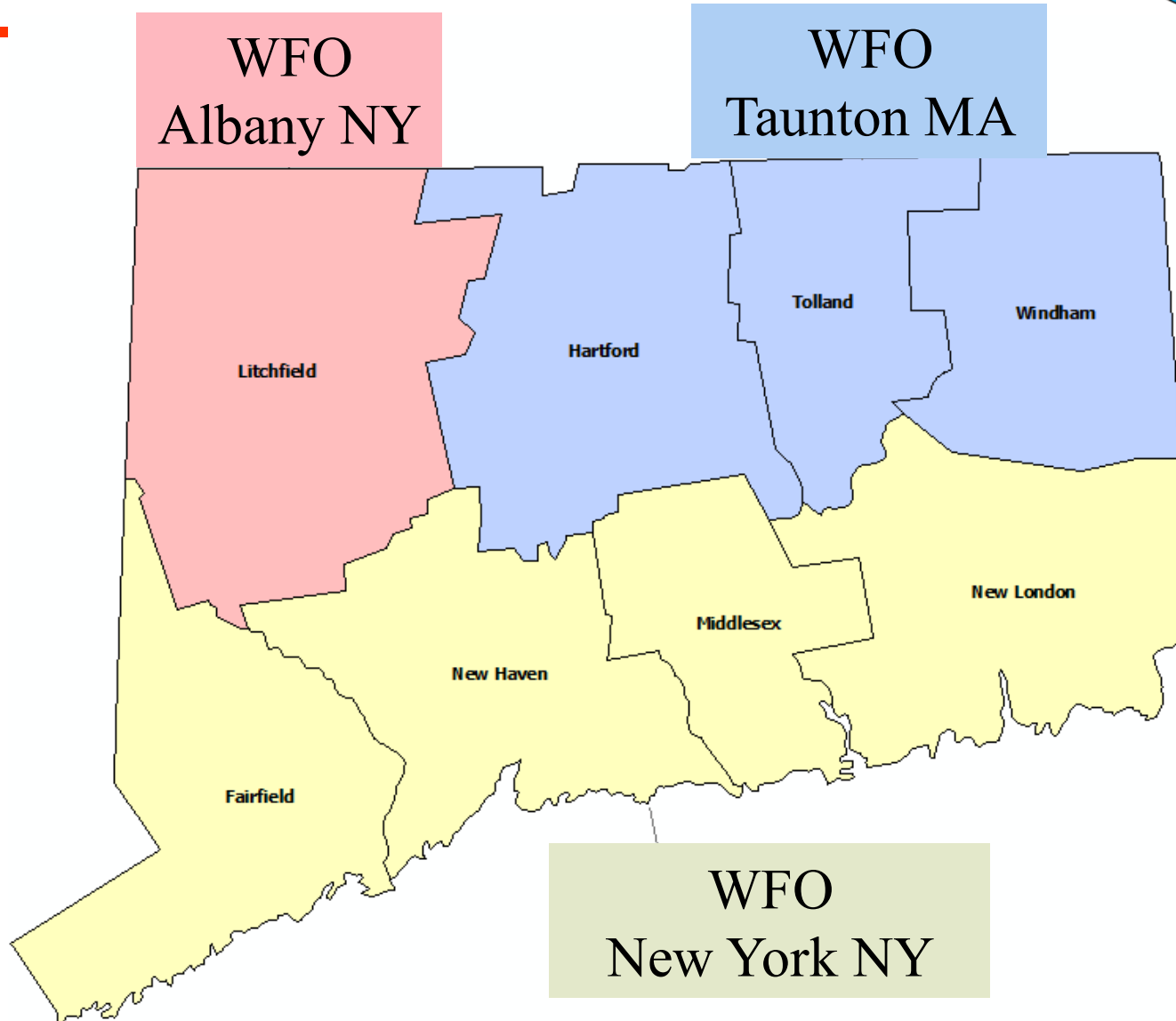
www.weather.gov/nyc



Population ~ 18.6 Million; 7% U.S. Population



NWS Offices Serving CT





Operations Room





AWIPS Work Station





NWS Weather Services



- We work together as a Team and strive to Deliver Unified Clear and Concise Messages
 - National Hurricane Center (NHC)
 - Storm Prediction Center (SPC)
 - Weather Prediction Center (WPC)
 - Ocean Prediction Center (OPC)
 - Mid Atlantic River Forecast Center (MARFC)
 - Weather Forecast Offices



NWS Weather Services



-
- National and Regional Centers Cover the Big Picture providing forecasts and guidance
 - Weather Forecast Offices “know” the local area (climate and weather) and use “tools” to deliver higher detailed and more specific forecasts



Remembering Hurricane Sandy 1 Year Later



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER WEATHER SAFETY INFORMATION CENTER NEWS SEARCH ABOUT

Local forecast by "City, St" or ZIP code
Enter location ... Go
[Location Help](#)

News Headlines

- Remembering Hurricane Sandy One Year Later
- NOAA Weather Radio New York City Remains out of Service
- The Original NWS New York, NY Website is Available Here while we Transition to our New Webpages

Hurricane Sandy New York, NY
Weather Forecast Office

Weather.gov > New York, NY > Hurricane Sandy

[Current Hazards](#) [Current Conditions](#) [Radar](#) [Forecasts](#) [Rivers and Lakes](#) [Climate and Past Weather](#) [Local Programs](#)

Hurricane Sandy - October 29, 2012

Summary: Hurricane Sandy was the 18th named tropical cyclone of the 2012 Atlantic hurricane season (June 1 - November 30). Sandy formed in the central Caribbean on October 22nd and intensified into a hurricane as it tracked north across Jamaica, eastern Cuba and the Bahamas. Sandy moved northeast of the United States until turning west toward the mid Atlantic coast on the 28th. Sandy transitioned into a **post-tropical cyclone** just prior to moving onshore near Atlantic City, NJ. For a complete summary of Sandy, view the [National Hurricane Center Sandy Tropical Cyclone Report](#)

Track	500mb and Surface	Satellite and Radar	Storm Surge	Winds
Waves	NWS Products	Photos	Local Storm Reports	Other Links

Track

The track of Sandy resulted in a worse case scenario for storm surge for coastal regions from New Jersey north to Connecticut including New York City and Long Island. Unfortunately, the storm surge occurred near the time of high tide along the Atlantic Coast. This contributed to record tide levels.

Source: National Hurricane Center (NHC) Sandy Report



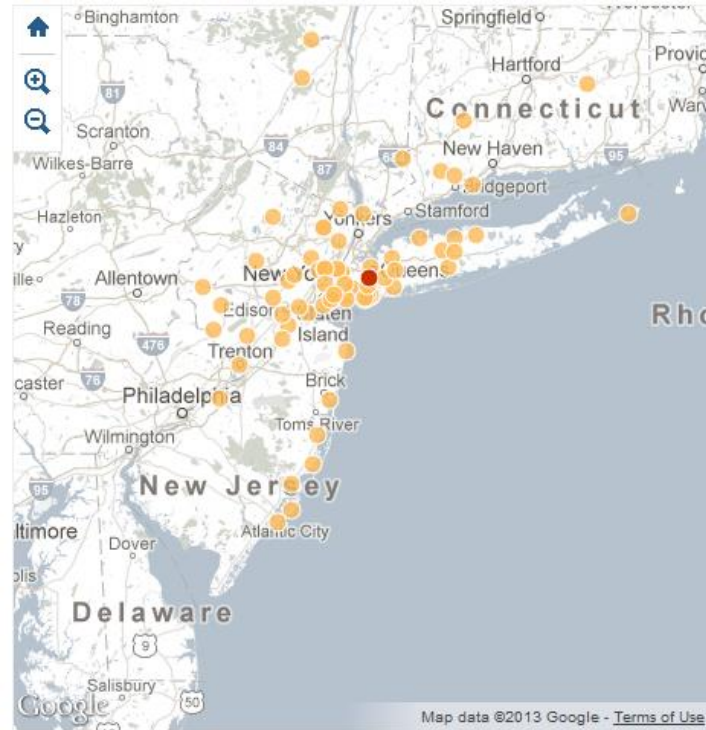
Review of Sandy Summary of Impacts Tri-State Area (NJ/NY/CT)



- Historic Coastal Flooding
- Damaging Wind Gusts
- Widespread Power Outages
- At Least 78 Deaths
- At Least \$70 Billion in Property Damage



Sandy's Impacts Deaths



Mapping Hurricane Sandy's Deadly Toll The NY Times

<http://www.nytimes.com/interactive/2012/11/17/nyregion/hurricane-sandy-map.html>





Sandy's Impacts Deaths



- 78 Deaths (Direct and Indirect)
 - 44 in NYC
 - 13 in Long Island
 - 12 in Northeast NJ
 - 05 in Southern CT
 - 04 in Lower Hudson Valley
- Approximately 2/3 Due to Surge and 1/3 Due to Winds



Sandy's Impacts Evacuation Orders



- More than 1 Million Evacuation Orders Implemented
 - 375,000 in NYC for Zone A (Cat 1)
 - 240,000 in Nassau County (Cat 1)
 - 32,500 in Suffolk County (Cat 1)
 - 362,000 in CT (Zones 1, 2, 3 and 4)
- Decisions for Evacuation are ALL TIED to Hurricane Category (Wind Speed) in Emergency Preparedness Plans



Sandy's Impacts Power Outages



- More than 3 Million Widespread Power Outages that Lasted at Least 2 Weeks
 - More than 1.1 Million LIPA Customers
 - 894,128 in Northeast NJ
 - 703,791 Con Ed Customers
 - 667,598 Statewide in CT
- Tri-State Area served by at Least 10 Different Utility Companies



Sandy's Impacts Property Damage



- Cost Estimates Provided by the Governors for the States of NY, NJ, and CT
 - New York \$42 Billion
 - New Jersey \$29.4 Billion
 - Connecticut \$360 Million



Sandy's Impacts Wind and Surge



- Main Impacts
 - Wind Damage (Trees and Power lines; some structural damage due to fallen trees)
 - Coastal Inundation caused widespread and significant property damage; NYC/NJ Metro Area Hardest Hit (including Long Island and CT)



WFO New York, NY Services for Sandy



- Let's Take a Look at the Services Provided by our Weather Forecast Office (WFO) Chronologically
- Starting with Days 6 and 7...



Days 6 and 7



-
- Early Preparedness Phase for Situational Awareness
 - This is the Time to begin Gathering and Processing Information for Potential Storm



Days 6-7 Text Services



- Hazardous Weather Outlook (HWO) issued daily
 - Plain Language
- Area Forecast Discussion (AFD) issued periodically
 - Scientific Language
- Email
 - Informational Plain Language



Sandy

Monday 10/29/12



6 Days Advance Notice...

- Hazardous Weather Outlook issued Tue. 10/23 at 4:35 am - Low probability of significant rainfall and strong winds early next week.
- Area Forecast Discussion issued Tue. 10/23 at 4:10 pm - A worst case scenario of flooding rains...**damaging winds**...and **significant coastal flooding** for parts of the area. STAY TUNED.



Email



First Email Sent Oct. 23, 2012 at 11:04 am

Hi folks.

The National Hurricane Center (NHC) is tracking tropical system Sandy:

http://www.nhc.noaa.gov/graphics_at3.shtml?5day?large#contents

As you can see, Sandy is forecast to move north across Jamaica and Cuba, then more northeast across the Bahamas before moving further east of Florida toward Bermuda Saturday.

The medium range forecast models show an upper level trough slowly amplifying as it very slowly approaches the region Sunday into Monday, which will have an impact on the future track of how Sandy evolves and moves.

Forecast uncertainty remains high.

I recommend that you maintain daily situational awareness.



Days 6-7 Decision Support Services



- Informal Telephone Consults begin with Local Emergency Managers
- Informal Communication using NWSChat Starts



Days 3-5

The Threat Phase



- This is the time to begin Evacuation Planning along with Preparing for a Variety of Impacts caused by High Winds, Storm Surge, and Freshwater Flooding
- NYC OEM requires at least 72 hours advance notice for evacuation of NYC's large Special Needs Population



Days 3-5 Text Services



- Hazardous Weather Outlook issued daily
- Area Forecast Discussion issued periodically
- Public Information Statements



High Wind Forecasts for Sandy





High Wind Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- Hazardous Weather Outlook (HWO)
 - Tue. 10/23 (4:35 am) - Low probability of significant rainfall and strong winds early next week.
 - Tue. 10/23 (3:55 pm) - Low potential for a major coastal storm with heavy rainfall...high winds...
 - Thu. 10/25 (5:16 am) - Increasing confidence in major coastal storm late this weekend into early next week. Potential for heavy rainfall...high winds
 - Thu. 10/25 (4:00 pm) - Increasing confidence in a dangerous coastal storm Sunday Evening into mid next week. Likelihood for...high winds causing widespread downing of trees and power lines.



High Wind Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- Area Forecast Discussion (AFD)
 - Tue. 10/23 (4:10 pm) - A worst case scenario of flooding rains...**damaging winds**...and significant coastal flooding for parts of the area. STAY TUNED.
 - Thu. 10/25 (4:10 am) - Impacts from Tropical Cyclone Sandy beginning on Sunday. A tight pressure gradient will produce strong and gusty easterly winds.
 - Thu. 10/25 (4:00 pm)
...POTENTIAL FOR A DANGEROUS COASTAL SYSTEM EARLY NEXT WEEK...
Coastal areas could have winds increasing to high wind criteria. Could be a prolonged event. This would batter the coasts...leading to widespread downed trees and power lines.



High Wind Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- AFD (Area Forecast Discussion)
 - Fri. 10/26 (3:54 pm)

...DANGEROUS COASTAL STORM LIKELY FOR EARLY NEXT WEEK...

Confidence is increasing in ...high winds causing widespread downing of trees and power lines. The strongest winds will be coincident with the closest approach and landfall of Sandy...with **potential for speeds of 40-50g70-80mph**. If these winds are realized...the combination of event duration...saturated grounds...and partial to full foliage...would cause widespread downing of trees and power lines...causing disruption to power and possibly transit for several days.



High Wind Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- PNS (Public Information Statement)
 - Thu. Oct. 25 (8:55 pm)

...PREPAREDNESS INFORMATION FOR UPCOMING COASTAL STORM...

Increasing chance that a strong coastal storm will track close to the Tri-State area early next week.

Gusty winds will also be possible for a relatively long duration of time. Be prepared for the potential of property damage and an extended period of power outages.

Long list of preparedness information



Decision Support Services for High Winds



Threat Phase – (Days 3 to 5)

- Briefings
 - Tue. 10/23 - Informal Local, State, Federal and Public entity briefings, and Media Interviews
 - Wed. 10/24 - Started Formal Emails and PowerPoint presentations to our customers
 - Wed .10/24 - Started daily Webinars
 - Thu. 10/25 - Started participation in federal, regional, state, and local conference calls.



Decision Support Services for High Winds



Threat Phase – (Days 3 to 5)

- NWS Webinar (Fri. 10/26 11:14 am) –



Probability of Tropical Storm Winds of 39-57 mph



- Increasing Probability of Tropical Storm Force Winds



Probability of Tropical Storm Winds of 58-73 mph



- Increasing Probability of Tropical Storm Force Winds





Decision Support Services for High Winds



Threat Phase – (Days 3 to 5)

- NWS Webinar (Sat. 10/27 at 10:30 am) –



Strongest Winds



- Sustained 40 – 60 MPH with Gusts of 70 – 80 MPH Monday into Monday Night
 - Higher wind gusts possible for tall skyscrapers
- Onset of Gales after Sunset Sunday
- Most Trees have Full Canopies
- Stay Tuned for High Wind Watch



Decision Support Services



Watch/Warning Phase (0-48 Hours)

NWS Staff Work in Emergency Operations Centers (EOC)

FEMA (Regions 1 and 2)

State of CT EOC

NYC Office of Emergency Management (OEM) EOC

Nassau and Suffolk Counties OEM EOCs

National Parks in Staten Island



Decision Support Services



Watch/Warning Phase (0-48 Hours)

NWS Interns Assigned as DSS Coordinators

Develop a 1-page Briefing with Lead Forecaster and WCM

Use NWSChat with on-site NWS Meteorologists

Coordinate all Changes with Lead Forecaster and WCM



Decision Support Services for High Winds



Watch/Warning Phase (0-48 Hours)

- Briefings
 - 10/27-10/29 - Numerous Local, State, Federal and Public entity briefings on specific surge/inundation amounts, and Media Interviews.
 - 10/27-10/29 - Formal Emails and PowerPoint presentations to our customers
 - 10/27-10/29 - Daily Webinars
 - 10/27-10/29 - Started participation in state/local conference calls. 8 to 12 per day.



High Wind Forecasts for Sandy



Watch/Warning Phase (24-48 Hours)

- High Wind Watch (NPW)
 - Sat. 10/27 (4:36 pm 1st issuance)

...DANGEROUS COASTAL STORM EXPECTED MONDAY INTO TUESDAY...

Winds...Northeast winds of 30 to 40 mph with gusts 50 to 60 mph Monday Morning...increasing to east **40 to 55 mph with gusts 70 to 80 mph Monday Afternoon and Evening.**

Impacts...**A significant threat to life and property exists.** Possibility of moderate wind damage. Winds will be capable of downing trees and snapping off large tree branches. **Power outages could last at least several days.** Minor structural damage to building and homes is possible. Windows in high rise building could be broken by flying debris.



High Wind Forecasts for Sandy



Watch/Warning Phase (24-48 Hours)

- High Wind Warning (NPW)
 - Sun. 10/28 (4:35 am 1st issuance)

...DANGEROUS COASTAL STORM MONDAY INTO TUESDAY...

Winds...East winds of **35 to 55 mph with gusts up 70-80 mph**...strongest Monday afternoon into Monday night.

Impacts...**Added**...Debris will block some roads.



High Wind Forecasts for Sandy



Warning Phase (12-24 Hours)

- High Wind Warning Updated (NPW)
 - Mon. 10/29 (7:42 am)

**...HURRICANE FORCE WIND GUSTS EXPECTED THIS
AFTERNOON AND EVENING...**

Winds... Southeast winds of 30 to 50 mph with gusts 80 to 85 mph. Gusts up to 90 mph possible along immediate south facing coastlines.



High Wind Forecasts for Sandy



Warning Phase (0-12 Hours)

- Special Weather Statement (SPS)
 - Mon. 10/29 (4:58pm)

...OCCASIONAL DAMAGING WIND GUSTS OF 70-90 MPH EXPECTED ACROSS THE NEW YORK CITY METROPOLITAN AREA...LONG ISLAND...AND SOUTHERN CONNECTICUT THROUGH 8 PM...

GUSTS OF THIS MAGNITUDE WILL DOWN NUMEROUS TREES...INCLUDING LARGE ONES. HIGH RISE BUILDINGS ARE ALSO SUSCEPTIBLE TO DAMAGE WITH THESE GUSTS. PERSONS ARE URGED TO REMAIN SHELTERED IN A STURDY BUILDING DUE TO THE THREAT OF FALLING TREES...LARGE LIMBS AND FLYING DEBRIS



Forecast Accuracy High Winds



Verification

High Wind Watch Issued
Sat. Oct. 27 at 4:36 pm

Verified with a
Lead Time of 45 Hours

High Wind Warning
Issued Sun. Oct. 28 at
4:35 am

Verified with a
Lead Time of 33 Hours

**Lead Times are Comparable to the
Issuance of a Hurricane Watch/Warning**

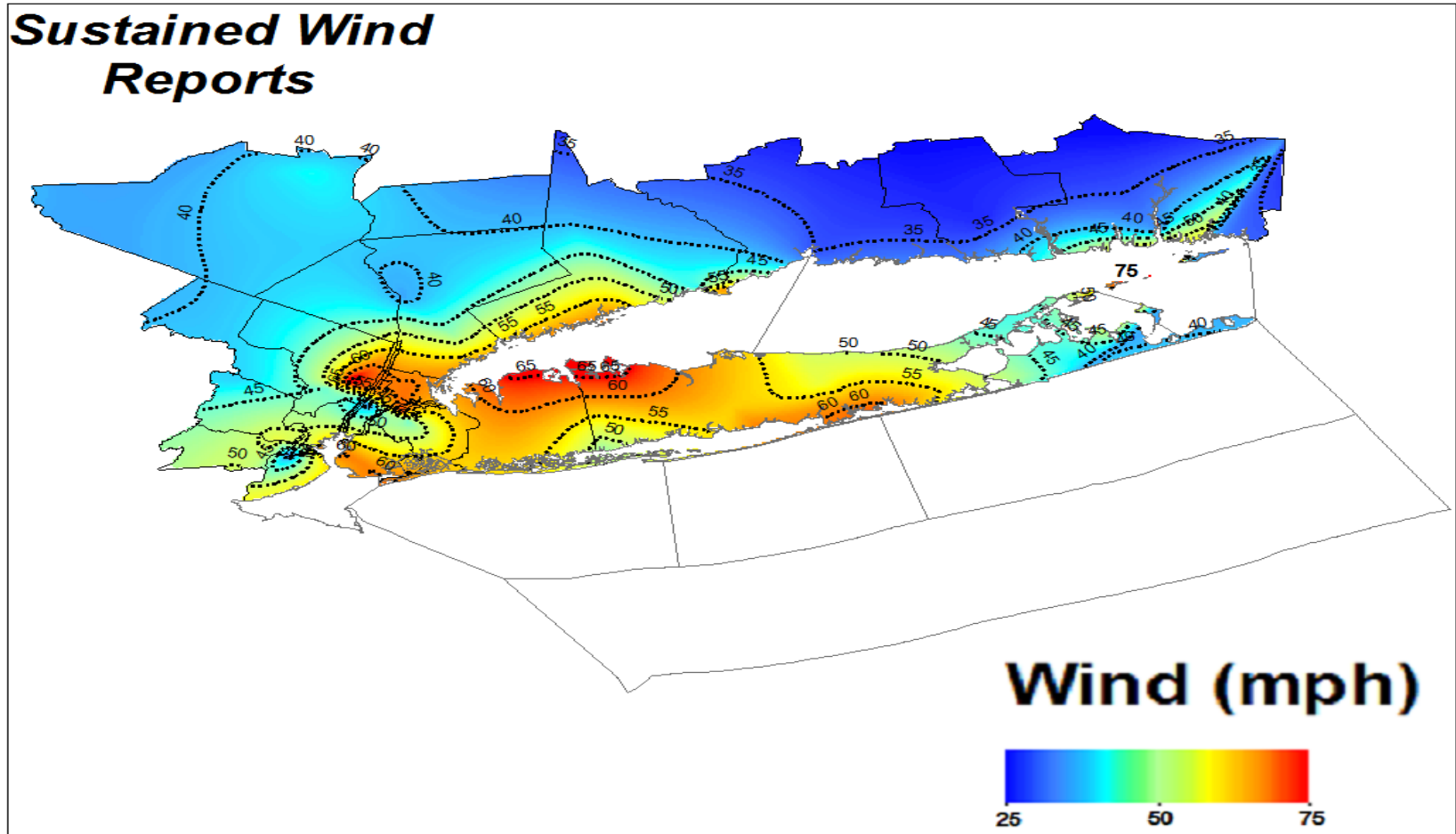
Lead Times are on the High End of National Watch/Warning Goals



Sandy's High Winds

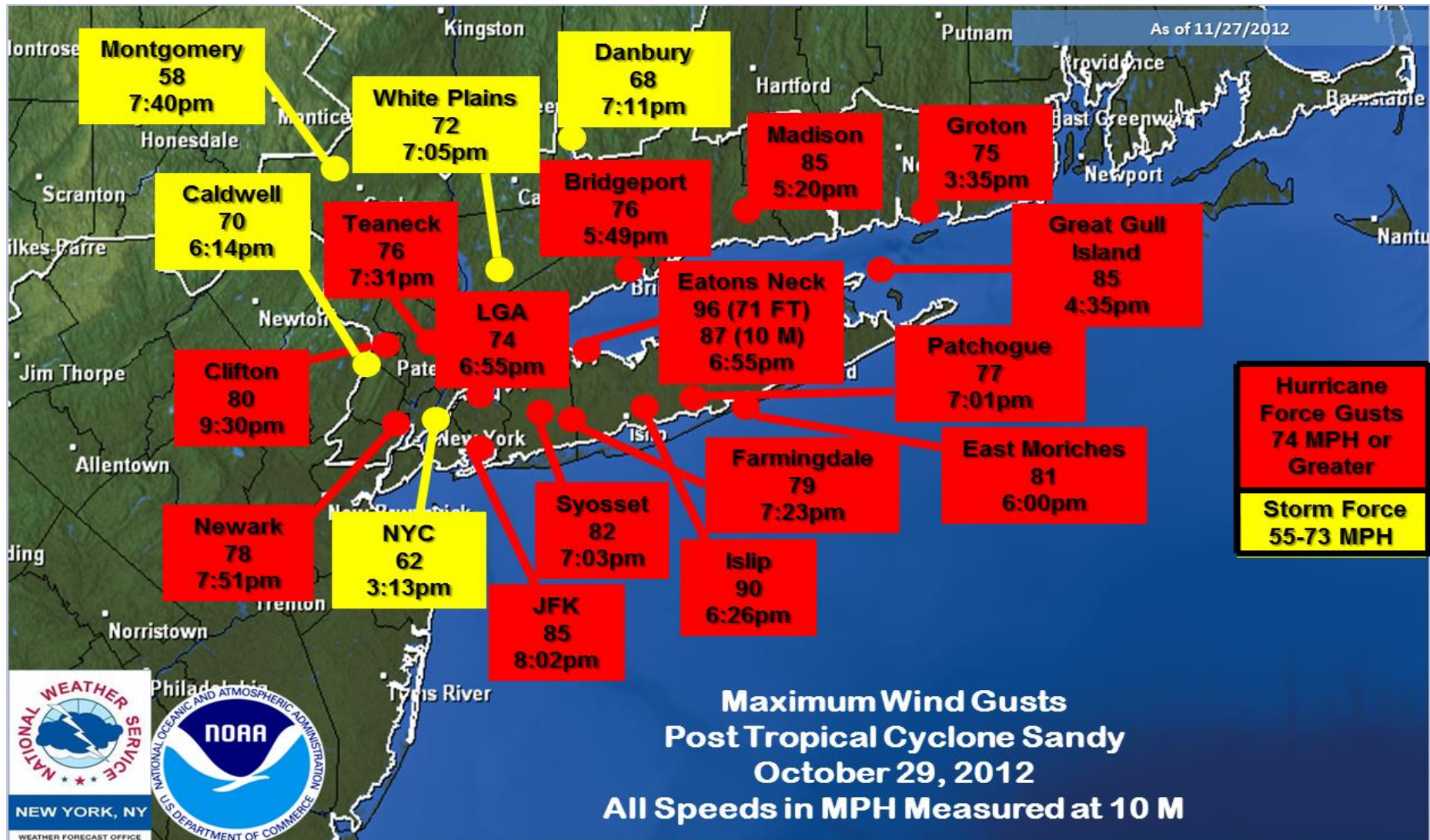


Sustained Wind Reports





Sandy's Wind Gusts





Forecast Accuracy High Winds



Successes

- Forecasts were extremely accurate with observations within 5-10 knots of forecast values.
- Peak wind gusts greater than 95% accurate
- Comparable lead time to a hurricane watch/warning



Forecast Accuracy High Winds



Recommendations

- Review Call To Action Statements for Inclusion of Safety Tips
 - Stay away from downed electric lines
 - Stay clear of the fall radius of large trees and their branches
 - Make sure generators are kept outside and exhaust is properly diverted away from your home
 - Check on the elderly, disabled, and infirmed.



Coastal Flooding Services for Sandy





Sandy Coastal Flooding



The Impacts

- Widespread major damage to coastal communities
 - Buildings, Tunnels, Roads, Rail, Electrical, Telco, Gas, Water, Sewage Facilities, Ports, Marinas, Boardwalks
- Severe beach erosion with several breaches of barrier beaches and destruction of many beachfront structures



Sandy Coastal Flooding



The Forecasts Quantifying the Surge

- 6 to 10 feet of surge during Mon. Eve 10/29 high tide combined with high wave action
 - Widespread 2-5 ft. Above Ground Level (AGL) coastal inundation
 - 3 to 6 ft. AGL along NY Harbor and 5 to 8 ft. AGL in Northeast Staten Island
 - Preceded by widespread moderate to major coastal flooding with Monday morning high tide
- Major to Record Coastal Flooding across entire coastline
- Minor to Moderate surge flooding up coastal rivers



Sandy Coastal Flooding



The Forecasts Timing the Surge

- **Sandy's sudden acceleration before landfall caused the highest winds to coincide with the approach of high tide across the NY Harbor/South shores resulting in higher storm tides**
- Conversely, the highest winds did not coincide with the approach of high tide across the western shores of Long Island Sound resulting in slightly lower storm tides
- **The NWS can not accurately predict a sudden acceleration!**



Coastal Flooding Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- HWO (Hazardous Weather Outlook)
 - Tue. 10/23 (3:55 pm) - Potential for major coastal storm with coastal flooding and beach erosion.
 - Thu. 10/25 (5:16 am) - Increasing confidence in major coastal storm with coastal flooding and beach erosion.
 - Thu. 10/25 (4:35 pm) - Increasing confidence in major coastal storm with significant shoreline impacts of coastal flooding and beach erosion.



Coastal Flooding Forecasts for Sandy



Threat Phase – (Days 3 to 5)

- AFD (Area Forecast Discussion)
 - Tue. 10/23 (4:10 pm) - A worst case scenario of flooding rains...damaging winds...and significant coastal flooding for parts of the area. STAY TUNED.
 - Thu. 10/25 (4:10 am) - Potential for moderate or higher coastal flooding.
 - Thu. 10/25 (3:59 am) - Potential for widespread significant coastal flooding.
 - Thu. 10/25 (3:54 pm) - Increasing confidence in prolonged and widespread significant coastal flooding event...with battering high surf, major beach erosion, wash overs, and damage to vulnerable coastal structures.



Coastal Flooding Preparedness for Sandy



Threat Phase – (Days 3 to 5)

- Public Information Statement (PNS)
 - Thu. Oct 25 (8:55 pm)

LISTEN CAREFULLY TO LOCAL OFFICIALS AND EVACUATE THE AREA IF TOLD TO DO SO. IF YOU DO NOT EVACUATE TO AN OFFICIAL SHELTER...YOU MAY CONSIDER STAYING AT A FRIENDS OR RELATIVES HOME OUT OF THE EVACUATION ZONE. **LEAVE LOW LYING OR COASTAL AREAS...AS WELL AS OFFSHORE ISLANDS.** THESE ARE THE LOCATIONS MOST PRONE TO STORM SURGE. **STORM SURGE IS THE MOST DANGEROUS PART OF A STORM SUCH AS THIS ONE.** THE SURGE IS A DOME OF WATER THAT COMES ACROSS THE COAST AS THE STORM MAKES LANDFALL. **IF YOU LIVE CLOSE TO THE COAST IN A MOBILE HOME YOU SHOULD EVACUATE TO A MORE SUBSTANTIAL SHELTER...EVEN IF YOU ARE NOT IN A STORM SURGE PRONE AREA.**

Long list of preparedness information followed...



Decision Support Services for Coastal Flooding



Threat Phase – (Days 3 to 5)

- Briefings
 - Tue. 10/23 - Informal Local, State, Federal and Public entity briefings, and Media Interviews
 - Wed. 10/24 - Started Formal Emails and PowerPoint presentations to our customers
 - Wed. 10/24 - Started daily Webinars
 - Thu. 10/25 - Started participation in state/local conference calls.



Decision Support Services for Coastal Flooding



Threat Phase – (Days 3 to 5)

- Coordination Calls

- Fri. 10/26 (11:00 am)

- Conference call with USGS, NHC, and SUNY Stony Brook on strategic deployment of supplemental surge sensors** along the entire coastal area. www.usgs.gov/hurricanes.

- Fri. 10/26 (12:30 pm)

- NHC/ER ROC/Coastal WFO's storm surge coordination call. NHC recommended that there was too much uncertainty on track and hybrid nature of the storm to give specific surge numbers .



Coastal Flooding Forecasts for Sandy



Watch Phase (36-48 Hours+)

- Coastal Flood Watch (CFW)
 - Watch issued for first astronomically high tide cycle forecast to meet moderate bench marks on Monday morning
 - Sat. 10/27 at 5:46 am (1st issuance)
 - 2 to 3 ft. surge Mon into Tue morning with possibly higher departures depending on Sandy's track. Major beach erosion. Widespread moderate coastal flooding



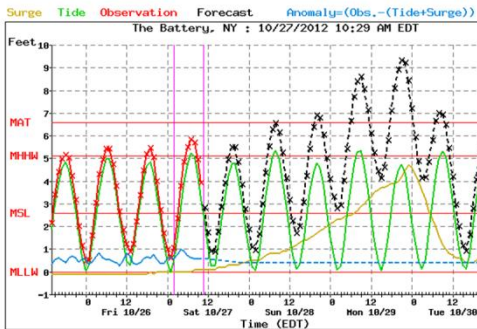
Coastal Flooding Forecasts for Sandy



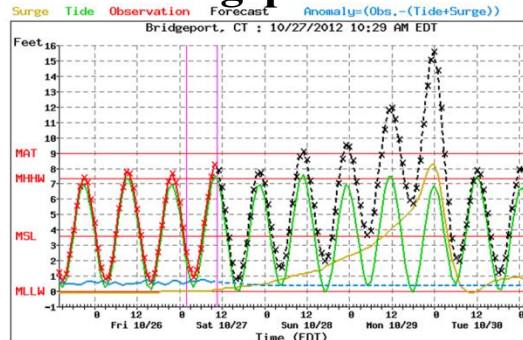
- NWS Webinar (Sat. 10/27 at 10:30 am) – Starting Sat. Morning there was enough confidence for us to brief of 4-8 ft. surge threat. Uncertainty on giving exact numbers prior to this time.



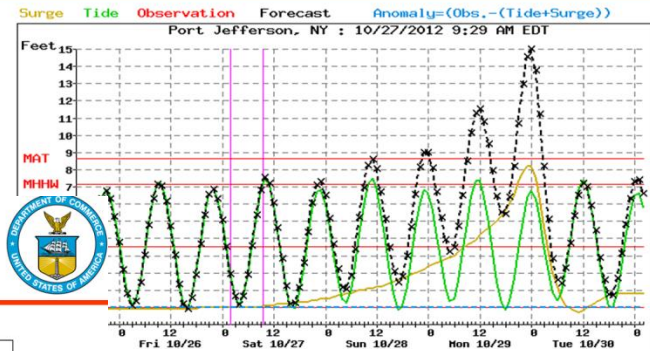
Coastal Flooding/Battery 4-8 Foot Surge Possible



Coastal Flooding Likely 4-8 Foot Surge Possible Bridgeport



Coastal Flooding/Pt Jefferson 4-8 Foot Surge Possible





Coastal Flooding Forecasts for Sandy



Watch Phase (36 – 48 Hours+)

- Internal Coordination Calls – Deliver Unified Message
 - Sat. 10/27 (12:30 pm) - NHC/WFO/OPC/NYC storm surge briefing. NHC and OPC were in agreement with our 4-8 ft. surge forecast for Mon. Night/Tue. Morning
 - Sat. 10/27 (1:45 pm) - ERH and Coastal WFO collaboration on products. Collaborated Coastal Flood Warning, High Wind Warning, Flood Watch, Hurricane Wind Watch.



Coastal Flooding Forecasts for Sandy



Watch Phase (36-48 Hours+)

- Coastal Flood Watch updated for Higher Surge (CFW)
 - Sat. 10/27 at 1:39 pm

2 to 4 ft. surge Mon. Morning high tide, 4 to 8 ft. surge Mon. Night into Tue. Morning. Major coastal flooding with potential damage. Major beach erosion, wash overs and damage to shoreline structures.



Decision Support Services Coastal Flooding



Watch/Warning Phase (0-48 Hours)

- Briefings
 - 10/27-10/29 - Numerous Local, State, Federal and Public entity briefings on specific surge/inundation amounts
 - 10/27-10/29 - Formal Emails and PowerPoint presentations to our customers
 - 10/27-10/29 - Daily Webinars
 - 10/27-10/29 - Started participation in state/local conference calls. 8 to 12 per day.



Decision Support Services Coastal Flooding



Watch/Warning Phase (24-48 Hours)

- Coordination Calls
 - Sat. 10/27 (3:00 pm) Collaborative conference call with NHC storm surge Unit and NYC OEM to develop a methodology for providing NYC AGL inundation amounts for key locations.
 - Sun. 10/28 (2:30 am) ERH and Coastal WFO collaboration on products. Upgrade watches to warnings.
 - Sun. 10/28 (3:56 am) NHC Storm surge unit and WFO coordination on storm surge forecast. Collaborated on a slight (around 1 ft.) increase in surge.



Weather Forecast Office (WFO) Tools for Coastal Flooding



- Tools used by WFO Forecasters are Inadequate and at too Low a Resolution to Produce Highly Detailed and Specific Storm Surge Forecasts



Coastal Flooding Forecasts for Sandy



Watch/Warning Phase (24-48 Hours)

- Coastal Flood Warning (CFW)
 - Sat. 10/27 (5:34 pm 1st issuance) - 4 to 8 ft. surge Mon Night into Tue Morning. Major to possibly record breaking coastal flooding Mon Night high tide cycle. Significant inundation and damage to flood prone structures. Breaking waves of 15-20 ft. along ocean facing shoreline and 5 to 8 ft. in LI Sound, bays and harbor. Major beach erosion and wash overs. Tide tables for Mon morning high tide cycle.
 - Sat. 10/27 (11:23 pm) - Increased to 5 to 10 ft. surge.
 - Sun. 10/28 (8:00 am) - Increased to 5 to 10 ft. surge...with 6 to 11 ft. surge in most flood prone spots.

...LIFE THREATENING COASTAL FLOODING EXPECTED MONDAY...



Coastal Flooding Forecasts for Sandy



Watch/Warning Phase (24-36 Hours)

- Coastal Flood Warning (CFW)
 - Sun. 10/28 (1:29 pm) 6 to 11 ft. surge...the higher end along NY Harbor...Western LI sound...and the south shore bays of Long Island
 - *Potential is increasing for significant inundation and damage to structures in flood prone areas.
 - *15 to 20 ft. breakers along ocean facing shorelines...5 to 10 ft. LI Sound, NY Harbor and Bays of LI. Major beach erosion and wash overs. **Destructive wave action on top of storm surge will cause significant damage to coastal infrastructure.**
 - *Added Monday Night tide tables



Coastal Flooding Forecasts for Sandy



Warning Phase (12-24 Hours)

- Coastal Flood Warning (CFW)
 - Mon. 10/29 (3:57am)
 - *Use of ranges in tidal tables to better express uncertainty in timing and extent of surge.
 - *Potentially historic coastal flooding Tonight into early Tuesday morning. **Potential is high for significant inundation and damage to structures in historically flood prone spots.**
 - *15 to 20 ft. breakers along ocean facing shorelines...and 6 to 12 ft. waves along exposed East and Northeast facing portions of Long Island Sound...Peconic and Gardiners Bays and New York Harbor. **These destructive waves on top of storm surge will cause significant damage to coastal structures.**
 - Mon. 10/29 (11:13 am)
 - Minor to moderate flooding due to surge up coastal rivers



Coastal Flooding Forecast Accuracy



Verification

Coastal Flood Watch **Verified with a Lead Time of 50 Hours**
Issued Sat. Oct. 27 at 5:46 **Hours** (Mon morning high tide)
am

National lead time goals for watches are 36 to 48 hrs.

Coastal Flood Warning **Verified with a Lead Time of 38 Hours**
Issued Sat. Oct. 27 at 5:34 **Hours** (Mon morning high tide)
pm

National lead time goals for warnings are 24 to 36 hrs.



Coastal Flooding Forecast Accuracy



WATER LEVELS FOR THIS EVENING AND TONIGHTS HIGH TIDE CYCLE

...NY HARBOR WATER LEVELS FOR THIS EVENING... Mon 10/29 357am CFW

COASTAL LOCATION	TIME OF HIGH TIDE	FORECAST TOTAL WATER LEVEL (MLLW)	FLOOD CATEGORY
THE BATTERY NYC	813 PM	10-12	MAJOR
BERGEN POINT NY	814 PM	12-13	MAJOR

...WESTERN L.I. SOUND WATER LEVELS FOR TONIGHT...

COASTAL LOCATION	TIME OF HIGH TIDE	FORECAST TOTAL WATER LEVEL (MLLW)	FLOOD CATEGORY
KINGS POINT NY	1227 AM	15-16	MAJOR
LATTINGTOWN NY	1205 AM	15-16	MAJOR
STAMFORD CT	1201 AM	14-15	MAJOR
BRIDGEPORT CT	1158 PM	14-15	MAJOR
NEW HAVEN CT	1157 PM	13-14	MAJOR

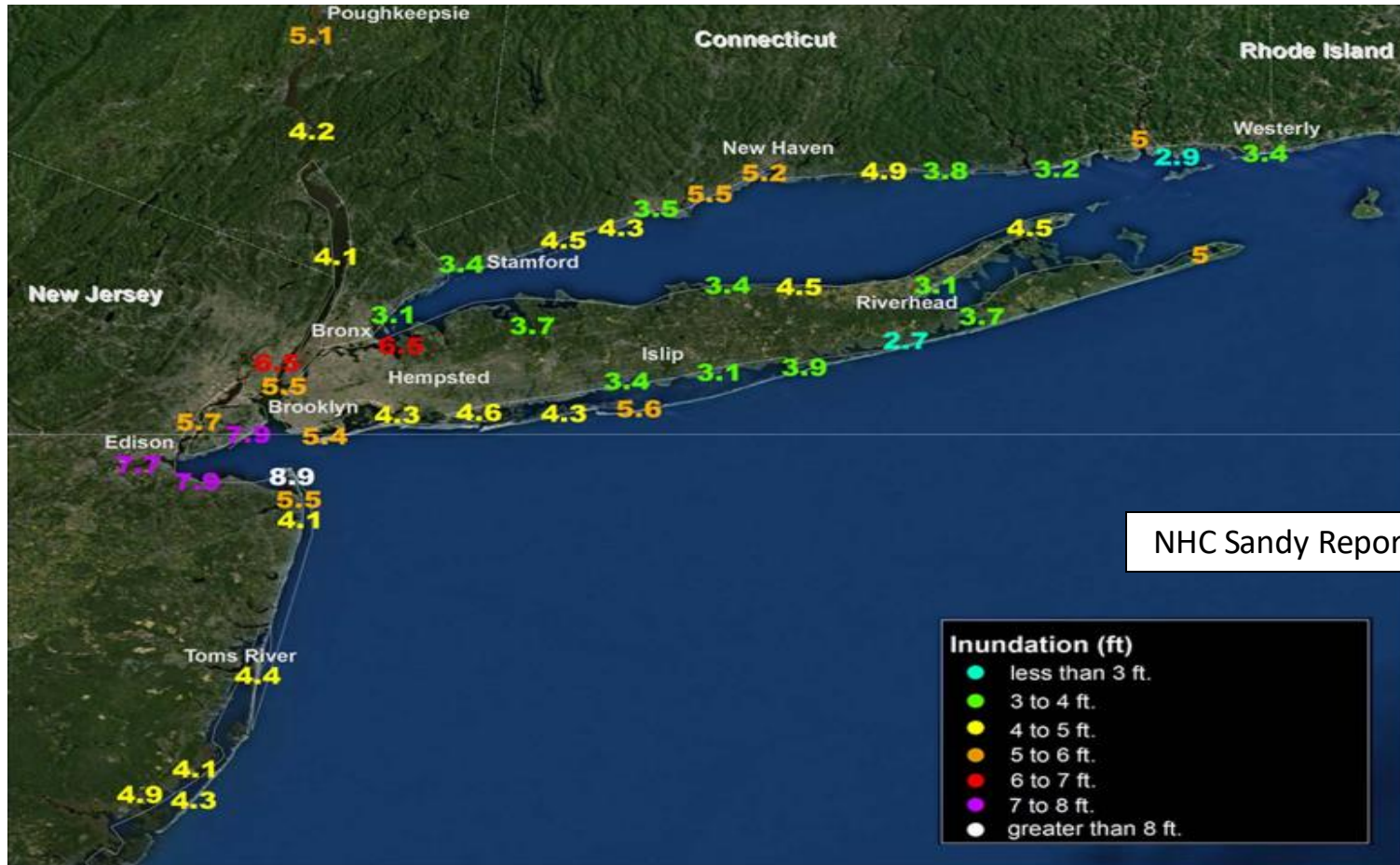
Observed

13.88 ft
14.6 ft

14.38 ft
14.06 ft
14.13 ft
13.26 ft
12.30 ft



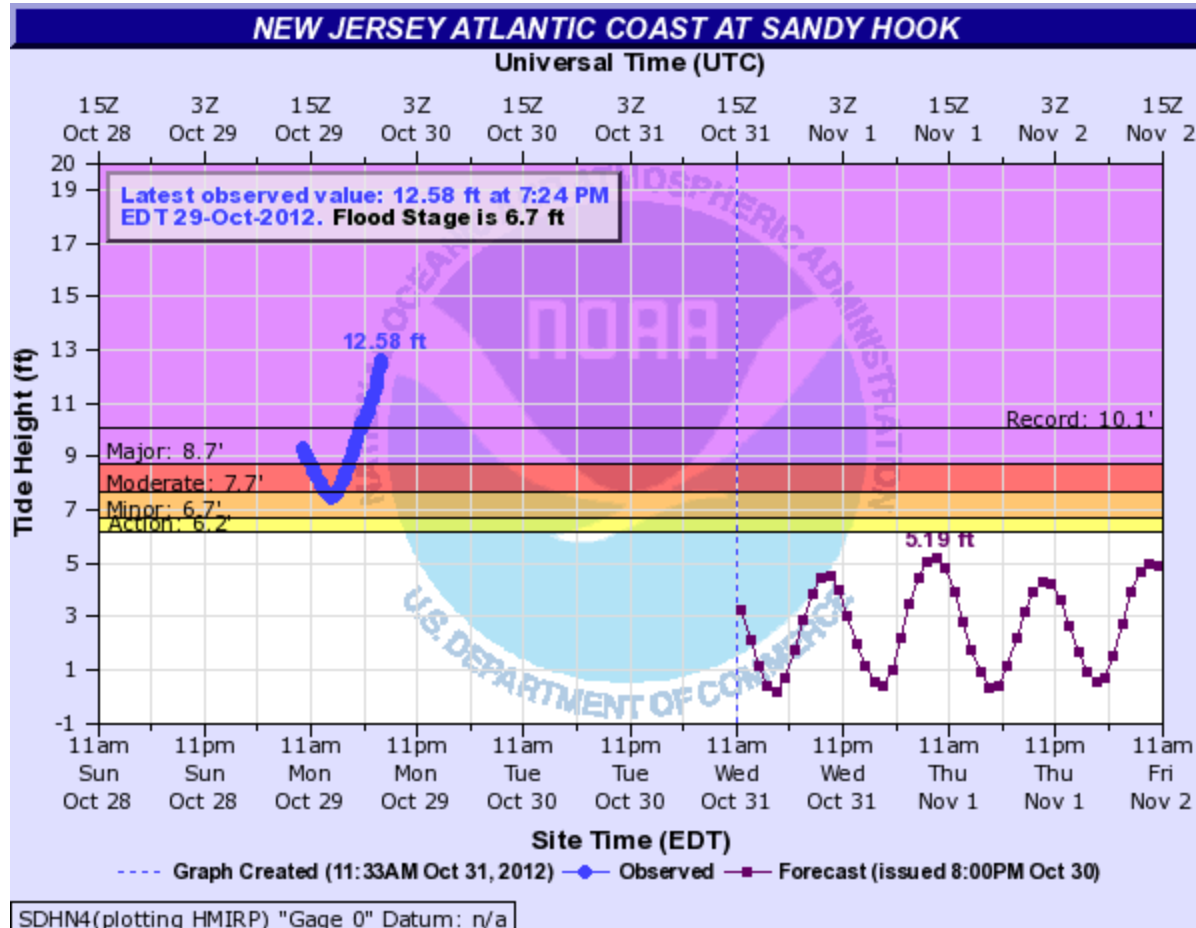
Surge Above Ground Level



NHC Sandy Report



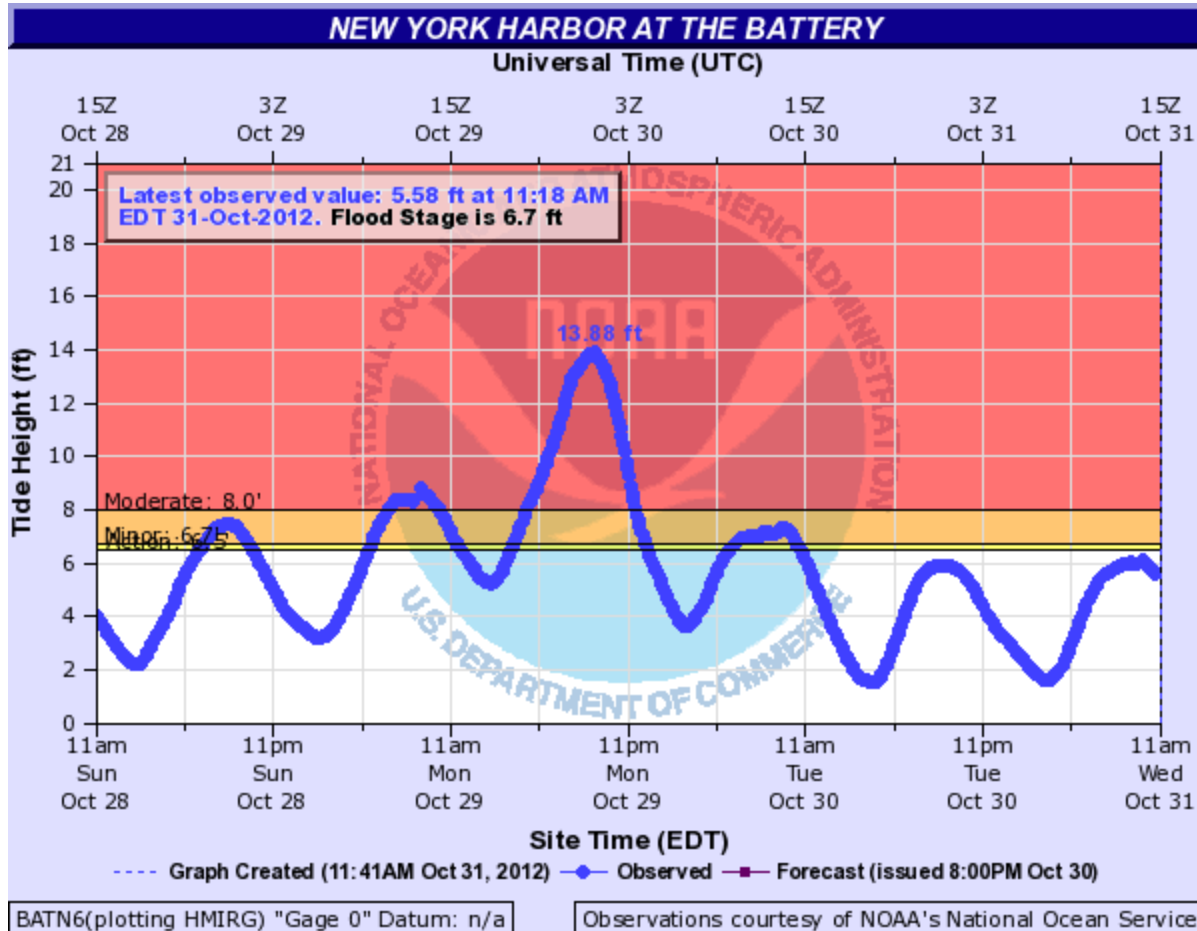
Sandy Hook, NJ





Battery

8.56 Foot Surge Above Tides





Coastal Flooding Forecast Accuracy



Successes

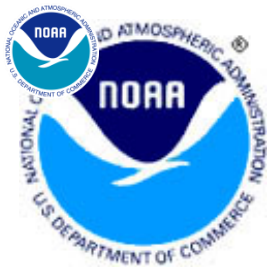
- Storm surge/storm tide forecast were within +/- 1 to 2 feet. At least 85 % accuracy in forecast.
- Positive feedback from many users including the Public, Emergency Managers, and the Media.
- Use of total water level ranges conveyed uncertainty and skill of forecast better than point forecasts.



Coastal Flooding Sandy Findings

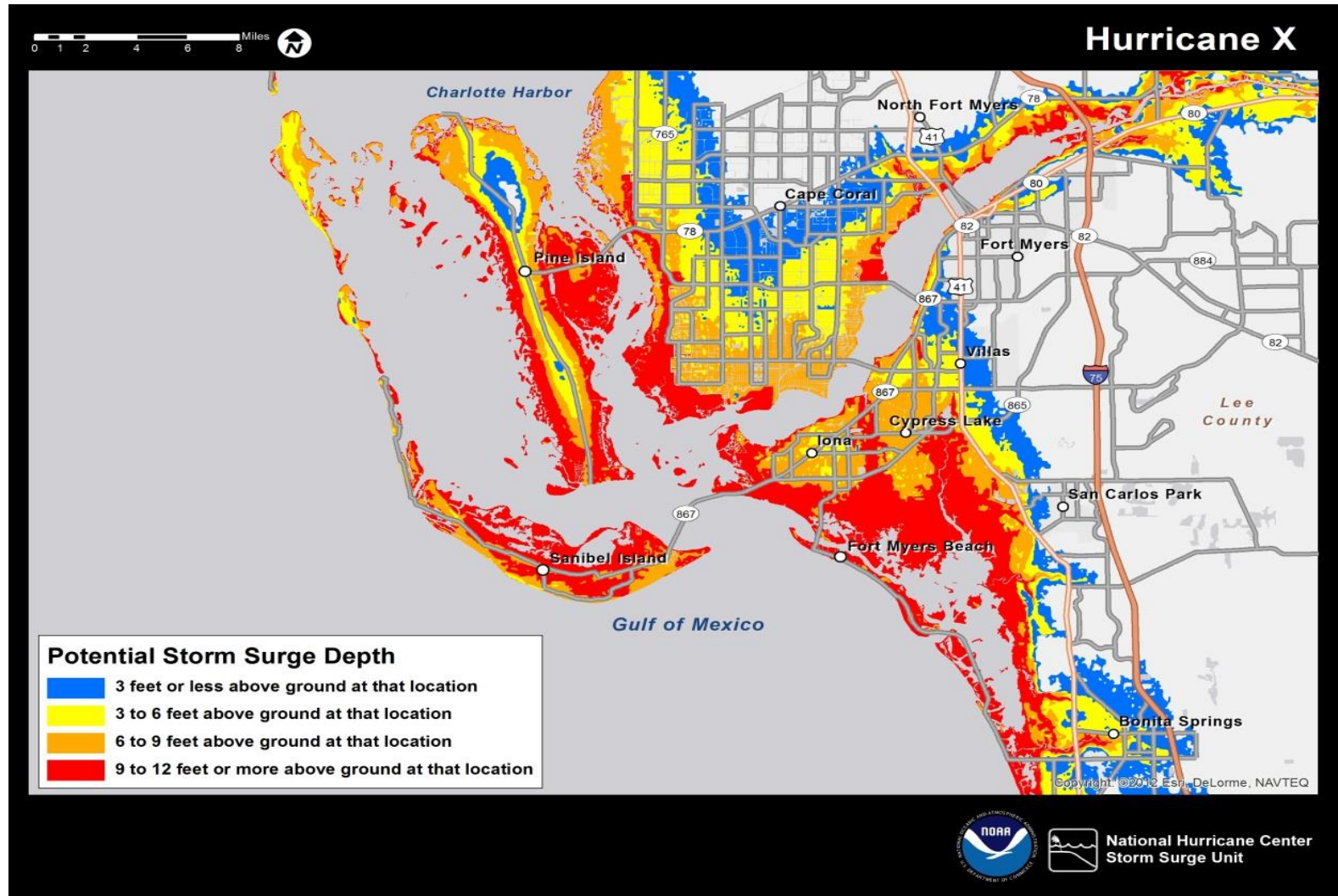
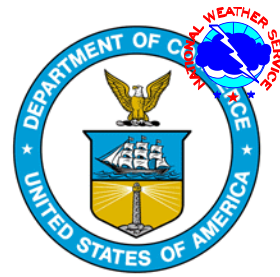


- Unprecedented hybrid system and some track uncertainty posed some uncertainty for NHC and WFOs in predicting surge, particularly more than 48 hours in advance
- **Difficult to effectively communicate surge impacts without inundation graphics...Lack of Visuals.**
- Lack of experience and understanding of storm surge and storm tide by decision makers and the public.
- Confusion among users of various datums (MSL, MLLW, NAVD88, NGVD, AGL, etc.)



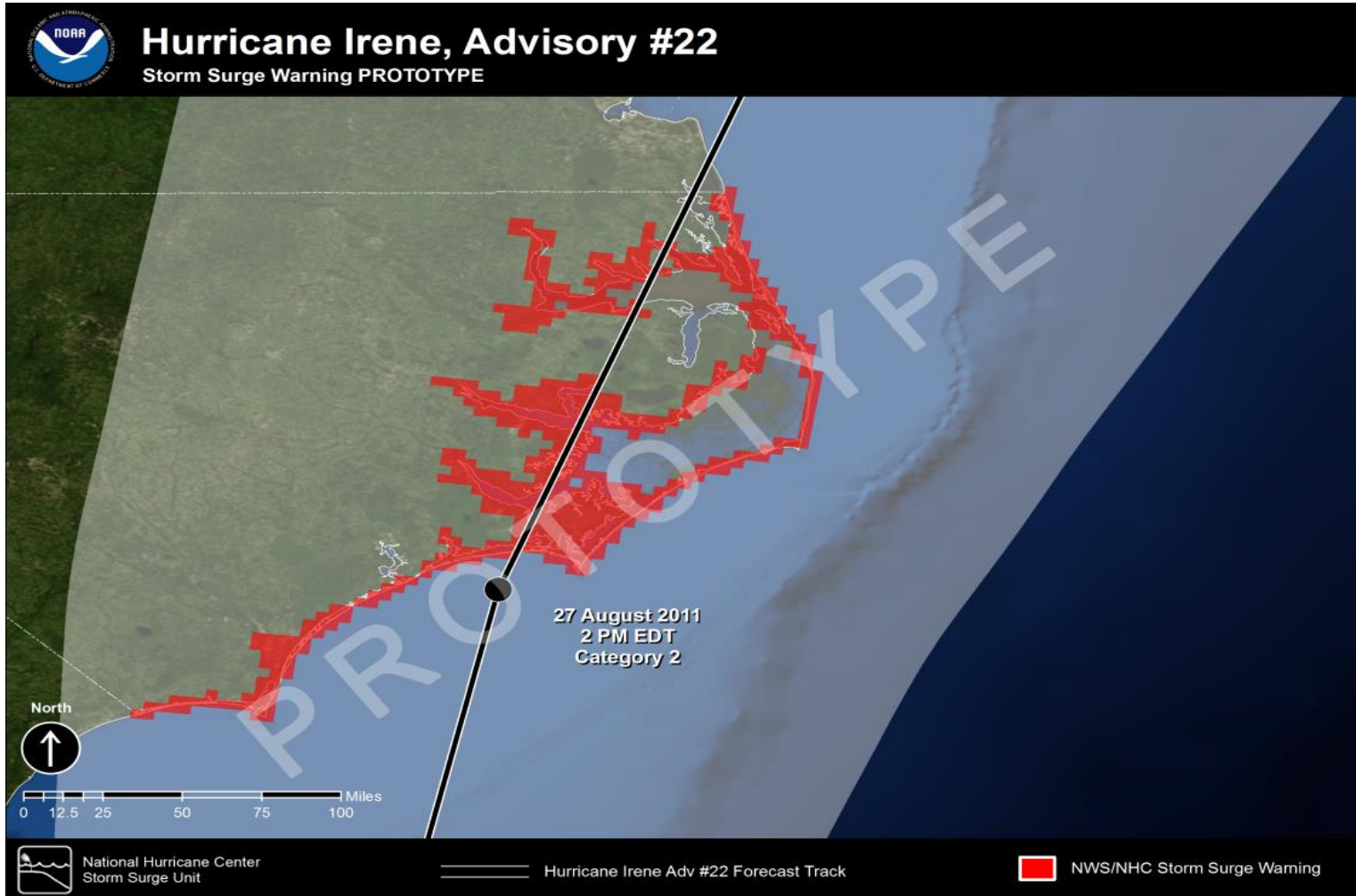
Education and Communication

Potential Surge Above Ground Level





Prototype of Storm Surge Warning Planned for 2015





Dissemination

Spreading the Word



Spreading the Word for an Extratropical System



- NWS Initiated SAME and Tone Alerts for the Issuance of Coastal Flood and High Wind Watches and Warnings – NWR Receivers
- EAS Community did “NOT” Interrupt Routine Programming to Automatically Rebroadcast Coastal Flood and High Wind Warnings – Not Considered Life Threatening



Spreading the Word for a Tropical System



- NWS would Initiate SAME and Tone Alerts for the Issuance of Tropical Storm and Hurricane Watches and Warnings – NWR Receivers
- EAS Community “would” Interrupt Routine Programming to Automatically Rebroadcast Tropical Storm and Hurricane Watches and Warnings – Considered Life Threatening



Wireless Emergency Alerts

Not Used for

Coastal Flood/High Wind Watches/Warnings
Not Considered Life Threatening



WEA During Sandy

NYC OEM Initiates Evacuation Messages



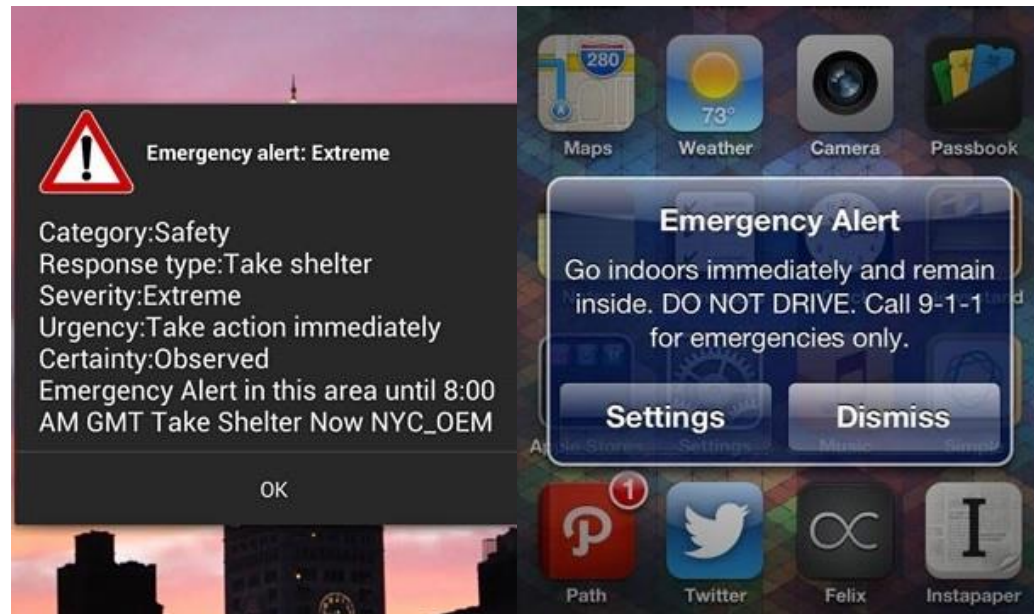
NWS

- 4 Flash Flood Warnings
- 13 Blizzard Warnings
- No Hurricane Warnings



NYC OEM

- ***“MANDATORY EVACUATION Zone A, Rockaways, Hamilton Bch, City Is. NYC.gov or 311 for details”***
- ***“Emergency Alert in this area until 8:00 AM GMT Take Shelter Now NYC_OEM”***
- ***“Go indoors immediately and remain inside. DO NOT DRIVE. Call 9-1-1 for emergencies only***





How did we Use Social Media?



- How Twitter is doing
 - Twitter Statistics
- Facebook statistics
 - Good post examples
- Social Media Benefits
 - Situational Awareness/Current Observations
 - Verification
 - How it helps in Warning decision making



Twitter



- Had an uncountable number of mentions and re-tweets at the height of Sandy. We do not respond to these but they help get our information and our account out there!
- Been managing Twitter almost exclusively through HOOTSUITE



Twitter During Sandy



A few of our higher retweets during the storm

NWSNewYorkNY
Oct 28, 9:02pm via HootSuite
Already observing surge values of 2-3 ft in NY Harbor, LI Sound, Raritan Bay, and South Shore Bays. #nywx #njwx #ctwx
98 retweets

NWSNewYorkNY
Oct 28, 5:26pm via HootSuite
You should be bringing your preparations for #Sandy to completion this evening! ow.ly/i/14hrU + #nywx #njwx #ctwx
51 retweets

NWSNewYorkNY
Oct 28, 1:48pm via HootSuite
Predicted water level of 11.7 ft at the Battery #NYC at 8:13PM MON would break record of 10.5 ft on 9/15/60 with Hurr. Donna.
259 retweets



Twitter During Sandy



New York, United States on Twitter
Popular & breaking twitter trends in New York, United States.

Topic	Tag	Action
@lucykafanov	BREAKING	view globally
nasdaq	BREAKING	view globally
buster	BREAKING	view globally
@hunterw	BREAKING	view globally
@dmvfollowers	BREAKING	view globally
@nwsnewyorkny	BREAKING	view globally

We were “trending” in New York the night of October 29. This means that we were one of the most “popular” topics at the time. These include people mentioning us, replying to us and retweeting us.

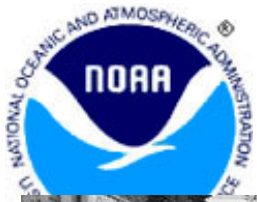


Twitter During Sandy



- Barely any spotter/EM reports were coming in during the event. The best way that we got real-time storm information and pictures (a lot of them) of flooding was :

TWITTER!



Pictures from Twitter



From Hurricane Donna-



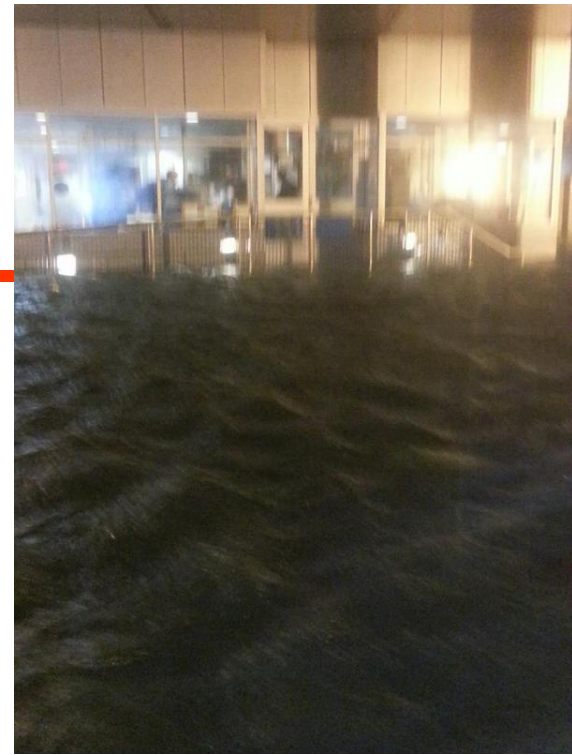
Lower Manhattan



Coney Island



South Street Seaport



Whitehall Ferry Terminal



New York Daily News @nydailynews 5m
Man found dead trapped underneath tree inside his home in Upper Manhattan, reports @CNBC bit.ly/SkKyvM #Sandy
Collapse Reply Retweet Favorite

38



Stamford Fire-Rescue @SFRD 5m
Our hearts go out to the Easton Fire Department. Multiple reports that an Easton firefighter was killed when a tree fell on his apparatus.
Retweeted by Gil Simmons NEWS8 CT
Expand



Eyewitness News @eyewitnessnyc 1m
BREAKING NEWS: A 29-year-old man from Flushing, Queens was struck by a tree limb and killed, fire officials and city officials said today.
Expand



NYT Metro Desk @NYTMetro 3m
Man in Flushing, Queens is 1st New York City fatality from the storm nyti.ms/SpLYFm



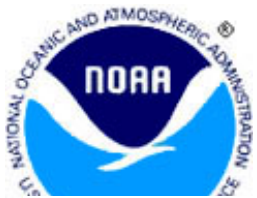
Facebook Update

New “Likes” Sandy vs. Irene



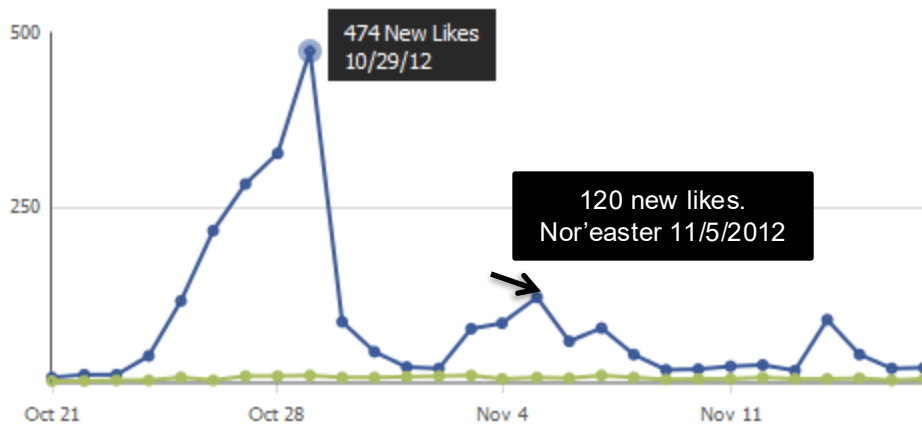
- **New “Likes” by the days during Sandy:**
 - 10/25: 115 new likes
 - 10/26: 216 new likes
 - 10/27: 283 new likes
 - 10/28: 327 new likes
 - 10/29: 474 new likes

- **New Likes By Day (highest days) during Irene:**
 - *August 24: 50 new likes*
 - *August 25: 95 new likes*
 - *August 26: 117 new likes*
 - *August 27: 89 new likes*
 - *August 28: 32 new likes*



Where Your Likes Came From

New Likes? Unlikes?



Like Sources?

- 933 On Page?
- 604 Mobile?
- 252 Timeline?
- 122 On Hover?
- 100 Facebook Recommendations?
- 86 On Photo?
- 42 Search Results?

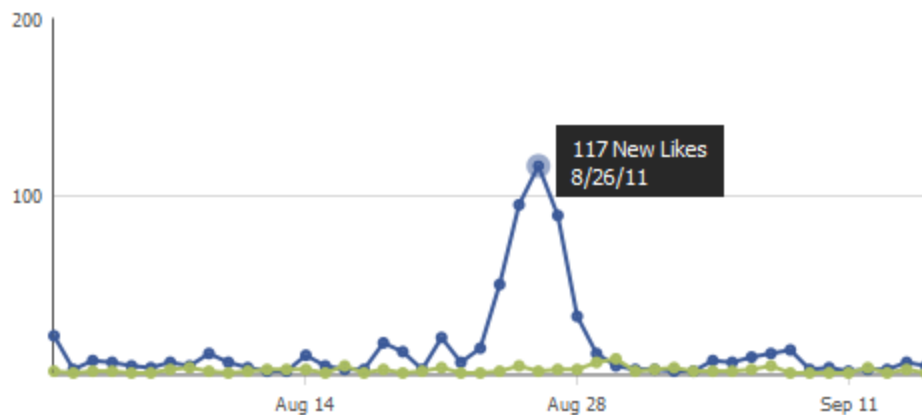
More ▾

Sandy

Irene

Where Your Likes Came From

New Likes? Unlikes?



Lik

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Posts from Sandy



Jason Reph my friend in West Babylon NY had to evacuate (South of Montauk HWY) and she said there was water over the canal roads inundating property at Sumpwams road and Shore Road (in the middle of the map by Suffolk Marine Center)
<https://maps.google.com/maps?q=Canal+St,+Lindenhurst,+Suffolk,+New+York+11757&hl=en&ll=40.694607,-73.317937&spn=0.005702,0.013036&geocode=FdyQbAIdV4ag-w&hnear=Canal+St,+Lindenhurst,+Suffolk,+New+York+11757&t=h&z=17>

DANGEROUS COASTAL STORM IMPACTING THE AREA
 Sunday Evening(10/28) through Tuesday (10/30)

For information, keep monitoring:
www.weather.gov/nyc and www.nhc.noaa.gov/
 Also Follow: @NWSNewYorkNY on Twitter



Canal St, Lindenhurst, Suffolk, New York 11757 - Google

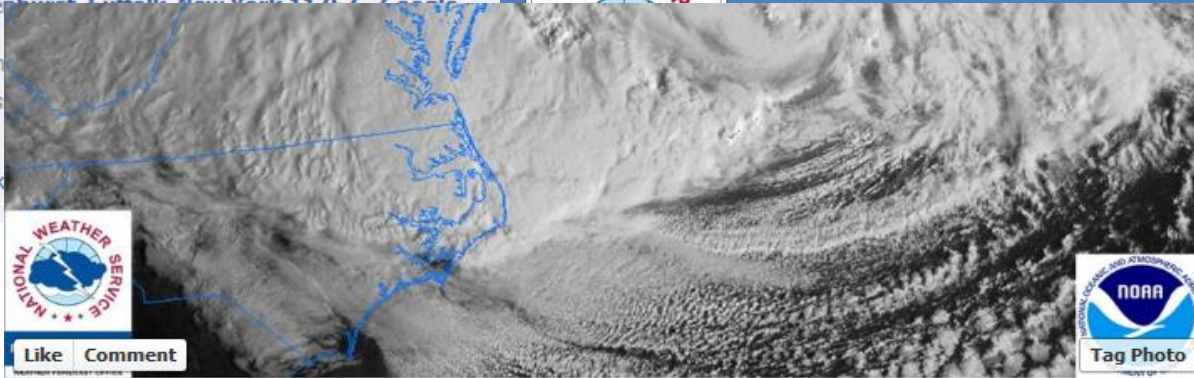
Maps

maps.google.com

Find local businesses

Maps

28 minutes ago · Liked



Like Comment



US National Weather Service New York NY

The dangerous coastal storm associated with Sandy has now begun moving north-northwest towards the New Jersey coastline. Winds have been increasing through the morning and will continue to increase as we head through the day. Significant coastal flooding has also been occurring with this morning's high tide and we expect an even higher surge with this evening's high tide. Here are some important im... See More

Like · Comment · Share · Edit · Promote · October 29

Lúcia Reine da Luz, Nuri Shakoov, Michael Raziano and 125 others like this.

1,519 shares

6 of 57

Album: Timeline Photos

Shared with: Public

Tag This Photo

Add Location

Change Date

View Larger

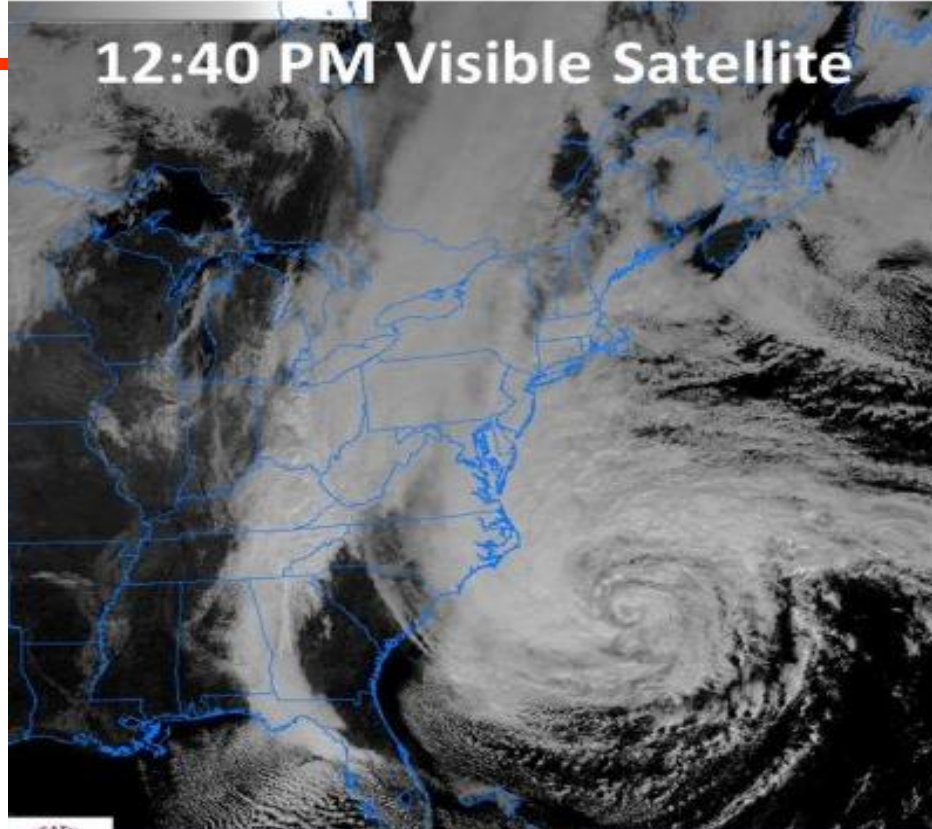
Download

Make Profile Picture for Page

Delete This Photo



Here is a satellite image from this afternoon of Sandy. This gives you an idea of the sheer size of the storm. This is why we stress not to focus on the center of the storm and where the center will make landfall. Significant impacts will...[See More](#)



5,136 people saw this post

4,546 people saw this post

Like · Comment · Share

807

Christine Robison Whelan, Katie Bittner, Susan Towsley and 99 others like this.

this.

View all 45 comments

We had 15-20 posts with over 3800 people “seeing” the posts





Coastal Storm Watches/Warnings Update

Visit weather.gov/nyc for detailed information on each product

High Wind Warning: All Counties for 6am Monday-6pm Tuesday

Flood Watch: All Counties for 6am Monday-6pm Tuesday

Coastal Flood Warning: All Coastal Areas for 6am Monday- 3pm Tuesday

Hurricane Force Wind Warning: All Forecast Waters (Atlantic Ocean Waters, South Shore Bays, NY Harbor, Long Island Sound, Peconic/Gardner Bays) for 6am Monday- 12pm Tuesday



To see what products have been issued for your specific area, go to weather.gov/nyc, and click where you live on the map on the home page.

Then you will see a list of each product valid for your area above the forecast that you can click on for more information.

HAZARDOUS WEATHER CONDITIONS

[High Wind Warning](#)
[Flood Watch](#)

[Coastal Flood Warning](#)

7-DAY FORECAST



NWS Chat – Sign Up



-
- Instant Messaging used by NWS to share critical warning decision expertise
 - Information Exchanged in Real-Time
 - NWS Needs Your Weather Reports from Your Local Area



Summary of Findings



- Education on storm surge is inadequate.
- Datum Confusion is prolific internally and externally.
- Visualizations are required to improve understanding and response to storm surge forecasts.
 - Need Inundation Graphics, showing both areal and depth of inundation in addition to Text
- Storm surge is still tied to the Saffir Simpson Scale in local Emergency Preparedness Plans for evacuation decisions.
- There is a Lack of Education and Skill in Communicating Forecast Uncertainty.



Questions?



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(631) 924-0593 Ext. 223