Flood risk: Lessons Learned from Hurricane Sandy

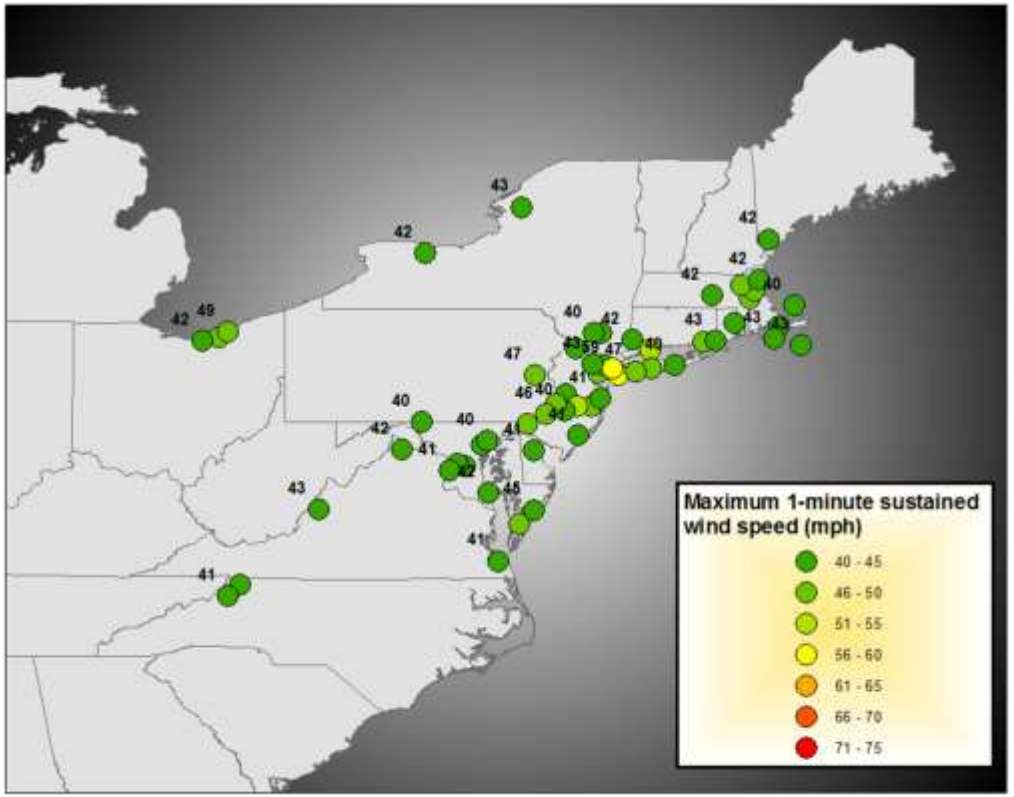
Cagdas Kafali, Ph.D.

Casualty Actuarial Society
2013 Seminar on Reinsurance
Southampton, Bermuda; June 6-7, 2013

Sandy Impacted Both the Caribbean and Mid-Atlantic Coastline During It's Nine Day Duration

- Sandy's peak intensity occurred off the coast of Cuba on October 25
- The lowest central pressure (940 mb) was observed just prior to landfall, making this the lowest for a northeast hurricane (6 mb lower than the 1938 "Long Island Express")
- Sandy's diameter made it the largest Atlantic hurricane on record. This large size actually helped to lessen the maximum wind speeds, as the pressure difference driving the winds was spread over a larger distance
- Strong winds offshore, coupled with astronomical high tides and westerly track, increased the storm surge risk

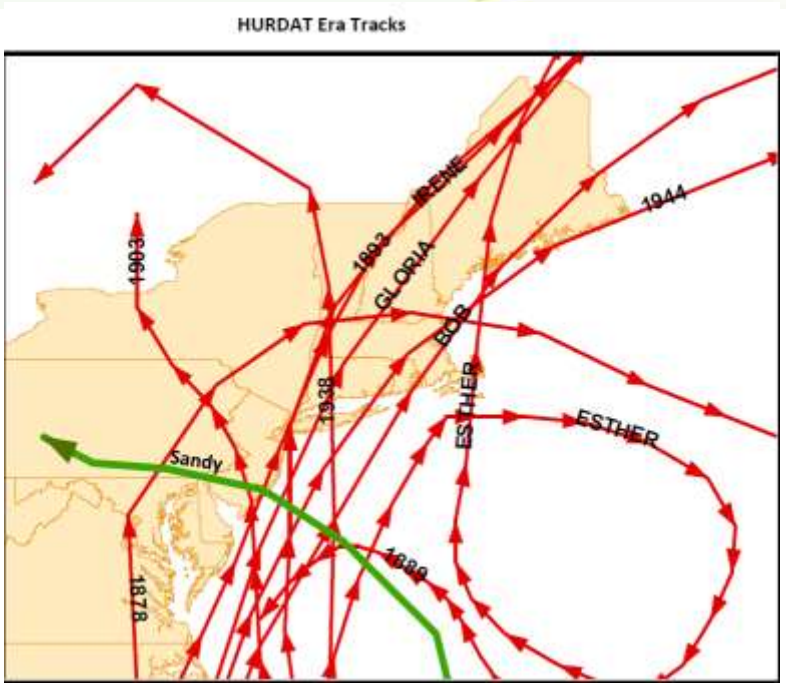
Observations from Sandy Indicate the Overland Wind Field Was Broad But Moderate



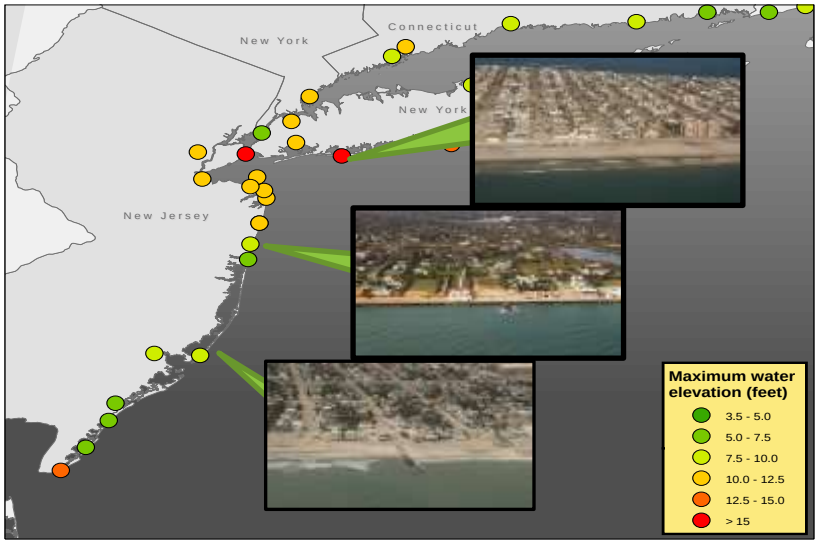
Source: NOAA-NWS 2-minute METAR observations adjusted to 1-minute averaging time

Sandy's Intense Storm Surge Was Influenced By Many Factors

- Westerly track propagation
- Low central pressure
- Large wind field
- Strong intensity of offshore winds prior to landfall
- Astronomically high tides

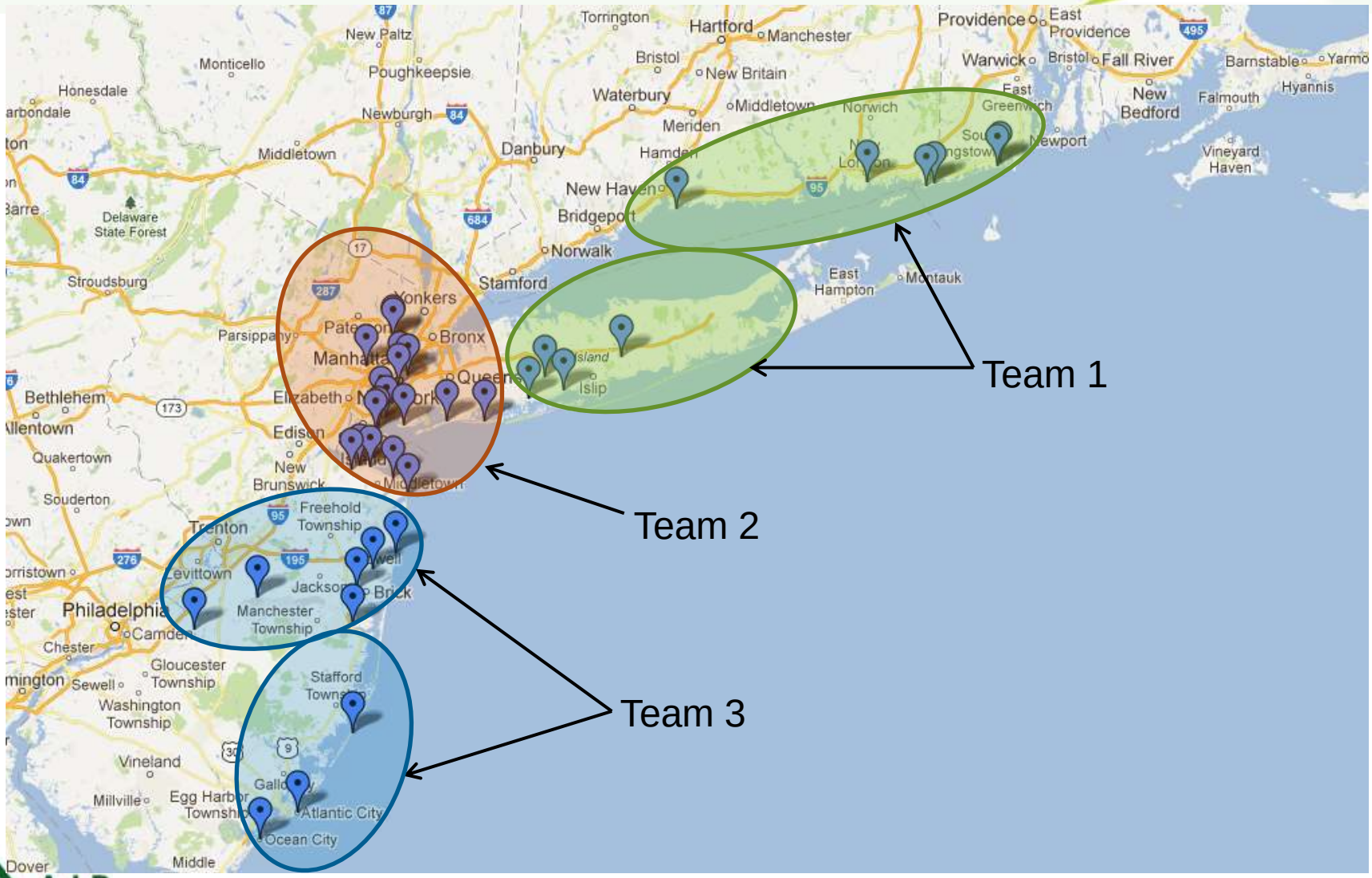


- Damaging surge occurred from Southern New Jersey to Eastern Long Island



Source: USGS/FEMA water height observations and http://coastal.er.usgs.gov/hurricanes/sandy/post-storm-photos/obliquephotos.html

AIR Sent Teams on Damage Surveys Following Sandy to Assess Affected Areas



Wind Damage to Residential Structures Was Generally Minor, Except in Cases of Downed Trees

- Minor damage seen in majority of cases
- Parts of New Jersey and New York observed moderate wind damage, mainly to older structures
- Significant damage was typically due to trees falling

Long Island, NY

Westerly, RI

Rockaway, NY

Ocean City, NJ

New London, CT

Wind Damage to Engineered Structures Was Less Pronounced

- Wind damage to engineered structures was occasional
- High-rise commercial structures in Atlantic City, NJ experienced some signage and cladding damage
- Few apartment buildings suffered roof damage due to rooftop equipment and damage to soffits

Long Island, NY

Cosey Beach, CT

Atlantic City, NJ

Rockaway, NY

Surge Damage to Residential Structures Was Significant in Many Coastal Counties

- Significant surge damage all along the coastline of NJ, NY, and parts of CT and RI
- First floor elevation, foundation type, and presence of basement were major factors of damage

Seaside Bright, NJ

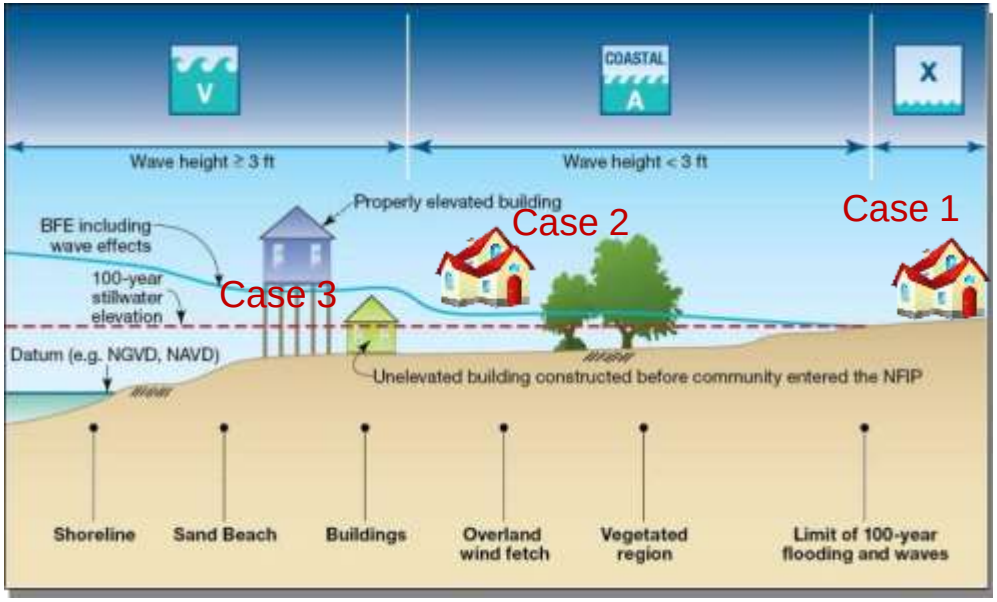
Long Beach Island, NJ

Westerly, RI

Long Island, NY

Significant Surge Damage in Residential Properties Can Be Attributed to Several Factors

- In some areas Sandy's surge extended beyond FEMA's 100-year flood zones (A and V)
- Within A and V zones, Sandy's surge heights exceeded recommended design levels (i.e., Base Flood Elevation or BFE)
- There were many residential properties that did not meet recommended design levels, both Pre- and Post-FIRM



Source: FEMA P-55 Coastal Construction Manual

In Some Areas Sandy's Surge Extended Beyond FEMA's 100-year Flood Zones (A and V)

- Damage occurred primarily to basements, garages and first floors in residential neighborhoods
- Significant contents damage

Significant damage to the basement

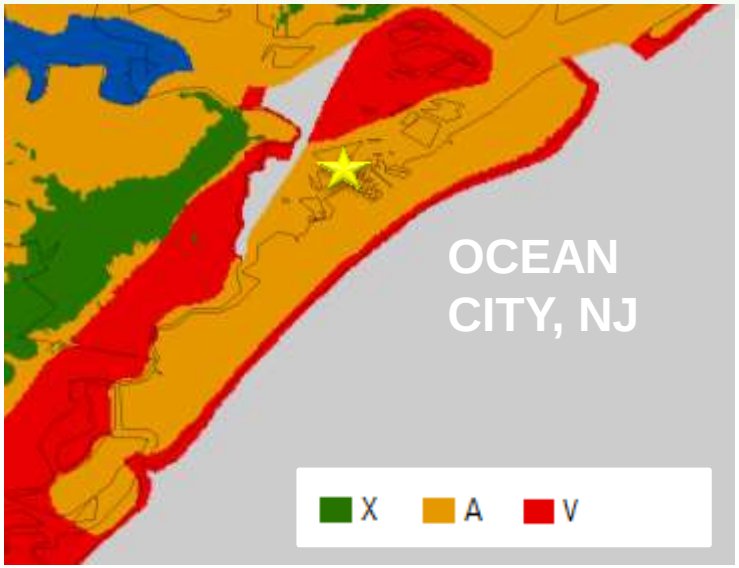
Damaged contents in garage

There Were Many Residential Properties That Did Not Meet Recommended Design Levels, Both Pre- And Post-FIRM

Midland Beach

New Dorp Beach

Houses Built According to FEMA Recommendations Generally Fared Much Better



Keyport, NJ

Measured surge height of 4ft in the center building

Surge Damage to Commercial Structures Was Significant But the Level of Insurance Coverage Varies Widely

- Wide spread flooding was prevalent in all the areas visited in Manhattan, NY and Atlantic City, NJ
- Presence of underground spaces used for storage, as a basement, or as a garage was widespread
- Widespread contents damage
- Power and gas were still to be restored to many facilities
- Small commercial businesses (restaurants, grocery stores) may not possess any type of flood coverage



Lower Manhattan, NY


Coney Island, NY

Many High-rise Commercial Buildings Were Closed Due to Damage to Critical Equipment and Utility Failure

X A V

Source for damage data points:
http://fema-services2.esri.com/arcgis/rest/services/2012_Sandy

Lower Manhattan, NY

Key Drivers Of Downtime and Business Interruption Losses in Commercial Exposures

- Concentration of critical components in “floodable” parts of the building
- Utility failures
- Restoration of functionality (repair crews and spare parts)
- Level of flood and BI coverage
- Policy conditions – deductibles, sub-limits




How Can Flood Damage Caused by Sandy Be Explained in the Context of NY and NJ Building Codes?

- Residential construction – community flood management program instituted by NFIP
- ASCE 24 addresses elevation for commercial buildings
- NFIP specified BFEs are relatively new when compared to the age of buildings located along the NY and NJ waterfronts
- Early BFEs did not account for wave action – BFEs accounting for wave action were inducted in the 1980s
- Older properties grandfathered into the NFIP could have habitable spaces below the BFE

Significant Auto Damage Occurred in Metropolitan Areas

- No evacuation
- Underground parking
- High population density

Lower Manhattan, NY

Long Island, NY

Damage to Other Lines of Business Was Also Significant, Particularly in Areas Exposed to Storm Surge

- Pleasure boats
- Builder's risk
- Infrastructure

New London, CT

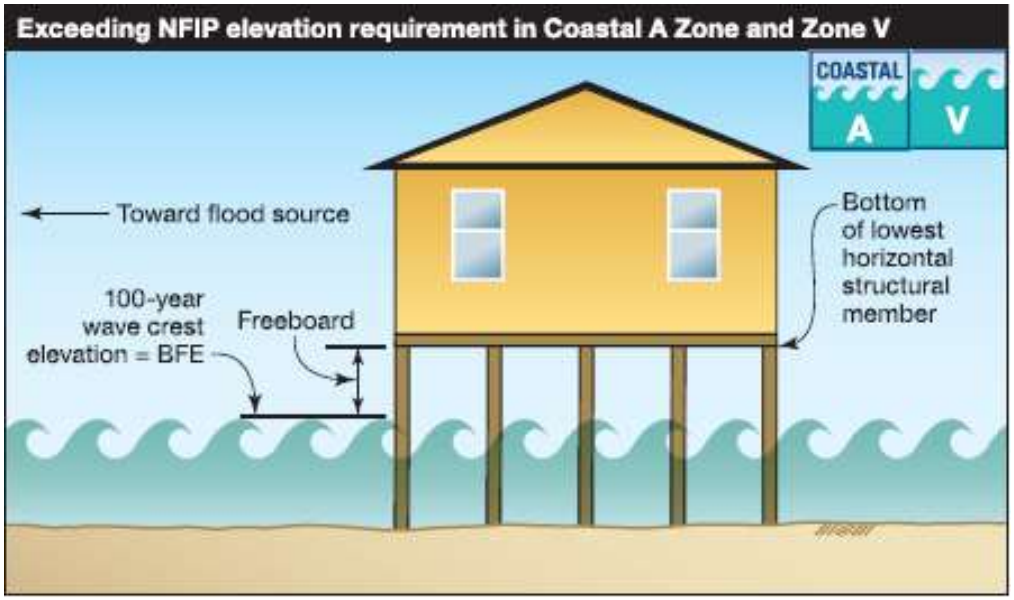
Lower Manhattan, NY

Ocean Breeze, NY

Long Island, NY

Summary

- Sandy exposed the vulnerability of urban Manhattan and coastal communities along the Jersey shore
- Several critical facilities are located in the FEMA flood zones
- Need to revisit and re-evaluate the FEMA flood maps and associated BFEs



Source: FEMA P-55 Coastal Construction Manual