Superstorm Sandy: History in the Making

2013 marks the first anniversary of Superstorm Sandy and the 75th anniversary of the Great New England Hurricane. This report examines five hypothetical storm scenarios for the Northeast that are defined using a mix of storm parameters from Sandy and the 1938 Hurricane and the impact of these storms on insured property exposure.

Executive Summary

Superstorm Sandy was the most powerful storm to make landfall along the northeastern coastline of the United States in the past two decades, causing destruction along its path in the form of wind, storm surge, inland flood and even fire. Extraordinary primarily due to its track and size, Superstorm Sandy measured close to 1,100 miles wide with a storm track almost perpendicular to the coast. Since 1900, Superstorm Sandy was only the second storm to make direct landfall on the New Jersey coast, the first being the 1903 “Vagabond Hurricane” which took a northwest path after landfall. In addition to Superstorm Sandy, the 1938 Great New England hurricane provides another key benchmark event by which all Northeast hurricanes are compared. It was the most intense storm to make landfall on the northeast coast, a fast moving storm with a nearly straight south to north track, typical of Northeast hurricanes.

Storm paths like that of the 1938 hurricane are used in deterministic hurricane scenario modeling for various business applications, such as catastrophe risk management, stress testing and for the assessment of extreme hurricane loss potential. Superstorm Sandy highlights the importance of hurricane track orientations and the potential for orientations that differ from key historic events. It was a unique storm, and its track and parameters can assist in developing scenario events that will lead to a deeper understanding of loss potential to property insurance portfolios from similar future events in the Northeast.

2013 marks the first anniversary of Superstorm Sandy and the 75th anniversary of the Great New England Hurricane. Considering the destruction caused by these events, we may speculate on what the impact would have been on property exposure in the Northeast if Sandy had taken a path similar to the 1938 storm, if its winds had been as severe as those of the 1938 storm or if the 1938 storm had taken a path similar to that of the 1903 storm.

This report explores some of the scenarios suggested above by combining various parameters from Superstorm Sandy and the 1938 Hurricane into five hypothetical events. These scenarios generate modeled insured property loss in the range of U.S. $15 to $130 billion. A storm scenario with wind field characteristics similar to the Great New England Hurricane traveling on a storm track similar to the 1903 storm landfalling on the New Jersey coast close to New York City could generate U.S. $100 to $130 billion in industry losses. Likewise, if Sandy took the same path as the 1938 Great New England Hurricane, the insured property loss could be in the range of U.S. $40 to $55 billion, with U.S. $8 to $11 billion of loss from the storm surge component alone.

In this report, we share an example of “what-if” modeling. When we have a better understanding of the impact different scenarios could have on your company’s portfolio, we are more strongly equipped to help you develop an effective action plan.
Introduction

Superstorm Sandy

Superstorm Sandy initially formed as a tropical depression in the southwestern Caribbean on October 22, 2012 and was upgraded to a hurricane two days later. After crossing the Caribbean Sea, it took a northeasterly track, following the coastline of North Carolina and South Carolina from October 27 to October 29, while remaining offshore. Sandy transitioned to a post-tropical cyclone just before landfall near Atlantic City, NJ on Oct. 29 20:00 EDT, but it still exhibited winds equivalent to a Category 1 hurricane. After landfall, the storm continued west-northwestward, eventually moving northward into Canada.

The minimum central pressure at landfall in New Jersey was estimated at 945 mb, based on the recorded pressure at Atlantic City at 22:24 UTC on October 29. The highest wind speed recorded was 75.1 mph at Cape May, NJ.

Superstorm Sandy brought storm surge to the entire east coast of the United States due to its large size. The highest storm surge occurred in New Jersey and New York. A full moon coincided with landfall, making high tides higher than normal and bringing damaging waves to the coast. The highest storm surge measured in New York was 12.65 feet above normal high tide levels at Kings Point on the western end of Long Island Sound. A storm surge of 9.56 feet above normal high tide levels was reported on the northern side of Staten Island at Bergen Point West Reach and 9.40 feet was reported at the Battery on the southern tip of Manhattan.

Flood height above ground level was observed at 4 to 9 feet in Staten Island and Manhattan, 3 to 6 feet in Brooklyn and Queens, 2 to 4 feet in The Bronx and Westchester County and 3 to 6 feet in Long Island (Nassau and Suffolk Counties). In New Jersey, flood height above ground level was observed at 4 to 9 feet in Monmouth and Middlesex Counties, 3 to 7 feet in Union and Hudson Counties, 2 to 4 feet in Essex and Bergen Counties, 3 to 5 feet in Ocean County, and 2 to 4 feet in Atlantic, Burlington, and Cape May Counties of New Jersey. Storm surge also occurred along the coast of Connecticut, Rhode Island and Massachusetts.

At top, homes underwater in New Jersey, while the bottom photograph shows piles of ocean sand removed from flooded properties on a street in Rockaway Beach, NY

According to estimates from the office of the governor of New Jersey, 346,000 housing units were damaged or destroyed in New Jersey. In New York, it was estimated that 305,000 homes were destroyed, mostly caused by storm surge. The New York City Metropolitan Transit Authority (MTA) suffered extensive damage, estimated at $5 billion, due to storm surge flooding that inundated eight tunnels. The MTA declared that the overall damage caused by the storm created the worst disaster in the history of the subway system. Many communities were inundated by water and sand, houses were washed from their foundations, cars were tossed about and boats were pushed well inland from the coast. Trees and power lines were knocked out by wind. Superstorm Sandy’s storm surge was a significant driver of property loss, while direct damage to property from the wind component was relatively small.

There were at least 147 direct deaths recorded across the Atlantic Basin due to Sandy; 72 of these occurred in the mid-Atlantic and northeastern United States. Property Claims Services (PCS) estimate loss to U.S. insurance industry from Sandy was $18.75 billion.
The 1938 New England Hurricane

The 1938 Great New England Hurricane, also known as the “Long Island Express,” was the most intense storm to make landfall on the northeastern coastline of the United States since 1900. As a very fast-moving storm with estimated forward velocity close to 50 mph, it caused destruction along its path across New York, Rhode Island, Connecticut, Massachusetts, New Hampshire, Vermont and Maine. Barometric pressure of 946 mb was recorded at the Coast Guard station in Bellport, Long Island. Based on various pressure records, the center of the eye was estimated to be 30 to 40 miles wide. Sustained winds at landfall on central Long Island, NY were estimated at 115 to 120 mph and 90 to 100 mph winds were estimated over a wide area of southern New England coast.

The 1938 Hurricane caused significant coastal flooding due to a combination of strong hurricane force winds and the fast forward movement of the storm. The resulting storm surge and extreme river flows washed away numerous bridges, completely severing railroad communications between New York and Boston, as well as the links between the principal cities in Connecticut and Rhode Island. The extreme high winds devastated many forests in the main path of the storm. Estimated loss to U.S. insurance industry from the repeat of the 1938 Hurricane today could be in the range of U.S. $30 to $40 billion.

Both Superstorm Sandy and the 1938 Hurricane are key benchmark events for the assessment of U.S. Northeast hurricane risk. Both storms demonstrated the vulnerability of insured property in the Northeast to hurricane forces winds and storm surge. If Sandy’s winds had been as strong as the 1938 Hurricane, the loss to insured property could have been more than double the original.

In order to better understand the catastrophic risk from hurricane in this region we developed five hypothetical scenario storms. These scenarios represent “what-if” events that use a combination of storm parameters and track orientations from Superstorm Sandy and from the 1938 Hurricane. These scenarios include:

- **Scenario #1** – Superstorm Sandy taking the path of the 1938 Hurricane (i.e., Sandy landfall on Long Island with a south to north trajectory)
- **Scenario #2** – Superstorm Sandy with the same intensity as the 1938 Hurricane (i.e., 1938 Hurricane parameters transposed on Sandy’s track)
- **Scenario #3** – Similar to Scenario #1, but with landfall shifted towards east
- **Scenario #4** – Similar to Scenario #2, but with landfall shifted towards north
- **Scenario #5** – 1938 Hurricane making landfall on the New Jersey coast close to New York City
“What-if” Scenario Events

For this study, we partnered with Kinetic Analysis Corporation (http://www.kinanco.com) to develop storm scenario footprints for both wind and surge hazards. Kinetic Analysis generated the event track and characteristics for these scenarios based on the desired landfall location, heading, forward speed, wind speeds (Vmax) and radius of maximum winds (Rmax). In these scenario events, wind field decay begins after the storm passes the landfall point, with inland decay characteristics typical of tropical systems, and the tracks are linear in nature. Kinetic Analysis then simulated and produced integrated, multi-hazard footprints for the scenarios in their tropical cyclone modeling platform.

Great care was given to create realistic, meteorologically correct scenario events based on combinations of the tracks and characteristics of the 1938 Hurricane and Superstorm Sandy. We paid attention to ensure that the resulting scenarios produced valid size / intensity comparisons relative to the original event characteristics, but on an alternative track. Surge height includes astronomical tides, wind and pressure and wave setup, but not wave runup.
Impact on Insured Property
The tables below contain the total insured property loss estimates for each of the scenarios from wind and surge perils. It also shows the top three states generating loss and their contribution by peril.

Coastal insured property exposure represents 54% of total insured property exposure from Connecticut, Massachusetts, New Jersey, New York and Rhode Island. In hurricane wind fields, the most intense winds exist on the right hand side of the hurricane track. In Scenario#5 shown above, significant exposure in New York is on the right hand side of the track, and much of it is exposed to winds in excess of 100 mph. Property loss from this particular scenario is estimated to be between U.S. $100 and 130 billion. Of this, loss from the storm surge component is estimated to be U.S. $15 to 20 billion (excluding NFIP insured losses).

For Scenario#3, with landfall located in Rhode Island, most of the exposure in New York and New Jersey is on the left hand side of the track and is exposed to less intense winds. The estimated loss for such an event is U.S. $15 to 20 billion, with 65% of the total loss for wind alone in Massachusetts.
Deterministic methods for managing hurricane risk

All major catastrophe modeling firms have probabilistic hurricane catastrophe risk models which are widely used in the insurance / reinsurance industry. These models are built using historical data as well as the latest available science and research. Deterministic methods have been popular in property risk management and in many business applications related to the insurance and reinsurance fields.

Advances in hurricane tracking technology and the collection and analysis of ground observation data by various agencies puts Superstorm Sandy above the 1938 Hurricane in terms of understanding the impact of hurricanes on the Northeast coast.

Due to its intense wind speeds at landfall, the 1938 Hurricane is often characterized as a 1:100 year event for the Northeast from a wind hazard perspective. However, this does not necessarily correspond to a 1:100 year event from the loss perspective of a specific insurance portfolio. A storm in the future exhibiting the strength of the 1938 Hurricane or a strong Category 2 with a northwesterly track and landfall close to New York City could cause significantly higher loss than a repeat of either the 1938 Hurricane or Superstorm Sandy.

When considering historical events / storm tracks for deterministic scenario loss modeling for the purpose of managing hurricane risk and stress testing, we strongly believe that it is important to consider various storm track orientations before and after landfall as well as landfall angles relative to the coastline in addition to the strength of the storm.

The five hypothetical storm scenarios presented in this report can help us understand the impact that storm track and intensity can have on loss estimates and the importance of considering storm scenarios other than key benchmark historical events only in deterministic scenario models.

Willis Re can help you

Northeast hurricane risk research has always been a part of our model evaluation and research agenda. Our advice draws from a diverse set of skills and experience, ranging from model development to the practical implementation of portfolio risk management and underwriting objectives. We can help your company develop and execute new action plans, which reflect a deep understanding of the changing landscape of hurricane risk and the risk represented by various models.

References


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