KAREN CLARK & COMPANY

Historical Hurricanes that Would Cause $10 Billion or More of Insured Losses Today

August 2012

This paper identifies all historical US hurricanes since 1900 that, if they were to strike again today (in 2012) with the same meteorological parameters, would likely cause $10 billion or more of insured losses. Twenty-eight such storms are identified, one of which has estimated losses in excess of $100 billion.

Report Highlights

- Almost half—13 out of 28—of the historical hurricanes causing insured losses of $10 billion or more made landfall in Florida. Florida also has the largest loss—$125 billion from a repeat of the 1926 Great Miami Hurricane.

- Three Category 4 hurricanes struck the Texas coastline near Galveston between 1900 and 1932, and all three would likely cause insured losses in excess of $10 billion—with the top two causing approximately $50 and $40 billion in losses today. Hurricanes Carla, Alicia and Ike would also cause losses over $10 billion today.

- In the Gulf region, Hurricane Katrina is the largest loss producer since 1900, and three other storms would likely cause at least $10 billion in insured losses—Betsy, Camille, and Frederic.

- Perhaps surprisingly, there are three historical storms in the Northeast that would likely cause losses over $10 billion—the 1938 Great New England, an unnamed storm in 1944, and Carol.

- There are only two historical events causing over $10 billion in the Southeast—Hazel and Hugo.

- One storm, the 1919 Florida Keys storm, would cause about $5 billion each in Florida and Texas.

- Hurricane Donna would likely cause $25 billion today and affect all states along the eastern seaboard from Florida to Maine.

This document summarizes the methodology used to develop the loss estimates and contrasts it with other sources of loss information. The paper concludes with a table summarizing the events that would cause $10 billion or more in insured losses and provides a map of landfall points, and more detailed summaries for the top two events in each region of the US.

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Introduction

Over 175 Atlantic hurricanes have struck the United States since 1900, causing varying amounts of damage. Many storms that hit in the earlier part of the 20th century would cause orders of magnitude more damage today, due to an increased density of structures in coastal areas associated with population growth and changes in construction practices that have resulted in larger and more expensive buildings. This paper identifies historical hurricanes that would be expected to cause $10 billion or more in insured losses if they were to hit again today.

Estimating losses from historical hurricanes requires multiple tools and data sources, including knowledge of current property values, the size and extent of the hurricane windfields, and historical loss information. To conduct this study, information was gathered from many sources, cross-referenced, and modified if necessary to estimate the losses today for each hurricane. This paper also explains why other sources of information tend to underestimate the insured losses historical storms would cause today.

Historical hurricane loss estimates are useful for several purposes. They provide a general indication of return periods of hurricane losses of different sizes and illustrate where the largest losses are likely to occur today. These loss estimates provide guidance from the historical data on the value of industry loss warranty (ILW) contracts, and they can be used to benchmark catastrophe model output.

Because there has been no definitive source of information for the size of losses historical hurricanes would cause today, this report fills an important void. In conducting this study, KCC has attempted to build on previous studies and to reconcile the conflicting sources and loss estimates for the most significant historical hurricanes.

Other Sources of Loss Estimates

Developing credible loss estimates for historical hurricanes is not a straightforward process, primarily due to data limitations. There is not one definitive source of this information, but rather multiple sources that frequently provide very different loss estimates for the same hurricanes. The primary sources are estimates derived from simulating the storms and superimposing them on current property values as the catastrophe model vendors sometimes do, Property Claims Services (PCS), and the work of Roger Pielke Jr. and others.[1]

The catastrophe modelers provide loss estimates for historical hurricanes by simulating the events and superimposing them on estimates of current property values. Loss estimates derived in this way can differ widely because the modelers use different damage functions, industry databases, and most importantly, different meteorological parameters for the historical storms. The meteorological data on historical hurricanes is quite sparse, subject to error, and particularly for storms occurring early in the 20th century, it is often incomplete. Different meteorological data sources can provide different information for the same key hurricane parameters, and this is what drives the variability in the simulated losses.

[1] Pielke et al. "Normalized Hurricane Damage in the United States: 1900 – 2005."

PCS estimates the insured losses directly by surveying insurance companies about their claims after major events. While PCS is the primary source for insured losses in the US, this data source is also imperfect and incomplete. PCS figures are only available going back to 1950, and the PCS loss estimates may not account for all sources of loss, depending on the companies surveyed and the nature of their property business.

PCS does not adjust loss estimates on an ongoing basis to reflect what size losses the historical hurricanes would cause today. Adjustments that have been made underestimate how much larger the losses would be today. For example, the Insurance Information Institute (III) website shows the PCS estimates for several storms in 2010 dollars. To adjust to 2010 dollars, the GDP implicit price deflator, a measure of the general rate of inflation, was used. Historically, construction costs have grown much faster than the general rate of inflation and so have insured property values. Simply adjusting for inflation also ignores increases in the number and size of properties since the events occurred.

For example, the final PCS loss estimate for Hurricane Andrew was $15.5 billion, and the 2010 loss according to the III website would be $22.4 billion. Accounting for growth in the number and size of buildings along with construction costs since 1992, KCC estimates Andrew would cost closer to $50 billion today.

The PCS numbers prior to Hurricane Hugo in 1989 are also likely biased low because in the earlier decades PCS did not re-survey companies after their initial estimates. Historically, PCS would survey companies within a few days or weeks of the event, and that would be the final estimate. In recent decades, PCS has continued to survey companies after each major event until the estimates no longer change. For events producing multi-billion dollar loss estimates, the resurveying process has typically led to increasing numbers. To again use Andrew as an example, the original PCS estimate was just over $7 billion, and it took several months of re-surveying to get to the final estimate of $15.5 billion.

The relatively recent work of Pielke et al. provides estimates of the economic losses that would result today from historical hurricanes. This study examines all hurricanes since 1900, and the authors have painstakingly pieced together information on the damages caused by each storm. The authors then adjust the figures to current values using indices for the growth of real wealth per capita, population, and general inflation.

The Pielke et al. study is a very valuable report, but there are a few challenges when using it for estimating the insured losses today. First, the authors estimate economic loss rather than insured loss, and there are significant difficulties in estimating the initial economic losses which are discussed in the paper. Insured losses can be estimated by using a 50 percent rule of thumb factor, but when this is done the resulting estimates can be significantly lower than estimates derived from other sources, such as the catastrophe model estimates.

KCC Methodology

KCC gathered and analyzed information from many different data sources, including various meteorological sources. None has complete information on all historical hurricanes, and for some of the hurricanes, the different sources have different values for the key meteorological parameters. Rather than giving one source full credibility, KCC tested the different parameters by comparing the meteorologically-derived loss estimates with the information on insured losses adjusted to 2012 values. A multi-step, iterative process was employed as described below.

First, the original (at time of storm) figures from the Pielke paper were halved (to reflect insured values) and then updated to present values using indices accounting for growth in real wealth per capita, population, and increasing construction costs using the 2012 National Building Cost Manual[2]. Trending the Pielke numbers to the present using the 2012 construction cost index rather than the implicit price deflator used in the Pielike approach resulted in a significantly higher loss estimate for each storm. As discussed earlier, the implicit price deflator likely underestimates the increasing construction costs because in many decades, building costs per square foot have increased much faster than the general rate of inflation.

The original PCS estimates were adjusted using the same factors for increasing wealth, population and construction costs. The PCS estimates prior to 1989 were also increased in an attempt to correct for the downward bias resulting from the lack of follow-up surveys for major events. In most cases, the adjusted PCS numbers are consistent with the adjusted Pielke estimates.

Second, the meteorological data on the landfalling hurricanes since 1900 was gathered from the various meteorological sources identified in the list of references. As mentioned earlier, the important meteorological parameters for the historical hurricanes are not always consistent among data sources and the loss estimates are highly sensitive to changes in the parameters.

From the conflicting meteorological information, KCC selected the most current set of parameters for each storm and used this data to generate a wind footprint. The wind footprint was then superimposed on the KCC database of total industry property values (KPD) and damage functions by construction and occupancy were used to estimate the insured losses.

In most cases, the meteorologically-derived loss estimates from step two fell comfortably within the range of the Pielke figures and the adjusted Pielke and PCS numbers, and these became the final KCC estimates. In cases where there were significant discrepancies, the storm parameters were re-examined and the losses re-estimated. This iterative process is what sets the KCC methodology apart. Recognizing the limitations in the different data sources, KCC first attempted to reconcile the conflicting information and when that was not possible made a final judgment call on the most reliable information for each storm.

A final step was to round each estimate to the nearest $5 billion to avoid the illusion of accuracy and false precision given the uncertainty around the estimates. KCC has developed a highly credible and robust set of historical hurricane loss figures, but given the shortcomings in the original data, these are reliable estimates and not precise numbers.

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[2] Gary Moselle (ed.), 2012 National Building Cost Manual (Carlsbad, CA: Craftsman Book Company, 2011).

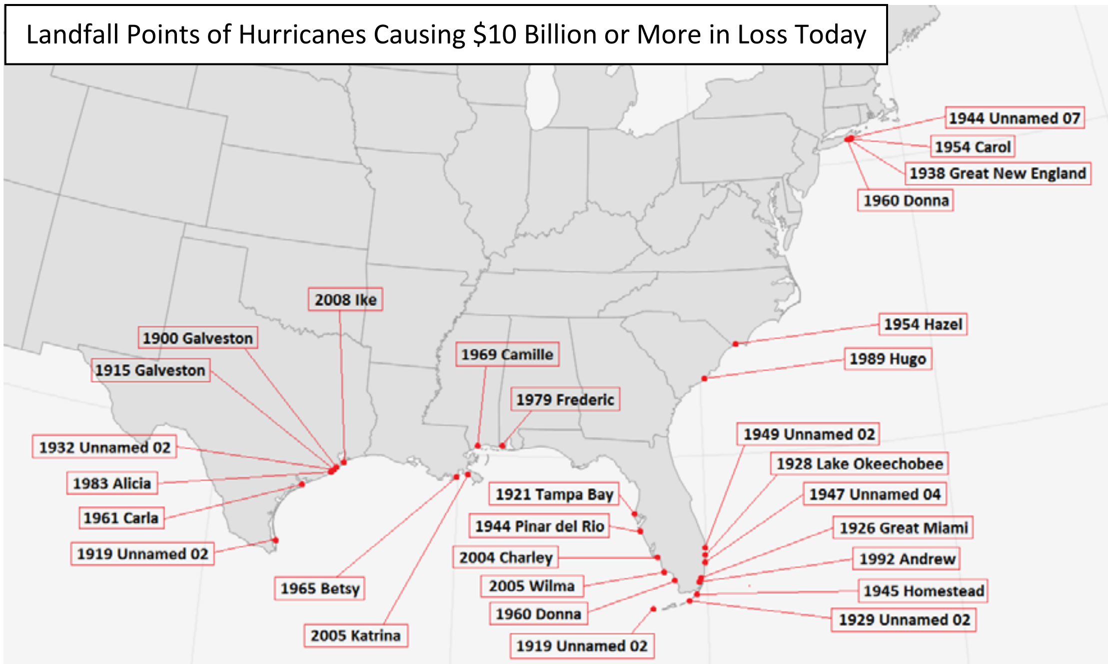
Results

The table below shows the 28 hurricanes that would likely cause more than $10 billion in insured losses today. The largest loss, $125 billion, would be caused by the Great Miami Hurricane of 1926. Thirteen of the 28 storms make landfall in Florida, six in Texas and four in the Gulf. Interestingly, there are three historical Northeast hurricanes that would cause $10 billion or larger insured losses today versus just two in the Southeast.

The results indicate that the US is likely to experience a $10 billion or larger insured loss one year out of four on average. In other words, there's a 25 percent chance of a $10 billion or larger loss this year. There's almost a five percent chance of a $50 billion or larger loss.

Year	Event	Region	Insured Loss ($B)
1926	Unnamed 7 (Great Miami)	Florida South	125
1928	Unnamed 04 (Lake Okeechobee)	Florida South	65
1900	Galveston	Texas	50
1947	Unnamed 04 (Fort Lauderdale)	Florida South	50
1992	Andrew	Florida South	50
1915	Unnamed 02 (Galveston)	Texas	40
2005	Katrina	Gulf	40
1938	Unnamed 04 (Great New England)	Northeast	35
1960	Donna	Florida, Northeast	25
1954	Hazel	Southeast	20
1965	Betsy	Gulf	20
1921	Unnamed 06 (Tampa Bay)	Florida Northwest	15
1945	Unnamed 9 (Homestead)	Florida South	15
1949	Unnamed 02	Florida Northeast	15
1954	Carol	Northeast	15
1969	Camille	Gulf	15
2005	Wilma	Florida South	15
1919	Unnamed 02	Florida, Texas	10
1929	Unnamed 02	Florida South	10
1932	Unnamed 02	Texas	10
1944	Unnamed 07	Northeast	10
1944	Unnamed 11 (Pinar del Rio)	Florida Northwest	10
1961	Carla	Texas	10
1979	Frederic	Gulf	10
1983	Alicia	Texas	10
1989	Hugo	Southeast	10
2004	Charley	Florida Northwest	10
2008	Ike	Texas	10

The map below shows the landfall points for the large loss producing historical hurricanes.



Landfall Points of Hurricanes Causing $10 Billion or More in Loss Today

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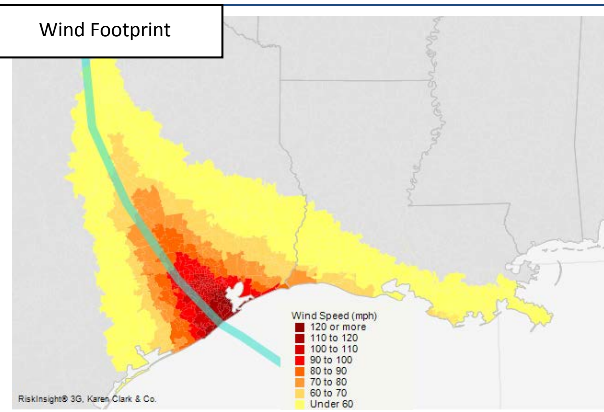
1900 Galveston - $50 Billion

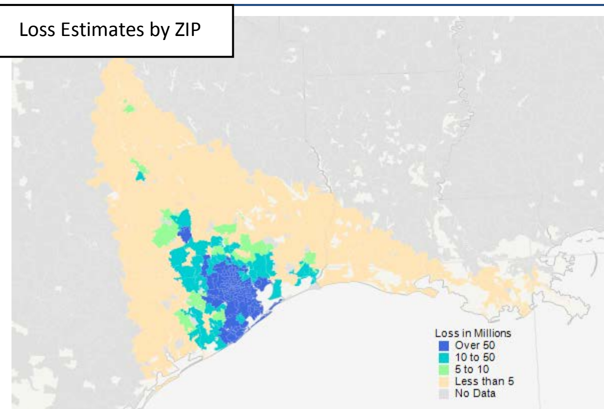
On September 9, 1900, the first hurricane of the season made landfall across Galveston Island with peak winds estimated at 138 mph. This storm, now commonly referred to as the Great Galveston hurricane, caused an estimated 8,000 fatalities and is the deadliest storm in US history. Almost all of the deaths took place in Galveston, where thousands drowned in the 15 feet of water that flooded the city.

Storm Track from HURDAT

Wind Footprint



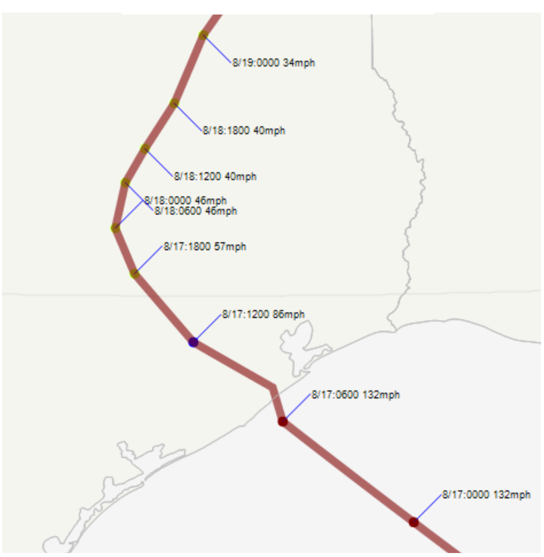
Loss Estimates by ZIP



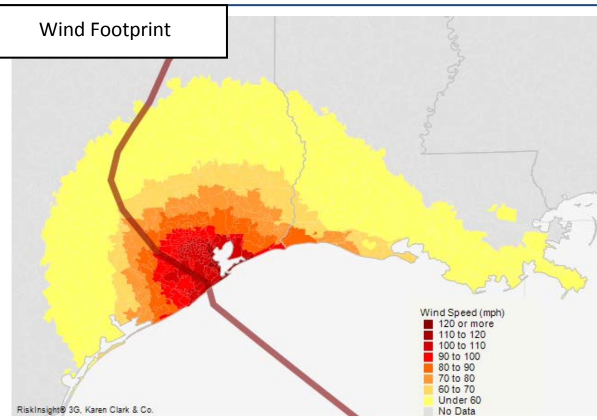
1915 Galveston - $40 Billion

On August 17, 1915, a Category 4 storm, now commonly known as the 1915 Galveston hurricane, struck Galveston Island with peak winds of approximately 132 mph. Only 11 deaths occurred in the city of Galveston, likely due to the Galveston seawall built after the first Galveston hurricane, 15 years prior. The storm caused up to 400 fatalities in total.

Storm Track from HURDAT



Wind Footprint



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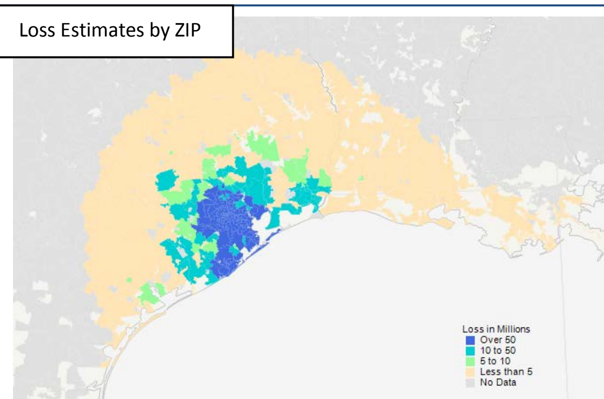
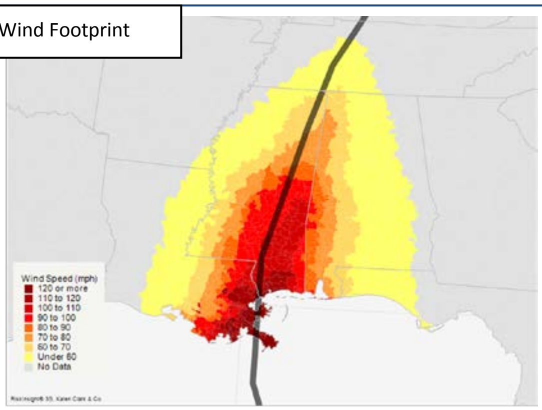


2005 Katrina - $40 Billion (excluding flood damages)

On August 29, 2005, Hurricane Katrina made landfall at Buras, Louisiana as a Category 3 storm. However, due to a large radius of maximum winds of 35 miles, Category 4 strength winds were likely experienced along the southeastern tip of Louisiana as the hurricane approached landfall. Katrina caused devastating damage to the New Orleans area, in large part due to massive flooding resulting from the failure of the levees. Approximately 1,800 deaths are attributed to this storm, the third deadliest natural disaster in US history.

Storm Track from HURDAT

Wind Footprint



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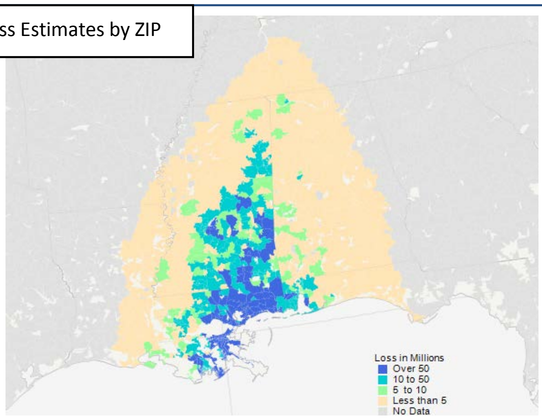
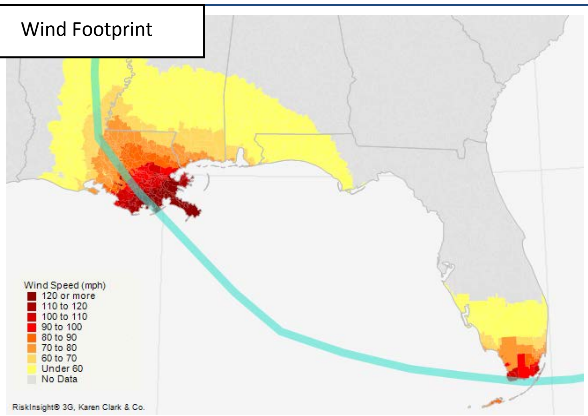


1965 Betsy - $20 Billion

On September 10, 1965, Hurricane Betsy struck Grand Isle, Louisiana, with winds of nearly 130 mph. Damage was heaviest in the New Orleans area, where levee failures resulted in massive flooding (particularly in the 9th Ward). Betsy also made a landfall in southern Florida a few days before hitting Louisiana, but damage there was considerably less than in Louisiana.

Storm Track from HURDAT

Wind Footprint



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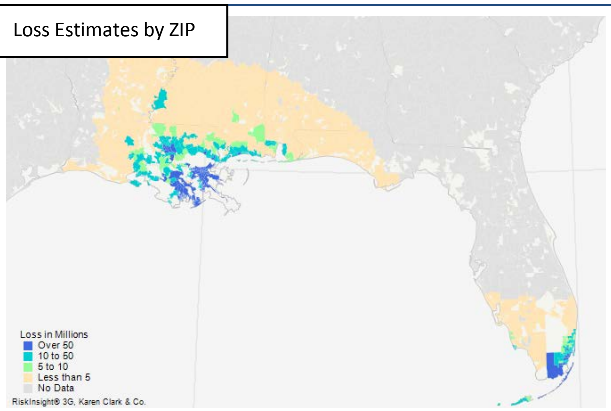
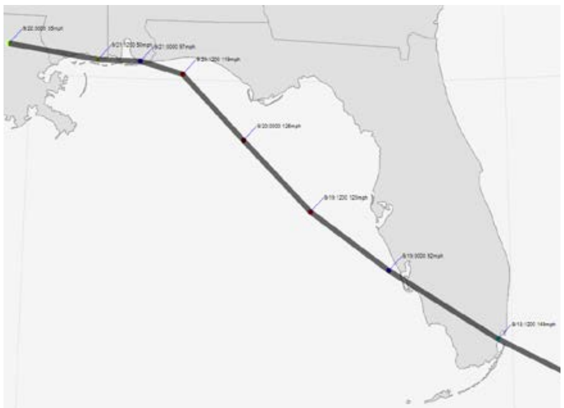


1926 Great Miami - $125 Billion

On September 18, the seventh storm of the 1926 hurricane season made its first landfall in Florida before travelling across the Gulf and making a second landfall in Alabama. The hurricane first hit near what is now downtown Miami with winds estimated at 144 mph. Of all historical hurricanes, the Great Miami would cause the most damage if it were to hit today. Between 25,000 and 50,000 people were left homeless due to the storm, and hundreds died even though Miami was sparsely populated at the time.

Storm Track from HURDAT



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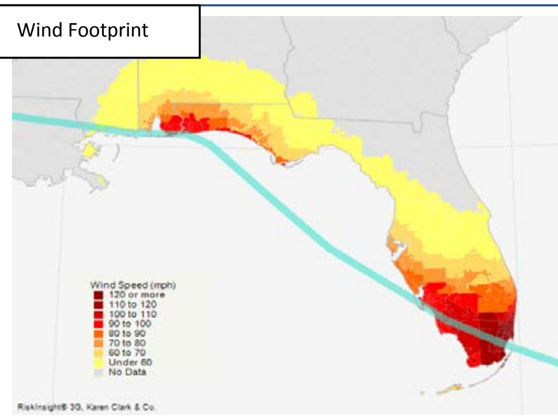

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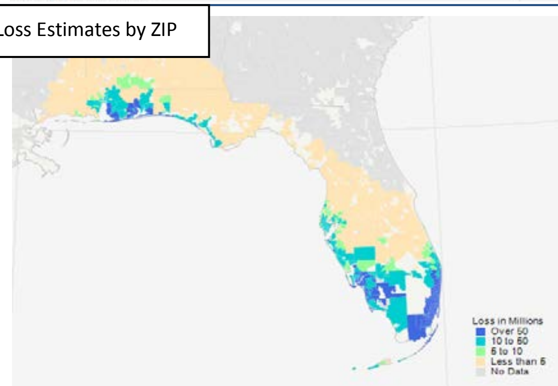
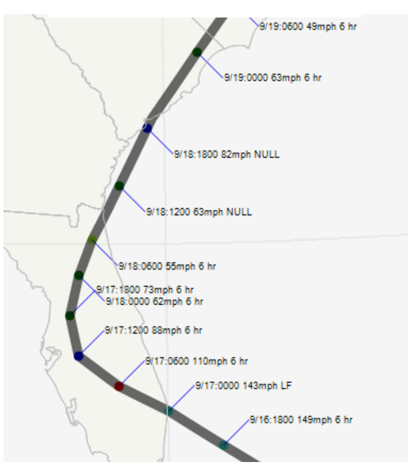


1928 Lake Okeechobee - $65 Billion

On September 17, the fourth storm of the 1928 hurricane season, now known as the Lake Okeechobee Hurricane, made landfall on the east coast of Florida with winds of up to 140 mph. Prior to landfall in Florida, the hurricane made a direct hit on Puerto Rico and was the only hurricane to hit the island as a Category 5 storm. More than 4,000 people were killed by the hurricane in total, with at least 2,500 deaths coming from the United States. This storm is the second deadliest natural disaster in US history.

Storm Track from HURDAT



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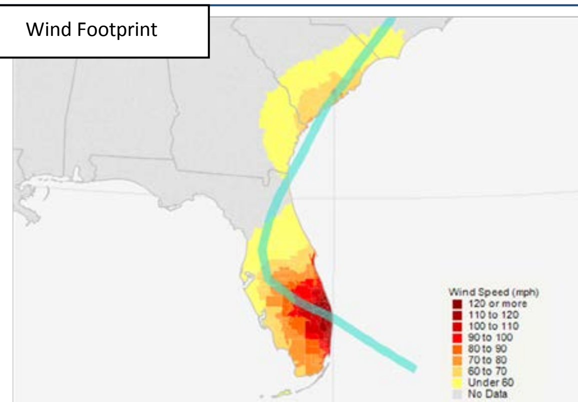
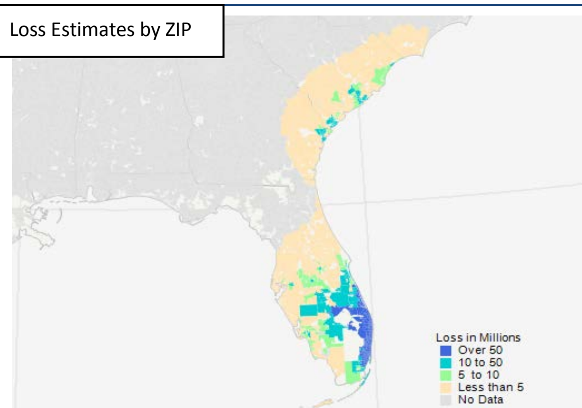


Loss Estimates by ZIP

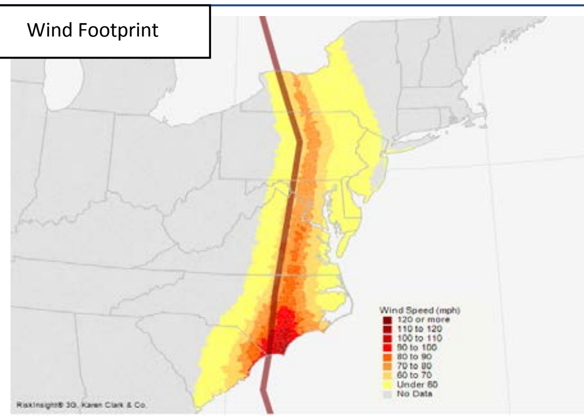


1954 Hazel - $20 Billion

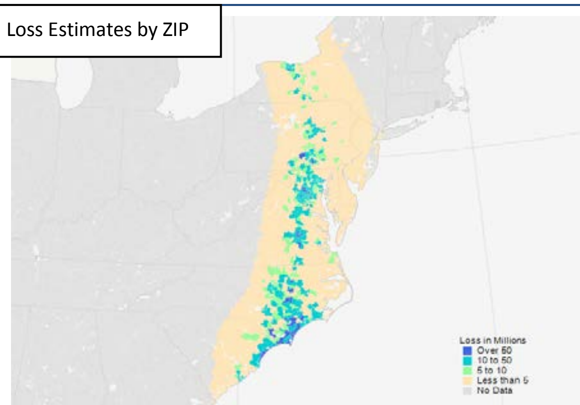
On October 15, Hurricane Hazel, the ninth storm of the 1954 hurricane season, made landfall near the border of North and South Carolina with winds estimated at 132 mph. The fast forward speed meant hurricane force winds were felt throughout the Mid-Atlantic region. The hurricane killed up to 1,200 people in total (including in Haiti and Canada), and left up to 100,000 people homeless.

Storm Track from RPI

Wind Footprint



Loss Estimates by ZIP

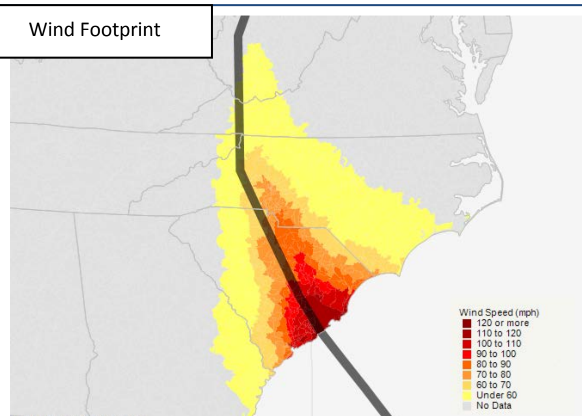


1989 Hugo - $10 Billion

On September 22, Hurricane Hugo, the eighth storm of the 1989 hurricane season, made landfall on Isle of Palms, South Carolina. The storm was estimated to have winds of up to 138 mph and resulted in total of 50 fatalities, approximately 29 in the Caribbean and 21 in South Carolina. More than 100,000 people were left homeless. High wind speeds were experienced further inland than expected causing significant losses in western North Carolina.

Storm Track from HURDAT

Wind Footprint



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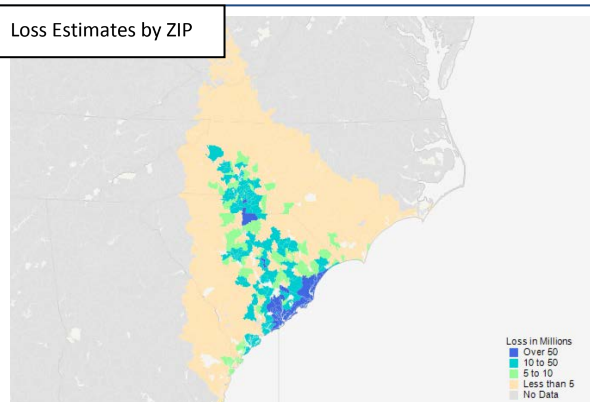
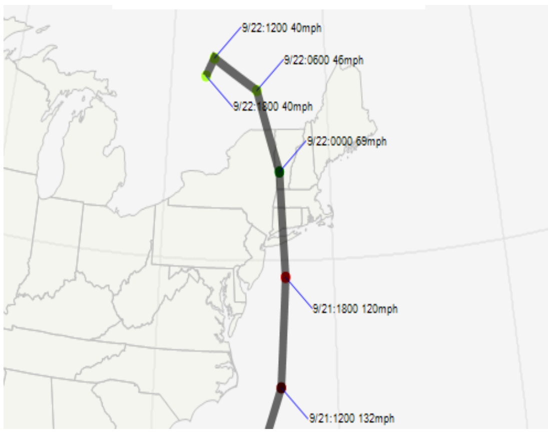


1938 Great New England - $35 Billion

On September 21, the fourth storm of the 1938 hurricane season, known as the Great New England hurricane, made landfall on Long Island, near the town of Bayport with peak winds estimated at 120 mph. Because of its fast forward speed, this storm caused damages throughout New England and up into Canada. The Great New England hurricane caused between 680 and 800 deaths and many more injuries, primarily due to the fact that local residents had no advance warning for this devastating storm.

Storm Track from RPI



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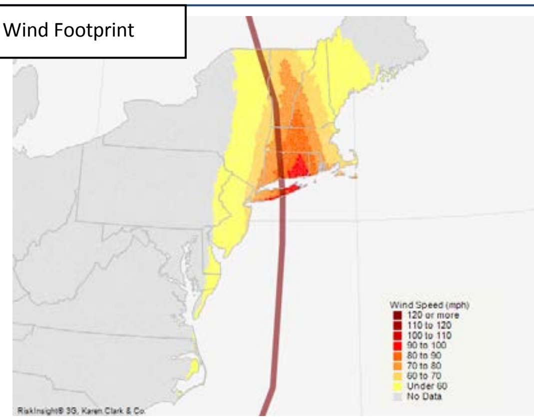

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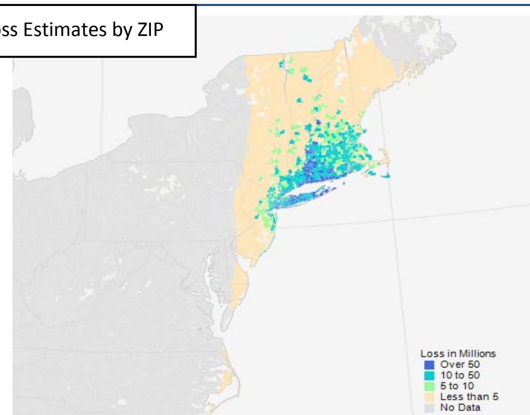
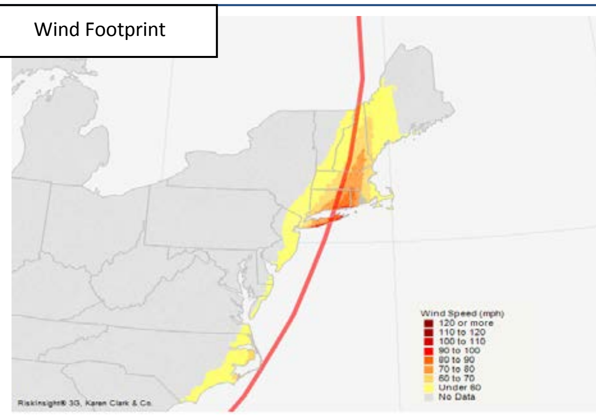


1954 Carol - $15 Billion

On August 31, the third storm of 1954 hurricane season, Hurricane Carol, made landfall along the eastern end of Long Island. Unlike many New England hurricanes, Carol had a well-defined but relatively small eye as it made landfall. Initially calm conditions quickly turned to hurricane force winds of up to 115. While not as large or devastating as the 1938 event, strong winds left much of the region without power and destroyed or damaged thousands of homes.

Storm Track from RPI

Wind Footprint



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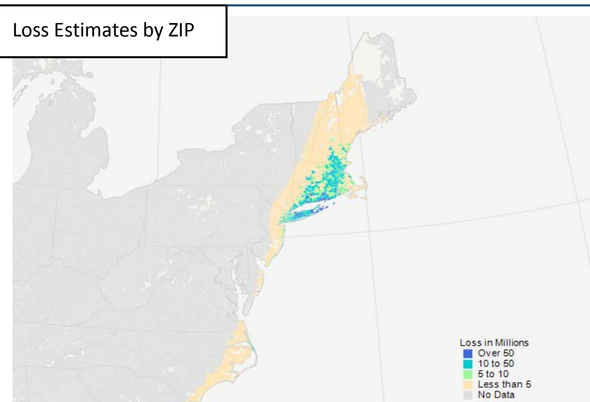

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