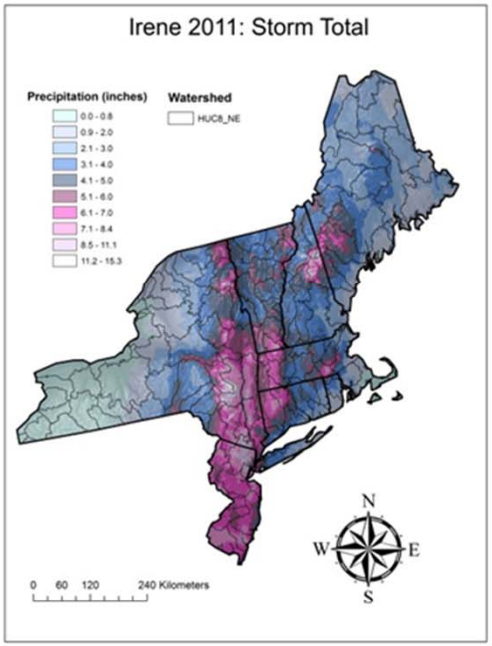
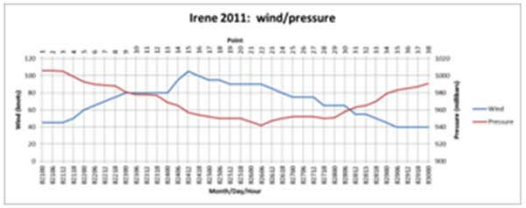
Extreme Precipitation in New England

By Bronson Shonk





Methods

Storm Track: Data for the storm tracks were recorded at six-hour intervals (0000, 0600, 1200, and 1800). Each six-hour point depicts a max wind, min pressure and approximate velocity values. Velocity was calculated by dividing the distance the storm traveled to a given point, divided by six. The Haversine equation was used in excel to find distance. The first velocity value for each storm is 0 because the distance traveled to that point is 0 km and the time passed is 0 hours. Darker values and larger points represent higher wind and smaller pressure values respectively. The actual values for wind, pressure and velocity can be seen on the graph and correspond with the storm track points on the map via the secondary x-axis (points). David Roth provided the best storm track data from CLIQR. The base map is from Arc Map and the GCS is HRAP Sphere.

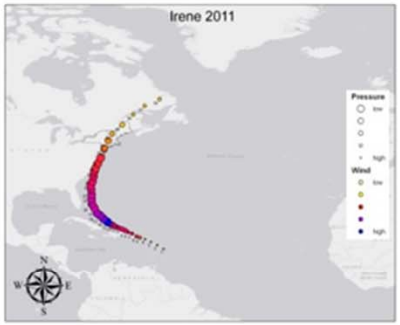
Storm Gauges: The NED was obtained from the USGS seamless website. 64 tiles that covered all of New England were downloaded at 30 meter resolution. Using the Mosaic to new raster tool the tiles were patched together. This task was automated in model builder due to the size of the data. Data was downloaded on 06/05/2012. Elevation, aspect and slope were calculated for each storm gauge using the extract multiple values to point's tool.

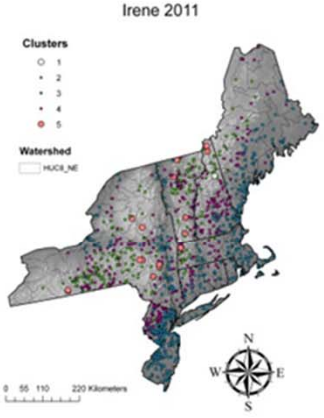
Clustering: Cluster Analysis was applied to three variables of the storm gauges to look for patterns that may be occurring between the geography of storm gauges and precipitation. Slope and elevation were extracted for each individual storm gauge for each storm. K-mean cluster analysis was run in SPSS with slope, elevation and total storm rainfall for the gauges. Five clusters were specified. The mean precipitation of these clusters was then compared statistically in JMP.

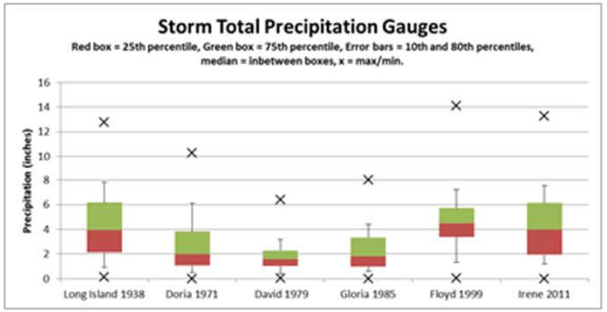
Precipitation: The precipitation maps for the storms are all generated through interpolation of the existing gauges with the exception of Irene which had satellite interpolated values available. These maps are draped over an elevation data set. The distribution of precipitation values across rain gauges was analyzed in JMP to compare means.

Introduction

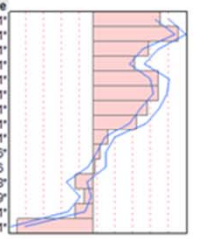
The goal of this study is to form a comprehensive understanding of Hurricane Irene and how it compared to previous storms. Five other large hurricanes were chosen to compare with Irene. These included Long Island Express 1938, Doria 1971, David 1979, Gloria 1985, and Floyd 1999. The storms were analyzed by storm track, storm intensity, precipitation totals from rain gauges, and by the geographic distribution of rainfall.







Level	- Level	Score Mean Difference	Std Err Dif	Z	p-Value
Irene 2011	David 1979	482.022	25.73951	18.7269	<.0001*
Floyd 1999	David 1979	420.603	18.79569	22.3776	<.0001*
Irene 2011	Gloria 1985	386.345	25.76429	14.9954	<.0001*
Irene 2011	Doria 1971	296.604	25.77653	11.5067	<.0001*
Long Island 1938	David 1979	295.208	18.27949	16.1497	<.0001*
Floyd 1999	Doria 1971	292.054	19.55701	14.9334	<.0001*
Long Island 1938	Gloria 1985	230.150	17.86482	12.8828	<.0001*
Long Island 1938	Doria 1971	189.603	19.18176	9.8845	<.0001*
Doria 1971	David 1979	126.772	20.24026	6.2634	<.0001*
Gloria 1985	David 1979	61.132	19.34733	3.1597	0.0016*
Long Island 1938	Irene 2011	15.378	26.49099	0.5805	0.5616
Long Island 1938	Floyd 1999	-57.104	16.97990	-3.3630	0.0008*
Gloria 1985	Doria 1971	-62.256	20.00808	-3.1115	0.0019*
Irene 2011	Floyd 1999	-109.829	25.94642	-4.2329	<.0001*
Gloria 1985	Floyd 1999	-340.760	18.45062	-18.4687	<.0001*



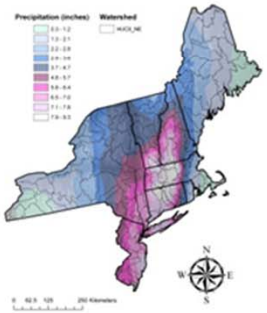
Results

The storm tracks showed a strong correlation with the distribution of rainfall. Because these Hurricanes generally began to lose power and increase in velocity as they moved through New England, the northern areas of the study area always received less total rainfall. The precipitation drapes over elevation show how the precipitation of these hurricanes was often funneled between the Adirondack and Green Mountains, with extreme precipitation values often falling over the mountains. Irene especially held true for this.

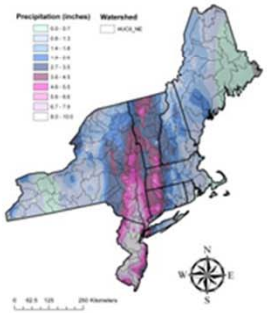
The comparison of precipitation means for each storm was able to give an understanding of one aspect of the strength of these storms. It was found that the storms were ranked as follows in terms of precipitation (largest to smallest): 1. Floyd 2. Irene and Long Island 3. Doria 4. Gloria 5. David. Irene and Long Island were found to be statistically the same. A comparison of mean wind strength reveled that Irene, Long Island, David and Floyd had greater wind strengths and were all statistically the same. Gloria then Doria followed in wind strength.

Cluster Analysis produced 4 distinct groups among each storm with the Mount Washington gauge always occupying its own 5th group. The geography of these groups is as follows: coastal plains/rivers/lake valleys, foothills, mountain valleys and high elevation/mountains. The mean precipitation of these clusters was compared in JMP with the exception of the Mount Washington cluster which could not be tested due to only having one case. The mean precipitation for all of the groups was found to be statistically the same except for the coastal plains/rivers/lake valleys group which had a significantly smaller mean precipitation.

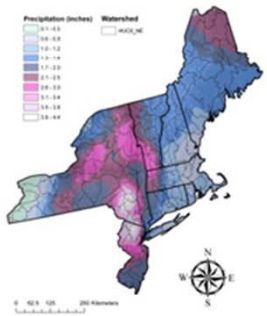
Long Island Express 1938



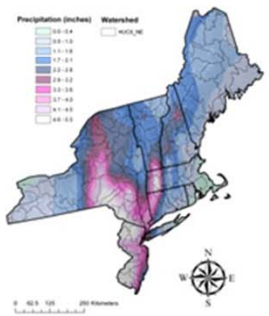
Doria 1971



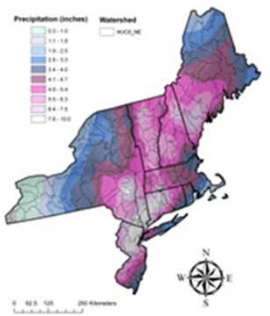
David 1979



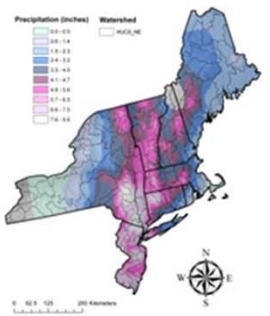
Gloria 1985



Floyd 1999



Irene 2011



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