Catastrophic Risk in New Jersey: Past, Present and Future
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Allianz Risk Transfer
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Natural Catastrophes
Impacts

- Insured losses from the 2009-2010 Northern Hemisphere winter were $2.6 billion, highest since 2003 (Munich Re)
- Insured losses from the 2005 hurricane season over $100 billion (Swiss Re)
- Most expensive tornado outbreak in US history in late April 2011: Insured loss estimates range between $3.5 - $6 billion
- 167 natural catastrophic events occurred in 2010 – RECORD (Swiss Re)
Weather and its Economic Impact
United States

- All 11 non-governmental sectors of US economy are sensitive to weather variability
- US economic output varies as much as 3.4% of the 2008 gross domestic product (GDP; $485 billion) as a direct result of weather variability
- NOAA estimates $2.65 trillion, or 25% of the US GDP, is impacted by weather
- Economic sensitivity of New Jersey is 8-10% of gross state product (GSP) due to weather variability
Exposure in New Jersey

- Fifth highest coastal exposure among hurricane exposed states
- AIR estimates of $505.8 billion of coastal exposure in 2007
- Inflating to present day, coastal exposure closer to $600 billion

Source: III/AIR
Loss Drivers in New Jersey

- Annual aggregate basis – Severe thunderstorms (tornado/hail/straight-line winds) contribute the most to insured losses
- Event basis – Winterstorms and hurricanes result in large insured losses; severe thunderstorm losses are negligible

### Significant Northeast Hurricane Losses 1900-present

<table>
<thead>
<tr>
<th>Storm Name</th>
<th>Year</th>
<th>Present Day Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vagabond Hurricane</td>
<td>1903</td>
<td>195,000,000</td>
</tr>
<tr>
<td>Long Island Express</td>
<td>1938</td>
<td>39,200,000,000</td>
</tr>
<tr>
<td>Great Atlantic Hurricane</td>
<td>1944</td>
<td>13,200,000,000</td>
</tr>
<tr>
<td>Carol</td>
<td>1954</td>
<td>16,100,000,000</td>
</tr>
<tr>
<td>Donna</td>
<td>1960</td>
<td>29,600,000,000</td>
</tr>
<tr>
<td>Agnes</td>
<td>1972</td>
<td>17,500,000,000</td>
</tr>
<tr>
<td>Belle</td>
<td>1976</td>
<td>500,000,000</td>
</tr>
<tr>
<td>Gloria</td>
<td>1985</td>
<td>2,400,000,000</td>
</tr>
<tr>
<td>Bob</td>
<td>1991</td>
<td>3,000,000,000</td>
</tr>
<tr>
<td>Floyd</td>
<td>1999</td>
<td>6,700,000,000</td>
</tr>
</tbody>
</table>

Source: Pielke et al. (2005)
Ash Wednesday Nor’easter of 1962

- New inlets cut on LBI
- Avalon lost 6 blocks
- 45,000 homes lost or destroyed
- Access on LBI prevented for weeks

Picture: USGS
Hurricane Return Periods

Return Period In Years For Category 1 Hurricanes

Return Period In Years For Category 3 Hurricanes

Category 1 (years)
- 4 - 6
- 6 - 10
- 10 - 15
- 15 - 24
- 24 - 35

Category 3 (years)
- 9 - 22
- 24 - 32
- 33 - 44
- 46 - 74
- 79 - 370

Source: NHC
Three hurricanes made landfall in New Jersey from the Revolutionary War to Civil War:

- Hurricane of August 1778 prevented a British/French naval battle
- “Snowicane” of 1804 struck Atlantic City as a Category 2 in October and dropped over a foot of snow in parts of New England

Source: Dunn and Miller (1964)
1821 Long Island-Norfolk Hurricane

- Struck Cape May as either a Category 3 or Category 4 hurricane on the Saffir-Simpson Scale
- Storm surge of 29 ft reported
- Second landfall in New York City as a Category 3 hurricane
- Manhattan flooded to Canal Street

Source: NOAA
1903 Vagabond Hurricane

Struck near Atlantic City as a Category 1 hurricane

Source: NOAA
1944 Great Atlantic Hurricane

- Paralleled Eastern Seaboard as a Category 3 hurricane before striking Long Island
- No direct landfall on New Jersey
- Close enough passage to do serious damage to Ocean Grove, Asbury Park, LBI, Atlantic City and Cape May
- Most damaging storm in the 20th century

Picture: NOAA
New Jersey Hurricanes: 1950 - 2010

- Carol (1954)
- Donna (1960)
- Agnes (1972)
- Belle (1976)
- Gloria (1985)
- Bob (1991)
- Floyd (1999)

Source: NOAA
Coastal County Population Growth
Ocean County

Hurricane Strikes vs Population for Ocean, New Jersey

Source: NOAA
Hurricane Irene
Forecasts

- Forecasted track 48 hours in advance took Irene up the coast and over the barrier islands as a hurricane.
- Prompted a full evacuation of all barrier islands, coastal communities, Hoboken, downtown Manhattan and Jersey City.
- Shut down mass transit and the Garden State Parkway south of Exit 98.

Source: NHC/NOAA
Hurricane Irene Impacts

- First hurricane to make landfall in New Jersey since 1903.
- Destroyed promenades and piers along the coastline.
- Caused severe flooding inland and prolonged power outages.
- Worst flooding in Vermont and New York in 100 years.
- Estimated $15 billion in economic losses and $3.7 billion in insured losses.
- Estimated $755 million in insured losses in New Jersey.

Source: Wunderground
Nightmare scenario: Borderline Category 3/4 making landfall in southern Ocean County

Economic/insured loss potential 2-3 times Hurricane Katrina

Source: AIR/III
Vulnerability of the New York/New Jersey Metro Region

- Top 10 in population vulnerable to coastal flooding
- Second only to Miami in assets exposed to coastal flooding
- Second only to Tokyo, Japan for assets exposed to wind damage
- BAU scenario: $2.5 trillion in assets exposed to sea level rise

Source: OCED
Future Projections

<table>
<thead>
<tr>
<th>Extreme Event</th>
<th>Baseline (1971-2000)</th>
<th>2020s</th>
<th>2050s</th>
<th>2080s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-in-10 yr flood to reoccur, on average</td>
<td>~once every 10 yrs</td>
<td>~once every 8 to 10 yrs</td>
<td>~once every 3 to 6 yrs</td>
<td>~once every 1 to 3 yrs</td>
</tr>
<tr>
<td>Flood heights associated with 1-in-10 yr flood</td>
<td>6.3</td>
<td>6.5 to 6.8</td>
<td>7.0 to 7.3</td>
<td>7.4 to 8.2</td>
</tr>
<tr>
<td>Flood heights associated with 1-in-100 yr flood</td>
<td>~once every 100 yrs</td>
<td>~once every 65 to 80 yrs</td>
<td>~once every 35 to 55 yrs</td>
<td>~once every 15 to 35 yrs</td>
</tr>
<tr>
<td>Flood heights associated with 1-in-500 yr flood</td>
<td>8.6</td>
<td>8.8 to 9.0</td>
<td>9.2 to 9.6</td>
<td>9.6 to 10.5</td>
</tr>
<tr>
<td>1 in 500-yr flood to reoccur, on average</td>
<td>~once every 500 yrs</td>
<td>~once every 380 to 450 yrs</td>
<td>~once every 250 to 330 yrs</td>
<td>~once every 120 to 250 yrs</td>
</tr>
<tr>
<td>Flood heights associated with 1-in-500 yr flood</td>
<td>10.7</td>
<td>10.9 to 11.2</td>
<td>11.4 to 11.7</td>
<td>11.8 to 12.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk</th>
<th>Baseline</th>
<th>2020s</th>
<th>2050s</th>
<th>2080s</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLR</td>
<td>--</td>
<td>+2-5 in</td>
<td>+7-12 in</td>
<td>+12-23 in</td>
</tr>
<tr>
<td>Rapid ice melt</td>
<td>--</td>
<td>+5-10 in</td>
<td>+19-29 in</td>
<td>+41-55 in</td>
</tr>
</tbody>
</table>

Source: NPCC
Weather Events and Climate Change

- Impossible to determine impact of climate change on individual events
- Recent publications suggest decrease in overall hurricane frequency and an increase in major hurricane frequency

Source: GFDL
How the Insurance Industry Can Help
Reducing Near-Term Budget Fluctuations

Index-based weather cover

- Simple, transparent solution which allows state or municipalities to quickly receive funds to offset costs incurred by weather variability.
- Almost any weather variable can be used: snowfall, precipitation, temperature, heating degree days.
- Bespoke structures are designed to fit budgets and provide maximum protection for premium paid.
How the Insurance Industry Can Help Planning for Future Financial Costs

Industry Catastrophe models

- Computer models which combine scientific, engineering, economic and financial principles provide insurers with projections of loss severity and loss frequency.
- Models contain hazard sets, which are hundreds of thousands of physically plausible but non-historical events, such as earthquakes, hurricanes, floods, blizzards and tornadoes.
- Input is a portfolio which contains information about the location, construction and value of each individual risk.
- Output gives expected loss values across various return periods and the annual average loss.
- Models can be tweaked to account for climate change by altering the frequency or the severity of different simulated events.
- Output then reflects losses expected in a new climate regime.