Catastrophic Risk in New Jersey: Past, Present and Future
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Allianz Risk Transfer
May 25th, 2011
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

Fig. 5. State sensitivity to weather variability as a percentage of total GSP.
Source: Lazo et al (2011)
Weather Risk in New Jersey

Pictures: NOAA
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

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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)
The Great Blizzard of 1888

- 40 inches of snow in New Jersey
- Central Park Observatory reported a daytime average of 9°F on March 13th
- 400 fatalities
- Estimated damage: $1.2 bn USD (2008)

Picture: LIFE magazine
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
Recent Nor’easters

- December 1992: Flooded mass transit and caused $2 bn (1992 USD) in economic damage
- January 1996: Near 3 ft. of snow throughout much of the state
- Nor’Ida (2009): Remnants of Hurricane Ida intensified and barrier islands sustained significant damage

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Picture: NOAA and The Star Ledger
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

- Most recent hurricane to strike New Jersey
- Struck as 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 - present

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

Source: NOAA
Coastal County Population Growth
Atlantic County

Hurricane Strikes vs Population for Atlantic, New Jersey

Source: NOAA
Coastal County Population Growth
Cape May County

Hurricane Strikes vs Population for Cape May, New Jersey

Source: NOAA
Coastal County Population Growth
Ocean County

Hurricane Strikes vs Population for Ocean, New Jersey

Source: NOAA

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Recent “Near Misses”

- Hurricane Edouard (1996) – Forecast to make landfall as a Category 3 near Atlantic City over Labor Day weekend
- Hurricane Isabel (2003) – Projected landfall in Cape May as a Category 3
- Hurricane Earl (2009) – Forecasted to move up New Jersey coast directly into New York City as a borderline Category 2/3
- 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

### Coastal Floods & Storms

<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 (in feet)</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>1-in-100 yr flood to reoccur, on average</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-100 yr flood (in feet)</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 (in feet)</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>

### Risk

<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
Conclusions

- Billions of dollars lost annually due to natural catastrophes
- Historical precedents for catastrophic weather events to occur in New Jersey
- Recent decades have experienced both population increases and relatively benign weather
- Climate change adds new challenges, by both altering the shape of the coast line and impacting the frequency and severity of individual weather events