

# Catastrophic Risk in New Jersey: Past, Present and Future

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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

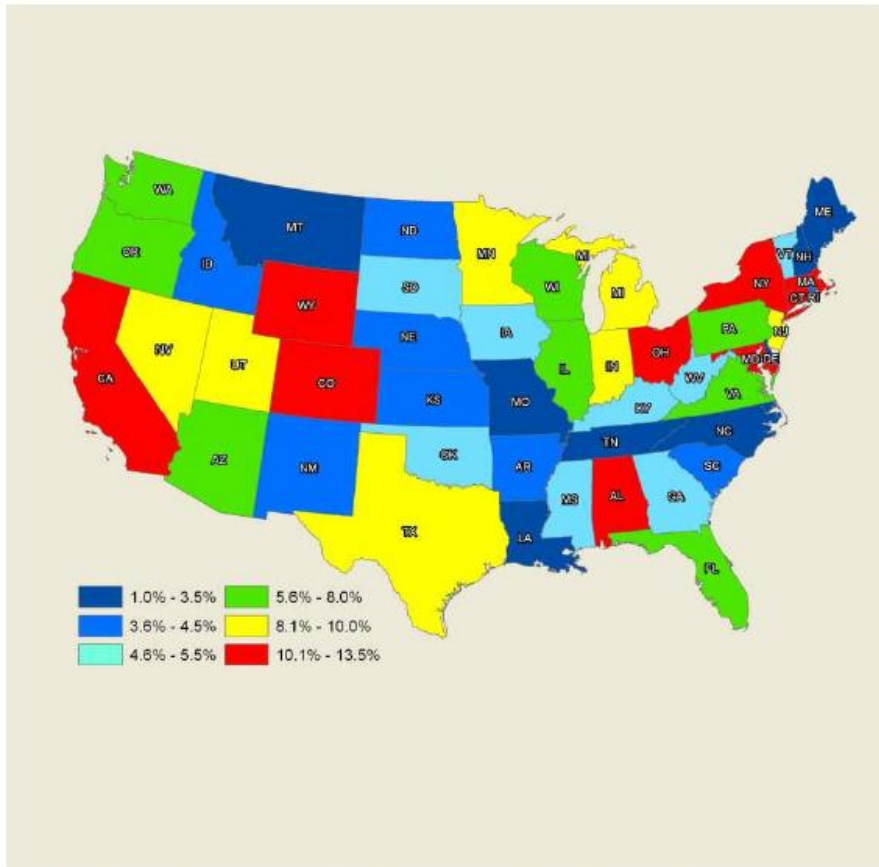
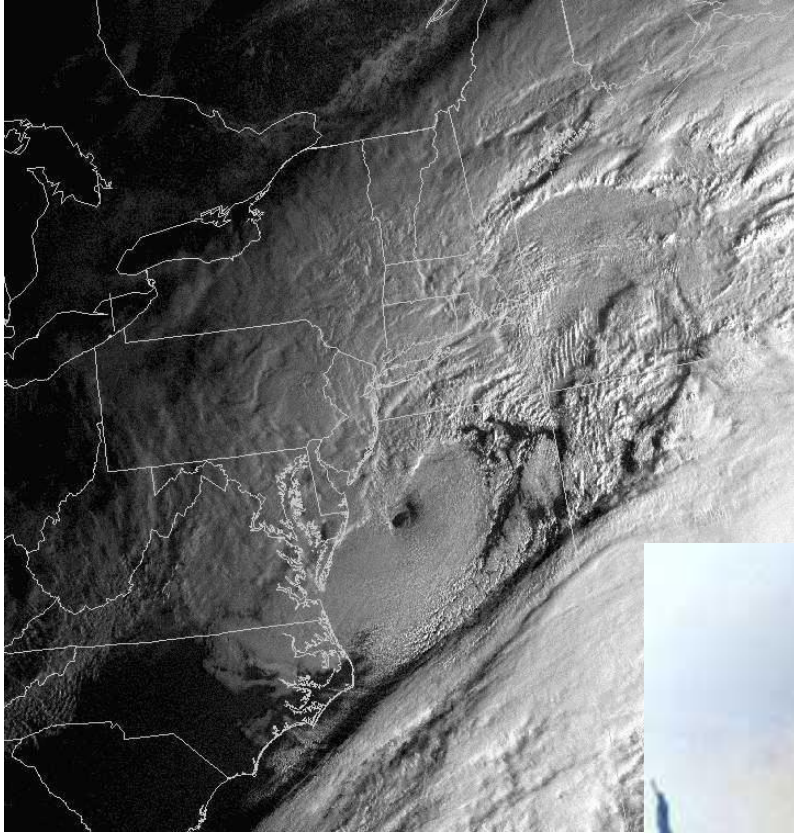


Fig. 5. State sensitivity to weather variability as a percentage of total GDP.

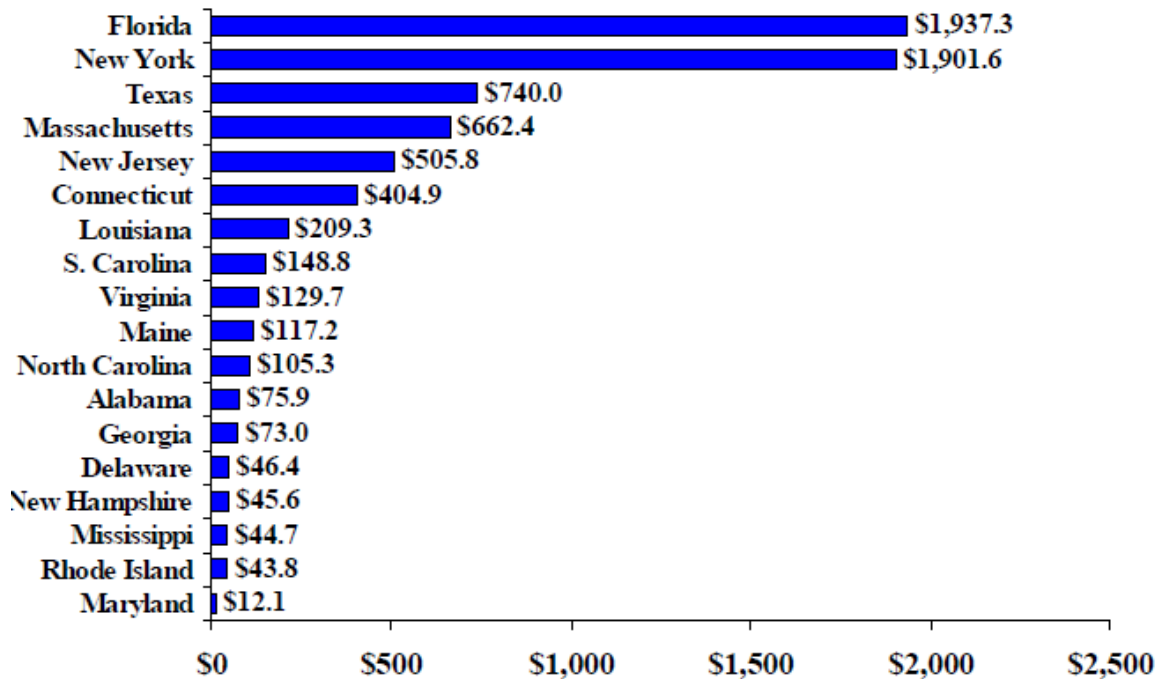
Source: Lazo et al (2011)

- 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

## Weather Risk in New Jersey



## Exposure in New Jersey



Source: III/AIR

- 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

## 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

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

Source: Pielke et al. (2005)



# The Great Blizzard of 1888



Picture: LIFE magazine

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

## Ash Wednesday Nor'easter of 1962

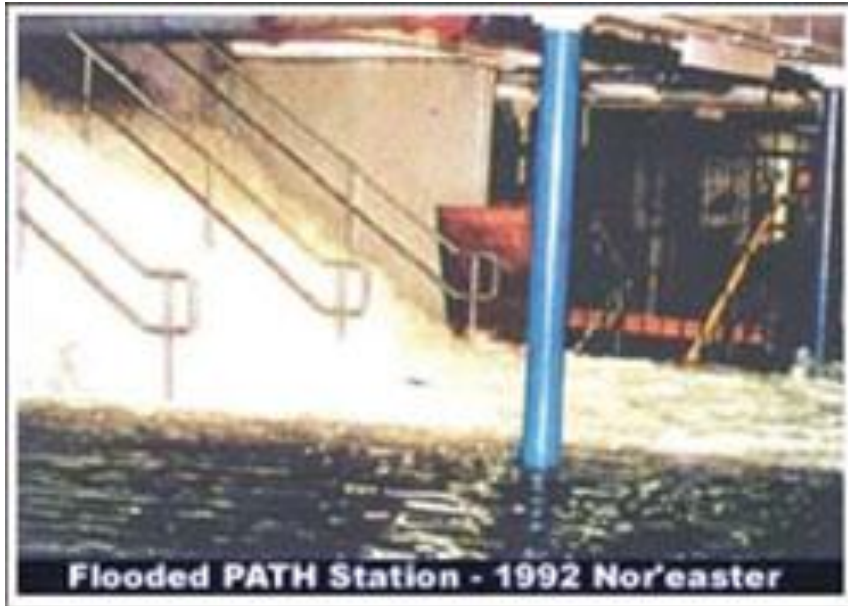


Picture: USGS

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



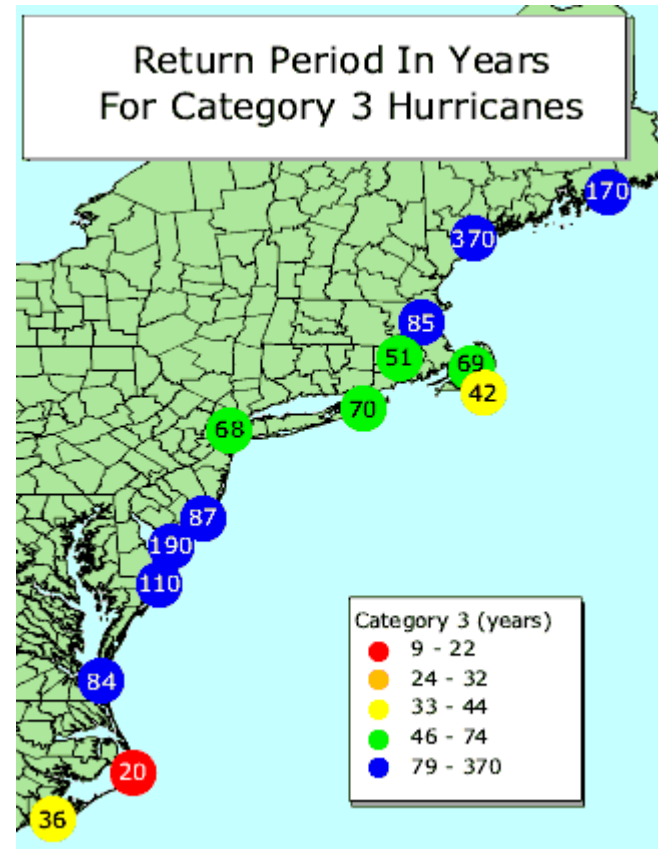
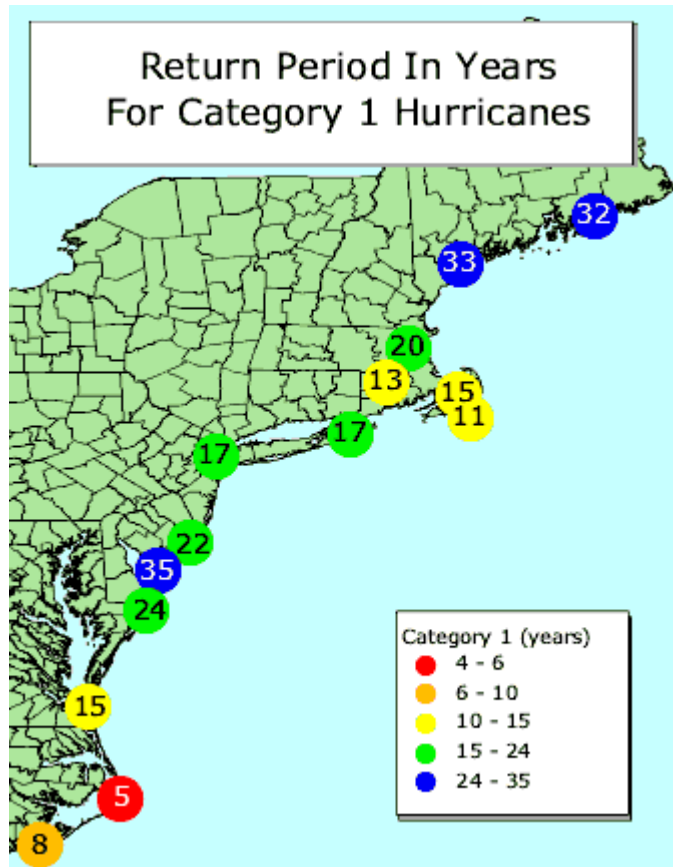
## Recent Nor'easters



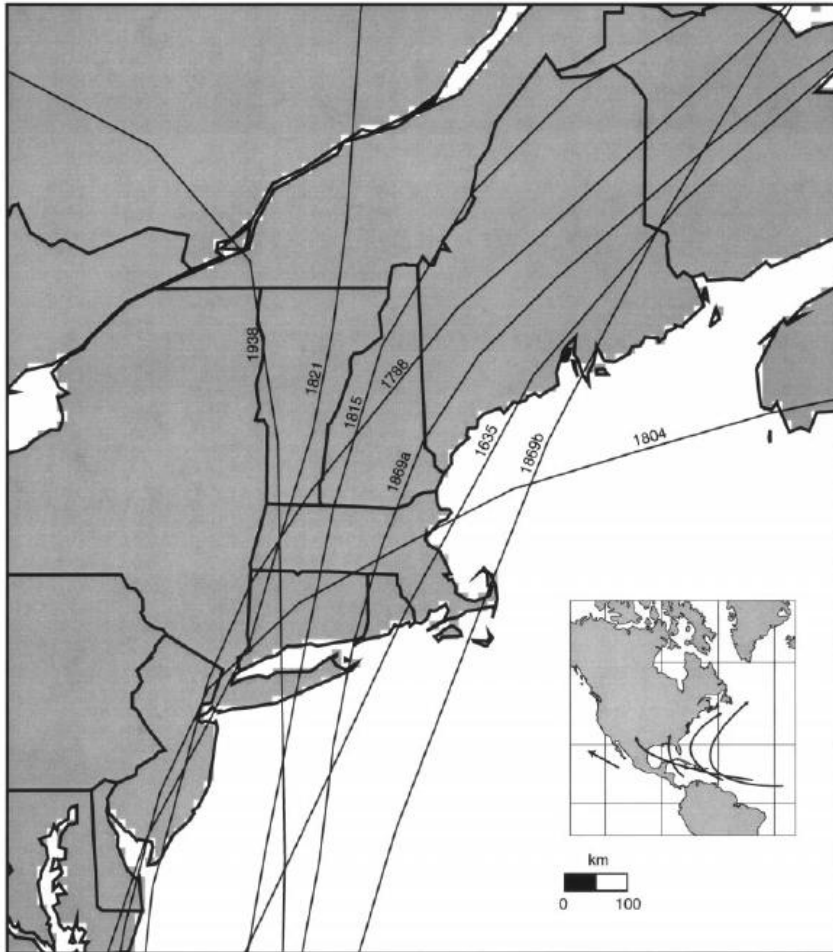
- December 1992: Flooded mass transit and caused \$2 bn (1992 USD) in economic damage
- January 1996: Near 3 ft. of snow throughout much of the state
- Nor'Ida (2009): Remnants of Hurricane Ida intensified and barrier islands sustained significant damage



# Hurricane Return Periods



## Pre-1900 Hurricanes

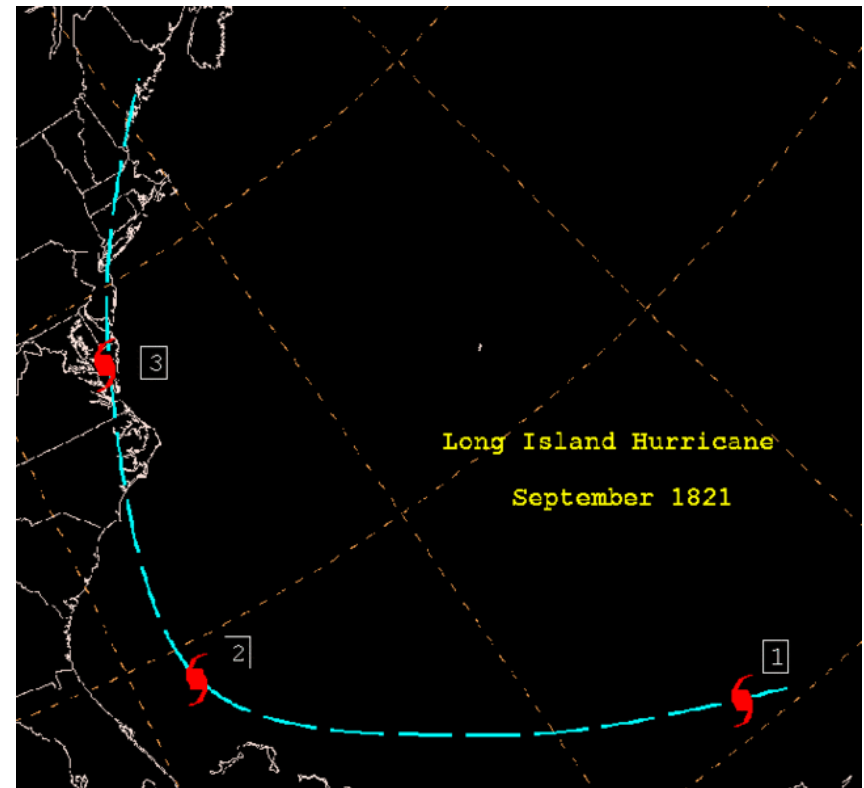


Source: Dunn and Miller (1964)

- 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

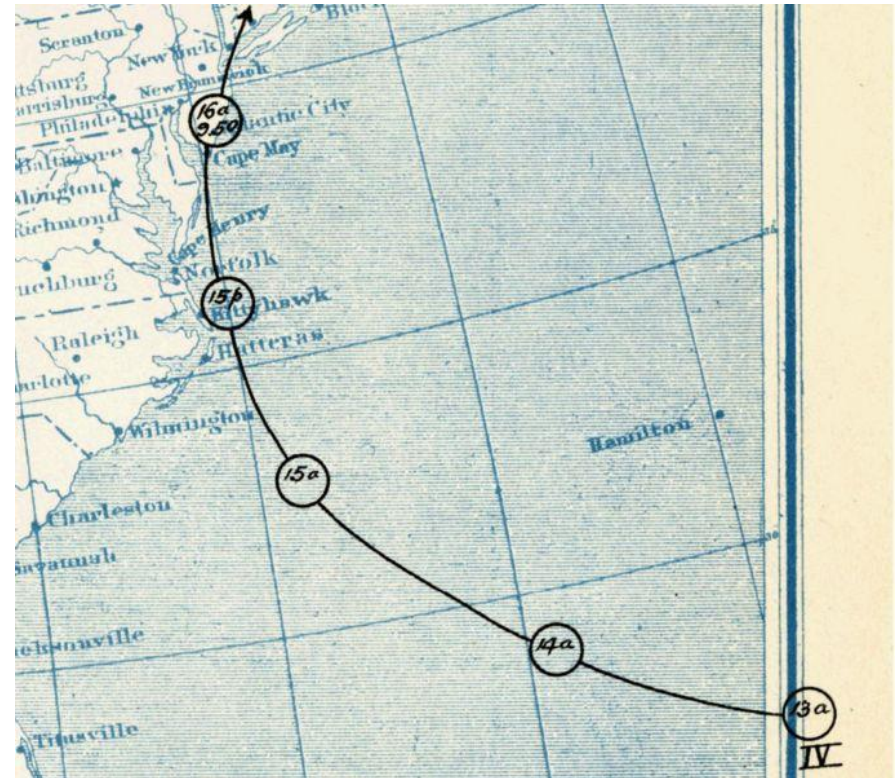
## 1821 Long Island-Norfolk Hurricane

- 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



# 1944 Great Atlantic Hurricane

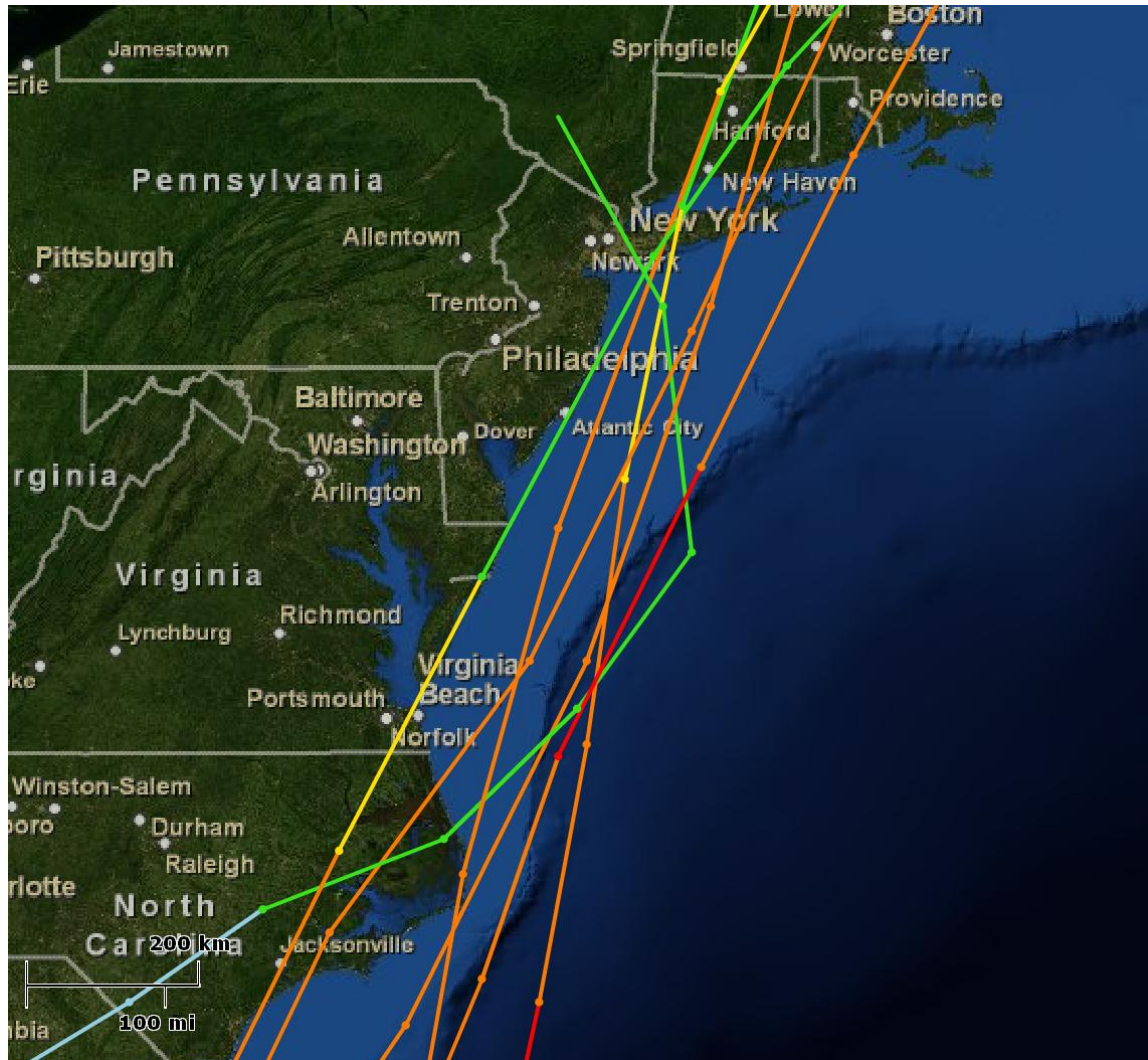
- Paralleled Eastern Seaboard as a Category 3 hurricane before striking Long Island
- No direct landfall on New Jersey
- Close enough passage to do serious damage to Ocean Grove, Asbury Park, LBI, Atlantic City and Cape May
- Most damaging storm in the 20<sup>th</sup> century



Picture: NOAA



## New Jersey Hurricanes: 1950 - present

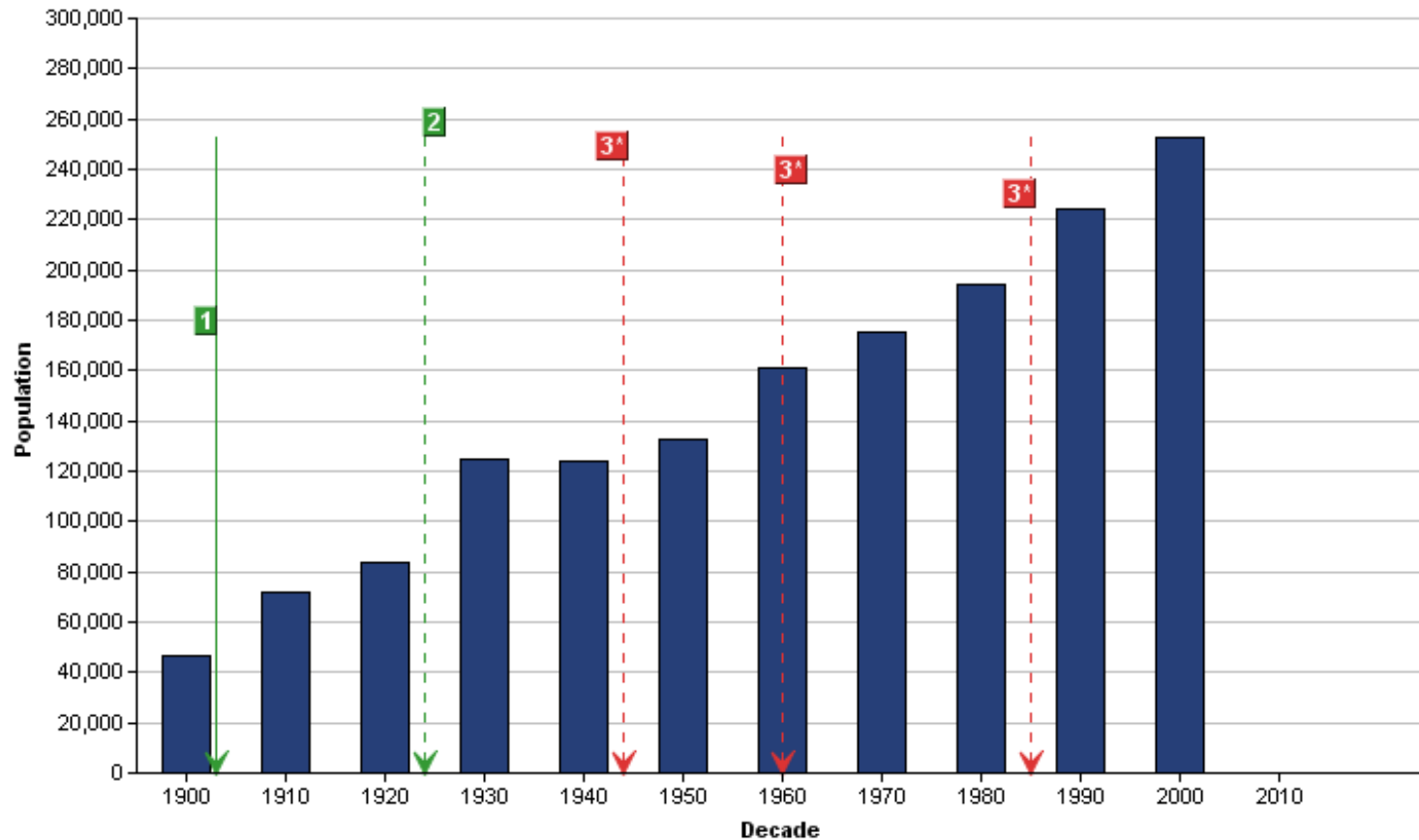


- Carol (1954)
- Donna (1960)
- Agnes (1972)
- Belle (1976)
- Gloria (1985)
- Bob (1991)
- Floyd (1999)

# Coastal County Population Growth

## Atlantic County

### Hurricane Strikes vs Population for Atlantic, New Jersey

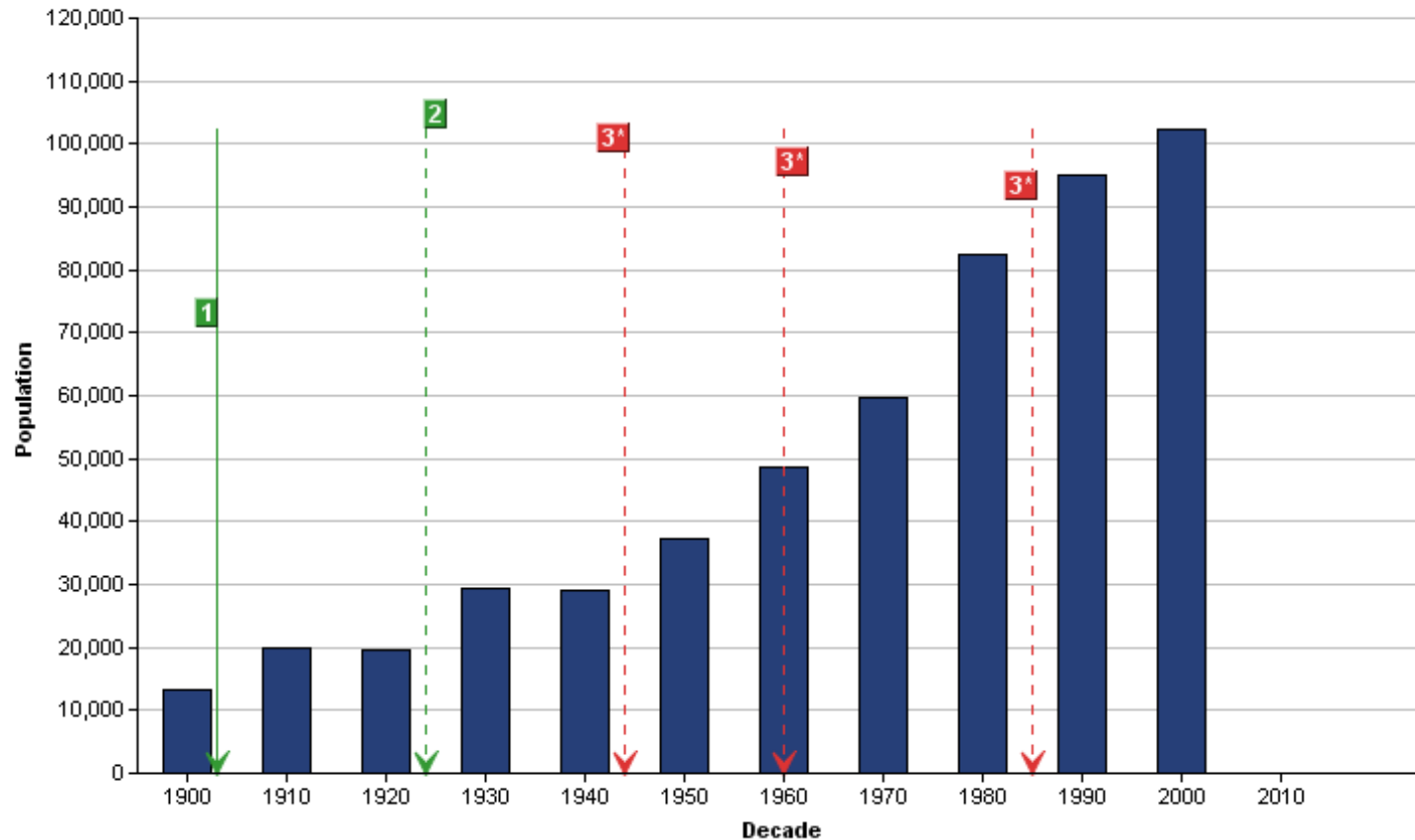


Source: NOAA

# Coastal County Population Growth

## Cape May County

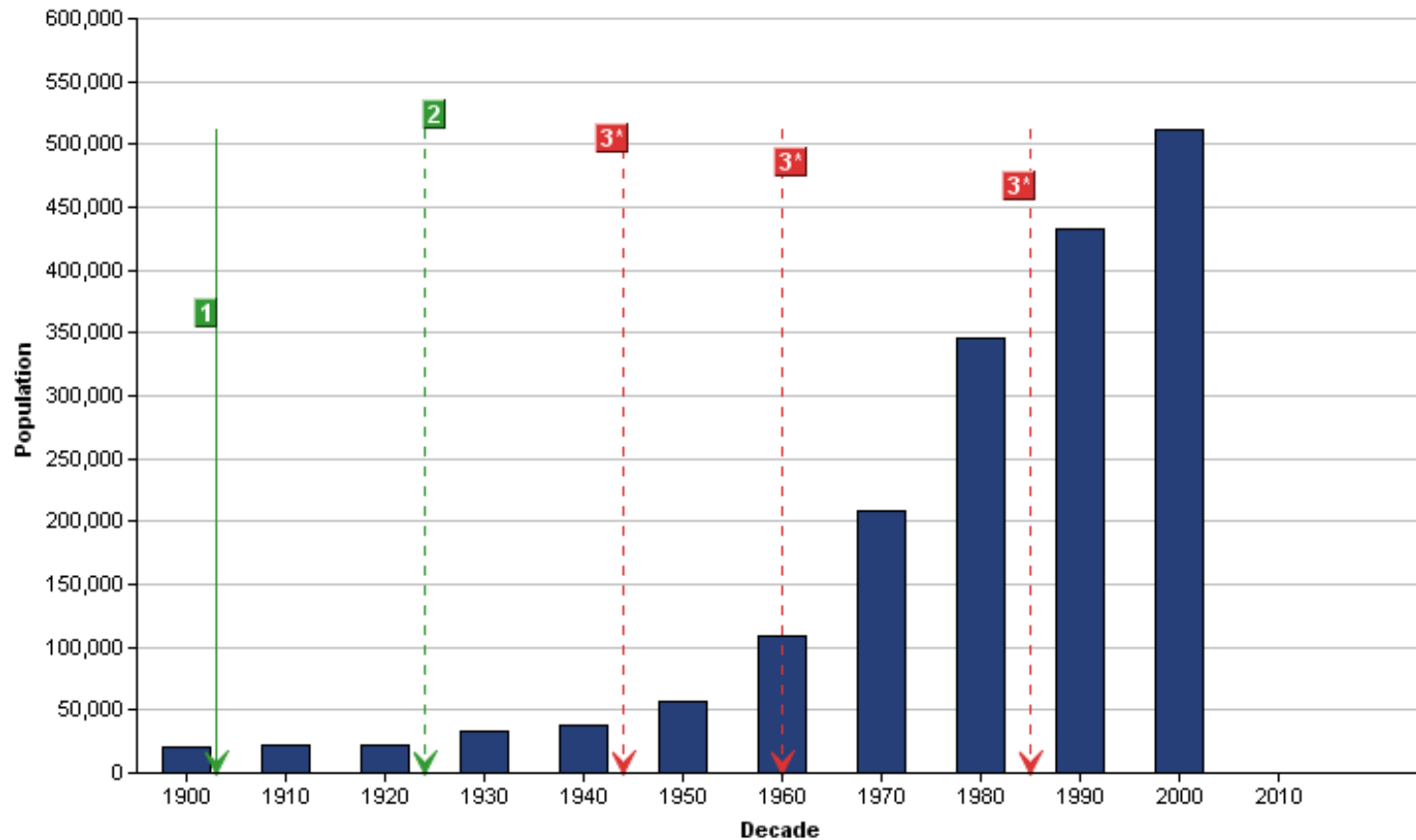
### Hurricane Strikes vs Population for Cape May, New Jersey



Source: NOAA

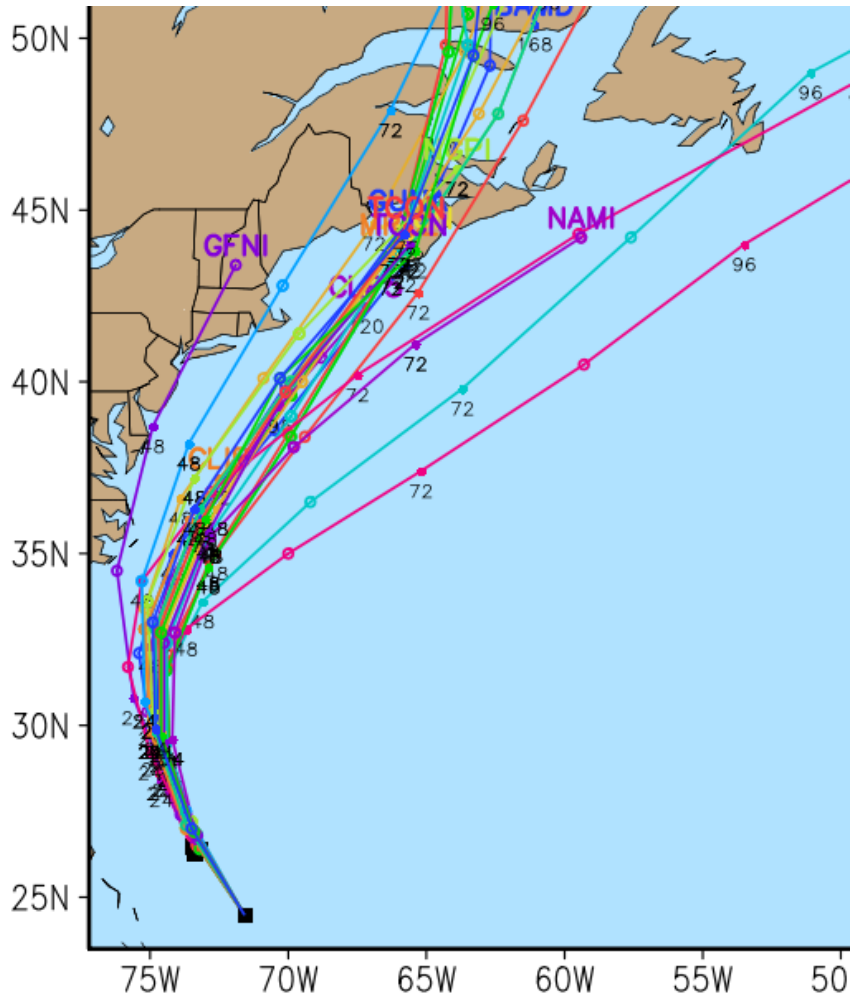
# Coastal County Population Growth Ocean County

## Hurricane Strikes vs Population for Ocean, New Jersey

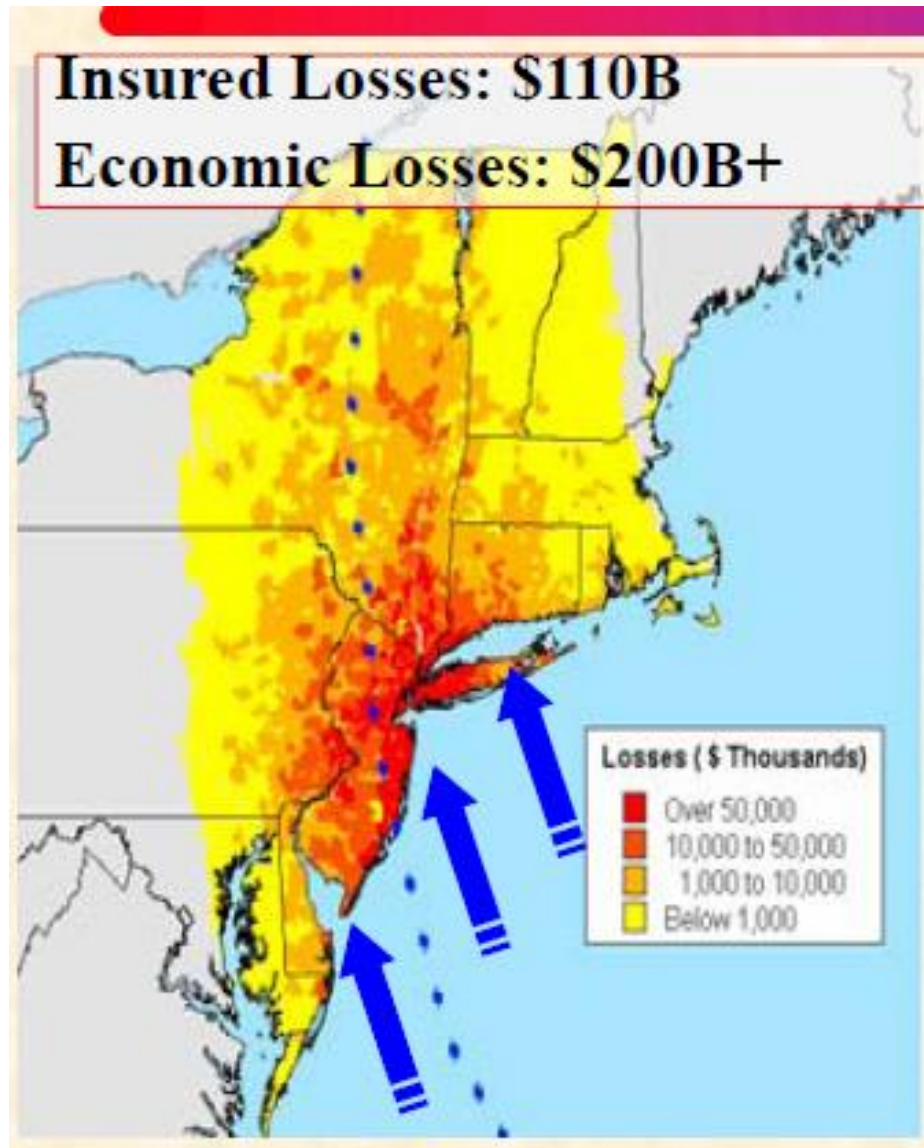


Source: NOAA

## 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

# Future Projections

Extreme Event	Baseline (1971-2000)	2020s	2050s	2080s
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<b>Coastal Floods &amp; Storms<sup>4</sup></b>	1-in-10 yr flood to reoccur, on average	~once every 10 yrs	~once every 8 to 10 yrs	~once every 3 to 6 yrs	~once every 1 to 3 yrs
	Flood heights associated with 1-in-10 yr flood (in feet)	6.3	6.5 to 6.8	7.0 to 7.3	7.4 to 8.2
	1-in-100 yr flood to reoccur, on average	~once every 100 yrs	~once every 65 to 80 yrs	~once every 35 to 55 yrs	~once every 15 to 35 yrs
	Flood heights associated with 1-in-100 yr flood (in feet)	8.6	8.8 to 9.0	9.2 to 9.6	9.6 to 10.5
	1 in 500-yr flood to reoccur, on average	~once every 500 yrs	~once every 380 to 450 yrs	~once every 250 to 330 yrs	~once every 120 to 250 yrs
	Flood heights associated with 1-in-500 yr flood (in feet)	10.7	10.9 to 11.2	11.4 to 11.7	11.8 to 12.6

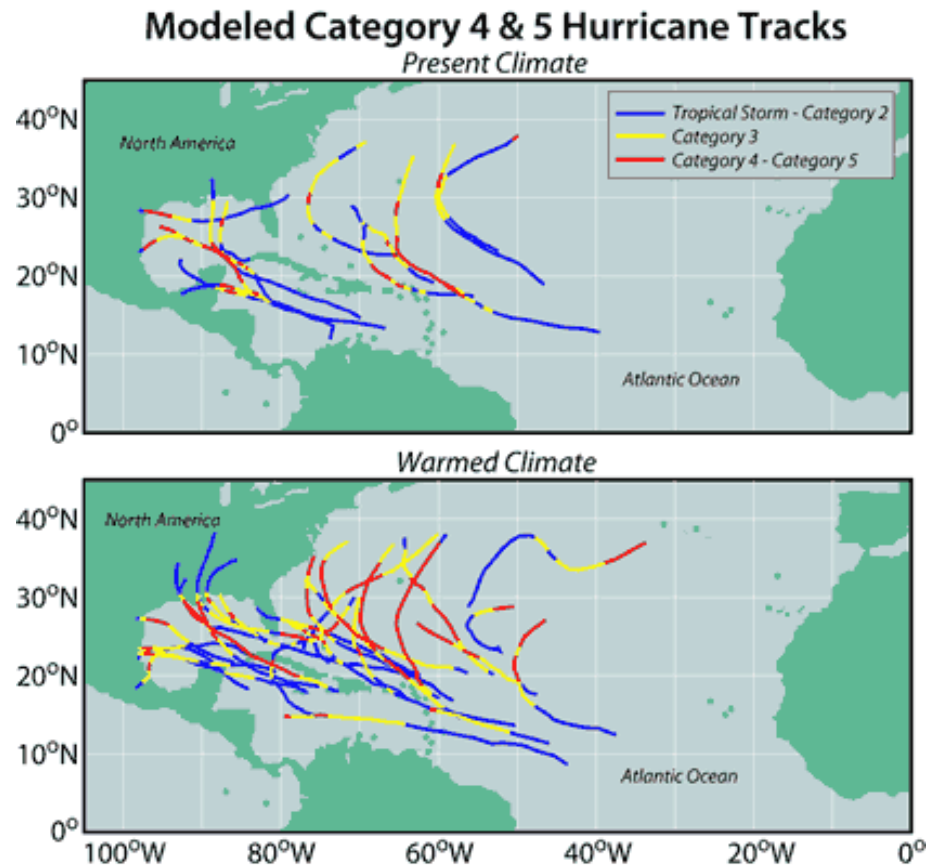
Risk	Baseline	2020s	2050s	2080s
SLR	--	+2-5 in	+7-12 in	+12-23 in
Rapid ice melt	--	+5-10 in	+19-29 in	+41-55 in

"Worst Case" Storm Surge - 25 Feet



# 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