

An aerial photograph of a city street that has been completely flooded. Numerous people are seen wading through the murky water, some carrying bags or holding onto trees. The street is lined with trees and buildings, and the water reflects the sky and the surrounding environment. The image is used as a background for the presentation slide.

Swiss Re



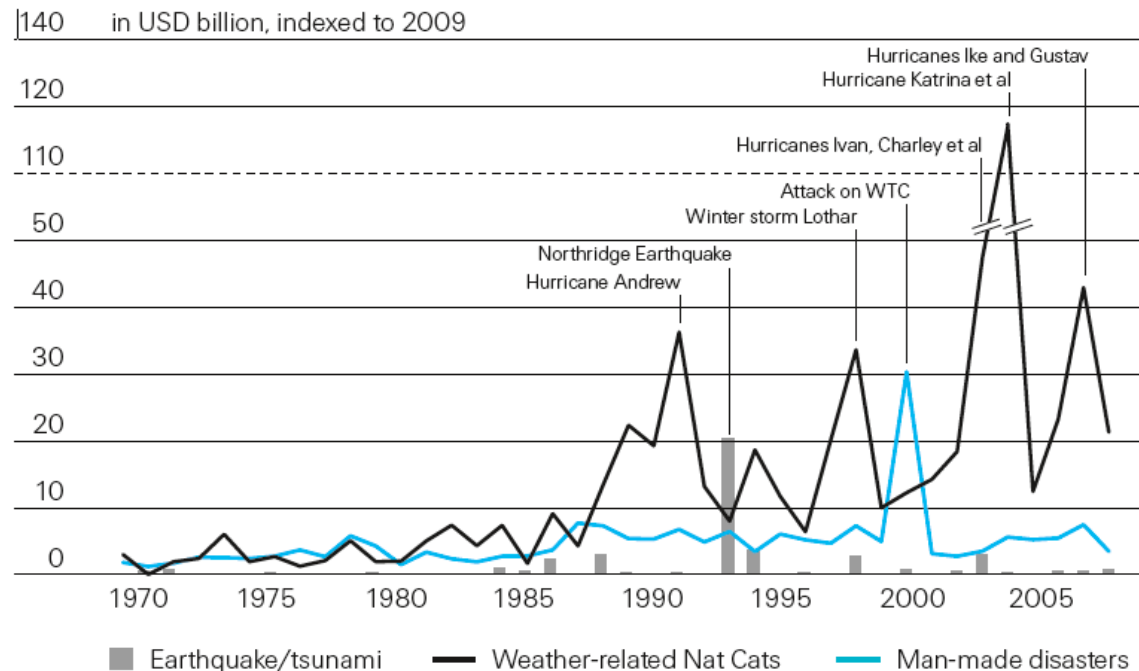
# Climate Change Risk in New York City: The Viewpoint of an Insurer

Megan Linkin, Cat Perils, Swiss Re, Get Past the Past:  
9/23/2010



# Insured Losses

## Global Natural Catastrophes 1970-2009



- Apparent increase from 1970 – 2009
- Weather-related perils result in highest aggregate loss
- Primarily driven by increased exposure in vulnerable areas.

Source: Swiss Re sigma report 1/2010

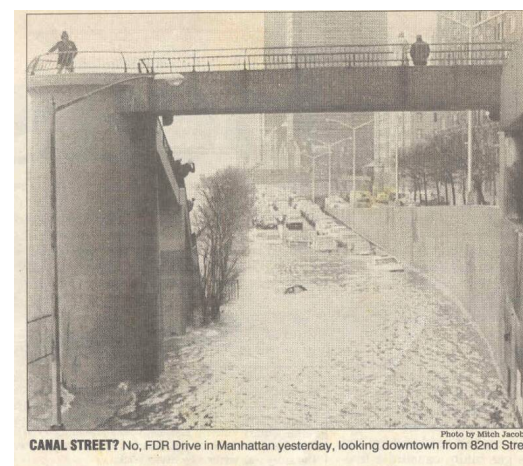
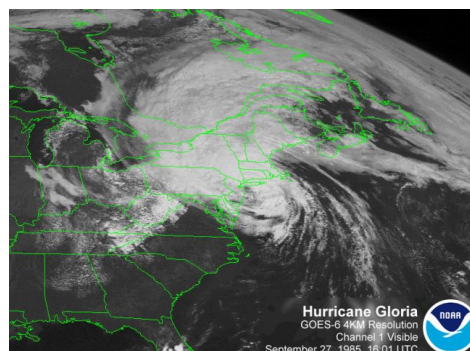
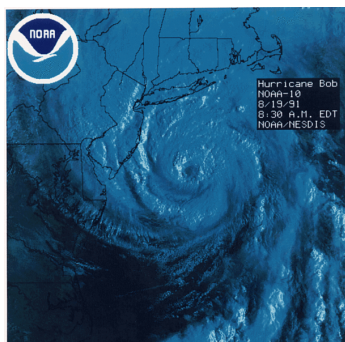


## New York City Facts and Figures

- Susceptible to hurricanes and nor'easters (large winter storms which cause heavy snow, storm surge and strong winds)
- Heavily developed downtown Manhattan is prone to severe flooding
- Total value of privately insured coastal properties is \$2.4 trillion USD (2007 USD) in New York State, all located in New York City or Long Island (AIR 2007).
- Among 136 global port cities, New York is in the top ten of population exposed to coastal flooding; second only to Miami in terms of asset value exposed to coastal flooding (OCED).
- Under IPCC business-as-usual, population threatened by sea level rise (SLR) doubles and asset values threatened by SLR increases seven-fold (\$320 billion to \$2.5 trillion; OCED).
- New York second only to Tokyo for potential wind damageability when an index is constructed from population and asset value (OCED).
- Unique, uninsured infrastructure (tunnels, bridges, subways).

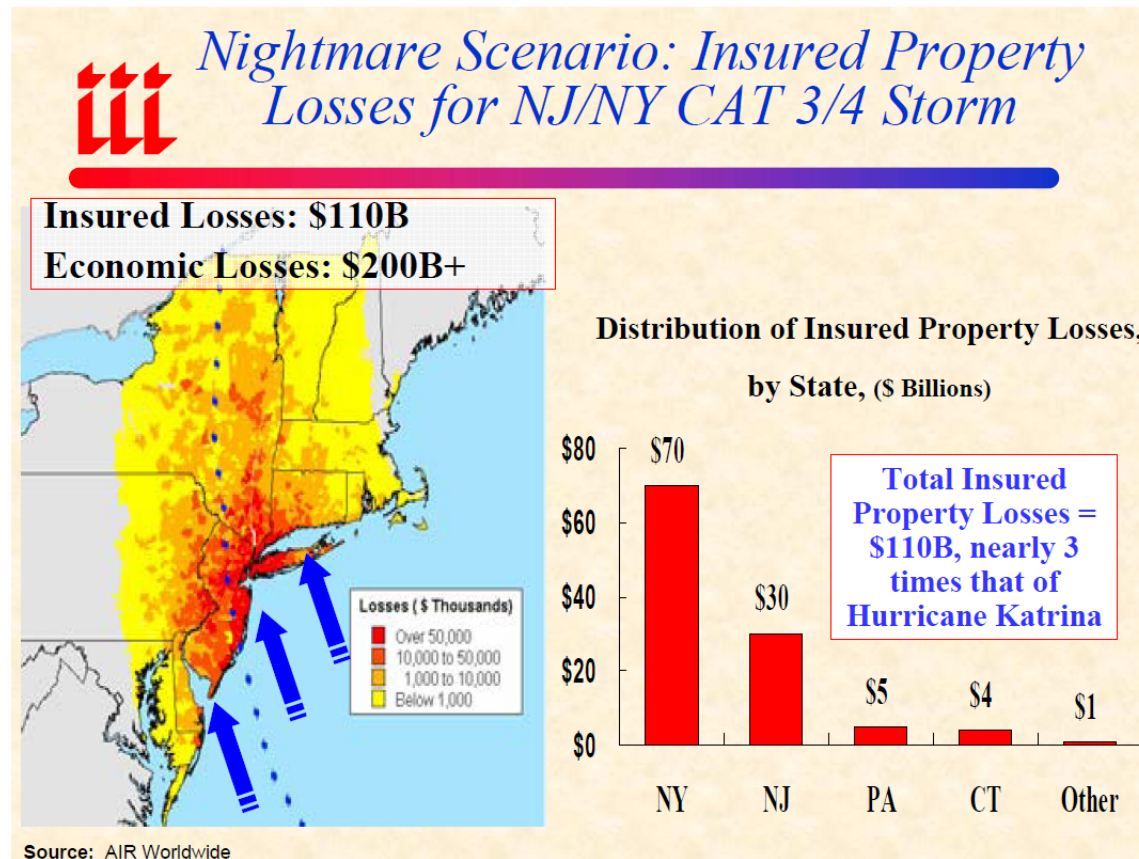
## Natural Catastrophes and New York City

Event	Year	Original	2009 as-if
Hurricane Gloria	1985	\$ 172,500,000	\$ 885,000,000
Hurricane Bob	1991	\$ 115,000,000	\$ 400,000,000
December Nor'easter	1992	\$ 220,000,000	\$ 715,000,000
March Superstorm	1993	\$ 105,000,000	\$ 320,000,000
Blizzard of 1996	1996	\$ 70,000,000	\$ 175,000,000
Presidents Day storm	2003	\$ 10,000,000	\$ 27,000,000



Sources: ISO/PCS, NOAA, New York Daily News

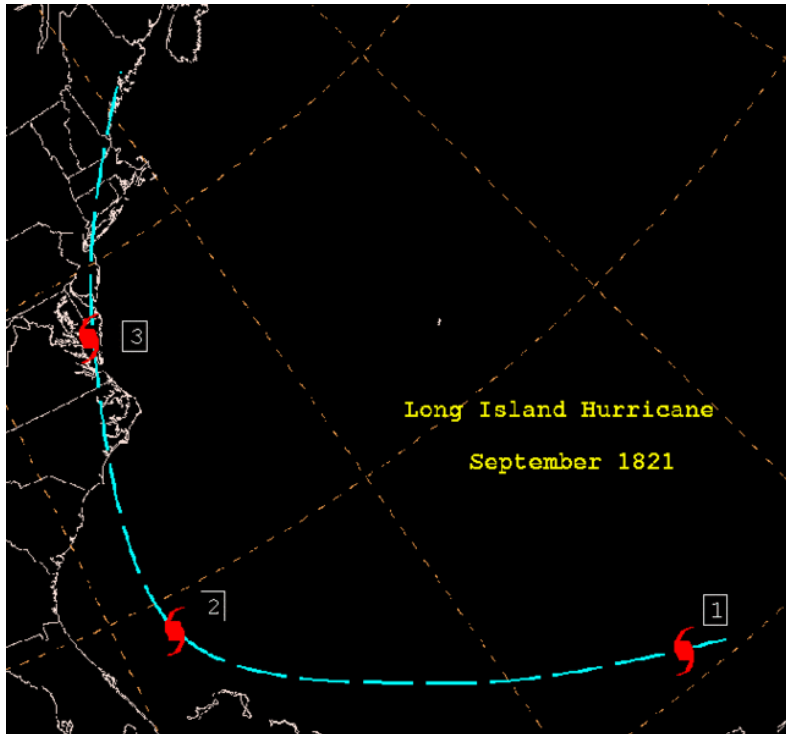
## Loss Potential New York City Metro Area



"It is not a question of *if* a major hurricane will strike the New York area but *when*."  
 -- Max Mayfield, former direction of the NHC

Source: AIR, III

## The 1821 Norfolk and Long Island Hurricane



- Most recent hurricane believed to make landfall in New York City as a major hurricane
- Tide rose 13 ft. in one hour
- Flooding from the East and Hudson Rivers occurred as far north as Canal St.

Sources: NOAA



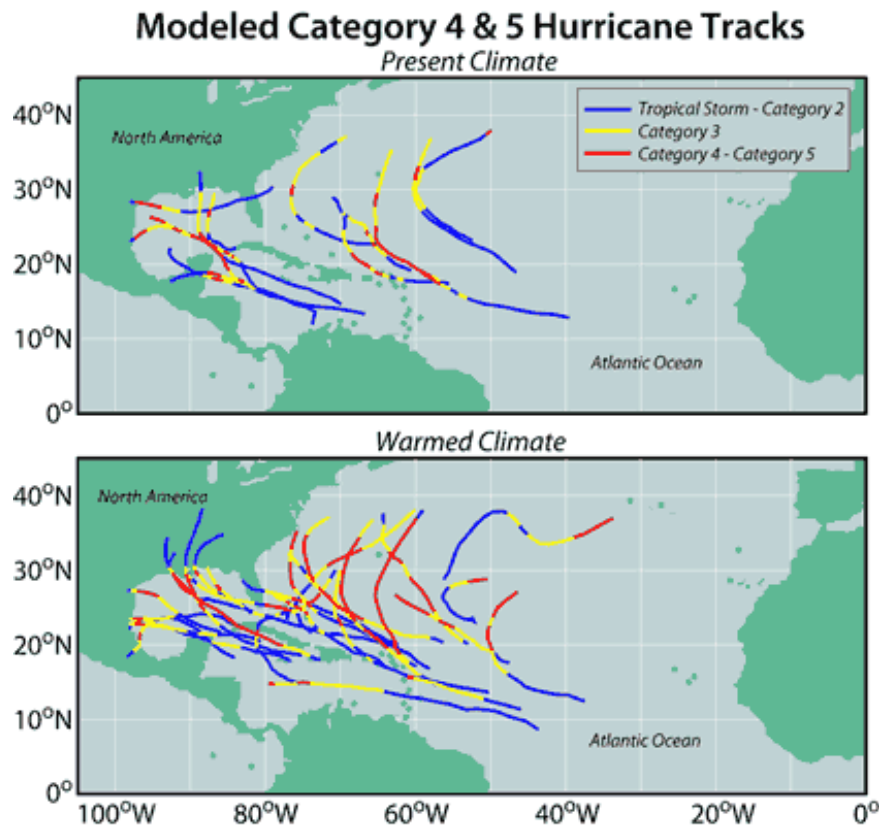
## The 1938 Long Island Express



- Most recent hurricane to make landfall on Long Island as a major hurricane
- Devastated Long Island, Connecticut, Rhode Island
- NYC mostly spared being on western side of the storm.
- Repeat today would cause \$70 billion economic losses (source: AIR).

Source: NOAA/SUNY Stony Brook

# Hurricanes and Climate Change Future Projections



- Most recent scientific research suggests the following as the main impacts of climate change on global tropical cyclones:
  - Decrease in overall event frequencies
  - Increase in occurrence frequencies of the most extreme (category 4 and category 5) hurricanes.
  - Increase in rainfall rates within tropical cyclones

Source: Bender et al (2010)



## Insurance Fundamentals

- Insurance protects against high-impact, low probability events.
- Insured pays the insurer a premium to procure payments for future losses
- Key: Create a risk community, where individual risk is shared by all.
- Premium calculation is actuarially based; policyholders who contribute more to the risk pay a higher premium
  - All other factors being equal, homeowner premiums in Miami, FL are higher than homeowner premiums in Eastport, ME due to increased hurricane risk.

## Reinsurance

### What is it?

- ***Reinsurance is insurance for insurance companies.***
- An agreement between the reinsurer and insurer (cedent): The reinsurer indemnifies the cedent; in return, the cedent pays a premium.
- Insurance companies purchase reinsurance to:
  - reduce volatility of underwriting results
  - capital relief/flexible financing
  - access the expertise and knowledge of the reinsurer
- Small local or regional insurers which do not greatly diversify their risks.
- Specialized insurers (those who write exclusively one line of business).
- Commercial insurers who write a small amount of large or unique risks (aviation or utilities facilities).
- ***Insurers whose portfolios are highly exposed to catastrophic events such as hurricanes, earthquakes and windstorms.***

## The Role of the (Re)Insurance Industry in Adaptation

- Help maintain long-term insurability and provide incentives for adaptation through risk-based premium pricing
- *Use insurance risk-evaluation tools (e.g., catastrophe models) to help policy makers and adaptation planners better understand and assess the financial implications of climate change*
- Encourage or spearhead research aimed at focusing output from the global climate models to be more useful to insurance underwriters and adaptation planners
- Support government adaptation efforts
- Provide educational information on climate change–related risks and increase awareness among customers.



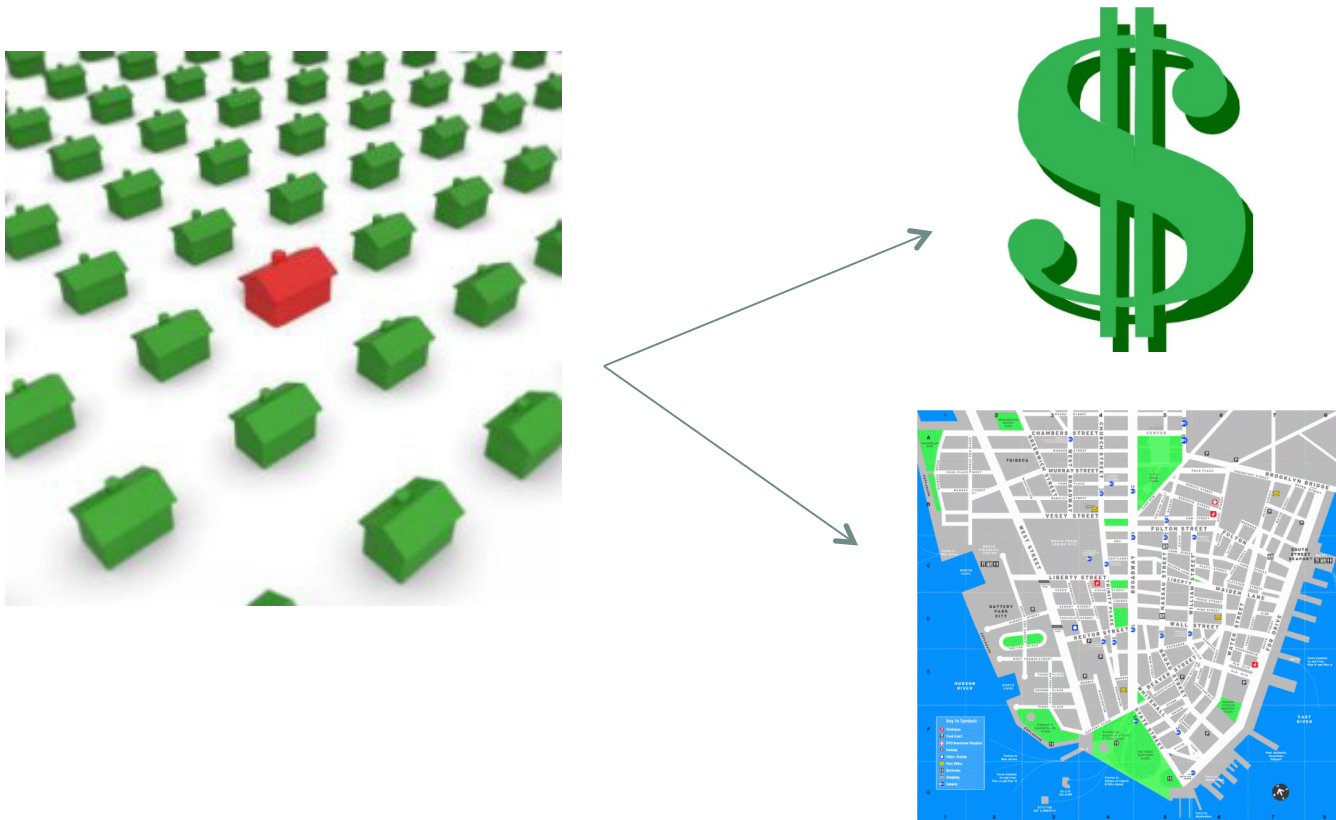
## The Cost of Natural Catastrophes Economic Assessment

	FIRE	NATURAL CATASTROPHES
Occurrence Frequency	High	Low
Event Size	Individual risk affected	Entire portfolio of risks affected
Location	Low importance	High importance
Pricing	Burning cost analysis and exposure rating	Statistical models
Loss potential from single event	Low to medium	Very high
Geographic Distribution	Minimal impact on losses, no accumulation control	Major impact on losses, accumulation control

## Catastrophe Models Fundamentals

- Encompasses physical science, engineering, economics and financial conditions to calculate damage and expected losses from a range of natural catastrophes.
- Four module model:
  - Hazard: Where, how often and with what intensity do events occur?
  - Vulnerability: What is the extent of the damage at a given location for a given event intensity?
  - Value Distribution: Where are the various types of insured objects and what is their value?
  - Insurance conditions: What proportion of the loss is insured (deductibles, inuring, coinsurance)?

## How Nat. Cat. Models Can Assist Planners



Images courtesy of Google

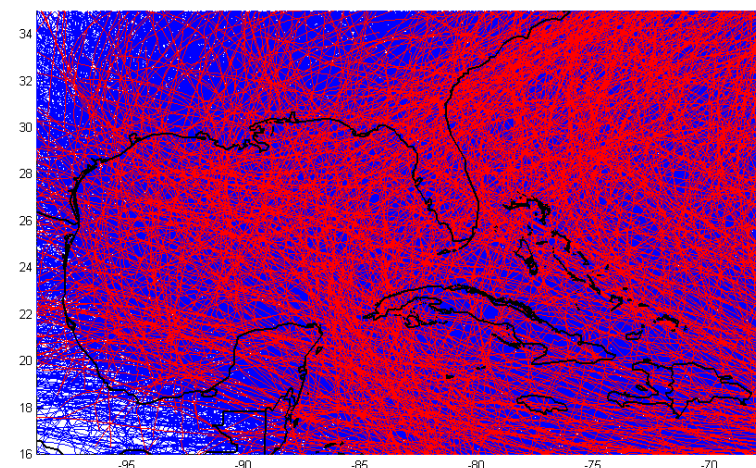


## How Nat. Cat. Models can Assist Planners

Risk	Location	Value
Building X	Manhattan	\$1,000,000
Building Y	Brooklyn	\$1,000,000
Building Z	Queens	\$1,000,000



Run 100  
years of  
possible  
events



Event Name	BLD X Loss	BLD Y Loss	BLD Z Loss	Total Loss
Event 1	\$5,000	\$2,500	\$1,000	\$8,500
Event 2	\$1,000	\$0	\$500	\$1,500
Event 3	\$5,000	\$2,000	\$1,000	\$7,000
Event 4	\$1,000	\$1,000	\$0	\$2,000

## How Nat. Cat. Models can Assist Planners

Event Name	Event Frequency	Total Loss	Exceedence Frequency	Loss Return Period
Event 1	0.01	\$8,500	0.01	100 yrs
Event 3	0.01	\$7,000	0.02	50 yrs
Event 4	0.01	\$2,000	0.03	33 yrs
Event 2	0.01	\$1,500	0.04	25 yrs

Model components (frequency or intensity of events) can be tweaked to simulate new possibilities under climate change

## How Nat. Cat. Models can Assist Planners

Event Name	Event Frequency	Total Loss	Exceedence Frequency	Loss Return Period
Event 1	<b>0.05</b>	\$8,500	<b>0.05</b>	<b>20 yrs</b>
Event 3	<b>0.05</b>	\$7,000	<b>0.10</b>	<b>10 yrs</b>
Event 4	<b>0.05</b>	\$2,000	<b>0.15</b>	<b>7.5 yrs</b>
Event 2	<b>0.05</b>	\$1,500	<b>0.20</b>	<b>5 yrs</b>

Model components (frequency or intensity of events) can be tweaked to simulate new possibilities under climate change

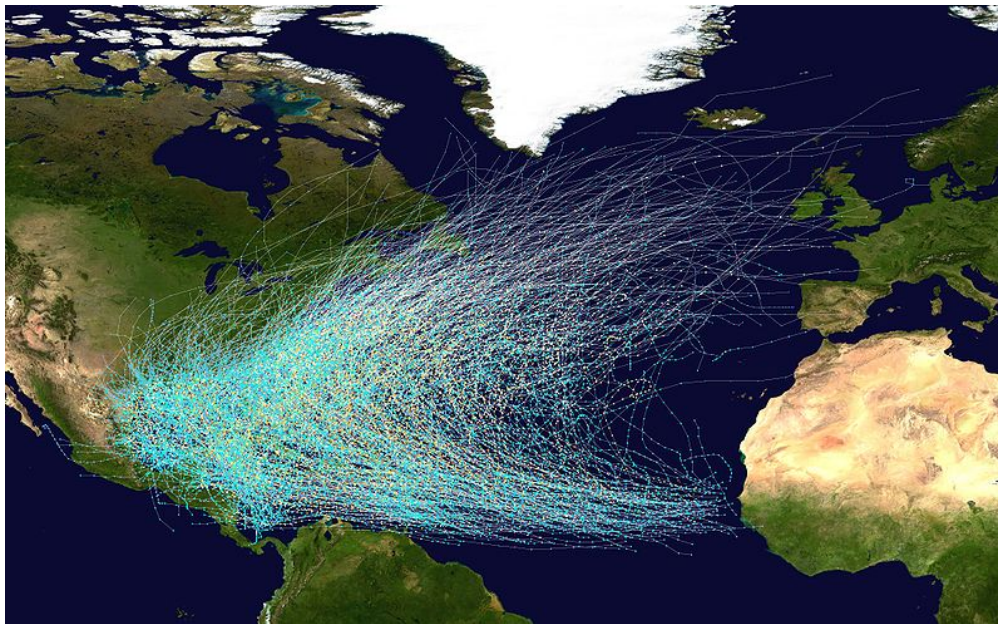


## Catastrophe Models Fundamentals

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## Historical Data

Underlying driver of natural catastrophe models



- Historical data serves as the base of many natural catastrophe pricing tools
- Used to generate probabilistic event sets comprised of over 100,000 storms representing thousands of years
- Frequency and intensity of events are closely tied to historical occurrence rates

Images courtesy of NOAA/NHC

## Climate Change and Nat. Cat. Models

### Implications and complications

- *How is the risk landscape going to change?*
  - Will the frequency of catastrophic hurricanes and nor'easters increase in the NYC metro area in the future?
    - If a hurricane is expected to impact NYC every 17 years, will this probability increase to 10 years in a high carbon dioxide environment?
  - Will the potential intensity of weather events change?
    - Will the worst possible event in NYC become a category 5?
  - Will SLR exacerbate storm surge in current flood plains?
  - Will SLR result in the creation of new flood plains?



## The Role of the (Re)Insurance Industry in Adaptation

- Use insurance risk-evaluation tools (e.g., catastrophe models) to help policy makers and adaptation planners better understand and assess the financial implications of climate change
- Encourage adaptation and mitigation efforts by providing financial incentives to better engineered or retrofitted structures.
- Encourage or spearhead research aimed at focusing output from the global climate models to be more useful to insurance underwriters and adaptation planners
- Support government adaptation efforts
- Provide educational information on climate change–related risks and increase awareness among customers.

## The Role of the Academic and Public Sectors

### Academic Sector

- Collaborate with the insurance industry to generate hazard sets for use in natural catastrophe models to reduce reliance on historical data.
- Continue to improve the spatial resolution and temporal resolution of global climate models used to make climate change projections so that the output may be useful to insurers and reinsurers.

### Public Sector

- Allow private insurers to charge risk-based actuarial premium rates.
- Discourage risky behavior by enforcing stricter zoning and land use laws and building codes.
- Provide subsidies to lower income citizens to retrofit or fortify their homes.
- Provide funding to research programs which spearhead climate research and improve the observations of the Earth system.



## Working Together Opportunities

- Collaborative studies between city, state and federal task forces and (re) insurance companies.
  - NPCC, ECA
- New technologies will allow for development and expansion of underwriting knowledge.
  - Wind farm coverage, carbon capture and sequestration
- Ability to work with nations, economies and markets to develop new, innovative insurance solutions beyond traditional insurance and reinsurance products.
  - Catastrophe bonds, microinsurance and weather derivatives.

Thank you

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