What Have the Catastrophe Modeling Firms Learned About Hurricane Modeling Since Katrina?

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General Session 1: Discussion of Post-Catastrophe Landscape
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Agenda

- Impact of climate on hurricane activity
- Model validation
- Causes of loss
- Exposure data quality
- Extreme events
- Real-time events

Climate Change: Projections Point to Less Frequent, but More Severe Tropical Cyclones

Source	Decrease in Overall Frequency	Increase in Most Intense Storms	Increase in Precipitation Intensity
IPCC	More likely than no (>50%)	Likely (>66%)	Likely (>66%)
Latest Research	Confirms Trend	Confirms Trend	Confirms Trend

- The response to forcing is not uniform across the globe
- Regional differences within ocean basins exist
- How much of this variability translates into landfall activity is not known, thus this is an active area of research

Research on the Impact of Climate Anomalies on Hurricanes has Influenced Modeling Advances

- Major modeling firms have released alternative hurricane models based on their views of risk under "warm sea surface temperature" conditions, such as those observed since 1995
- Some modelers have used a "near-term" approach based on a forecast of SSTs over next five years, others a "conditioned" approach based on climatology under only warmer-than-average years
- Some modelers have done original peer-reviewed research on landfalling hurricane risk under warm SST conditions
  - Conclusions are not as simple as

    More or stronger basinwide storms → More damage from landfalls
  - Probabilistic catastrophe models are not forecasts of future activity, however a climate conditioned model can be used to estimate the impact of persistent climate conditions

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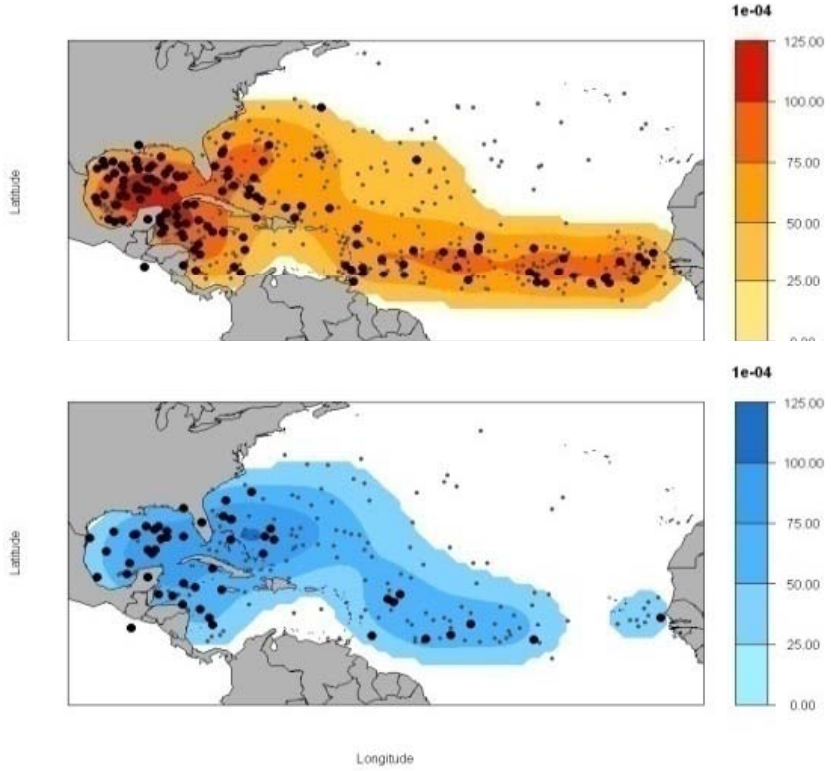
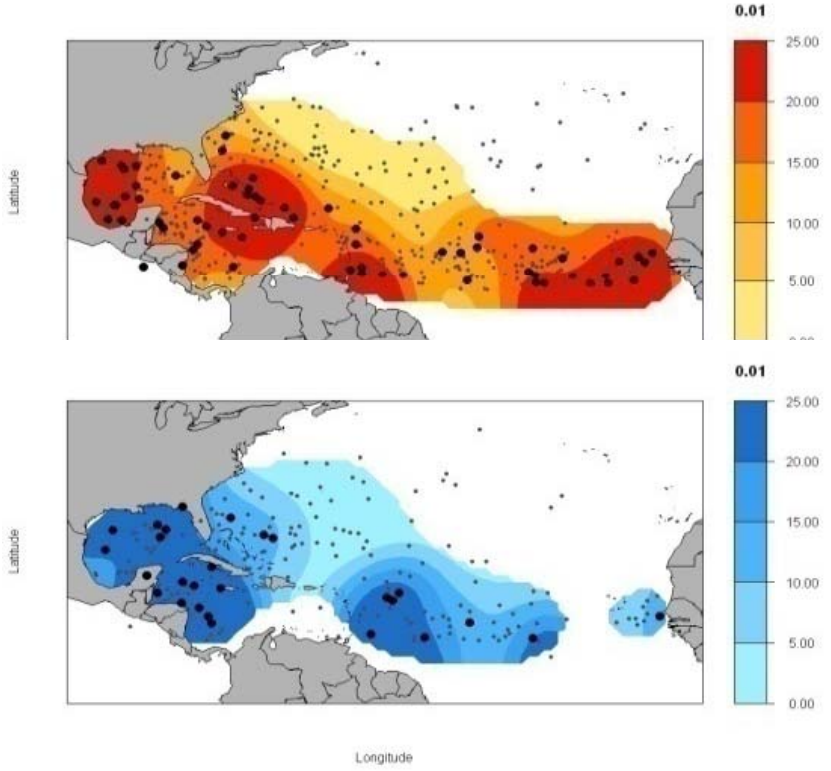
Key to Estimating Future Changes of Landfall Risk Is Understand its Current Variability



Genesis Density

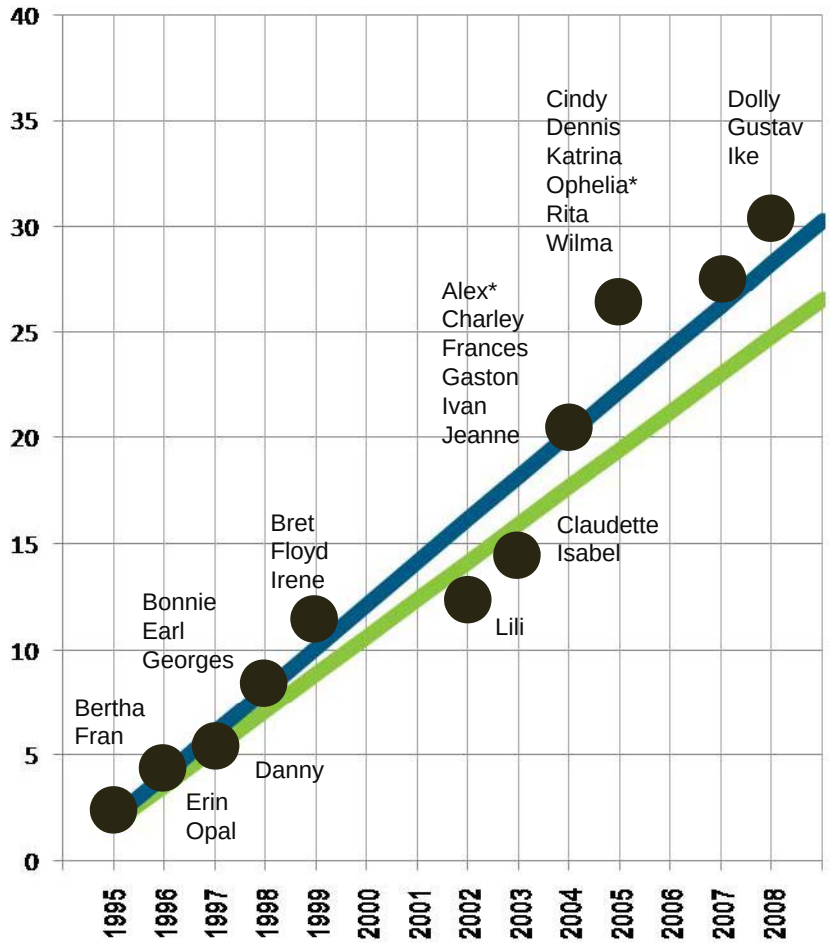


US Hurricane Landfall Probability

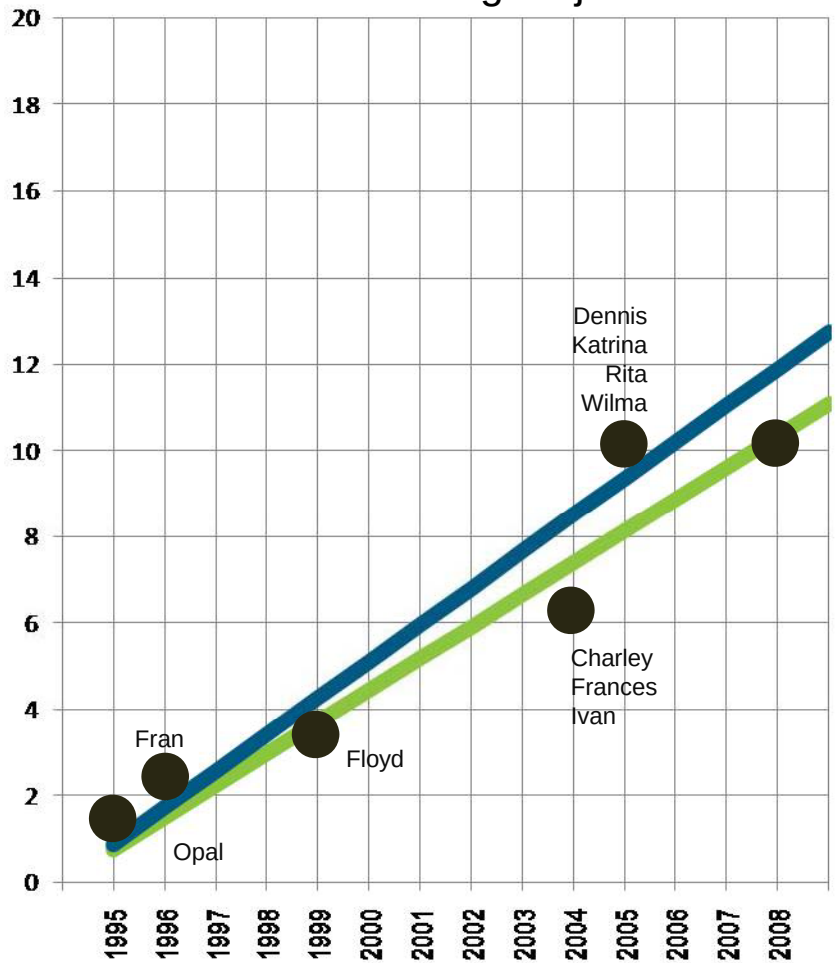
- Dailey et al., 2009, “On the Relationship between North Atlantic Sea Surface Temperatures and U.S. Hurricane Landfall Risk”, Journal of Applied Meteorology and Climatology, vol.8, pp.111-129.

Probabilistic Models Estimate the Impact of Climate Conditions that Persist for a Significant Number of Seasons

U.S. Loss Producing Hurricanes



U.S. Loss Producing Major Hurricanes



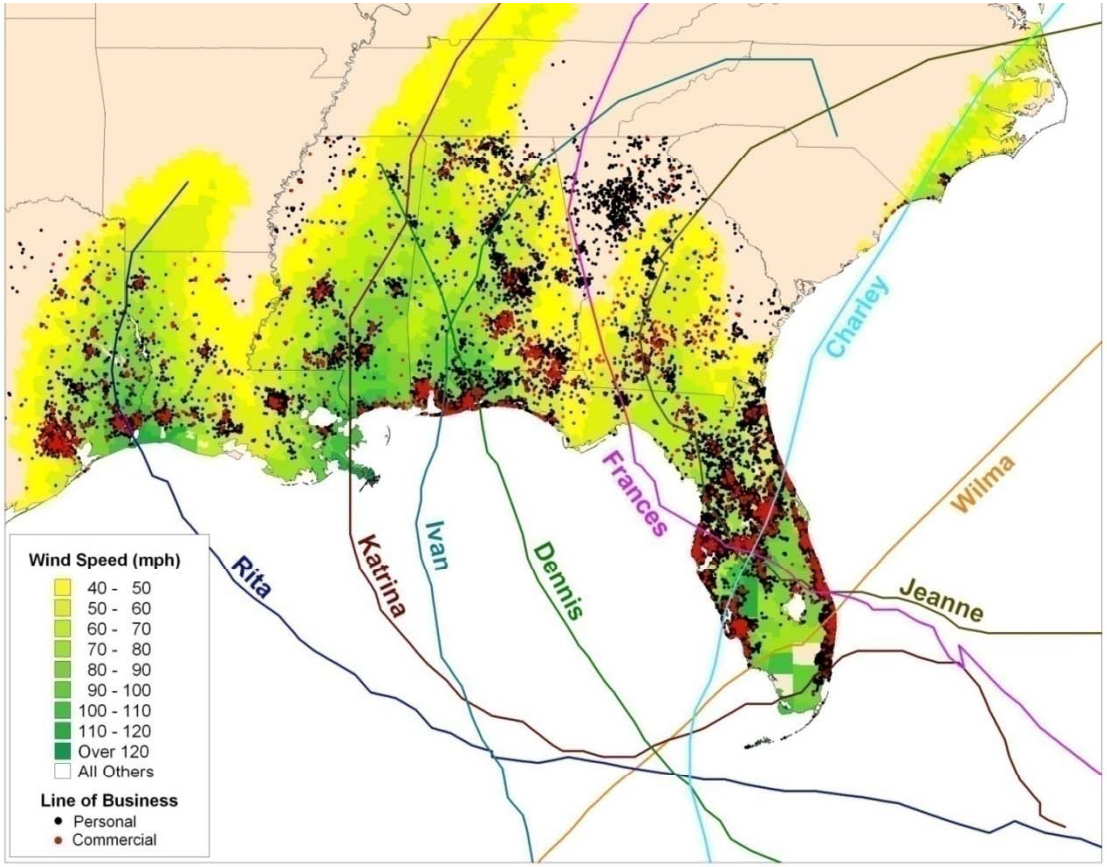
AIR US Hurricane Model Standard Catalog

AIR US Hurricane Model Warm SST Catalog

Observed

*Bypassing hurricane (no landfall but produces loss)

Validation: The 2004/2005 Hurricanes Provided Unprecedented Quantities of Detailed Claims Data



- Modeling firms review actual insurer claims data against modeled damage for same locations for given events and examine results by coverage, construction, and occupancy type
- Example: validation for inland loss potential of model vs. real claims

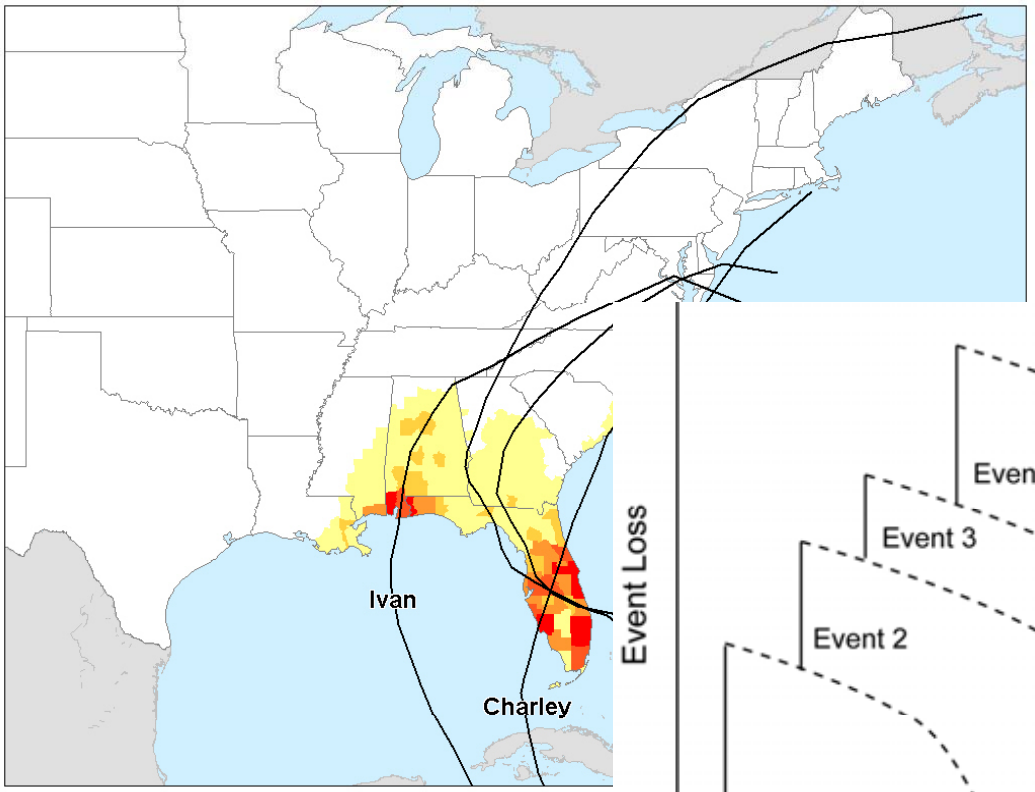
Pool Enclosure Damage Was a Significant Loss Driver in the 2004 and 2005 Hurricanes

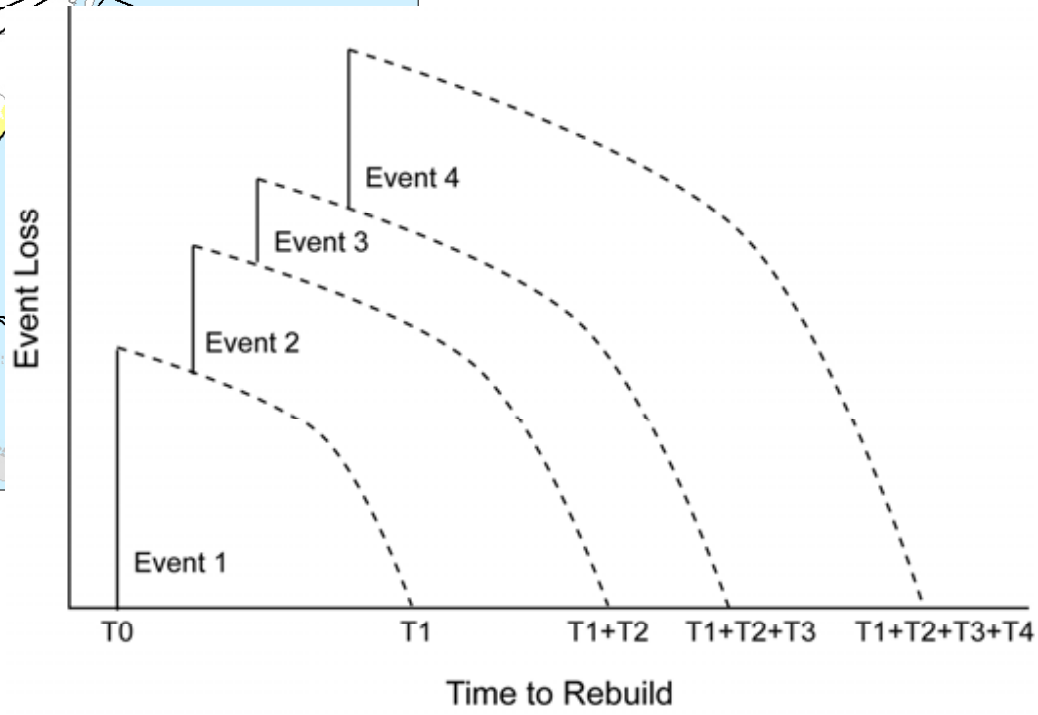
- Pool enclosures are common in Florida and can cost between $10K to $50K
- About 15-20% of losses were attributed to pool enclosure damage for 2004 and 2005 hurricanes
- Average claim per unit of exposure was reported to be as high as 35% higher for homes with pool enclosure

Causes of Loss: Demand Surge

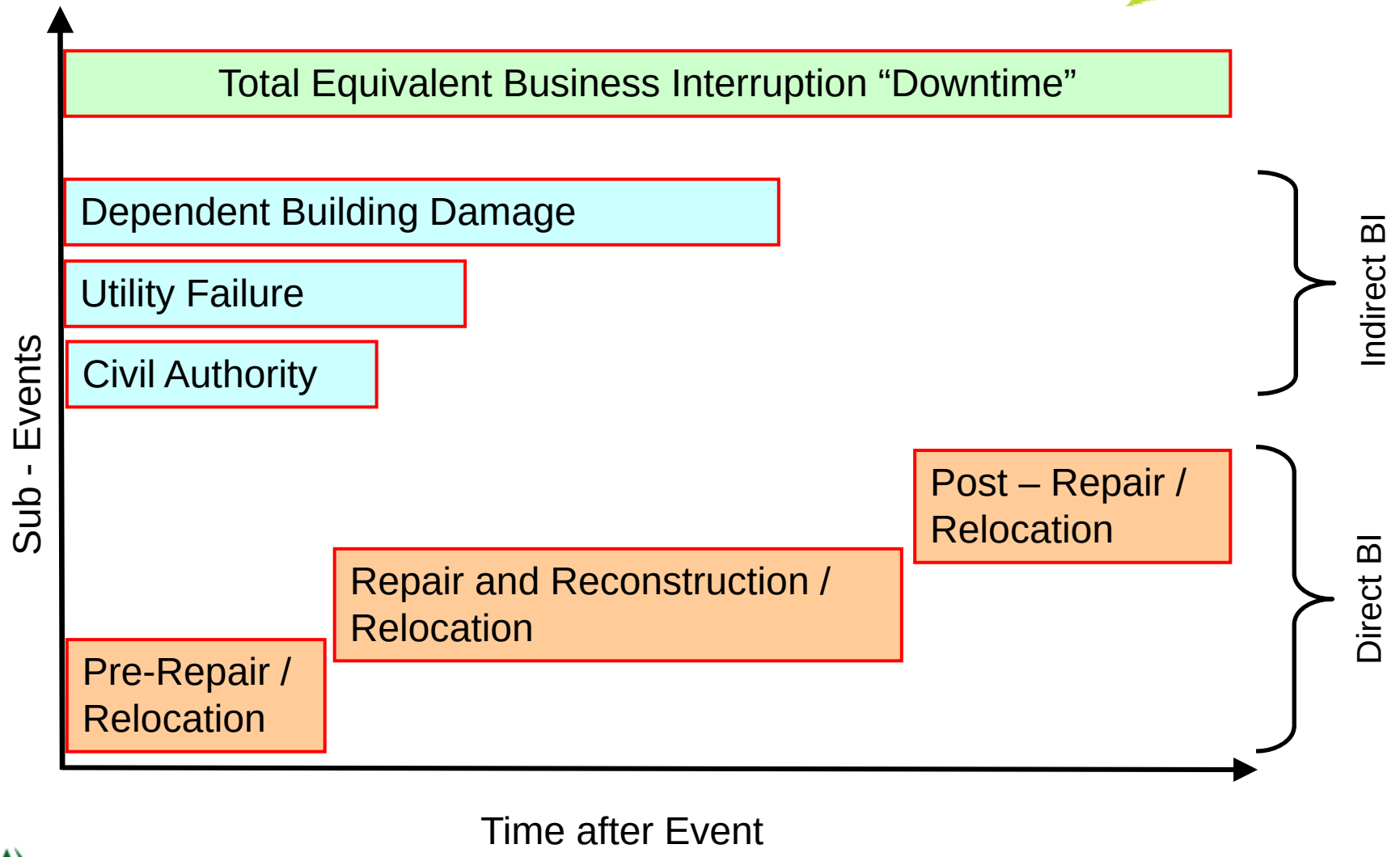
- Demand surge functions consider the sudden and usually temporary increase in the cost of materials, services, and labor following a catastrophe
- Demand surge can be related to the size of the industry insurable loss as well as to the number and location of events in a given year
- While significant uncertainty surrounds demand surge estimation, functions may be based on:
  - Historical data
  - Client claims data
  - Statistical analysis
  - Component level cost data

Demand Surge from Aggregation of Events Should Also Be Considered





Causes of Loss: Modeling Direct and Indirect Business Interruption



Exposure Data Quality: Paramount to Model Results, Yet Often Needs Improvement

- Location information
  - Geographic resolution of the data – getting to an exact latitude and longitude
- Risk characteristics
  - Vulnerability functions have been developed to account for many building characteristics in the calculation of damage
- Replacement values
  - The full cost to replace the building in the event of a total loss

Vulnerability Varies for Each Collection of Risk Characteristics

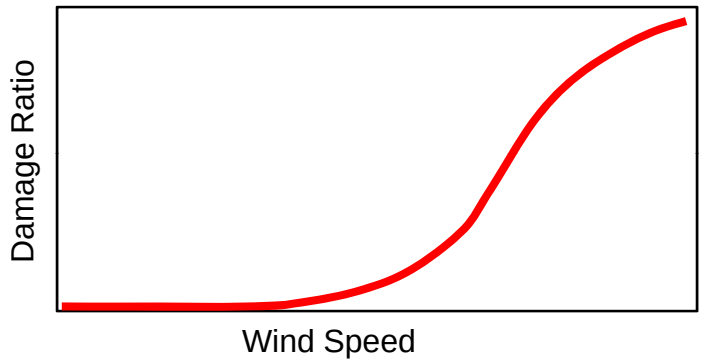
- Construction type
- Occupancy class
- Year built
- Number of stories
- Additional risk characteristics

Vulnerability of the Risk

- Damage to buildings and their contents is a function of construction type and occupancy class
- For a given construction type, occupancy provides insight into some of the key characteristics of a building, e.g. shape, window area and type of contents likely to be present

Valuation Is a Key Driver of Accurate Loss Estimates

- Estimated loss is calculated directly from the replacement value



Ground-Up Loss =
Damage Ratio x Replacement Value

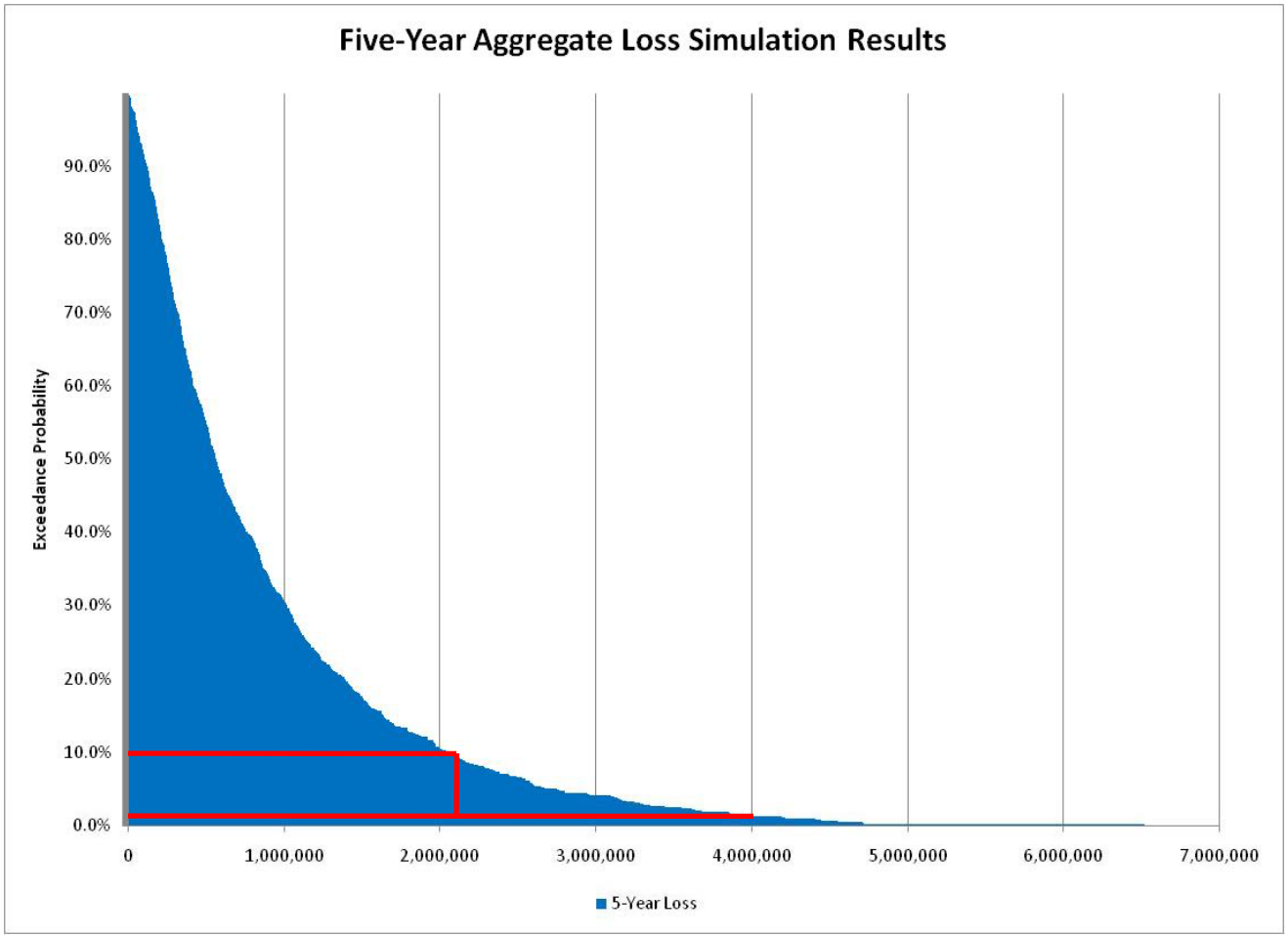
- Reported replacement values are often lower than actual values
  - Portfolios don't always keep pace with changes in construction costs
  - Limits are being reported instead of replacement values
  - Replacement values are just wrong (e.g. $10,000 on a commercial building)

Modelers are in a Unique Position to Help Companies Address Exposure Data Challenges

- Deliver commercial and residential property specific data including replacement value
- Provide data analytics to assess and evaluate exposure data against the industry
  - Validation
  - Scoring
  - Benchmarking
  - Insurance to value
- Enhance the capture and use of quality exposure data at the point of underwriting
- Facilitate transfer of exposure data throughout the insurance value chain by supporting open and standardized industry data formats

Extreme Events: Model Users and Stakeholders Must Closely Examine the Impact on Decisions

- Enterprise risk management uses of models have focused on “tail” or less frequent events, sometimes over multi-year simulations, since 2005



Ratings Agencies are Now Focusing on More Sophisticated Measures of "Tail" Risk

- Fitch is using model results directly in its economic capital model evaluating financial strength
- A.M. Best requires "tail value at risk" (average of extreme event values) in its Supplemental Rating Questionnaire
  - Modeling firms have facilitated the calculation in software

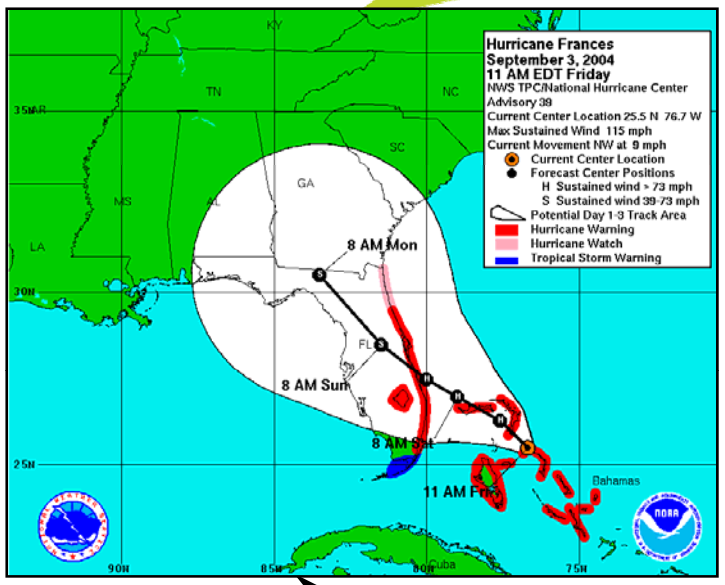
Indicated CAT Risk Exposure	2006 Per Occurrence Gross Losses (I)				2006 Per Occurrence Pre-Tax Net Losses (II)			
Loss Return Period (Annual Probability)	(01) Probable Maximum Loss (PML) ($000s)	(02) % of 2006 Group PHS	(03) TVAR or TCE* ($000s)	(04) % of 2006 Group PHS	(05) PML (Including Reinstatement Costs ($000)	(06) % of 2006 Group PHS	(07) TVAR or TCE* (Excluding Reinstatement Costs ($000s)	(08) % of 2006 Group PHS
1. 50 Years (2.0%)								
2. 100 Years (1.0%)								
3. 250 Years (0.4%)								
4. 500 Years (0.2%)								
5. 1,000 Years (0.1%)								

*TVAR (Tail Value at Risk) or TCE (Tail Conditional Expectation)

Real-Time Loss Estimates: Increasingly Important for Catastrophe Planning

- Modeling firms all provide some assistance in estimating the impact of "live" hurricanes, but take different technical approaches
  - Some use the parameters of the actual event in real-time as reported by weather observations to simulate scenarios for that event
  - Others identify "like events" in previously simulated catalogs of possible hurricanes
- While the technology predates Katrina, clients are making increasingly advanced use of the services for
  - Informing owners and stakeholders of the impact
  - Claims and disaster response planning
  - Financial/liquidity planning and reinsurance notices

Typical Real Time Loss Estimation Process



System forms

System intensifies

System impacts land

System dissipates

Event tracking begins

Begin running hazard and damage models

Modeler Postings

Post-disaster Surveys

Detailed claims analyses

Summary: What Have We Learned Since Katrina?

- Climate Conditions – incorporation of climate conditions such as warm sea surface temperatures, which may lead to less frequent, but more severe tropical cyclones
- Model Validation – the 2004/2005 hurricanes provided unprecedented quantities of detailed claims data for validating, refining and incorporating additional vulnerability functions
- Causes of Loss – improvements to the modeling of demand surge, losses from multiple-event seasons, and indirect business interruption
- Property Exposure Data – tools and services to address exposure data challenges through data analytics such as validation, scoring, benchmarking and insurance-to-value
- Extreme Event Results – more scrutiny of the "tail" of the loss possibilities in catastrophe model results
- Real-Time Modeling – advancements to provide a probabilistic approach that incorporates the uncertainty inherent in real-time parameters

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Thank You

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