KAREN CLARK & COMPANY

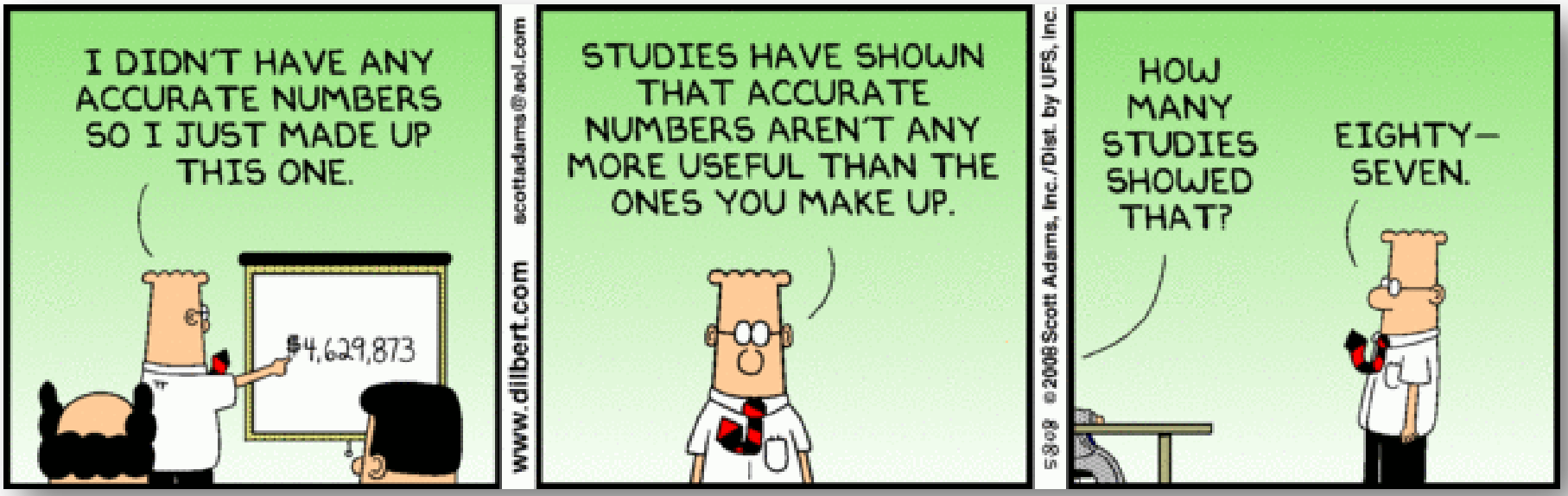
The Expanding Role of the Actuary in Catastrophe Loss Estimation and Management

CAS Annual Meeting

Orlando, FL

November 13, 2012

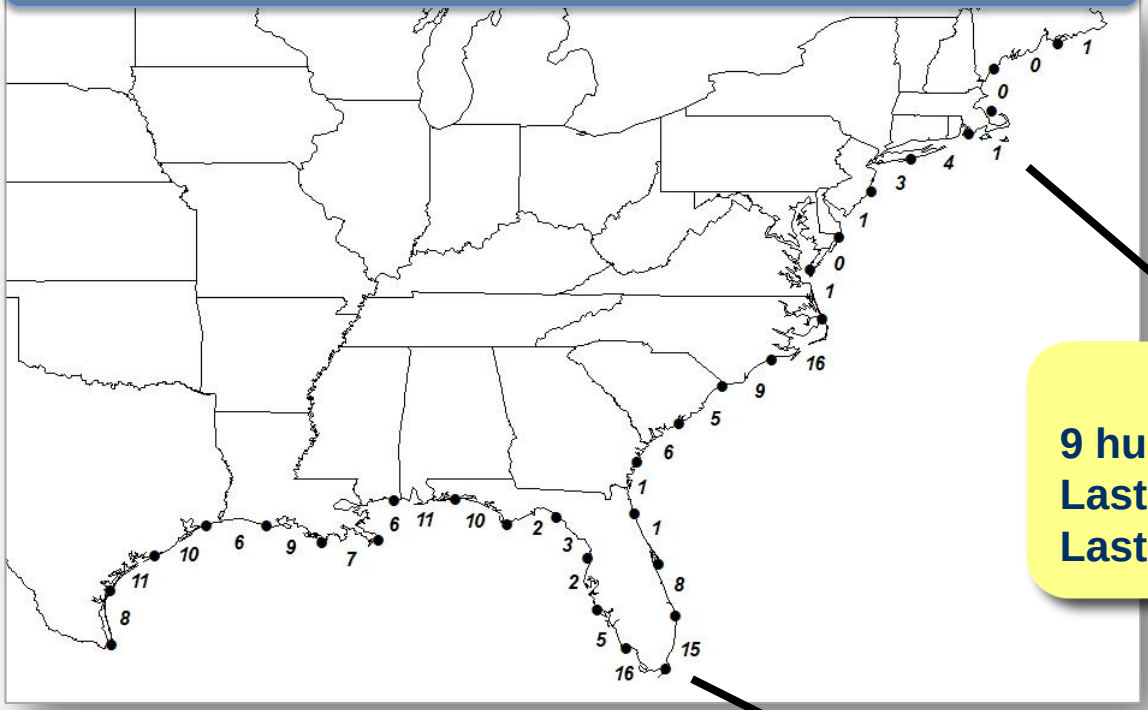
Given All of the Unknowns and Uncertainty Why Do We Base All Risk Management Decisions on One Number?



Who's the Real Devil in All of This?

Catastrophe Models Are Based on Historical Data(!)

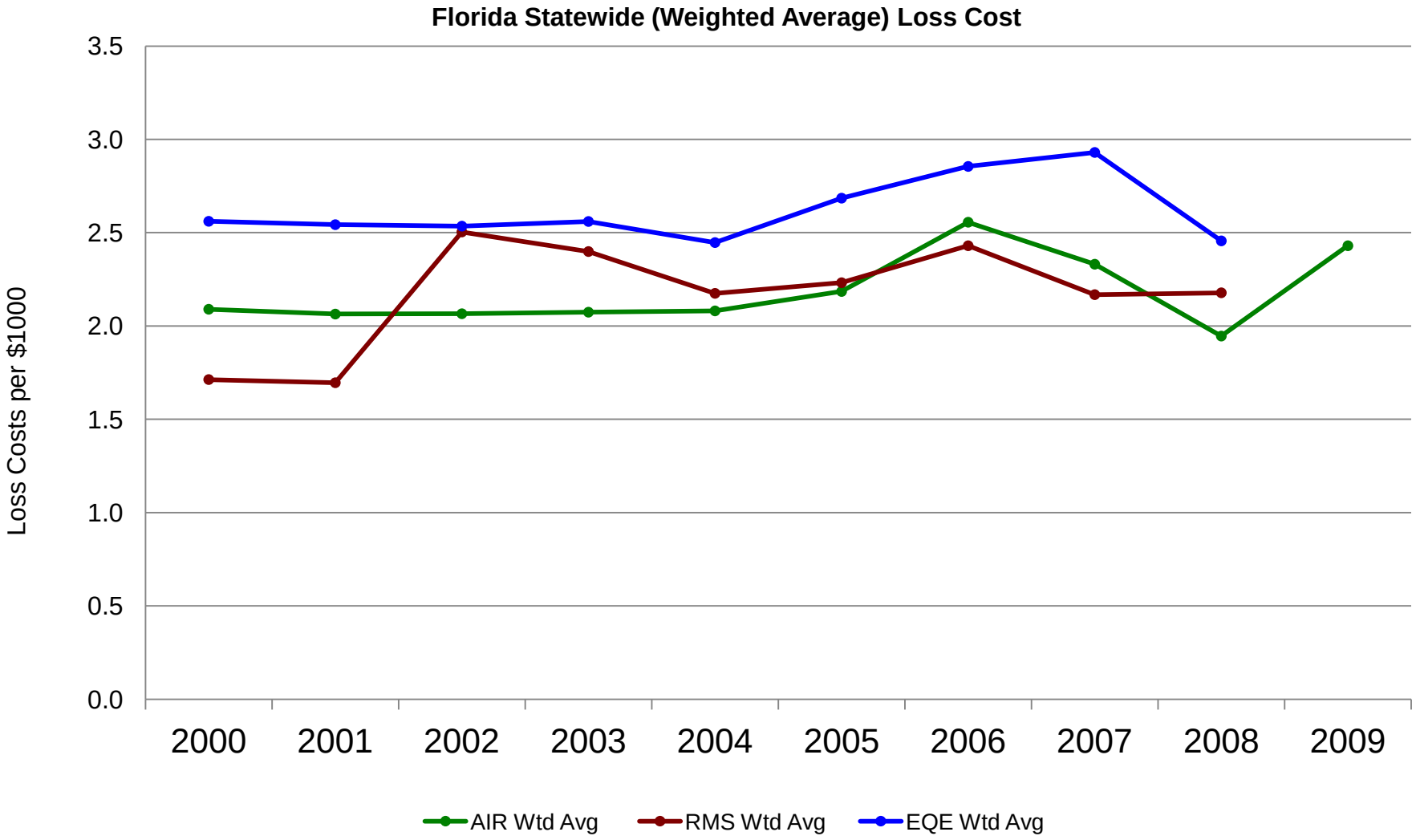
US Hurricane Landfalls



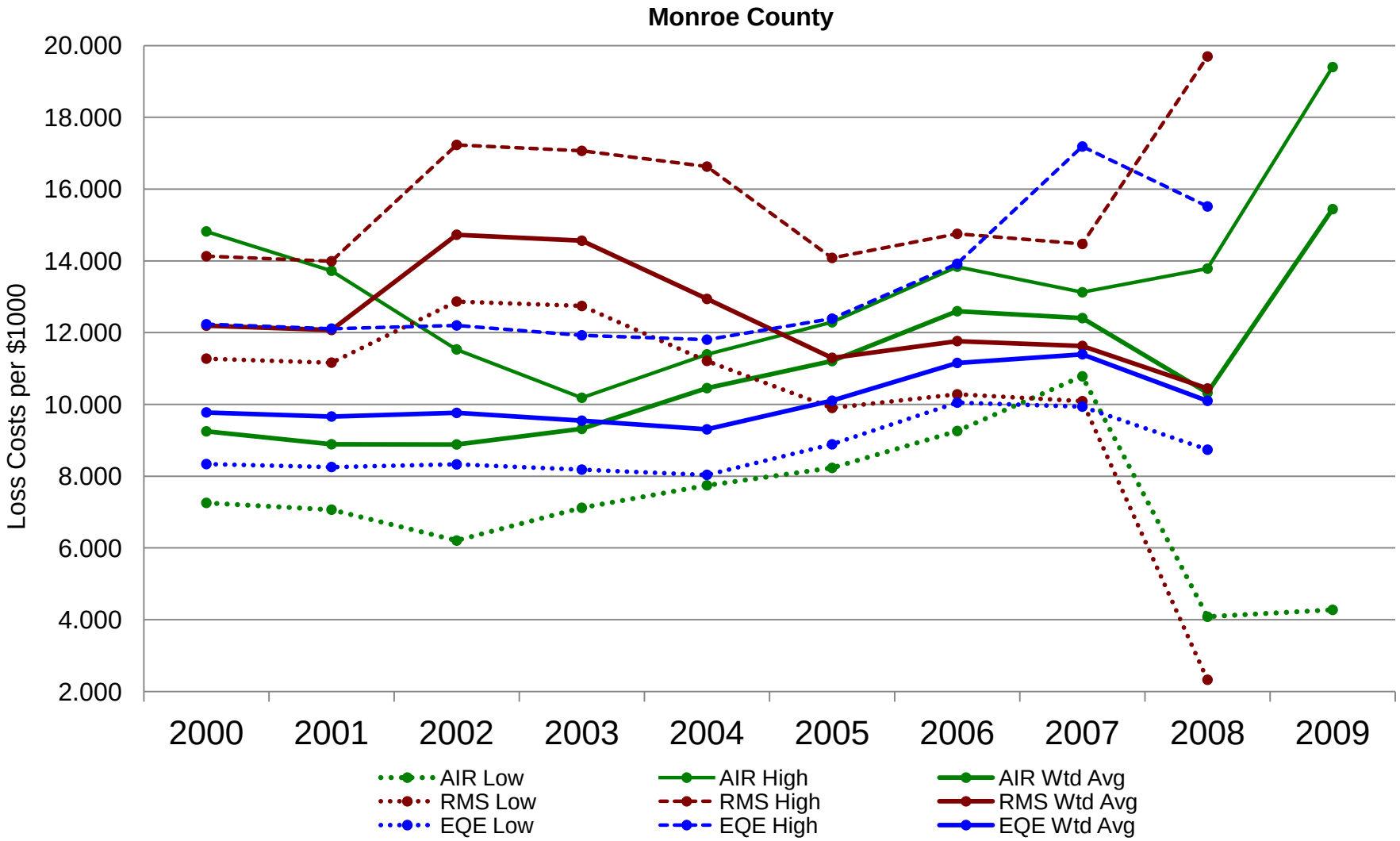
Northeast
9 hurricane landfalls since 1900
Last hurricane was 1991
Last major hurricane was 1938

Florida
63 hurricane landfalls since 1900
6 significant hurricanes over 2004 and 05 seasons
Approximately $35 billion in claims data in 04 and 05

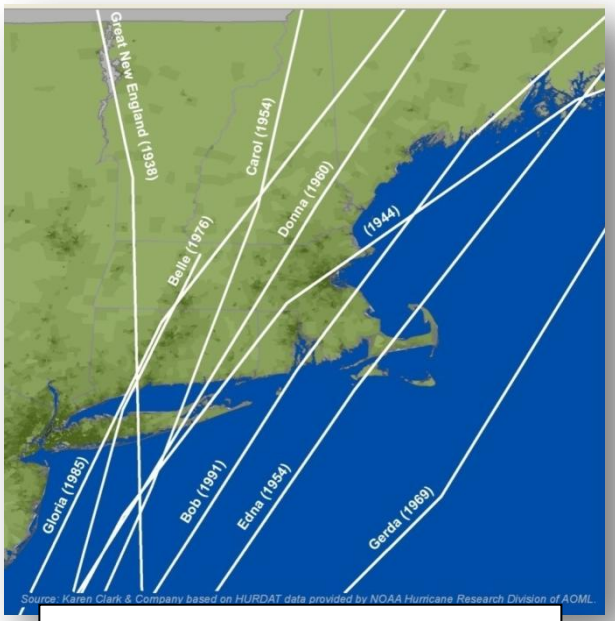
Much of the Volatility in Model Loss Estimates is Due to Paucity of Data and Not New Scientific Knowledge



Uncertainty and "Noise" Are Greater at Higher Resolution



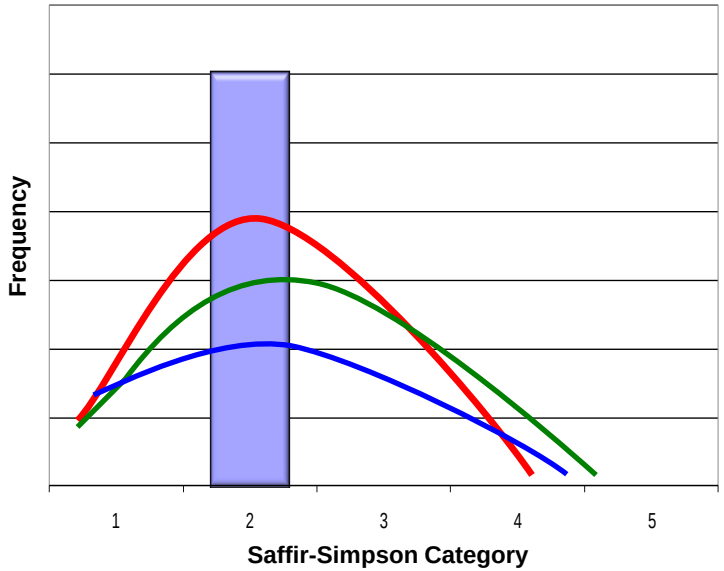
In Most Peril Regions, Scientists Have Very Little Reliable Data and Don't Know the Probabilities of Severe Events



Tracks of Landfalling Northeast Hurricanes Since 1900

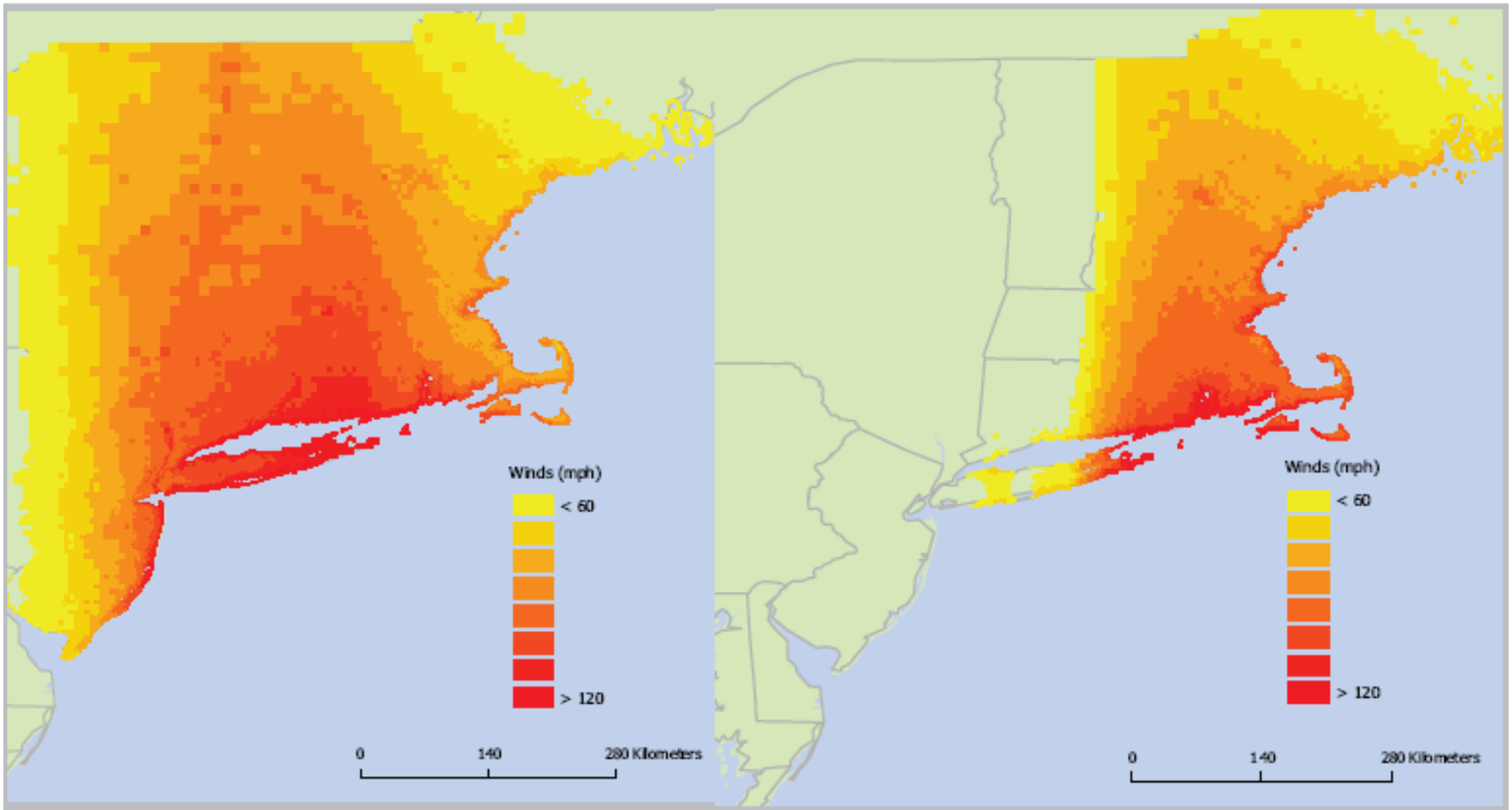
Year	Maximum Wind Speed* (mph)
1938	----
1944	----
1954	----
1954	----
1960	----
1969	----
1976	----
1985	104
1991	104

Source: NOAA
*Overland



Because There is So Little Actual Data, a Model Vendor Can Make Very Different Assumptions in Model Updates

RMS Wind Footprint for the Same Storm in Two Model Versions



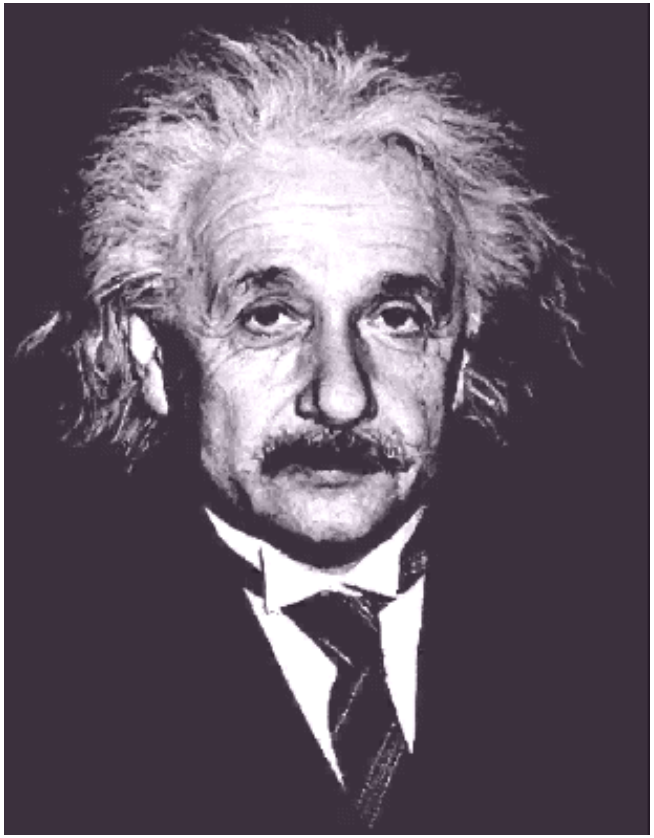
Modeled wind field of the 1938 Great New England Hurricane, assuming it has a classic hurricane structure (left) and a transitioning storm structure (right)

Drinking Too Much of the Kool-Aid

A Few Risk Management Challenges

- Over reliance on vendor models due to
  - ✓ Scientific seduction
  - ✓ False model precision
  - ✓ Convenience
- Highly volatile loss estimates due to noise and over specification
  - ✓ Pressure on modelers to incorporate more and more variables
  - ✓ Little or no data supporting most model variables
  - ✓ Loss estimates highly sensitive to changes in model assumptions
  - ✓ Added complexity means higher propensity for mistakes and “bugs”
- No transparency on underlying calculations
  - ✓ Difficult to distinguish improvements from noise and other problems with the models
  - ✓ Too much valuable time spent trying to decipher model changes
- Other than “knobs” no flexibility to customize approach or build proprietary view of risk

How Can We Address These Issues?



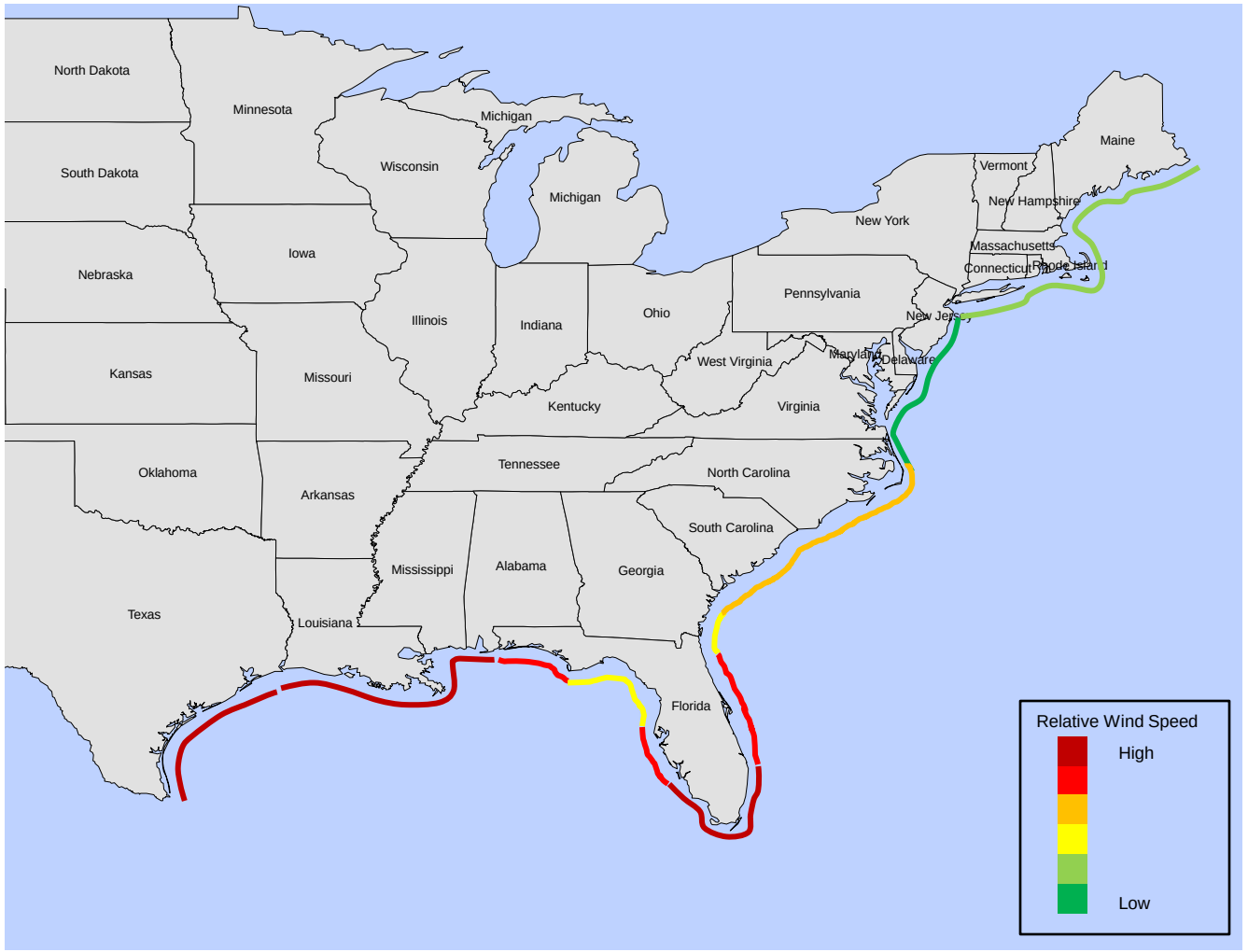
"We can't solve problems by using the same kind of thinking we used when we created them."

Time to Think Outside the Black Box

- The cat models will never be able to produce accurate EP curves or PMLs (too many unknowns)

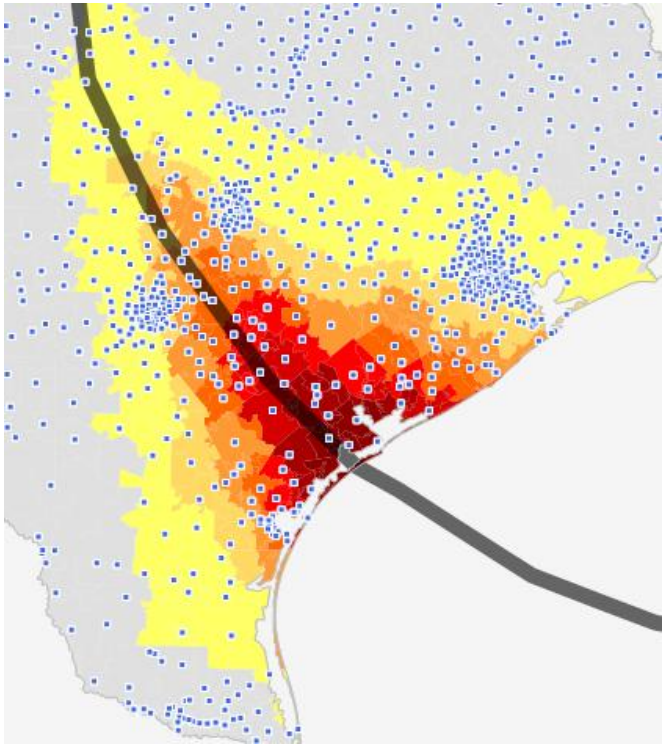
- We can develop other scientific approaches that are
  - ✓ Consistent
  - ✓ Transparent
  - ✓ Efficient
  - ✓ Flexible

Characteristic Events (CEs) Provide These Benefits and a New Perspective on Risk

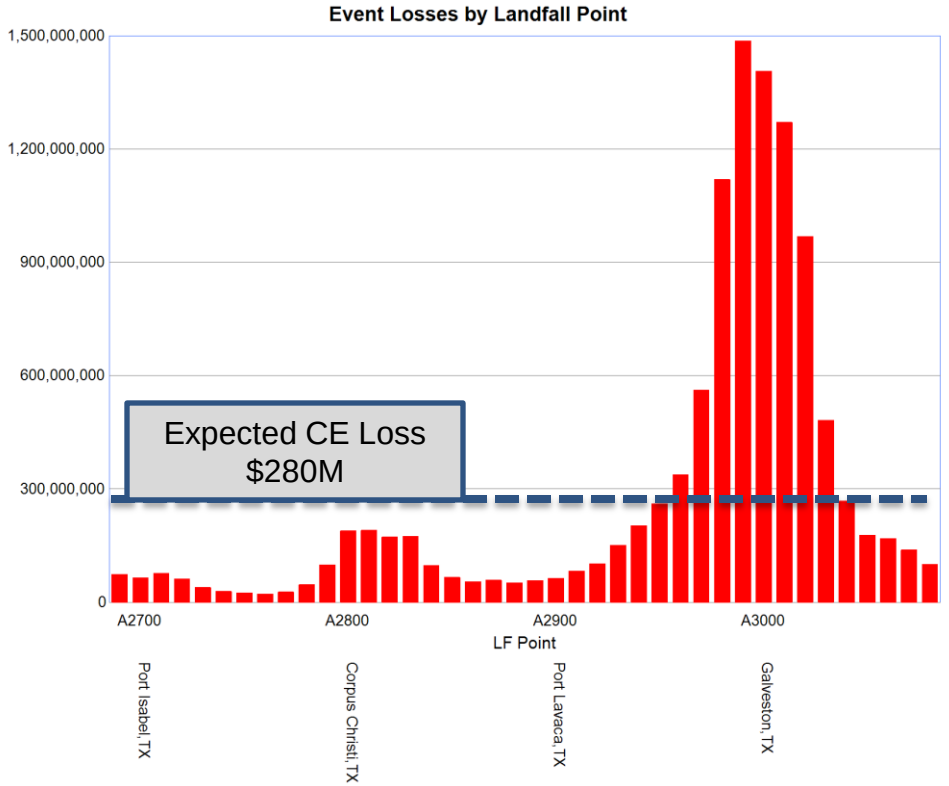


Sample Company 100 Year CE Results for Texas

1. Losses are calculated by floating the Characteristic Event windfields over the company's exposures.



2. CE losses are estimated at ten mile landfall points and summarized for each event. The resulting regional loss summary identifies the range of potential losses and identifies peak loss scenarios. The expected losses for the region can be compared to model PMLs.



CEs Are Based on Same Scientific Formulas as Models

$$V_{1\min,10m}(t,r>R,z_0)=$$

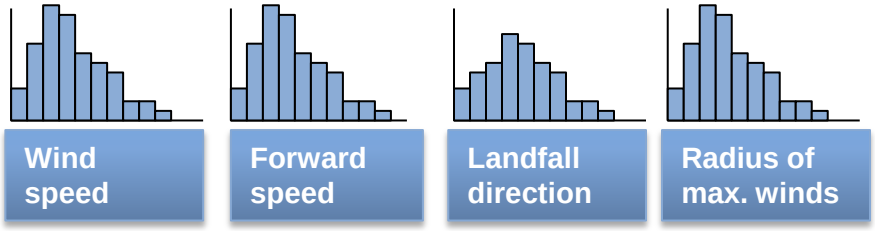
$$(fr(z_0))\left\{gf(z_0,t_{tav})\left(c_1e^{-t^{c_2}}\right)\left(c_3\left[\sqrt{\frac{1}{\rho\, e}(P_w-P_0)}-\frac{Rf}{2}\right]\left[c_4+c_5\ln(c_6R)+(c_7+c_8\ln(c_6R))\ln(c_6r)\right]\right)+1.5T^{c_9}T_0^{c_{10}}\cos(\beta)\right\}$$

- Difference between minimum central pressure and peripheral pressure
- Coriolis parameter, dependent on latitude
- Air density coefficient, dependent on latitude
- Radius of maximum winds
- Storm's forward, or translational, speed
- Radial distance from storm center to location
- Angle between track direction and surface wind direction
- Storm inflow angle
- Air density factor

One Fundamental Difference from the Models – Defined Probability versus Randomly Generated Events

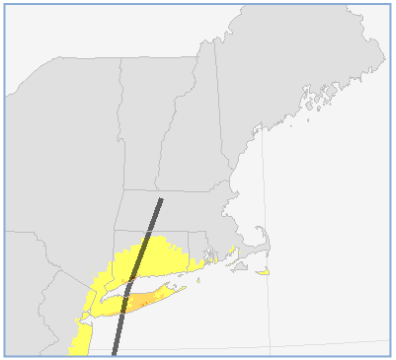
Historical hurricane data from National Hurricane Center…

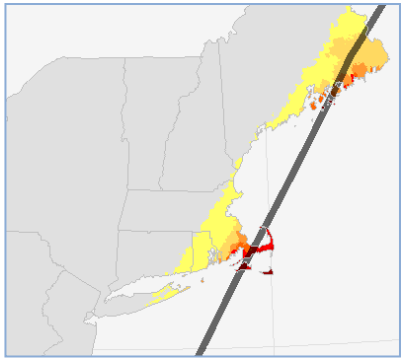
Catastrophe Models – Random Events



Random Event 1
Wind speed = 75 (SS1)
Rmax = 40
…..

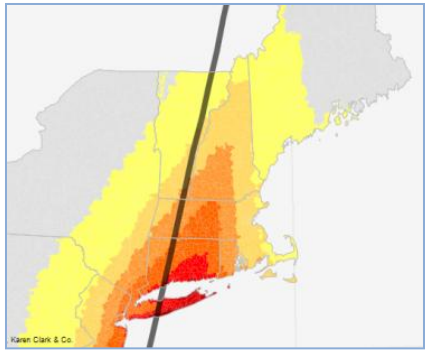
Random Event 2
Wind speed = 152 (SS4)
Rmax = 13
…..

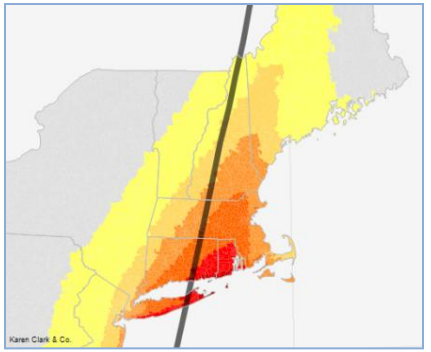


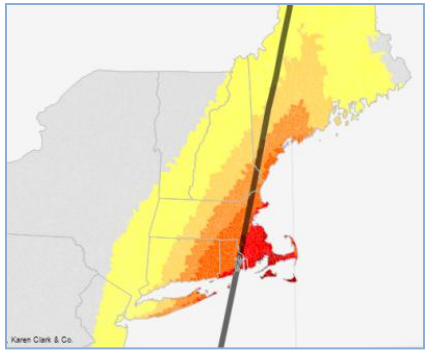


Events are generated by sampling from parametric distributions.

CEs – Defined Probability Events



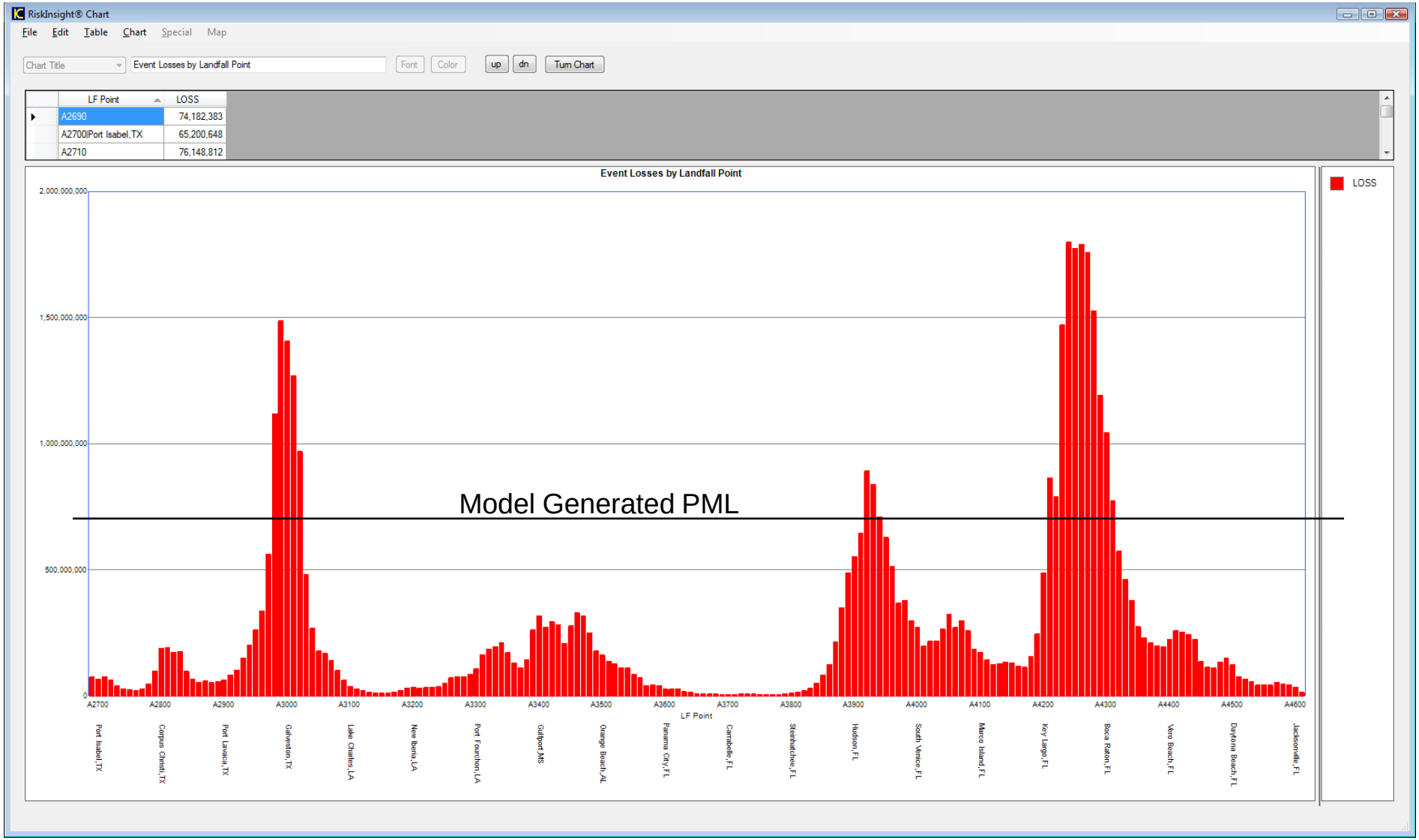




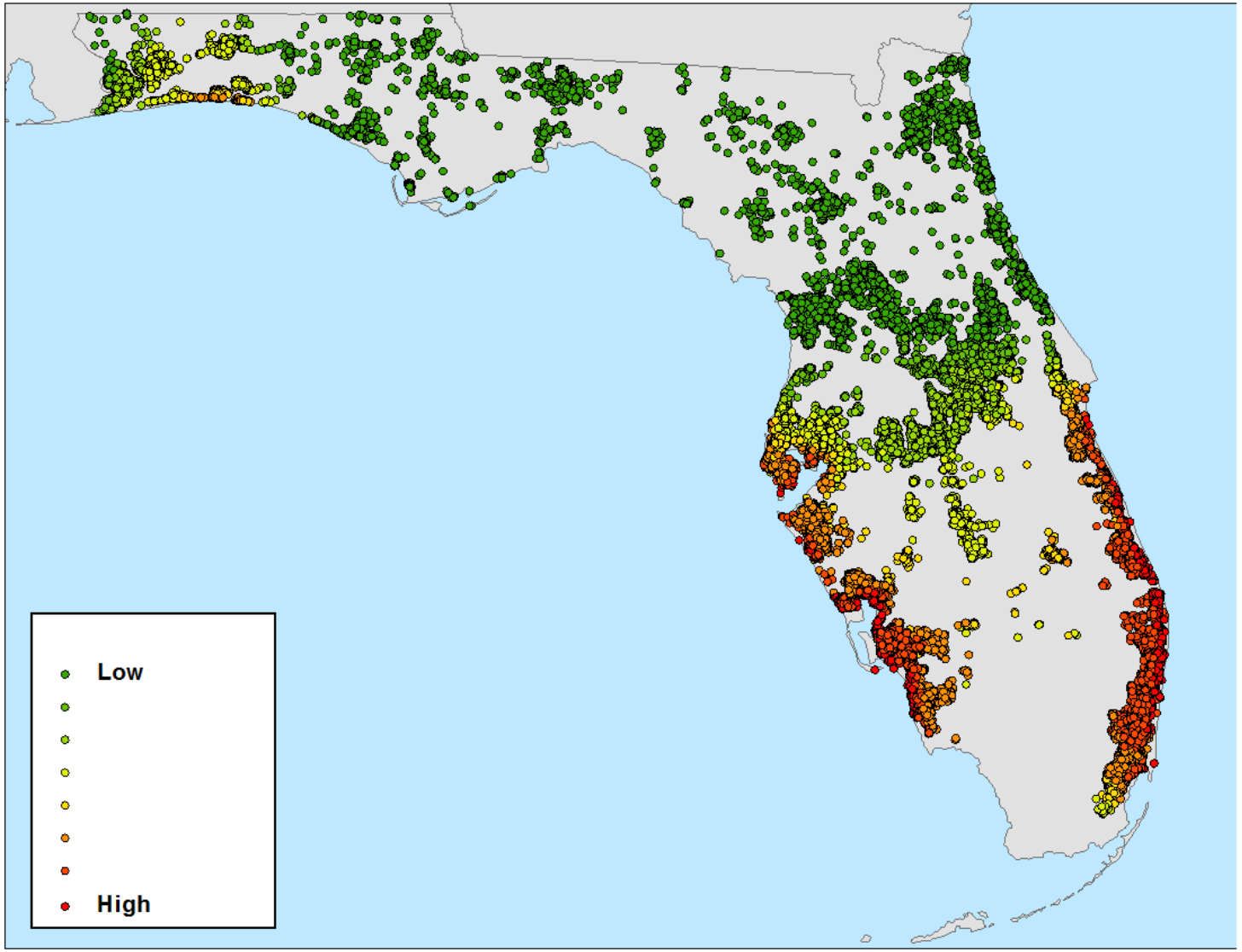
Characteristic Event 1, 2, ….
Wind speed = 122 (SS3)
Rmax = 40
…..

Events are defined based on meteorological characteristics representative of specific return periods.

Model-Generated PMLs Mask Exposure Concentrations and Give a False Sense of Security

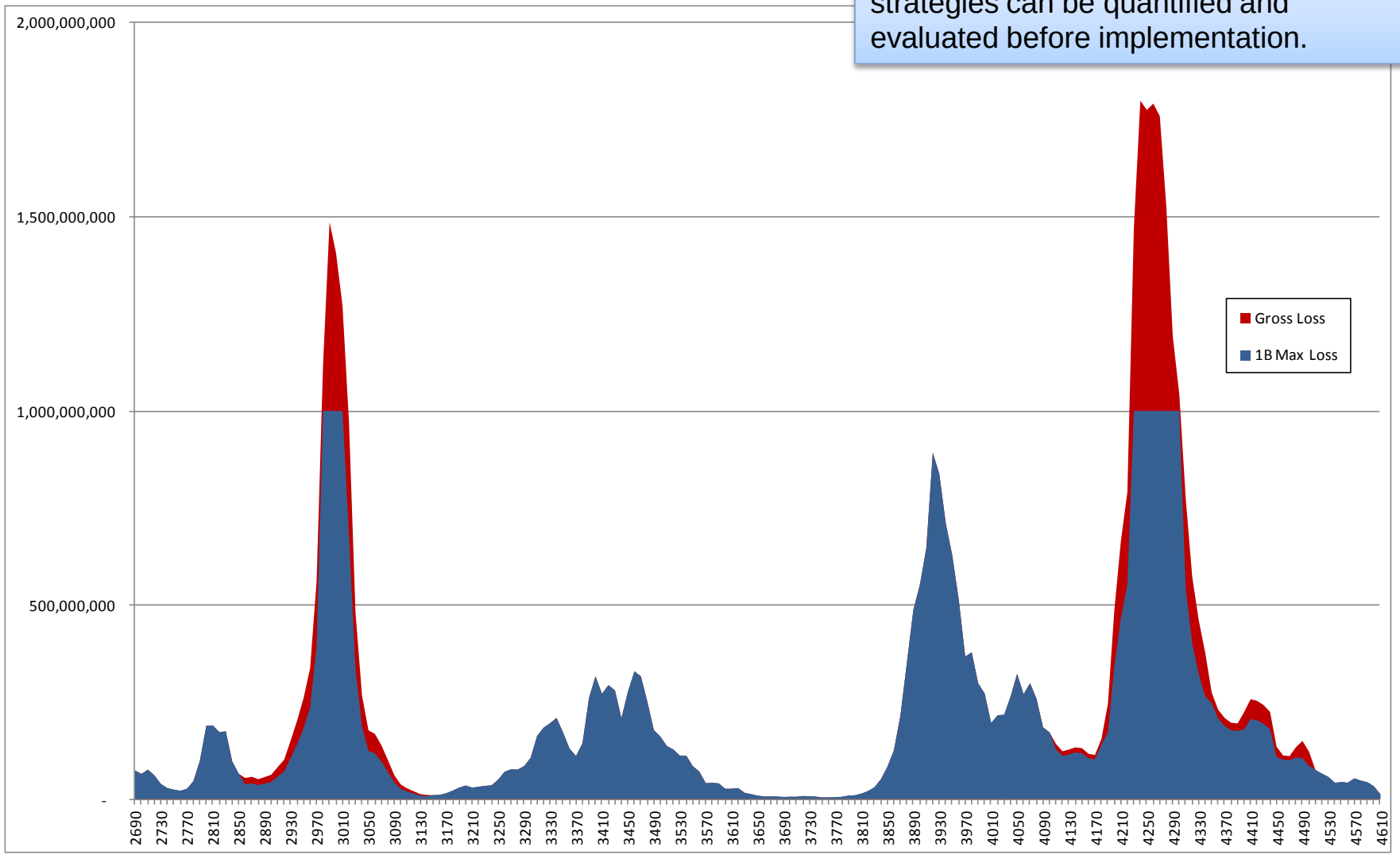


CEs Are Operational Risk Metrics and Can Be Drilled Down to Individual Policies and Locations



Portfolio Strategies Based on CEs Reduce Potential for Surprises and "Black Swans"

Alternative growth and contraction strategies can be quantified and evaluated before implementation.

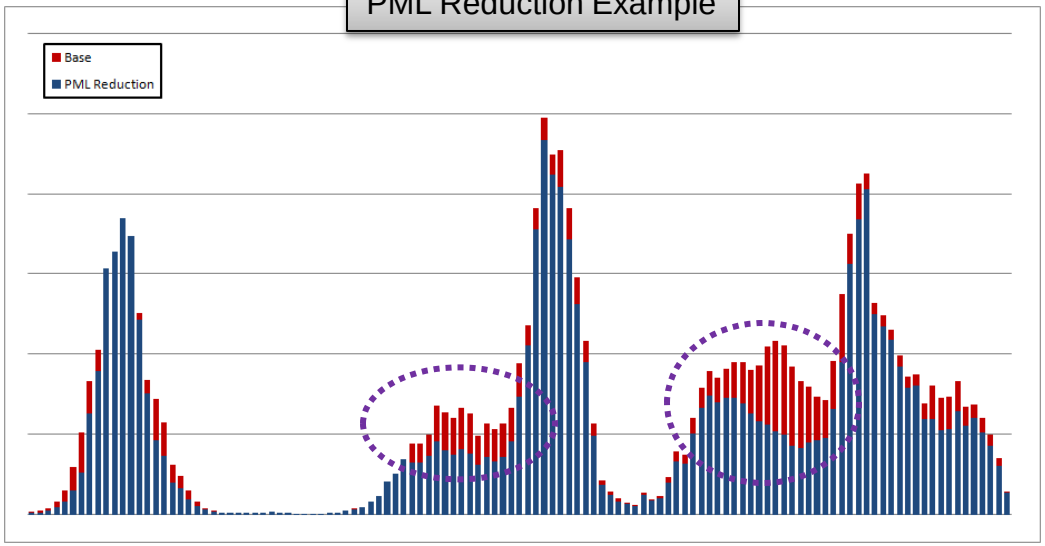


PMLs Address Risk Versus Return Trade-offs and CEs Address Solvency Issues

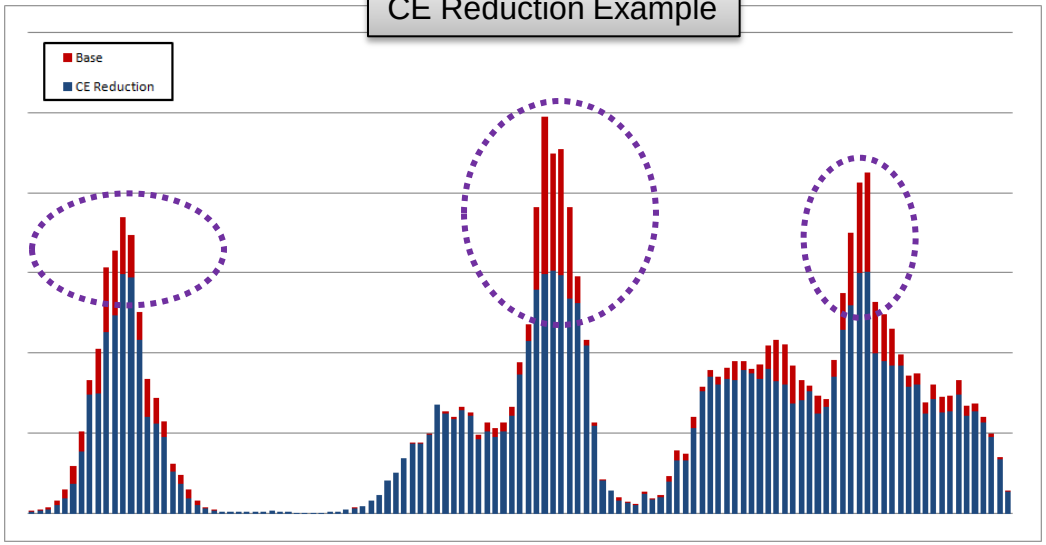
There is not a clear relationship between PML and exposure. PML optimization scenarios can emphasize reductions across a large number of events without reducing peak losses.

By providing visibility into the relationship between exposure and large losses, CE reduction scenarios focus attention on managing solvency impairing events.

PML Reduction Example



CE Reduction Example



How Actuaries Can Use CEs

- A source of scientific information to benchmark and test the models
  - ✓ How do the expected CE losses compare to the model-generated PMLs?
  - ✓ Are there any models that are outliers for my book of business?
  - ✓ Which models am I most comfortable with?
  - ✓ How should I weight the different models by peril region?
- Fixed event set for more robust operational risk metric
  - ✓ CEs allow you to test growth and contraction strategies and to monitor effectiveness of risk management strategies over time
  - ✓ AALs and PMLs are too volatile for individual account decision making--CEs provide consistent yardstick for more profitable underwriting strategies (avoid adverse model selection)
- Richer discussion around risk appetite and risk tolerance
- Analytics for optimal trade-off between profit and solvency
- Key component of more sophisticated and proprietary risk management framework

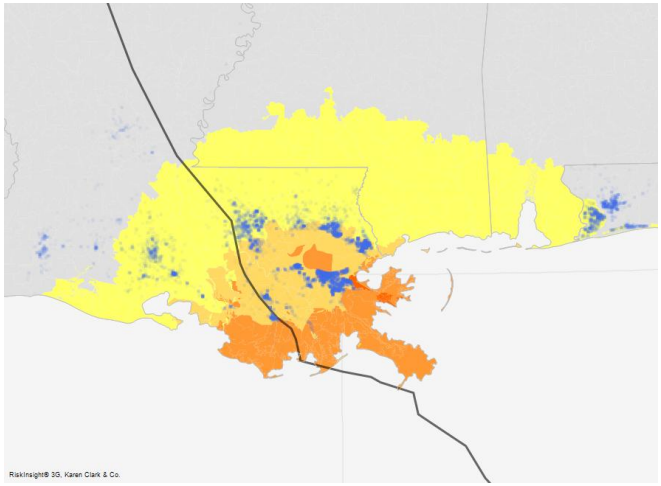
Historical Events Can Be Superimposed on Today's Exposures to Benchmark Lower Return Period Losses

Year	Event	Region	Insured Loss ($B)
1926	Unnamed 7 (Great Miami)	Florida South	125
1928	Unnamed 04 (Lake Okeechobee)	Florida South	65
1900	Galveston	Texas	50
1947	Unnamed 04 (Fort Lauderdale)	Florida South	50
1992	Andrew	Florida South	50
1915	Unnamed 02 (Galveston)	Texas	40
2005	Katrina	Gulf	40
1938	Unnamed 04 (Great New England)	Northeast	35
1960	Donna	Florida, Northeast	25
1954	Hazel	Southeast	20
1965	Betsy	Gulf	20
1921	Unnamed 06 (Tampa Bay)	Florida Northwest	15
1945	Unnamed 9 (Homestead)	Florida South	15
1949	Unnamed 02	Florida Northeast	15
1954	Carol	Northeast	15
1969	Camille	Gulf	15
2005	Wilma	Florida South	15
1919	Unnamed 02	Florida, Texas	10
1929	Unnamed 02	Florida South	10
1932	Unnamed 02	Texas	10
1944	Unnamed 07	Northeast	10
1944	Unnamed 11 (Pinar del Rio)	Florida Northwest	10
1961	Carla	Texas	10
1979	Frederic	Gulf	10
1983	Alicia	Texas	10
1989	Hugo	Southeast	10
2004	Charley	Florida Northwest	10
2008	Ike	Texas	10

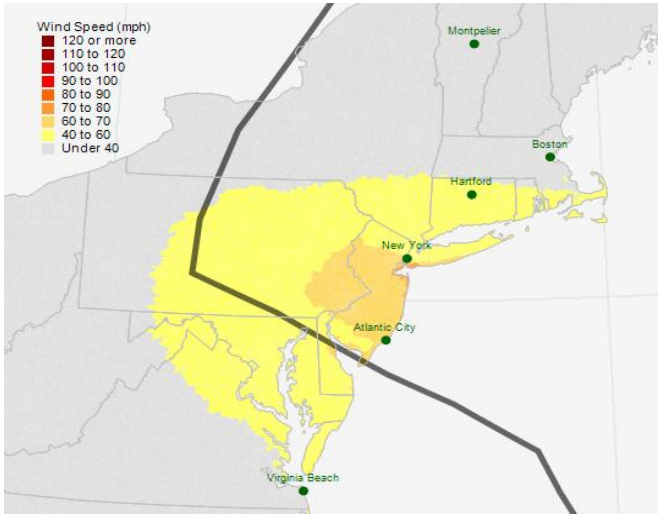
Source: "Historical Hurricanes That Would Cause Over $10 Billion Today" Special report by Karen Clark & Company

Actual Event Footprints Should Also Be in the Actuarial Toolkit

Hurricane Isaac



Hurricane Sandy



Superimpose intensity contours on detailed exposures

Estimate number of claims to plan adjusting activities

Post event detailed claims analyses for competitive advantage

Summary of Key Points

- Cat models, like other actuarial and statistical models, are based on historical data and have low credibility where there is little or no data supporting the model assumptions
- Because the volatility in the model loss estimates is often caused by noise due to lack of data and not new science, actuaries need other tools to develop a more robust view of risk
- CEOs and boards of directors want more clarity and visibility on cat risk through transparent and consistent risk metrics
- Newer tools and technology empower you to build a robust and proprietary view of risk now demanded by senior executives and external stakeholders such as rating agencies and investors
- Using vendor models and model output is not enough

According to RMS…and in Conclusion

"A catastrophe model is not the only tool and should not be the only tool companies use to assess risk."

Michael Young,
Senior Director for Mitigation and Regulatory Affairs, RMS,
speaking at the NAIC Northeastern Zone Meeting, June 2011