



Catastrophe Modeling: Questions You Should Ask – Theory and Practice

**CAS Special Interest Seminar
In Focus: Taming Cats-Managing Natural and Man-
Made Catastrophe Risks
Baltimore, Maryland
October 4-5, 2012**



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Key Questions

- Why use a cat model in the first place?
- What is the model designed to cover and, importantly, what it is not designed to cover?
- What questions can the model help me answer? Which ones can't they answer?
- How can you deal with the uncertainty inherent in the model?
- How can you judge whether a catastrophe model is reliable? What do I do when the models disagree?
- How do I interpret modeled losses of actual events?

Why use a cat model in the first place?

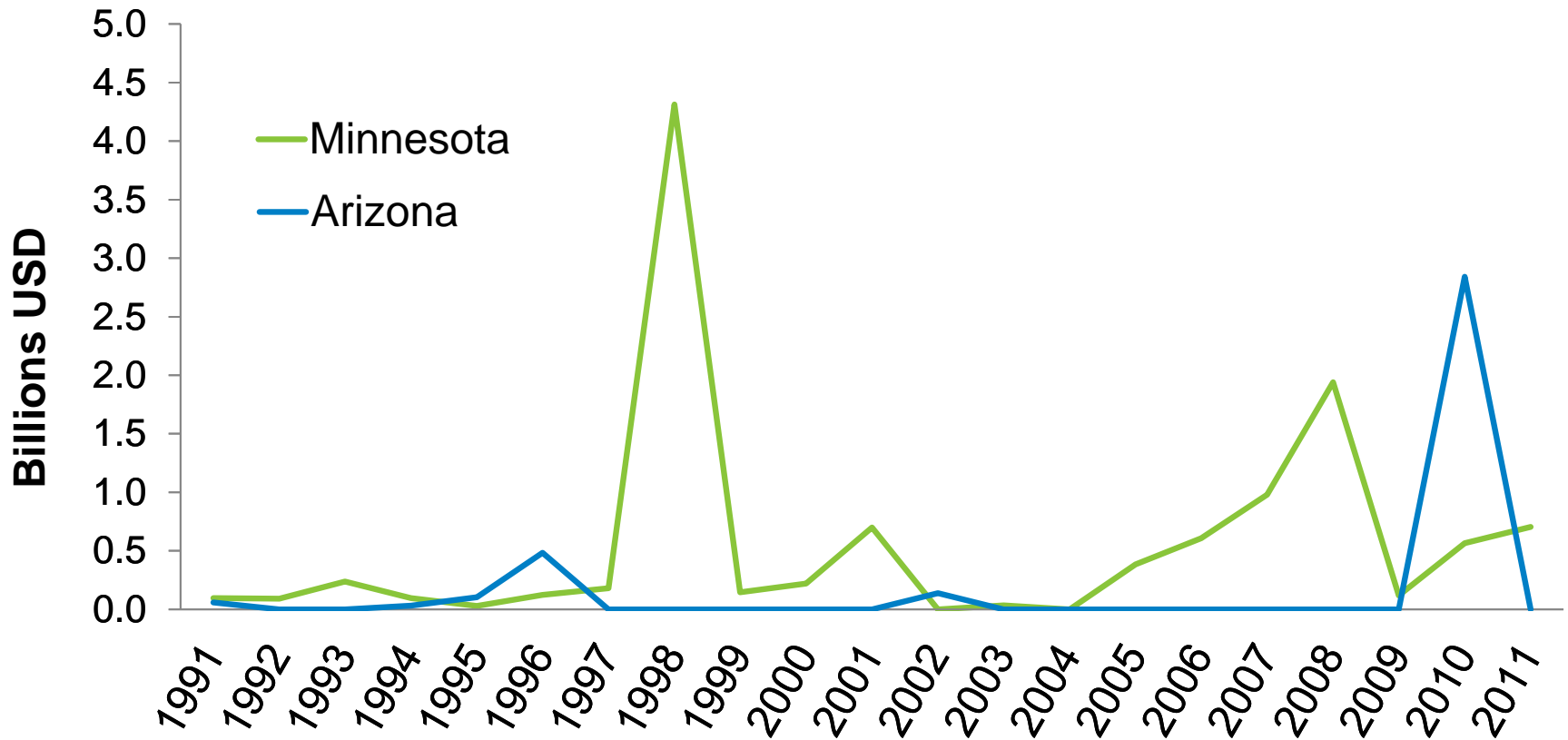


Why Do We Need Catastrophe Models?

- Due to the low frequency of severe catastrophes, traditional methods that rely solely on company claims data may not be a good predictor of possible losses
 - Models contain thousands of modeled events that are model a wide range events, even ones that we haven't seen yet. For example, a 10,000 year catalog for severe thunderstorm may contain 400,000+ events
 - Events modeled include the range of low to high frequency, high to low severity catastrophes
- The constantly changing landscape of exposure data limits the usefulness of past loss experience
 - New properties continue to be built in areas of high hazard
 - Building materials and designs change
 - New structures may be more or less vulnerable to catastrophic events than old ones

Insured Losses from Severe Thunderstorm Can Be Very Volatile from Year to Year

Severe Thunderstorm Losses (PCS)



Source: PCS, trended to 2011

Why use a model?

- What George said...
 - ⇒ *Historical experience can't possibly describe your cat risk*
 - ⇒ *It's unlikely the "true" 1-in-100 year event has happened.*
- Regulators require it (e.g., ORSA)
 - ⇒ *And, it's only going to get worse!*
- Rating agencies require it
- Your board requires it
- Management CYA!

Why use a model?



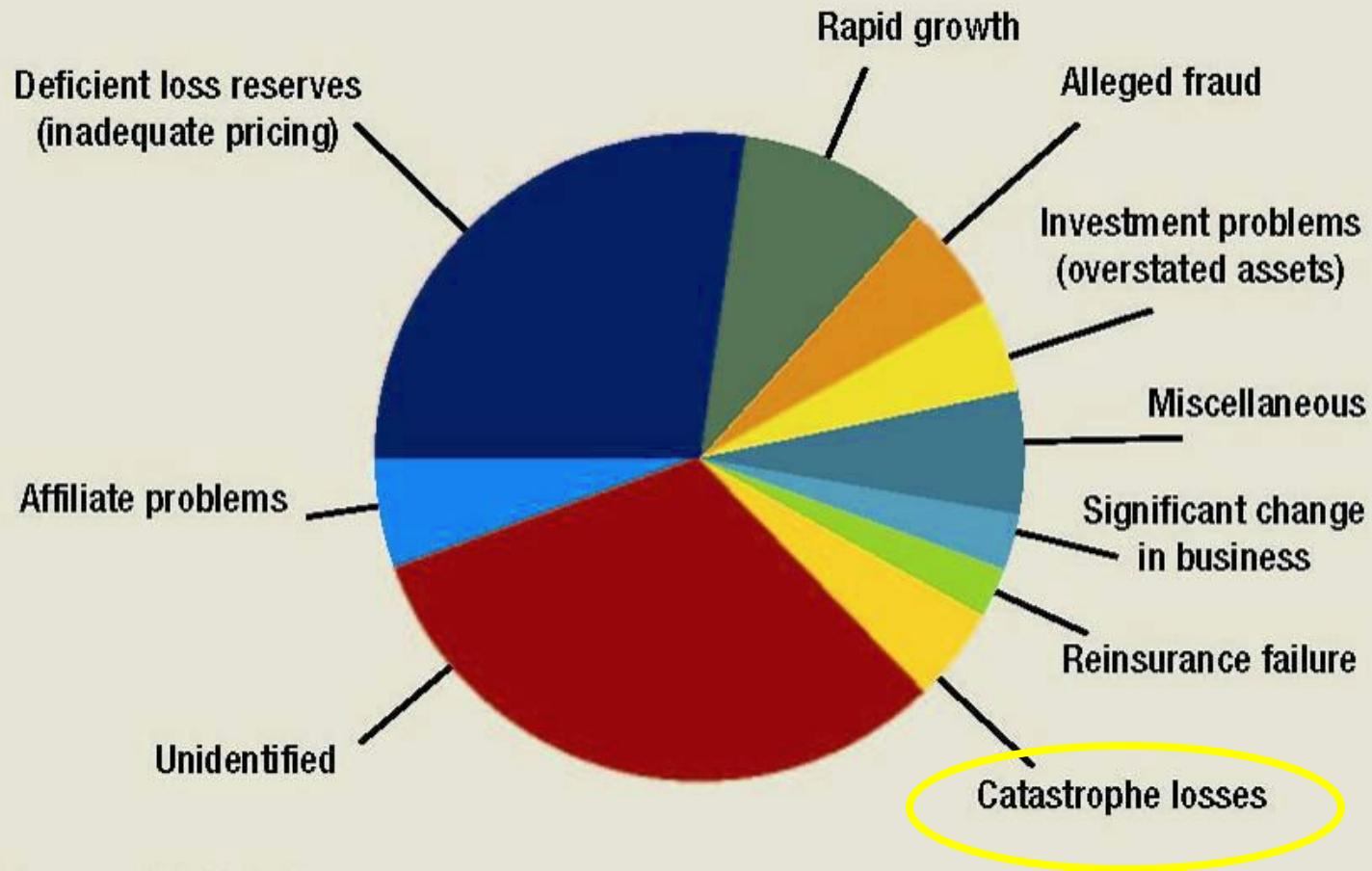
What if Andrew or Joplin hit your book?



AVOID BEING A HEADLINE LIKE THIS
Three Companies Taken Over Made Insolvent by Joplin Twister

Why Use A Model?

P/C FICs – Primary Causes (1969-2009)



Source: A.M. Best Co.

What is the model designed to cover and, importantly, what it is not designed to cover?



Severe Thunderstorm – What’s Modeled and Not Modeled

Modeled Perils

- Tornadoes
- Straight line winds (>58 mph)
- Hail (>1” in diameter)

Non-Modeled Perils

- Storm-induced flooding

Modeled Coverages

- Coverage A – Dwelling
- Coverage B – Other Structures
- Coverage C – Contents / Personal Property
- Coverage D – Additional Living Expense / Business Interruption

Modeled Loss Components

- Demand Surge

Non-Modeled Loss Components

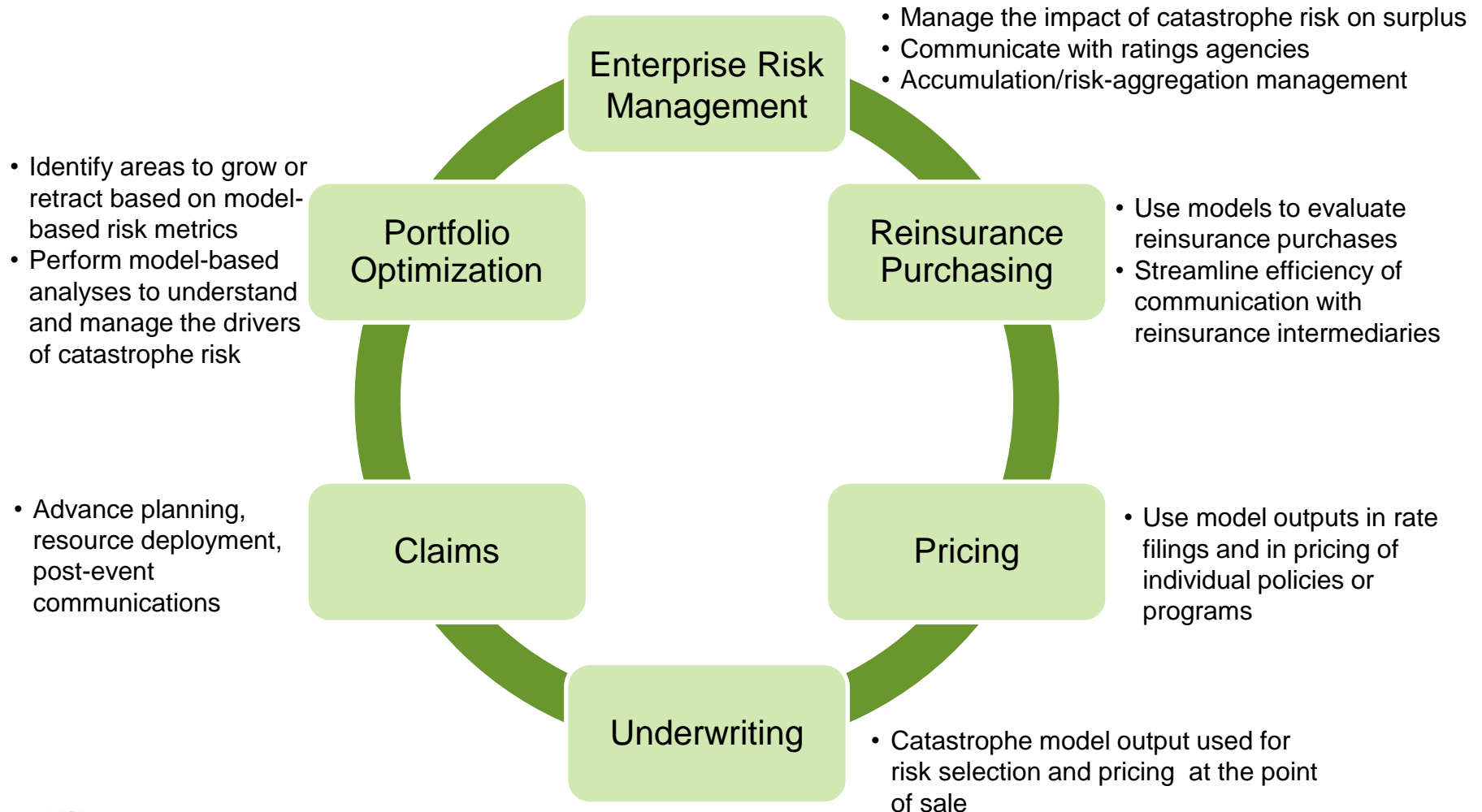
- Loss adjustment expenses
- Hazardous waste removal
- Loss inflation due to political pressure
- Indirect business interruption

Note: Model may be designed to provide only modeled events above \$25 million in industry loss, consistent with the industry definition.

What questions can the model help me answer? Which ones can't they answer?



Insurers Use Catastrophe Models Across Multiple Functional Areas



When is a Catastrophe Model Not Well Suited, or Needing Adjustment

- Trying to forecast events of the coming year
- When exposure data is faulty
- Granularity of model doesn't fit the business question
- As a simplistic answer without understanding the model
- When the model is not well validated

What Questions Can The Models Help Me Answer

They do best answering questions like the following:

- What happens if a cat 5 hurricane hits [fill in the blank]?
- How much is my cat risk changed by introducing a 2% hurricane deductible or starting to write larger homes?
- What if I require storm shutters?
- How much reinsurance should I buy?

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More important question is when should I use the model?

When to use the model?

Appropriate Uses

- ERM
- Portfolio pricing
- Portfolio underwriting
- Claims planning
- Portfolio optimization (in high cat “cost” areas)
- Underwriting at point of sale (in high cat “cost” areas)
- Reinsurance structuring

“Sketchy” Uses

- Underwriting at point of sale (except maybe, maybe in high cat “cost” areas)
- Portfolio optimization (except maybe, maybe in high cat “cost” areas) Po

**How can you deal with the
uncertainty inherent in the model?**



Dealing with Uncertainty in Cat Risk

- Understand it
 - Parameter
 - Process
 - Model
 - Primary and secondary
 - Exposure data
- Recognize and evaluate it
- Minimize it
- Talk about it

Dealing With The Uncertainty In The Models

- Live with it, it ain't going away.
 - ⇒ *Storms and weather are too changeable and chaotic*
- Improve your data
 - ⇒ *Garbage in, garbage out*
 - ⇒ *You can't do anything about GO, but you can do something about GI*
- Run multiple models
- Alter your data and exposures, and alter “switches” to stress test the models
- Run alternative analyses – e.g., deterministic scenarios
- Understand how property characteristics impacts your results





How can you judge whether a catastrophe model is reliable? What do I do when the models disagree?





Key Requirements for a Robust Catastrophe Model

- Model must be consistent and unbiased when tested against a wide range of historical datasets
- Model should produce reasonable and unbiased loss estimates in real time
- Model components should be independently validated and obey basic physical expectations of the underlying hazard

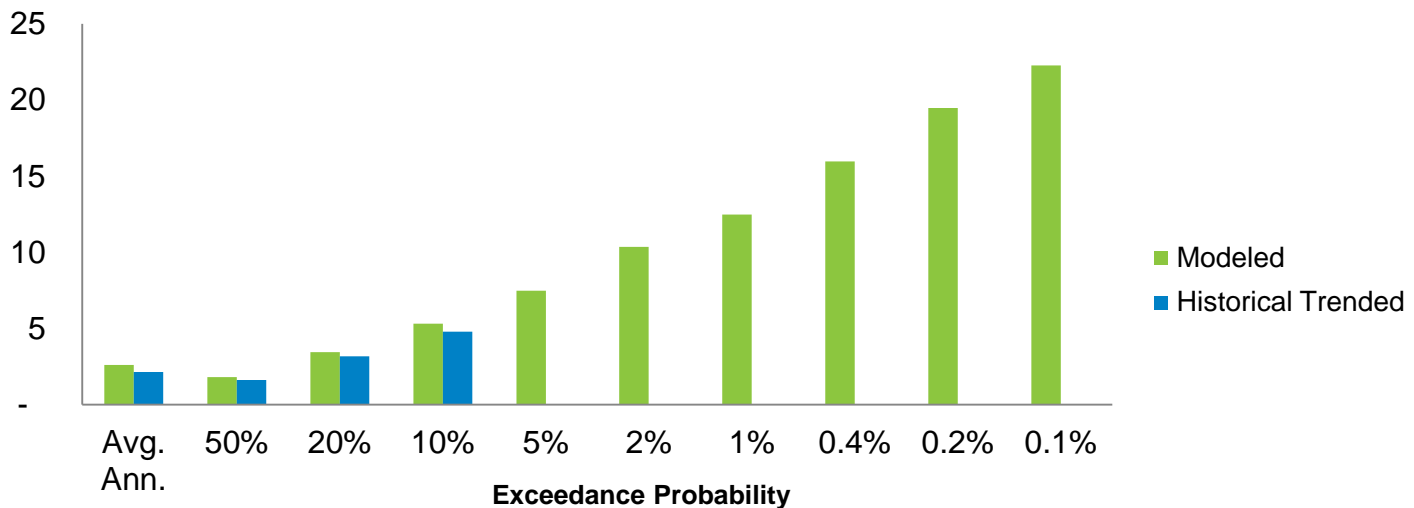
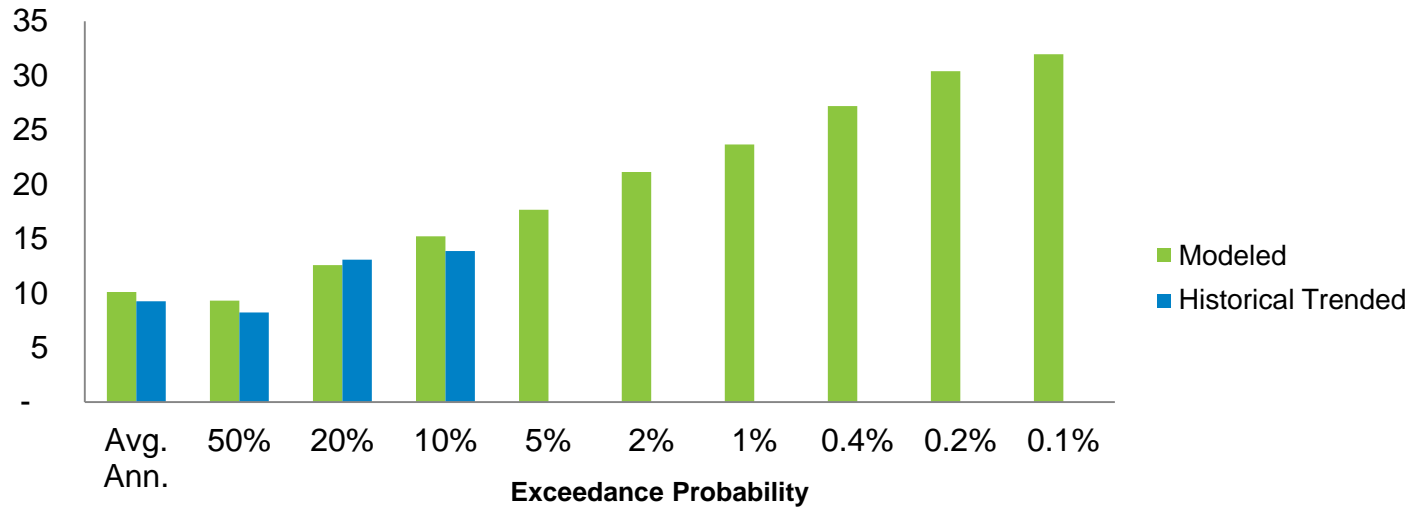
Models Can Be Validated in a Number of Ways

- Validation against market pricing 
- Real-time loss validation 
- Component-level validation 
- Industry and company loss validation 

Models Can Be Validated in a Number of Ways (Continued)

- Component-level validation 
 - Abundance and reliability of various data types
 - Exposure reasonability—replacement values and benchmarking against industry exposure databases (IEDs)
 - Hazard (frequency, intensity, footprints of major past events)
 - Vulnerability (relative vulnerability and sensitivity of results by LOB, coverage, occupancy, construction type, age, etc.)
 - Policy conditions and financial calculations (e.g. calculations of limits, step functions, storm surge, demand surge, etc.)
- Industry and company loss validation 
 - Trending historical losses is far from trivial
 - There is a distribution around every point estimate

Modeled Losses Validated Against Historical Data



Which Model, If Any, Should I Use?

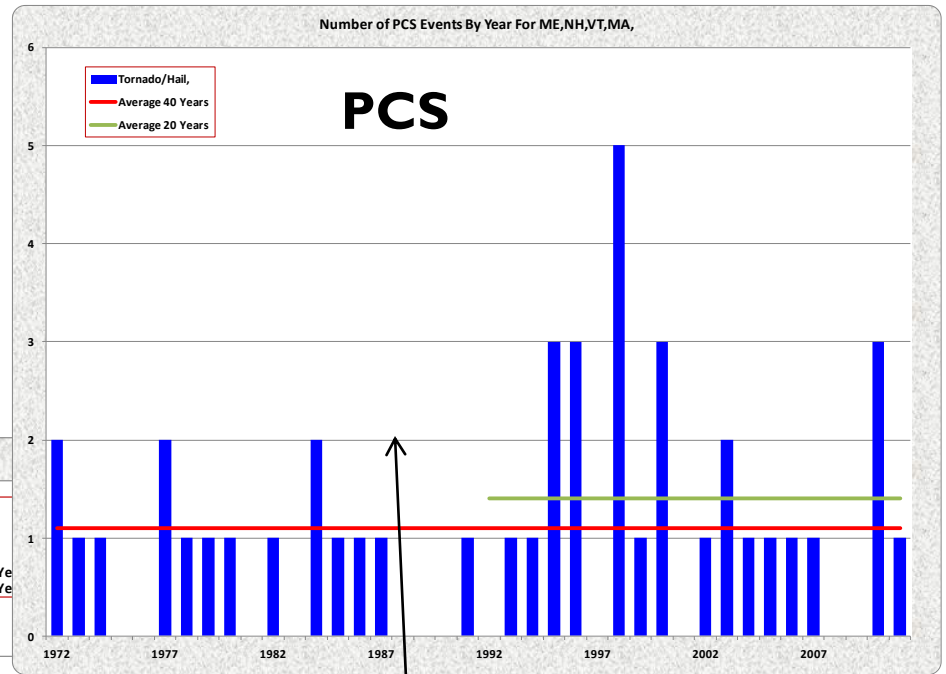
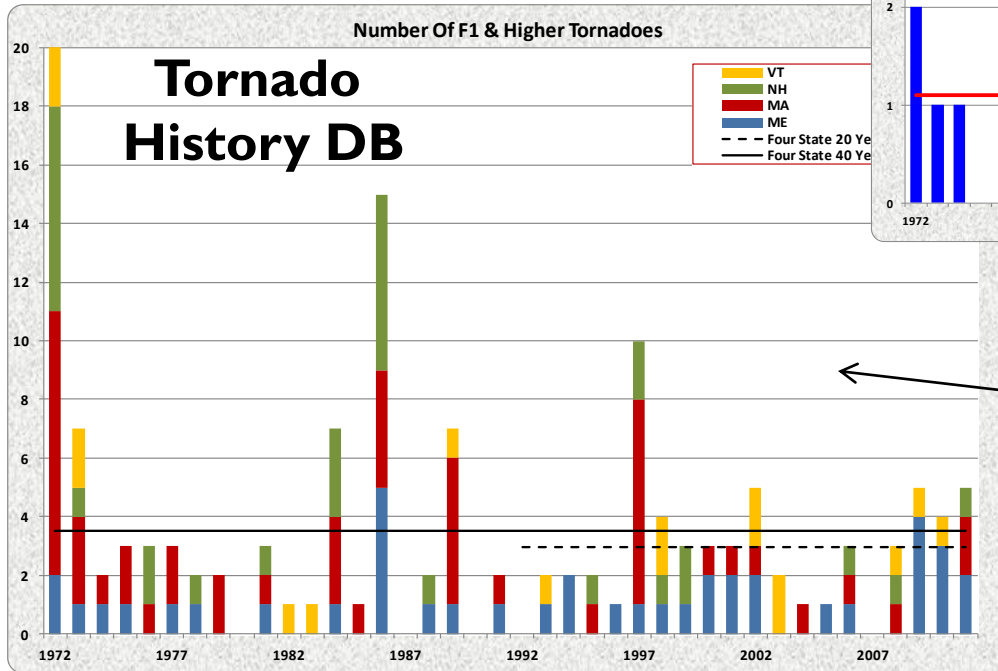
- The days of simply averaging the modeled output are gone
 - ⇒ *Rating agencies want to know what you think of the modeled output?*
 - ⇒ *Users need to understand their own risk*
- That being said, you have to dig deeper than the EP curve
- Turn modeling into an actuarial analysis

Turn Modeling Into Actuarial Exercise

- Bring historical losses on-level (adjust for trend and exposure changes)
- Compare frequency and severity separately
- Include external data points (e.g., PCS, tornado data, HURDAT)
 - ⇒ *Adjust external data to company's geographical footprint*
- Selected a distribution
 - ⇒ *Pick one (the “best”) or adjust weights between the models*
 - ⇒ *We don't recommend “throwing away” any model information*
- Simulate cat losses using selected distributions

External Data

Use as many data points as possible:
PCS (frequency and severity)
NOAA/Severe Weather Center
Tornado history database
HURDAT



PCS and tornado history adjusted to four northeast states

**How do I interpret modeled losses
of actual events?**

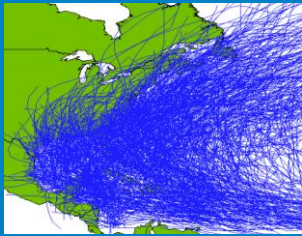


Model vs. Actual Comparisons

- What can an individual event tell us about a model?
- What do I need to do to have an “apples to apples” comparison?

Catastrophe Modeling Framework

Hazard



Event
Generation



Intensity
Calculation



Exposure
Information

Engineering



Damage
Estimation

Limit

Deductible

Policy
Conditions

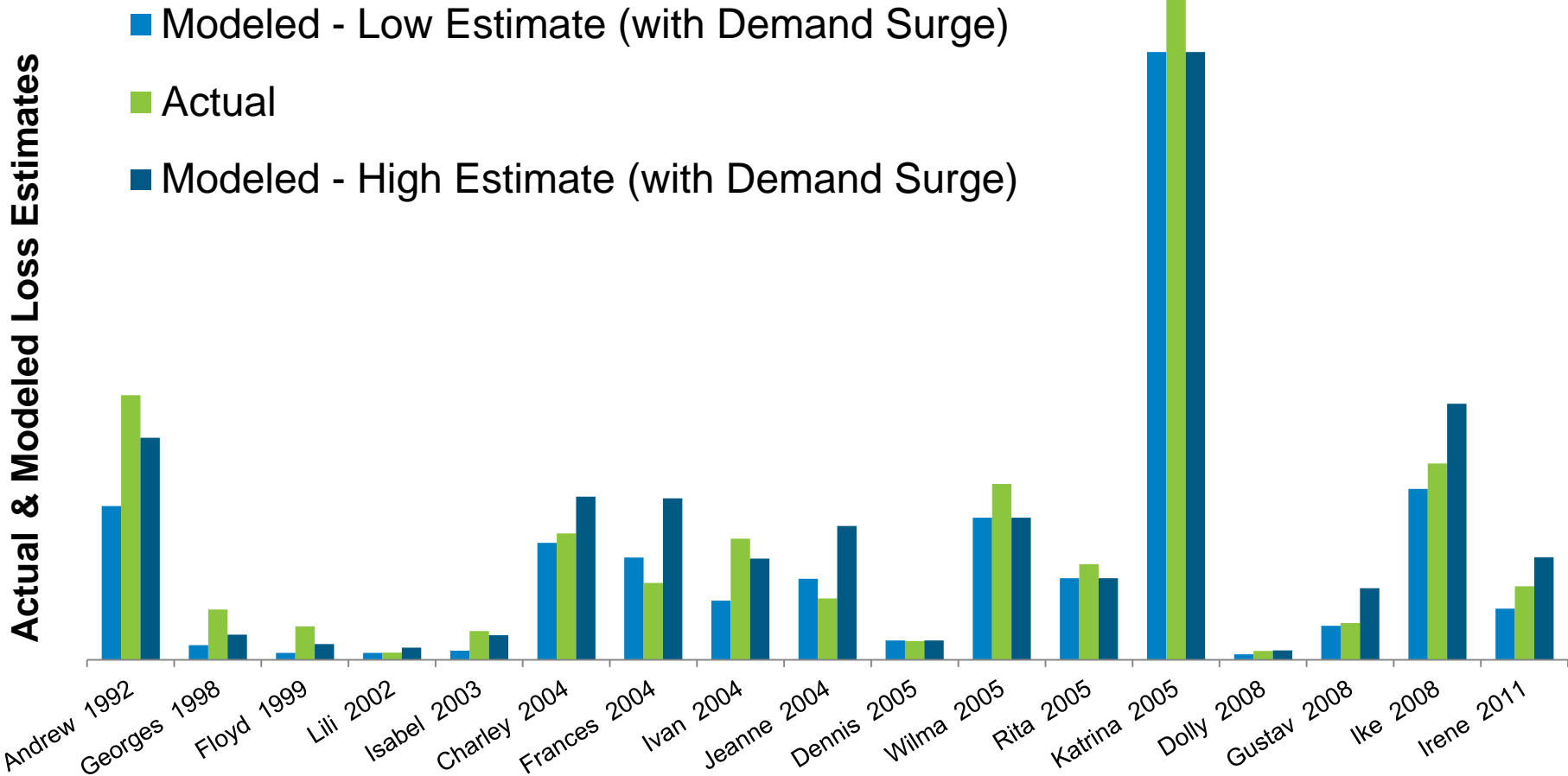
Financial



Loss
Calculation

Industry Loss Validation for Larger Historical Storms

Historical Loss Causing Hurricanes (1992-2011)



Low & high modeled estimates for Hurricanes Dennis, Wilma, Rita, and Katrina represent the single, final loss estimate for each storm and not a range of (low-to-high) losses.

Uncertainty in Evaluating an Individual Event - Hurricane Isaac as an Example

- Pre-landfall, 8/28: Range of estimated loss -- \$300M to \$7.5B
 - \$480B exposed at that time, per NHC cone of uncertainty
- Post-landfall, 8/30: \$700M to \$2B
 - **Expected (mean) insured** industry loss to **onshore** U.S. property exposures from Hurricane Isaac of nearly USD 1.2 billion, with a **90% confidence interval** of USD 700 million to USD 2 billion.
 - Scenarios provided include a select sample of 11 possible events (to describe the range) and a larger sample of ~500 events to model and evaluate the loss distribution

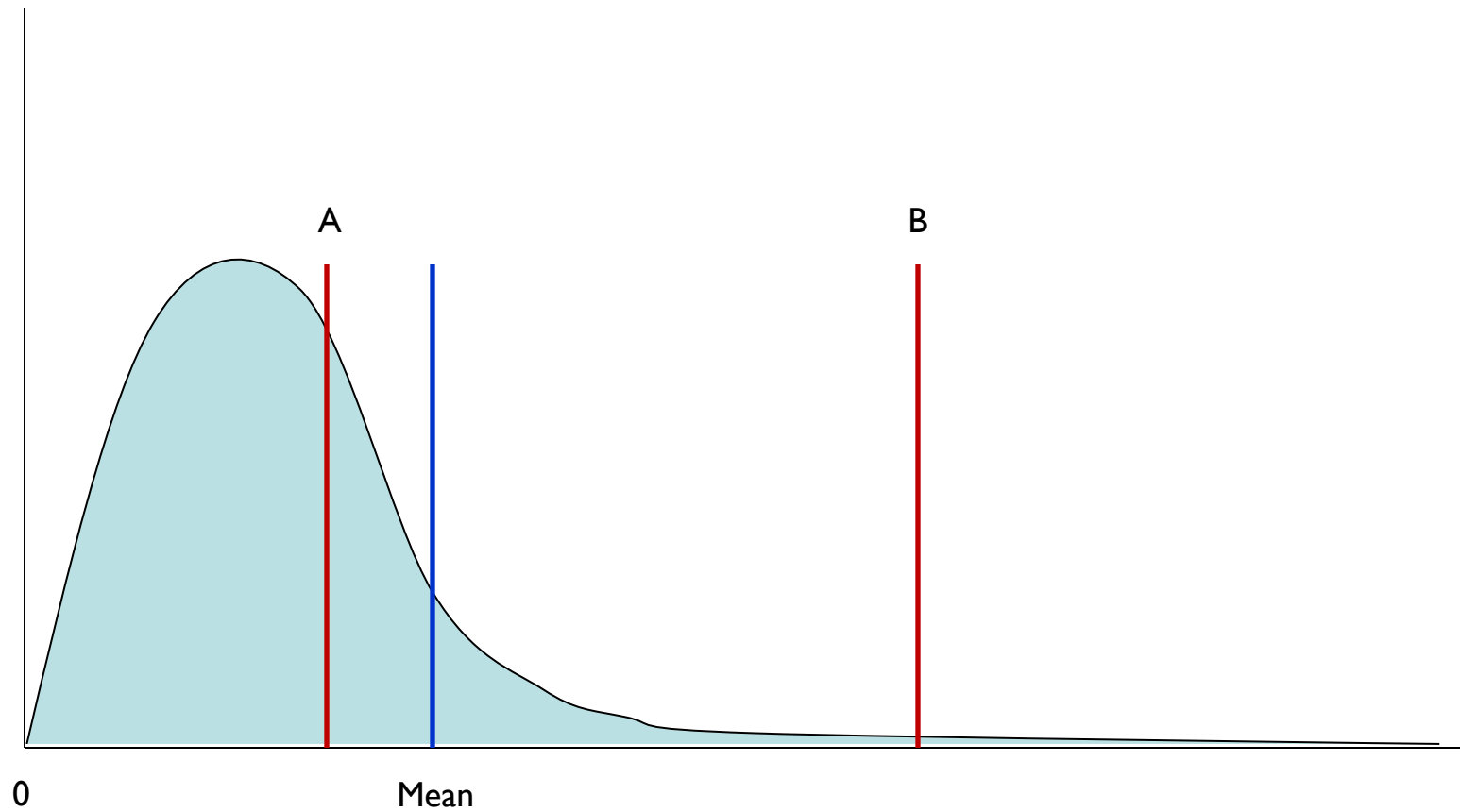
Best Practices to Enhance the Interpretation and Communication of Real-Time Results:

- Always communicate the range of loss estimates produced by the “All simulated scenarios” event sets, not just any single estimate or just the maximum;
- Always make sure the loss results include demand surge;
- Confirm that any storm surge losses are based on correctly coding policies with respect to whether they cover such losses;
- Benchmark estimated losses against losses based on market share information and industry loss estimates;
- Present any known issues with exposure data quality that might affect the loss results;
- Disclose any adjustments made to reflect non-modeled costs such as loss adjustment expenses, wind pool assessments, and inland flooding.

How Do I Evaluate Actual Event Versus Modeled Event

- You have to realize the specific actual event will likely never happen again
- The modelers can't replicate the exact event, so they give a range of events against which to compare it
- What modeled number do I use to make the comparison?
 - ⇒ *Depends on the model*
 - ⇒ *Know what the model number means, e.g., RMS number is mean of a distribution, AIR is a single point estimate*

Compare Model To Compare



Smart Use of Catastrophe Models

- Dive into the extensive available documentation
(No excuse for “black box” mentality)
- Do your own validation
- Know how applicable to the particular business question;
know the model’s limitations
- Keep in mind uncertainty
- Learn from actual events

- ASOP # 38