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Uncertainty in Cat modeling

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Uncertainty in Cat modeling

Why do we need Cat models?

Origin of uncertainty in Cat modeling:

- Hazard, vulnerability, etc..

How to deal with uncertainty in pricing:

- Explicitly model some of the uncertainty
- Multi modeling
- In-house modeling capabilities

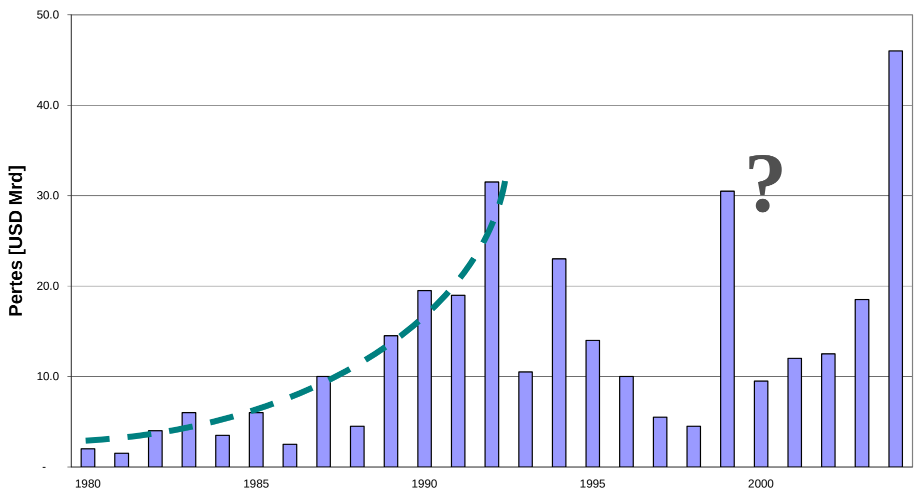
How to deal with uncertainty in risk management :

- Account for uncertainty
- Modeled PMLs versus limits for exposure control

Why do we need Cat models?

Growth in insurance losses due to natural catastrophes over the years

(Source: Sigma, SwissRe).



Hurricane Andrew (1992) as key event for Cat modeling:

- Pricing cannot be based only on experience
  need to take into account growth in exposure.

Why do we need Cat models?

Exposure changes:

- More exposure in hazardous areas
- Inflation
- Change in construction codes
- *Cat models provide "as-if" losses for current exposure*

Accumulation risk:

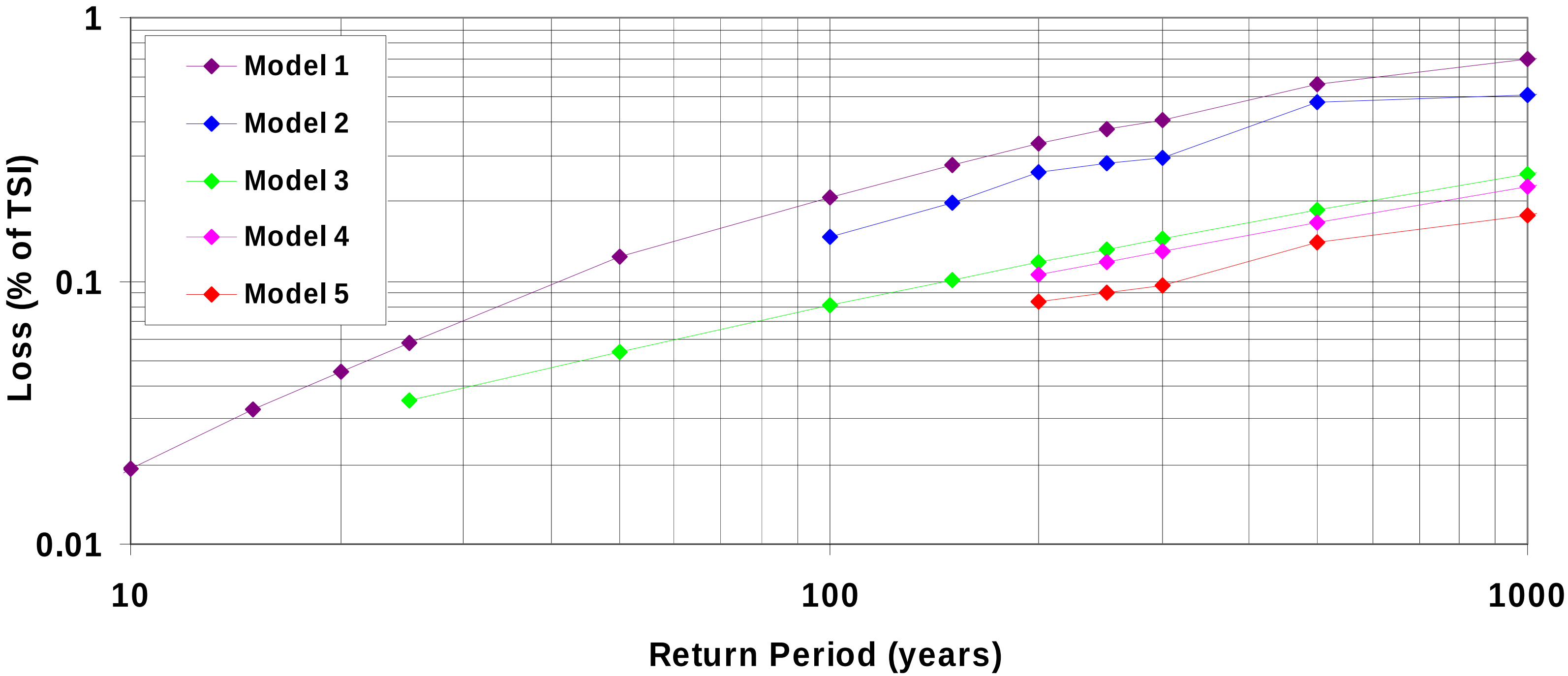
- Natural catastrophes cause widespread losses across large regions, lines of business
- *Cat models capture accumulation risks via "scenario analysis"*

Catastrophes are rare events:

- Scarce experience of large loss events
- *Cat models use laws of physics to produce many years of simulated losses*

Why do we need Cat models

But various Cat models can produce widely different estimations of loss cost for pricing.



We need Cat models

..... but

their results are highly uncertain.

So where does this uncertainty come from and how can we deal with it?

Origin of uncertainty

Poor understanding of catastrophic events:

- Few events have been observed/recorded in history
- Complex physical phenomena

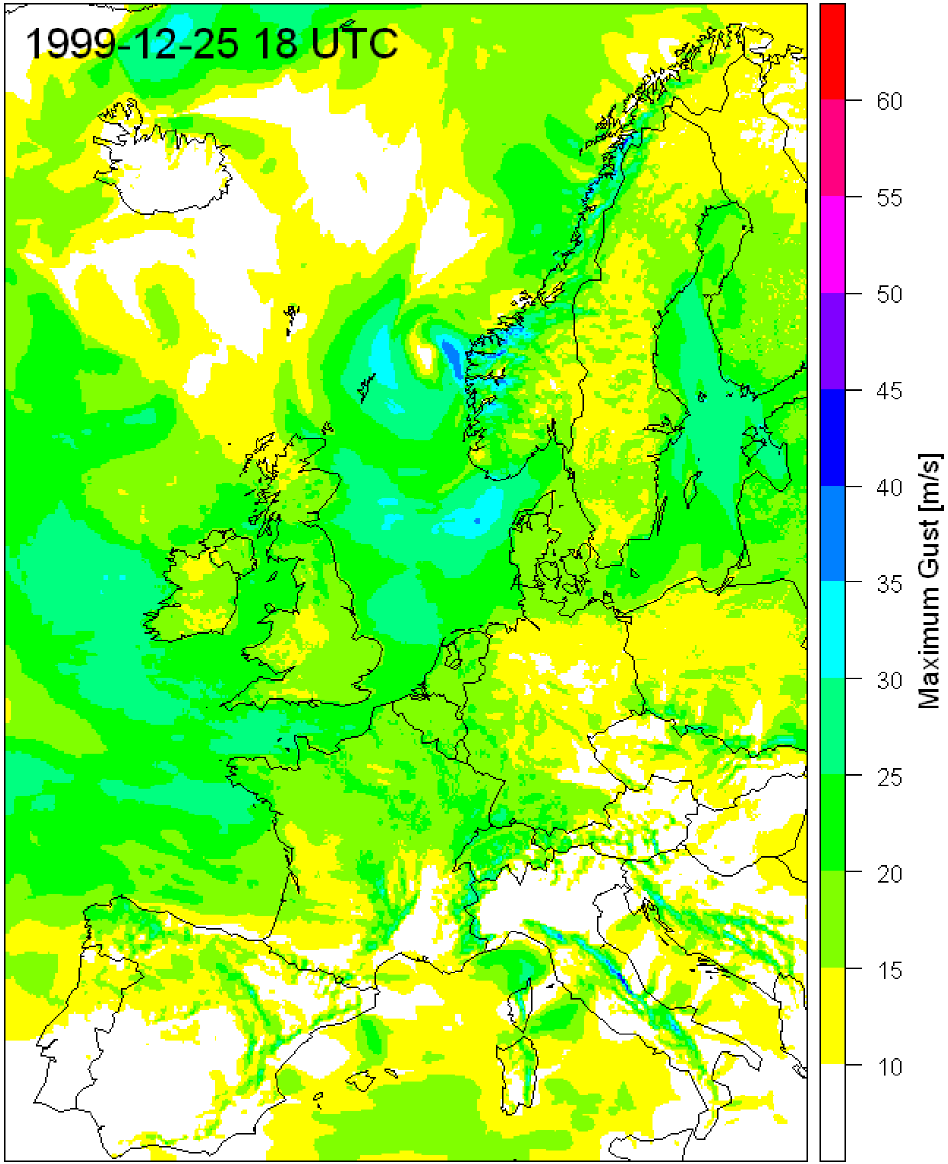
Random nature:

- Large spatial and temporal variation in damages (e.g. due to turbulence)
- Each event is unique!

Not everything is modeled:

- Models are only abstraction of reality.

Origin of uncertainty: Hazard



- Inherent complexity in modeling extreme natural events.
- Simulation of extra-tropical cyclones in Europe using CatFocus™ based on Numerical Weather Prediction models (Meteo Swiss).
- Storm Lothar in December 1999.

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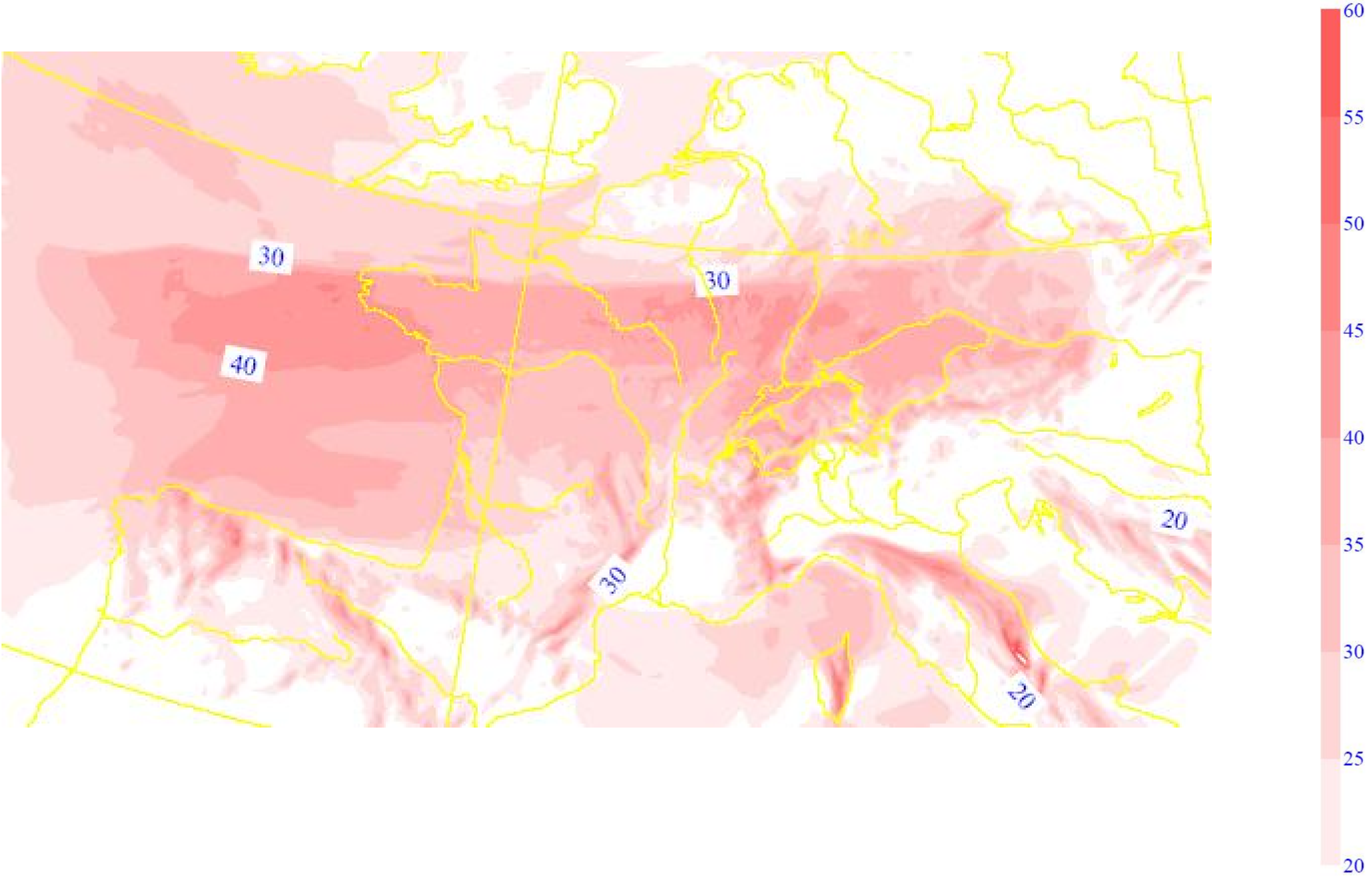
Origin of uncertainty: Hazard side



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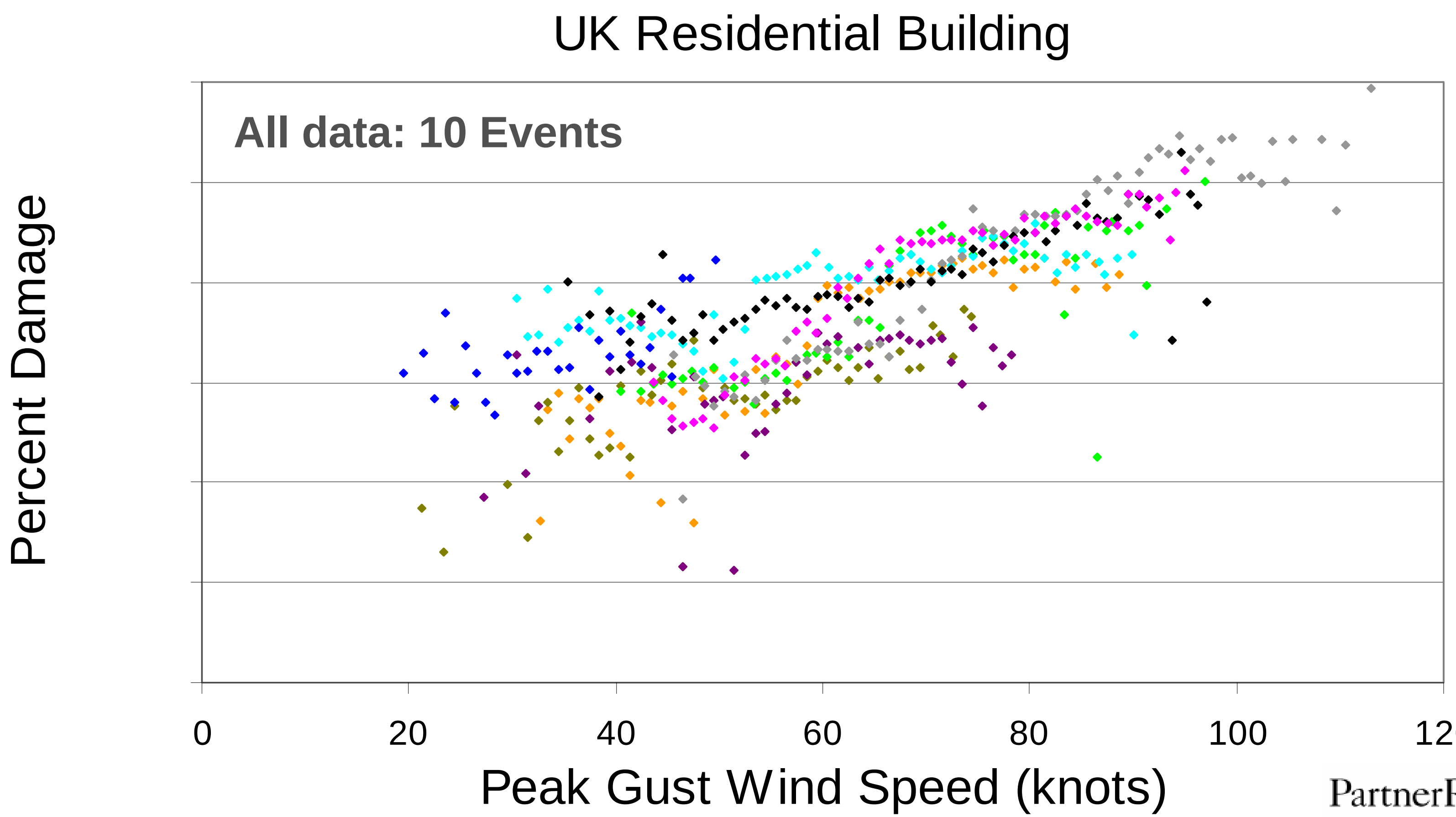
Origin of uncertainty: Vulnerability

Large spread of damage from claims data



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Source: CatFocus™ (PartnerRe)

How to deal with uncertainty: Pricing

Most Cat models explicitly consider part of the inherent uncertainty:

- Uncertainty arising mainly from random nature of damage (so-called secondary uncertainty).
- Certain types of epistemic uncertainty (i.e. lack of knowledge)

Do not rely on a single model:

- Results may vary substantially between models:
- Cat models are expert opinions. Their divergence reflect our lack of understanding

Consider non-modeled perils:

- Many perils or types of damage fall outside the scope of Cat models (snow pressure, volcanic eruptions, subsidence, …)

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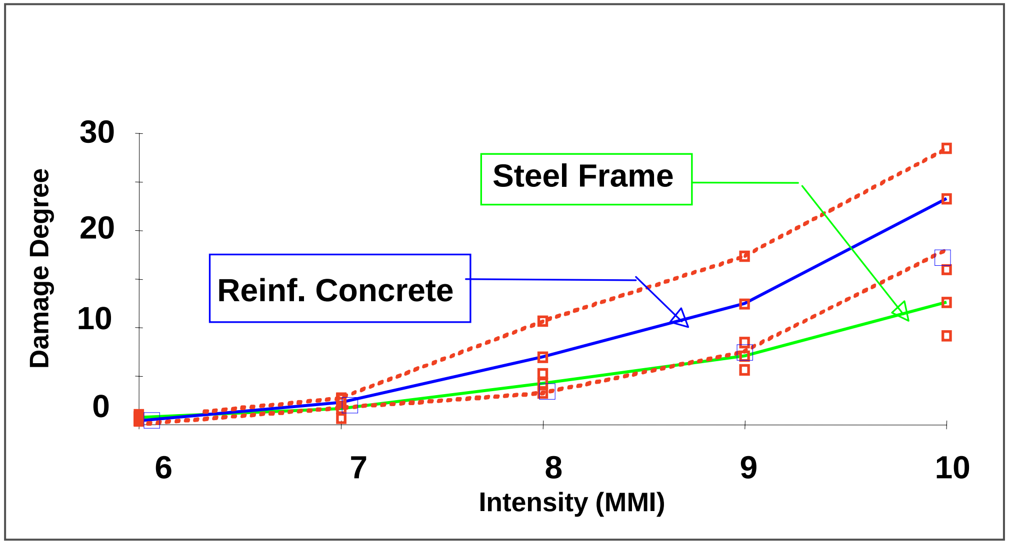
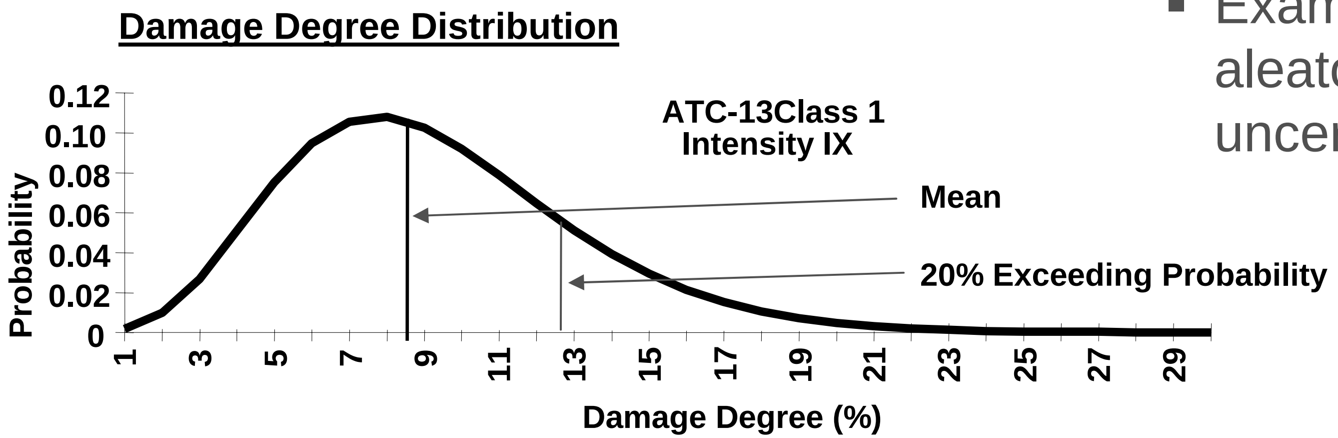
How to deal with uncertainty: Pricing





Modeling secondary uncertainty:

- Distributions of damage degree for given level of intensity/wind speed
- Example of aleatory uncertainty.

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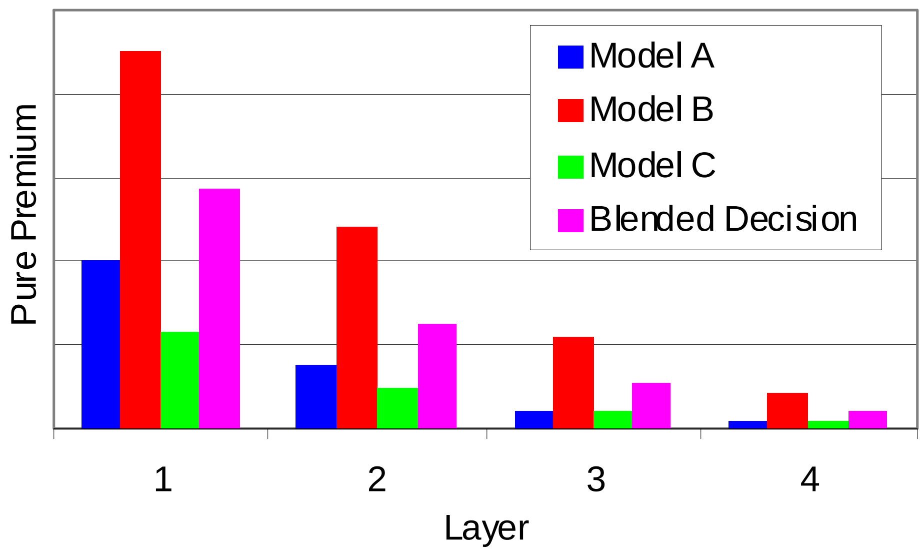
How to deal with uncertainty: Pricing

Multi-modeling is the key for dealing with large differences between Cat models:

- Do not rely on a single model
- Results from various models as different expert opinions:
  - Vendor and in-house Cat models
  - Actuarial models (experience rating, Pareto models)
- Pricing decision based on:
  - Various model outputs
  - Credibility of individual models
  - Blended decision



How to deal with uncertainty: Pricing

Unfortunately multi modeling is not widely practiced because:

- It is time consuming:
  - Lot of time spent in reformatting data
  - Models may run for ever…
- Licensing Cat models is expensive
- Humans prefer the illusion of certainty that single-model outputs may confer

How to deal with uncertainty: Pricing

In-house modeling gives a reference to gauge various other models:

- In-house model is not a black box
- Researchers bring expertise in Cat modeling that helps:
  - understanding of strengths and weaknesses of models
  - Possibility to analyze unconventional risks or structures
- At PartnerRe we have developed our CatFocus^{TM} suite of models covering Atlantic Hurricane, Pacific Tropical Cyclones, Europe Windstorms, and Earthquake perils worldwide.

How to deal with uncertainty: Risk management

Proper risk management should consider uncertainty:

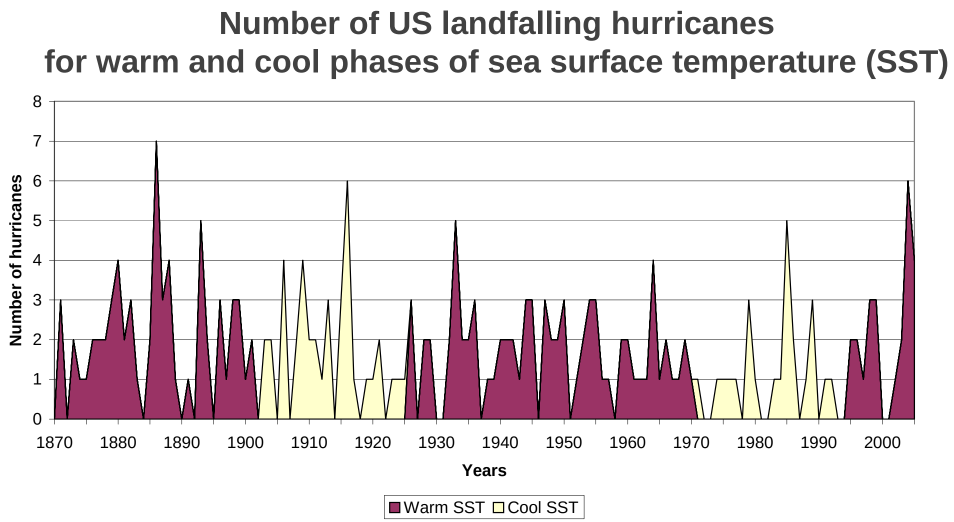
- For Exposure control:
  - It is crucial to a reinsurer/insurer since it guarantees that its portfolio remains well diversified
- For quantification of capital requirements:
  - Accumulation of risks versus diversification

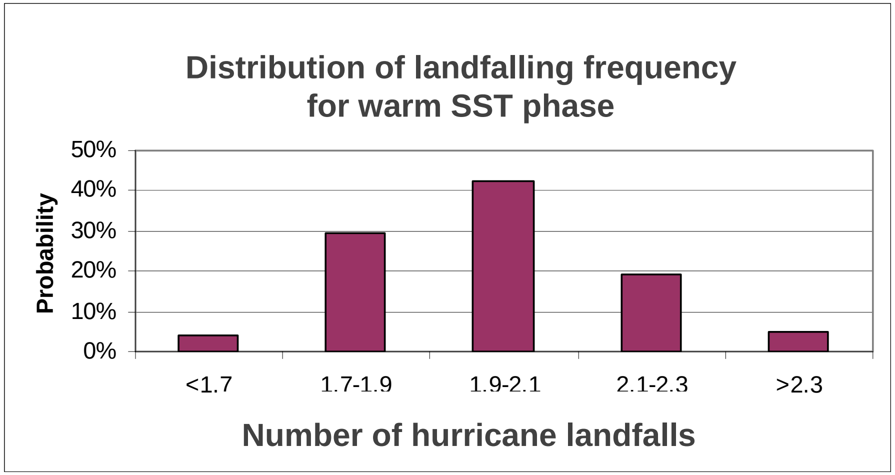
How to deal with uncertainty: risk management

Try to avoid using models for exposure control:

- Use limits to measure exposure whenever possible. They confer the certainty that no single event can exceed them!
- Modeled PMLs should be used only for treaties with no occurrence limit. PMLs carry a large uncertainty as they may considerably vary from model to model

How to deal with uncertainty: risk management





Account for uncertainty in quantification of capital requirement:

- Example of hurricane frequency:
  - Use of near-term view on hurricane activity carries with it a larger uncertainty
  - Number of landfalls per year may be anywhere between 1.7 and 2.3.

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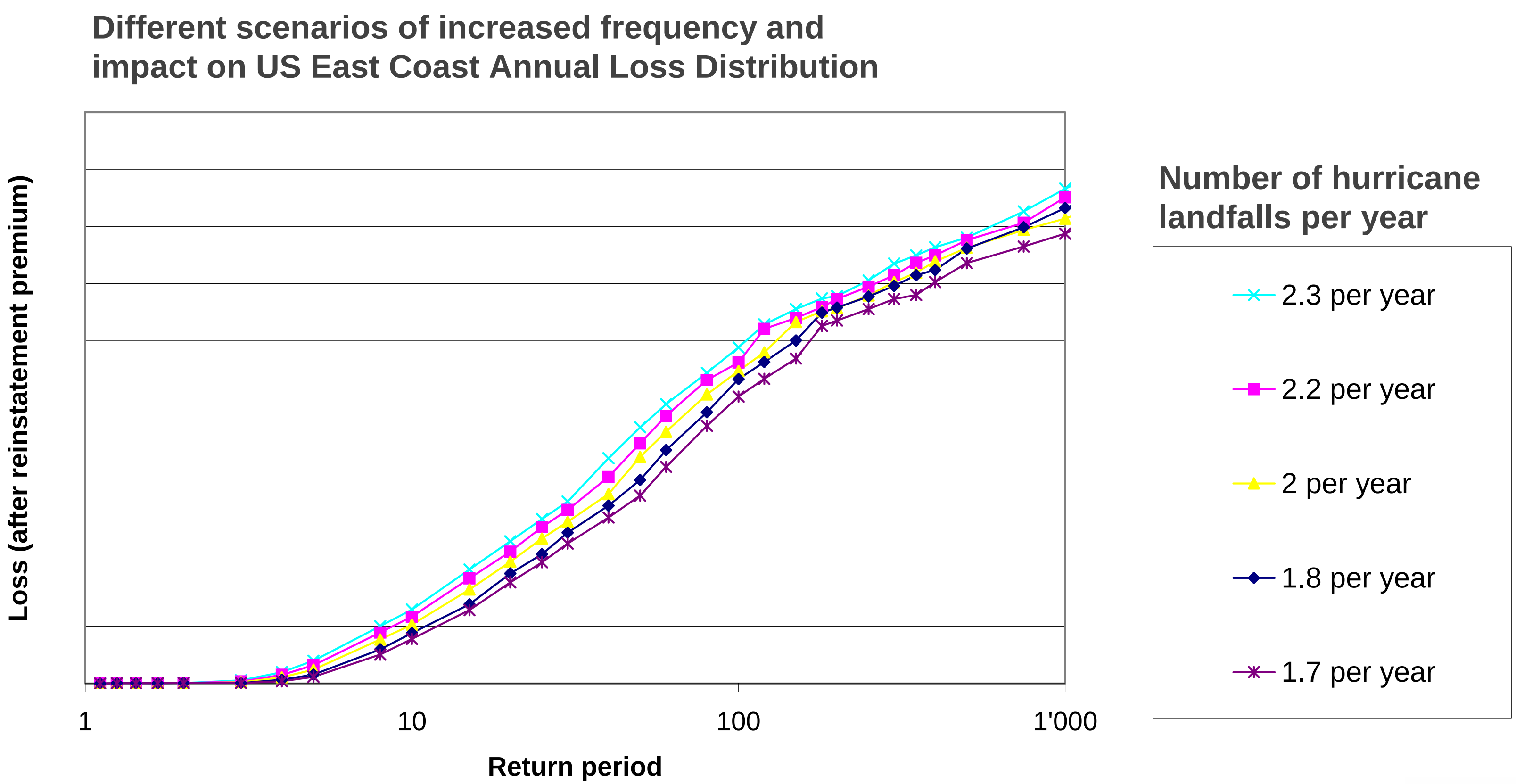
How to deal with uncertainty: Risk management

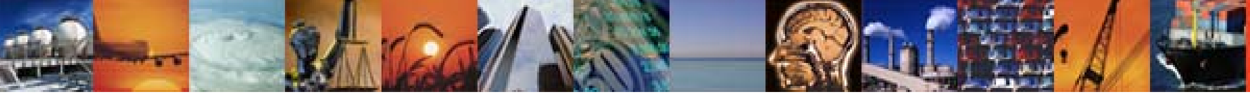


Conclusions

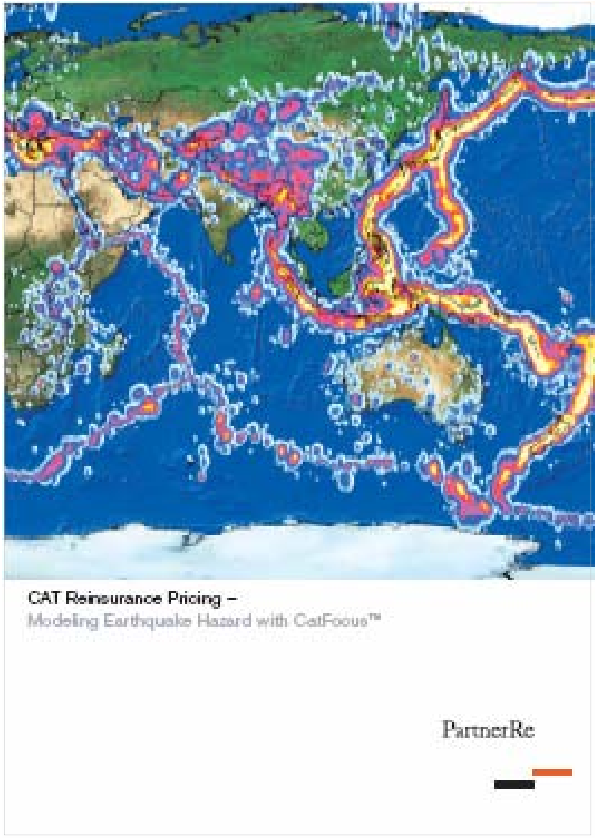
Can Cat models be trusted?

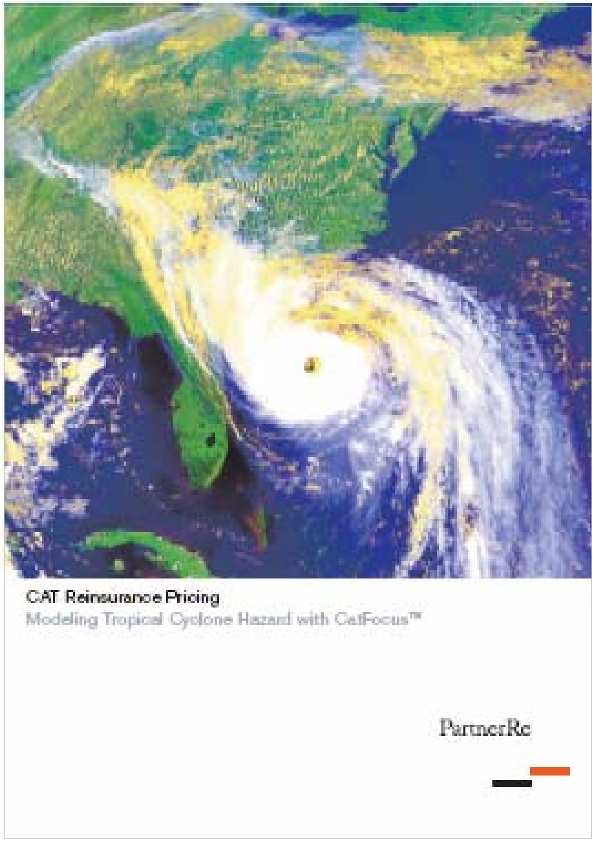
Yes … but not blindly. Use them with care and be aware of their limitations.

Underwriting can enormously benefit from the quantification of risk provided by Cat models. But model outputs will never replace good underwriting judgment



Publications on Cat modeling





Class Report

DAY 2 MODELLING EUROPEAN WINDSTORM

A model challenge

Inherent complexity and differences in modelling methodology for windstorm risk lead to PML estimations that can sometimes vary by multiple factors leading to considerable pricing uncertainty, says PartnerRe's Hervé Castella and Edzard Romaneessen.

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