Catastrophe Model Risk

Gero Michel, CRO and Head of Risk Analytics
Montpelier Re

Catastrophe Model Risk

It might not feel like it - given the always present burden of regulation and process - but catastrophe model skill is especially needed in a soft market!

In a soft market models can become a powerful competitive (if not disruptive) advantage - *if we understand their unique potential as well as the biases and errors.*

Catastrophe Model Risk, Definition

Model Risk:

Offset mark to model vs. mark to market

Difference between results of two ñsimilarò models

Difference between model results and actual results

Catastrophe Model Risk

Basis Risk (imperfect Hedging)
Complexity (over-fitted)
Correlation, Correlation Uncertainty
Metric: ñEL/Meanò might not be the right measure
Model Implementation
Model Usage (data etc.)
Regulation (Model) Risk (ñoverregulatedò?)
Time inconsistency (long-term average vs. forecasting)
Uncertainty and Volatility (epistemic and aleatoric)
Wrong Model

4

Michel, 10/1, 2015

1. Are we Using the ñRightòModel?

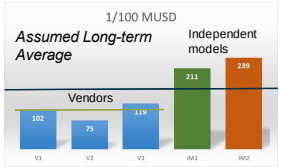
Models are based on assumptions:

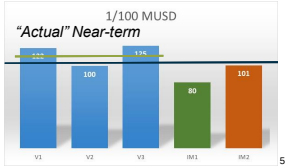
Exposure calibration: too high = too low vulnerability

Data: valid and representative (hazard drives the plethora of data)

Scope: time, region, coverage

Model theory: relevance of process





5

Michel, 10/1, 2015

2. *Ensemble Modeling = "Good"* - Are two Models an ñEnsembleò?

Good ensemble models include ñend-memberò models with vastly different assumptions and are supposed to cover the entire ñrisk-spaceò

Group of base models with different
Â *Classification/Initial conditions*
Â *Assumptions/concept/strategy*
Â *Selection of input data*
Â *Parts mutable or immutable*
Etc.

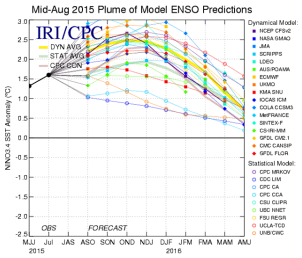


Figure 6. Forecasts of sea surface temperature (SST) anomalies for the Niño 3.4 region (5°N-5°S, 120°W-170°W). Figure updated 18 August 2015.

6

Michel, 10/1, 2015

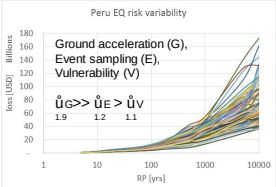
3. Aleatoric Model Uncertainty - What Range do we Want to Consider?

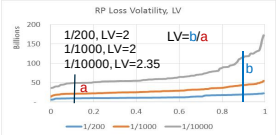
Uncertainty creates bias for "non-linear model" (e.g. ground acceleration)

Hazard dominates model risk

Vastly different for different perils

Larger for higher damage ratio (EQ, FL, TO vs. ETC)





7

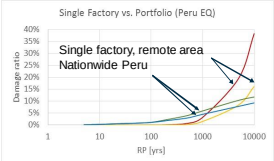
Michel, 10/1, 2015

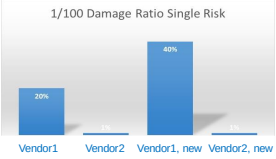
3b. Aleatoric Model Uncertainty - Higher for Single Risks

Model Risk decreases with diversification and portfolio size

Portfolio management may hence have higher skill than prizing

Models used for prizing single risks and local portfolio need >> # events than diversified portfolios





8

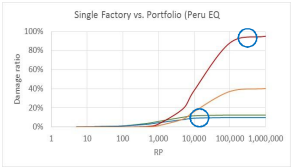
Michel, 10/1, 2015

4. How Many Events/Years do we Need to Model?

Rule of Thumb: As many as you need to flatten the curve!

Millions of years for local insurance books International portfolios are fine with 10K years (in case local sub-portfolios are unlikely to contribute to tail).

It is often more economical and rewarding to run several sets of 10K years rather than a few sets of 100k year portfolios

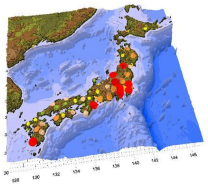


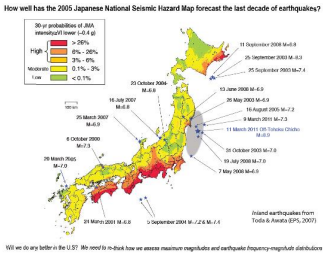
9

Michel, 10/1, 2015

5. Epistemic Risk, Japan EQ Model Failure

- EQ forecasting using time-lack, Poissonian, or Clustering
- The best solution might not be the most commonly believed?





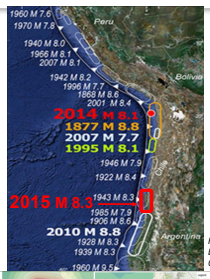
Communication Ross Stein, 2011

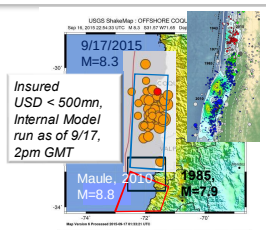
CAEQ risk assessment follows the same principalé !

10

Michel, 10/1, 2015

5a. CL, Sept 17, 2015: You may Want to Rebuild Your Model After a Large Eventé





http://seismo.berkeley.edu/blog/seismoblog.php/2014/04/02/filling-a-seismic-gap

Perceived Shaking	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
Potential Damage	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PGA MMI (%g)	<0.08	0.3	2.8	6.2	16	32	40	75	>139
PGV MMI (cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	81	>178
Instrumental Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X+

See e.g. Yu-nung Nina Lin et al.
For post-seismic N migration of deformation

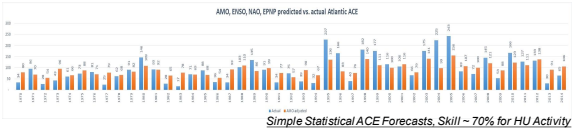
AIR 9/21 USD 600-800mn

James Daniel oral communication

11

Michel, 10/1, 2015

5b. High Forecasting Skill but What useé ?



Simple Statistical ACE Forecasts, Skill ~ 70% for HU Activity

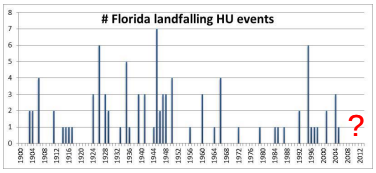
ïRandom Processesòseem to drive variability. Loss prediction using the above has often little skill (landfall odds, where storms make landfall etc.). The value is rather in **forecasting years with lesser/or more than average** activity.

Allow "reasonable" activity forecasting into your annual strategy and risk appetite!

12

Michel, 10/1, 2015

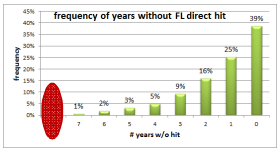
5c. 1/150 ïPositiveò Event vs. Largest Recent ïNegativeò Event (Katrina) = 1/25! é How Much is Random and How Much can be Learned?



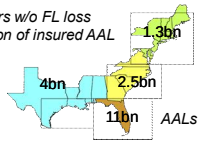
"Over-dispersed and clustered" HU events:

Last 8 years without a landfalling HU

This did not happen once in 150yrs!



8 years w/o FL loss
~ -90bn of insured AAL

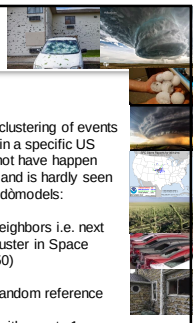


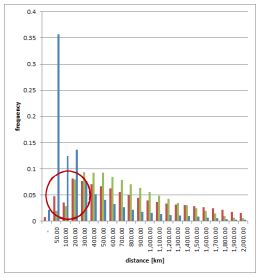
AAL, average annual loss

13

Michel, 10/1, 2015

5d. Correlation/Clustering in time: 4th Event Losses, Nebraska 2014





ïBlockingò and clustering of events over >1 month in a specific US territory might not have happen often in history and is hardly seen in ïbootstrappedò models:

Blue: nearest neighbors i.e. next events. They cluster in Space (data since 1950)

Green: purely random reference

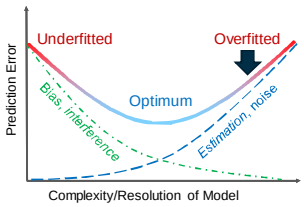
Red: selection with events,1 months apart: Some clustering! (*higher than green*)

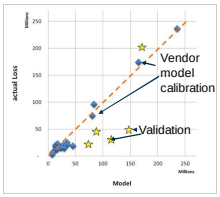
14

Michel, 10/1, 2015

5e. The Higher the Resolution the Higher the Model Riské ?

Increasing #variables = increasing complexity





Overfitted = Error of prediction of the independent validation data > than error of prediction of the calibrated model

15

Michel, 10/1, 2015

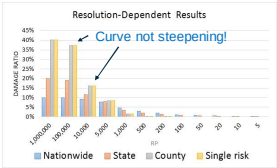
6. Exposure Model Risk

ïGarbage in…" - not wrong but misleading…?

Exposure is derived by a model(index) and may not be independent from a catastrophic model (dependent variable)

How does company exposure compare to exposure used to calibrate model? What is the "best" resolution for Exposure input?

Exposure should be considered "stochastic"…



16

7. How can we Best Adjust/Calibrate Models?

Commonly done: *Quality score*

Component adjustment (e.g. adjust frequency, intensity, or vulnerability separately)

Historical benchmark losses

Adjustment based on internal stochastic model(s)

17

We Conclude: Epistemic Risk is the # 1 Catastrophe Model Risk

The scarcity of information, the need for detailed loss forecast, the concept of ïlong-termò and the ïbelieveòthat we understand a process drives failure!

"Big Data" concepts, i.e. deviating from theory to agnostic data processing might help (deducing rather than inducing) …"Paradigm shift in Modeling"

18

With all this, What do I Need to do as a Risk Officer?

"Get your brain back": Invest in an own catastrophe model that helps calibrate or rebuild the currently used models in your company

Use the Vendor Model as a trading platform (and see what others follow)

Your Model must be: 1) able to forecast, 2) good at comparing risk across the world, 3) built on parsimonious assumptions (tradeoff between complexity and bias), 4) flexible and quick. Team up with scientists (wisely!)

Consider uncertainty in prizing and capital cost assumptions (same ELR might have very different meaning)

Build on a trusted portfolio (even) more than on technical prizing