Verisk

Spreadsheets to Analytics: An AIR Perspective

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Agenda

- Overview of Verisk and AIR Worldwide
- Goals for Today's Session
- Moving From Process to Progress in Analysing Data
  - Exposure Data
  - Interpreting Loss Data
- Group Exercise

Overview of Verisk and AIR Worldwide

Verisk

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Verisk Analytics

The world's most effective and responsible data analytics company in pursuit of our customers' most strategic opportunities…

…providing predictive analytics and decision support solutions to customers in specific vertical markets

Property/Casualty Insurance
72%

Energy and Specialized Markets
21%

Financial Services
7%

% of Total Revenue

Distinctives

- Unique Data Assets
- Deep Domain Expertise
- Deep Integration into Customer Workflows
- Steady Stream of First-to-Market Innovations

$19 Billion
market cap

14 Petabytes
of information in our data stores

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The Verisk Way: Our Guiding Principles

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The Verisk Way guides how we serve customers and what we expect of ourselves.

Verisk: The Original *InsurTech*


Natural
Catastrophes


Crop and
Agriculture

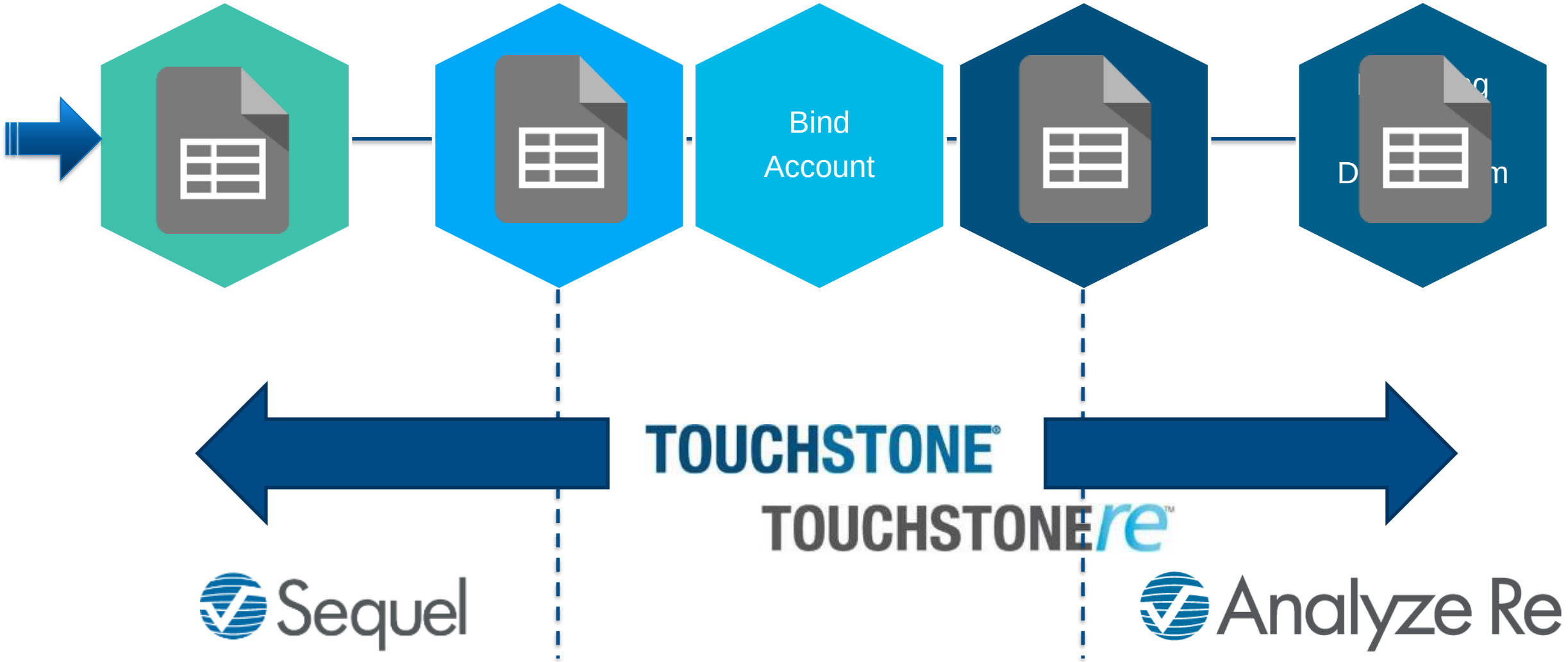

Terrorism and
Political Risk


Life and Health


Casualty and
Cyber


Climate Change

Delivering Analytics Throughout the (Re)Insurer Value Chain

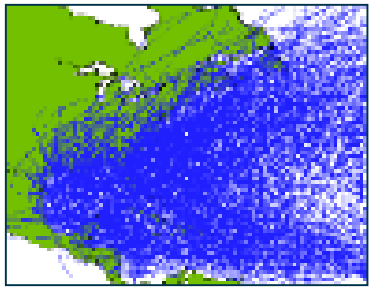


Goals for Today's Session

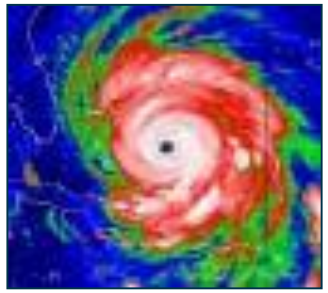
Interpreting Key Data Elements in Cat Modelling Workflow

HAZARD

EVENT GENERATION



LOCAL INTENSITY CALCULATION

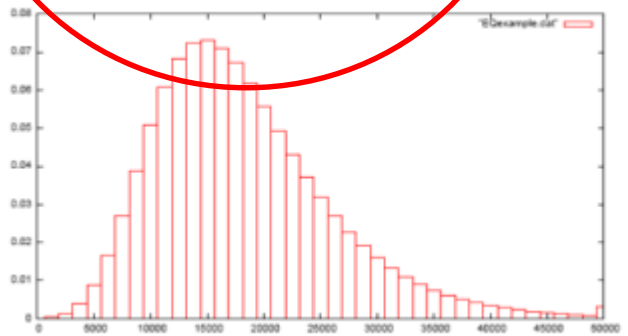


ENGINEERING

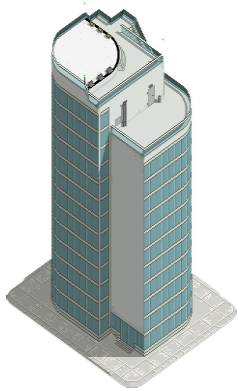
DAMAGE ESTIMATION

FINANCIAL

INSURED LOSS CALCULATION



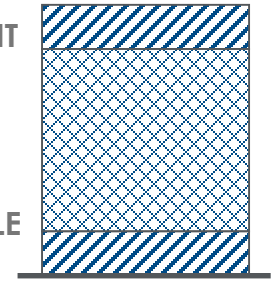
EXPOSURE DATA



POLICY CONDITIONS

LIMIT

DEDUCTIBLE



Exposure Data

Evaluating Risk During the Selection Process

- What is exposure data?
- What are some important considerations with each data element?
- How much can poor exposure data affect my loss results?
- What are some common user errors when preparing exposure data to be modeled?
- What hazard or risk information can I use to determine whether or not I should underwrite a risk?

What is Exposure Data?

Location Information

Where is the risk located?

Replacement Values

How much would it cost to replace irrespective of insurance?

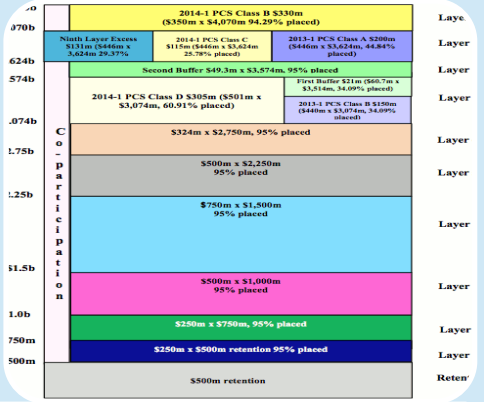
Risk Characteristics

What is the risk built from?

What is it used for?

When was it built?

How tall is it?



Policy Terms and Conditions

How do(es) the insurance and/or reinsurance contract(s) covering the risk pay out?

Let’s look at a sample D&F account…

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PROPERTY BROKERAGE CORP

POLICY No. AIR_TPX_005_1

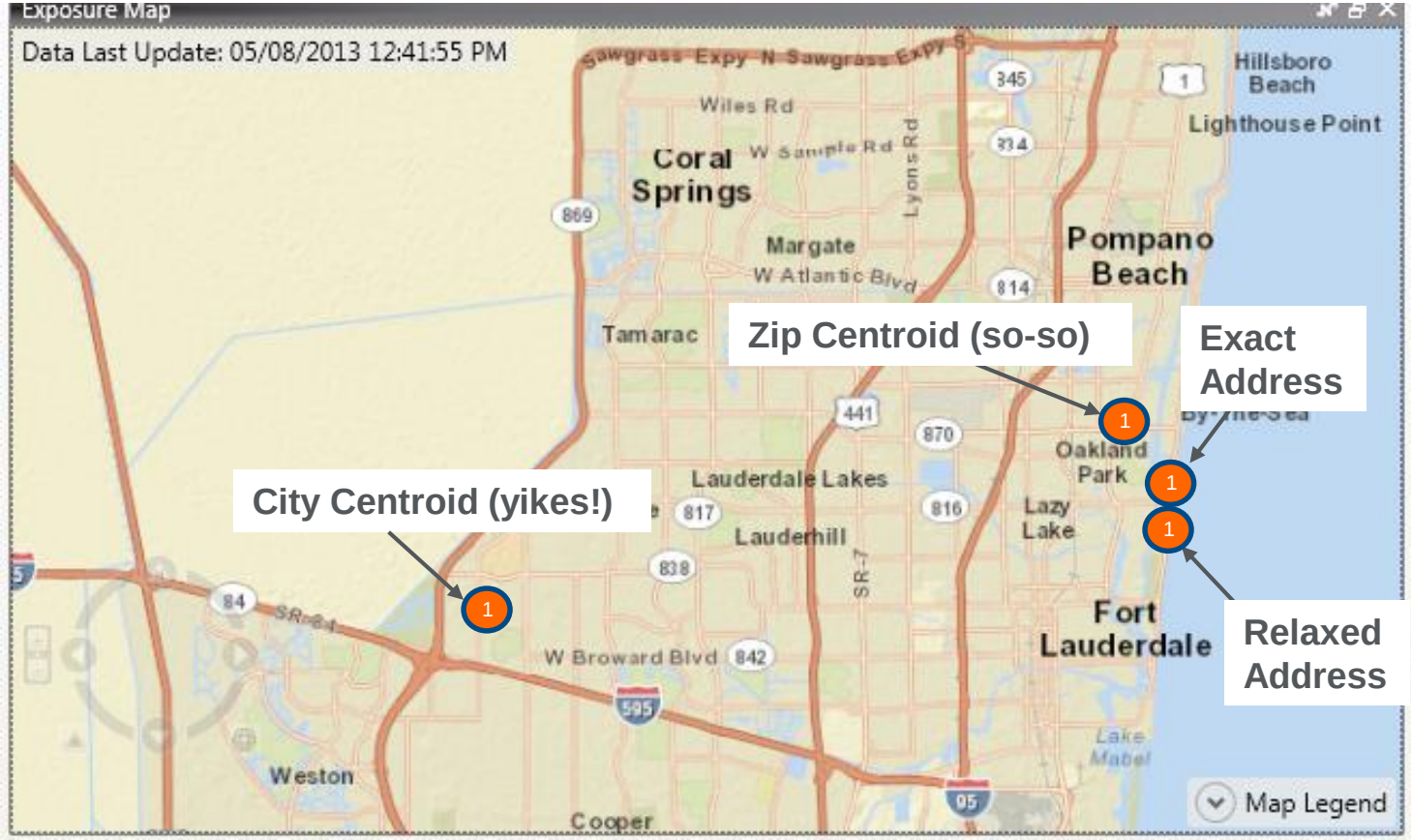
LAYER TERMS / RISK DETAILS

Type:	Package
Insured:	Lux Hotels America Incorporated, Grand Lux Hotels Group Incorporated, Lux Motels of America Incorporated
Period:	From: 1st January 2019 To: 31st December 2019
Limit/Sum	
Insured (100%):	USD 10,000,000 (100%) any one loss or series of losses arising out of any one Event Excess of USD 2,000,000
Policy Sub-Limits:	Applicable to any one loss or series of losses arising out of any one event subject further to the Sub-Limits below: USD 2,500,000 for Florida Wind Storm USD 5,000,000 for California Earthquake
Premium:	USD 1,230,000 (100%) Annual
Order Hereon:	40% of 100%
Brokerage:	12%

Schedule of Values for D&F Account

Location	Construction	Occupation	SQ Ft	ISO Protection Class	ATC Quake Zone	Buildings A$	Contents	Business Interruption	Claims Costs	Revenue/Income	Total Declared Value
High-rise hotel 4 stories 480 BOYNTON BEACH BLVD Boynton Beach FL 33436	4-story concrete	hotel, office, conference space	18000.0000	2	5	$ 4,700,000	$ 50,000	$ 470,000		$ 2,154,000	$ 7,374,000
Lux Hotels Lakeside Resort 103 EASTPARK DR Brentwood TN 37027	low rise wood frame	hotel with 8 separate bungalows	21000.0000	2	5	$ 5,000,000	$ 50,000	$ 500,000	$ 1,455,000	$ 832,500	$ 7,837,500
5001 W 79 ST Burbank IL 60459		hotel, hotel	24000.0000	2	5	$ 6,300,000	$ 60,000	$ 630,000		$ 1,048,500	$ 8,038,500
Hillside Resort 150 ANZA BLVD Burlingame CA 94010	masonry, swimming pool	low rise hotel	19000.0000	2	5	$ 40,800,000	$ 410,000	$ 4,080,000		$ 6,793,500	$ 52,083,500
3135 S ATLANTIC AVE Daytona Beach FL 32118	concrete	hotel, conference room	20000.0000	2	5	$ 7,900,000	$ 80,000	$ 790,000		$ 1,315,500	$ 10,085,500
Houstonian Lux Flagship 302 FM 1960 RD W Houston TX 77073	reinforced concrete	high-rise hotel, 6 stories, two towers	1076740.5900	3	5	$ 1,502,241	$ 1,112,763	$ 625,000		$ 486,001	$ 3,726,005
13232 NORTHWEST FWY Houston TX 77040	masonry, indoor/outdoor pool	low rise hotel	980497.9000	2	7	$ 1,684,410	$ 1,018,342	$ 625,000		$ 499,163	$ 3,826,915

Importance of Accurate Geocode Results

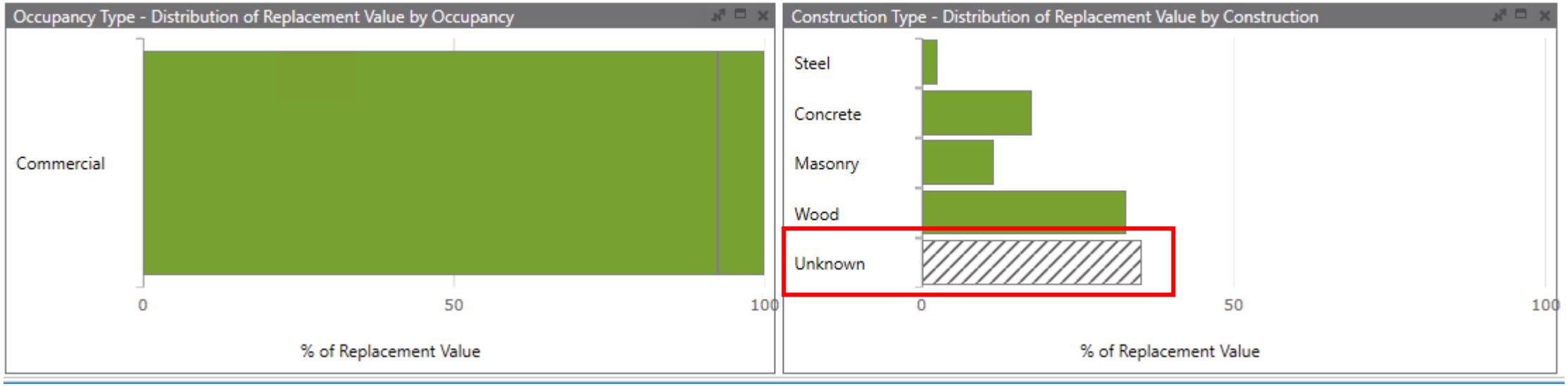


Impact of Changing Geocodes on Loss

	AAL	5.00%	2.00%	1.00%	0.40%	0.20%	0.10%
Exact	1,247,972	4,663,147	14,539,134	30,804,848	54,922,366	76,883,667	108,006,549
Relaxed	1,160,006	4,490,843	13,061,845	28,923,811	49,907,901	69,969,493	97,463,301
ZIP Centroid	996,462	3,954,456	10,642,893	23,093,934	42,298,559	66,261,219	84,785,907
City Centroid	285,327	1,192,848	3,375,207	6,250,623	11,697,261	15,539,587	24,141,491

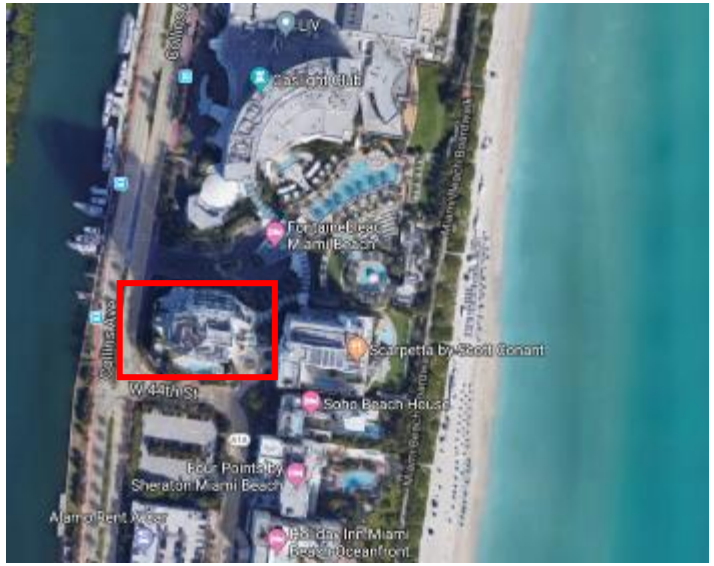
	AAL	5.00%	2.00%	1.00%	0.40%	0.20%	0.10%
Exact	-	-	-	-	-	-	-
Relaxed	-7%	-4%	-10%	-6%	-9%	-9%	-10%
ZIP Centroid	-14%	-12%	-19%	-20%	-15%	-5%	-13%
City Centroid	-71%	-70%	-68%	-73%	-72%	-77%	-72%

Reasonability of Construction/Occupancy Codes



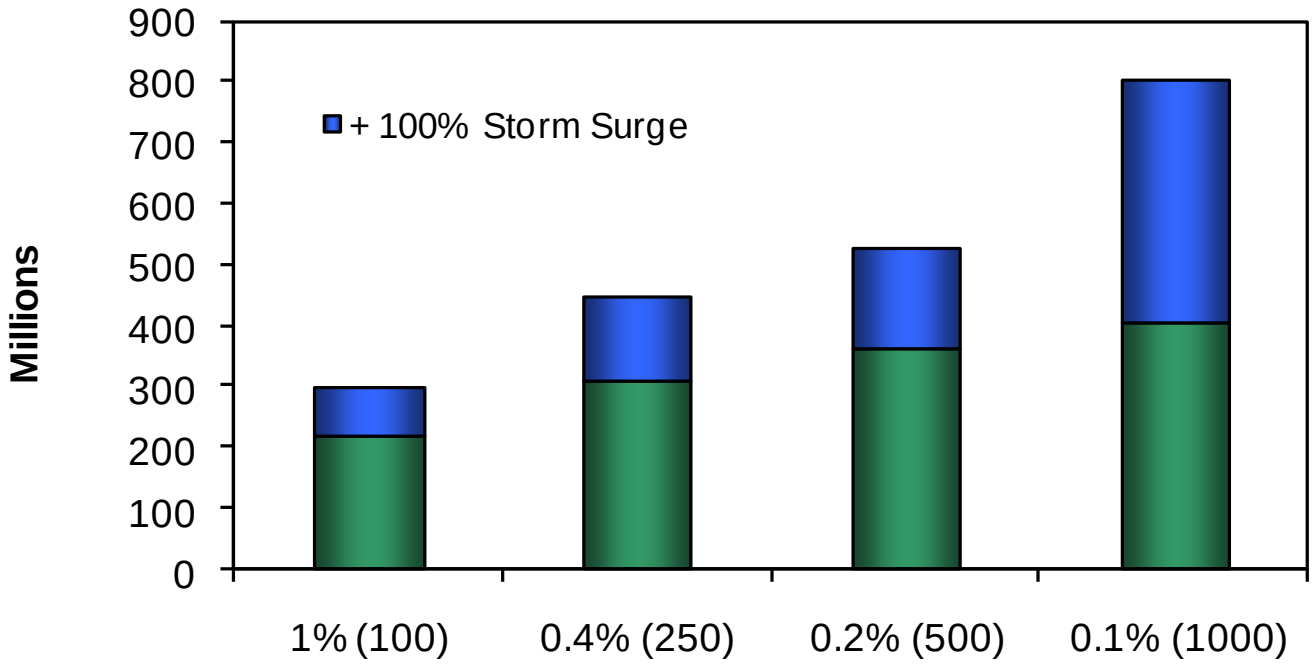
Checking Individual Locations' with Unknown Values

- Location has the following fields coded as unknown
  - Construction
  - Year Built
  - Height
- There is additional information that could help better represent the risk
  - First floor height above garage?
- What about the hazard??



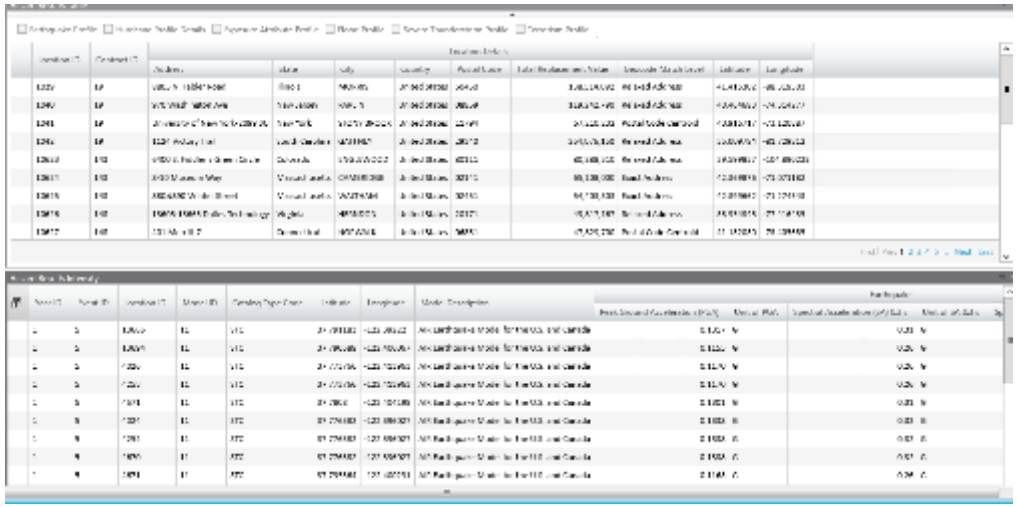
Ensure the Correct Perils Are Included in Your Analysis

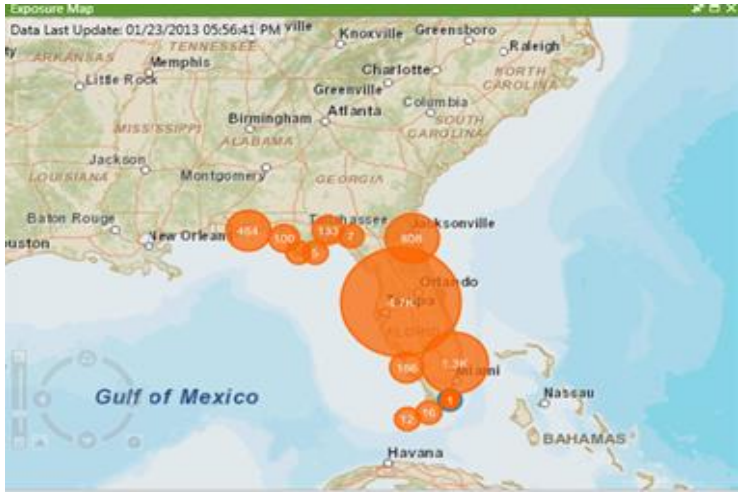
- Recall the slip indicates quake and windstorm cover
  - Does quake include all perils?
  - Does windstorm include storm surge?



Navigating Loss Data

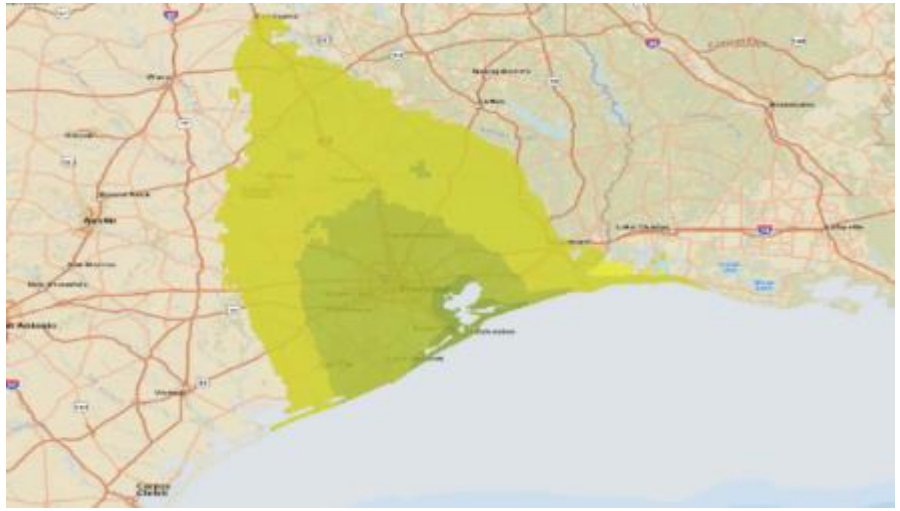
Catastrophe Models Provide a Wide Range of Outputs





Event Loss Summary Table - AIR_Institute_Eww_AS

Year	Event ID	Peril	Ground Up	Retained	Gross
			Mean	Mean	Mean
9847	1696677	ST	327,298,791	119,584,106	207,714,684
1536	13331	EQ	189,593,513	0	189,593,513
4390	37400	EQ	175,905,551	0	175,905,551
720	19227	TC	591,894,763	441,225,189	150,669,573
3995	107597	TC	630,968,446	480,954,249	150,014,196
5964	161180	TC	643,179,222	495,180,625	147,998,597
8470	228600	TC	580,641,838	432,966,874	147,674,964
106	2754	TC	317,250,176	170,920,233	146,329,942
9725	262342	TC	499,306,546	354,242,290	145,064,256



Average Annual Loss (Expected Value)

- We can combine the mean annual losses to arrive at the Expected Value (EV) for the portfolio by summing them and dividing by the number of event years in the catalogue:

Summary EP Table

Agg/Occ	Perspective	AAL(EV)	SD	20	50	100	250	500	1,000
AGG	Ground Up	6,630,536	24,753,884	30,886,184	65,842,762	95,130,374	167,601,978	225,760,876	371,719,930
	Retained	4,694,386	17,067,704	22,626,276	41,566,458	66,643,214	104,231,455	161,829,671	244,552,125
	Gross	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
	Net of Pre-Cat	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
OCC	Ground Up	6,015,196	23,605,984	27,770,160	60,079,085	89,660,760	162,588,072	217,879,127	344,790,310
OCC	Retained	4,229,041	16,363,640	19,909,887	37,191,259	59,281,633	99,172,459	156,816,491	244,536,739
	Gross	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555
	Net of Pre-Cat	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555

- The EV is often also referred to as the Average Annual Loss (or AAL) and can be expressed on an **occurrence** or **aggregate** basis

Calculating Average Annual Loss

- Event losses from all simulated years are summed and divided by the number of years in the catalogue

$$\frac{\$10{,}000}{10\ years} = \$1{,}000\ AAL$$

Year	Loss ($)
1	0
2	0
3	2,500
4	0
5	1,250
5	1,250
6	0
7	0
8	5,000
9	0
10	0
Total Losses	**10,000**

How Should We Interpret the Average Annual Loss?

- The expected value (EV) is the mean of the distribution of annual losses

Summary EP Table

Agg/Occ	Perspective	AAL(EV)	SD	20	50	100	250	500	1,000
AGG	Ground Up	6,630,536	24,753,884	30,886,184	65,842,762	95,130,374	167,601,978	225,760,876	371,719,930
	Retained	4,694,386	17,067,704	22,626,276	41,566,458	66,643,214	104,231,455	161,829,671	244,552,125
	Gross	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
	Net of Pre-Cat	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
OCC	Ground Up	6,015,196	23,605,984	27,770,160	60,079,085	89,660,760	162,588,072	217,879,127	344,790,310
OCC	Retained	4,229,041	16,363,640	19,909,887	37,191,259	59,281,633	99,172,459	156,816,491	244,536,739
	Gross	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555
	Net of Pre-Cat	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555

- Actual losses in any given year can be significantly higher or lower than the mean
  - The AAL should not be used on its own for pricing or ratemaking, since it is not a reliable measure of the likely loss from one year to the next
  - The AAL represents the **long-term** average loss

How Might We Use the Standard Deviation?

- The Standard Deviation (SD) is displayed along with the AAL in the user interface of the software:

Summary EP Table

Agg/Occ	Perspective	AAL(EV)	SD	20	50	100	250	500	1,000
AGG	Ground Up	6,630,536	24,753,884	30,886,184	65,842,762	95,130,374	167,601,978	225,760,876	371,719,930
	Retained	4,694,386	17,067,704	22,626,276	41,566,458	66,643,214	104,231,455	161,829,671	244,552,125
	Gross	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
	Net of Pre-Cat	1,936,150	9,400,331	7,081,307	22,815,924	40,152,431	68,563,509	116,955,551	143,440,838
OCC	Ground Up	6,015,196	23,605,984	27,770,160	60,079,085	89,660,760	162,588,072	217,879,127	344,790,310
OCC	Retained	4,229,041	16,363,640	19,909,887	37,191,259	59,281,633	99,172,459	156,816,491	244,536,739
	Gross	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555
	Net of Pre-Cat	1,824,107	8,987,294	6,675,370	22,202,705	39,498,091	68,519,883	111,110,691	140,808,555

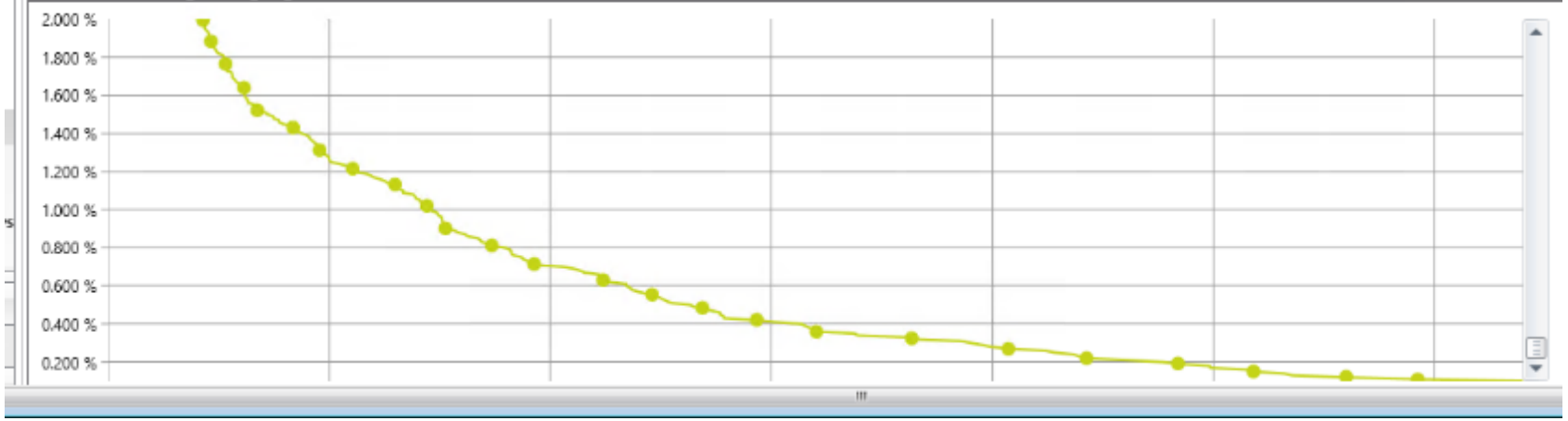
- SD can be useful in ratemaking in conjunction with the AAL
  - Actuaries might use “mean plus K standard deviations” as a proxy for loss costs including a cat risk load when allocating revenue need to territory (e.g. county)
  - AAL plus (e.g.) 20% of standard deviation once common in reinsurance pricing

Loss Exceedance Probability Curves

Summary EP Table

Agg/Occ	Perspective	By Peril	AAL(EV)	SD	20	50	100	250	500
AGG	Ground Up	**All Perils**	**11,472,138**	**31,969,829**	**53,024,704**	**96,273,634**	**147,605,450**	**241,019,781**	**318,055,335**
		EQ	3,387,900	16,719,644	14,670,491	47,054,249	78,020,654	141,333,625	175,905,551
		ST	1,038,870	5,147,669	2,464,119	4,347,851	6,972,570	19,032,139	38,536,994
		TC	7,045,367	26,938,340	31,740,093	68,210,736	104,576,802	192,471,368	289,681,838
	Retained	**All Perils**	**8,069,376**	**23,547,762**	**34,614,990**	**66,770,096**	**103,676,234**	**185,188,505**	**256,923,481**
		EQ	2,374,253	12,737,954	9,613,177	31,864,160	56,765,421	97,065,148	128,502,335
		ST	649,074	3,210,067	1,465,612	2,415,372	3,213,056	6,565,721	24,457,731
		TC	5,046,049	19,623,530	22,917,257	42,714,953	70,126,672	131,047,972	209,793,032
AGG	**Gross**	**All Perils**	**3,402,762**	**11,423,819**	**16,112,994**	**36,947,944**	**54,975,158**	**81,245,584**	**122,208,658**
		EQ	1,013,647	5,828,679	3,891,654	13,812,747	27,081,001	47,186,048	57,977,469
		ST	389,796	2,879,147	1,050,042	2,554,084	4,089,167	8,740,548	18,201,981

Annual EP Chart - AIR_Institute_Evw_AS



Loss Exceedance Probability Curves

- Exceedance probability curves are calculated on an annual **occurrence** or annual **aggregate** basis.

- Start with event losses by simulation year and prepare the data in one of two ways:
  - **Occurrence** basis: Obtain the *largest* loss within each simulated year
  - **Aggregate** basis: Obtain the *total* of all losses within each simulated year

- The aggregate EP curve is generally preferred as it gives a more complete picture of the potential loss

Return Periods are Frequently Misinterpreted

~~"Katrina was a 1 in 20 year hurricane loss for the U.S."~~

2005 2025

"There is about a 5% annual probability that a Katrina-sized hurricane loss could occur in the U.S."

2018
~5% Probability

2019
~5% Probability

. . .

Long Return Periods May Be Dismissed As “Not In My Lifetime”

- Return periods are associated with imprecise “PML”
  - PML stands for “Probable Maximum Loss”
  - Holdover from pre-modeling days

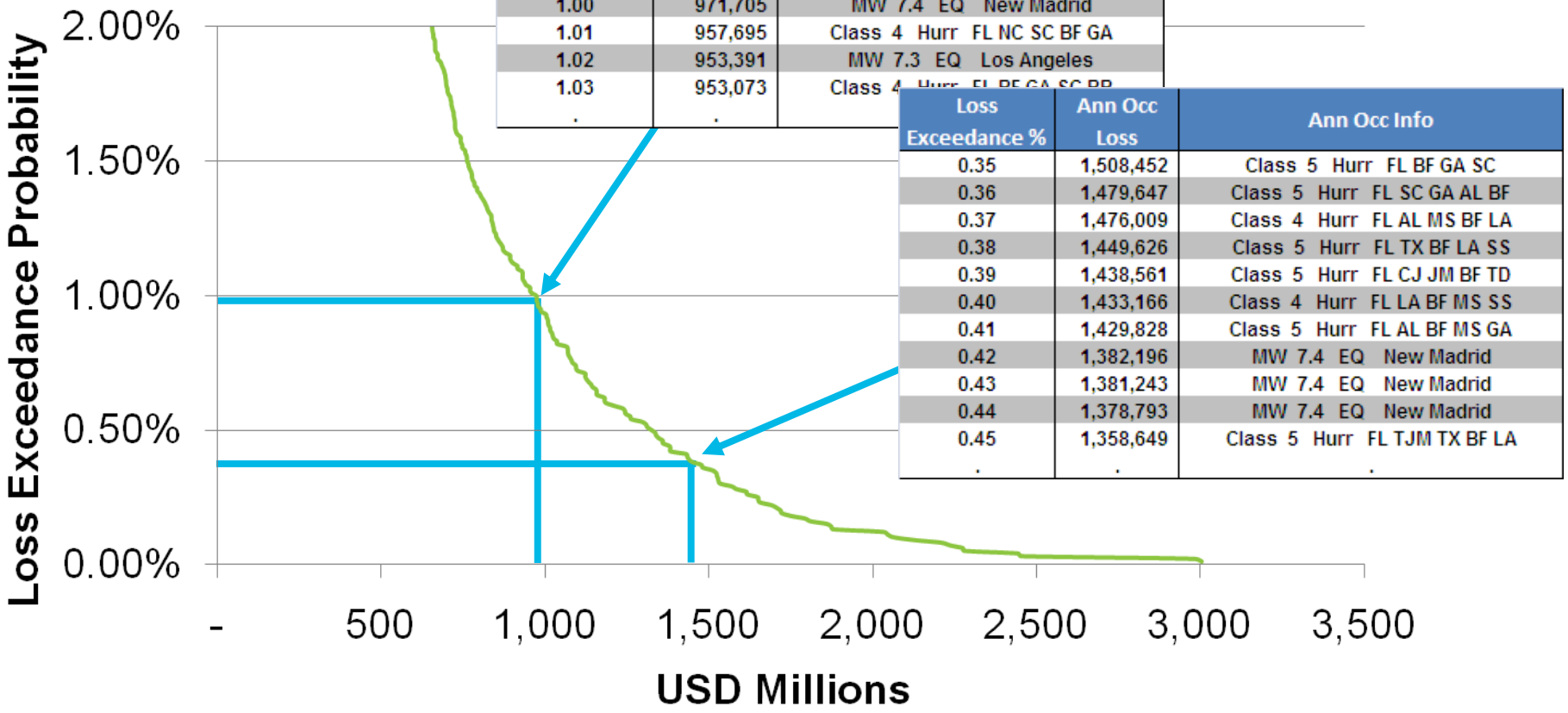
- PML means different things to different people
  - “It’s the worst case scenario”
  - “Something that will never happen”
  - “The one in one hundred event”
  - “Whatever A.M. Best asks us for”

- Today’s models provide a full probability distribution of potential losses
  - Communicate in terms of probabilities (“1% probability”)
  - Avoid other interpretations

Models Provide Probabilities of Loss, Not Probabilities of Events

Loss Exceedance %	Ann Occ Loss	Ann Occ Info
0.97	977,066	Class 5 Hurr FL TX LA PQ BF
0.98	974,039	Class 4 Hurr SC NC FL CJ GA
0.99	973,674	Class 5 Hurr FL JM BF CJ
1.00	971,705	MW 7.4 EQ New Madrid
1.01	957,695	Class 4 Hurr FL NC SC BF GA
1.02	953,391	MW 7.3 EQ Los Angeles
1.03	953,073	Class 4 Hurr FL BF GA SC PR
.	.	

Loss Exceedance %	Ann Occ Loss	Ann Occ Info
0.35	1,508,452	Class 5 Hurr FL BF GA SC
0.36	1,479,647	Class 5 Hurr FL SC GA AL BF
0.37	1,476,009	Class 4 Hurr FL AL MS BF LA
0.38	1,449,626	Class 5 Hurr FL TX BF LA SS
0.39	1,438,561	Class 5 Hurr FL CJ JM BF TD
0.40	1,433,166	Class 4 Hurr FL LA BF MS SS
0.41	1,429,828	Class 5 Hurr FL AL BF MS GA
0.42	1,382,196	MW 7.4 EQ New Madrid
0.43	1,381,243	MW 7.4 EQ New Madrid
0.44	1,378,793	MW 7.4 EQ New Madrid
0.45	1,358,649	Class 5 Hurr FL TJM TX BF LA
.	.	.

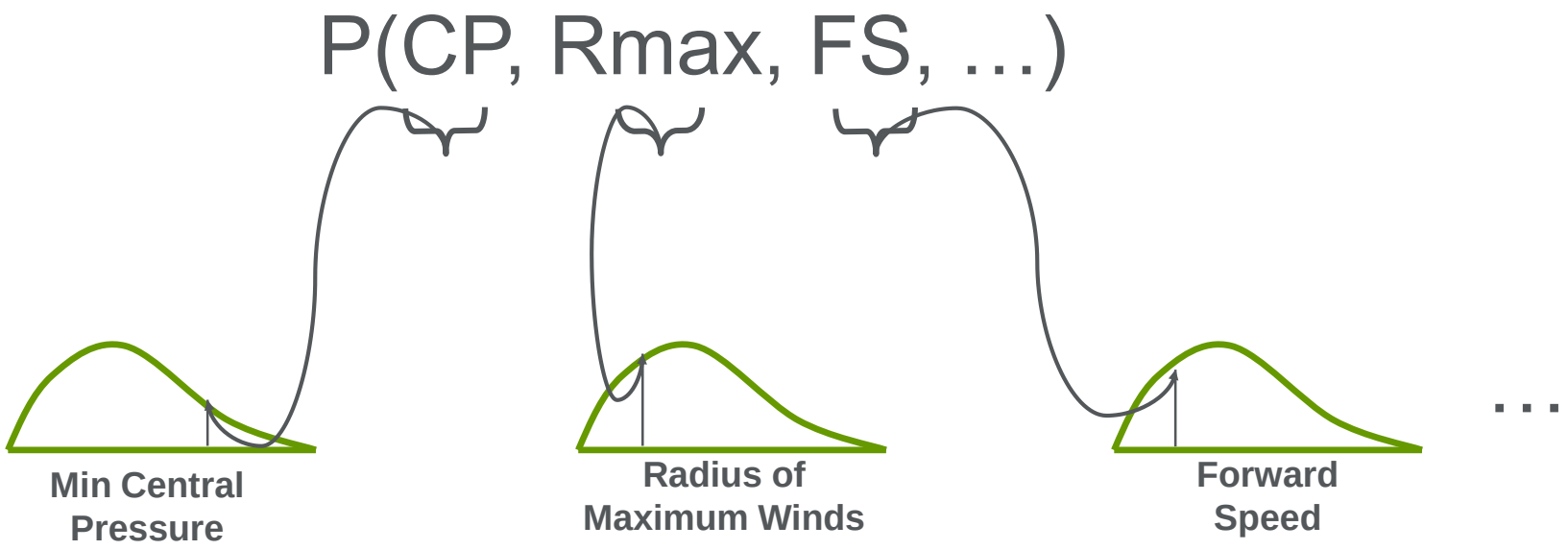


Stochastic Hurricane Catalogue Includes Many Parameters

Year	Event ID	Day	LF Num	SS	LF Seg	CP	Max Wind Speed	Landfall Lat	Landfall Long	Radius Max Wind	Forward Speed	Landfall Angle
1	1	280	1	1	7	984	80	28.291	-96.492	12	15	20
3	2	231	1	3	22	963	113	29.472	-83.236	11	14	23
4	3	269	1	2	43	979	96	34.891	-76.42	13	23	32
4	4	230	1	2	5	969	102	27.048	-97.297	12	19	45
5	5	285	1	2	4	975	97	26.002	-97.16	14	18	34
8	6	289	1	4	10	944	132	29.689	-93.713	9	20	18
8	7	204	1	1	39	987	76	32.937	-79.563	16	18	19
9	8	245	1	3	30	957	114	25.952	-80.131	12	16	23
11	9	290	1	2	43	979	98	34.93	-76.33	18	16	20
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.

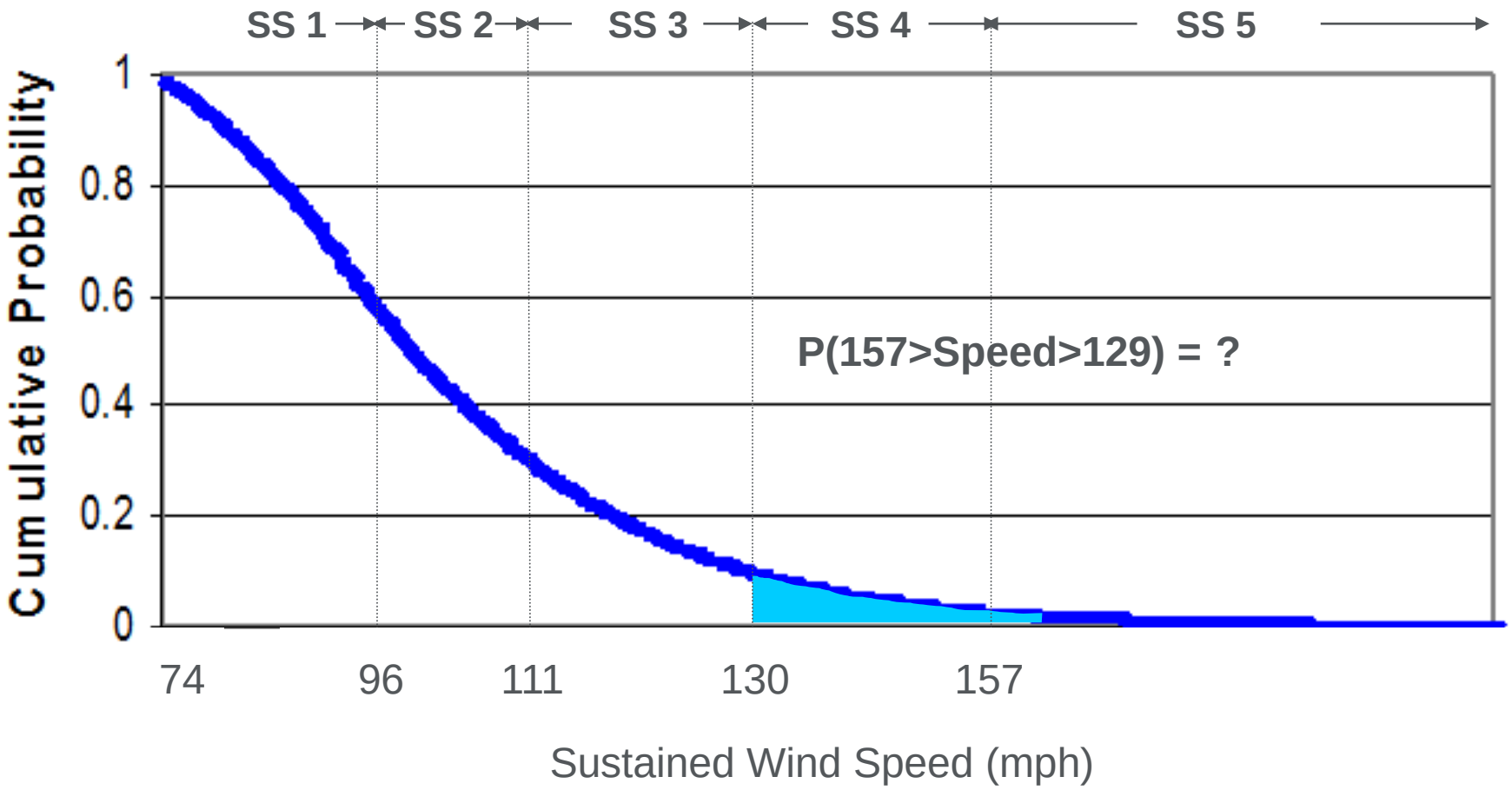
- In nature, there are an infinite number of combinations of storm parameters
- When we create stochastic events for the catalogue, we have to use continuous probability distributions for each parameter in order to reflect reality

What is the Probability of a Specific Event?



P(Single Event) = **1 / ∞ = 0**

What is the Probability of a Category 4 Hurricane?



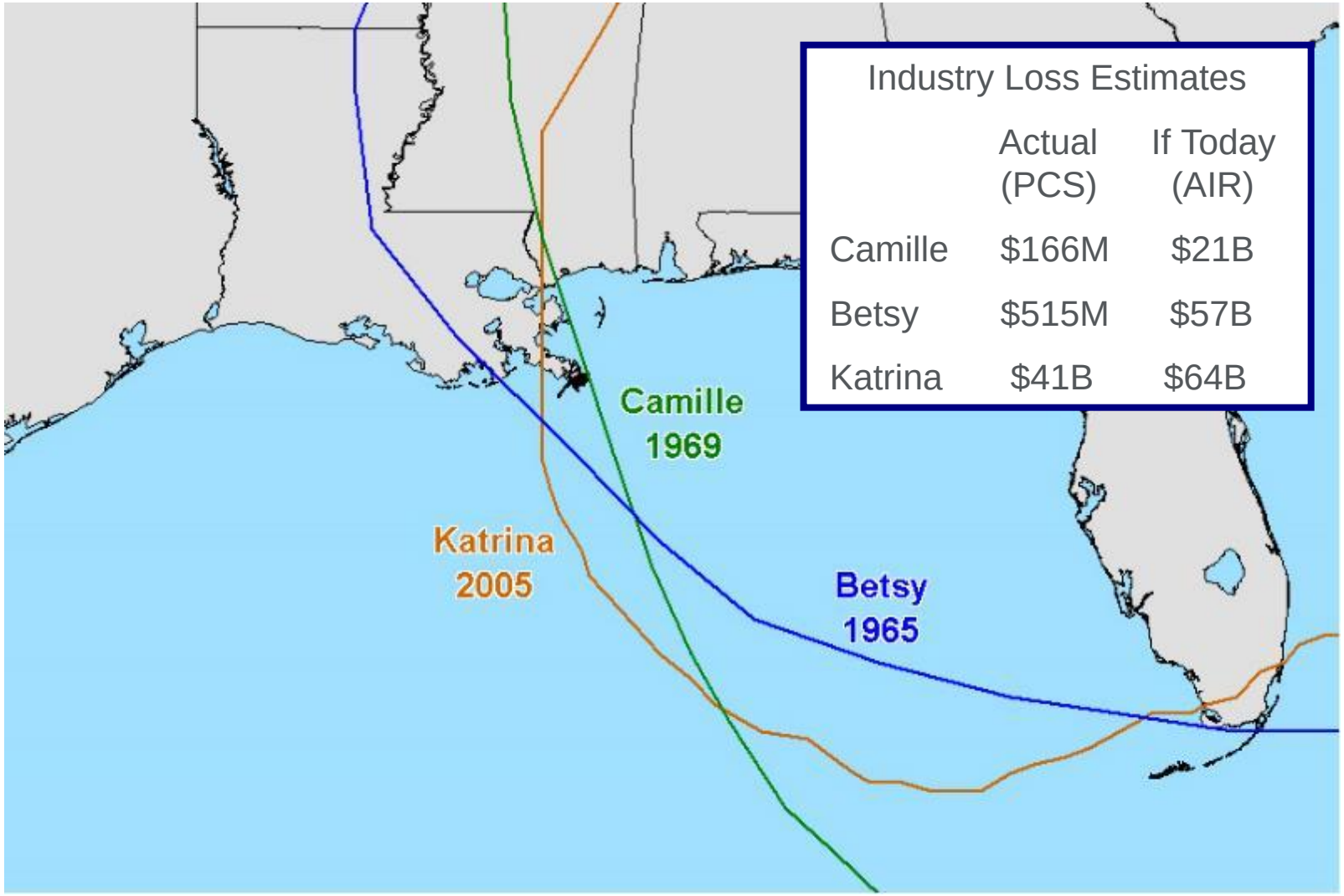
Models Provide Probability of Different Types of Events...

Event ID	Year	State	County	SS Scale	Longitude	Latitude	Central Pressure	Max Windspeed	Industry Loss
270012931	3888	LA	Plaquemines	3	-89.17	29.37	962.8	109.1	2,379,385,213
270002073	638	TX	Galveston	4	-94.39	29.49	943.8	126.4	1,169,523,187
270004331	1304	MS	Jackson	3	-88.42	30.27	958.7	116.2	2,425,661,519
270000660	200	LA	Iberia	3	-91.68	29.49	957.7	114.7	1,467,115,619
270012025	3617	LA	Lafourche	5	-90.5	29.16	897.7	165.8	32,179,256,355
270000349	103	LA	Iberia	4	-92.07	29.58	934	133.7	4,550,417,528
270023237	7015	TX	Brazoria	3	-95.18	29.05	951.2	121.7	6,552,011,909
270011455	3438	MS	Jackson	3	-88.52	30.22	956	113.6	4,130,229,662
270014646	4414	LA	Plaquemines	4	-89.07	29.87	931.3	135.3	27,758,529,327
270000935	277	TX	Brazoria	4	-95.61	28.78	942.8	126.3	6,029,080,432
270029991	9057	AL	Baldwin	3	-87.59	30.34	955.6	115.8	1,580,530,915
270020334	6128	AL	Baldwin	4	-87.74	30.34	930.9	140.9	4,993,300,124
270012769	3842	MS	Jackson	5	-88.5	30.23	911.3	158.7	16,793,312,346
270018283	5529	MS	Jackson	5	-88.42	30.27	897.4	164.5	56,942,806,766
270019373	5853	AL	Baldwin	3	-87.74	30.34	962.4	107.3	1,004,149,493
270000363	108	LA	Plaquemines	5	-89.07	29.85	915.7	150.9	11,024,114,242
•	•	•						•	•
•	•	•						•	•
•	•	•						•	•

Gulf Hurricane

P (Cat 3) =	2,355/10,000	23.6%
P (Cat 4) =	956/10,000	9.6%
P (Cat 5) =	132/10,000	1.3%

Don’t Focus Too Much on Specific Scenarios



Industry Loss Estimates

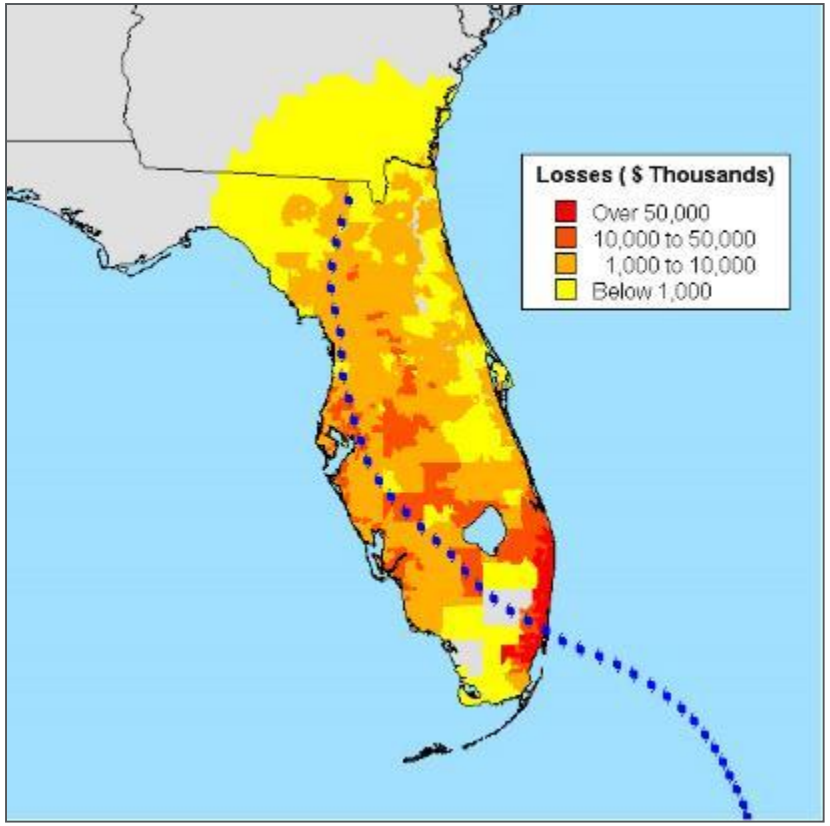
	Actual (PCS)	If Today (AIR)
Camille	$166M	$21B
Betsy	$515M	$57B
Katrina	$41B	$64B

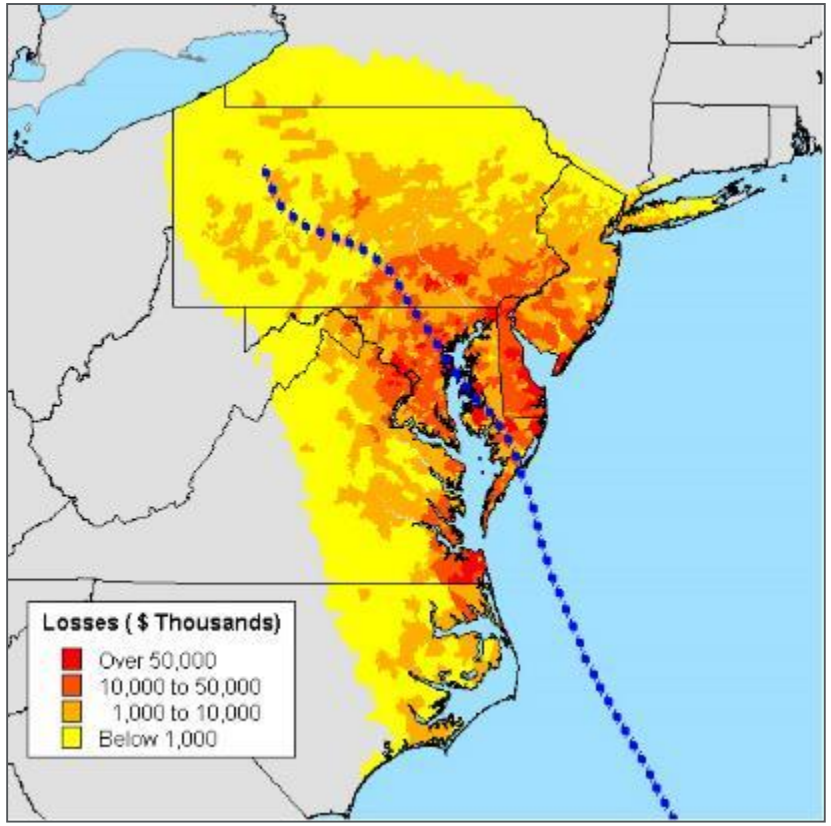
Models Provide the Probability of a Specified Loss or Greater

Loss Exceedance(%)	Ann Agg Loss	Agg Year	Ann Occ Info
0.62	67,204,216,241	1914	Class 3 Hurr TX GOM OK LA MX
0.63	66,024,139,935	6582	Class 4 Hurr TX LA GOM MS AL
0.64	65,589,072,155	8340	Class 4 Hurr TX GOM LA MS AR
0.65	64,800,596,415	3880	Class 4 Hurr TX CU GOM PR LA
0.66	64,022,035,892	2429	Class 1 Hurr TX GOM LA MX CU
0.67	63,781,817,238	3307	Class 1 Hurr TX MX JM GOM LC
0.68	63,429,969,268	4852	Class 4 Hurr TX GOM LA MS AL
0.69	63,229,794,260	4459	Class 2 Hurr TX GOM LA BZ HN
0.7	61,442,909,554	3240	Class 1 Hurr TX GOM LA MQ CU
0.71	61,393,795,101	3260	Class 5 Hurr TX MX GOM JM LA
0.72	60,841,428,341	2038	Class 3 Hurr TX GOM OK MX LA
0.73	60,600,487,625	1242	Class 4 Hurr LA GOM MS CU DO
0.74	60,319,337,308	4697	Class 5 Hurr TX FL MX GOM CU
0.75	60,247,180,280	6009	Class 4 Hurr TX GOM LA AR TN
0.76	59,469,360,107	8076	Class 2 Hurr LA GOM MS MX AL
0.77	59,077,328,988	4655	Class 3 Hurr LA GOM MS JM CU
0.78	58,688,708,424	7761	Class 2 Hurr MS FL LA GOM AL
0.79	58.443.864.905	1289	Class 3 Hurr TX GOM GP LA DO

	Gulf Hurricane
$P_{Loss} > \$64B$	.67%

Loss Probabilities Depend on Regions Considered





	Gulf Hurricane	U.S. Hurricane
$P_{Loss} > \$64B$	0.67%	5.3%

Group Exercise: Asking Questions to Evaluate Risk

Verisk

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Questions to Address

- Two similar D&F accounts with the same premium, signed line.
- Is the exposure coded properly based on the information in the slip?
- What exposure elements are strong in each of the accounts? Where are there some deficiencies in the exposure elements?
- What are the perils driving the losses for each account? How do you think the available exposure information is impacting loss? Is there a significant amount of coastal exposure?
- What resources would you use to make changes to the data to retrieve the best modelling results?
- Assuming you can make no changes to the data, do you think one of these accounts less risky than the other?