The Florida Public Hurricane Loss Model Selected Results

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- One of the lessons of hurricane Andrew was that the insurance industry needed catastrophe models to estimate hurricane losses
- Traditional actuarial models and practices were inherently ineffective in dealing with low frequency, high severity catastrophic losses. Losses were predicted using recent past experience.
- Lead to volatile premiums, and sharp periodic jumps in premiums. Bad for homeowners and the insurance and reinsurance firms
- Since Florida had not experienced major hurricane for several decades before Andrew the homeowner insurance premiums in 1992 were inadequate
- They have since increased dramatically, and the debate continues whether they are excessive or inadequate

- CAT models have a long term horizon, use more realistic models to estimates losses, better deal with low frequency events, and can potentially result in relatively stable premiums.
- Since hurricane Andrew it has increasingly become the practice to estimated hurricane losses using complex catastrophe models
- The state of Florida has about $1.83 trillion in insured *personal residential properties* and 182 billion in insured *commercial residential properties* exposed to hurricane risk. We developed a cat model to assess hurricane risk and predict insured losses for these properties.
- The Florida Office of Insurance Regulation funded Florida International University to develop a public hurricane loss model for residential properties.
- The first completed version of the personal residential model was activated in March 2006. Recently we also developed and activated a model for commercial residential properties.

- Model went through an extremely rigorous review process and is certified by the Florida Commission on Hurricane Loss Projection Methodology----the gold standard for such models.
- Model has been used by FL-OIR over 430 times: we processed data and produced results for about 430 company portfolios of policies.
- It has been used recently by insurance companies about 70 times.
- The Florida Cat Fund and the Citizens Group are users of the model.

Participating Institutions

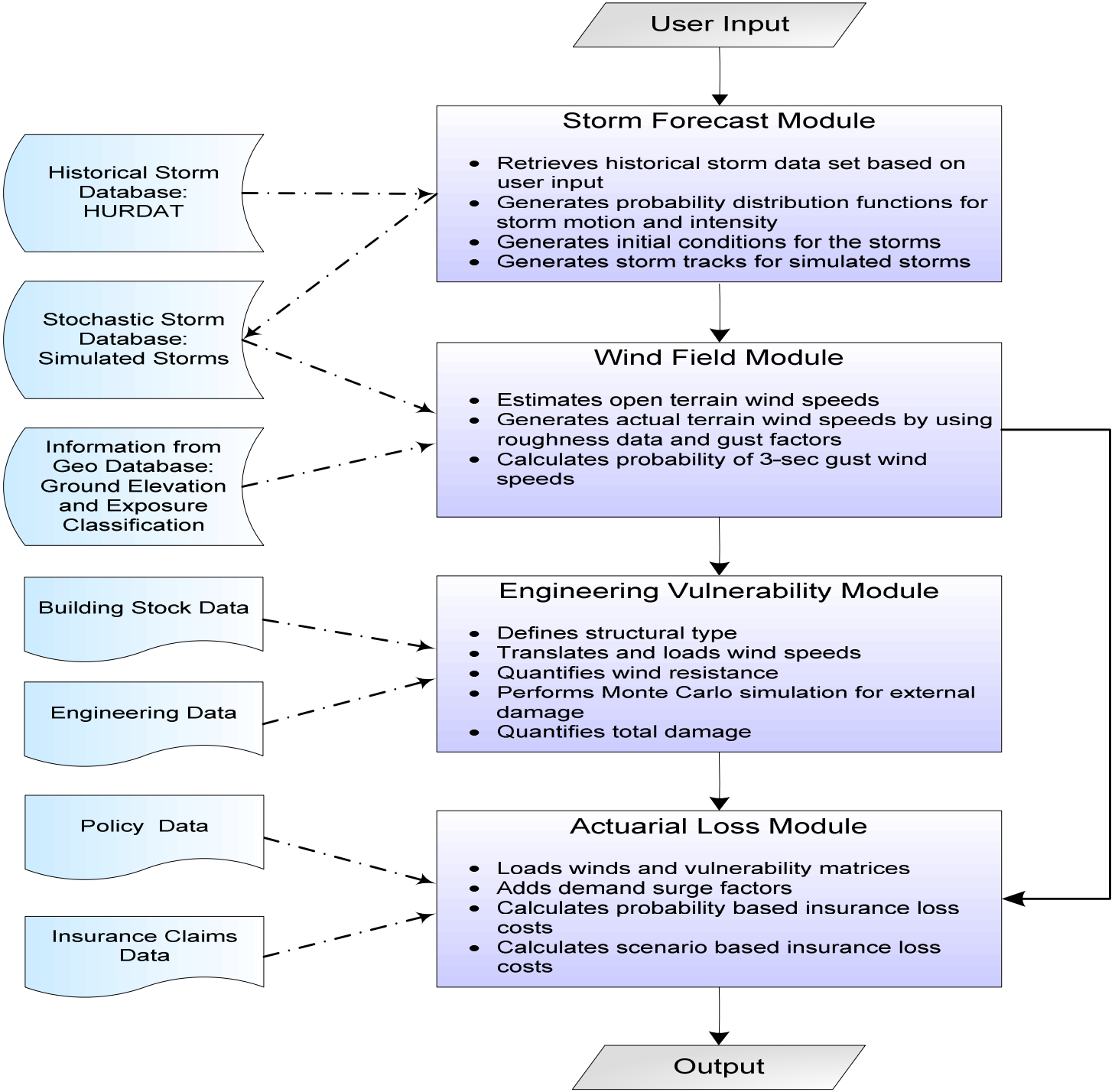
- Florida International University/ IHRC (lead institution)
- Florida State University
- Florida Institute of Technology
- Hurricane Research Division, NOAA
- University of Florida
- University of Miami
- About 2 dozen professors and experts and about 2 dozen graduate students were involved in the development and operation of the model.
- Team includes some of the leading meteorologists, engineers, and computer scientists.

What is the model?

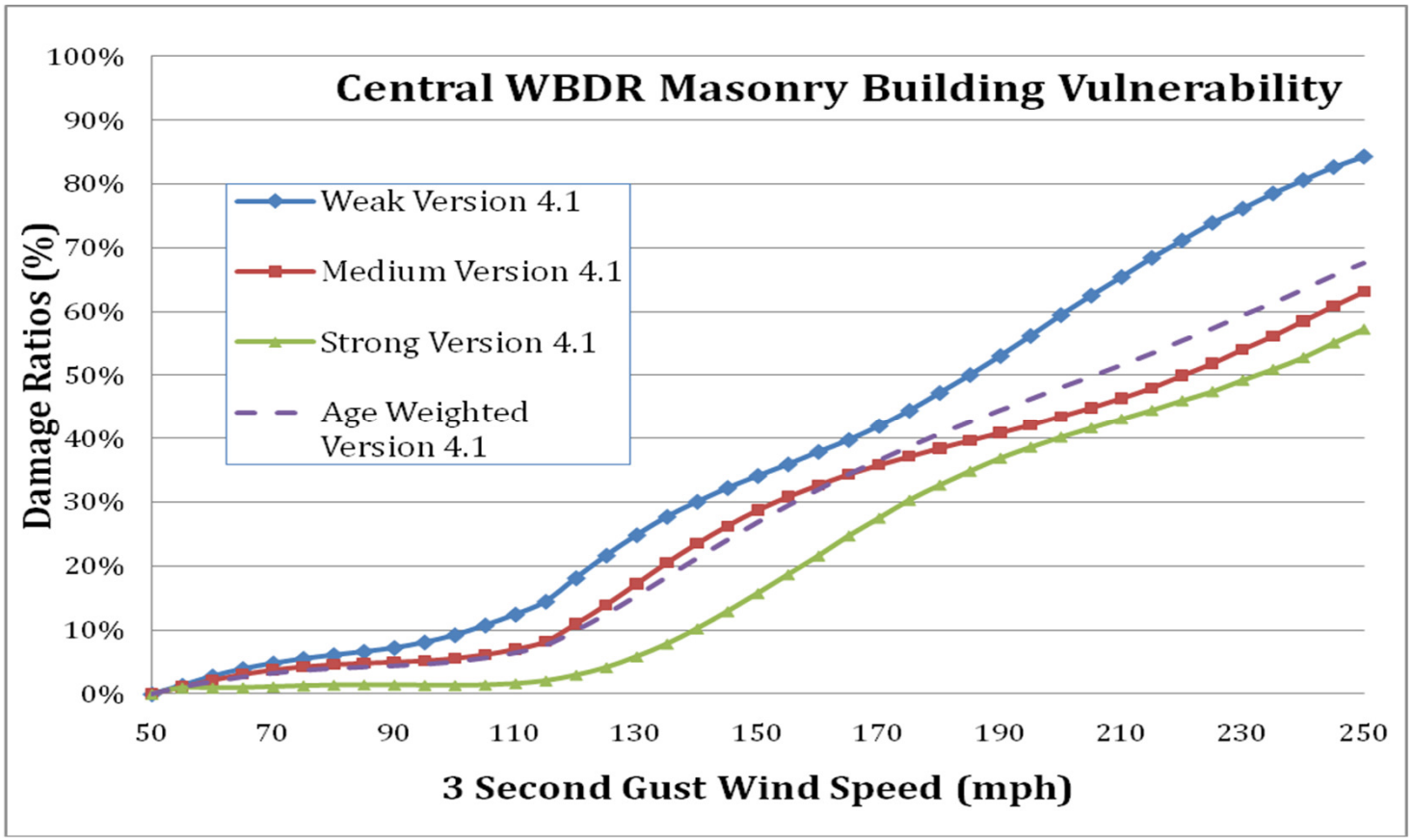
- The model is a very complex, state of the art, set of computer programs.
- The programs simulate and predict how, where and when hurricanes form, their wind speed and intensity and size etc, their track, how they are affected by the terrain along the track after landfall, how the winds interact with different types of structures, how much they can damage house roofs, windows, doors, interior, contents etc, how much it will cost to rebuild the damaged parts, and how much of the loss will be paid by insurers
- Its development required experts in meteorology, wind and structural engineering, statistics, actuarial sciences, finance, GIS, and computer science.

What can the model do?

- The model can generate for a given policy or portfolio of residential policies, the annual average losses and the probable maximum losses. Such loss estimates are typically used by insurance companies as input in the rate making process and are used by state regulators to help evaluate rate filings
- We can do scenario analysis. Once we have ascertained a land falling hurricane's, track, size and wind speed, we can predict the losses they are likely to inflict down to the street level.
- The model has capability to estimate the loss reduction from certain mitigation efforts.

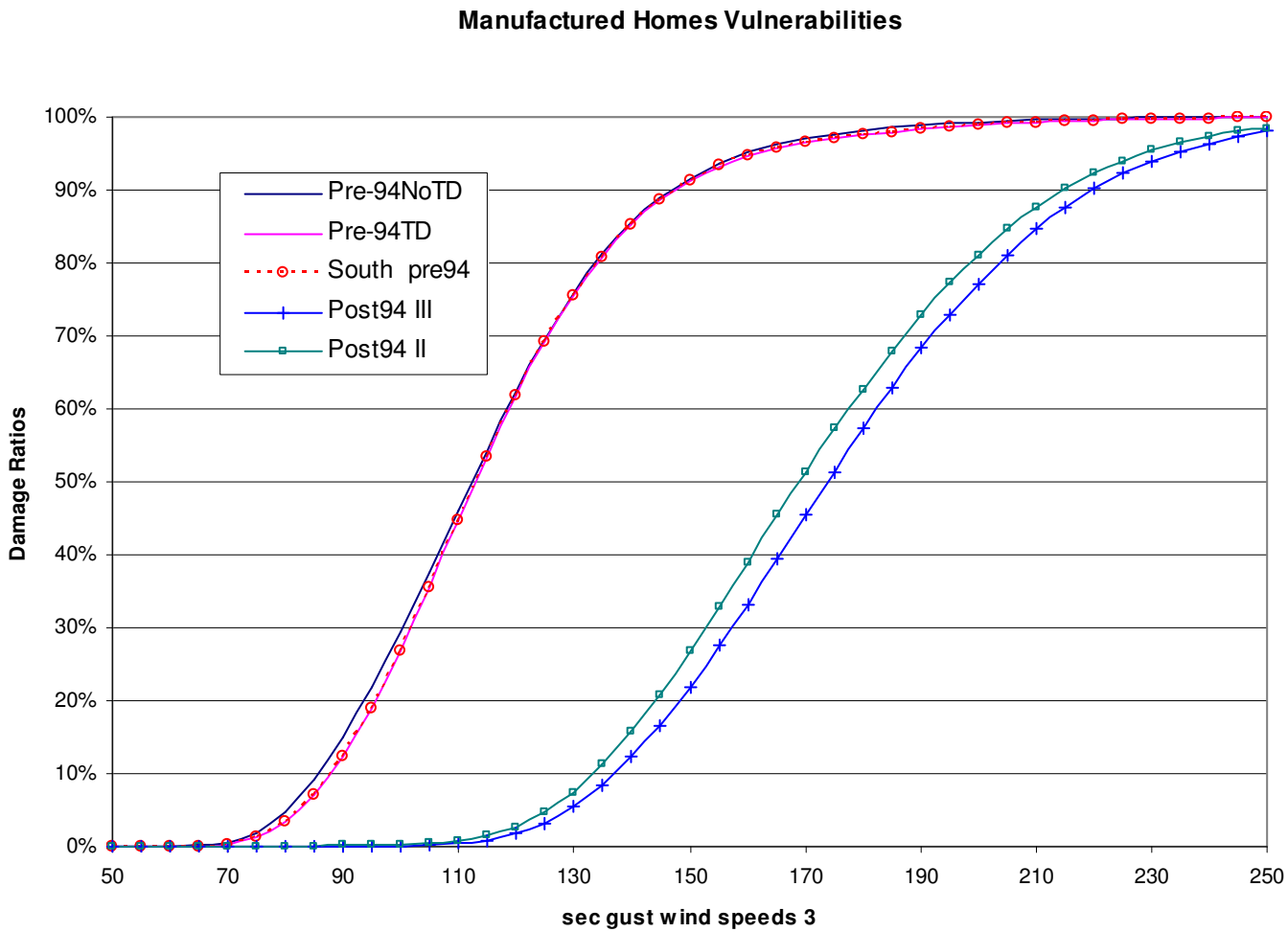

User Input
Storm Forecast Module
Retrieves historical storm data set based on user input
Generates probability distribution functions for storm motion and intensity
Generates initial conditions for the storms
Generates storm tracks for simulated storms
Historical Storm Database: HURDAT
Stochastic Storm Database: Simulated Storms
Wind Field Module
Estimates open terrain wind speeds
Generates actual terrain wind speeds by using roughness data and gust factors
Calculates probability of 3-sec gust wind speeds
Information from Geo Database: Ground Elevation and Exposure Classification
Engineering Vulnerability Module
Defines structural type
Translates and loads wind speeds
Quantifies wind resistance
Performs Monte Carlo simulation for external damage
Quantifies total damage
Building Stock Data
Engineering Data
Actuarial Loss Module
Loads winds and vulnerability matrices
Adds demand surge factors
Calculates probability based insurance loss costs
Calculates scenario based insurance loss costs
Policy Data
Insurance Claims Data
Output

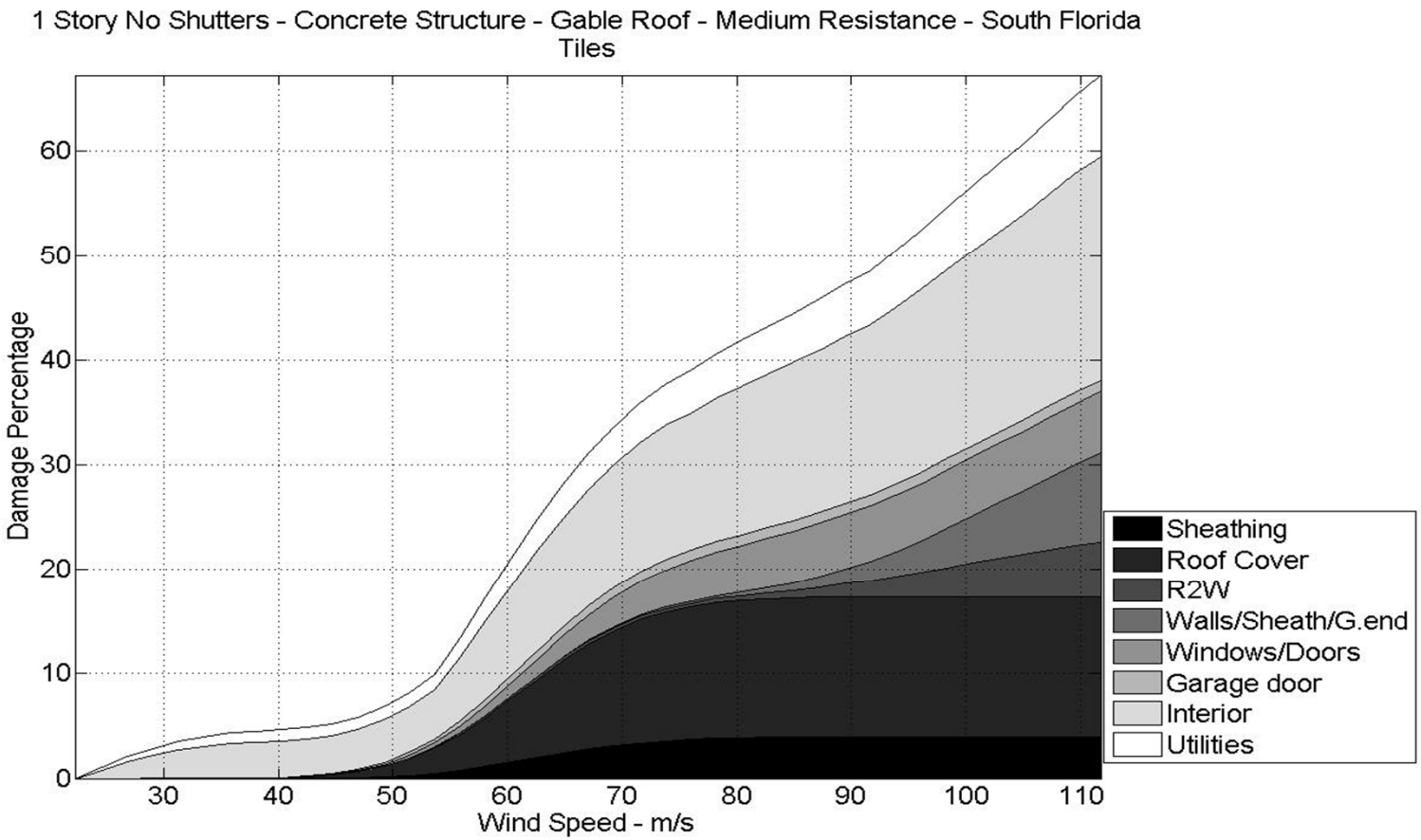
Number of land falling hurricane per year in Florida	Modeled probability	Historical probability
0	60%	58%
1	26.7%	27%
2	9.4%	12.7%
3	2.8%	2.8%
4	0.8%	0



Weighted masonry structure vulnerabilities in the Central wind-borne debris region.

Manufactured Homes Vulnerabilities




1 Story No Shutters - Concrete Structure - Gable Roof - Medium Resistance - South Florida Tiles
Damage Percentage
0
10
20
30
40
50
60
30
40
50
60
70
80
90
100
110
Wind Speed - m/s
Sheathing
Roof Cover
R2W
Walls/Sheath/G.end
Windows/Doors
Garage door
Interior
Utilities

Average Annual Loss
Based on 2007 Cat Fund exposure data

Personal Residential

- Zero deductible statewide AAL = $ 4.596 billion
- Net of deductible statewide AAL = $2.9 billion

Personal and Commercial Residential

- Zero deductible statewide AAL = $ 5.89 billion

Personal Residential PML (zero deductible)

Return Period (Years)	Estimated Loss Level (Billions)
500	$62.6
250	$55.2
100	$45.1
50	$36.8
20	$25.9
10	$17.3
5	$7.05

Personal and Commercial Residential PML

Return Period (Years)	Estimated Loss Level (Billions)
500	$92.88
250	$81.17
100	$63.79
50	$51.01
20	$33.40
10	$20.97
5	$8.12

What if scenarios

- One of the most speculated and debated issues is estimates of losses for “what if” scenarios.
- In particular, to properly understand the risks involved and to differentiate the vulnerability of different parts of the state, it is useful to estimate insured losses for hypothetical events in key locations such as Miami, Tampa, Jacksonville, etc.

Loss Estimates for Selected Hypothetical Events

- We estimated both zero deductible and net of deductible statewide losses for personal residential properties for some hypothetical events
- Events are Cat 1, 2, 3, 4, 5 hurricanes landing at 4 key locations in Florida: Jacksonville, Miami, Tampa, and Panama City
- The meteorological characteristics of a given category hurricane at landfall are held constant across all locations (same central pressure, radius of max winds, forward speed, direction at landfall)
- Hurricanes move inland at 90 degree direction to coastline until they exit the state
- Use the 2007 statewide exposure data provided by the Cat Fund (Zip code level data by coverage, construction type, and deductible group)

Expected Insured Personal Residential Wind Losses for Given Simulated Hurricane Landfalls ($billion). Based on 2007 Exposure Data

Landfall Location		Hurricane Category				
		1	**2**	**3**	**4**	**5**
Jacksonville	Zero Ded	1.8	2.2	3.2	9.1	16.2
	Net of Ded	0.4	0.6	1.5	7.1	14.0
	% Diff	-78	-73	-53	-22	-14
	Peak Winds	99	109	133	168	190
Miami	Zero Ded	6.4	8.0	11.4	19.2	31.6
	Net of Ded	2.9	4.0	6.9	14.6	26.4
	% Diff	-55	-50	-39.5	-24	-16.5
	Peak Winds	100	111	141	168	188
Tampa	Zero Ded	10.3	12.7	18.5	35.0	50.0
	Net of Ded	4.8	6.8	12.3	28.4	43.6
	% Diff	-53.4	-46.5	-33.5	-19	-12.8
	Peak Winds	94	111	146	183	196
Panama City	Zero Ded	0.2	0.28	0.67	2.0	3.4
	Net of Ded	0.07	0.12	0.44	1.75	3.0
	% Diff	-65	-57	-34.3	-12.5	-11.8
	Peak Winds	83	95	115	147	165

- As expected, Tampa and Miami produce the highest personal residential losses and are the most vulnerable areas.
- Highest net of deductible losses are $43.6 billion produced by a Cat 5 hurricane landing in Tampa and going east (goes through the highly populated suburbs of Orlando)
- In contrast a Cat 5 landing at Miami will cause $26.4 billion net of deductible loss (afterwards goes west through the unpopulated Everglades)
- Losses increase exponentially with hurricane category
- Cat 5: 70% of loss is due to structure loss

  Cat 1: 50% to 90% due to structure loss

Impact of hurricane deductibles

- Hurricane deductibles in Florida are controversial: increased from average of $250-$500 in the early 1990s to 2% to 5% of coverage now with higher property values.
- Current deductible structure reduce insured losses by 45% to 80% for the more frequent Cat 1,2 hurricane depending on location.
- Substantial reduction and major shift in burden to homeowners (likely requiring increased federal and state support)
- For Cat 5 hurricanes loss reduction range from 12% to 16%; as expected burden will largely fall on insurance and reinsurance companies or the Cat Fund
- Because of change in mix of new and old, tougher building codes, the loss estimates have declined over recent years

Maximum Damage Reduction (%) Due to Mitigation Measures V4.1

	Masonry	Frame
• **Roof strength**		
– BRACED GABLE ENDS	---	1%
– HIP ROOF	15%	16%
• **Roof Covering**		
– RATED SHINGLES (110 MPH)	1%	1%
– 8d NAILS	37%	29%
• **Wall-Floor Strength**		
– STRAPS	---	9%
• **Roof to Wall Strength**		
– CLIPS	18%	19%
– STRAPS	22%	28%

Maximum Damage Reduction (%) Due to Mitigation Measures

	Masonry	Frame
• **Wall-Foundation Strength**		
– VERTICAL REINFORCING	22%	---
• **Opening Protection**		
– PLYWOOD	6%	4%
– STEEL	9%	7%
– ENGINEERED	12%	9%
• **Window etc Strength**		
– LAMINATED GLASS	9%	7%
– IMPACT GLASS	11%	9%
• **Total Mitigated Structure**	**48%**	**43%**