Why Don't Catastrophe Models Work? Or Do They?

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CAS Spring Meeting
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Fajardo, Puerto Rico

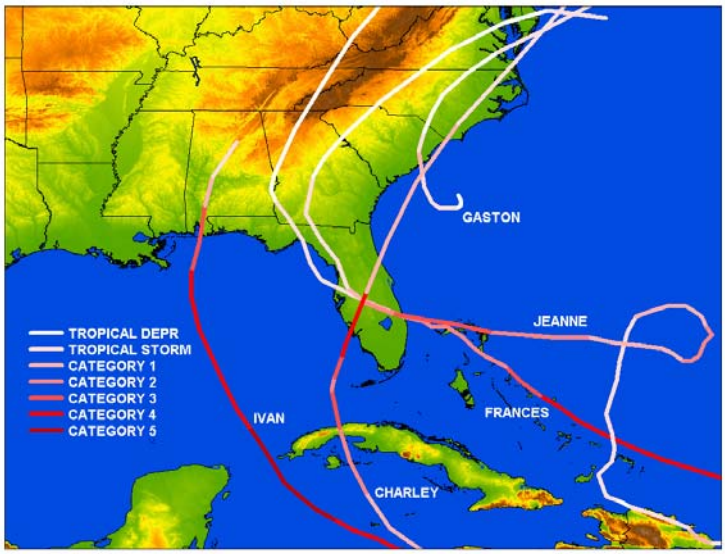
BETTER TECHNOLOGY
BETTER DATA
BETTER DECISIONS

AIR

Agenda

- Review of 2004 and 2005 hurricane seasons
- Understanding model results
- Adjusting model output for additional sources of loss
- What about input data?

The 2004 Hurricane Season



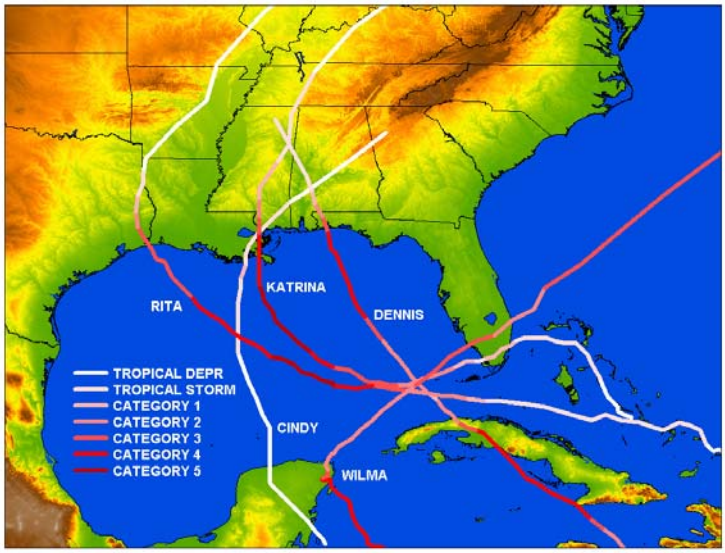
If You Think the 2004 Season Was Unusual…

	Estimated Return Period*	
	U.S.	Florida
Three or More Landfalling Hurricanes	5	40
Four or More	12	204
Five or More	31	1,111
Six or More	86	5,000

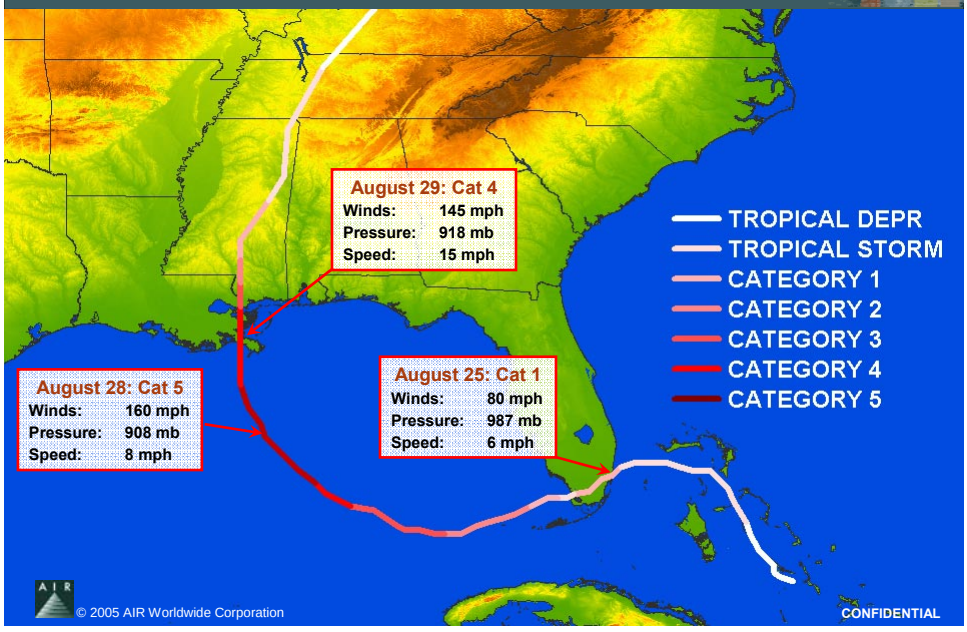
*Generated from the AIR Hurricane Model

Note that Ivan made landfall in Alabama, so Florida has only had three direct landfalls this year

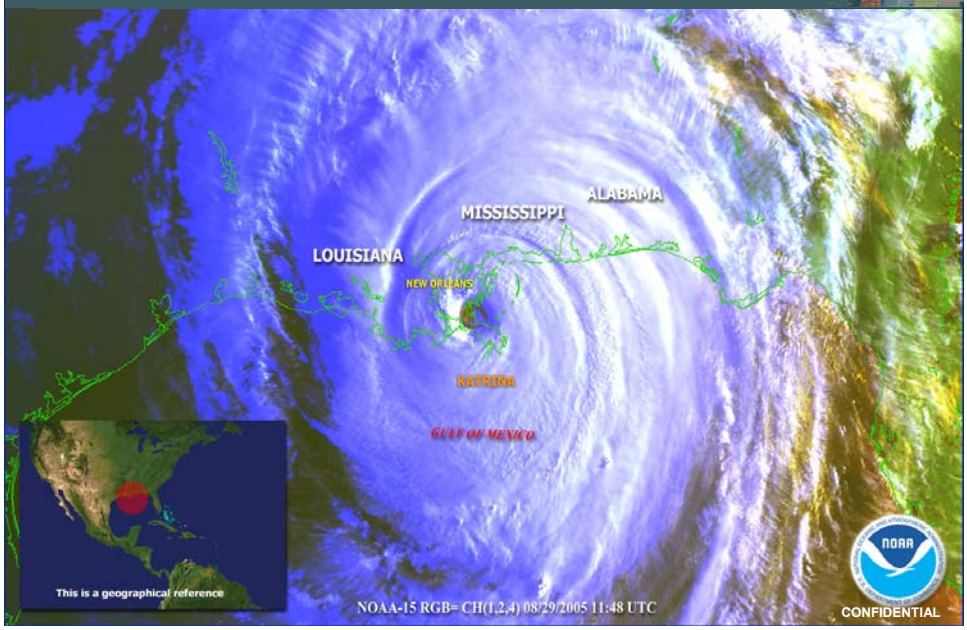
The 2005 Hurricane Season



Hurricane Katrina's Track and Meteorological Parameters



August 29: Katrina Makes Landfall Near Buras, Louisiana as a Category 4 Hurricane



Storm Surge versus Flood Inundation

Storm surge (the difference between storm tide and normal high tide) is the water driven onshore by high winds. The water subsequently recedes.

Flood inundation is defined as the standing water in New Orleans caused by the breaking of the levees.

Insured Versus Flood Losses

AIR and PCS Estimated Insured Losses for Hurricane Katrina (USD Bn)

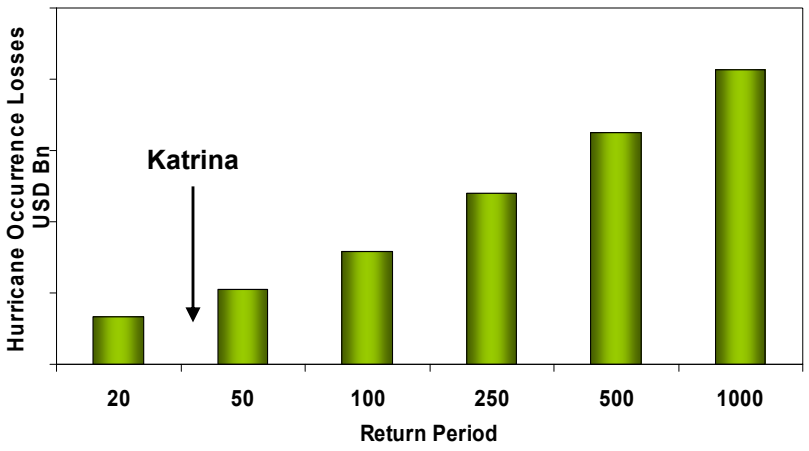
	AIR* (with 30% demand surge)	PCS
LA	20.8	24.3
MS	10.8	12.1
AL	1.6	1.1
FL	0.7	0.5
Other	0.1	0.1
Total	34.0	38.1

AIR Estimated Flood Losses for Hurricane Katrina (USD Bn)

	Total Damage (USD Millions)
New Orleans Flood	22.5
LA Surge	16.2
MS Surge	4.4
AL Surge	.8
FL Surge	.3
Total	43.9

**AIR's loss estimates assume that 10% of the total flood and surge damage will be covered by private insurance.*

Even Before Katrina, AIR Hurricane Model Had Katrina-Size Losses and Greater



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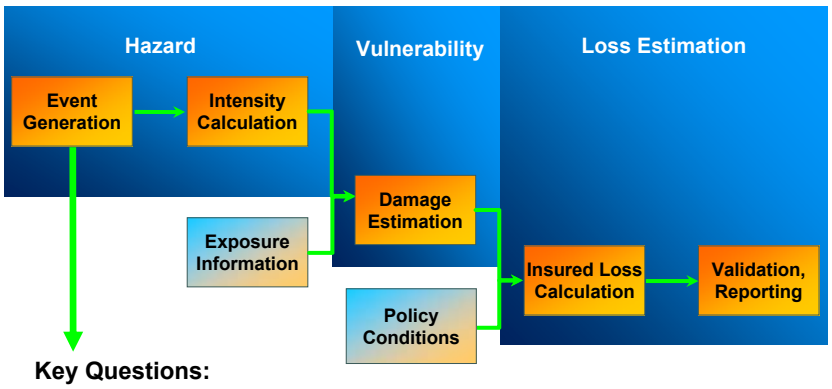
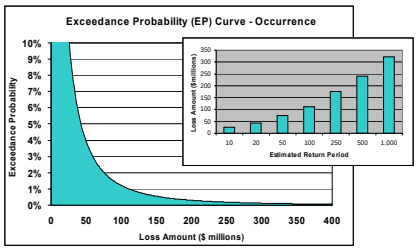
Catastrophe Model Components

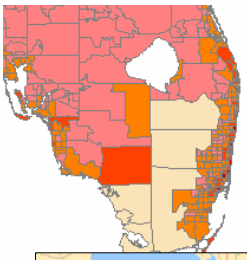


Key Questions:

- **What?**
- **Where?**
- **How big?**
- **How often?**
- **How much?**

Catastrophe Models Provide a Wide Range of Outputs





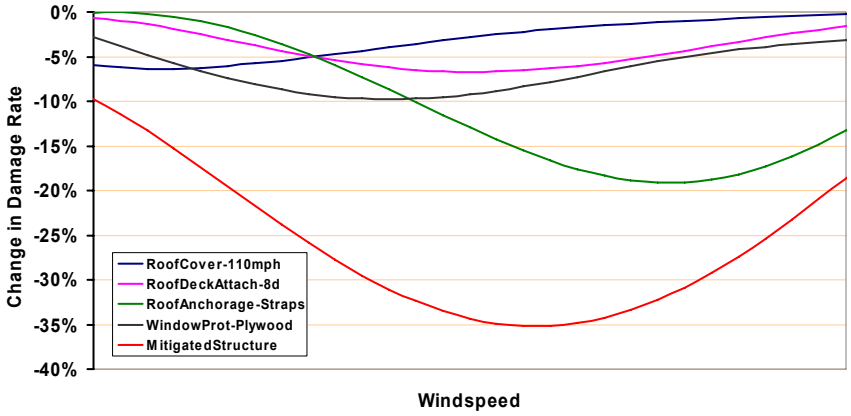
Event	Year	Company Loss	Event Info
270011986	3657	2,811,789	Class 5 Hurr FL LA BF MS TX
270017822	5454	2,672,028	Class 5 Hurr NY NJ CT MA PA
110128230	4470	1,951,563	MW 8.1 EQ New Madrid
270004221	1295	1,946,088	Class 5 Hurr FL BF SS SJ VQ
270019211	5872	1,786,625	Class 5 Hurr TX FL LA BF MS
270018458	5649	1,658,905	Class 4 Hurr NY CT NJ MA NH
270006717	2023	1,634,955	Class 4 Hurr FL BF SS SJ VQ
270010779	3294	1,625,767	Class 5 Hurr FL NC SC TN BF
110083756	2917	1,605,027	MW 8.3 EQ San Francisco
270010551	3232	1,562,932	Class 5 Hurr FL AL JM MS LA
270022466	6869	1,562,240	Class 2 Hurr FL PQ DR GA BF
270016561	5063	1,475,085	Class 5 Hurr FL BF GA SC
110124693	4350	1,465,897	MW 8.2 EQ San Francisco
270007716	2349	1,444,885	Class 5 Hurr FL MS JM AL LA
270021324	6512	1,397,606	Class 4 Hurr FL CJ JM BF TD

Data Required for Modeling - Hurricane

Location	Replacement Value	Building Characteristics	Secondary Characteristics	
Street Address	Building	Construction	Window Protection	Large Missile Source
Zip Code	Appurtenant Structures	Occupancy	Glass Type	Small Debris Source
	Contents	Year Built	Glass Percent	Roof Pitch
	Time Element	Height	Building Condition	Building Foundation Connection
			Roof Anchorage	Year Roof Built
			Roof Deck	Exterior Doors
			Roof Geometry	Roof Covering
			Roof Deck Attachment	Roof Attached Structures
			Roof Cover Attachment	Wall Attached Structures
			Wall Type	Wall Siding

Impact of Secondary Risk Characteristics Varies Based on Perils and Location of Exposures

- The impact of individual risk characteristics varies over the ranges of potential intensities



Which are the Most Important Characteristics for Hurricane Risk to Wood Frame Residential?

Variability of Losses (%)

	Florida Coastal	
Building Feature	**Minimum**	**Maximum**
Roof Cover	-1	8
Roof Geometry	-13	2
Storm Shutters	-13	1
Roof Anchorage	-1	12
Siding	-3	9

It is important to understand how characteristics work together. For a given construction, simultaneously selecting the best vs worst level for each characteristic can yield losses from 26% lower to 54% higher than the base loss for a total loss range of 80%.

The More You Run the Model, the More You Learn About Your Portfolio

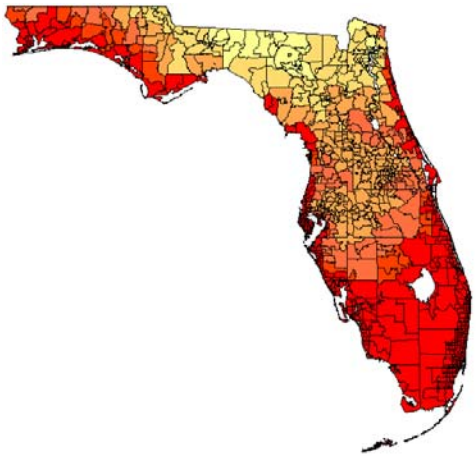
- Which policies contribute the most to my large loss potential?
- What characteristics contribute disproportionately my large loss potential?
- What geographic areas contribute the most my large loss potential?
- What is the marginal impact of additional exposures?
- What is the impact of changing underwriting guidelines?
- What is the impact of risk transfer alternatives?
- What happens if I grow in a certain area?

"AIR models not only provide answers, they teach you what questions to ask."

Rade Musulin, ACAS, MAAA
Vice President – Operations, Public Affairs & Reinsurance, Florida Farm Bureau

I've Run the Model, Have I Accounted for All the Risk?

- If you've got your exposure right then your loss distribution provides a robust starting point for catastrophe risk management through understanding the relative risk
- AIR models losses to onshore property including:
  - Building
  - Appurtenant structures, outbuildings
  - Contents
  - Additional living expenses, direct business interruption



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What is Implicitly Modeled?

- Damageability relationships begin from an engineering base and are subject to uncertainty
- Claims data from clients which is used as part of the validation of these relationships does not always separate out details of loss we must assume some ancillary losses are in the data
- Losses from things like debris removal, claims inflation (including padding, fraud,…), power outages are implicitly modeled for normal events
- It is, however, not unreasonable to add separate explicit adjustment factors to your loss estimates, especially for mega catastrophes

Models Account For Additional Losses

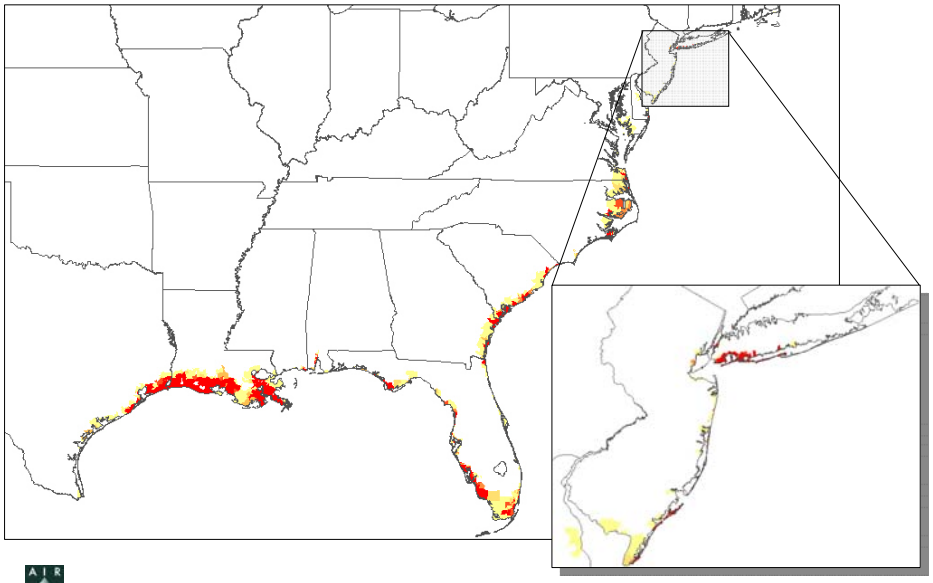
- Demand surge
  - Updated, user-definable function related to industry loss
- Storm surge
  - New model and ability to adjust percentage applied
- Loss assessments
  - Industry and residual market losses to be used as basis of assessment calculations

Additional Items Leading to Increased Losses

- Delay in repairs due to
  - Infrastructure damage
  - Delay in building permit process
  - Shortage of building inspectors
- Extended exposure to elements
- Temporary fixes made to mitigate future loss while waiting for repair
- Compliance with building code upgrades
- Per diem rates paid to workers brought in from other areas
- Increase in loss payments to avoid bad press
- Claims overpayments due to workload pressures on claims adjusters

- **ITV issues should not be confused with demand surge**

Loss Potential Due to Storm Surge

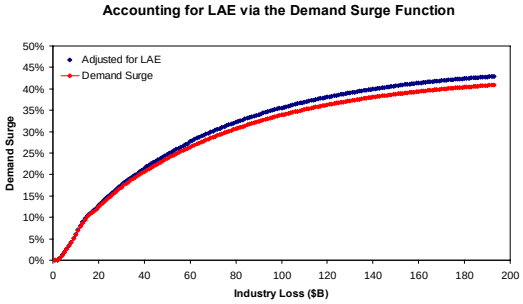


Additional Sources of Loss to Consider in Estimating the Absolute Level of Loss Potential

- AIR modeled losses do not include:
  - Loss adjustment expenses
  - Indirect business interruption
  - Inland flooding
  - Damage to offshore property, e.g. boats, oil rigs, etc.
  - Hazardous waste cleanup
  - …
- Review of experience from past events can provide guidance for factors to be used to adjust modeled loss distribution
- Very dependent on unique nature of event

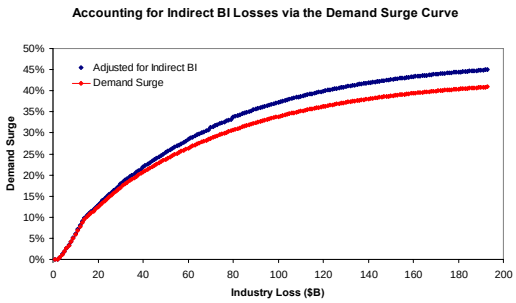
Loss Adjustment Expenses

- **Loss Adjustment Expense (LAE)** is the cost incurred to investigate and settle claims and includes such items as fees for claim adjusters, investigators and appraisers, legal fees, and other administrative expenses associated with claims settlement.
- LAE varies by company depending on their specific loss amount and policies and procedures followed for claims settlements.
- Company specific policies like hiring in-house claim adjusters against independent claim adjusters could significantly affect LAE.
- Companies add LAE factors based on internal claim studies
  - Factors vary by peril
  - Factors vary by size of loss

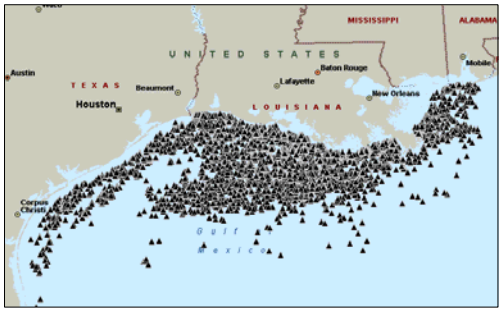


Indirect Business Interruption Due to Natural Catastrophes

- Losses not directly tied to the physical damage of an insured building that still force a business to remain closed or incapacitated
  - Interruption of utilities causing power or telephone outages
  - Damage to infrastructure limiting physical access
  - Damage to supplier or customer buildings

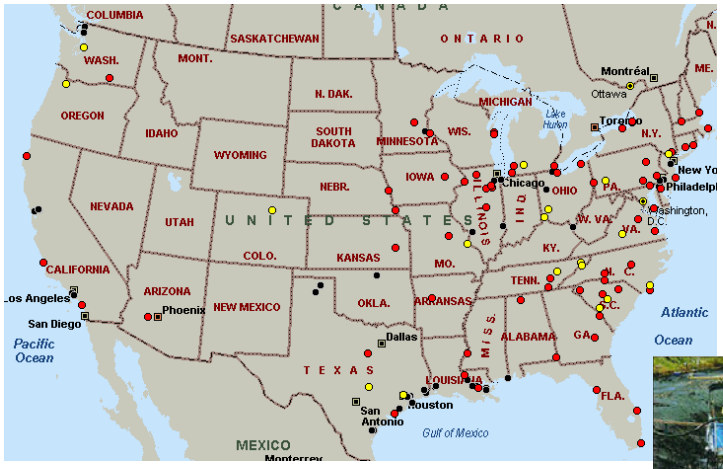


Damage to Offshore Properties



AP / Peter Cosgrove

Locations with Large Potential Hazardous Waste Cleanup Costs



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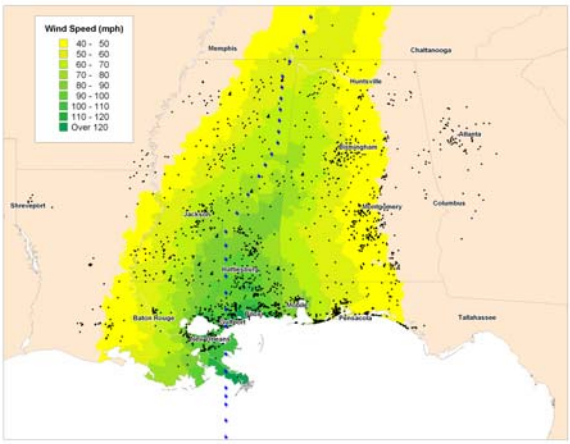
Findings from Systematic Analysis of Client Exposure and Claims Data



- Claims outside windfield
- Very small replacement values
- Understated replacement values
- Damage ratios not consistent with wind speeds
- Commercial damage ratio significantly higher than residential damage ratios

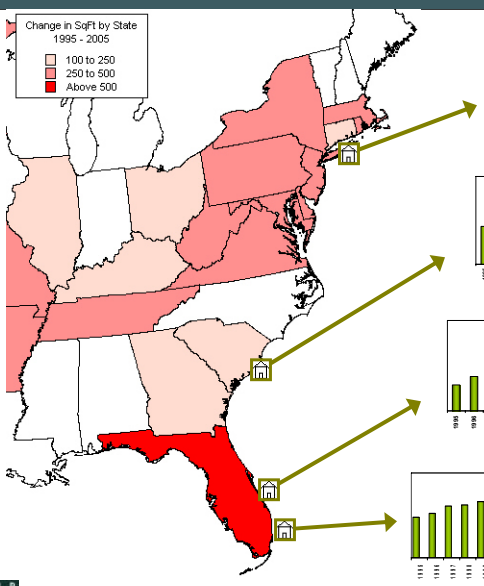
Highlights of AIR Exposure Data Quality Analysis

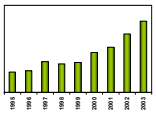
- Nine out of ten commercial properties analyzed had replacement values less than the amount estimated using a standard engineering-based cost estimation process.
- The coverage limit should not be used as a proxy for the replacement value, particularly for polices covering only a share of the property.
- Over 50 % of companies analyzed lacked construction and/or occupancy information for more than a 1/3 of their policies.
- Accurate analysis of multiple-location policies requires an address for each location.

Growth in the Number of Housing Units, 1995-2005

California	**35%**
Florida	**24%**
Georgia	**44%**
N. Carolina	**41%**
S. Carolina	**37%**
Texas	**37%**
U.S.	**31%**

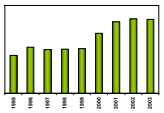
New Homes Are Getting Larger





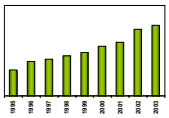
Sag Harbor/Long Island

1995 ~ 2,100 sq. ft.
2003 ~ 3,550 sq ft
Growth ≈ 70%



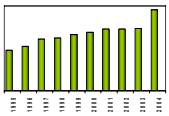
Charleston Area

1995 ~ 2,200 sq. ft.
2003 ~ 2,850 sq ft
Growth ≈ 30%



Palm City Area

1995 ~ 2,080 sq. ft.
2003 ~ 3,060 sq ft
Growth ≈ 47%



Fort Lauderdale Area

1995 ~ 2,900 sq. ft.
2004 ~ 4,400 sq ft
Growth ≈ 52%

New Homes Are Also More Architecturally Complex

Yesterday…

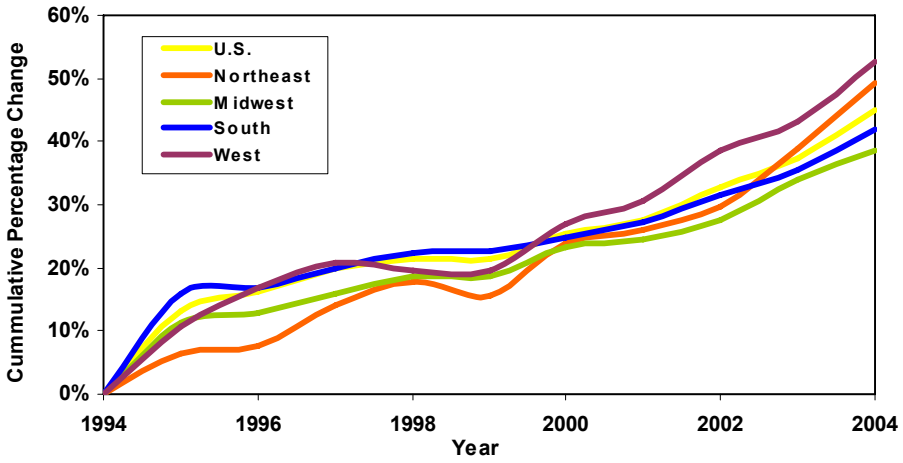
and today.

Interiors Feature More Opulent Finishes

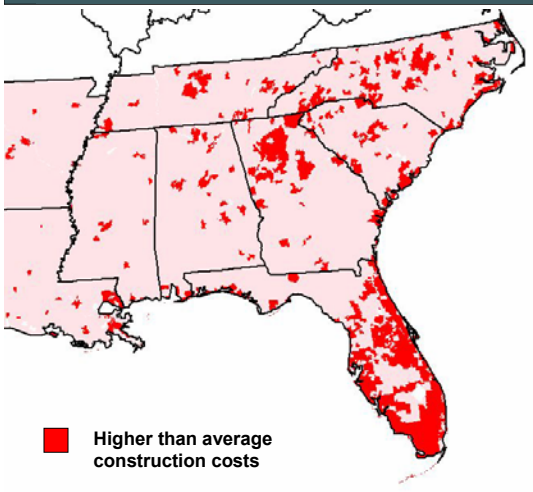
Yesterday…

and today.

Change in Residential Costs Per Square Foot – U.S. Regional Average Costs



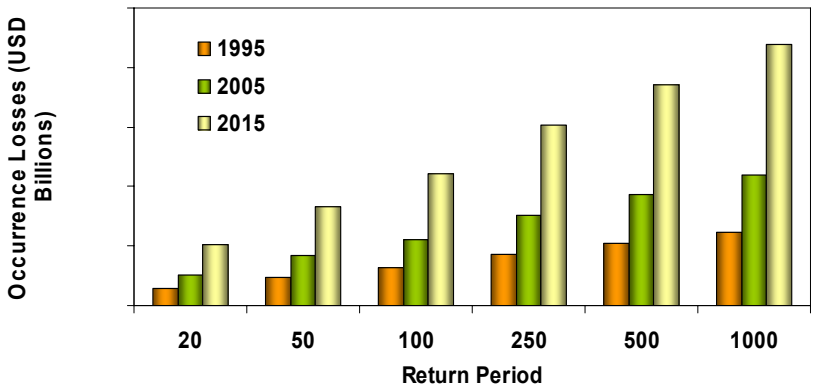
Construction Costs Vary by Location



Local and Site-Specific Factors Affecting Construction Costs

- **Demographics**
  - Wealthier neighborhoods are typically charged higher labor rates
- **Accessibility**
  - More costly - narrow roads, steep terrain, remote area, congested urban area, heavy traffic, elevator required to transport labor and materials, etc.
  - Less costly - flat terrain, suburban area, nearby access to major routes, light to normal traffic, etc.
- **Local Ordinances**

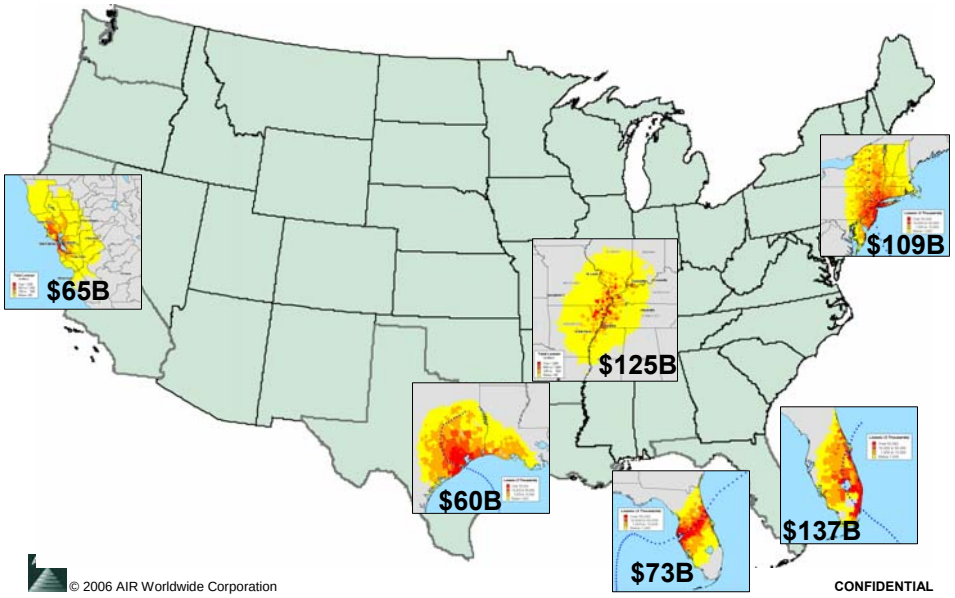
Exposure Growth Alone Results in a Doubling of AIR Industry Losses Over Past Decade



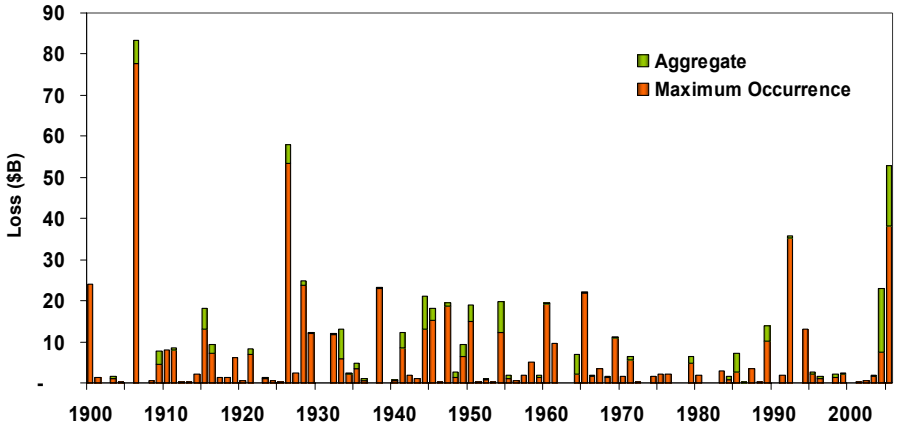
Losses include hurricane, earthquake, fire following, winterstorm, severe thunderstorm

Losses include aggregate demand surge

Event Causing Insured Loss Greater Than $50B



Estimated Historical Hurricane and Earthquake Losses Using Today's Property Values



Summary

- Catastrophe models are robust tools for estimating relative risk
- Models users need to understand what models do and don't include and make appropriate adjustments to estimate absolute levels of loss
- Growth in property exposures is a primary driver of increasing catastrophe losses