

MANAGING EXTREMES

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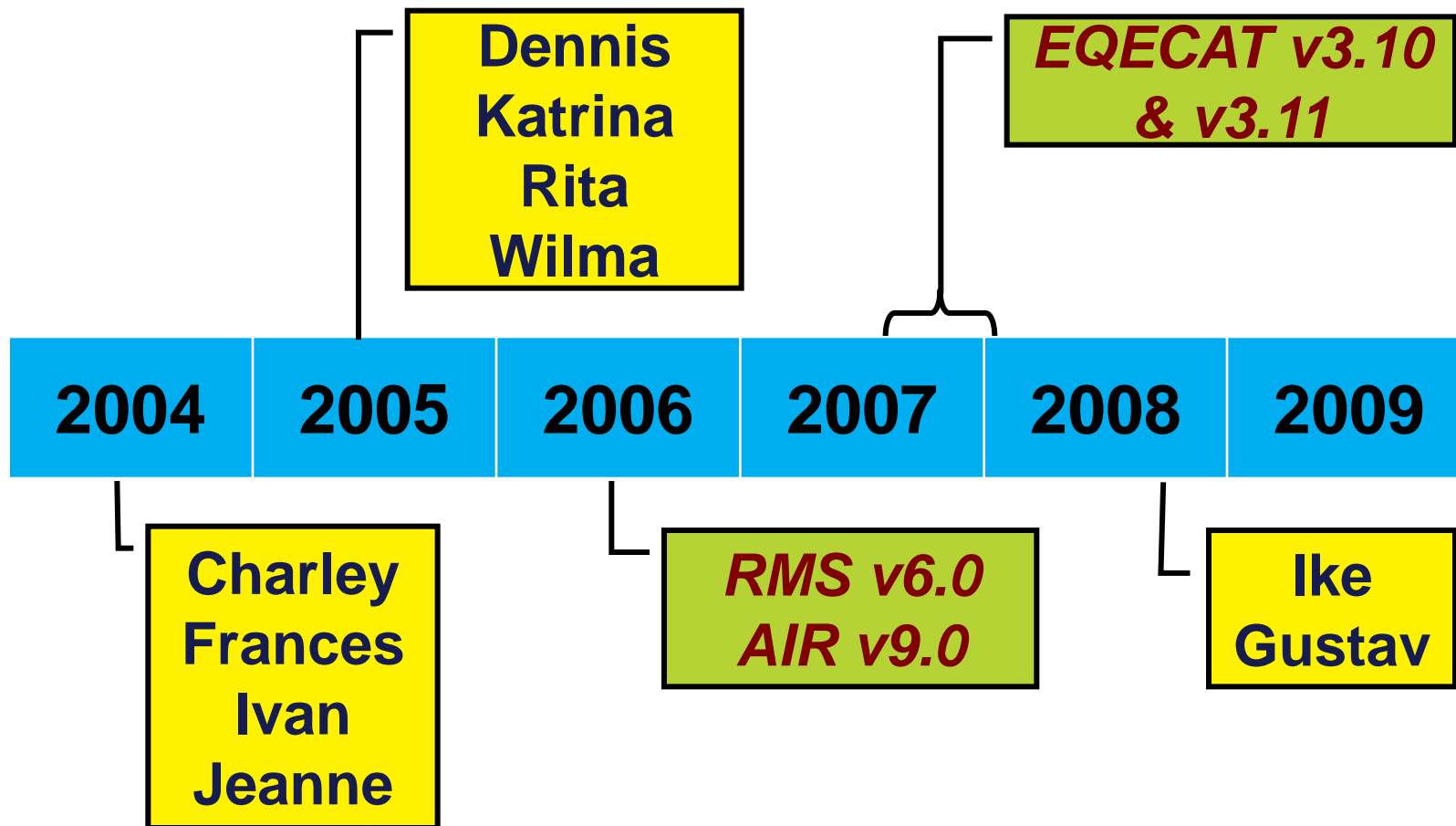
HURRICANE

Understanding the Patterns & Complexity of
U.S. Hurricane Model Changes



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> \$1b Hurricanes And Updates To The Models



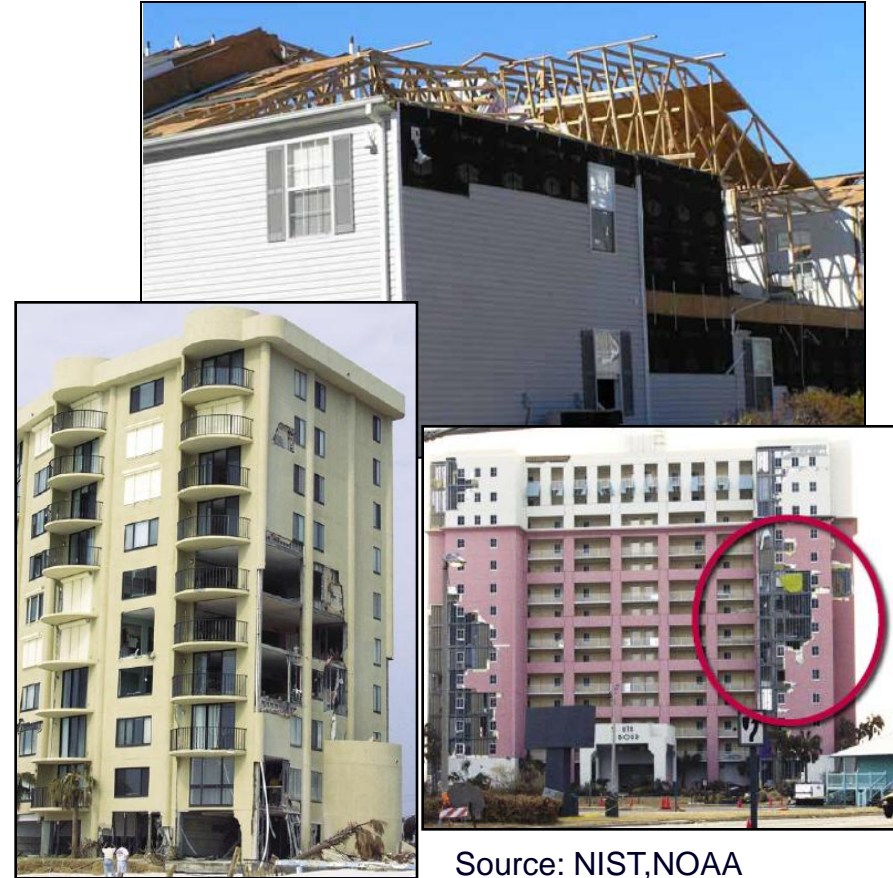
Improvements To The Models In 2006-07

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Improvements in 2006-07 were primarily to the vulnerability component

- Significant increases to the damage functions
- Enhanced suite of commercial occupancy damage functions
- Revised damage functions for residential and commercial lines



Source: NIST,NOAA

Improvements To The Models In 2010-2011

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Improved Vulnerabilities

Improved Hazard & Vulnerabilities

Dennis
Katrina
Rita
Wilma

*EQECAT v3.10
& v3.11*

2004

2005

2006

2007

2008

2009

Charley
Frances
Ivan
Jeanne

*RMS v6.0
AIR v9.0*

Ike
Gustav

2010

2011

2012

EQECAT v3.16

RMS v11.0

AIR v12.0

Improved Understanding Of Hurricane Winds

- New science and high resolution detailed data from recent events
- New windspeed observations
- Improved understanding of hurricane behavior
 - Hurricane windfield
 - Storm filling
 - Surface roughness effects on wind speed
 - Evolution of hurricane structure

What RMS Has Published On Their Hurricane Model Changes

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Summary Of RMS' V11 Model Release

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RMS RiskLink v11.0

- U.S. hurricane model update
 - Wind & storm surge
 - Offshore energy
 - Industrial facilities
- New countries to North Atlantic hurricane model suite
 - Eastern Canada, Bermuda, Mexico, Belize, Costa Rica, Guatemala, Honduras, Nicaragua
- European windstorm and earthquake models
- China and Hong Kong typhoon model
- Chile earthquake model
- Minor updates to U.K. and Germany flood, Japan typhoon models



Technical Highlights Of RMS Model Updates- Hazard

Hazard model updates using new data, new science, and new technology on hurricane structure and evolution

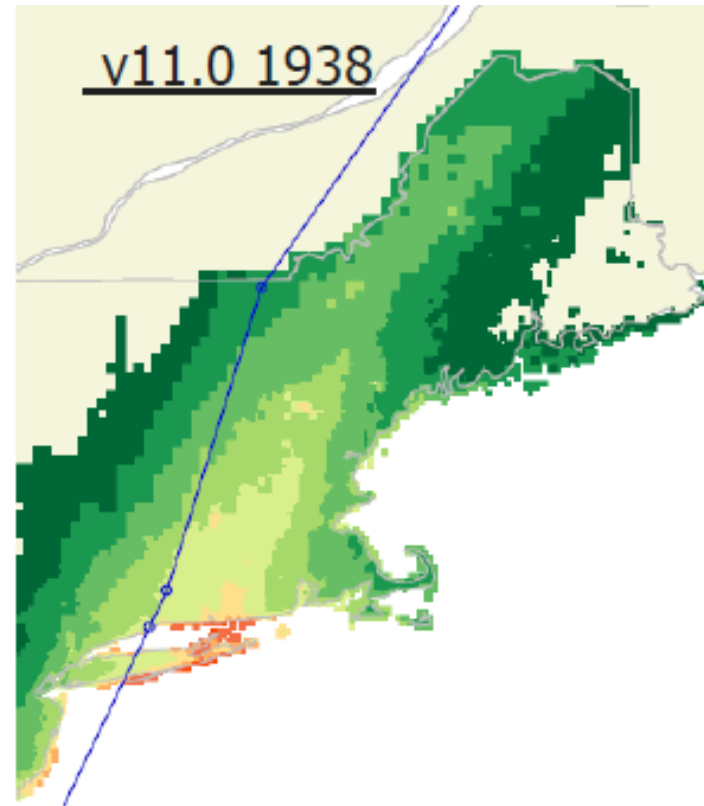
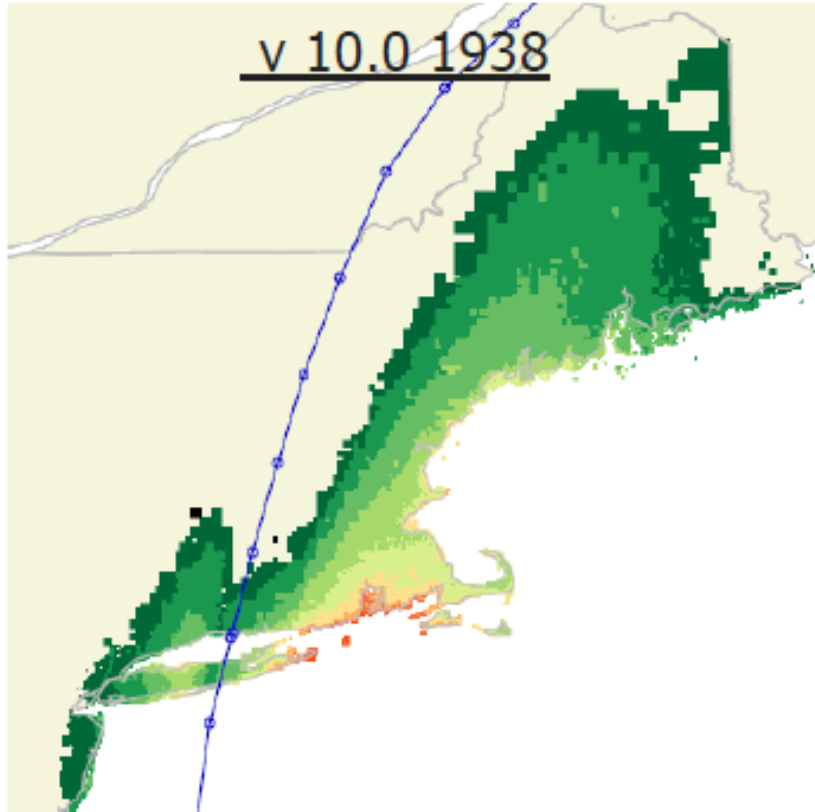
- Revised inland filling assumptions and wind field model
 - Over 20,000 wind speed observations
 - 10 times more wind/surge data
 - Different models for the U.S. Gulf coast, the Florida Peninsula, the Atlantic Seaboard, the Caribbean, and Central America
- Revised stochastic event set (near term and long term rates)
- Updates to surface roughness impact on wind speed based on pre and post landfall research

New View of Transitioning Storms Windfield

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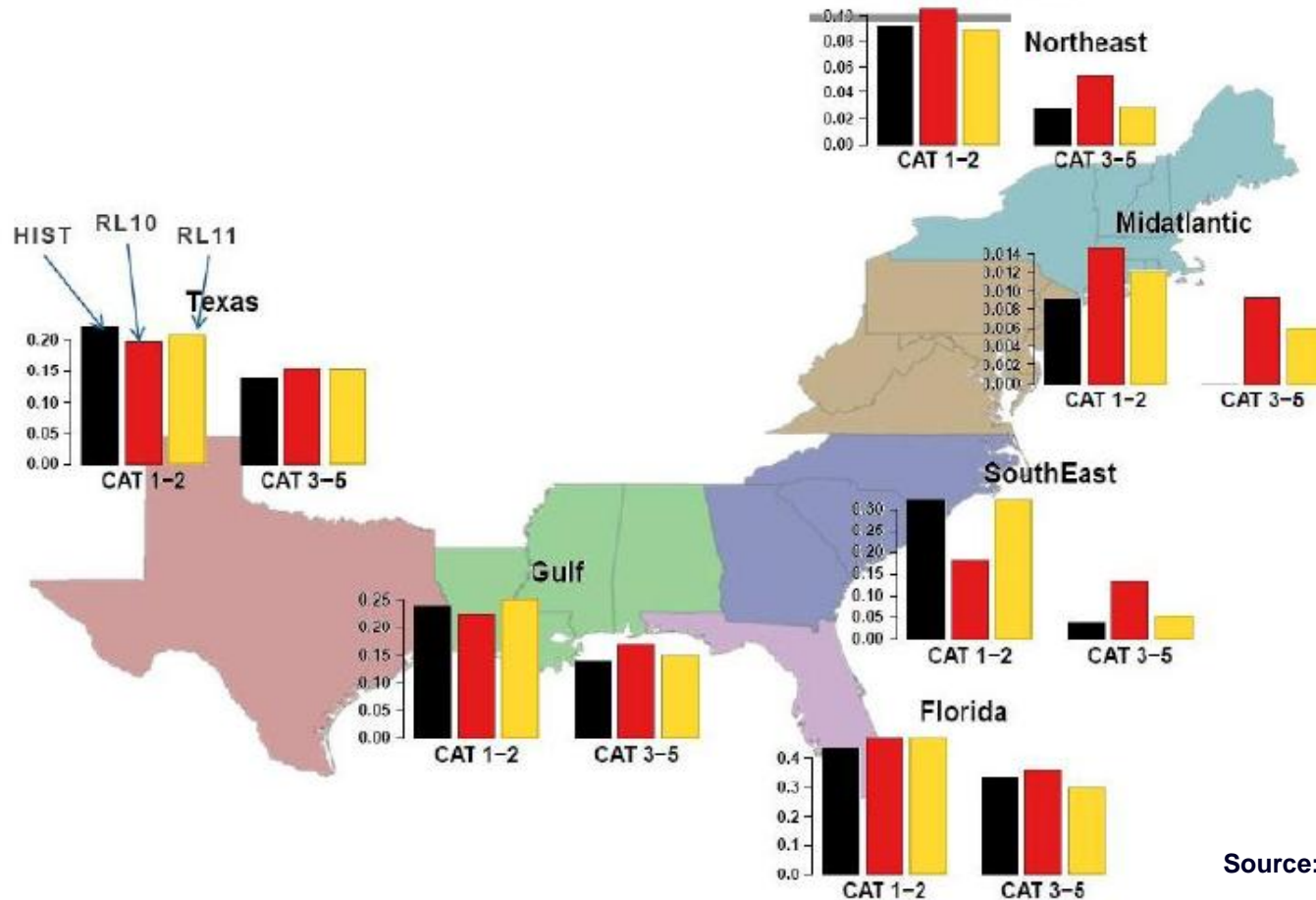
New view of transitioning storm windfield impacted loss results significantly in the North East and Mid Atlantic



Source: RMS Inc.

Revised Event Set And Event Rates

Fully revised stochastic events, Long term and Near term event rates



Source: RMS Inc.

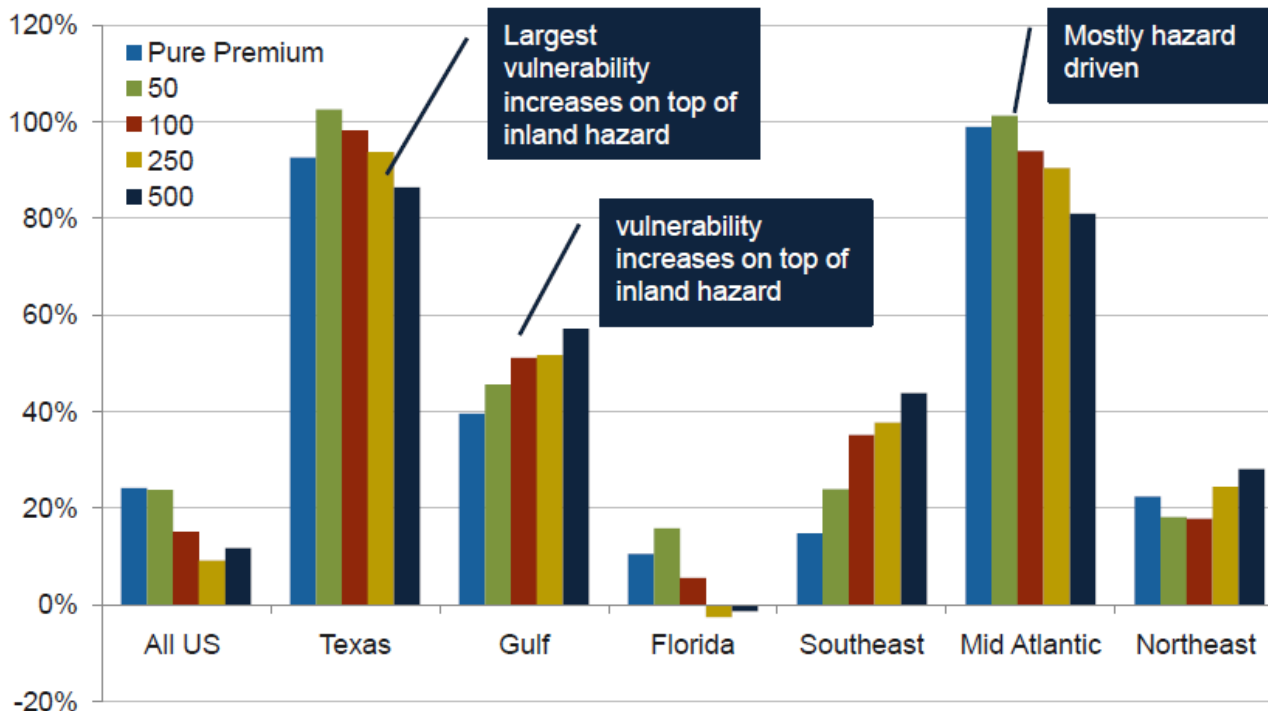
Highlights Of RMS Model Updates - Storm Surge

- Numerical storm surge model dynamically linked with the windstorm model throughout entire lifecycle
 - Better captures the surge build up at sea e.g. Ike and Katrina and penetrates further inland than current model
- Model allows user-defined input of local flood defenses
- New storm surge analysis options allow analysis for storm surge leakage

Changes To RMS' Industry Loss Results

- Losses are generally increasing in all regions
- Relatively large increases in Texas and Mid Atlantic regions

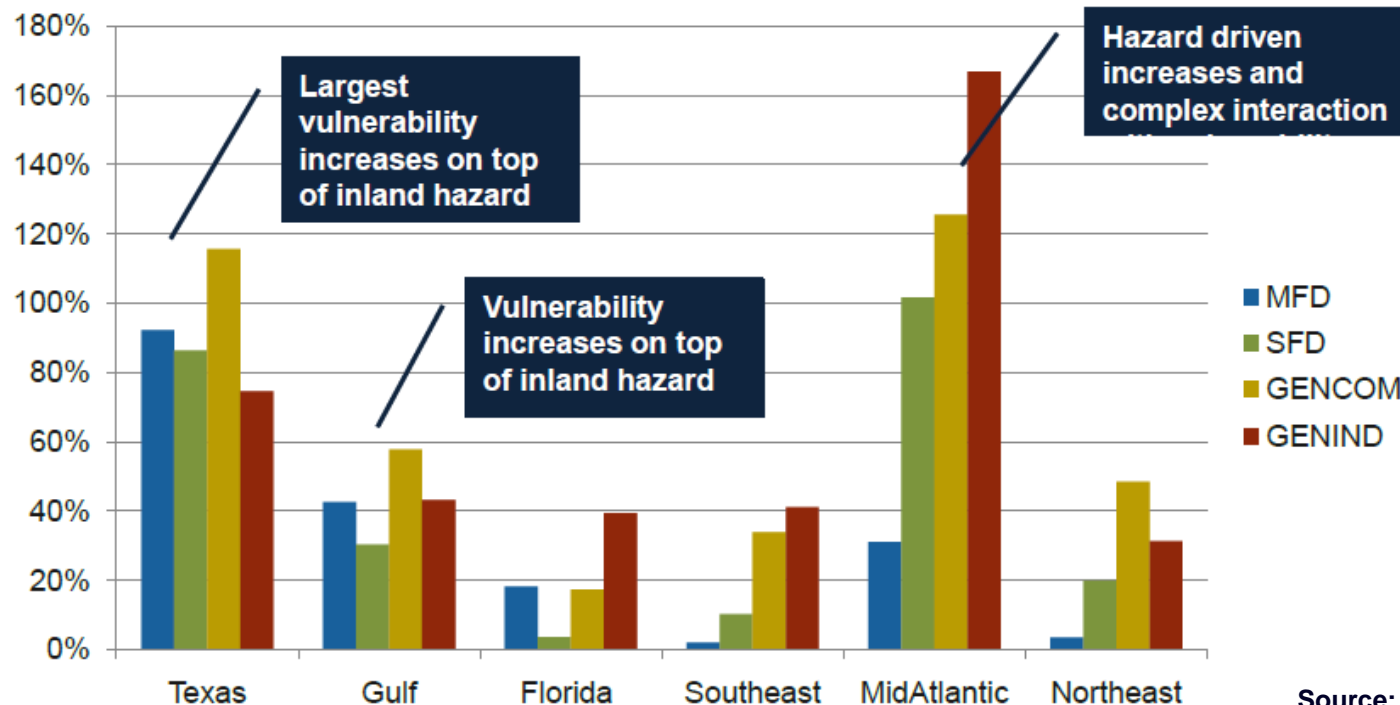
Change between v10.0 and v11.0 (wind only, Near-term catalog, GR OEP) for RMS' 2011 All lines Industry portfolio results



Changes To RMS' Industry Loss Results

- Increase in loss results for all LOBs in all regions
- Relatively large increase in results for commercial lines compared to residential

Change between v10.0 and v11.0 (wind only, Near-term catalog, GR AAL) for RMS' 2011 Industry portfolio results



Source: RMS Inc.

What AIR Has Published On Their Hurricane Model Changes

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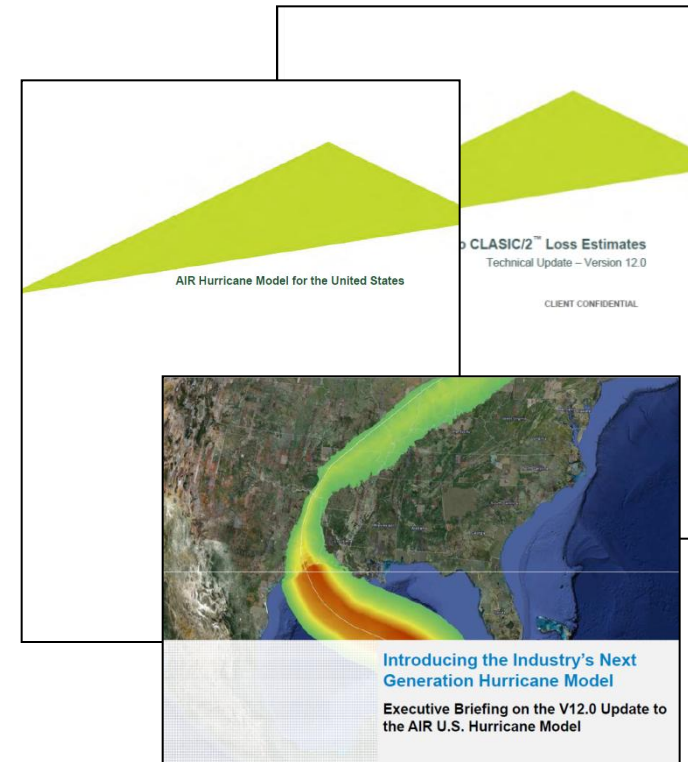
Summary Of AIR V12 Model Release

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AIR CLASIC/2 v12.0

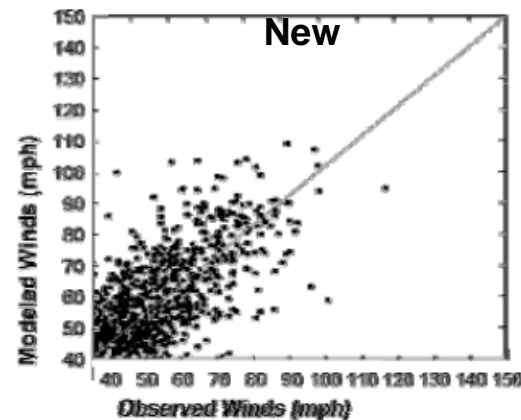
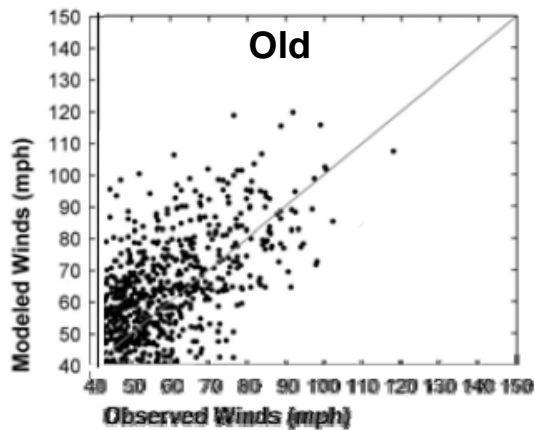
- U.S. Hurricane Model
 - Wind & Storm surge
 - Offshore energy
 - Industrial facilities
- Caribbean Hurricane Model
- Mexico Hurricane Model
- European Windstorm Model



Highlights Of AIR Model Updates- Hazard

Hazard model updates using new data, new science, and new technology on hurricane structure and evolution

- Revised wind field model
- Enhanced surface roughness models
- Revised inland filling rates and re-intensification assumptions
- Updated stochastic event set (near term and long term)

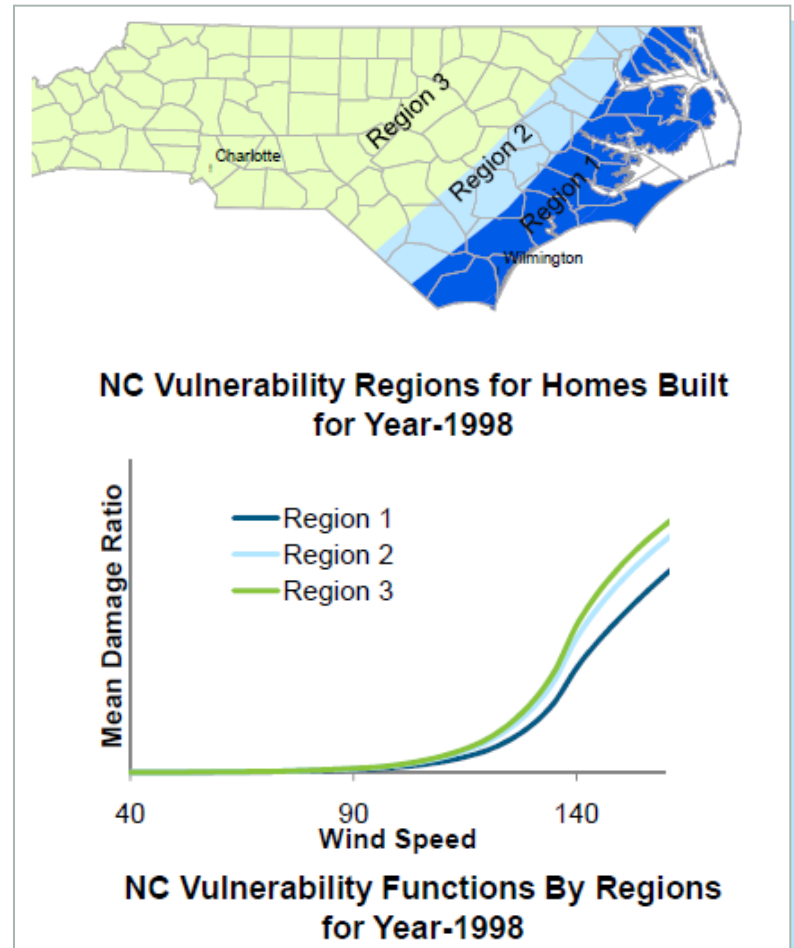


Source: AIR Worldwide corporation

Highlights Of AIR Model Updates - Vulnerability

Updates to the vulnerability model using the new claims data and engineering research

- Introduction of spatial variability in damage functions (regional damageability model)
- Significant changes to commercial damage functions
- Increases to the damage functions at low to moderate wind speeds
- New suite of damage functions for large industrial facilities



Highlights Of AIR Model Updates - Storm Surge

- Storm surge hazard model methodology itself has not changed
- Updates to the wind hazard components of the model such as Rmax, central pressure, and surface wind that inputs in to the storm surge hazard to cause changes to loss estimates
- Updated storm surge damage functions for AUTOs lines
- Updated storm surge damage functions for business interruption (BI) coverage
- Updated storm surge specific regional unknown damage functions

2012 – 2013 Scheduled Releases

AIR	EQE	RMS
2012	2012	2012
<p>Australia Brushfire Australia Cyclone Australia Earthquake India Cyclone US Earthquake (Builders Risk) US Hurricane (Builders Risk + Surge Auto update) Next Generation Platform – I</p>	<p>180 peril/region models Includes 77 aggregate (CHAS) models RQE Platform – I</p>	<p>Europe Windstorm v11 Service Pack 3 Japan Earthquake v11 Service Pack 4</p>
2013	2013	2013
<p>Hawaii Earthquake Hawaii Hurricane Japan Earthquake Japan Tsunami Japan Typhoon Pandemic UK Windstorm (Storm Surge) Next Generation Platform - II</p>	<p>Europe Earthquake - I (Historical Event Catalogue) Japan Earthquake (Event Rates) Latin America Earthquake - I (Historical Event Catalogue) North Atlantic Hurricane (for Florida) US Flood RQE Platform – II</p>	<p>Japan Earthquake (updated hazard map) New Zealand Earthquake (Liquefaction hazard map) North Atlantic Hurricane (Medium Term Rates and Surge) – update subject to review of model</p>

Models listed in **ORANGE** indicates a new model

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