CATASTROPHE INSURANCE (C) WORKING GROUP

U.S. Hurricane Model Update

NAIC
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The AIR Catatrophe Model: Value Proposition

A robust catastrophe model should deliver ***consistency, superior risk differentiation*** and, more importantly, provide information about potential losses ***before they occur***.

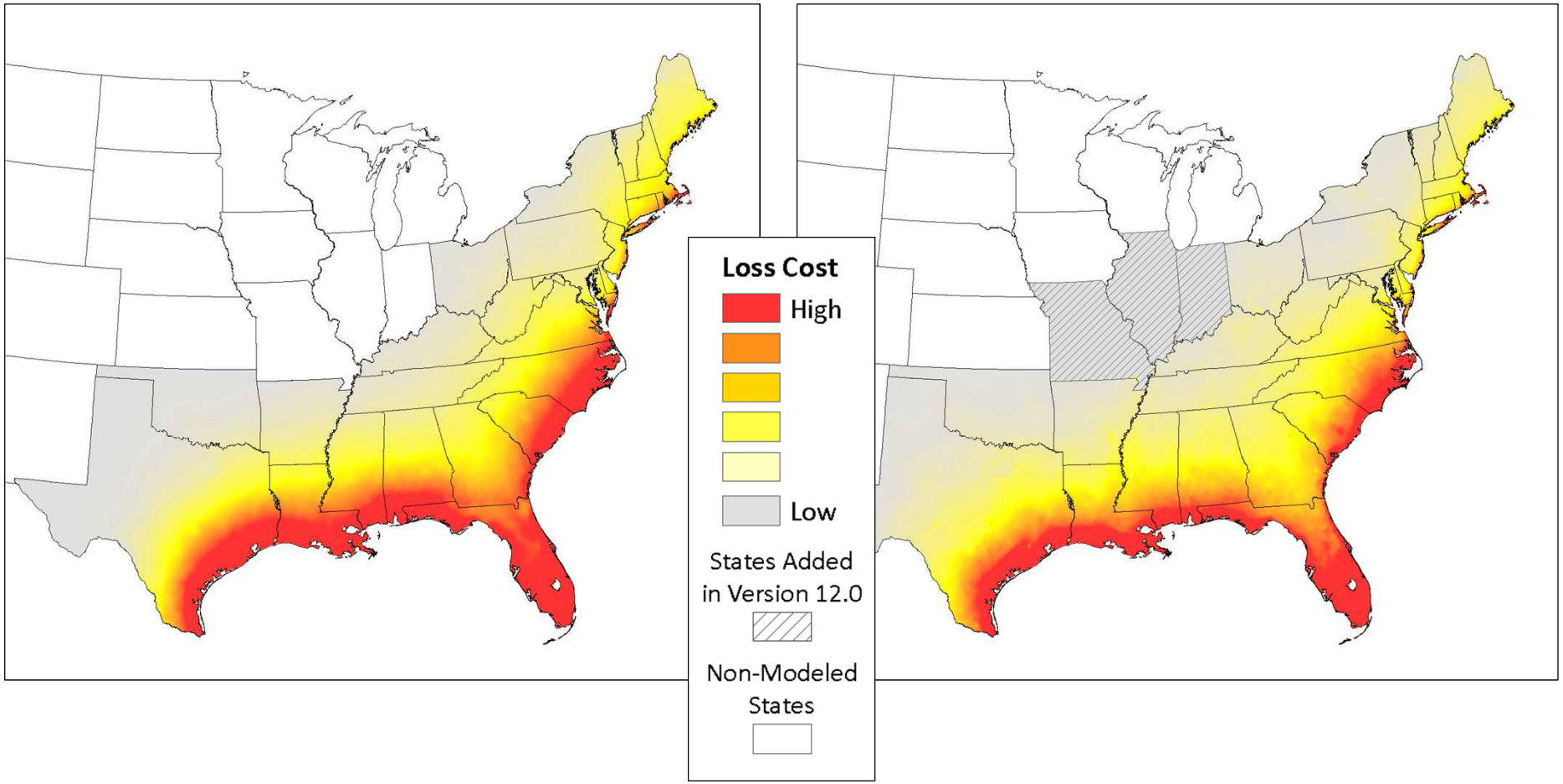
Catastrophe Models Add Value Precisely Because They Supplement Sparse Historical Data

- Physical science, engineering, statistical and actuarial techniques are integrated and implemented in a technological platform that offers risk information
- Model results are better estimates than the results of rules of thumb or extrapolations of history
- As each embedded discipline matures, a major job for modeling firms is to constantly incorporate new theories, techniques and observations without rocking the boat with unwarranted, abrupt changes

The Version 12.0 Update to the AIR U.S. Hurricane Module Maintains a Consistent Overall View of Risk…

Version 11 (2009)

Version 12 (2010)



…While Providing the Most Realistic and Detailed View Of Hurricane Risk Available

- The Version 12.0 model enables ***significantly more precise risk differentiation*** based on
  - Geography
  - Construction
  - Occupancy
  - Year built
  - Individual building characteristics
- The Version 12.0 model provides the most ***comprehensive*** view of U.S. hurricane risk available
  - Basinwide catalog provides consistent view of risk across U.S., Caribbean, Offshore, and Mexico
  - Model domain includes 29 states to provide complete coverage of inland risk
  - Incorporates spatial and temporal variations in vulnerability

Hazard Update Refines View of Local Windspeed

- Ongoing research and observations of 4-D storm structure have been integrated into the hurricane model
- Updated land use data from the USGS has been used to update local wind adjustments at a finer resolution
- Direction of the upstream wind is explicitly modeled
- New states added to provide even more complete coverage of inland risk (Illinois, Indiana, and Missouri)
- A small percent of storms have been modeled to re-intensify, consistent with historical patterns
- Basinwide catalog provides consistent view of risk across U.S., Caribbean, Offshore, and Mexico

Refinements in Vulnerability Module Allow for Greater Differentiation of Risk on a Micro Level

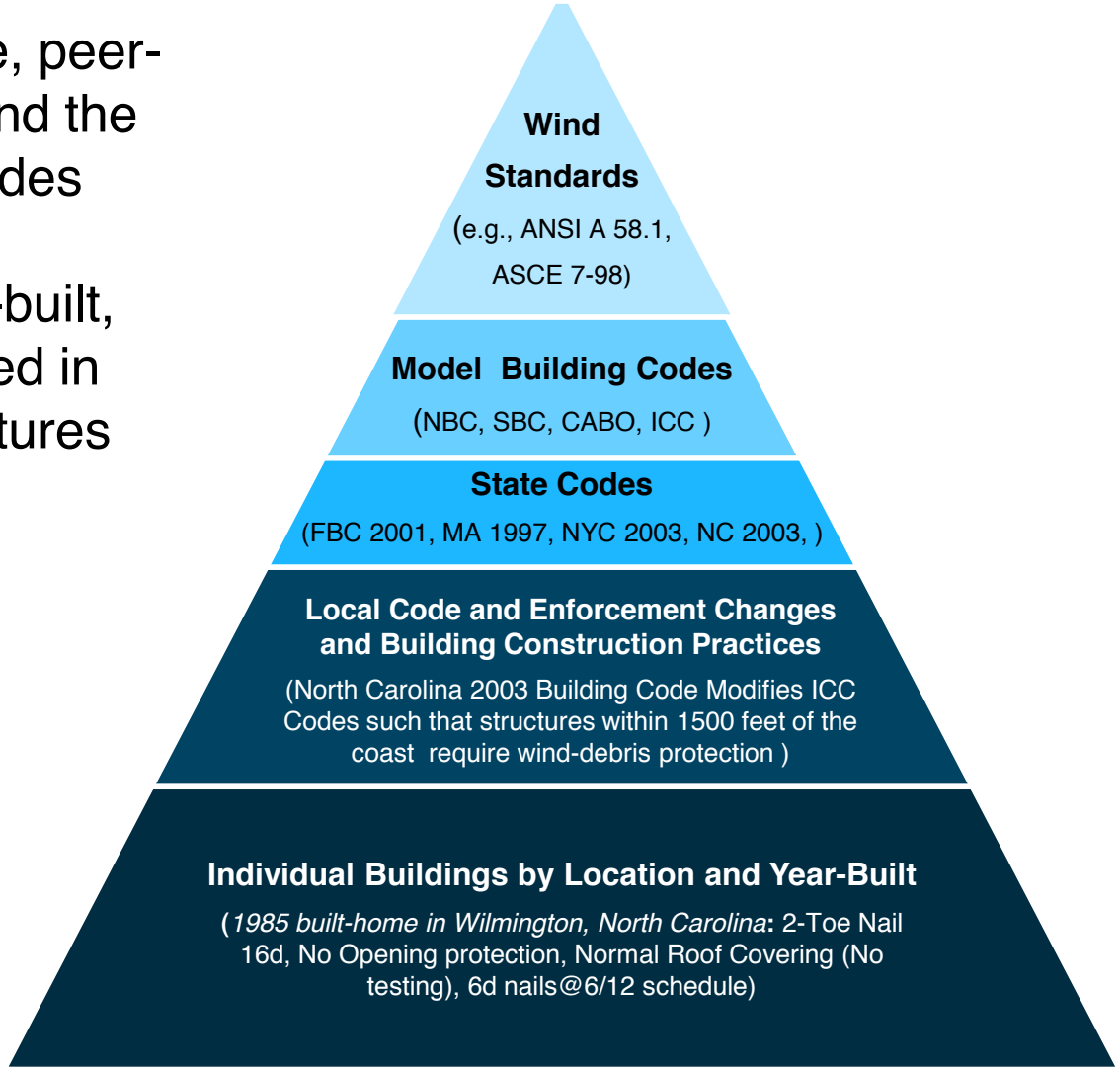
- Explicit modeling of the evolution of building codes and their enforcements across all hurricane states
- Refinements in vulnerability relationships for single family homes
  - Vulnerability increased at low to moderate wind speeds and decreased slightly at high wind speeds; relative vulnerability between construction types did not change significantly
  - A comprehensive and coherent methodology for developing damage functions by region and year built
  - Updates to the Individual risk model to reflect findings from detailed claims data and damage reports

Vulnerability Analyses Confirmed Many of the Unique Aspects of the AIR US Hurricane Model

- **Duration** is critical for the accurate loss estimation from historical events
- **Significant uncertainty** exists in the damageability at the same level of the modeled wind speeds. Claims data indicates that **damage uncertainty can't be** modeled with simple parametric probability distributions
- A significant percentage of business interruption losses come from **indirect causes**
- Claims analysis confirms that hurricane damage penetrates **hundreds to thousands of miles from the coast**

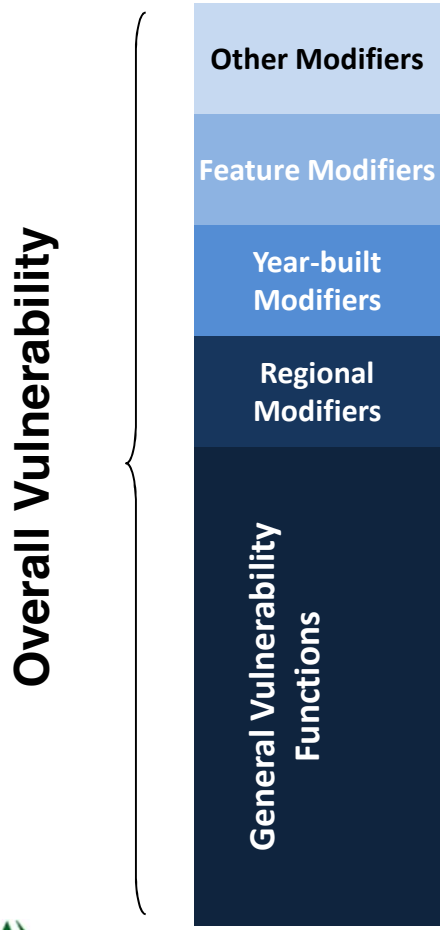
AIR Implemented a Comprehensive Approach to Model Spatial and Temporal Variations in Vulnerability

- AIR undertook an extensive, peer-reviewed study to understand the large number of building codes and standards that exist
- For each location and year-built, *model buildings* were defined in terms of secondary risk features such as roof covering type

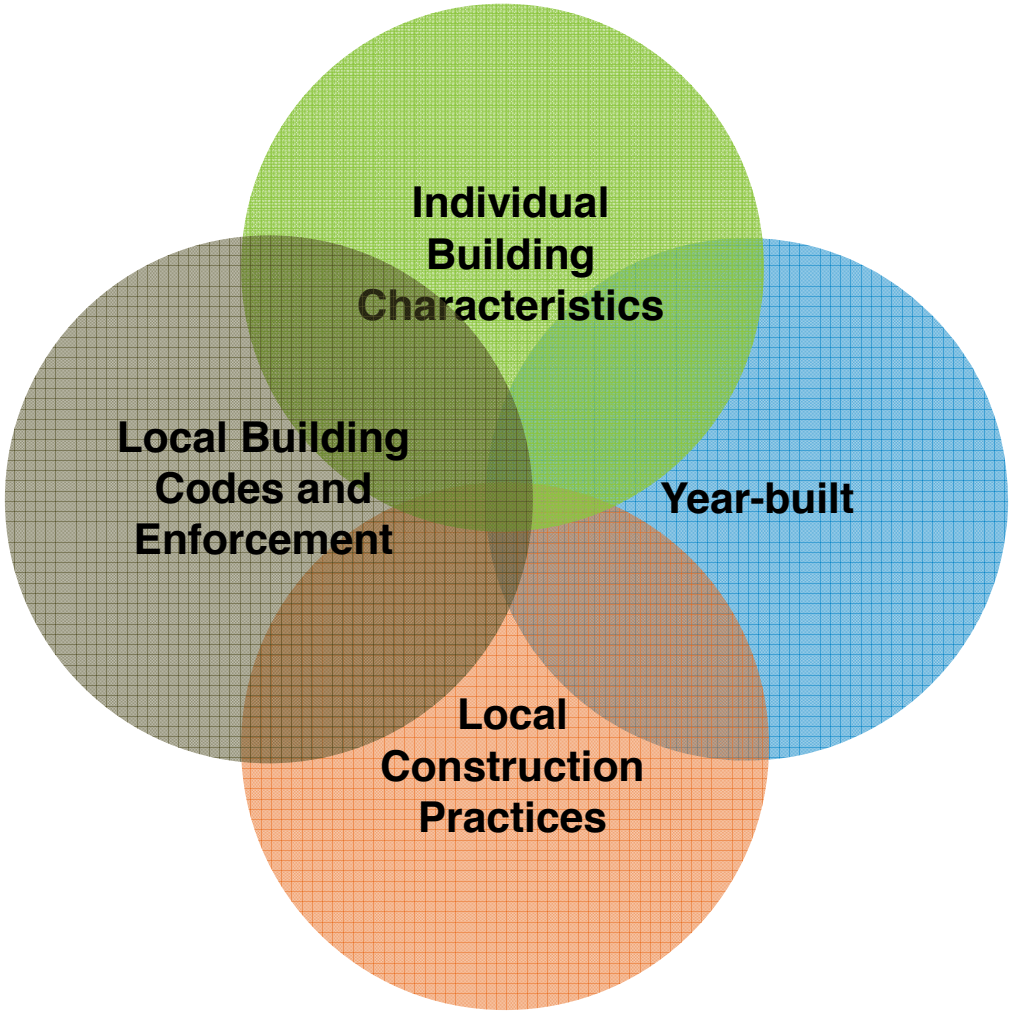


A Coherent Approach to Modeling Vulnerability Better Captures the Impact of Interrelated Building Characteristics

Typical Approach



AIR Enhanced Approach



Addition of New Individual Risk Feature "Seal of Approval"

Seal of Approval accounts for the *different* levels of engineering attention given to a design of a structure for the estimation of mitigation impacts to a well-built structure

Fully Engineered Structure:

The structure has been designed by a Professional Engineer. The Professional Engineer is required to seal the calculations and drawings by the local jurisdiction.

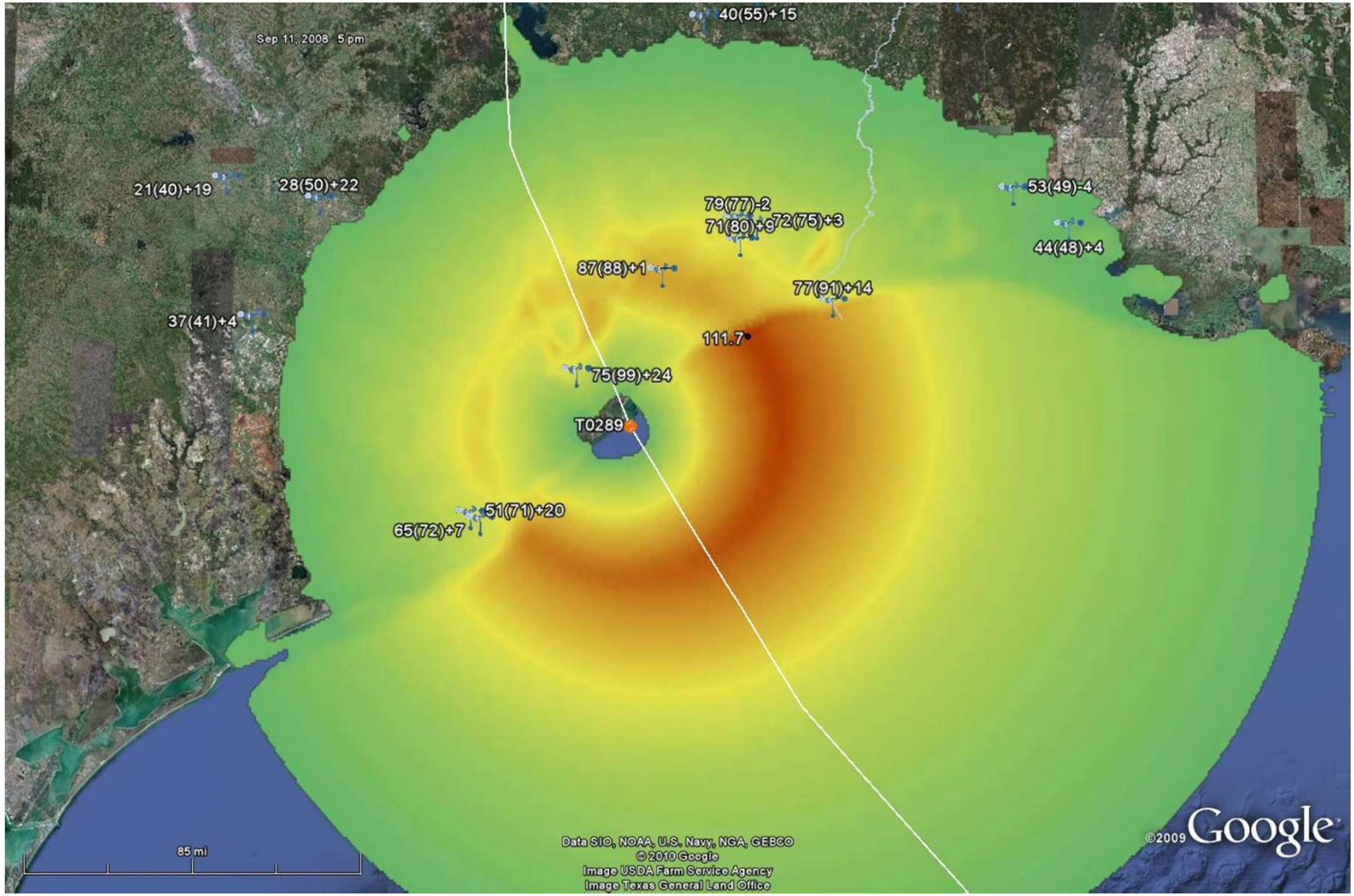
Partially Engineered Structure

The structure has been inspected by a Professional Engineer and found "deemed-to-comply" with the respective Building Code. The local jurisdiction does not require the Professional Engineer to seal the calculations.

Minimally Engineered Structure

The structure does not satisfy any of the conditions mentioned above.

An Unprecedented Set of Observation Data Enables More Robust and Detailed Hazard Validation



AIR's U.S. Hurricane Model Version 12.0 Sets a New Precedent for Comprehensive External Peer Review

Hazard

Dr. Kerry Emanuel, MIT

Dr. Peter Black, United States Naval Research Laboratory, Monterey

Dr. Robb Contreras, Areté Associates

Vulnerability

Dr. Joe Minor, Independent wind engineering consultant

Dr. David Rosowsky, Rensselaer Polytechnic Institute

Mr. Jay Crandell, P.E., ARES consulting

Mr. Tom Smith, TLSmith Consulting

Dr. Marc Levitan, Louisiana State University

Dr. Carol Friedman, Louisiana State University

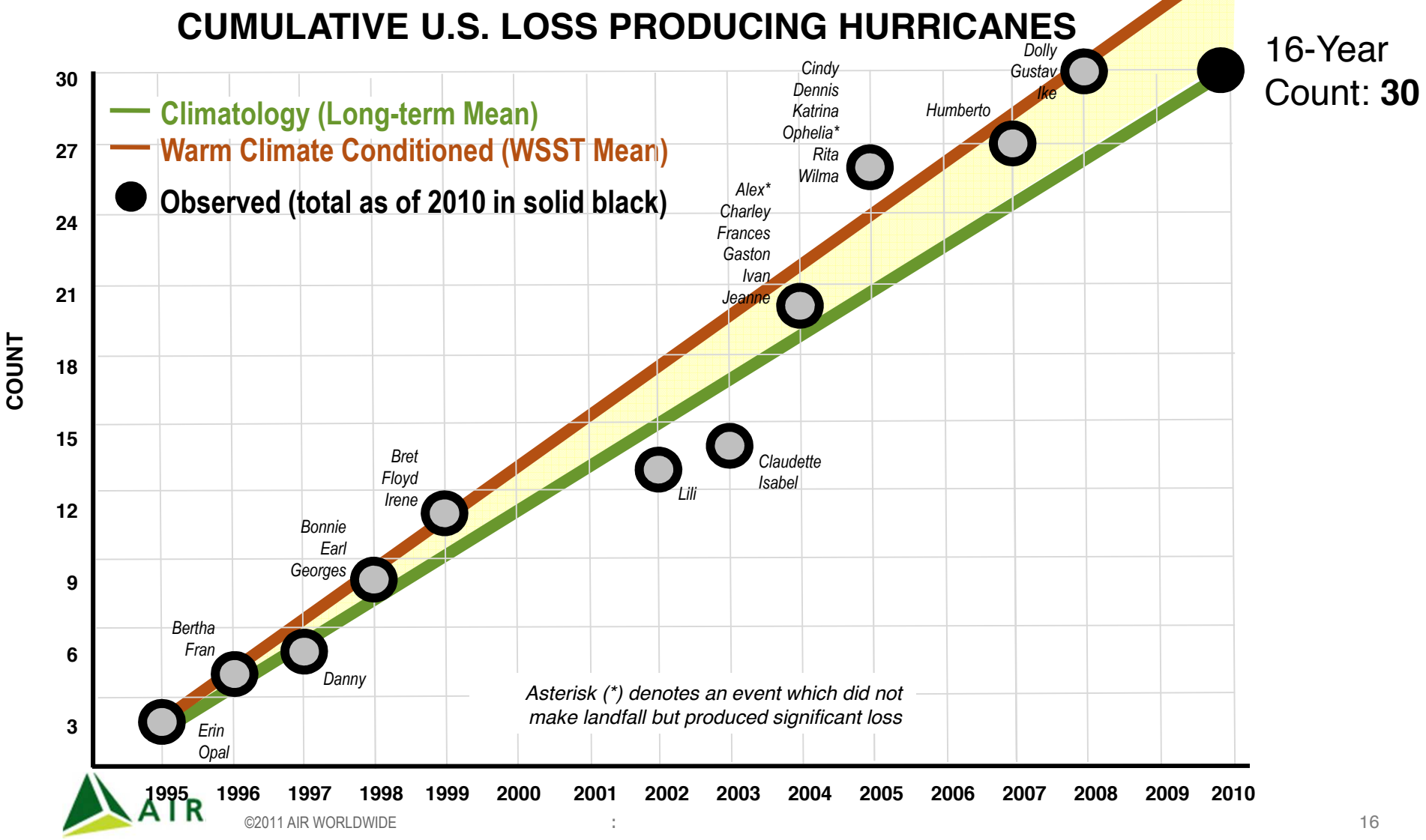
Warm Sea Surface Temperatures

AIR

AIR's Position on Long-Term Views of Risk

- The Standard Catalog is a long-term view of risk conditioned on the characteristics of all Atlantic hurricane seasons since 1900
- The Warm SST (WSST) Catalog is also a long-term view of risk, but conditioned on only those seasons since 1900 in which the Atlantic Ocean has been warmer than average (observed ~50% of the time)
- Neither of the stochastic catalogs was designed to "forecast" losses for the upcoming season because:
  - Year-to-year swings in TC activity are too large to make skillful forecasts of insured loss months or years in advance
  - There is no guarantee that the coming season will have anomalously warm SSTs
- Both views of risk are credible and scientifically valid, though the WSST catalog is based on less data, and is thus subject to elevated levels of uncertainty
  - Standard catalog is based on over 100 years of TC data and over 20 years of AIR research and development
  - WSST catalog is based on original peer-reviewed published research by AIR scientists which objectively measures the relationship between landfall risk and a warm ocean

U.S. Hurricane Activity During Recent Warm SST Atlantic Seasons Is In-Line with Long-Term Averages



Summary

- The AIR U.S. Hurricane Model Provides
  - A ***consistent*** and ***realistic*** view of hurricane risk
  - A ***comprehensive*** view of hurricane risk
  - ***Superior risk differentiation*** based on such factors as geography, construction, occupancy, year built and individual building characteristics
- The AIR U.S. Hurricane model has been subjected to ***an unprecendented level of validation*** to provide information about potential losses ***before they occur***