Tropical Cyclone Catastrophe Modeling for the North Atlantic Basin on the Oasis Platform

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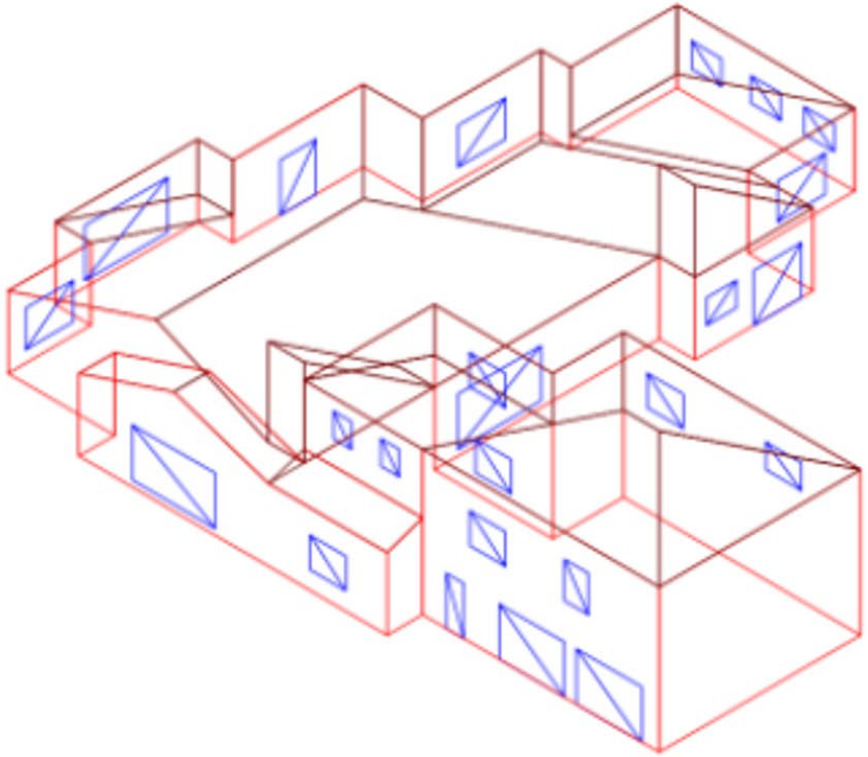
HurLoss Model Background

- First major peril model implemented on Oasis LMF (2017)
- Available on Nasdaq Risk Modelling for Catastrophes (NRMC) platform
- Input/output via Open Data Standards
- Accessible from Moody's RMS Intelligent Risk Platform (June 30, 2024)

Major Updates in Oasis-HurLoss 3.0

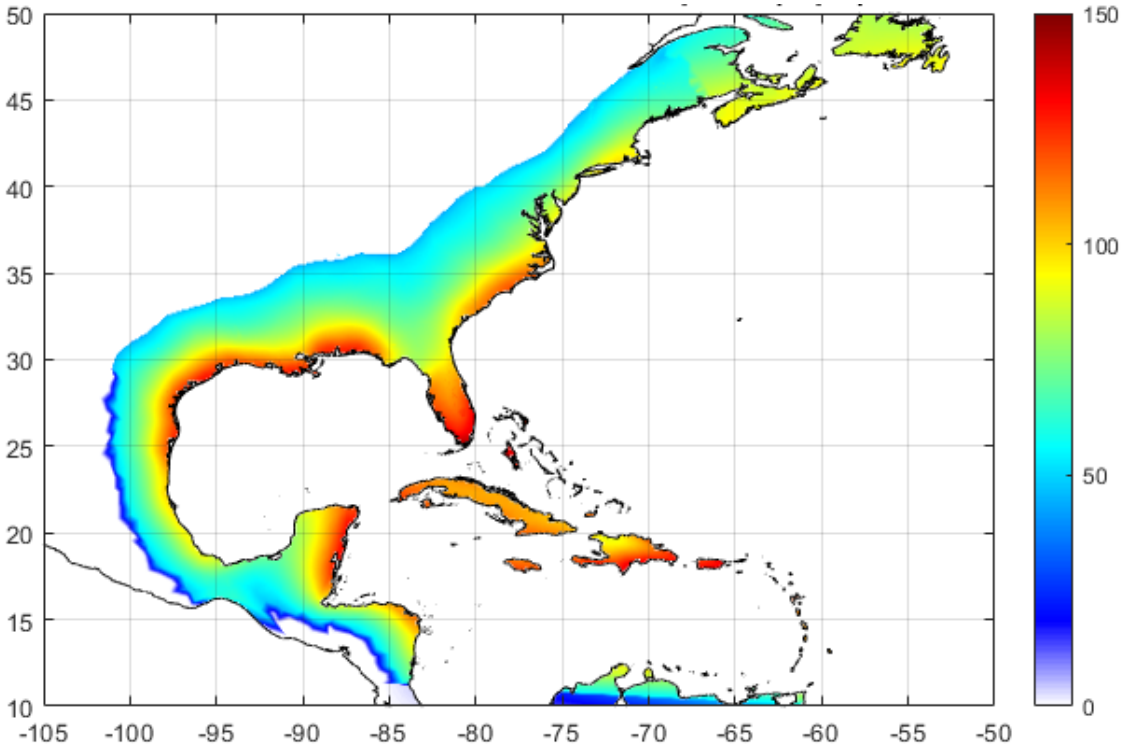
- Hurricane event set
- Long-term, current and future climatology
- Storm surge
- Surface roughness
- Vulnerability modeling
  - Florida Building Code changes
  - High-value homes



Updated and Expanded Hurricane Event Set

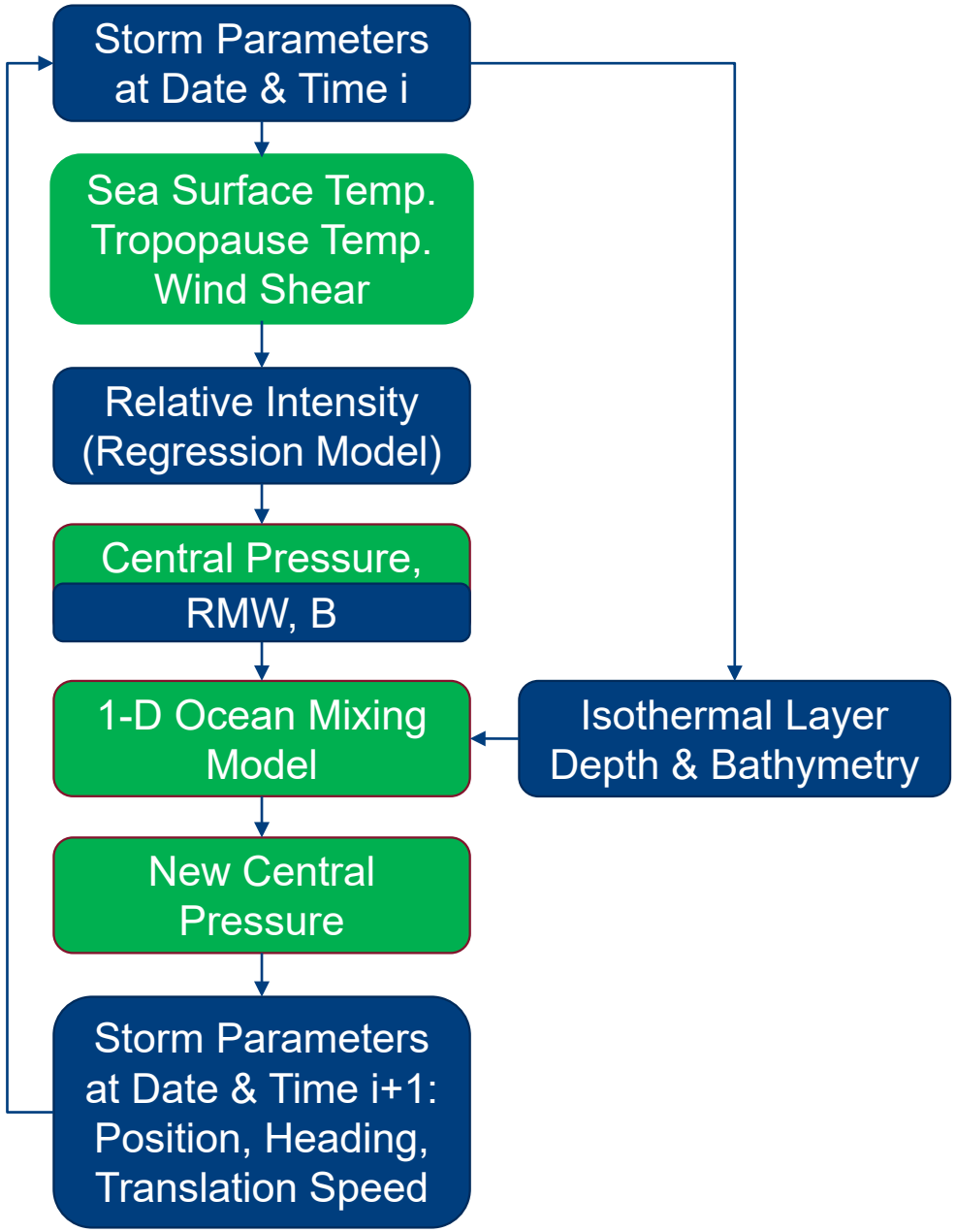
- Full North Atlantic basin model
  - U.S., Caribbean, Bermuda, and eastern portions of Canada, Mexico, and Central America
  - 37 new countries or territories
- Full track modeling approach ensures proper correlation of hurricane hazard throughout basin

100-Year Return Period Peak Gust Wind Speed (mph)



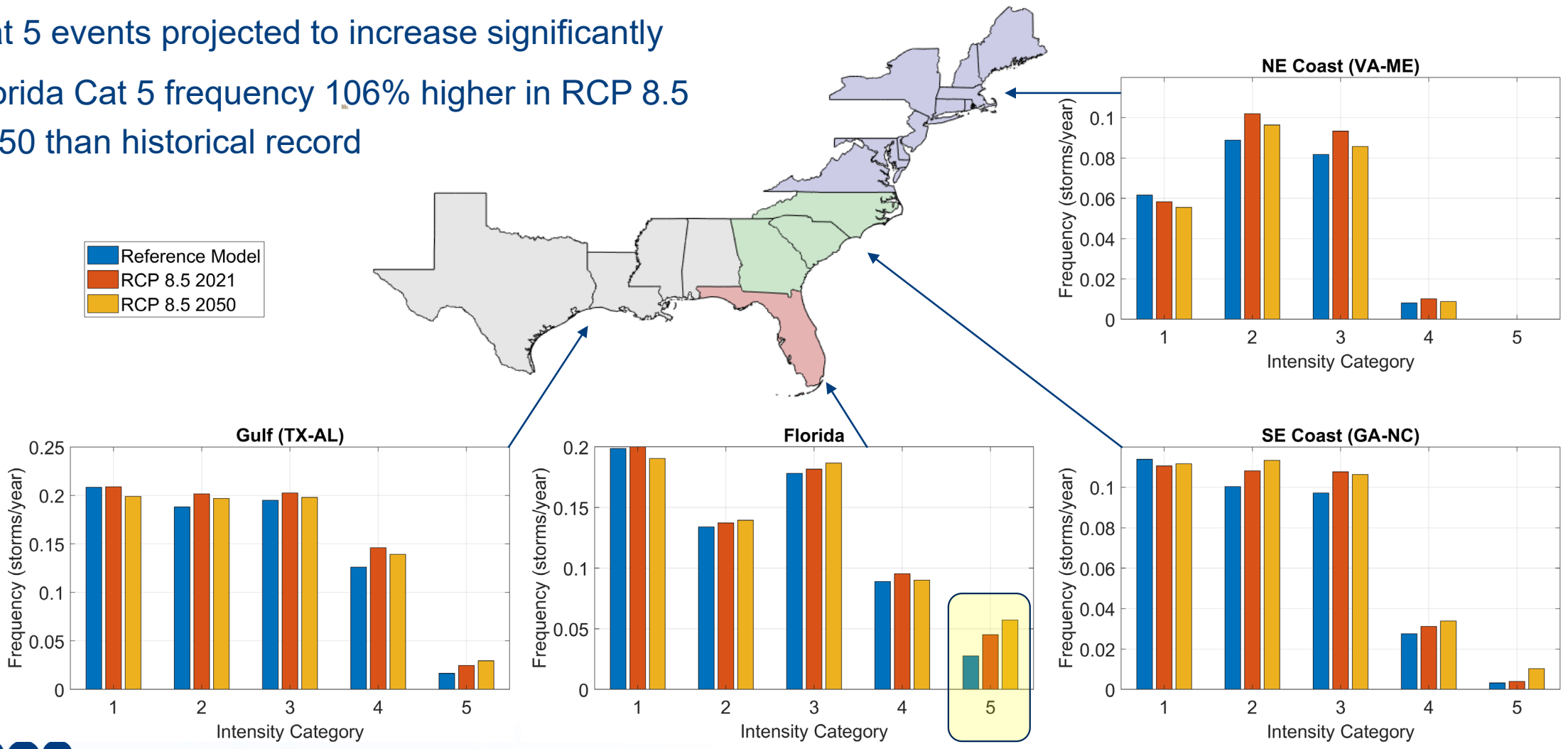
Climate Change: Approach

- Replace historical environmental data from re-analysis with GCM outputs in existing physically-based hurricane model
  - Sea surface temperature
  - Tropopause temperature
  - Vertical wind shear
- Increasing ΔT → more intense events
- Increasing wind shear → lower intensity and frequency
- Model quantifies the net effect



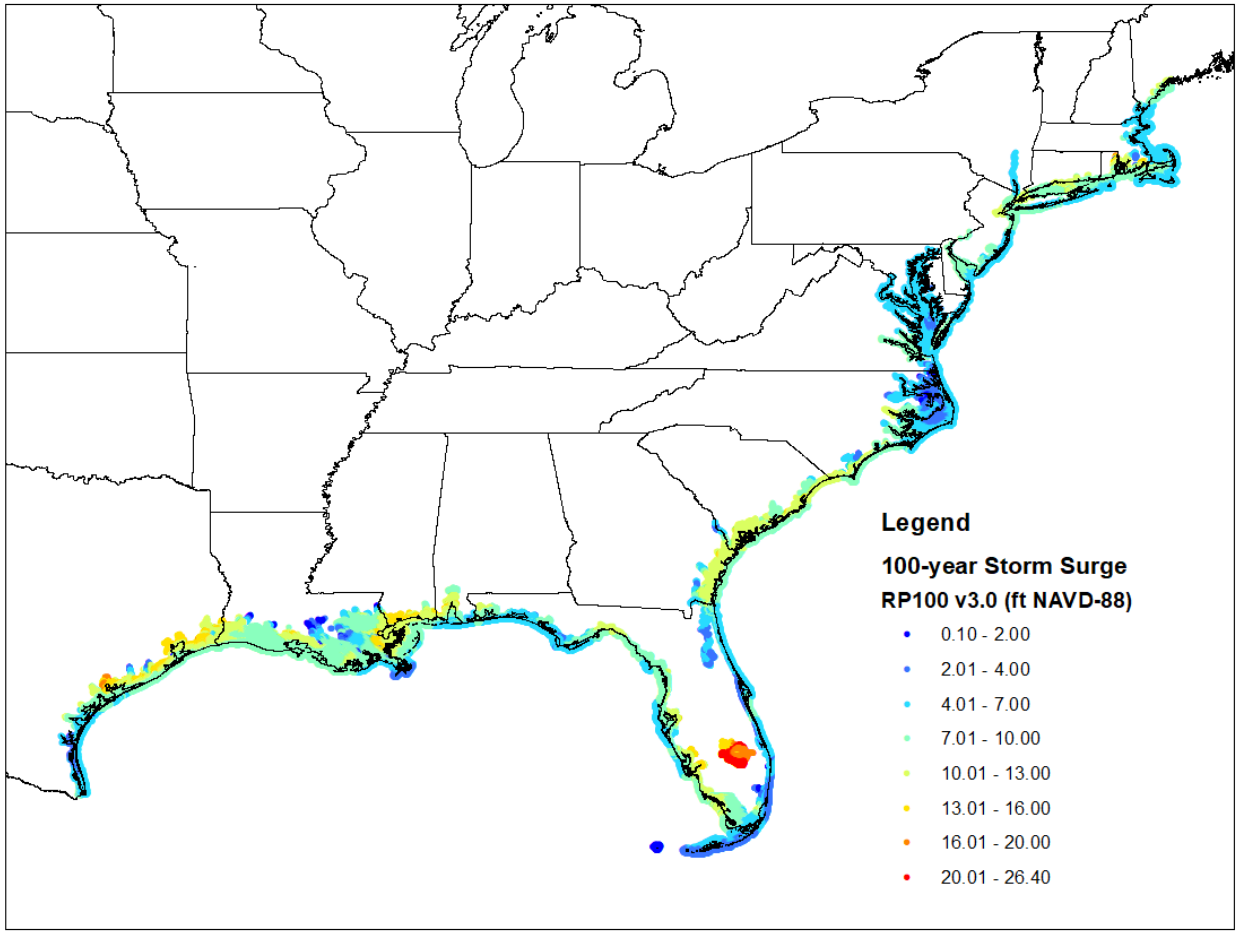
Climate Change Results: Intensity and Frequency

- Cat 5 events projected to increase significantly
- Florida Cat 5 frequency 106% higher in RCP 8.5 2050 than historical record

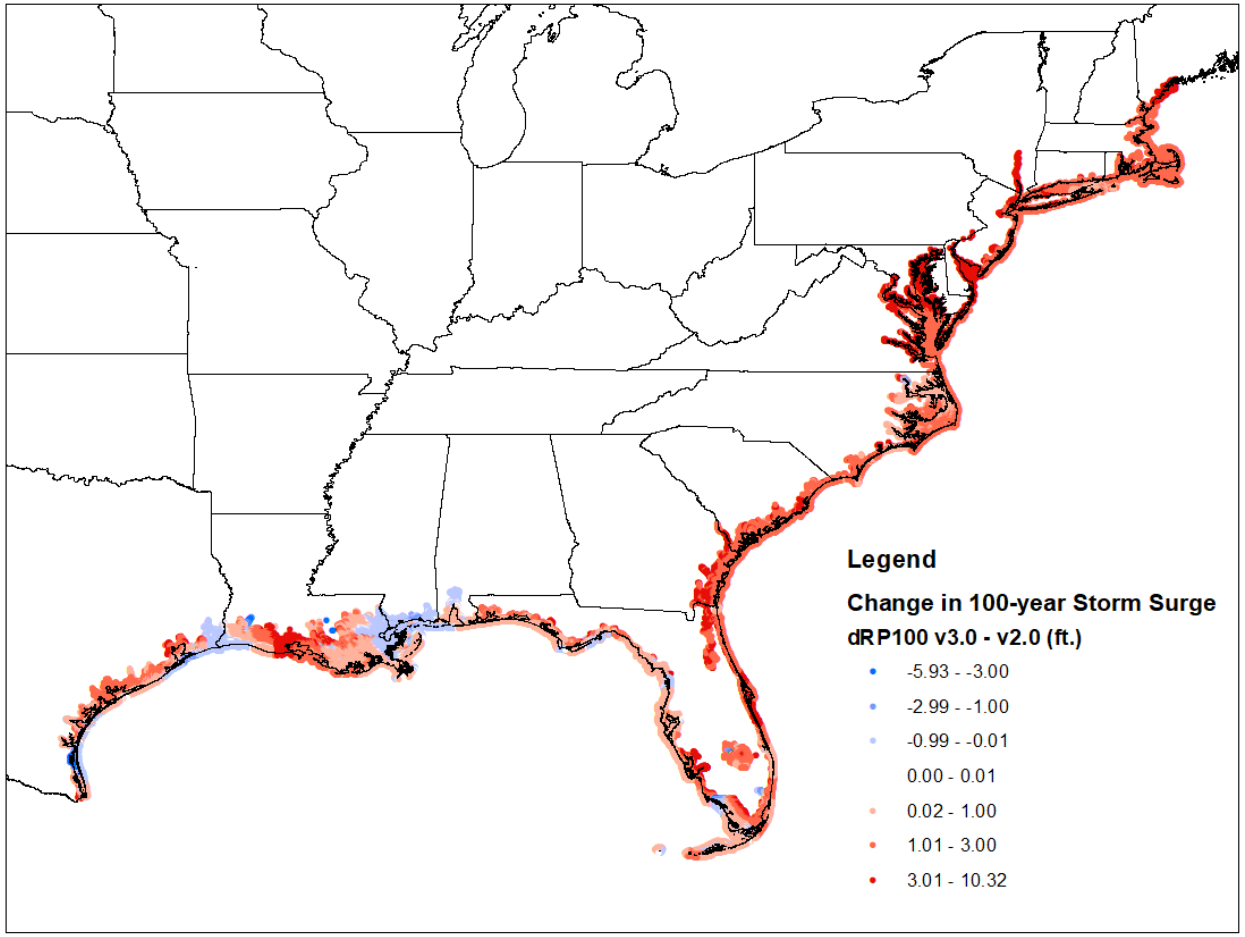


Storm Surge

100-Year Return Period Still Water Elevation (ft, NAVD-88)

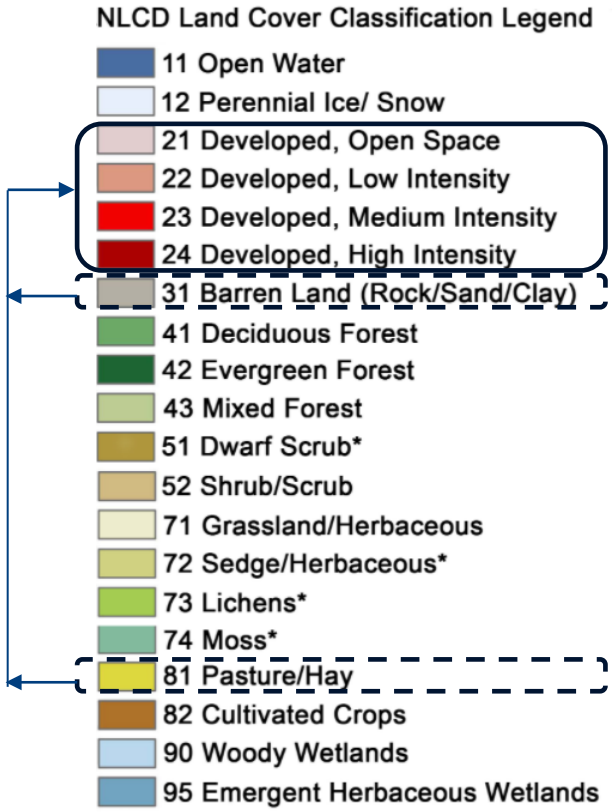


Increase from v2.0 (ft) – primarily due to addition of wave set-up

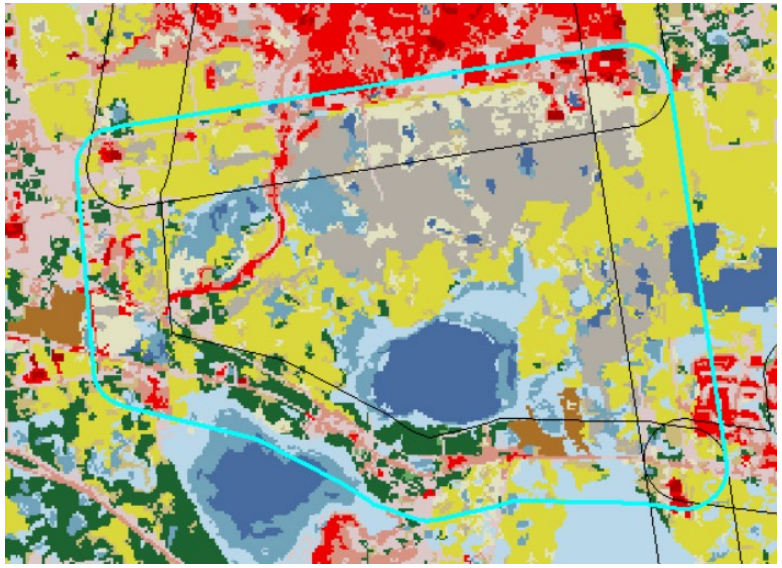


Surface Roughness

- Changes in land use and tree canopy coverage

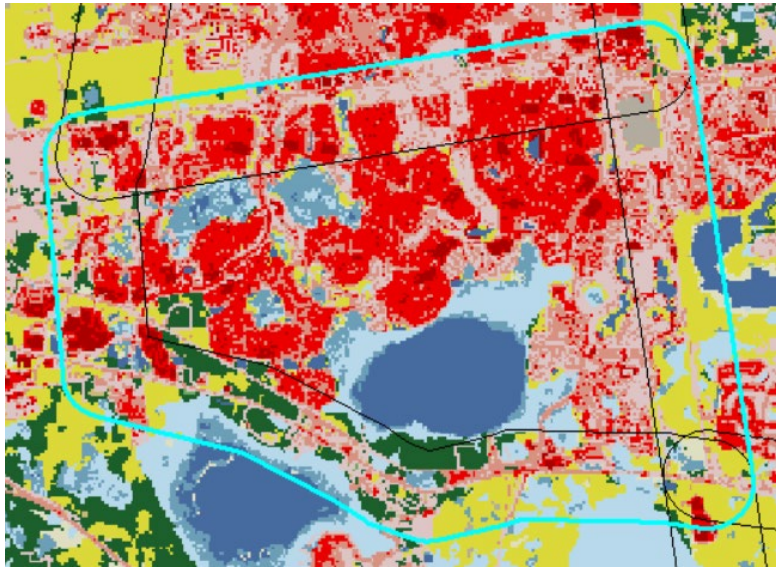


NLCD 2011



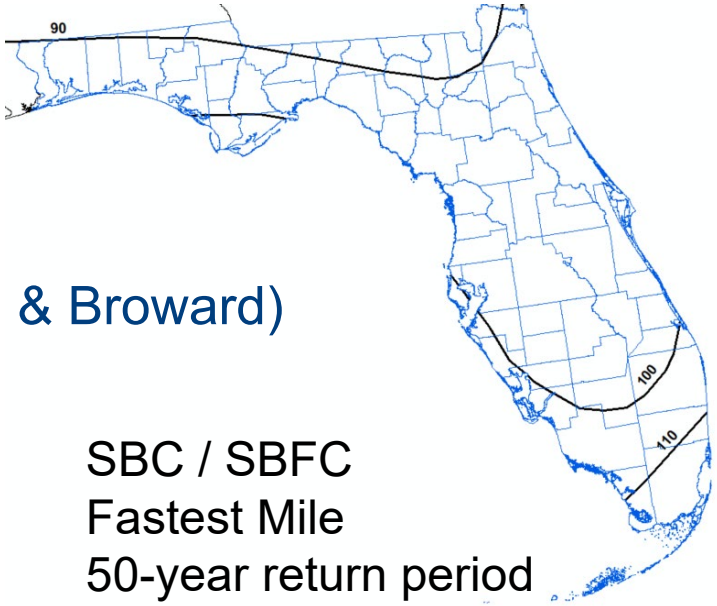
NLCD 2019

45% increase in z_0 → 20% decrease in AAL/TIV

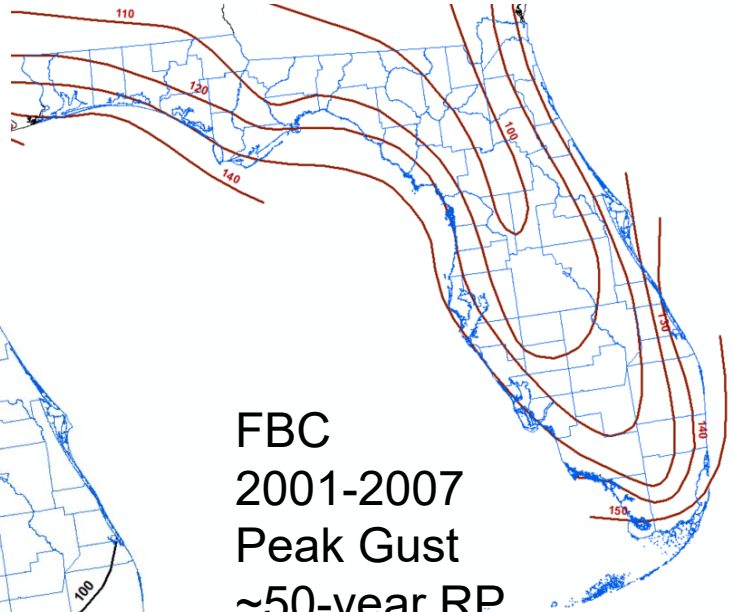


Post-1994 Florida Construction

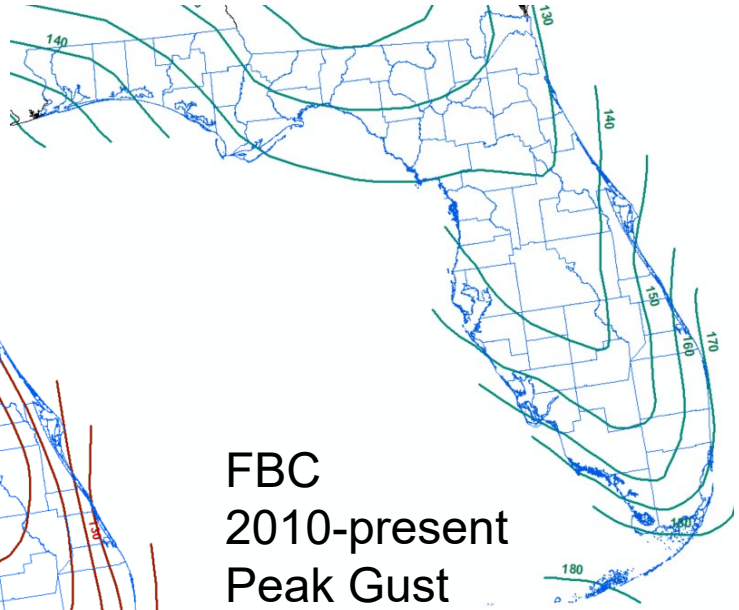
- 4 Year-Built Eras (was 2)
  - 1995-2002
  - 2003-2007
  - 2008-2012
  - 2013-present
- 5 Regions (was 4)
  - Monroe
  - HVHZ (Miami-Dade & Broward)
  - Palm Beach
  - WBDR
  - Non-WBDR



SBC / SBFC
Fastest Mile
50-year return period
WBDR = SFBC only



FBC
2001-2007
Peak Gust
~50-year RP
Wind Load Factor = 1.6
WBDR = 120+ or
110+ within 1-mile of coast
Panhandle exception in FBC 2001, 2004

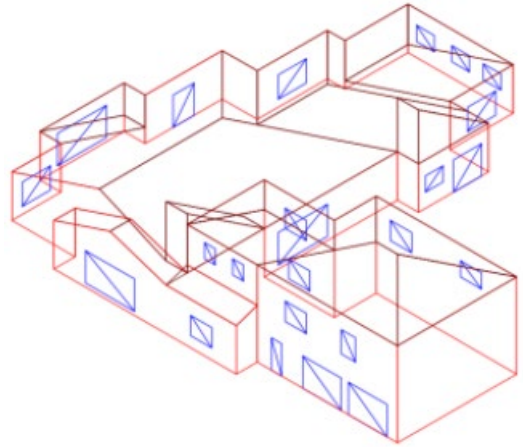


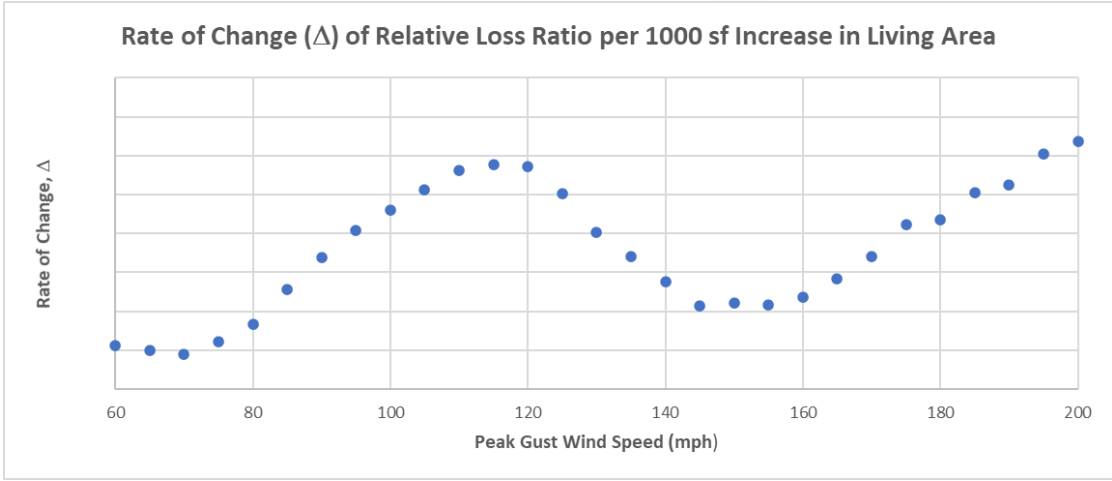
FBC
2010-present
Peak Gust
700-year RP
Wind Load Factor = 1.0
WBDR = 140+ or
130+ within
1-mile of coast

High-Value Homes

Reduced losses in high-value homes (when normalized by building TIV)

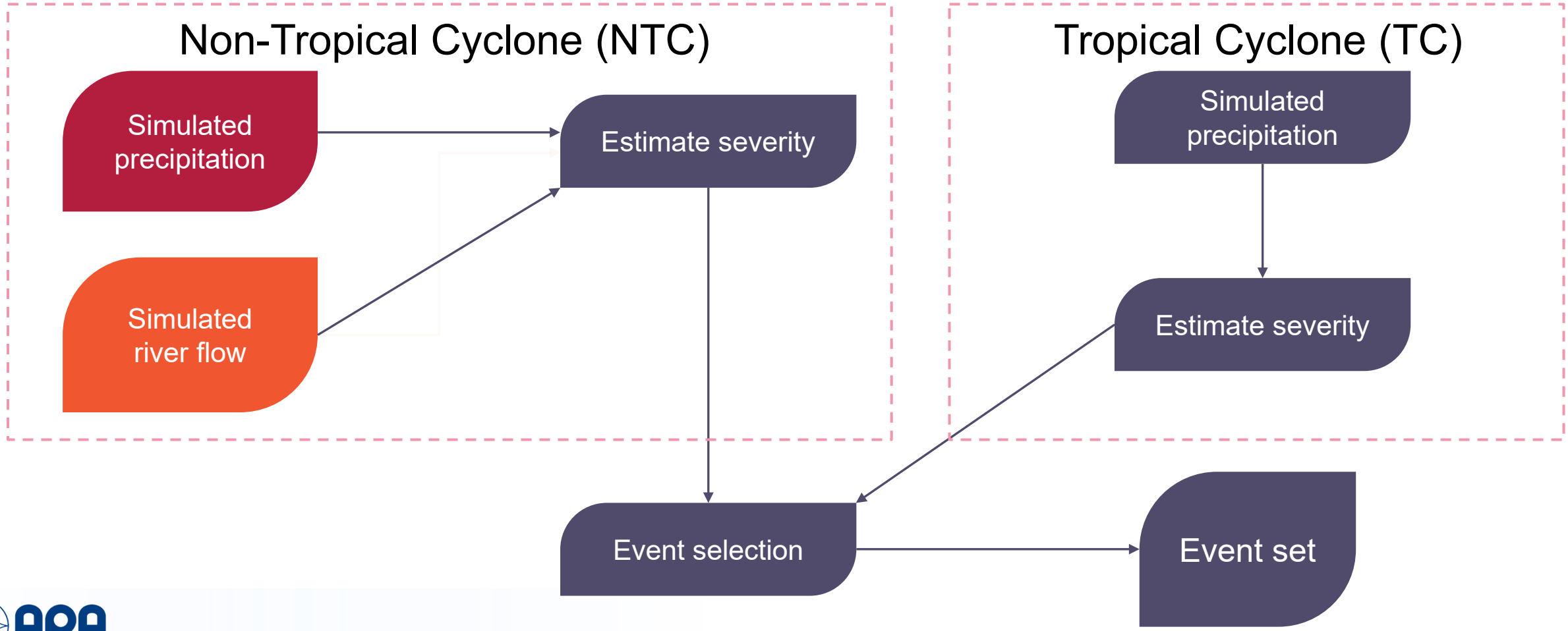
1. Higher proportion of building value in interior finishes
2. Reduced “low-end” losses
   - Minor losses to siding, exterior fixtures, soffits, fascia, gutters, etc. increases with building perimeter
   - Building value increases with living area
3. Generally better design & construction



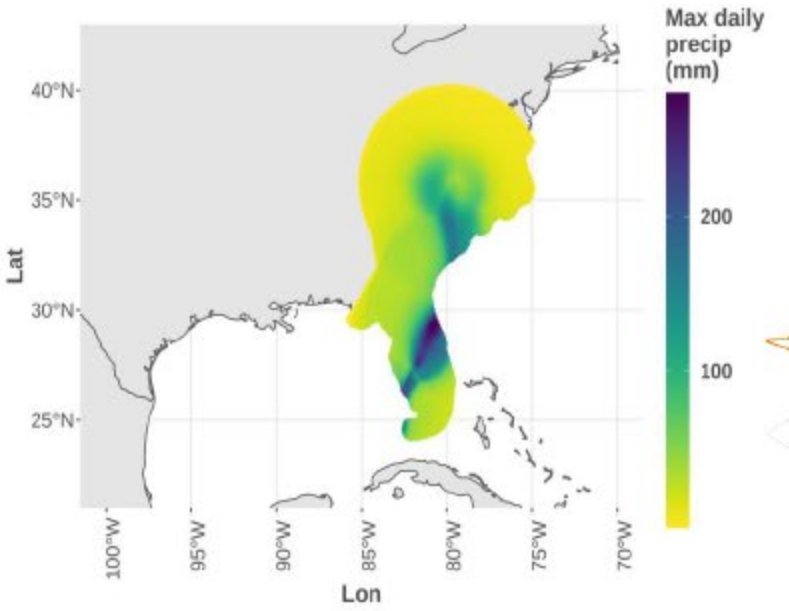


Correlated Hurricane and Flood Modeling with JBA risk management THE FLOOD PEOPLE

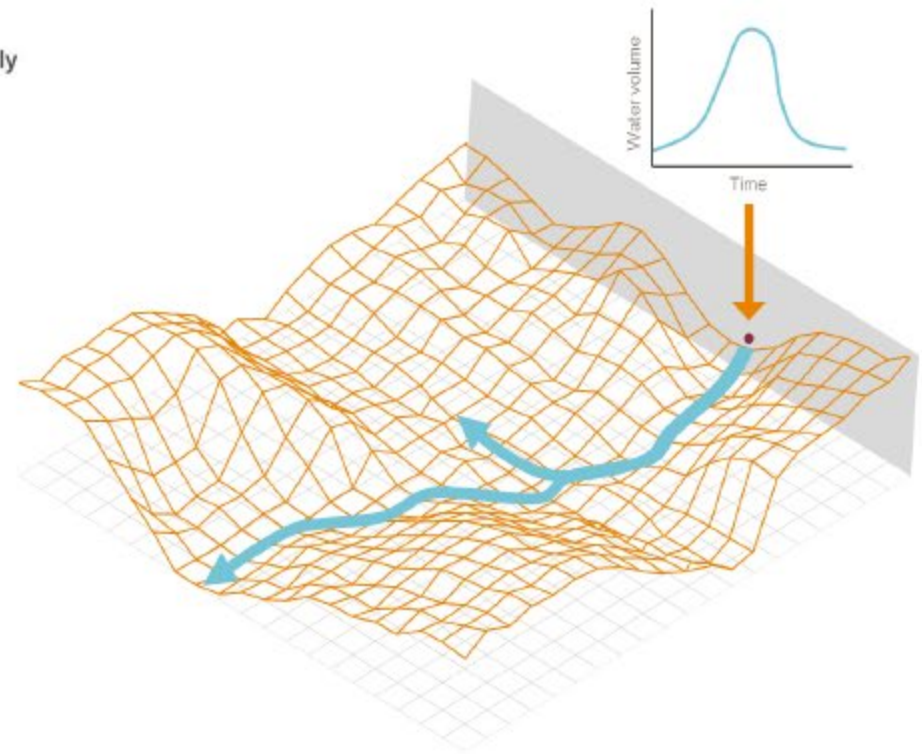
- Key challenge: bring together two event sets with different durations and weights



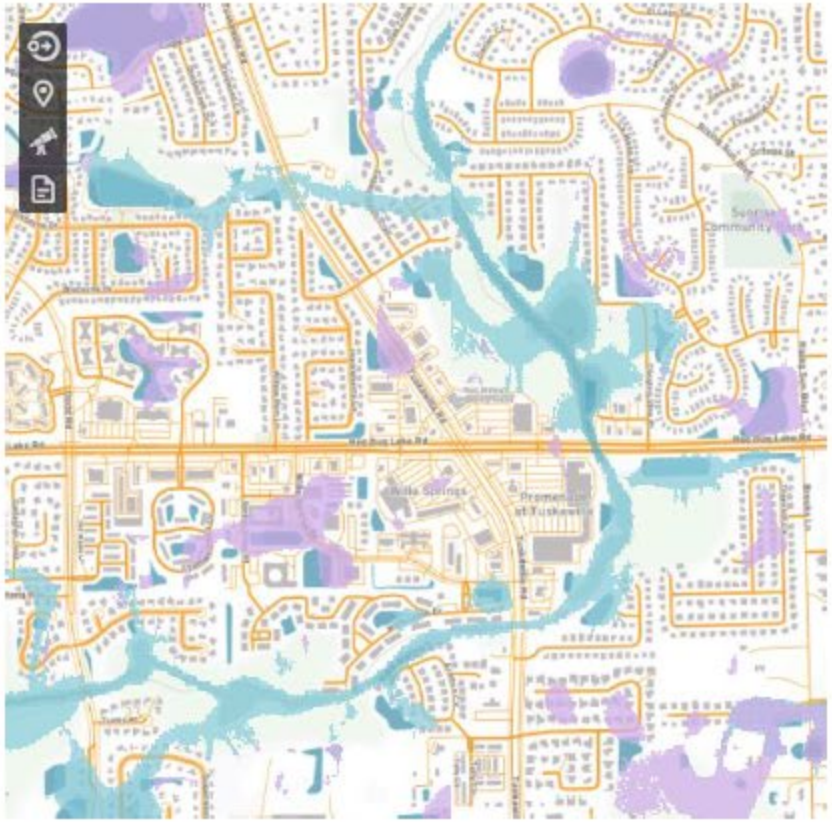
Correlated Hurricane and Flood Modeling with JBA risk management THE FLOOD PEOPLE.



TC rainfall



Simulated catchment response



Data granularity

Correlated Hurricane and Flood Modeling with JBA risk management and THE FLOOD PEOPLE.

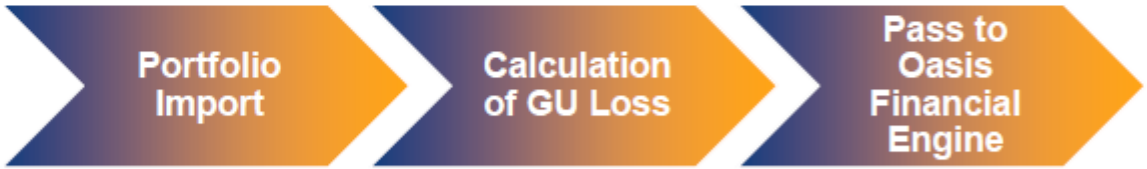
Implementation on:

OASIS LOSS MODELLING FRAMEWORK

Nasdaq

Aiming for single workflow

ODS Open Data Standards



Event ID	ARA Output	JBA Output	Event Type
Event_1	$1,374,202		TC Wind
Event_2	$901,690	$1,203,376	TC Wind & Flood
Event_3		$1,111,107	NTC Flood
Event_4	$615,545		TC Wind
Event_5	$875,431		TC Wind
Event_6		$136,414	NTC Flood
Event_7		$814,061	NTC Flood
Event_8	$1,749,189	$147,149	TC Wind & Flood
Event_9	$1,600,854	$1,284,078	TC Wind & Flood

Summary

- Oasis-HurLoss 3.0 (available now on NRMC)
  - Updated and expanded hurricane event set
  - Long-term, current and future climatology views
  - Updated and expanded storm surge with wave set-up
  - Florida Building Code changes
  - High-value homes
- Accessible from Moody's RMS Intelligent Risk Platform (June 30, 2024)
- Fully correlated U.S. hurricane and flood model with JBA (2024 Q4)

Thank You

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