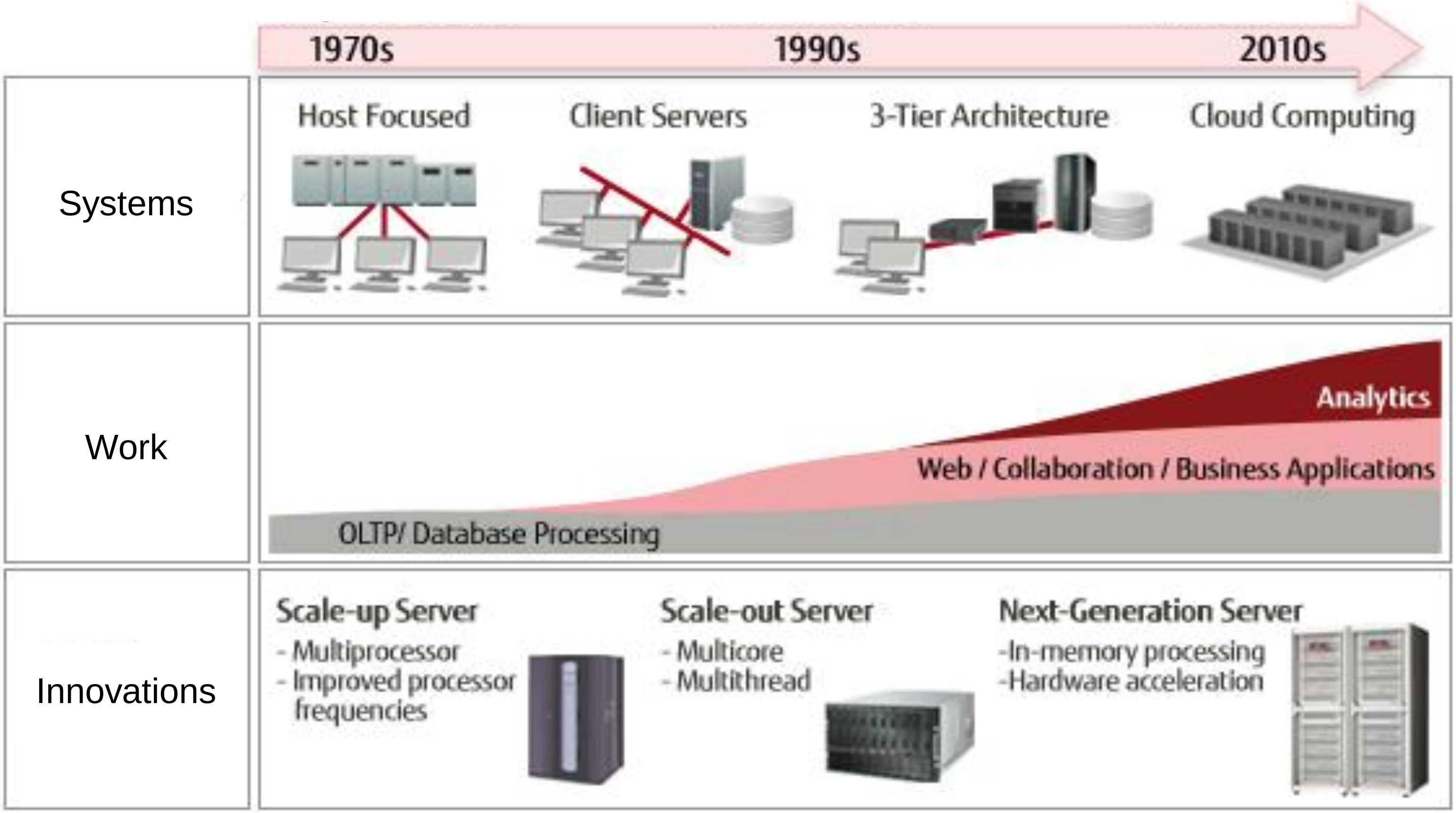
A Short History of Computing Technology

http://alphabytesoup.files.wordpress.com

Technology Trends Drive "Hi-Res" Computer Modeling

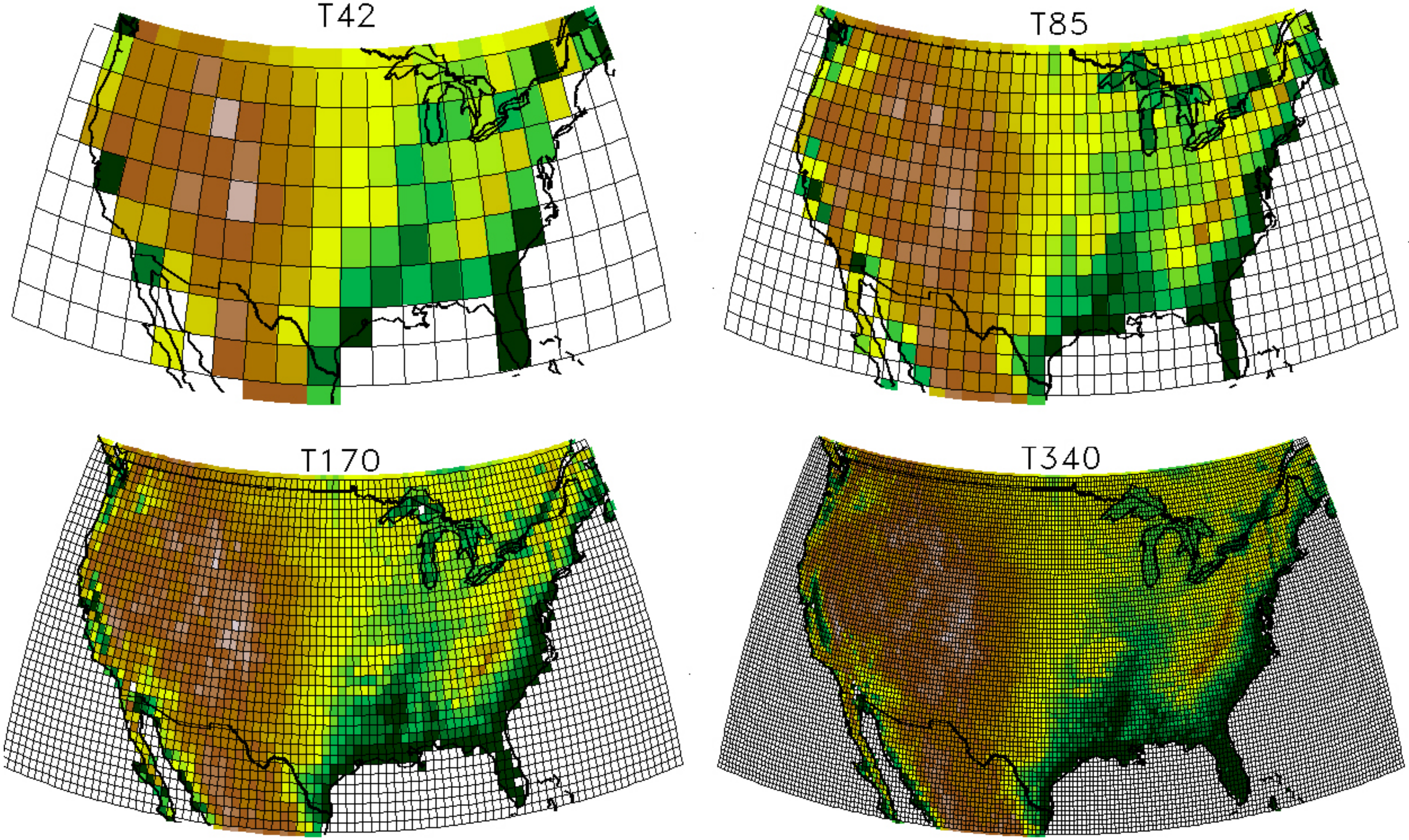


http://www.fujitsu.com

Examples

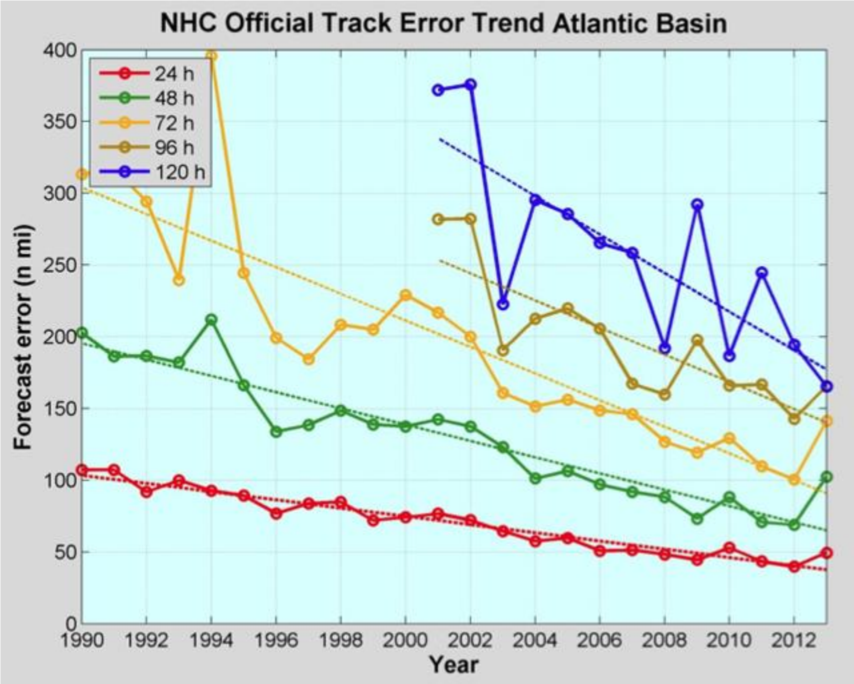
- Faster processors (Moore's Law)
- Multiple cores and processors
- Grid and Cloud Computing

Climate Research Gains with Advances in Computing Power



https://www2.ucar.edu/news/understanding-climate-change-multimedia-gallery

Hurricane Forecasts Have Improved with Better Technology



- 60% reduction in 1-3 day track forecast errors in last 24 years
- 40% reduction in 4-5 day track forecast errors in last 13 years

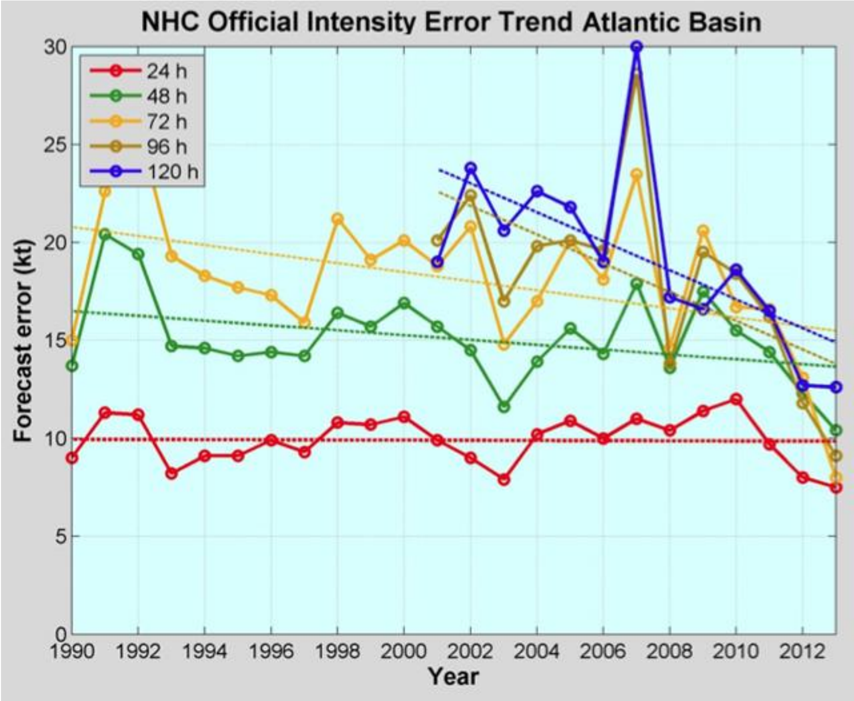


Image credit: 2013 National Hurricane Center Forecast Verification Report

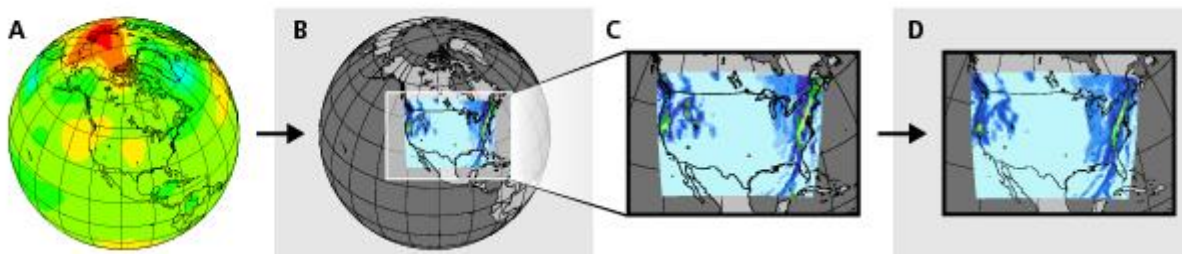
Jeff Masters' Wunderblog. August 2014

- Noticeable improvement in intensity forecasts for 2013
- Improvements attributed to
  - Higher resolution grids
  - Better physical models

Catastrophe Models are Increasingly High Resolution

- RMS to deliver “HD models” with their RMS(one) Platform
- AIR increasing resolution of models, including flood

http://riskinc.com/Publications/rmsone-brochure.pdf



http://www.air-worldwide.com/Publications/AIR-Currents/2013

Applications of high resolution models for catastrophes

- Higher resolution grids for hazard models
- More detailed industry exposure databases
- Additional damage functions, building details, and financial terms

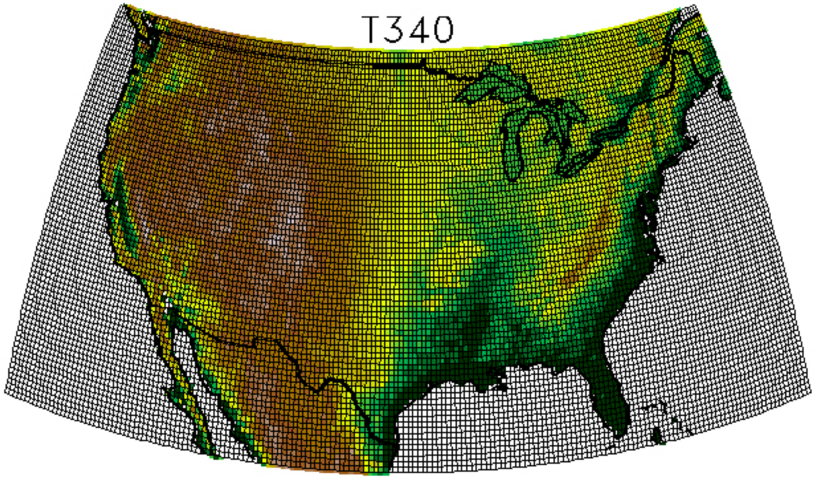
Will CAT Models become more Accurate in “Hi Res”?

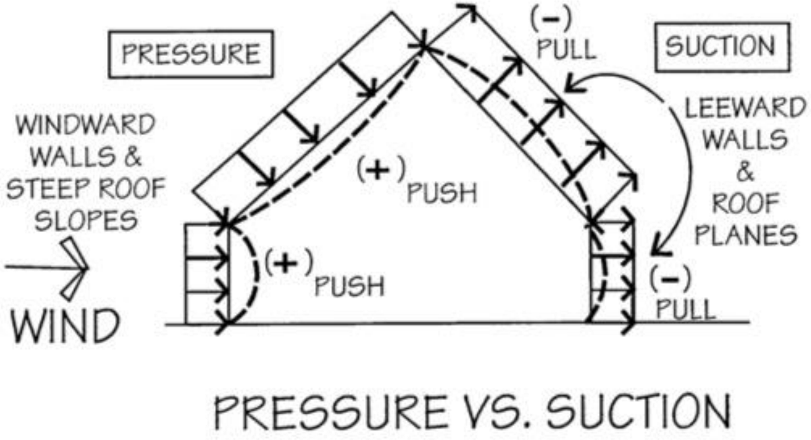
Perhaps…. But probably not *. There are limitations:

- Scale of the problem
- Accuracy of underlying data
- Reliance on empirical relationships and simplifying assumptions

* Some exceptions

Important Processes Occur at Very Small Spatial Scales

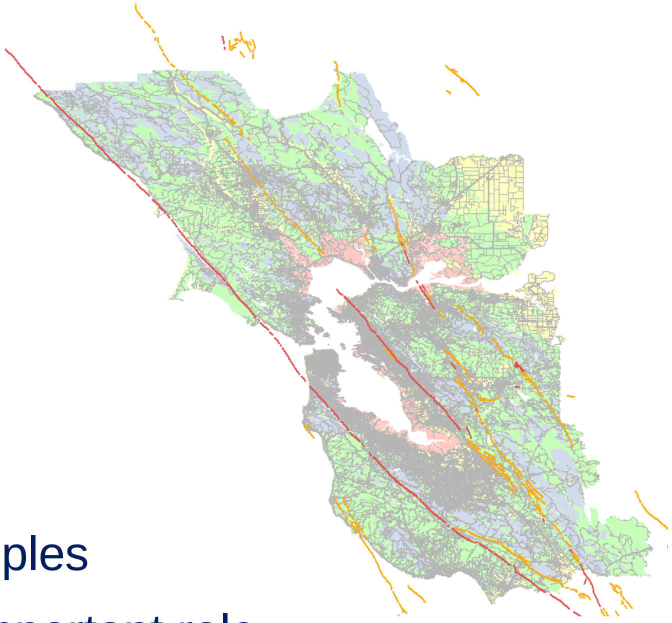




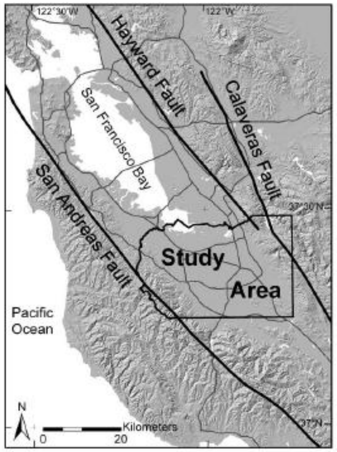
Weather and Climate ~ Order of (km)

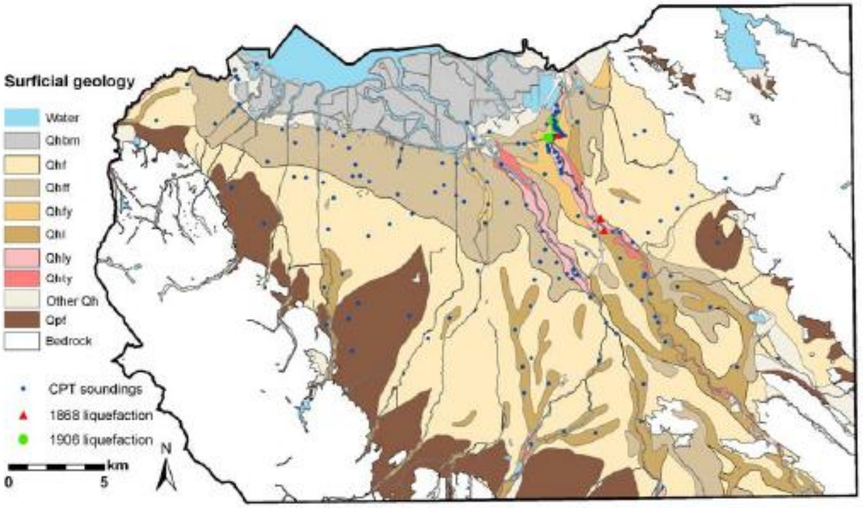
Wind Loads on Buildings ~ Order of (m)

Inaccuracies in underlying data is unavoidable

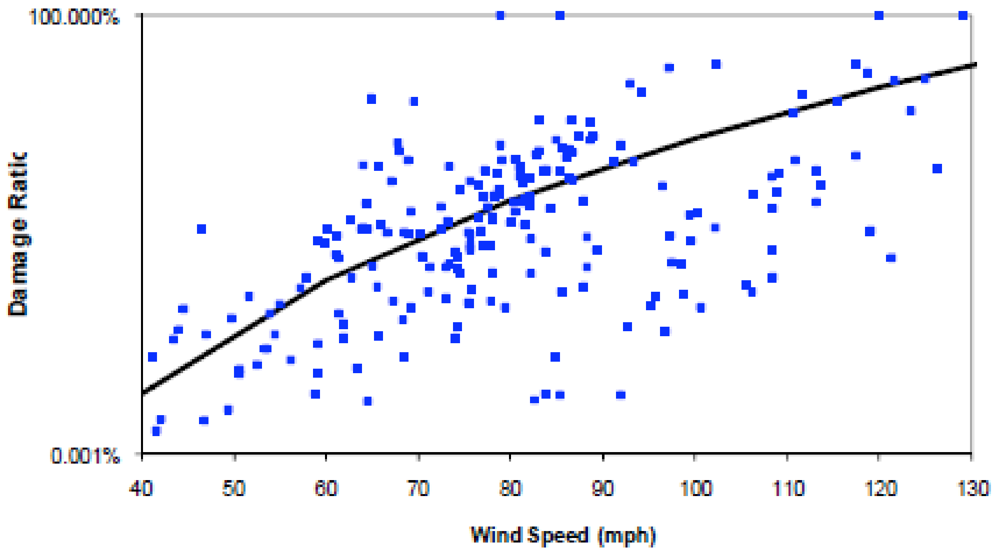


- Fault locations are approximately mapped
- USGS: "Surface geology provides only a rough estimate of the site effect."
- Even the highest resolution data is limited
  - Practical limitations to number of soil samples
  - Other factors (e.g., water table) play an important role

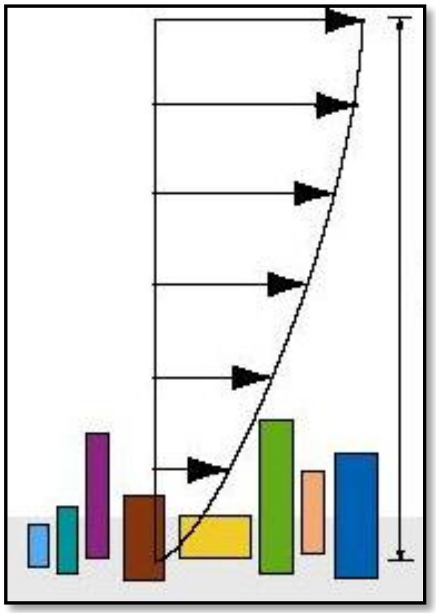




Empiricism and Simplifying Assumptions are Widely Used



Widely scattered claims information



Roughness ~ F(land use)

Data: http://www.iawe.org/Proceedings/11ACWE/11ACWE-Jain.Vineet2.pdf

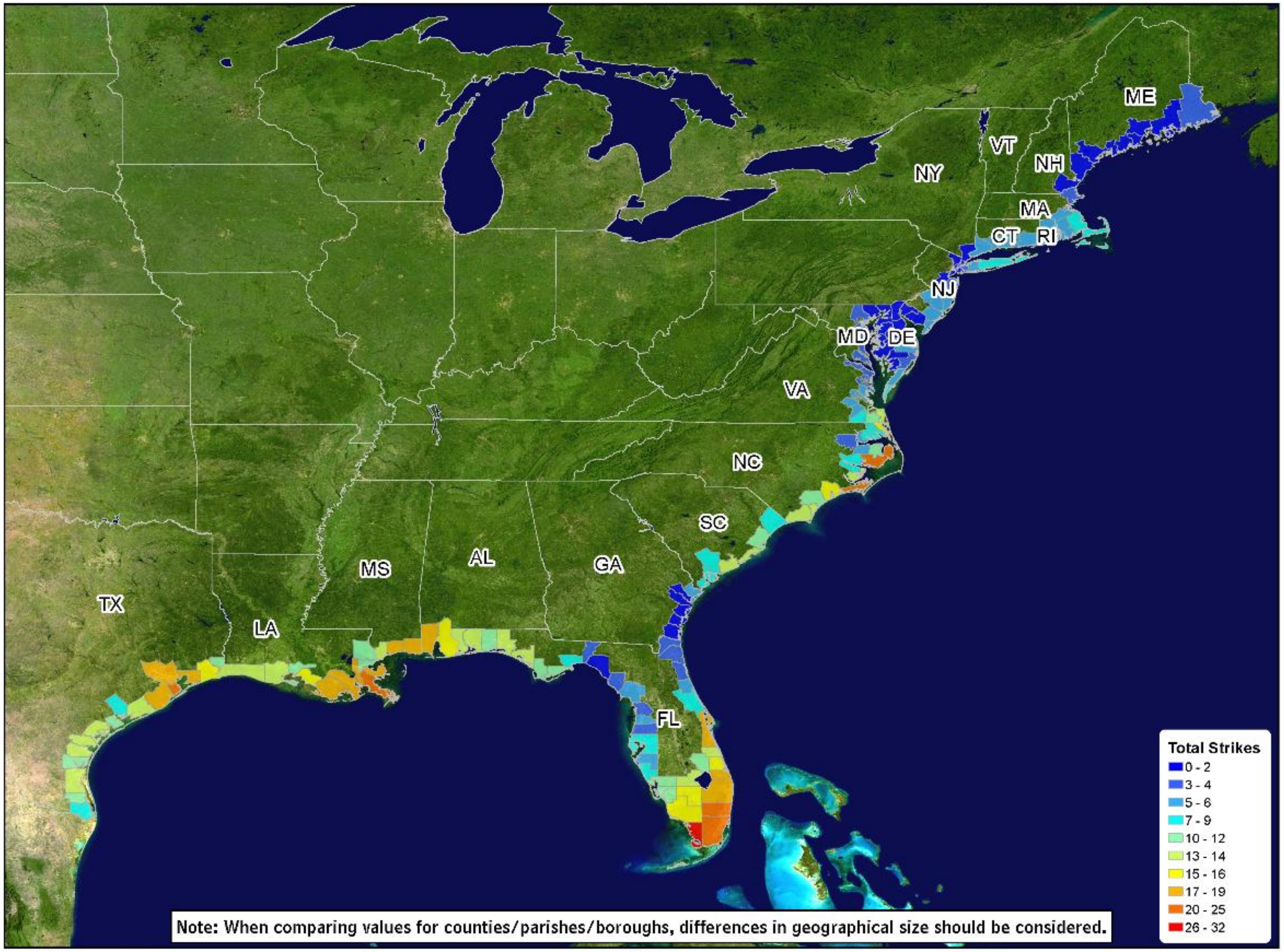
Additional Computing Power can be Deployed to Gain Insight

- Additional analyses, to monitor exposure changes
- Longer catalogs, to increase tail convergence
- More scenarios, to improve geographic coverage
- Multiple samples, to stress-test model assumptions

Practical Examples

- Simulating frequency-severity assumptions
- Hurricane Modeling with RiskInsight
- Surge modeling with Oasis

The Historical Hurricane Landfall Record is Short ….

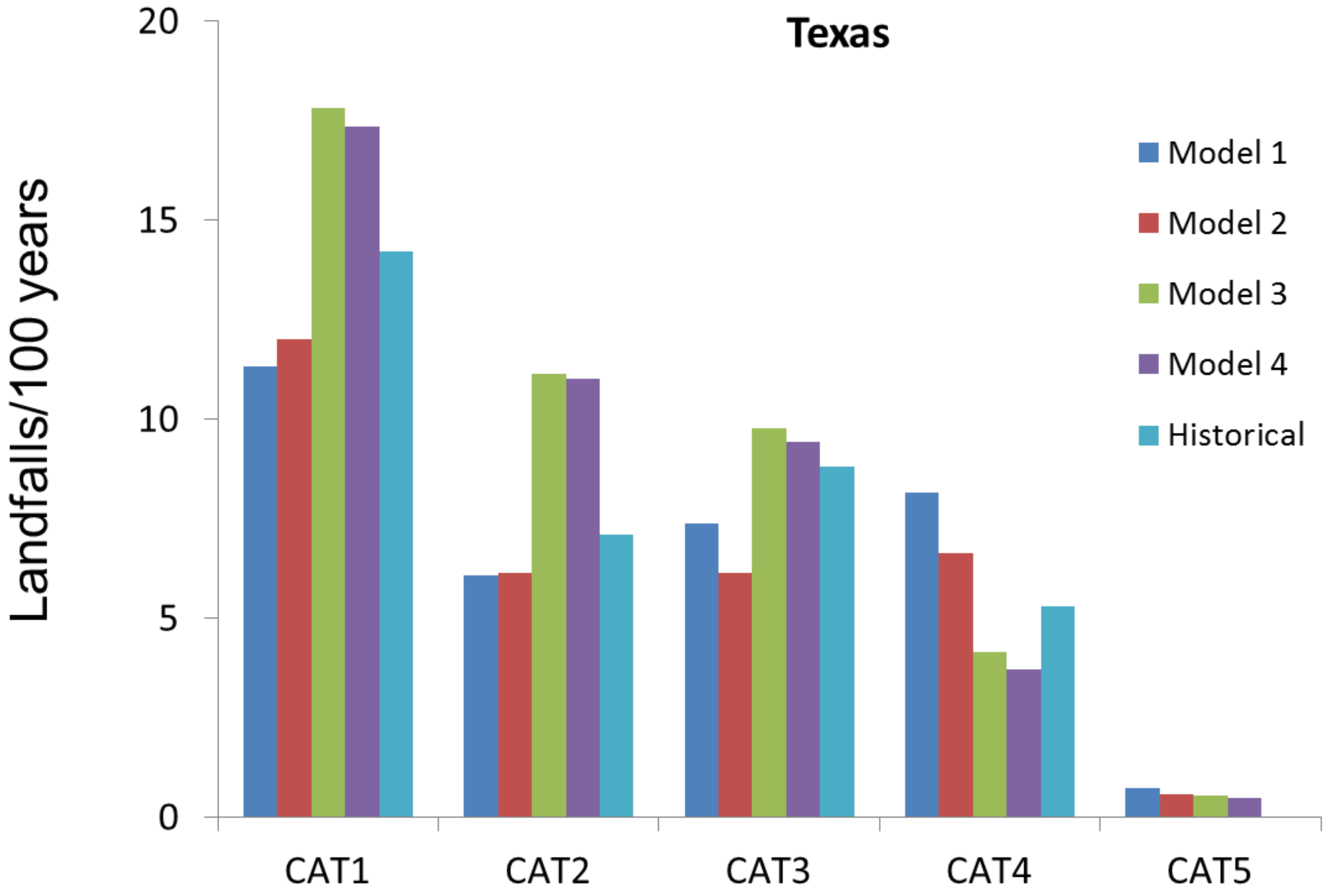


Total number of hurricane strikes by counties/parishes/boroughs, 1900-2010

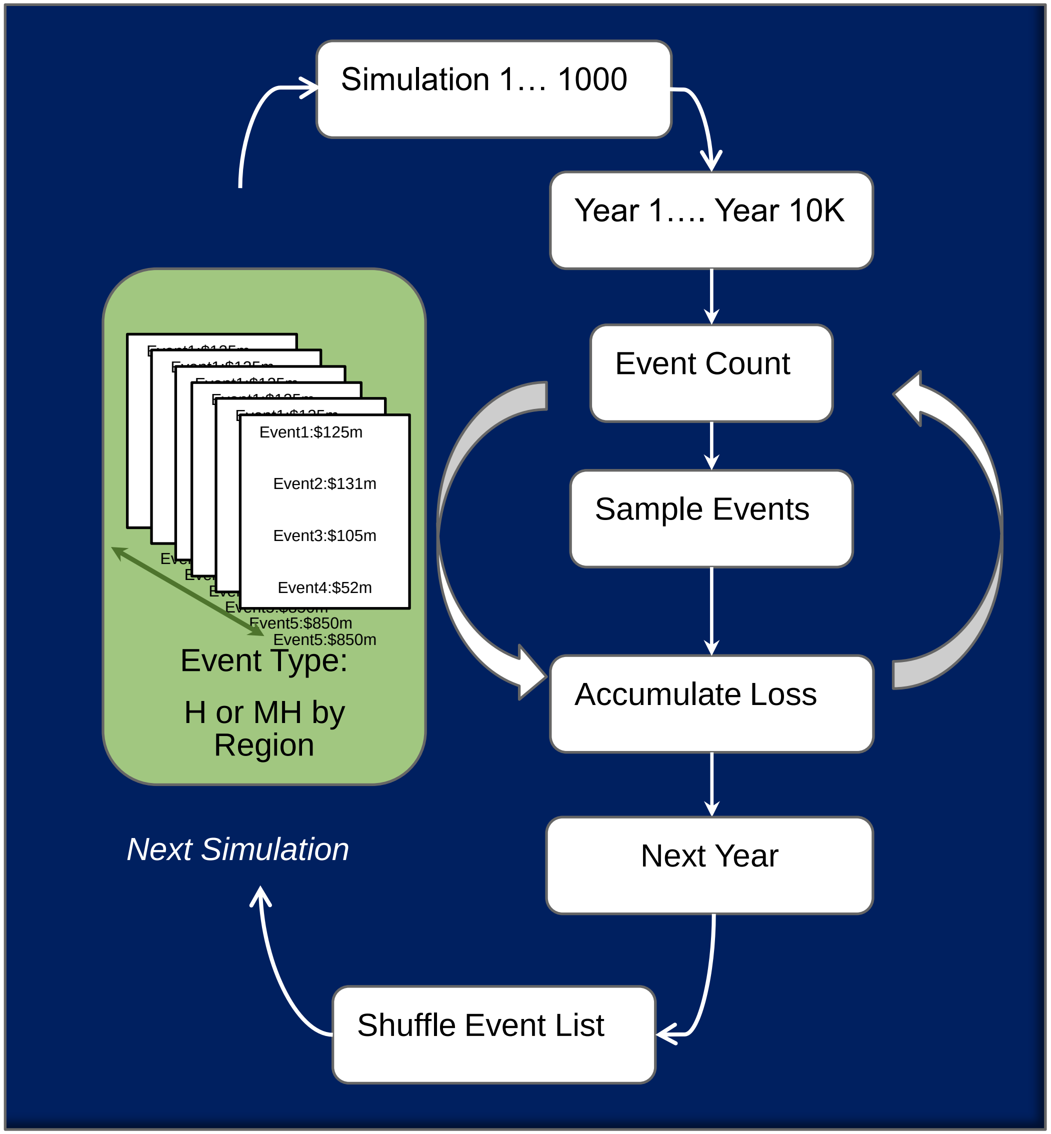
Data from NWS NHC 46: Hurricane Experience Levels of Coastal County Populations from Texas to Maine. Jerry D. Jarrell, Paul J. Hebert, and Max Mayfield. August, 1992, with updates.

http://www.nhc.noaa.gov

… Leading to Variability in Hurricane Landfall Assumptions



Simple Stress Test for Uncertainty in Landfall Frequency

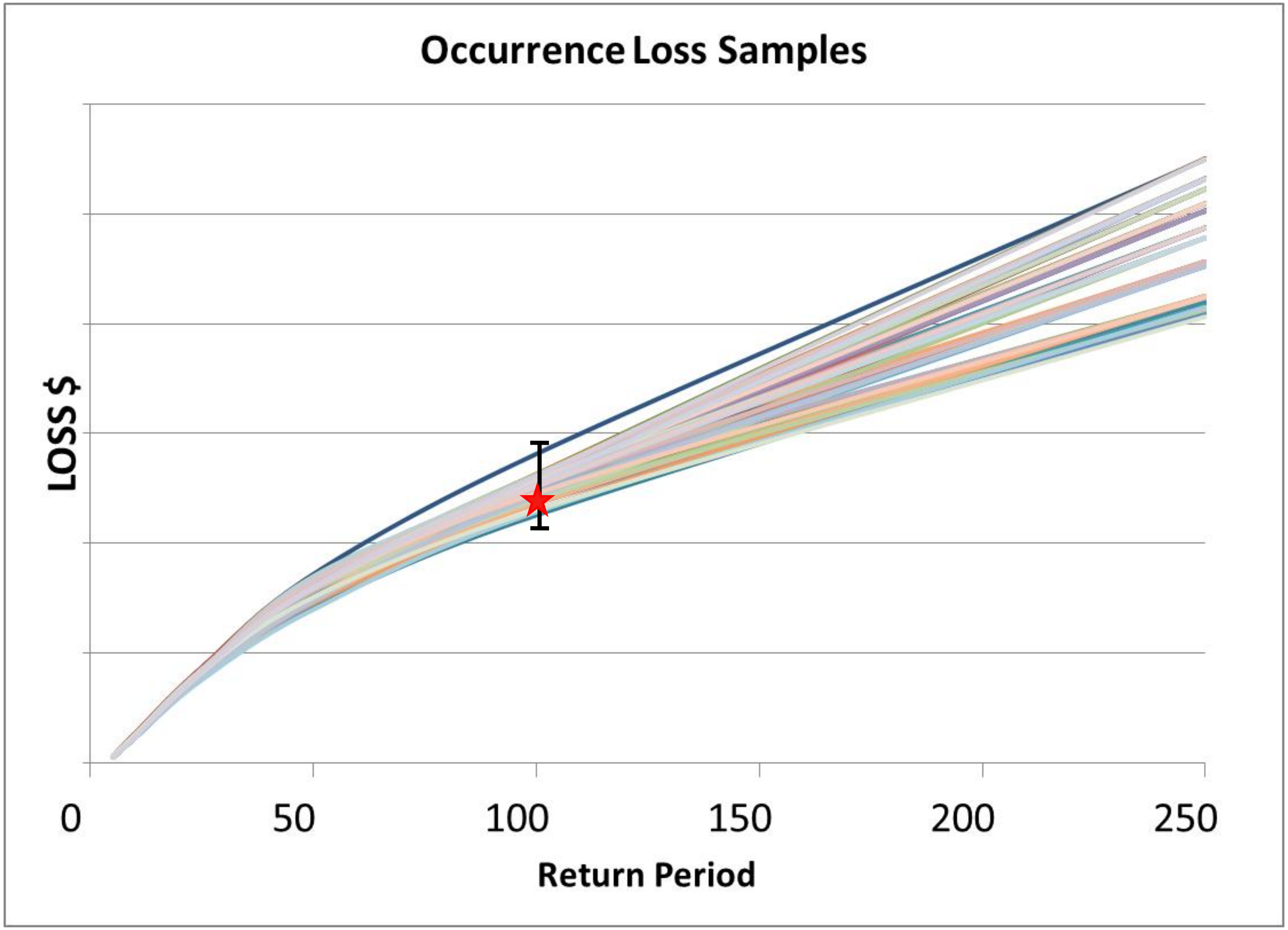


- Straightforward process for frequency-based models

A more general approach:

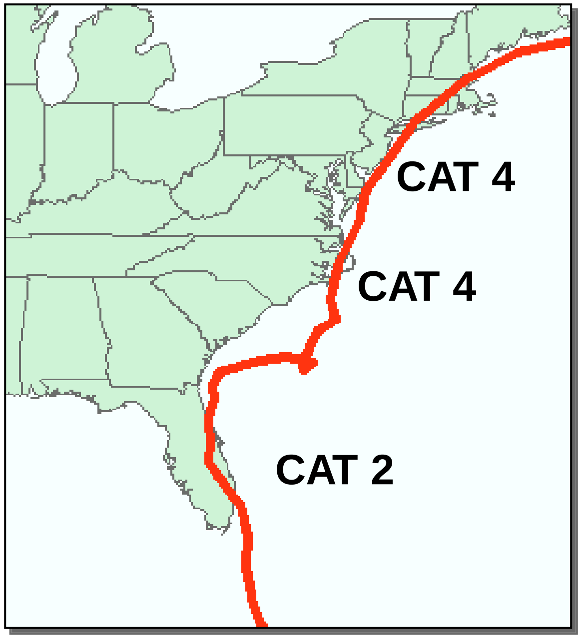
- Separate events into different “pools” by region and category (or H vs MH)
- Simulate Poisson process to generate events
- Event pools
  - Single model
  - Multiple model
  - Open source footprints
- Can be done in Excel

Illustrates Uncertainty in “PML” Estimate



Methodology Allows Control over Event Catalog

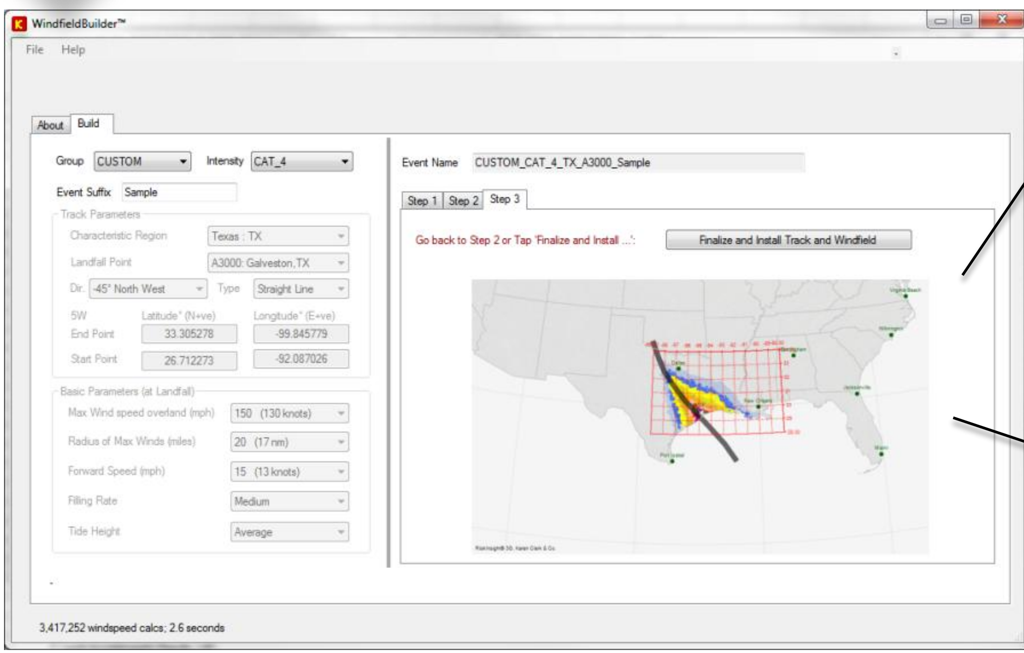
- Remove Events
  - Non-plausible tracks
  - Inconsistent parameters

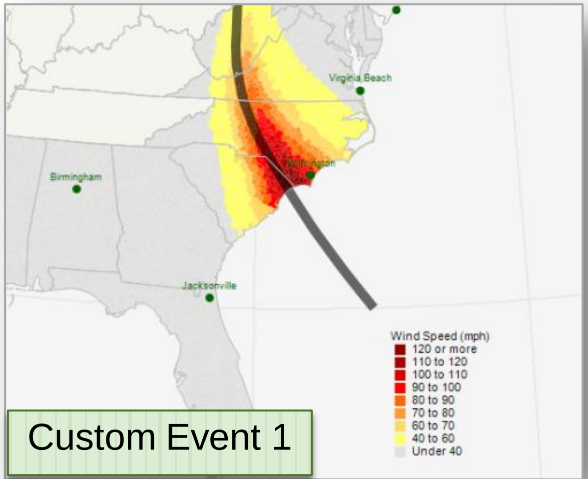


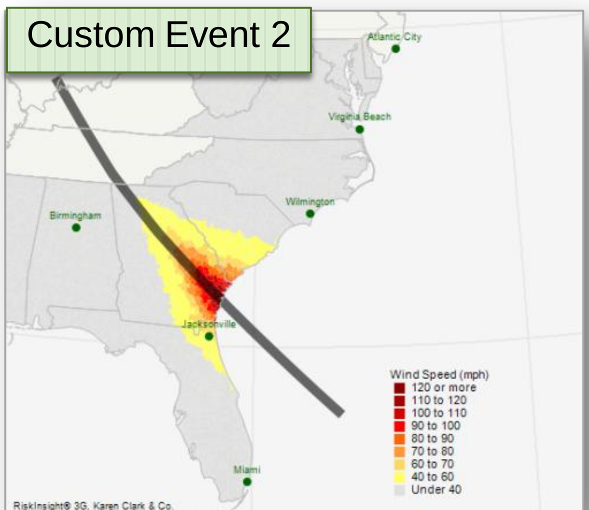
- Open source models allow greater control
  - Add events that may be missing
  - Damage functions tuned to your claims

RiskInsight® Provides Efficient Tools for Creating Custom Event Footprints

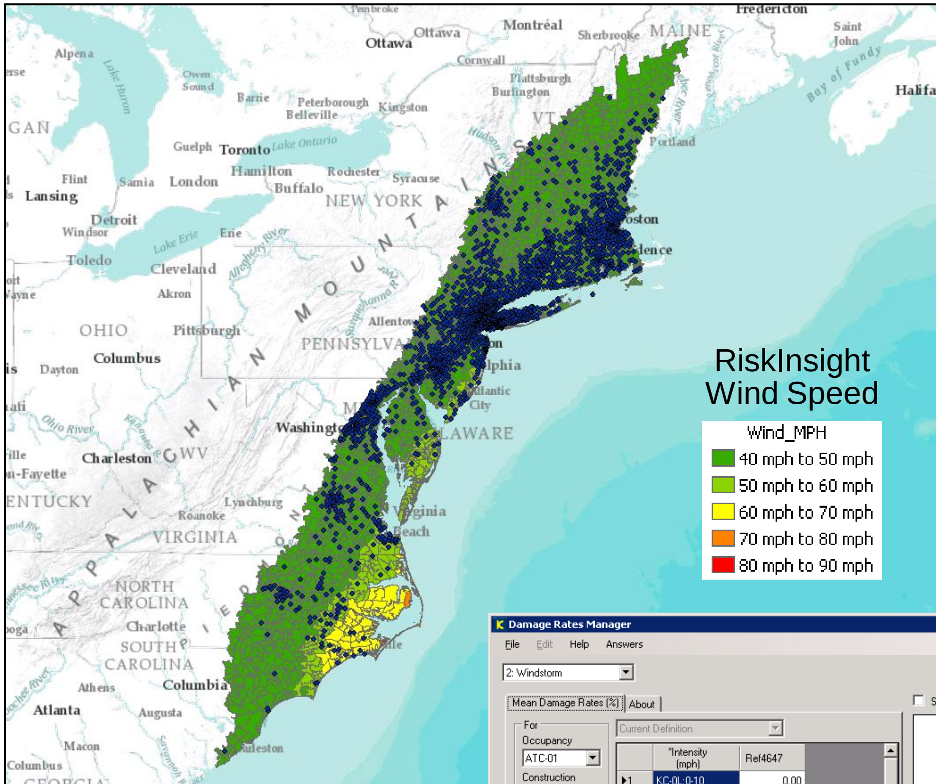
Enter desired event parameters to generate high-resolution event footprints

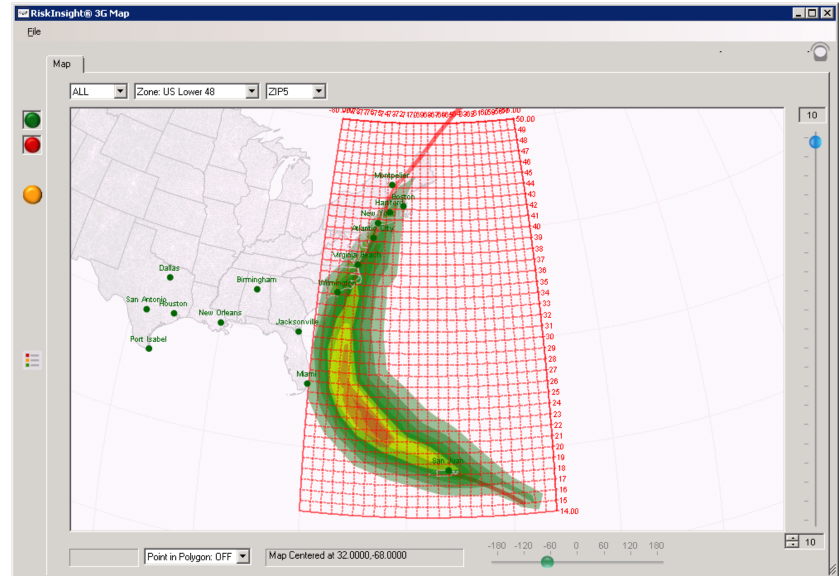


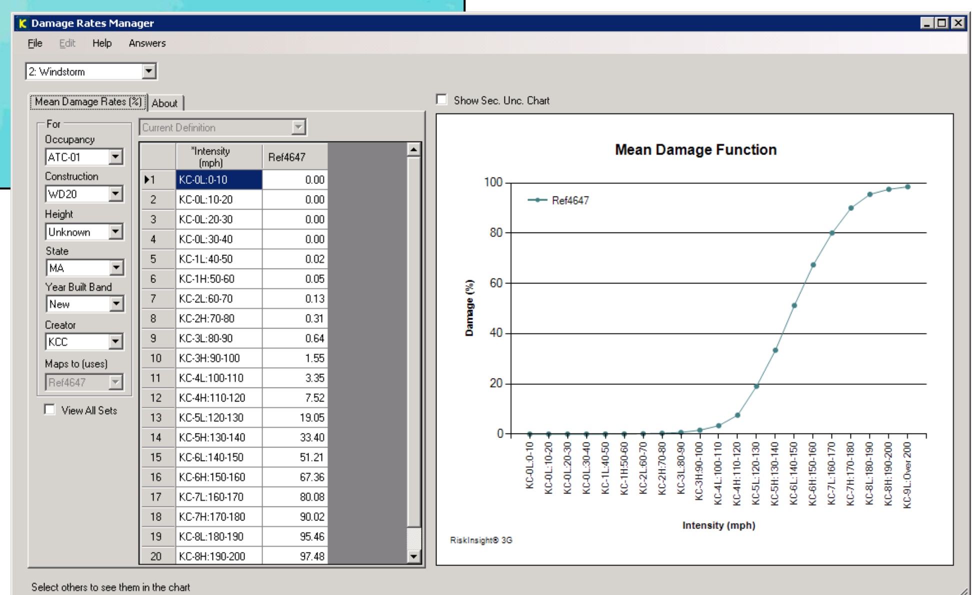




Transparent Hazard and Vulnerability Enables Claims Analysis







Example Application – Storm Surge Modeling With SLOSH

- SLOSH (Sea, Lake, and Overland Surge from Hurricanes)
  - Model developed by the National Weather Service to estimate storm surge depths used by the NHC, USACE, FEMA, and NOAA
  - Used in evacuation planning studies

- SLOSH Overview
  - Composite modeling approach using hypothetical hurricanes under different storm conditions
  - Uses geographical basins with known topography and bathymetry characteristics
  - Each grid cell within a basin has an associated surge depth: data points include MEOW (Maximum Envelope of Water) and MOM (Maximum of the MEOWs)

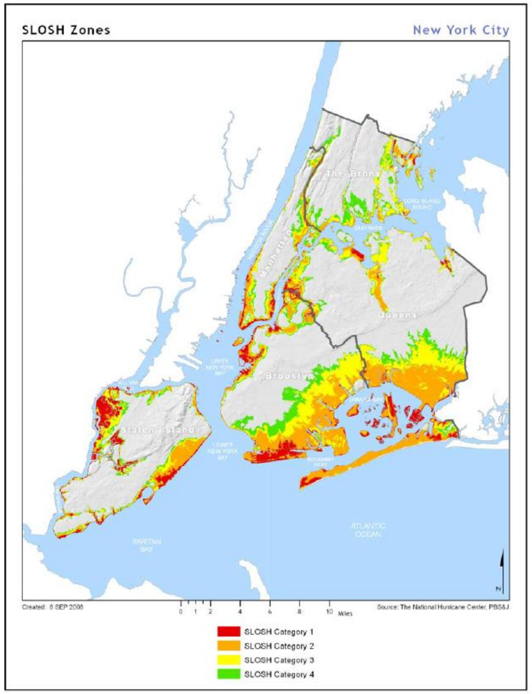
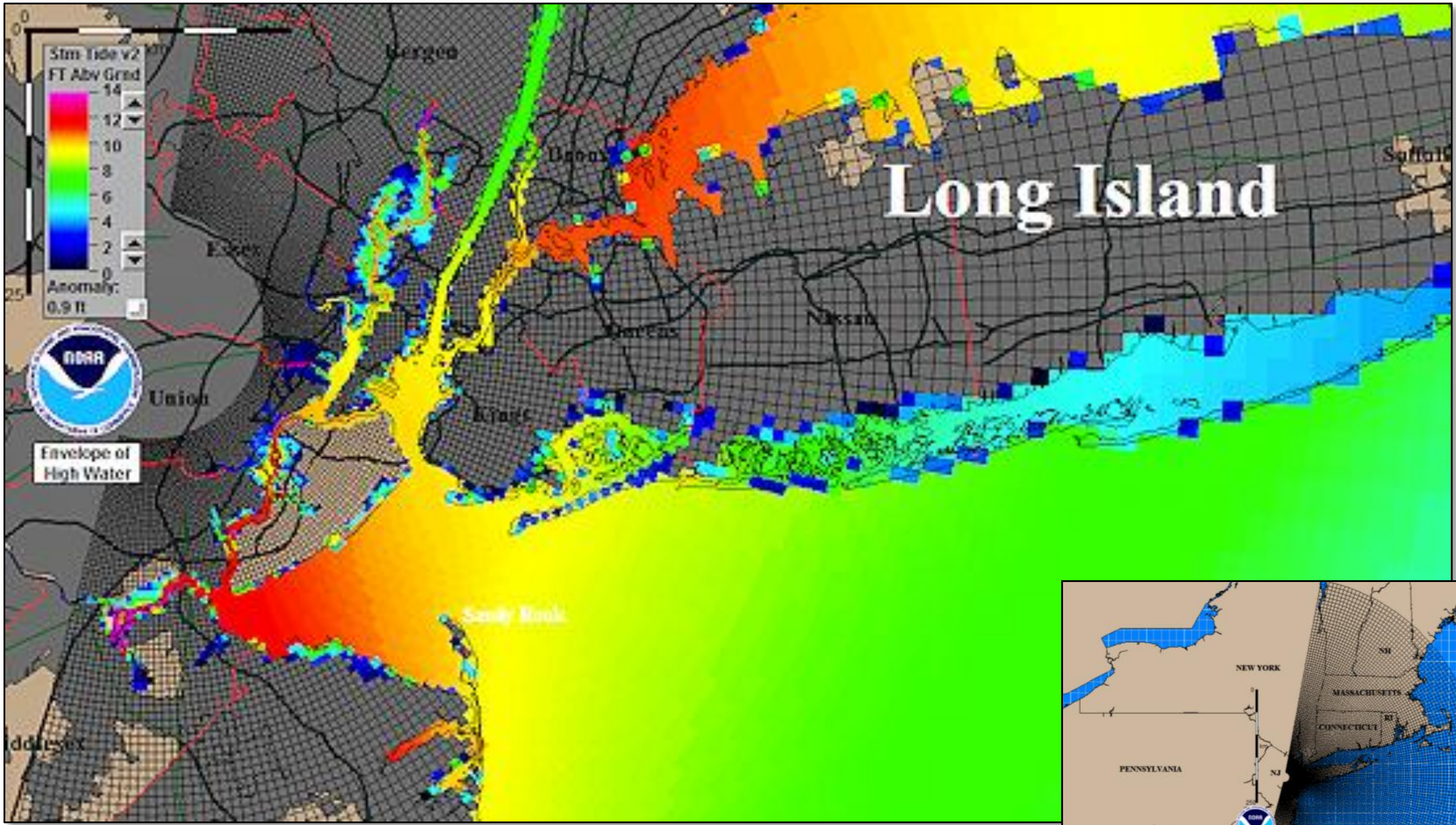
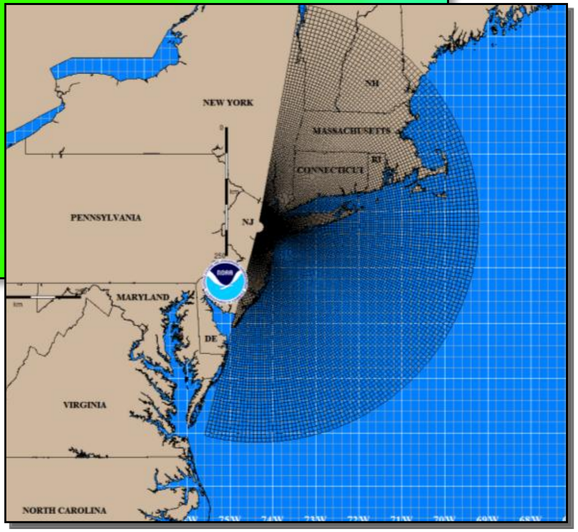


Figure 42: New York City SLOSH Model

http://www.nyc.gov/

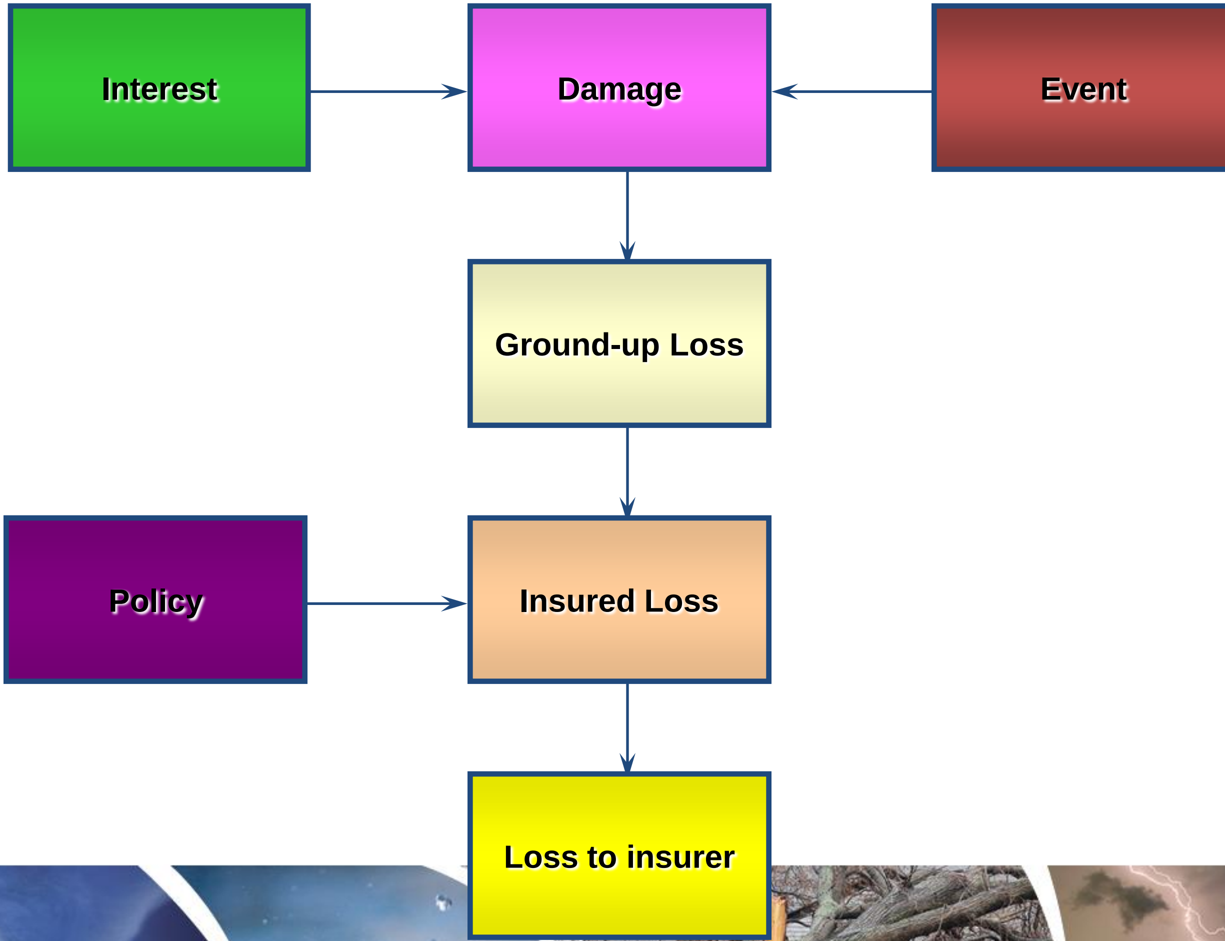
SLOSH Hurricane Sandy Estimate



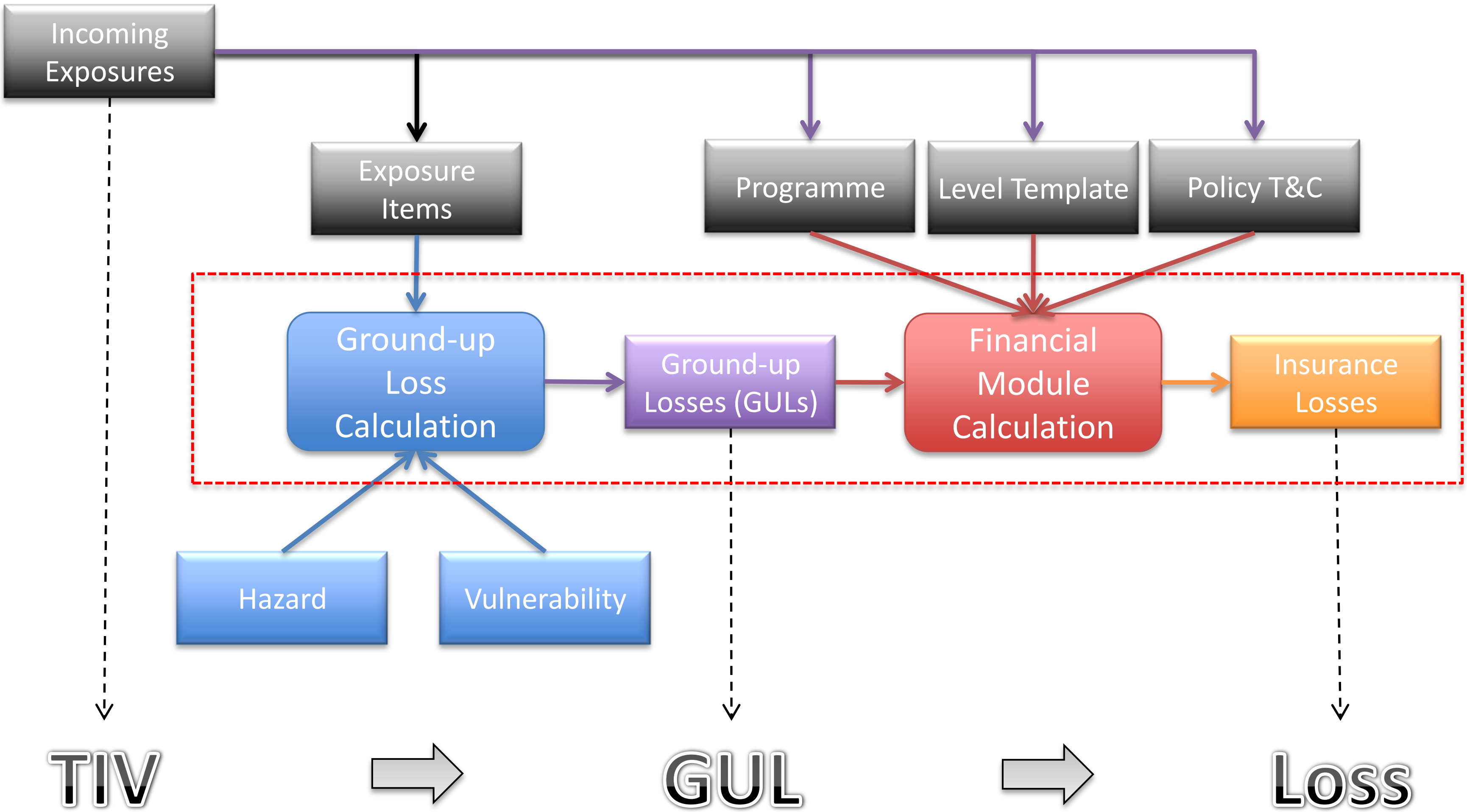


Forbes, C. et al., Predicting the Storm Surge Threat of Hurricane Sandy with the National Weather Service SLOSH Model, J. Mar. Sci. Eng. 2014, 2(2), 437-476

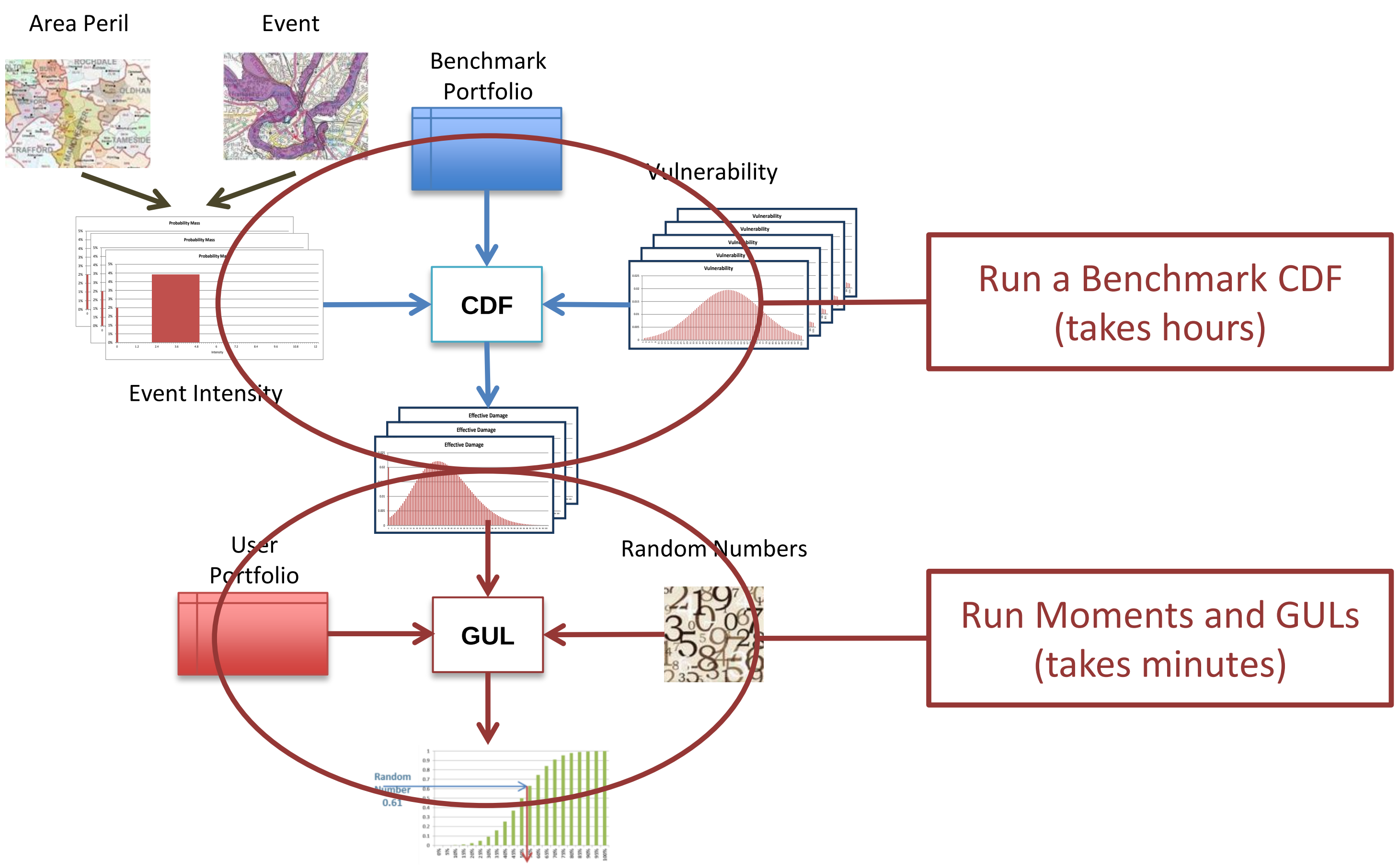
The Event Paradigm



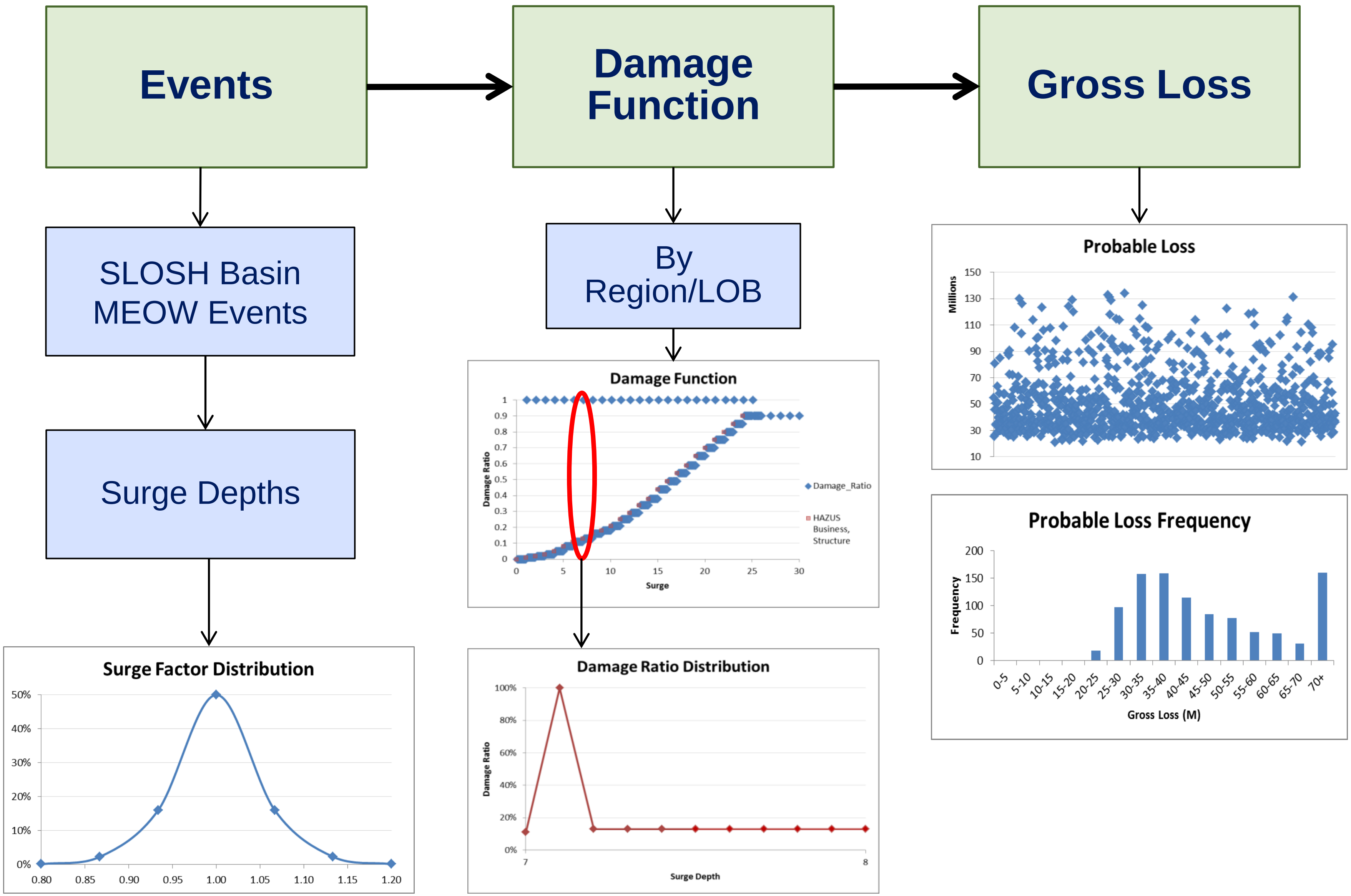
Oasis Functionality



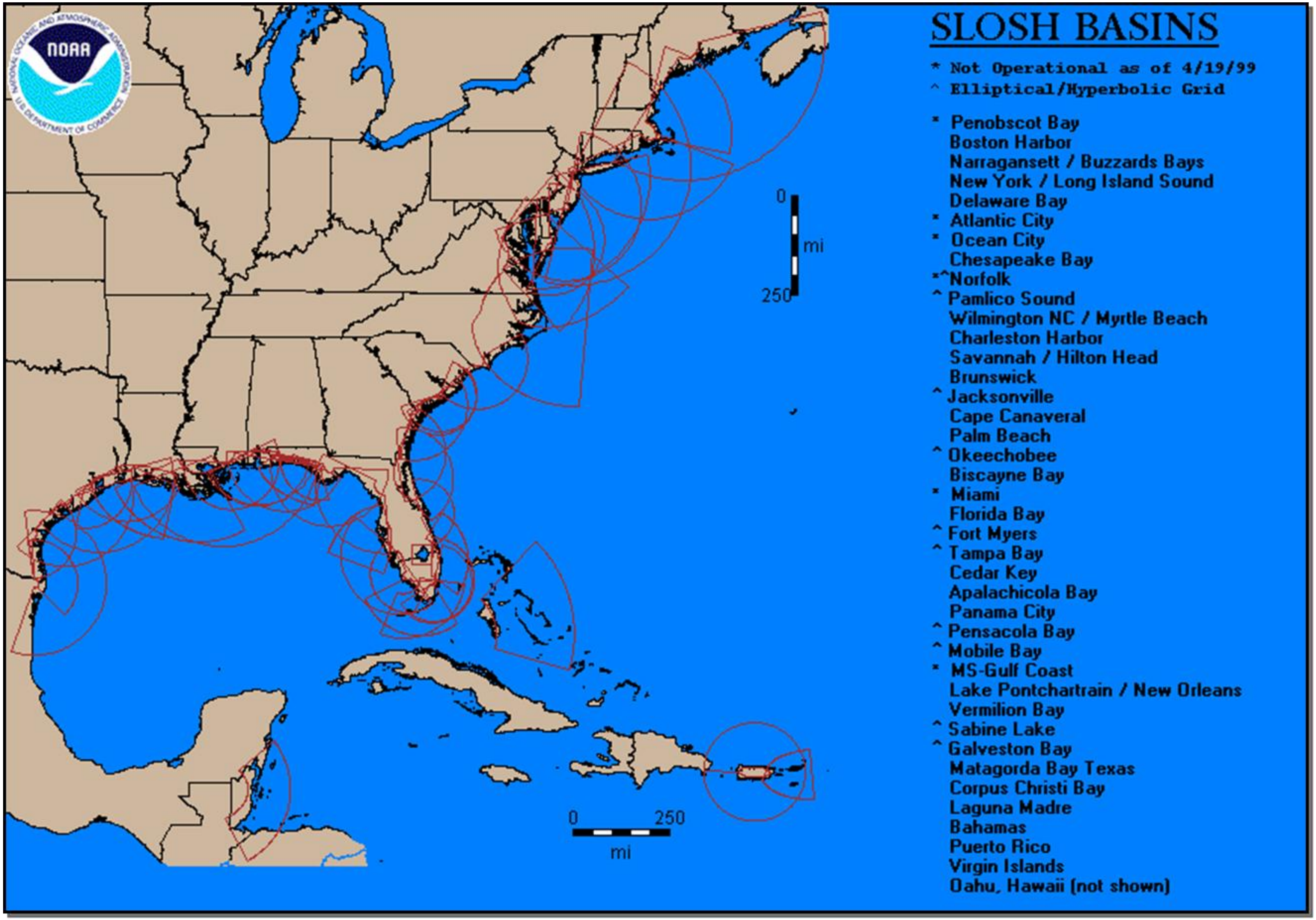
CDF and GUL Processes



OASIS Framework: Single Event Uncertainty

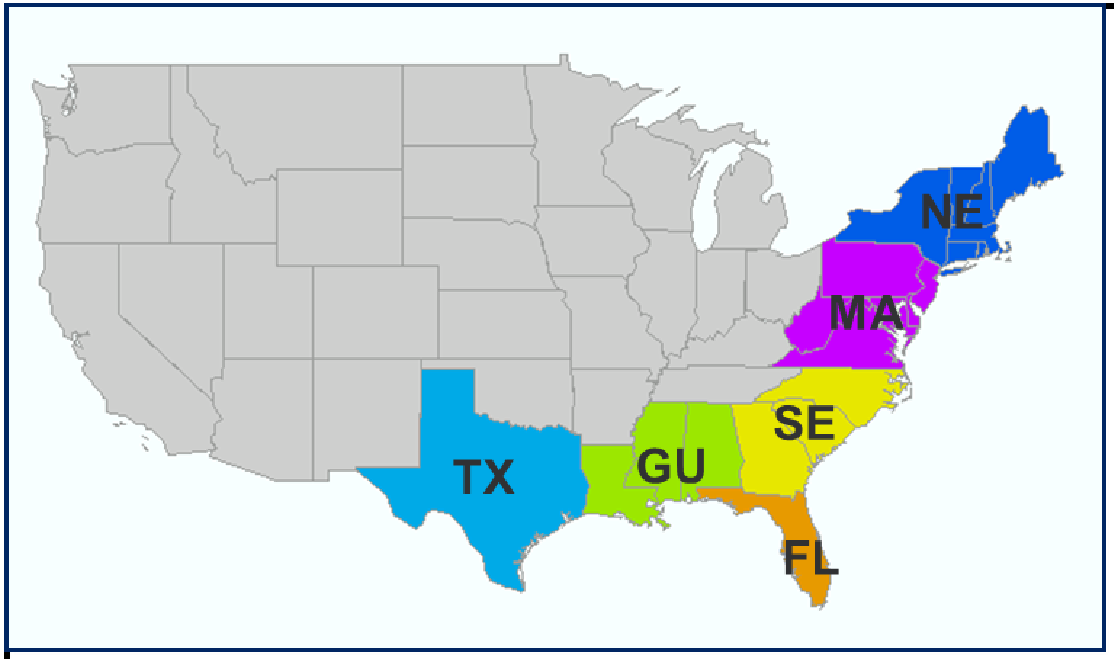


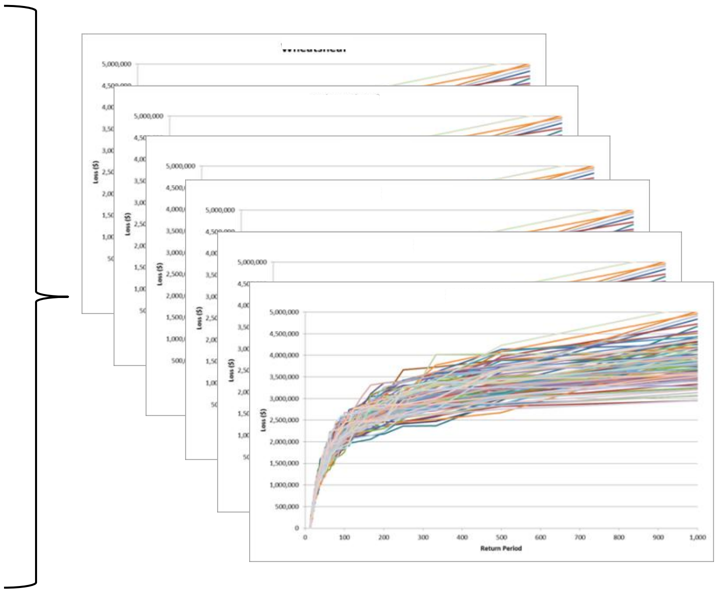
Prototype Surge Model Using SLOSH with Oasis



http://www.nws.noaa.gov/mdl/marine/Basin.htm

Scale Up to Simulate Surge Exceedance Probabilities





Summary

- Advances in computing will lead to more “Hi-Res” cat models
  - Potential benefit for some perils (notably flood)
  - Uncertainty remains, especially in vulnerability and financial components
- Alternatively, technology can be applied towards probing assumptions and stress testing results
- Open source models and platforms are important tools in enabling transparency and improving understanding of catastrophe exposure