Estimating Severe Thunderstorm Risk in North America

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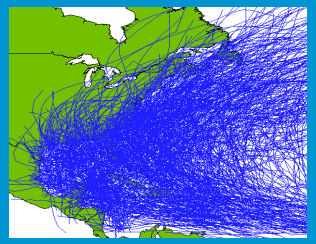
What are Catastrophe Models and Why Do We Need Them?

- Due to the low frequency of severe catastrophes, traditional methods that rely on company claims data may not be a good predictor of possible losses

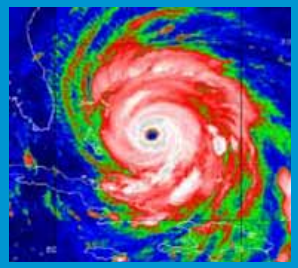
- The constantly changing landscape of exposure data limits the usefulness of past loss experience

- Models should capture potential losses before they occur, and provide an objective and stable view of risk over time

AIR Catastrophe Modeling Framework



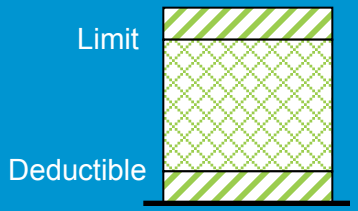
Event Generation



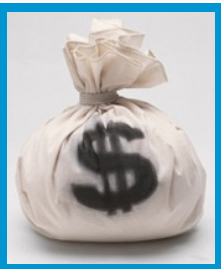
Intensity Calculation

Exposure Information

Damage Estimation



Policy Conditions



Loss Calculation

Goal of this Project

- To develop a 10,000 year stochastic set of severe thunderstorm (hail, tornado, and straight line wind) "macroevent" outbreaks for the United States and Canada
  - Consisting of individual severe storm "microevents" with associated parameters such as length, width, and intensity

- Today, I will address two components of this project:
  - Where to put the simulated events
  - How large should the event footprints be

Day-by-Day Stochastic Simulation Methodology

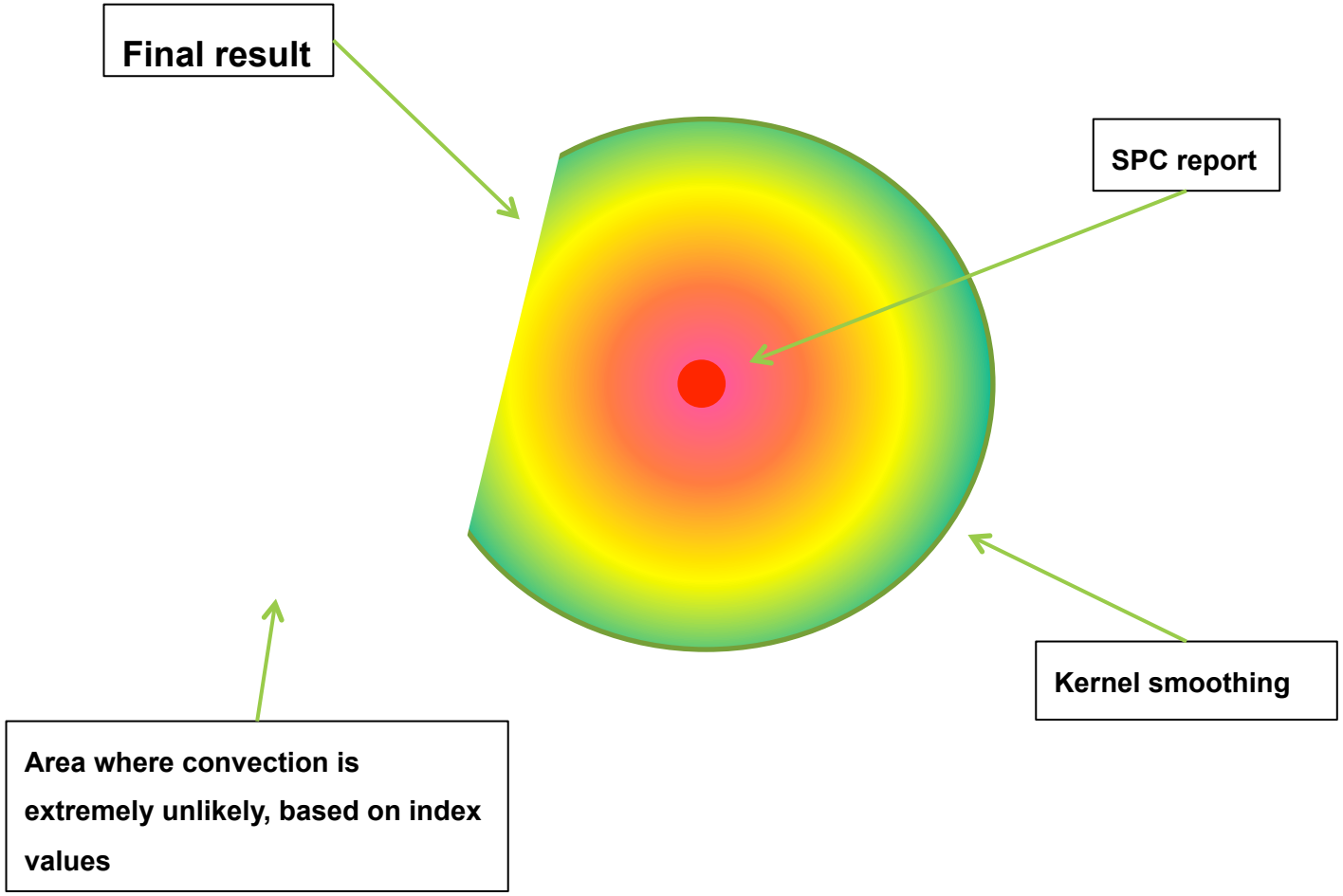
- Our model will simulate daily activity
- For each year in the 10,000 year simulation, we pick a "seed" historical year to draw data from
- The simulation proceeds by determining if any severe thunderstorm events should be simulated on January 1, then January 2, etc.
- Methodology to be described in the next few slides

Instead of a Purely Statistical Model, AIR Plans to Include Meteorological Parameters

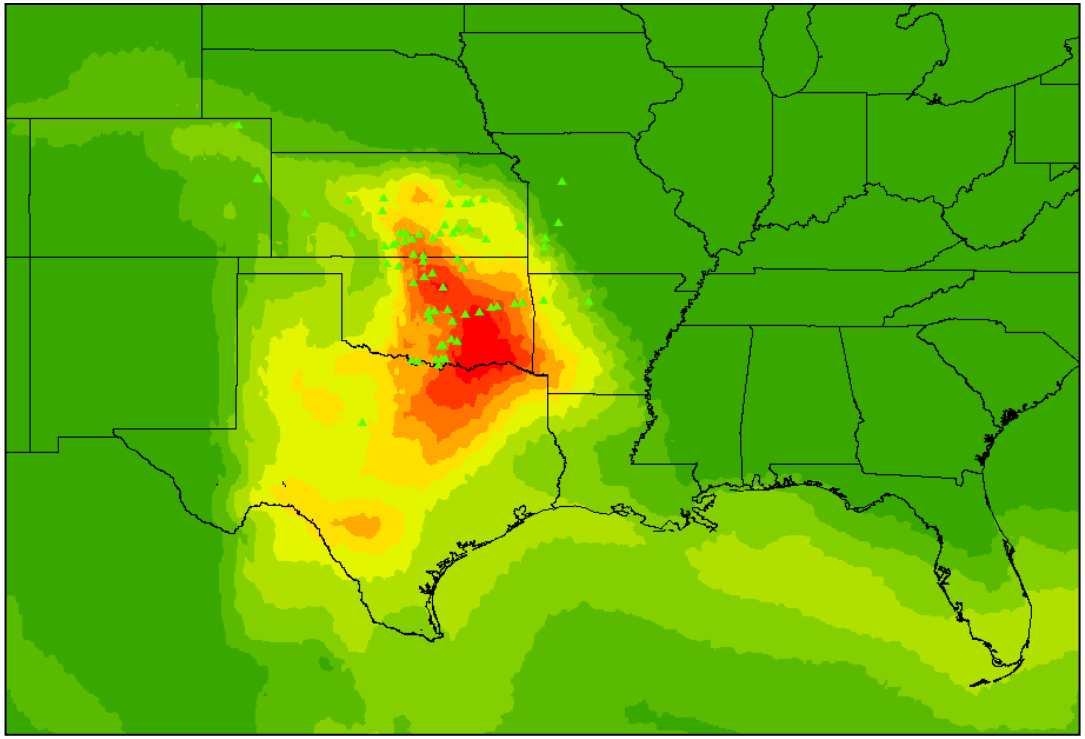
- AIR has an existing severe thunderstorm model that is a statistical resampling of SPC (Storm Prediction Center) reports, with augmentation to account for reporting growth and population bias

- In the upcoming version of the model, we will continue to account for growth and bias, but also incorporate meteorological information such as CAPE, shear, and composite indices

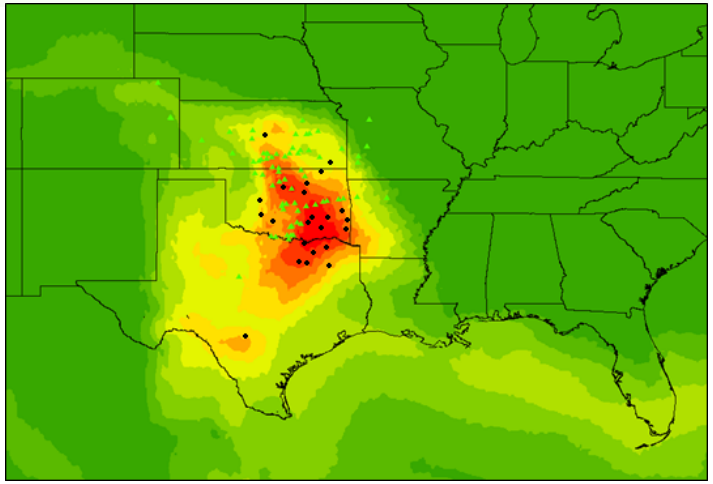
The Meteorological Parameters Change the Smoothing Pattern in a Physically Reasonable Manner



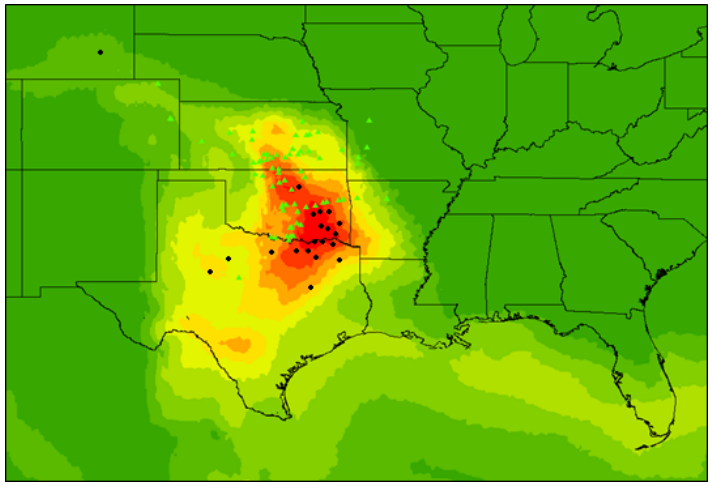
May 10, 2010 Case Study: Comparing Hail Index Values and SPC Reports to Stochastic Simulations



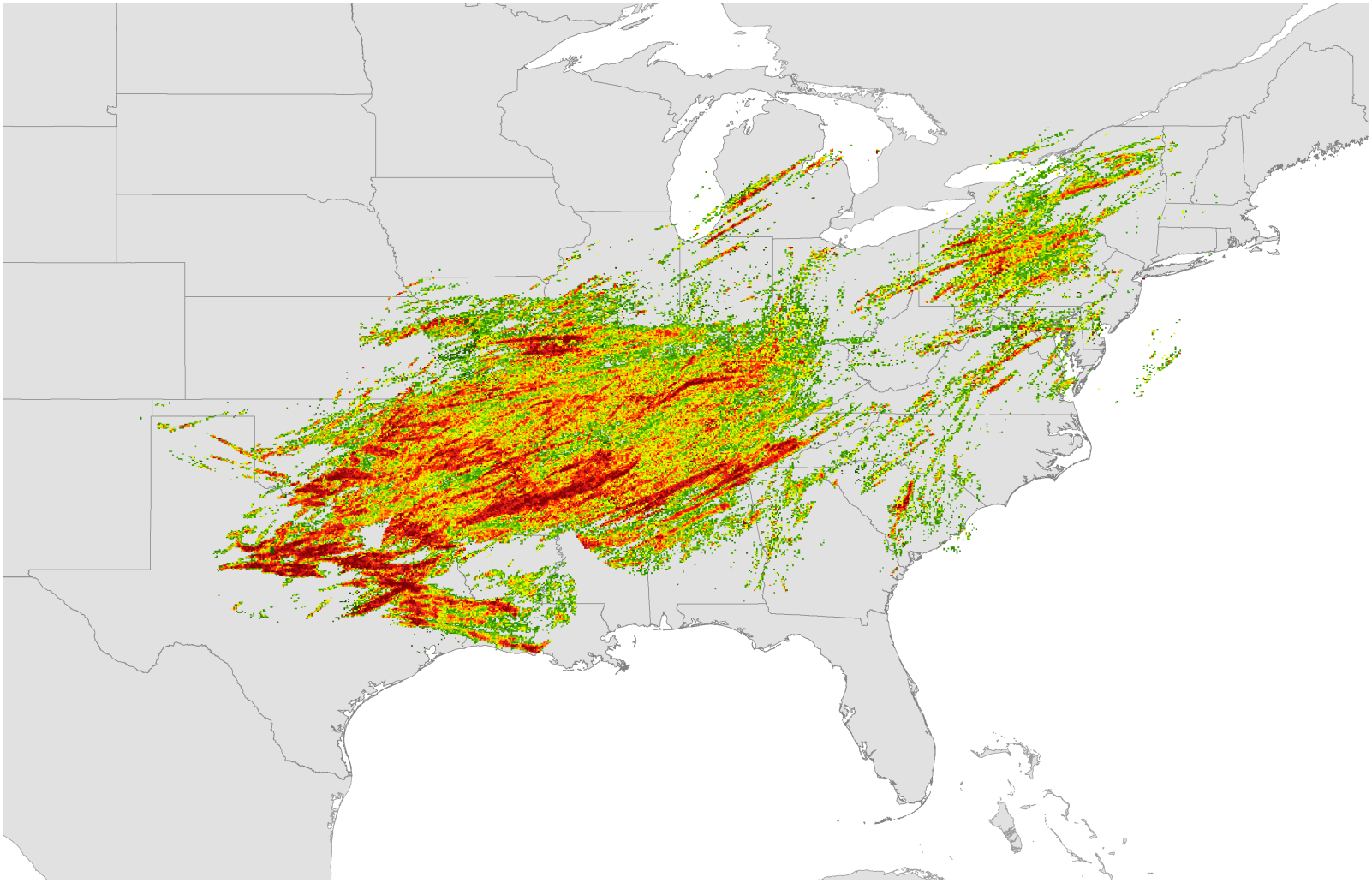
Index values with SPC reports



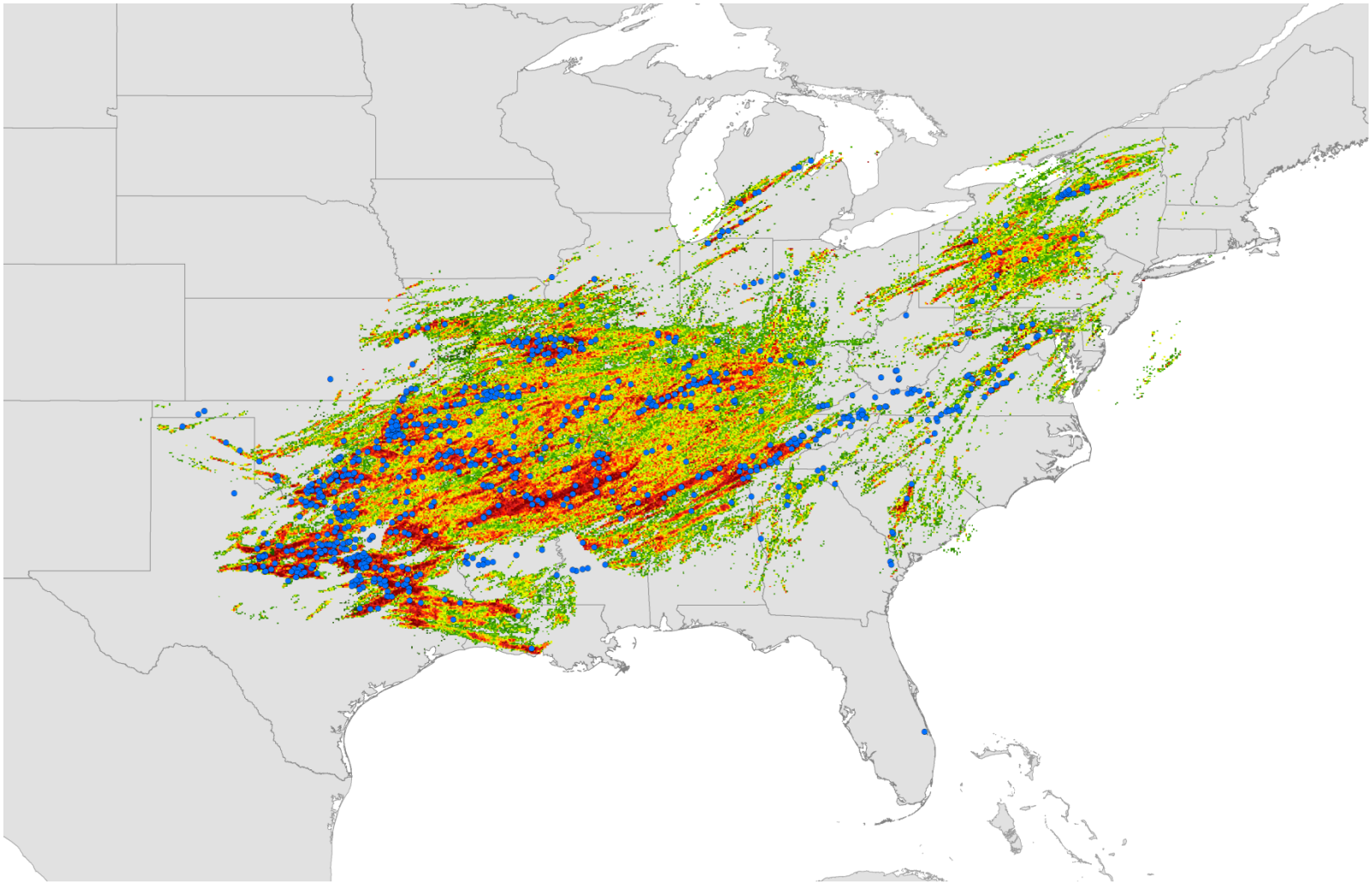
Index values with SPC reports and examples of potential stochastic events



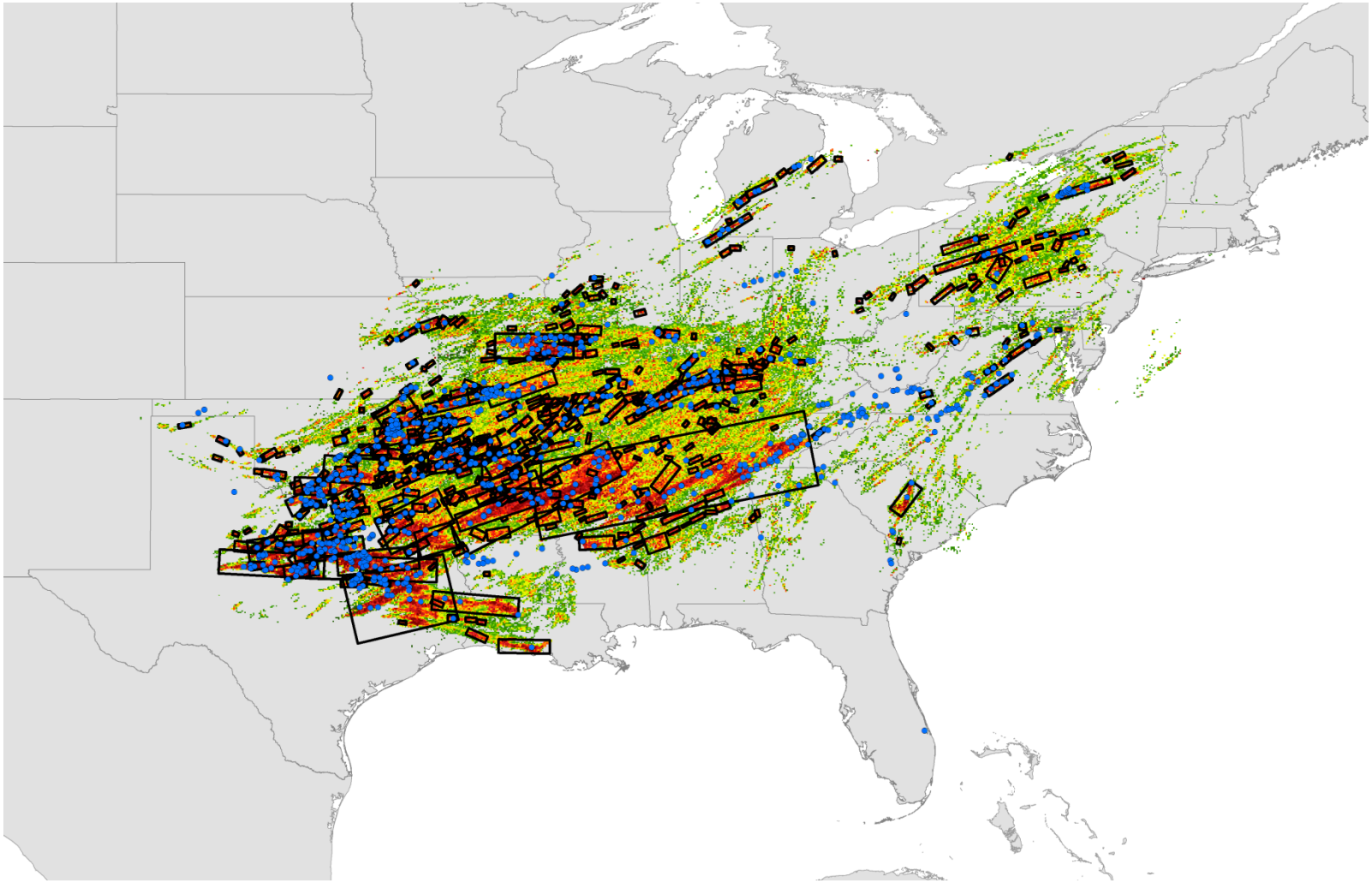
April 2011 Case Study: Determining Hail Swath Lengths and Widths Using Raw VIL Density Data



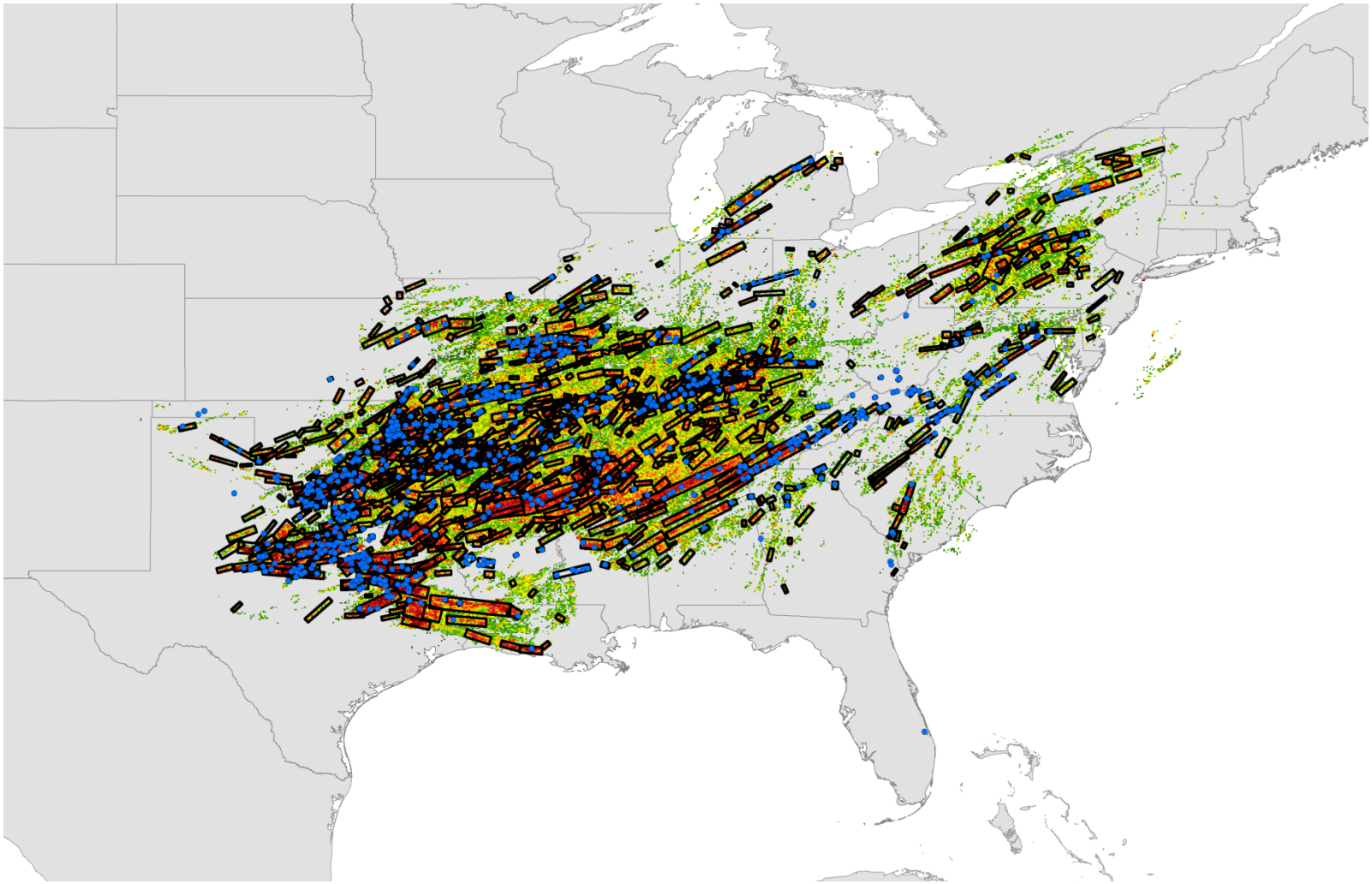
April 2011 Case Study: VIL Density with SPC Reports Contribute to Hail Swath Definition



April 2011 Case Study: An Automated Algorithm Provides Very Large Swaths

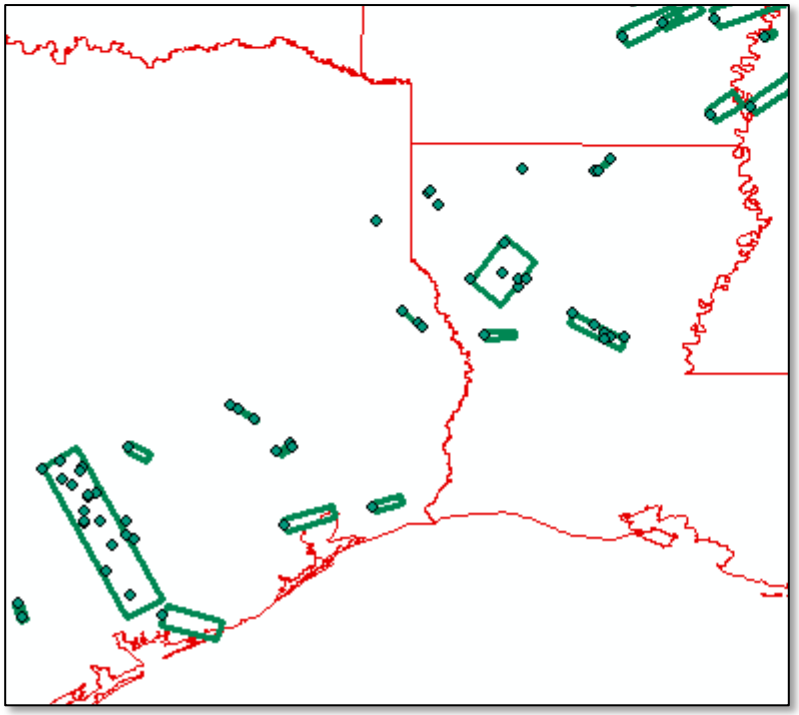


April 2011 Case Study: AIR Scientists Have Refined the Hail Swaths With SPC and Radar Data

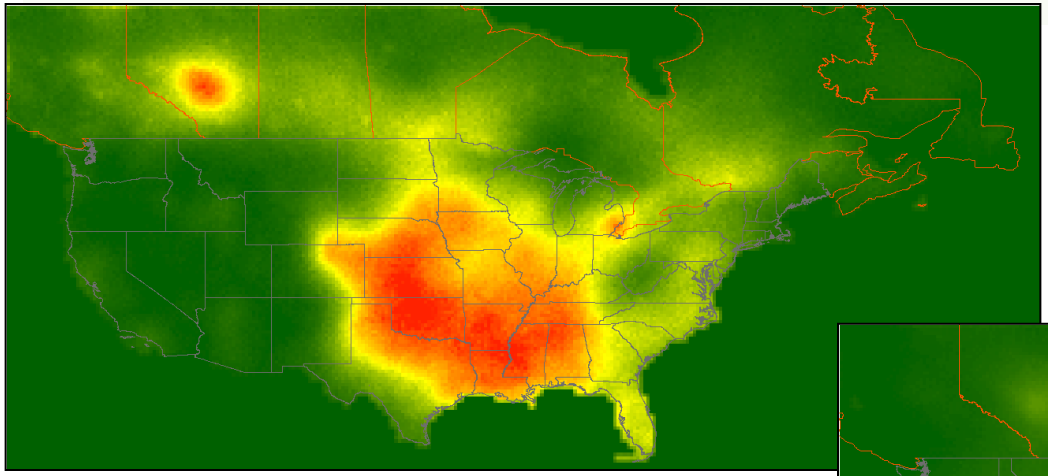


AIR Is Using Clustering Algorithms to Develop Swath Dimension Distributions When Radar is Unavailable

- When radar data is unavailable for hail, and for all straight-line winds, a clustering algorithm is applied to group events that are close in time and space
- Distributions that vary by location can be fit to the results of the radar and cluster analyses

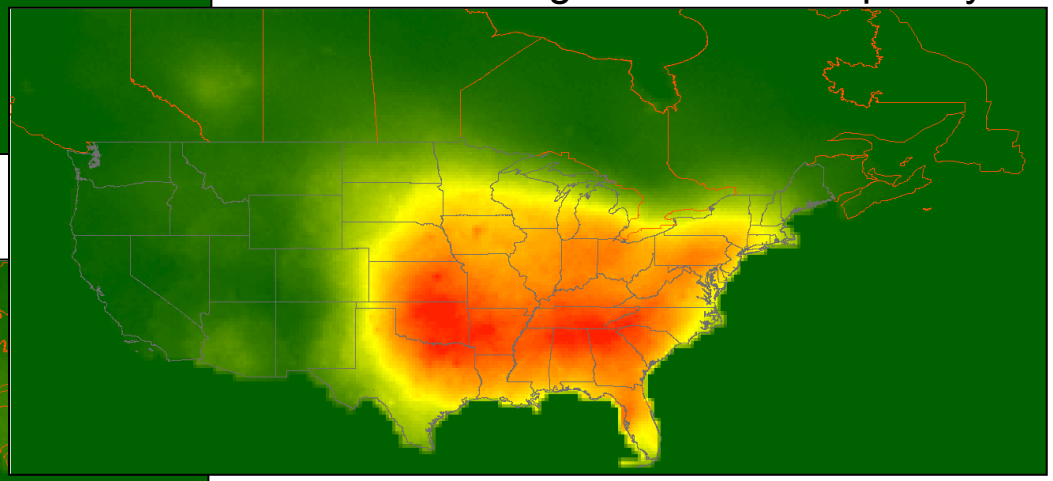


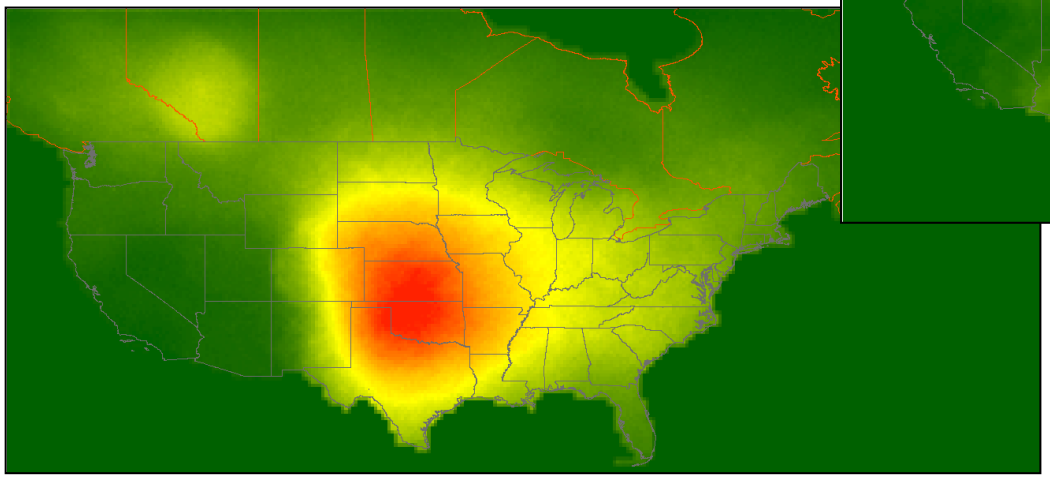
Results: Total Frequency by Subperil



← Tornado frequency

Straight line wind frequency





← Hail frequency

Summary

- AIR is working on developing an accurate view of several historical events using high-resolution radar data and cluster analyses
- Historical events can help inform more accurate footprint parameters for length, width, and intensity to use in stochastic modeling
- Meteorological parameters will help inform the location of stochastic event footprints

Jackson, TN, Super Tuesday 2008

Moore, OK, 2013