Discriminating between Severe and Non-Severe Storms using Multiple Data Sources

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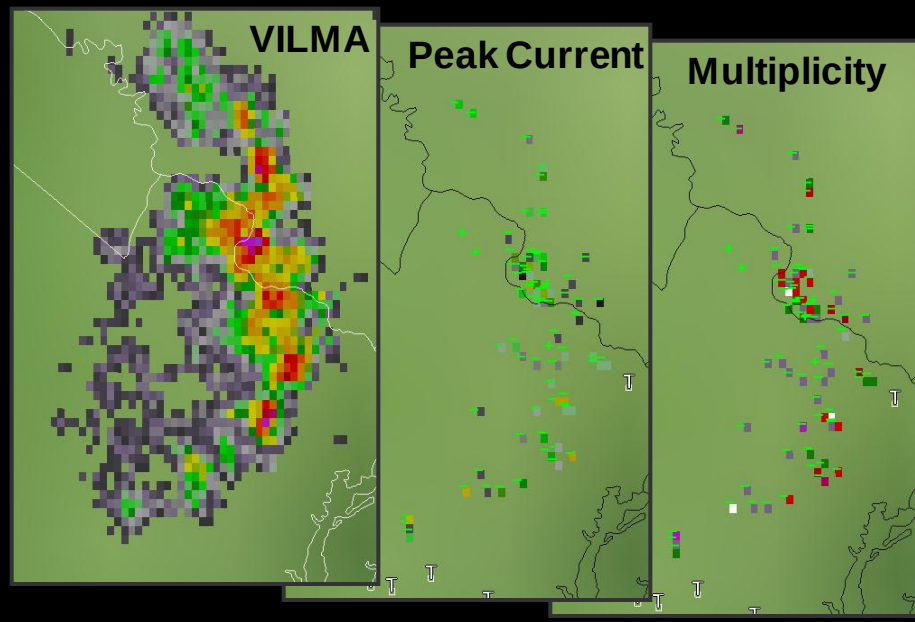
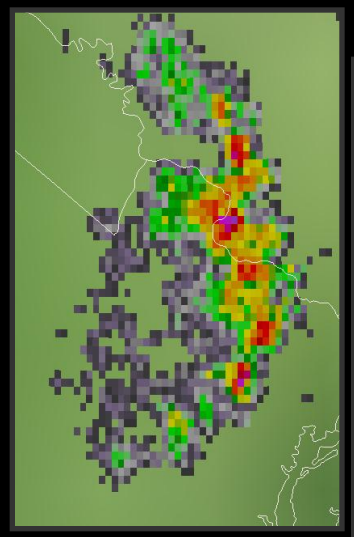
GOES-R GLM AWG/R3 Science Meeting
29–30 September 2009
Huntsville, AL

Objectives and Goals

- Objectives
  - Establish relationships between total lightning and storm severity
  - Develop lightning based severe storm guidance products
  - Prepare for upcoming GLM data
- Goals
  - Transition away from (and complement) the more traditional case study mode
  - Develop robust storm-scale relationships between lightning, radar, and severe weather
  - Quantify total lightning characteristics (IC+CG) for use in severe storm nowcasting



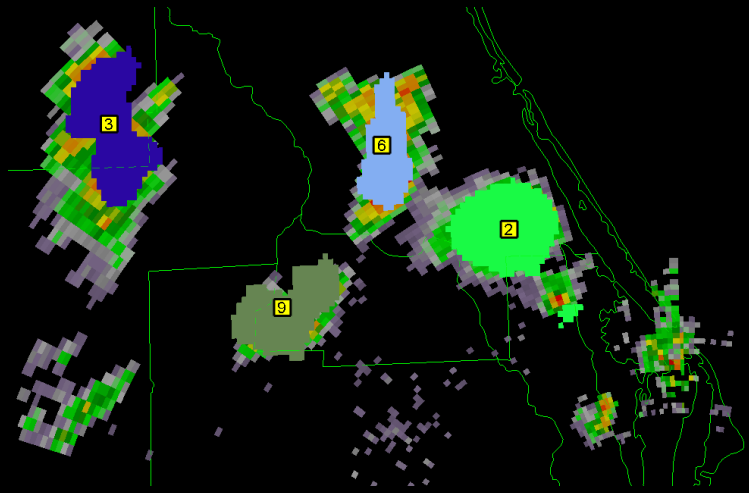


GLM Proxy

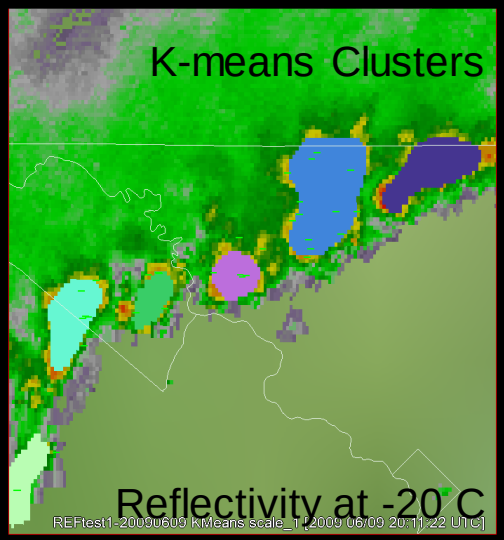
LMA Column Density (VILMA)

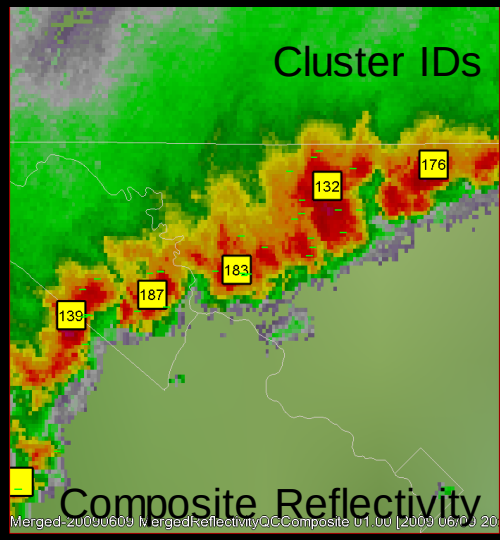
Automated Procedures

- WDSS-II Procedures
  - Base product generation
  - Storm clustering and data mining
- Perceived Benefits
  - Combining multiple datasets
  - Automated storm database creation
  - Examining <u>many</u> storms and parameters
- Storm Selection
  - Identification of cases
  - Sampling many environments
  - Automated vs. manual



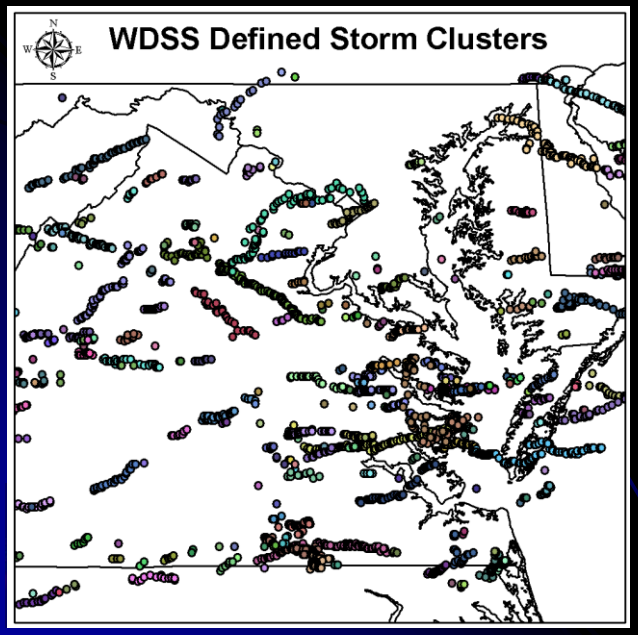
<u>9 June 2009</u>

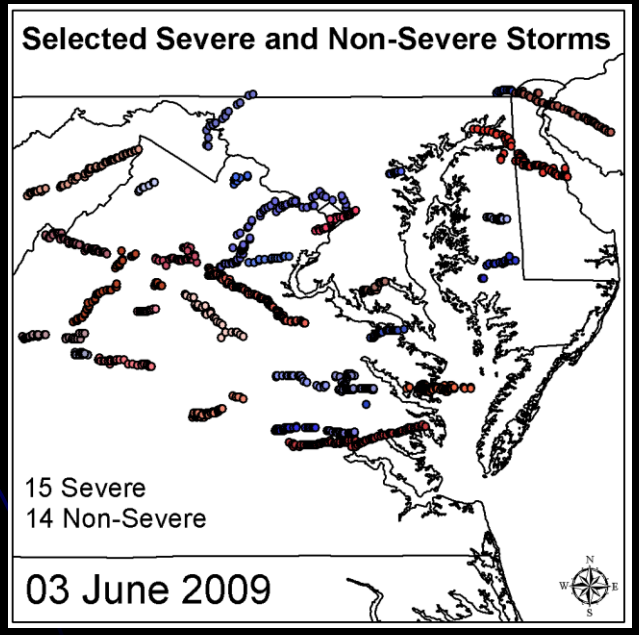


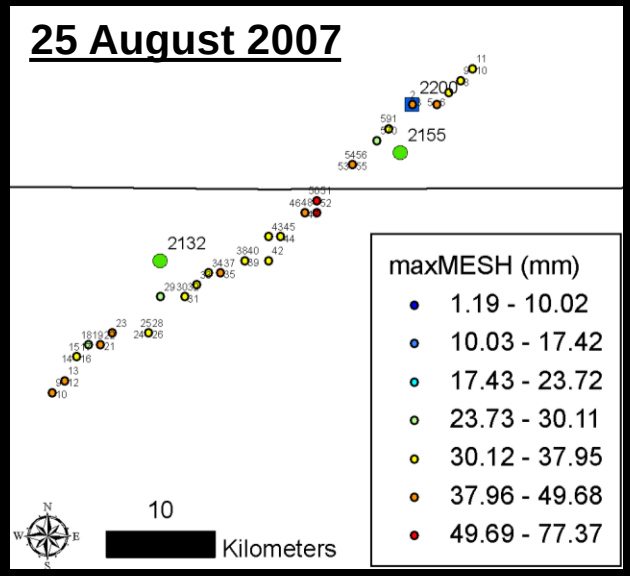


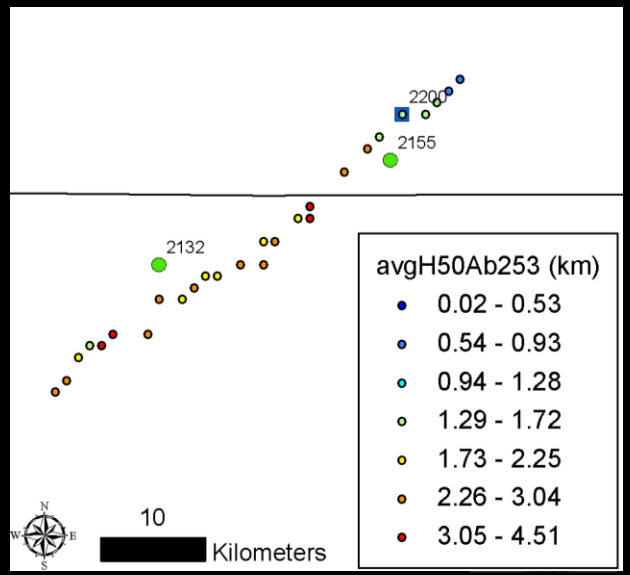
Manual Storm Selection within GIS

- Identify Storms of Interest
  - Duration and path of WDSS defined clusters
  - Distance from radar and LMA sensors
- Collocate Storm Features and Reports
  - Point by point comparison
  - Establish each storm's severity









Confirmation Within WDSS-II

- Manual Inspection of Features
  - Confirm each GIS selected storm
  - Ensure coherence of segmotion clusters
- Storm Report Investigation
  - Storm-relative accuracy (space and time)
  - Potential missed events/reports

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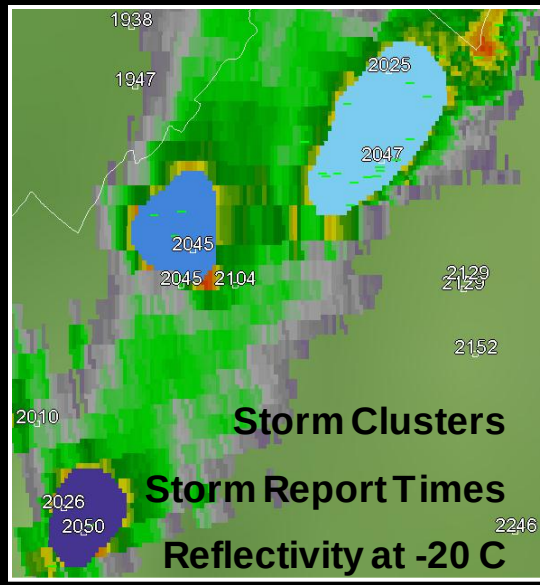

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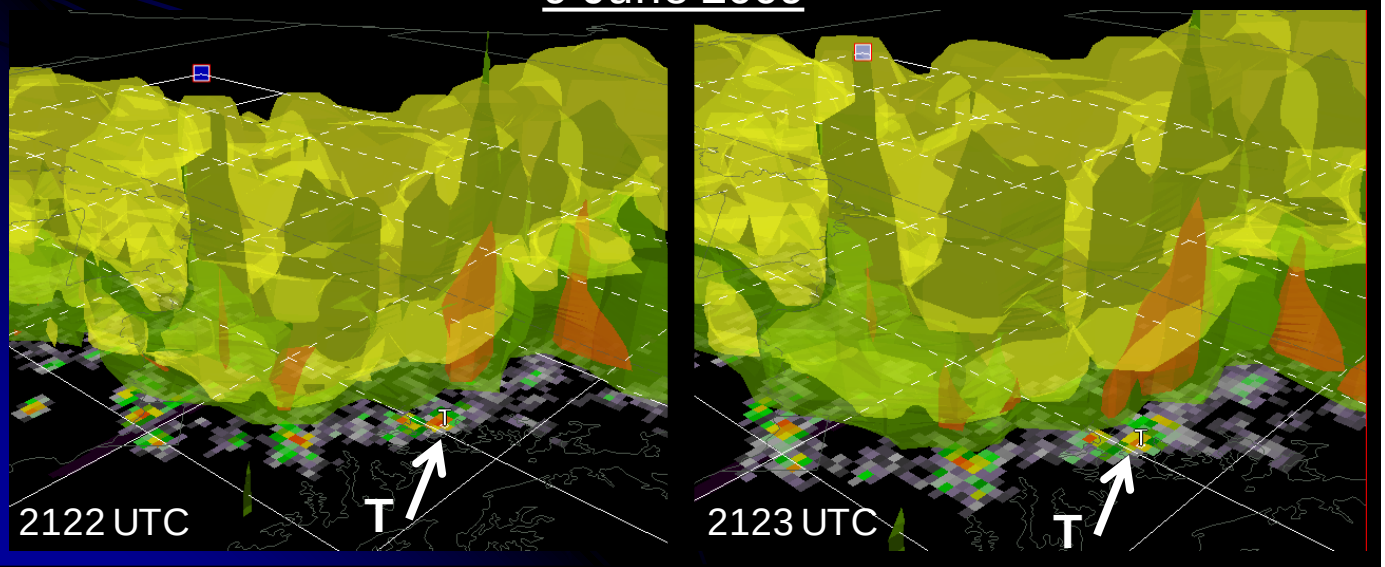
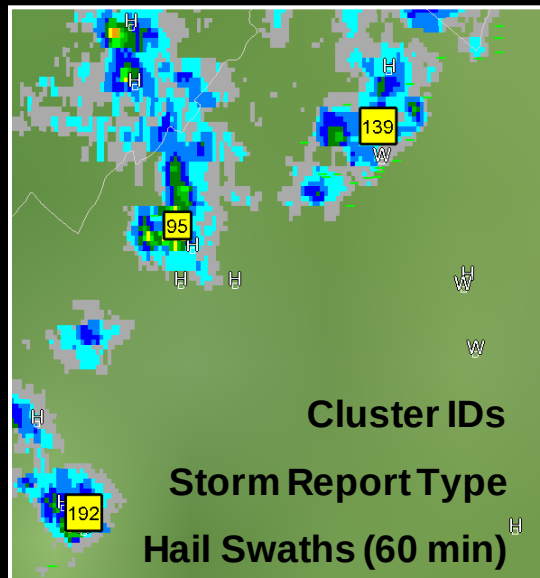
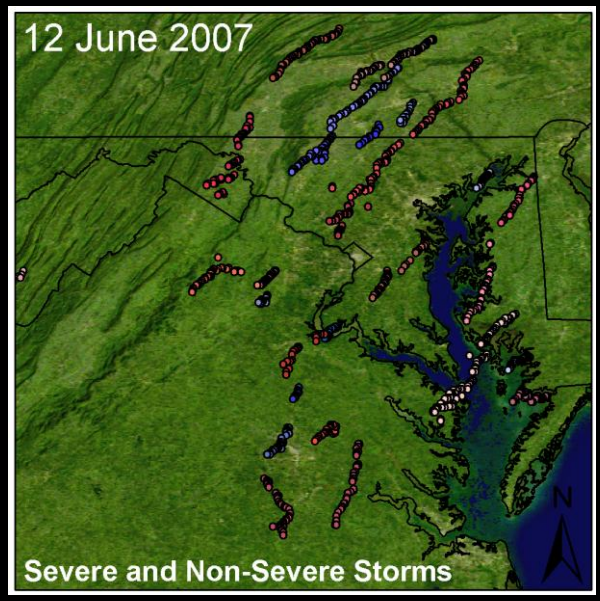
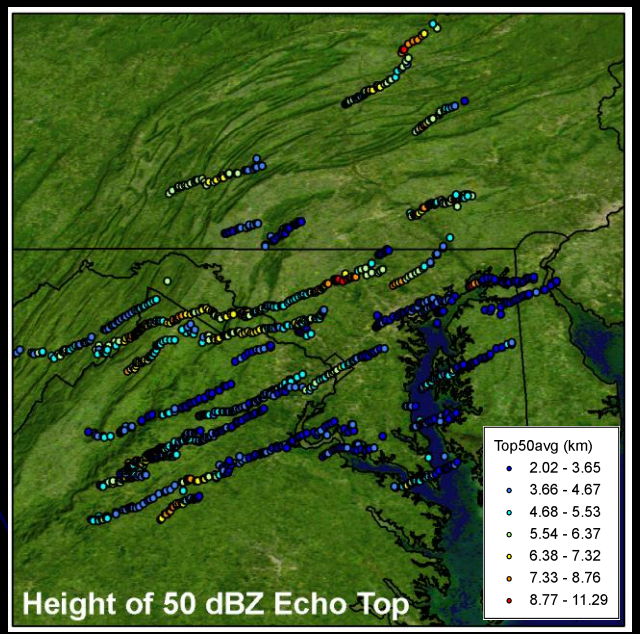


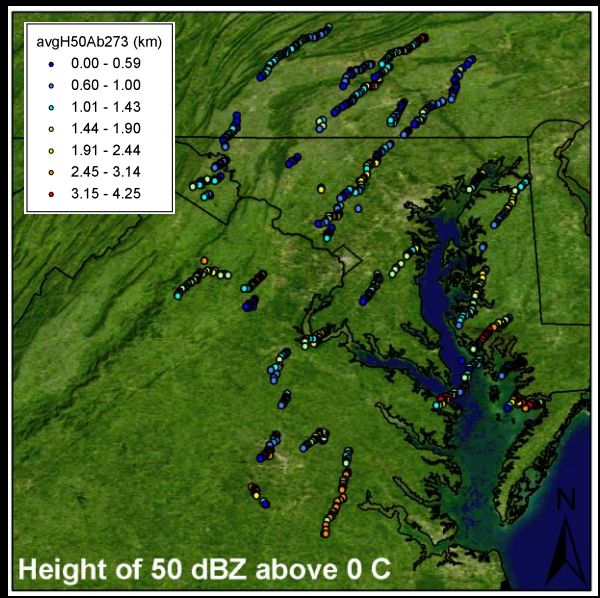


GIS Display and Analysis

- Flexible Query and Visualization Tools
  - Depicting severe vs. non-severe storms
  - Displaying trends that may indicate severity
  - Overlaying storms onto many spatial fields
  - Viewing storm features at varying scales

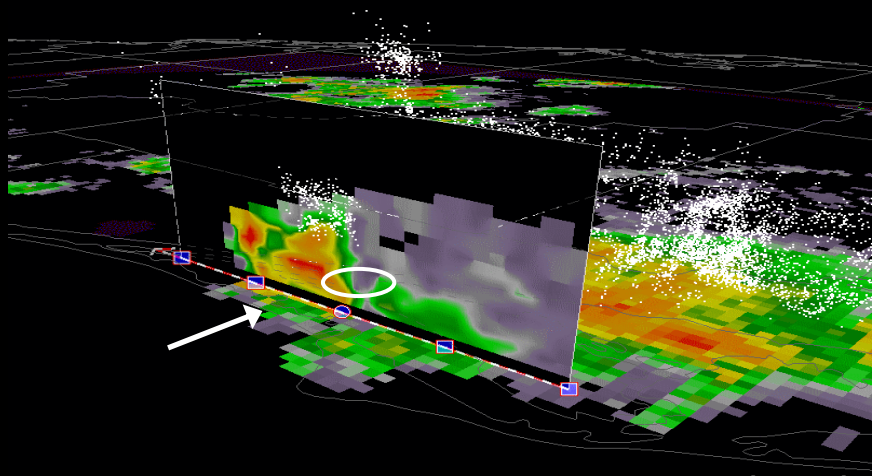






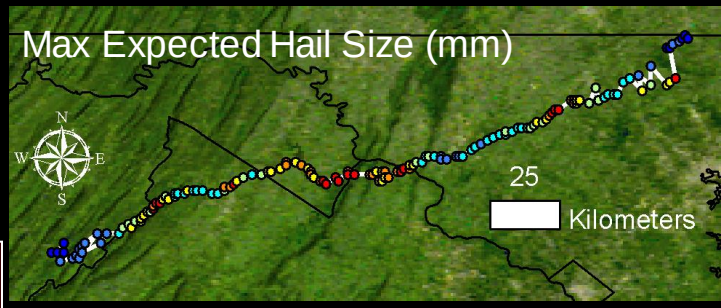
Early Observations

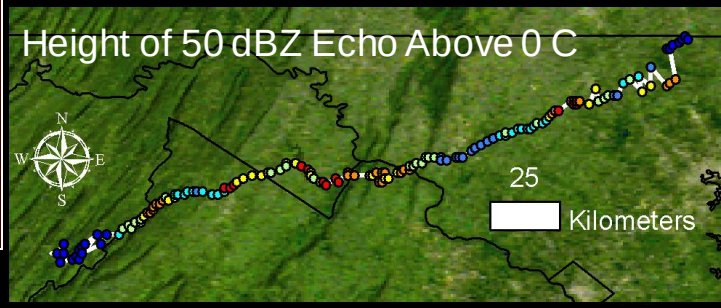
- Topographic Influences
  - Land/Sea, Urban, and Orographic
- Storm Scale Features
  - Lightning Jumps
  - Building/Collapsing cores
  - Decaying Storms
- Relationships are not always clear cut
  - Within severe storms
  - Borderline severe vs. non-severe



14 August 2005 (KSC)
LDAR 20050814-194518.786

10 June 2008





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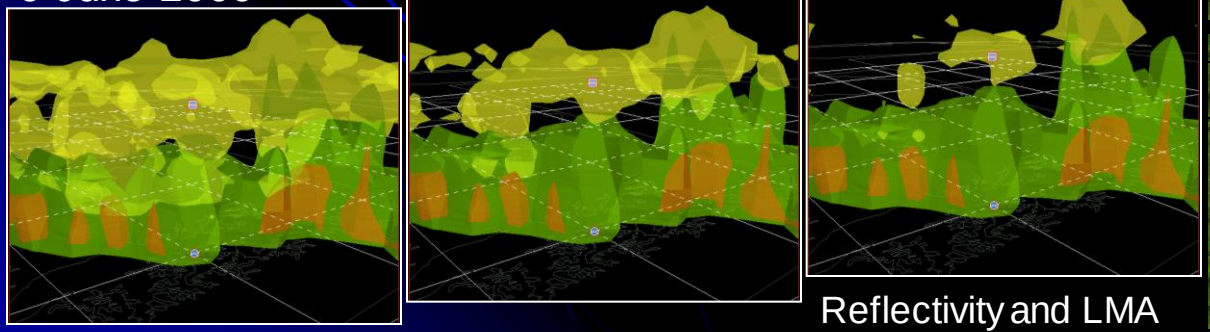
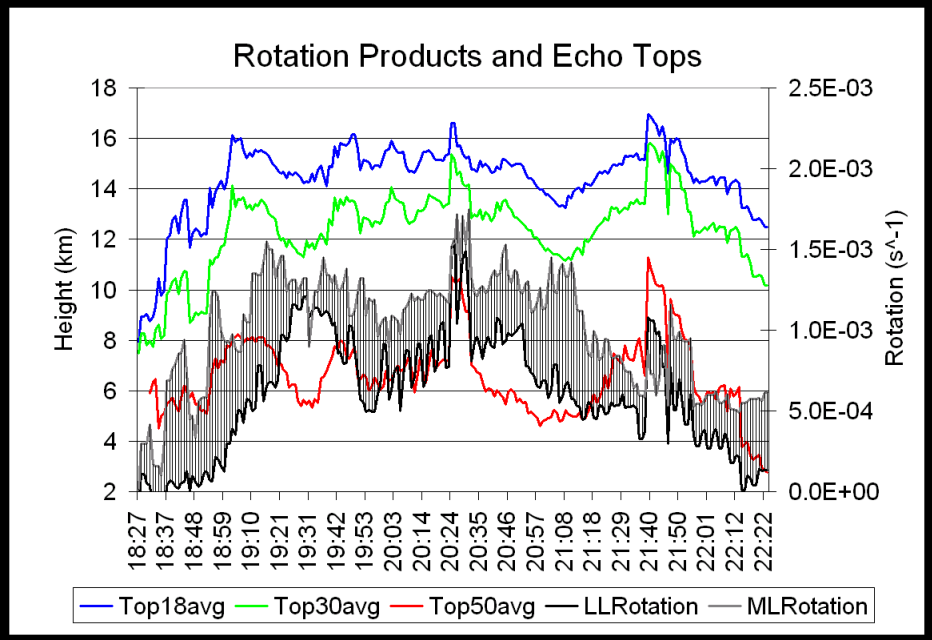
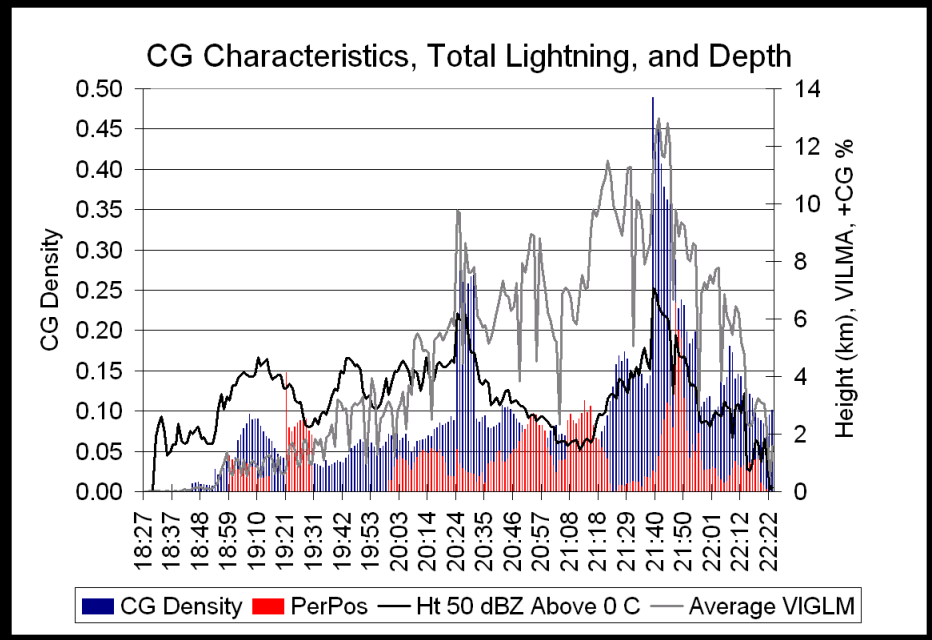
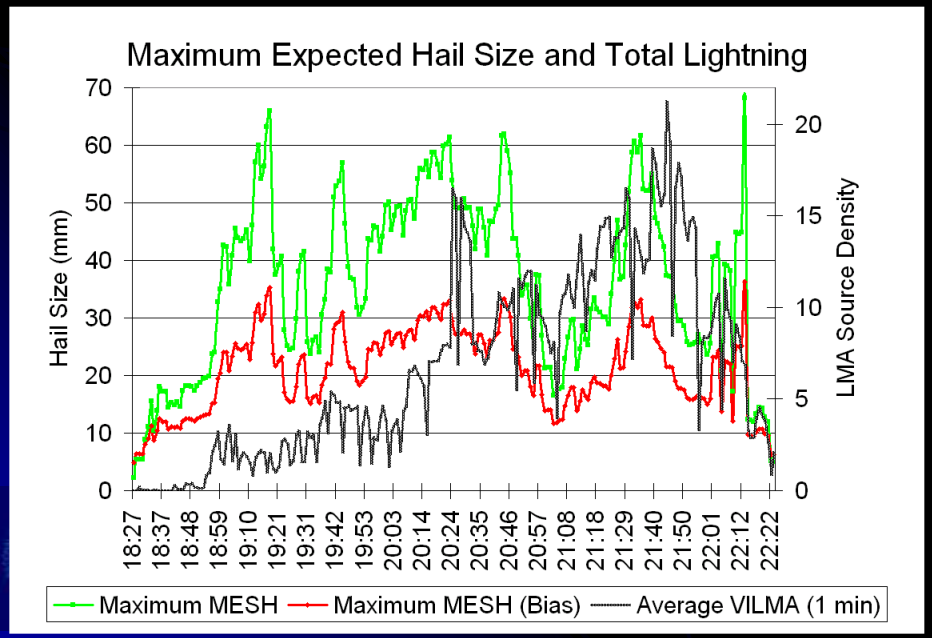


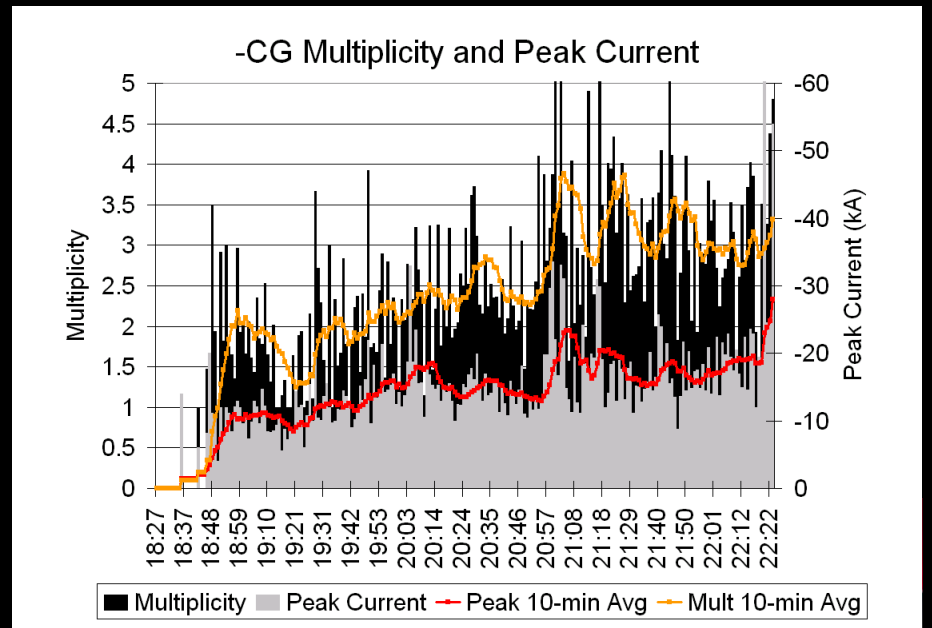
Reflectivity and LMA

Time Series Analysis









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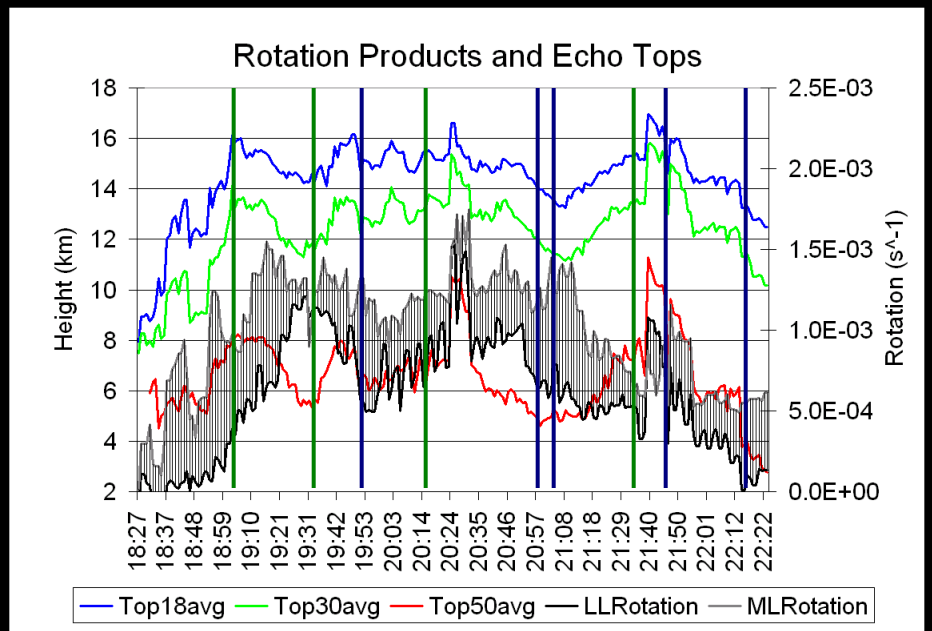
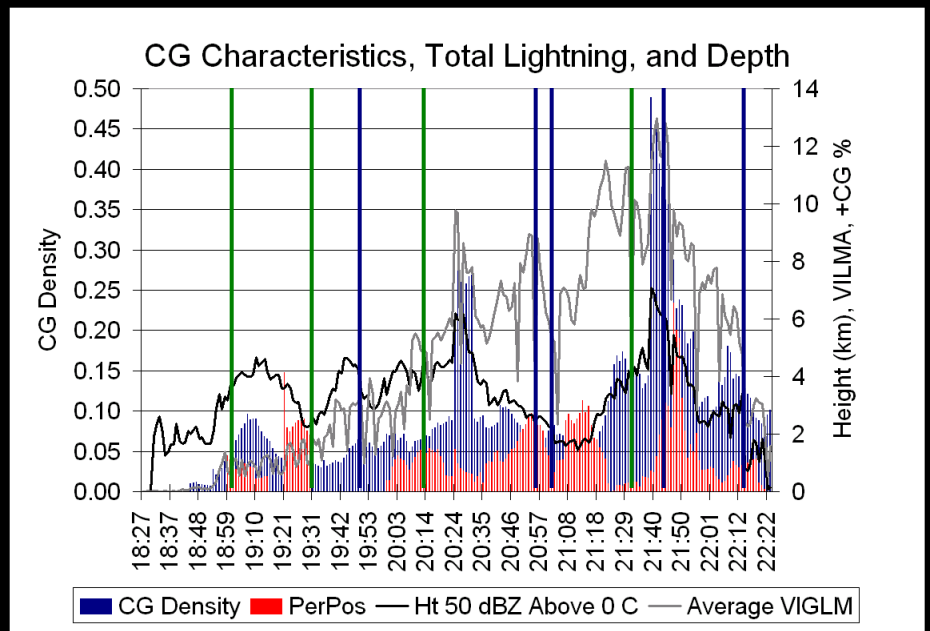
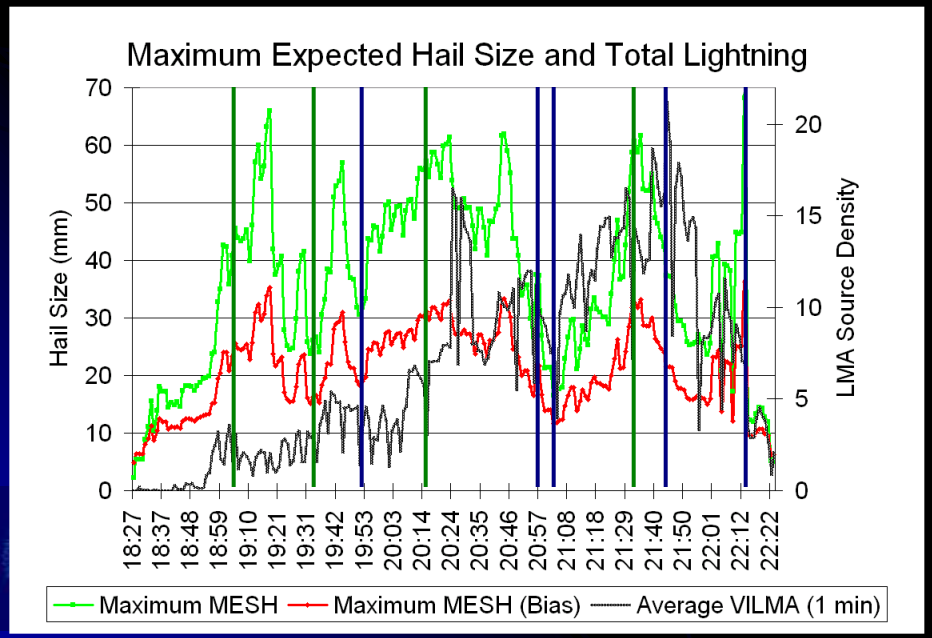
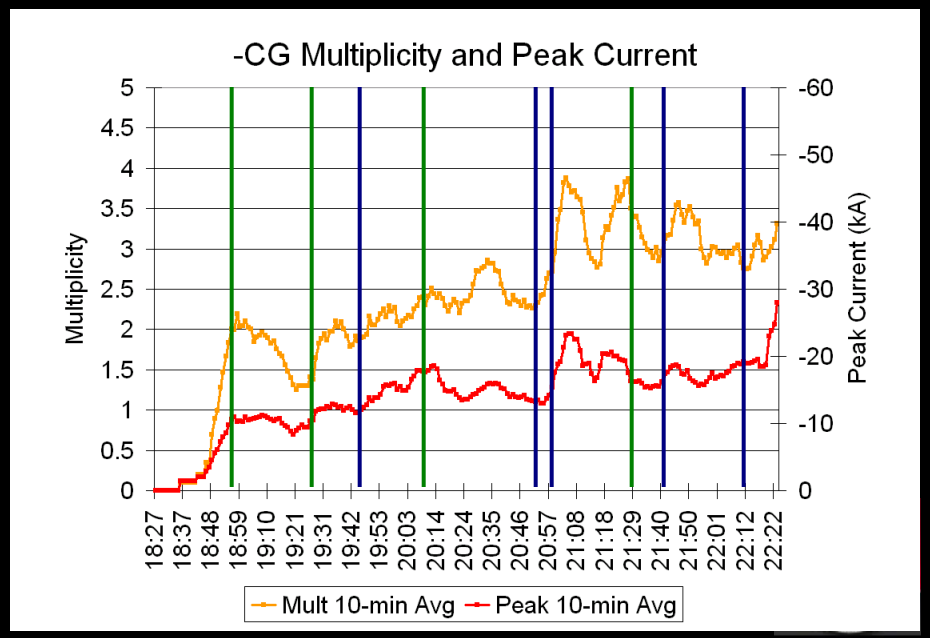




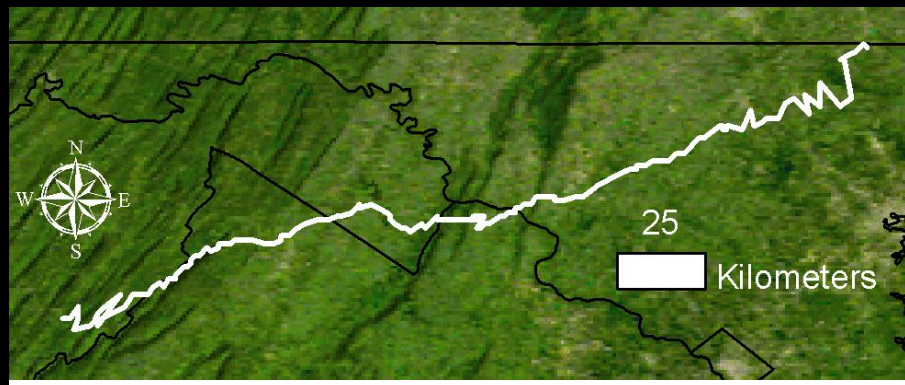


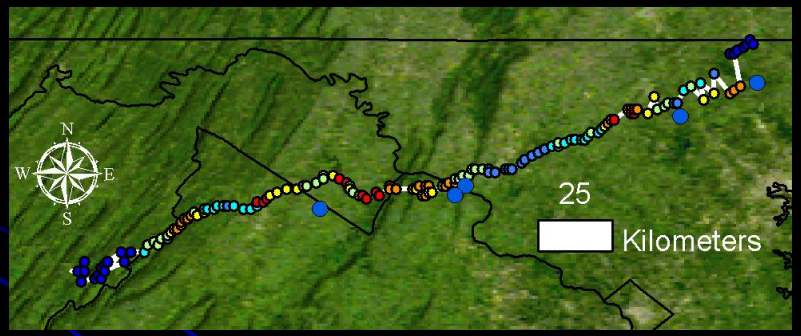


Vertical Distributions

- Value added by the 3rd dimension?
- Interrelate IC, CG, and radar-derived parameters with storm processes
- Multi-sensor approach will help ensure optimal GLM effectiveness

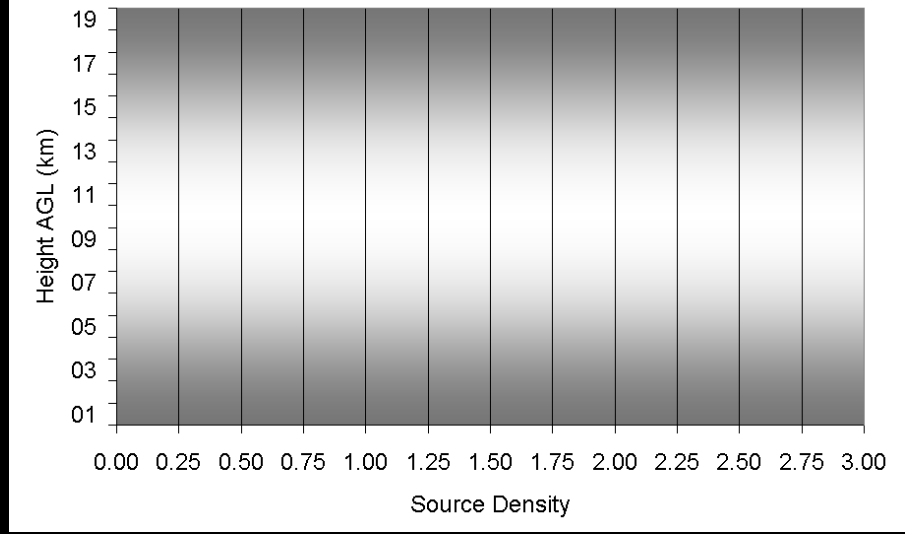
Time and Space Synchronous Storm Reports





Height of 50 dBZ Echo Above 0 C

Max Expected Hail Size (mm)



Statistical Analyses

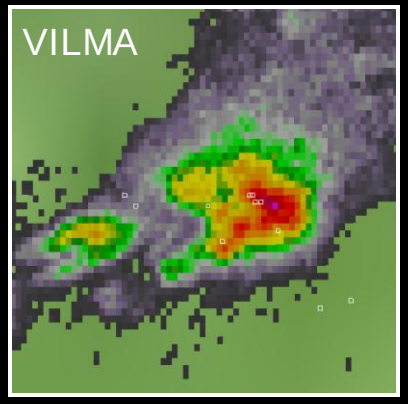
- Compiling an Enormous Dataset
  - Many cases, storms, and parameters
- Subsets of the Final Database
  - Individual data points
  - Severe vs. non-severe
  - Trends within individual storms
- Variety of Approaches
  - Basic correlations
  - Linear regression models
  - Multivariate statistics
  - Time-series analysis
  - Decision tree-based

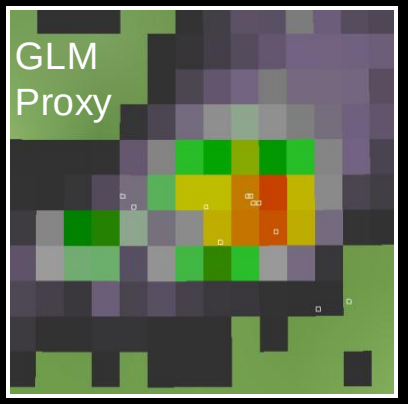
Processed Cases	Storms (S/N)
12 June 2007	17/11
16 July 2007	5/12
25 August 2007	16/17
4 June 2008	9/11
10 June 2008	16/18
3 June 2009	17/17
9 June 2009	12/21
Current Total	**92/107**

Processed So Far

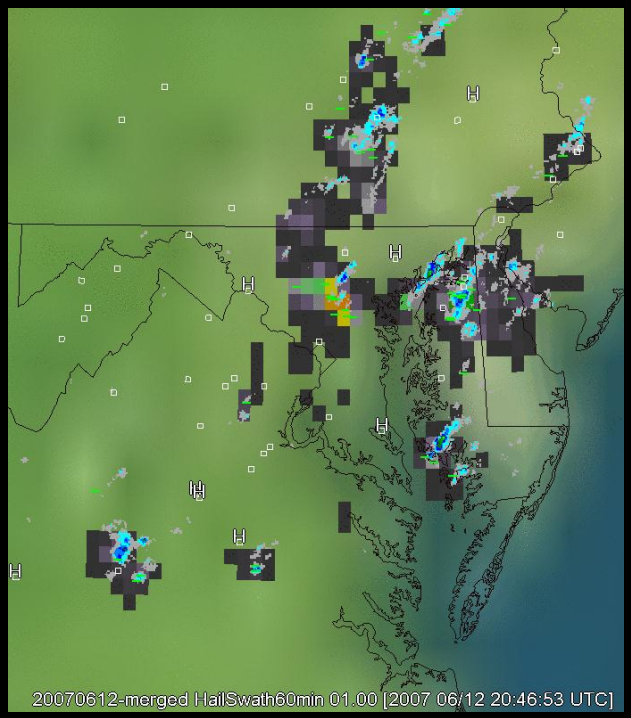
Remaining Questions

- GLM Proxy Parameter
  - Creating proxy data from LMA
  - Flash extent density products
  - Measure of lightning activity level
- Timing of Established Relationships
  - Lead time vs. concurrence
  - Applicable to risk reduction
- Definition of lightning-based storm severity guidance products
  - Number of variables/predictors
  - Deterministic vs. probabilistic
  - Display and distribution





Above: Accumulated VILMA and GLM Proxy (60min)



Animation:
GLM Proxy
NLDN Flashes
Hail Swaths
Hail Reports
Wind Reports