Storm Tracking and Lightning Cell Clustering using Geostationary Lightning Mapping Data for Data Assimilation and Forecast Applications

GR3 No. 47

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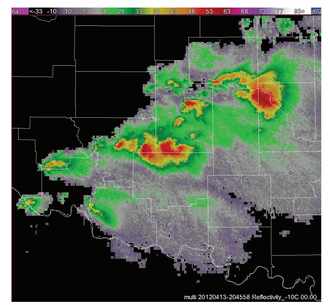
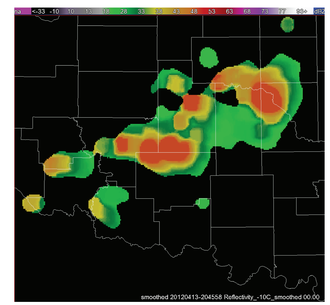
Introduction

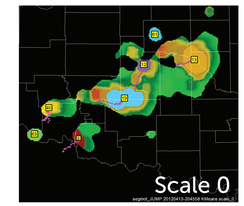
Total lightning data consists of multiple aspects including such details as the total flash rate of a storm or the maximum flash density in a storm. The gridded location and duration of flashes may be easier assimilated than the total flash rate of a storm, but it is currently unknown whether a product such as maximum flash extent density will show the same trends as the total storm flash rate or even how these products vary across different storm modes.

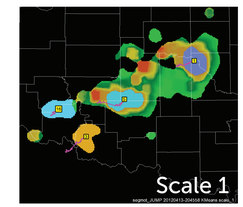
An automated process to determine these statistics across a wide range of storms is inherently dependent upon the storm tracking algorithm and associated settings used. Dropped tracks, storm mergers and misidentified clusters can all affect the statistics. The development and tuning of the automated storm tracking/clustering algorithm used in this project is also being implemented in the National Weather Service / GOESR-GLM "National Lightning Jump Field Test Project" in conjunction with GOESR3 project no. 64 with scientists Carey & Schultz.

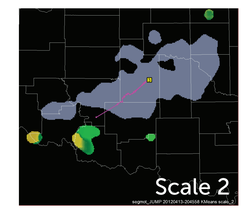
Storm Tracking on Reflectivity at -10 C











(1) A 3D 1-km merger of 88-D across the domain is completed

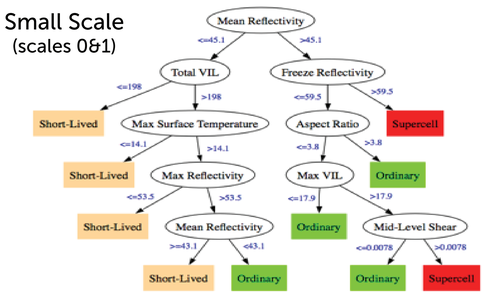
(2) Data is mapped to the height of -10 C from the RUC.

(3) Reflectivity at -10 C is then smoothed/dialated:
- -- Threshold on 20 dBZ & 50 dBZ
  (anything below 20 dBZ = 0 dBZ & above 50 dBZ = 50 dBZ
- -- Percent filter (90%) is run on a 11x11 neighborhood (5 pixels in each direction) such that the fields become dialated.

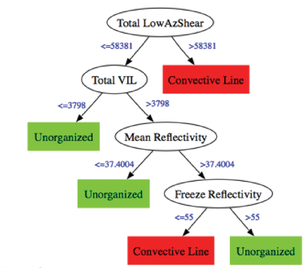
(4) Storm Identification & Tracking is completed via WDSS-II KMEANS & Segmotion algorithms
Minimum size of storms set for each scale (200, 600, & 1000, with final scale unbounded);
Clusters are grown beyond minimum size using an enhanced watershed approach

Automated Storm Typing

Small Scale
(scales 0&1)



Large Scale
(scale 2)



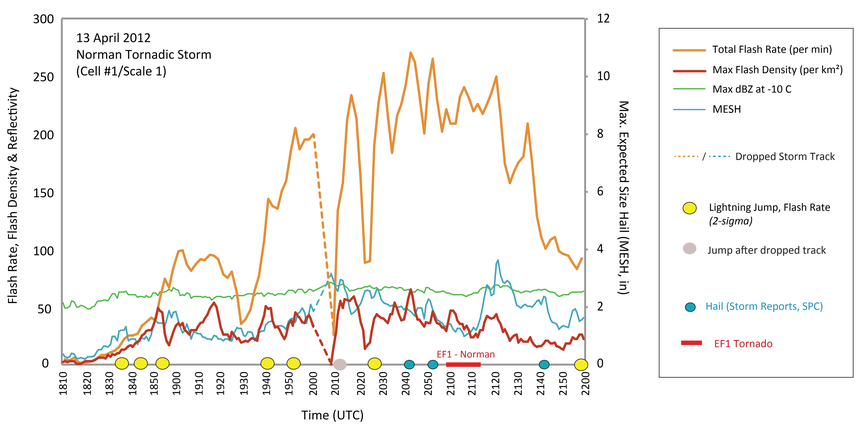
From Kolodziej (2010)

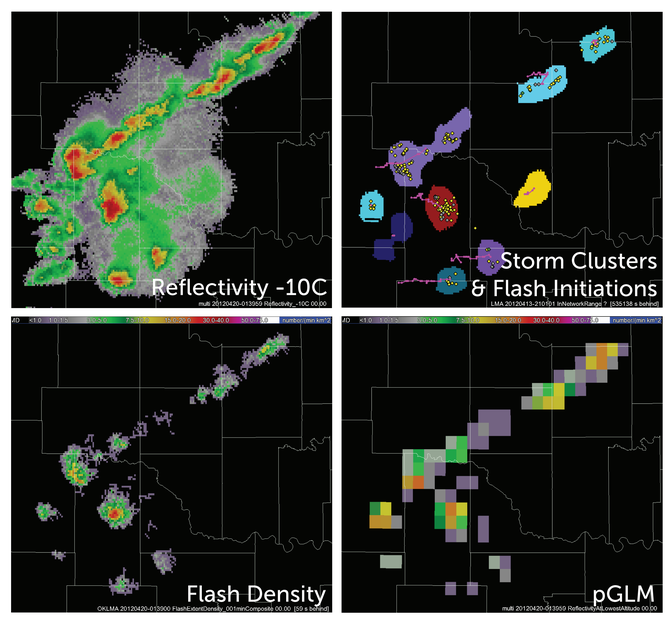
Total Storm Flash Rate (via initiations) vs Maximum Flash Extent Density vs pGLM

Easier to capture the maximum 'Flash Extent Density' as it is typically associated with main updraft core; often miss indiviual flashes.

Flash Extent Density will be a closer match to the gridded visualization from GLM.

Initial tests (71 events) of max flash density with the lightning jump algorithm (2-sigma version) have similar POD (82/82) and lower FAR (38/31) than total flash rate.





Expected Accomplishments for Year 2 & Beyond

- Test storm tracking continuity and evolution using radar, lightning and combination. Incorporate results into ongoing "Lightning Jump Field Test Project" in coordination with GOESR3 proposal no. 64 for real-time implementation and evaluation at the Hazardous Weather Testbed in Norman.
- Determine how various flash trends (e.g., flash rate vs. maximum flash density and associated "jumps") tracked in a storm cell or cluster relate to severe weather hazards as determined from a combination of storm reports and radar statistics.
- Use automated storm typing to determine if and how statistics of flash rate and density vary across different storm modes. Determine statistical ranges of total flash rate and maximum flash density for different storm modes.
- Determine differences in statistics between lightning data at 1 km resolution and at the expected GLM resolution using a pseudo or proxy GLM product.
- Develop strategies for incorporating a pGLM flash product into models via data assimilation (in coordination with Mansell, Fierro, and Allen at NSSL/CIMMS).