Applying GLM and ABI Observations to Severe and Convective Storms

GLM Science Meeting – September 2020

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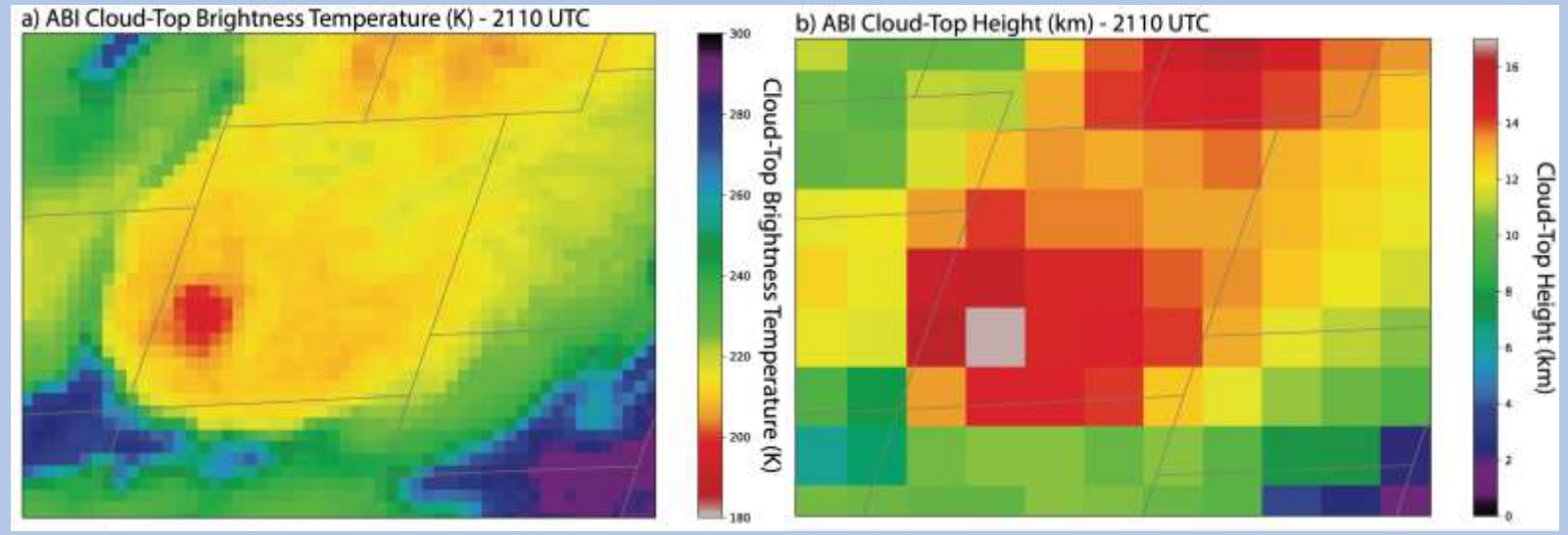
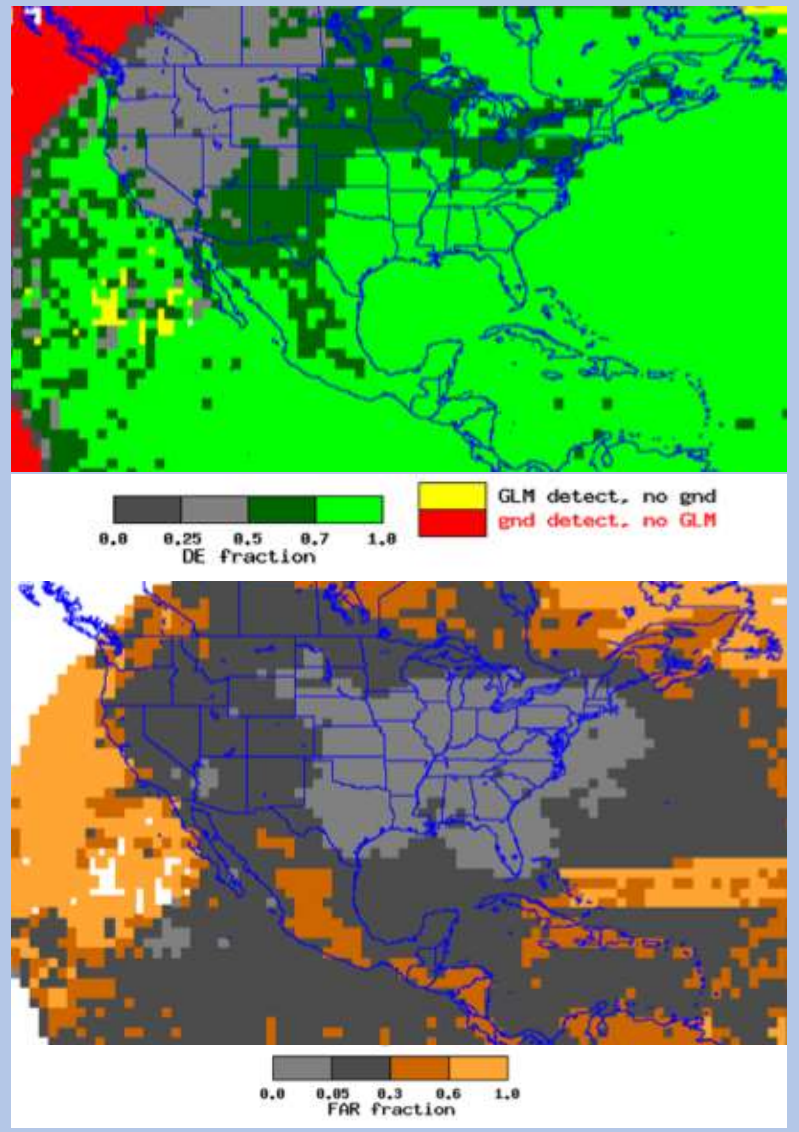
- Goal: Improve the applicability of Geostationary Lightning Mapper data for the operational and severe storms research communities.
- Issue: No other GLM-like sensor for validation.
- **Research question: Can we use data from the ABI to validate gridded GLM imagery?**
  1. Spatial variations in ABI/GLM data consider.
  2. GLM response from ABI-observed convective evolution.





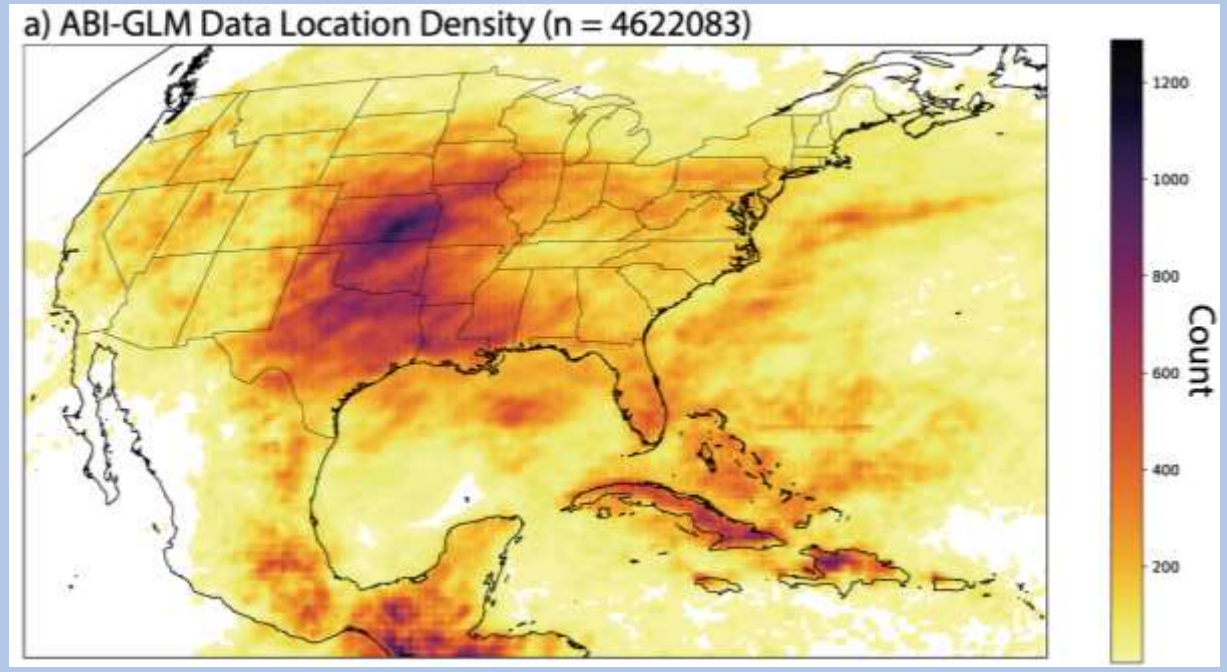
Bateman and Mach 2020

Data, Methods, and Filtering

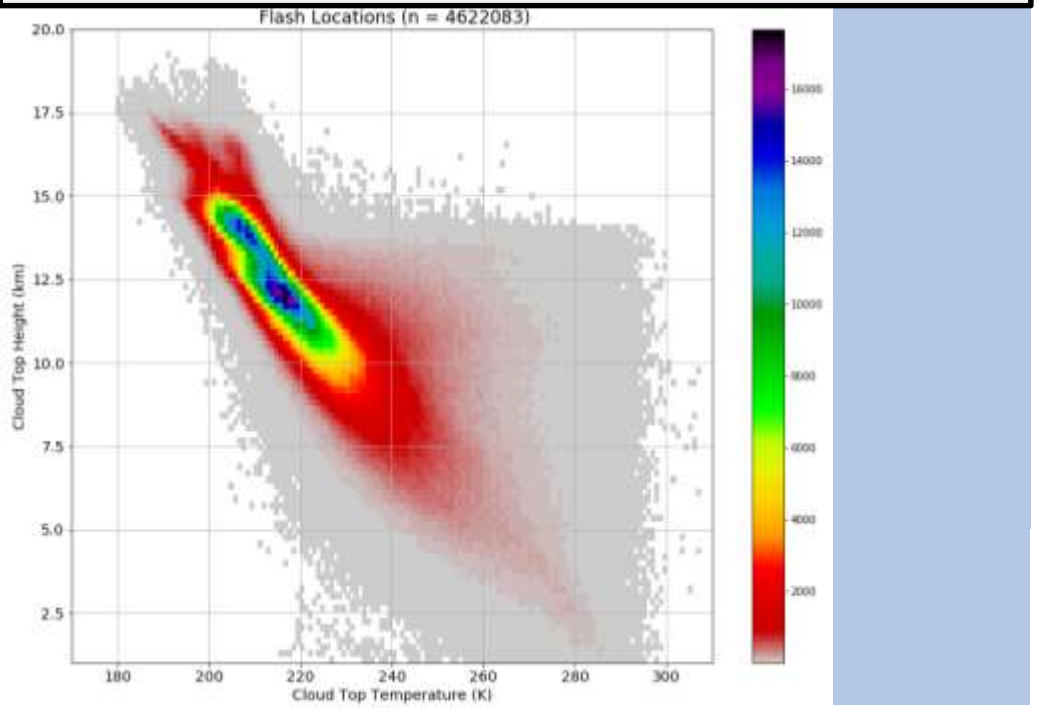
- GLM data (glmtools)
  - Flash Extent Density (no. flashes per 5 min)
  - Minimum Flash Area (km2)
- ABI data
  - Cloud-Top Height (km)
  - Clean-IR Brightness Temperature (K)
- NWS LSRs (severe hail, tornado, wind)

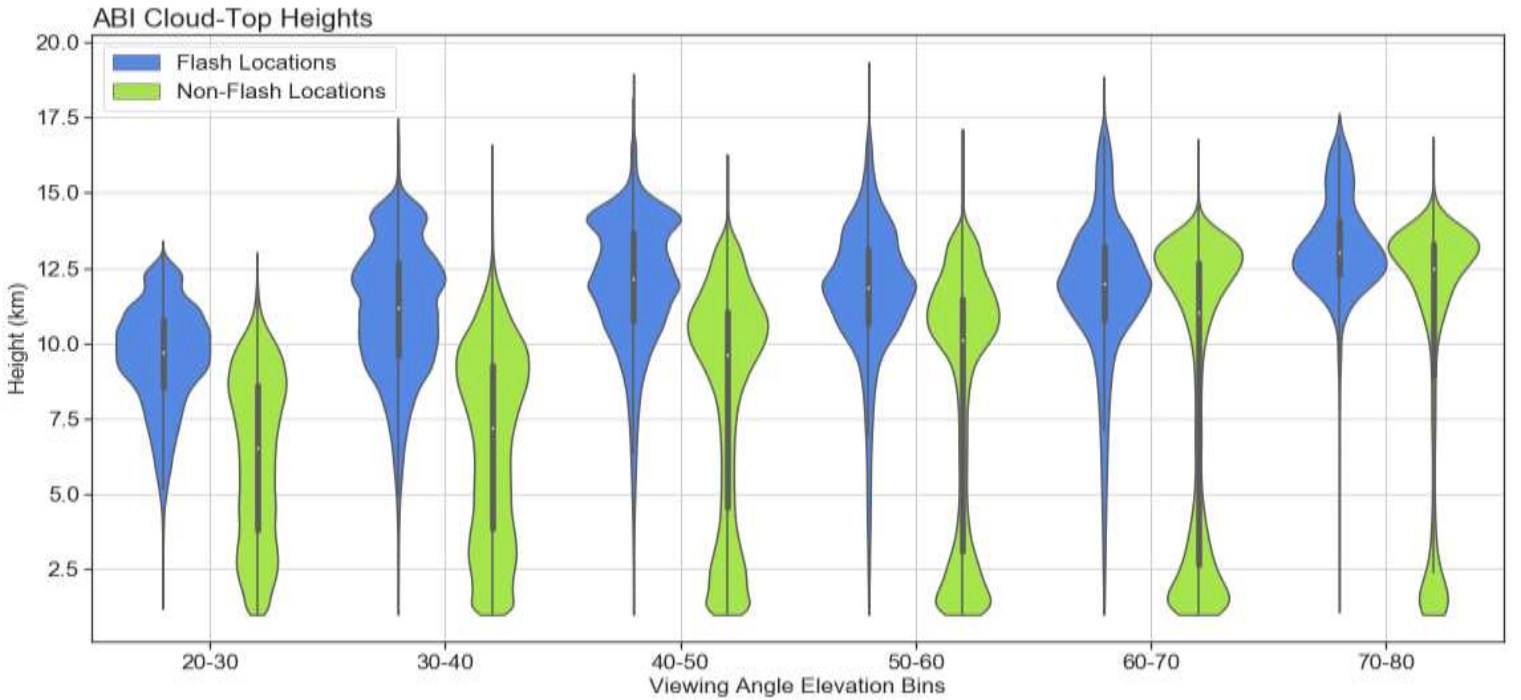
- Max/min sampling method
  - 20 km resolution
- Viewing angle elevation
- 7-week study (13 April – 31 May 2019)
- LSR integration (9509)
  - Flag points within ~30 km and +/- 5 min

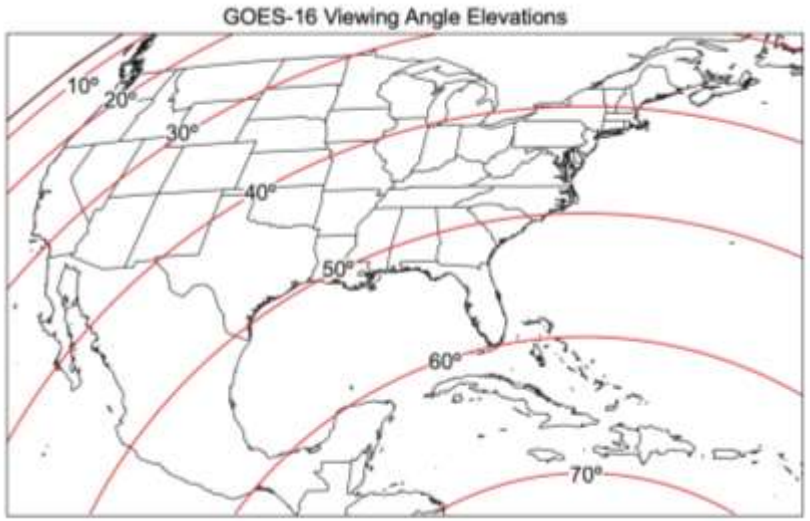
- Extremely low points (hts. < 1km)
- False flashes and location errors
  - FED > 10 flashes (per 5 min.)
  - Hts. < 4 km
  - Temps. > 270 K

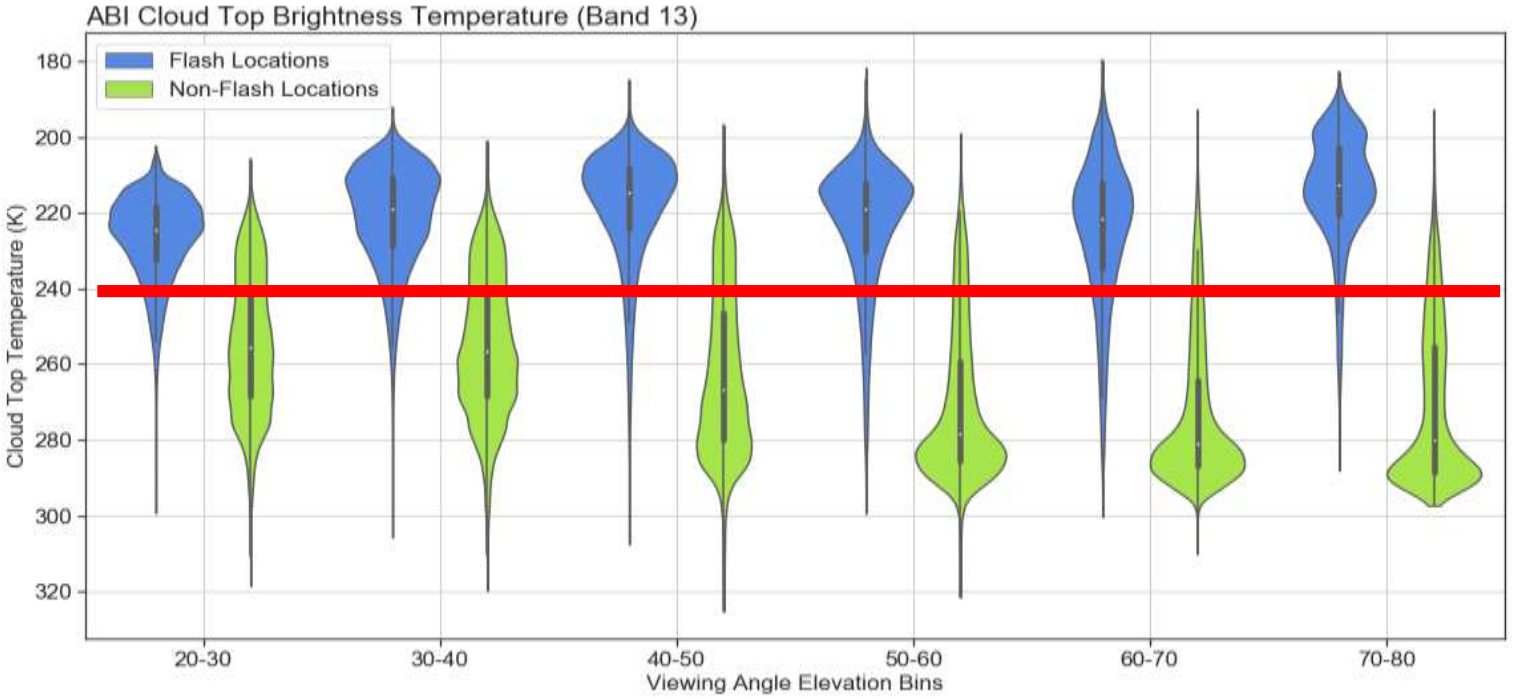


Cloud-Top Characteristics of Flashes



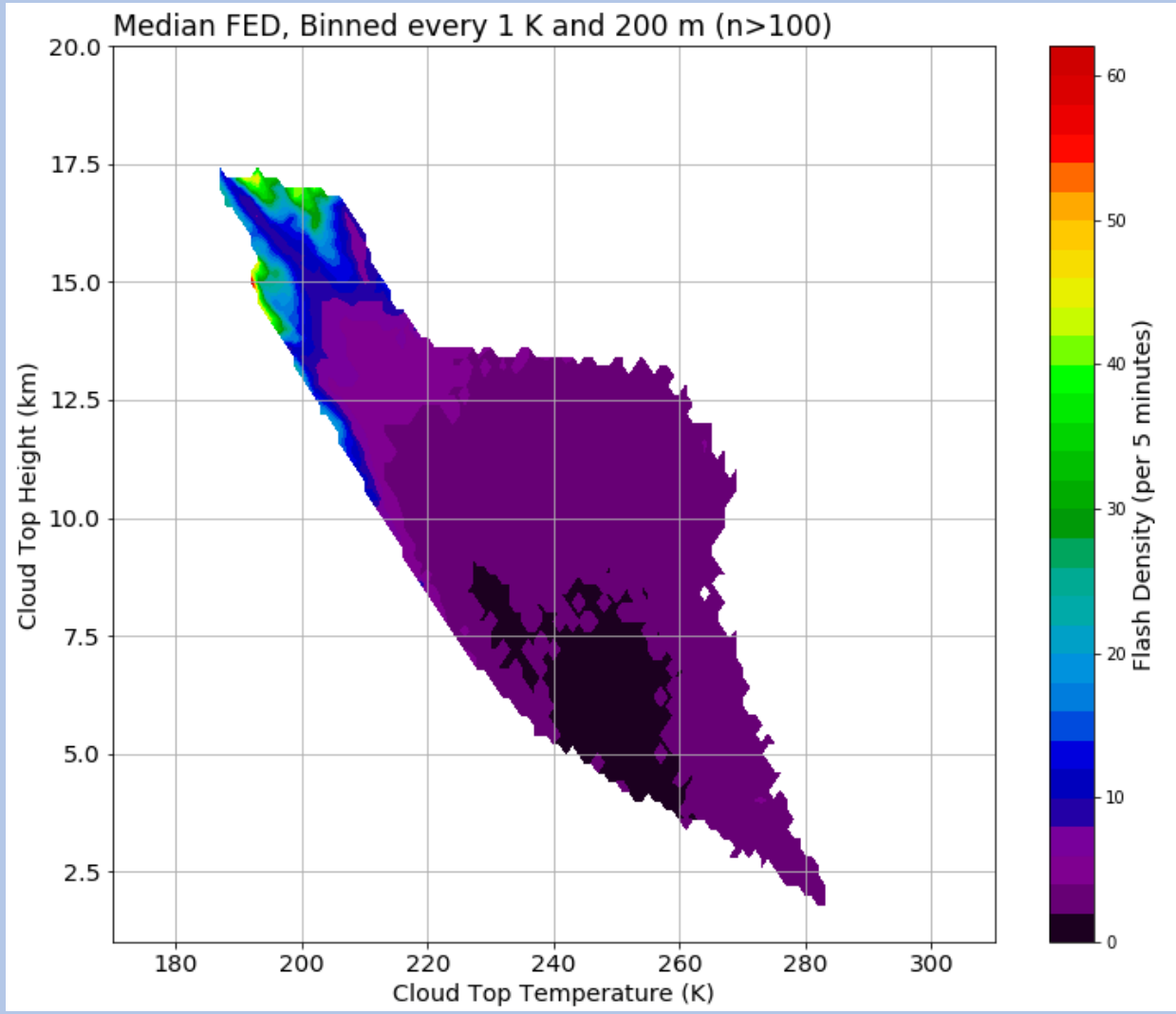


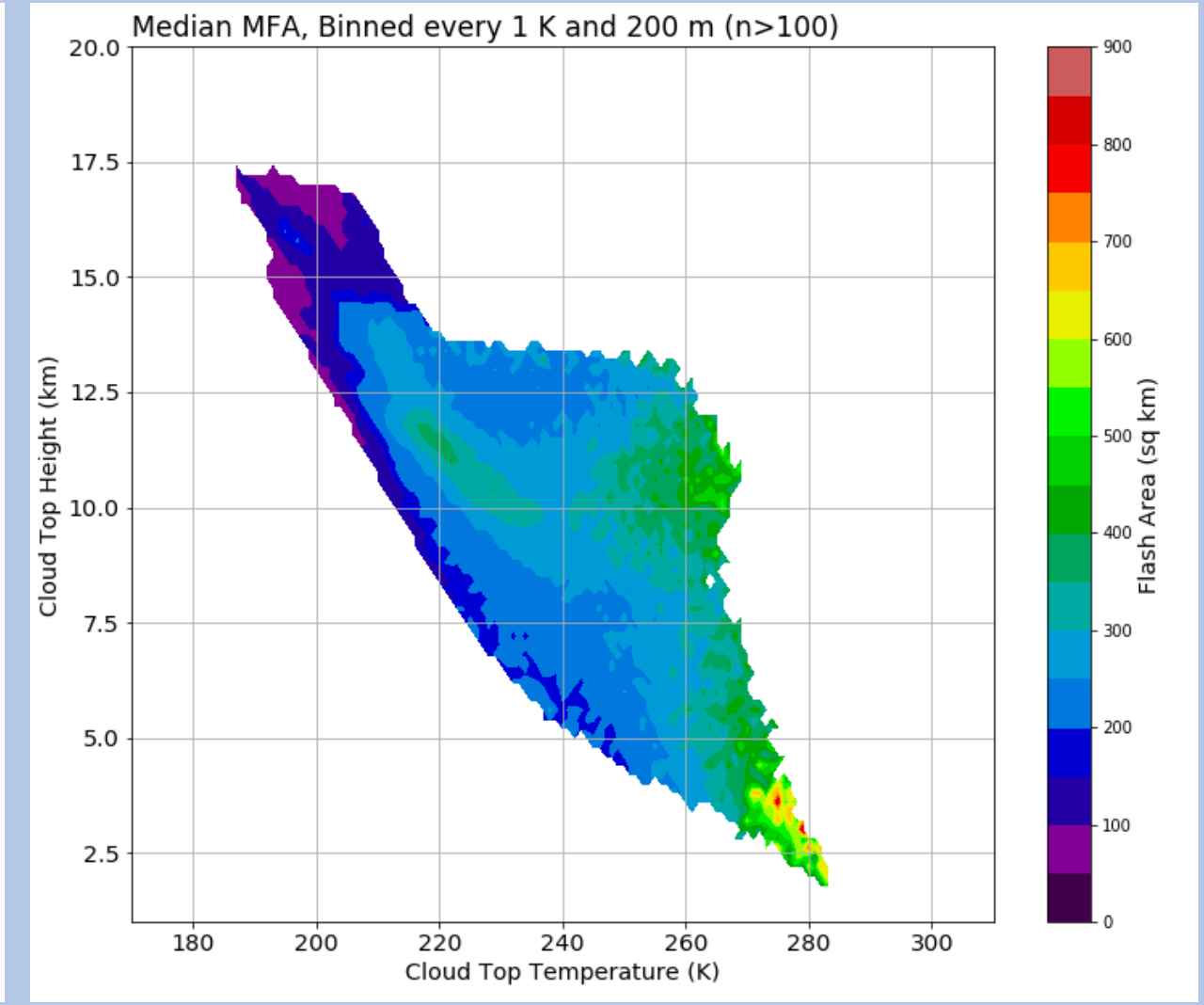




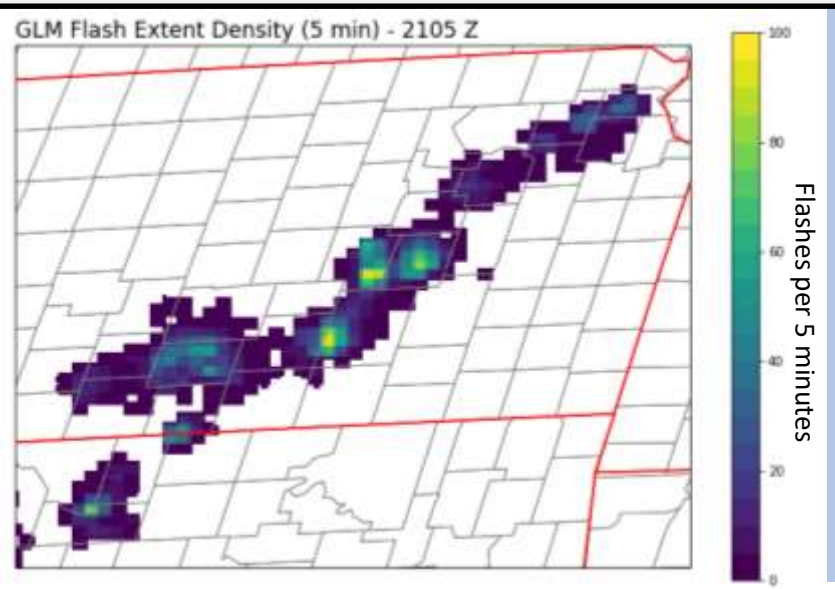
GLM Response to Varying Convective Intensity (Non-Severe and Severe)

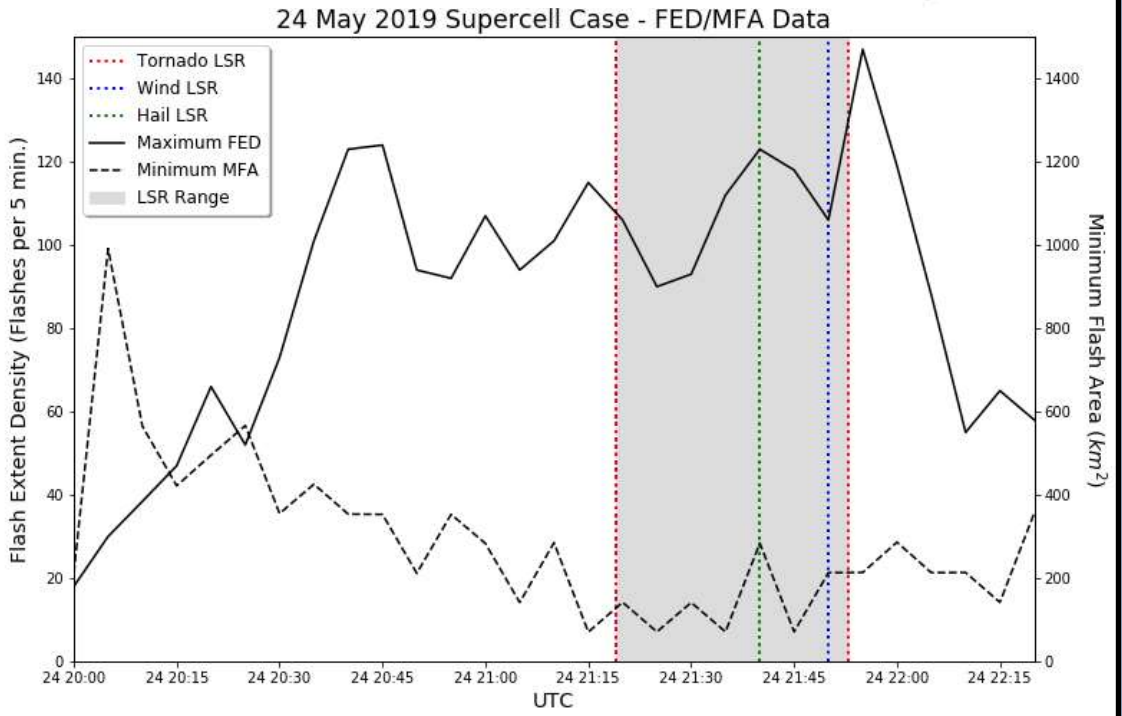
Convective vs Stratiform Flashes
Greater FED → Smaller MFA
Less FED → Larger MFA





Case Studies





Conclusions

- Overarching conclusion
  - ***The combination of ABI data and GLM data provide complementary insight into thunderstorm morphology and meaningful lightning interrelationships with evolving storm characteristics.***
- Specifically…
  - Areas with cloud-tops colder than 240 K typically produce lightning.
  - The GOES-16 viewing angle to convective features complicates the interpretation of ABI data, especially cloud-top height.
  - Increasing local flash density is strongly related to decreasing flash areas, higher cloud-top heights, and colder cloud-top temperatures.
- Future work
  - Optical energy
  - Significance testing (severe vs non-severe)
  - Ground-based comparisons (MRMS)
- *GLM and ABI Characteristics of Severe and Convective Storms* (AGU-JGR)

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