Early Operational Activities with the Geostationary Lightning Mapper

Geoffrey T. Stano[1,2], Matthew R. Smith[1,3], Christopher J. Schultz[1,4], Paul J. Meyer[1,4], and Kevin M. McGrath[1,5]

[1]NASA Short-term Prediction Research and Transition Center (SPoRT), Marshall Space Flight Center, Huntsville, Alabama, United States

[2]ENSCO, Inc.,

[3]Earth System Science Center, University of Alabama in Huntsville,
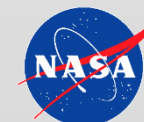
[4]Marshal Space Flight Center, Earth Science Division,

[5]Jacobs Technology, ESSSA Group

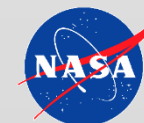52nd Canadian Meteorological and Oceanographic Society Congress
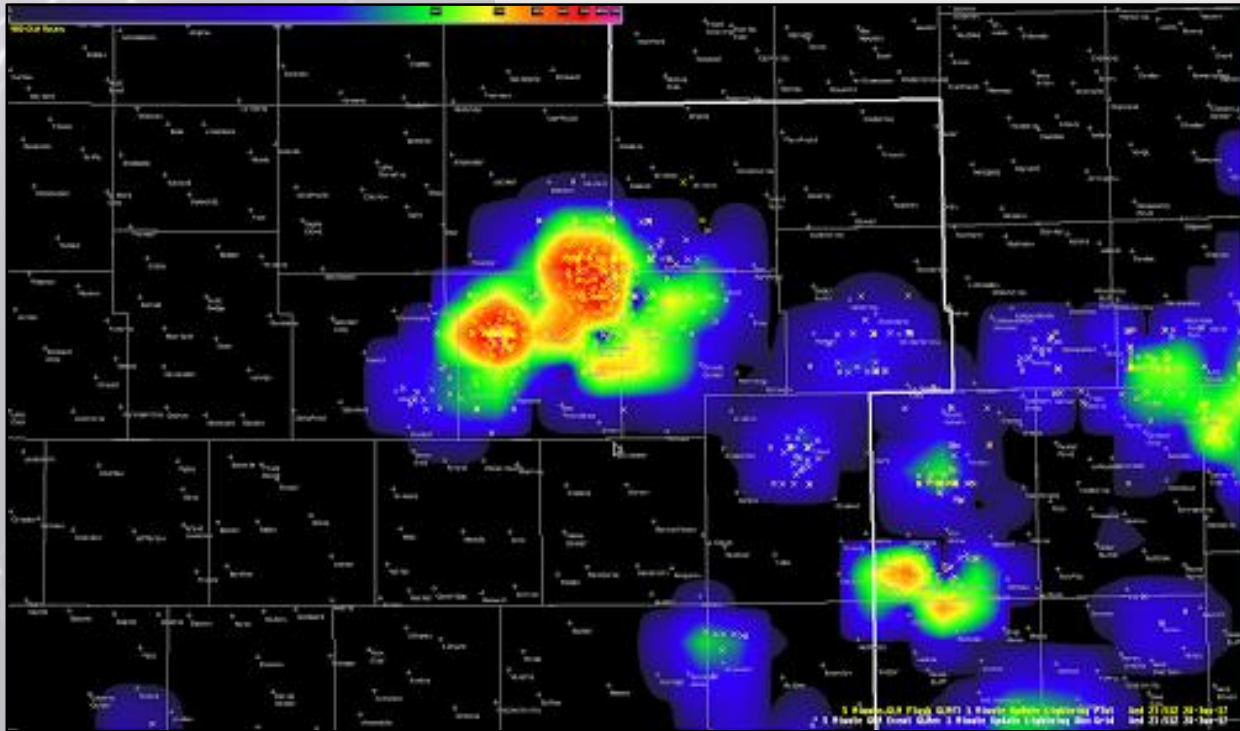
Halifax, Nova Scotia

12 June 2018

A Short Outline

- Role with the GOES-R Proving Ground
- Goals of an operational assessment
- Early, potential uses (examples)
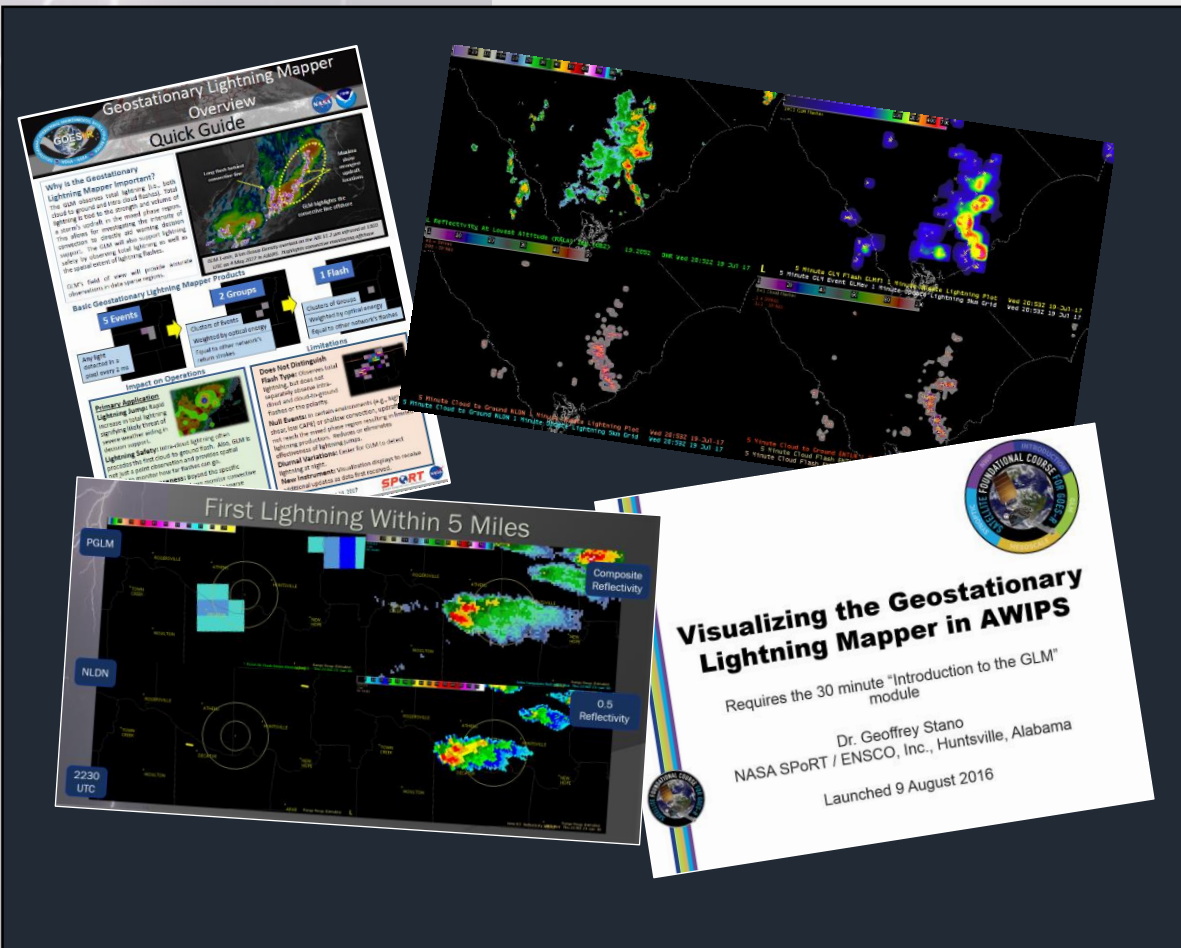- Future Work

Role With the GOES-R Proving Ground

Sample of GLM event density with flash centroid points. (Preliminary, non-operational)

- Liaison to the U.S. National Weather Service for NASA SPoRT
  - Work with multiple operational partners
- Serve as GLM liaison for GOES-R
  - Focus on training
  - Focus on operational applications
- Work to advocate for operational needs
- Greatly supported by co-authors in developing quality training material
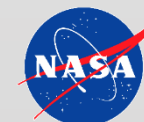
Goals of the Operational Assessment

Examples of initial training material.

- Provide initial training

- Variety of geographic and forecast needs

- Evaluate GLM in day-to-day operations

- Compliment other Proving Ground work

- Identify uses (more than just severe weather)

- Identify forecaster-requested training

- Identify forecaster-requested "products"

- Incorporate forecaster examples into an applications library for training
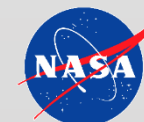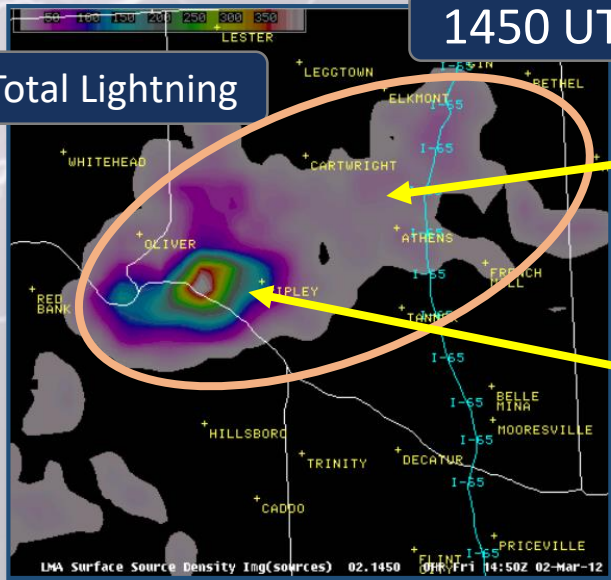
Total Lightning

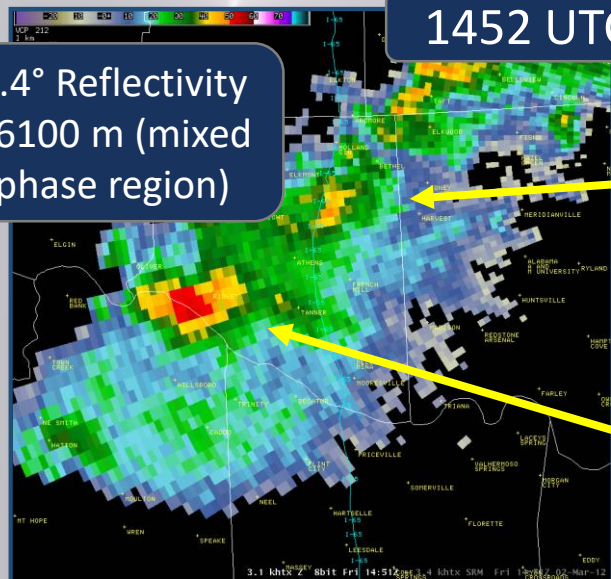1450 UTC

Total Lightning
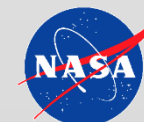
Spatial extent

Developing updraft

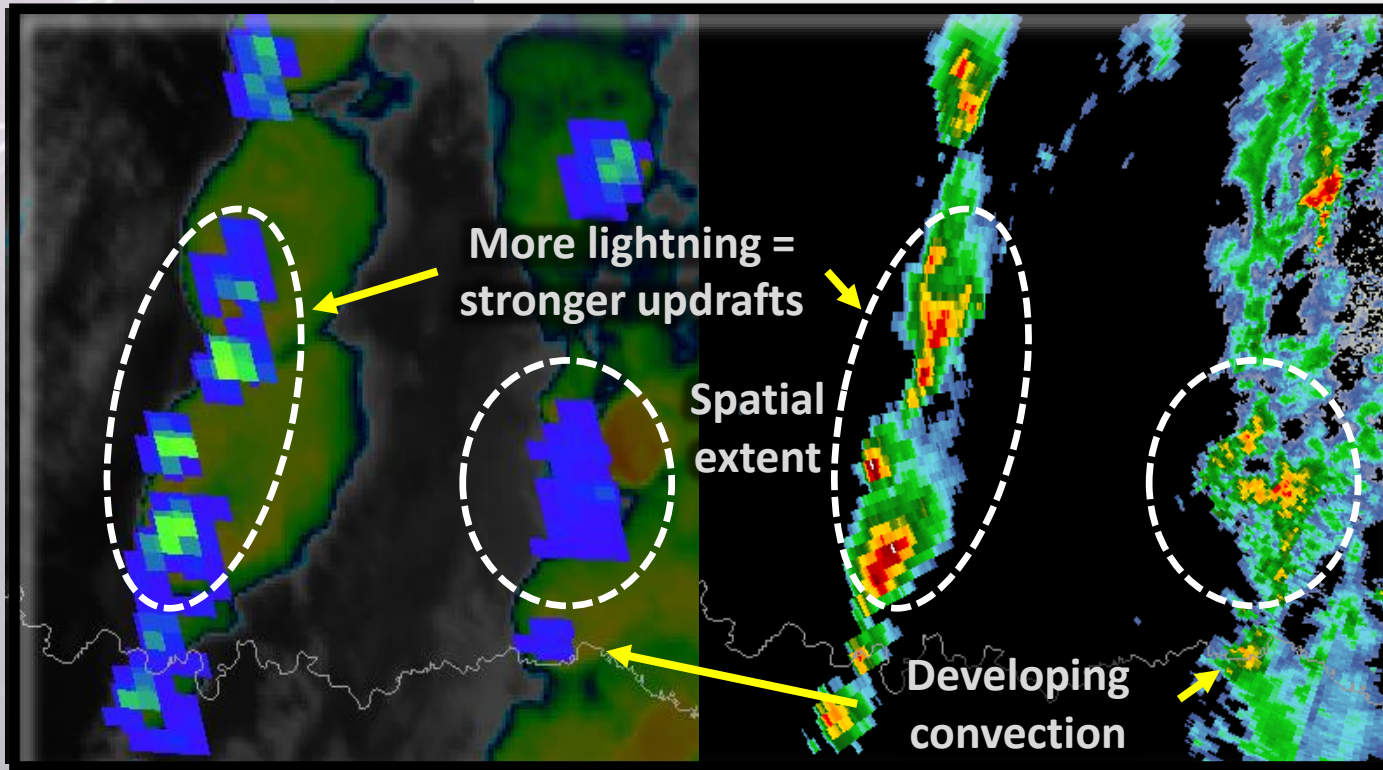1452 UTC

3.4° Reflectivity ~6100 m (mixed phase region)

Lightning 10s of km from updraft

Maximum of lightning coincident with updraft

- Total lighting = cloud-to-ground **and** intra-cloud
- Physical reasoning for total lightning
  - Charging occurs in mixed phase region
  - Larger, stronger updrafts = more total lightning
- Advantages
  - Intra-cloud often precedes first cloud-to-ground
  - Total lightning proxy for storm strength
  - Monitor convective development / weakening
  - Observe the spatial extent
- Early training matches GLM to forecaster conceptual model
  - Builds trust in GLM, particularly for data sparse areas

NASA

SPORT
Short-term Prediction Research and Transition Center

GLM Capabilities: Monitor Convection

More lightning = stronger updrafts
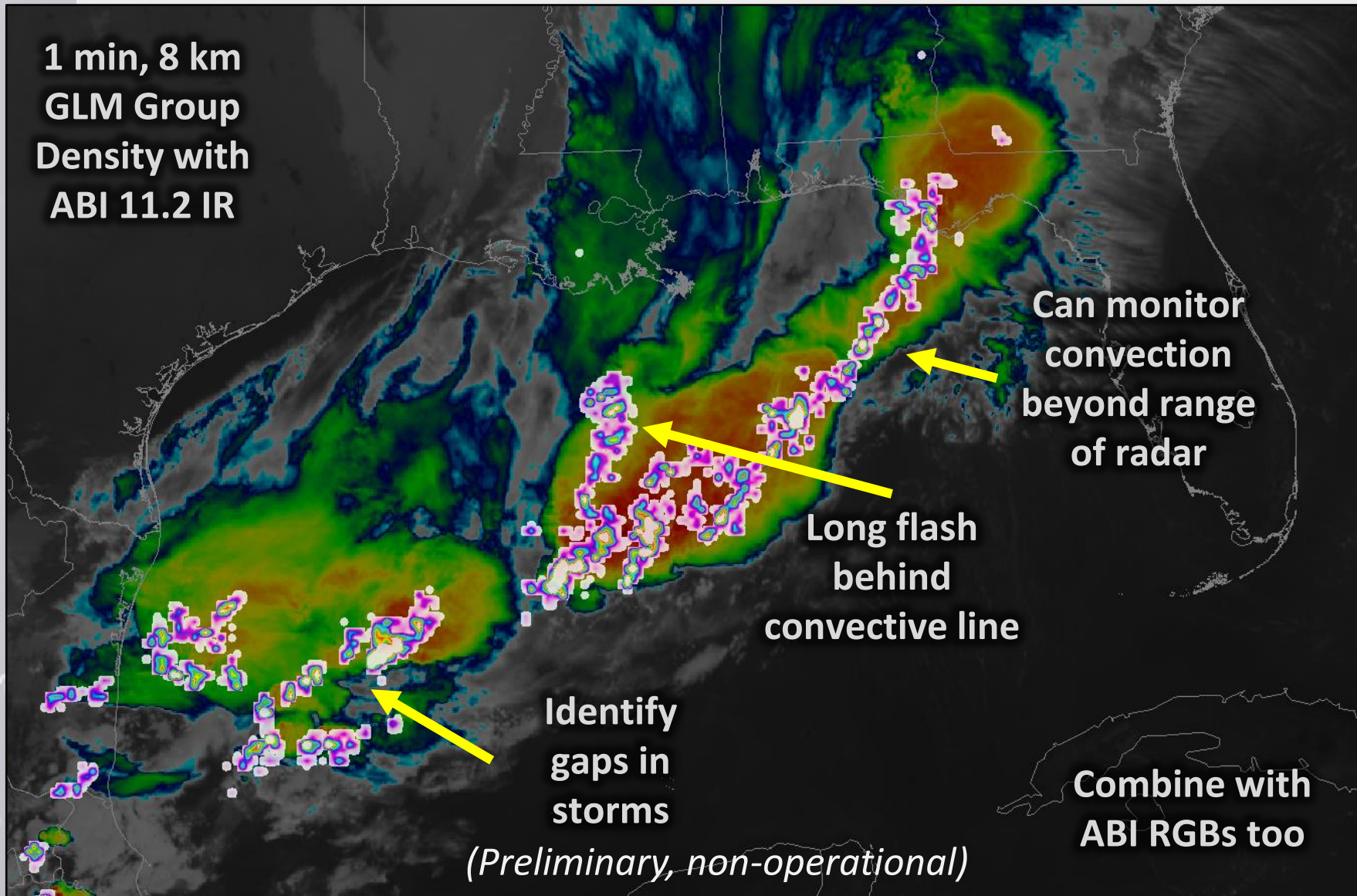
Spatial extent

Developing convection

Example of GLM flash extent density overlaid on 10.3 micron ABI IR (left) compared to radar reflectivity (right)

- Identify spatial extent of lightning
  - Can extend well into the stratiform region
  - Signify possible updates to convective SIGMETs?
- Monitor convective updrafts
  - Train in regions with radar to earn trust
  - Use GLM alone in data sparse regions
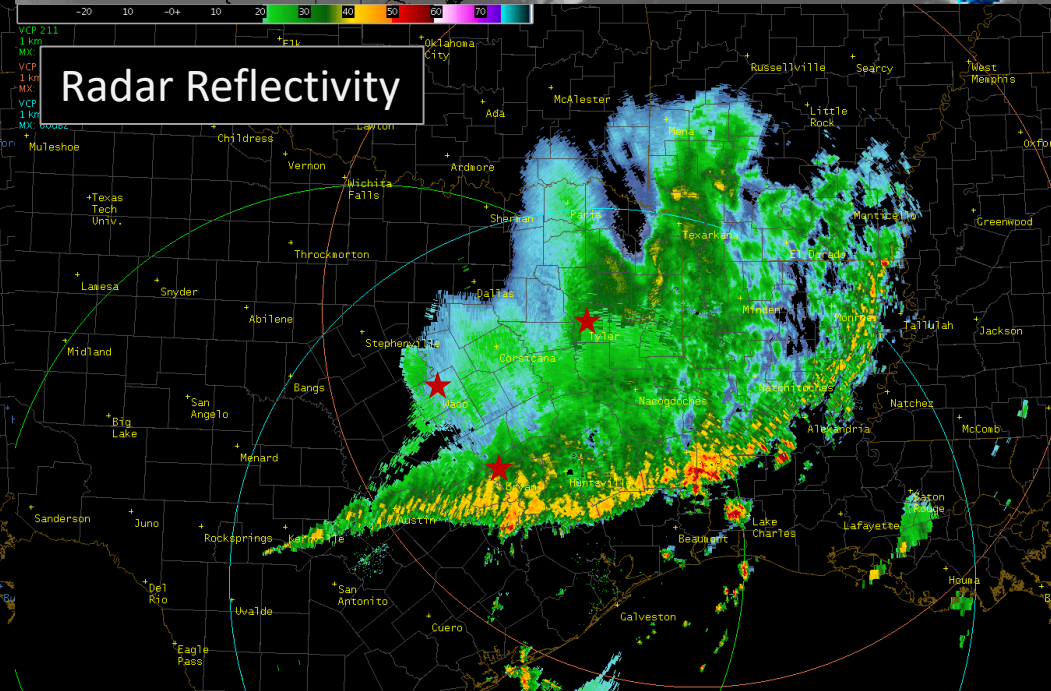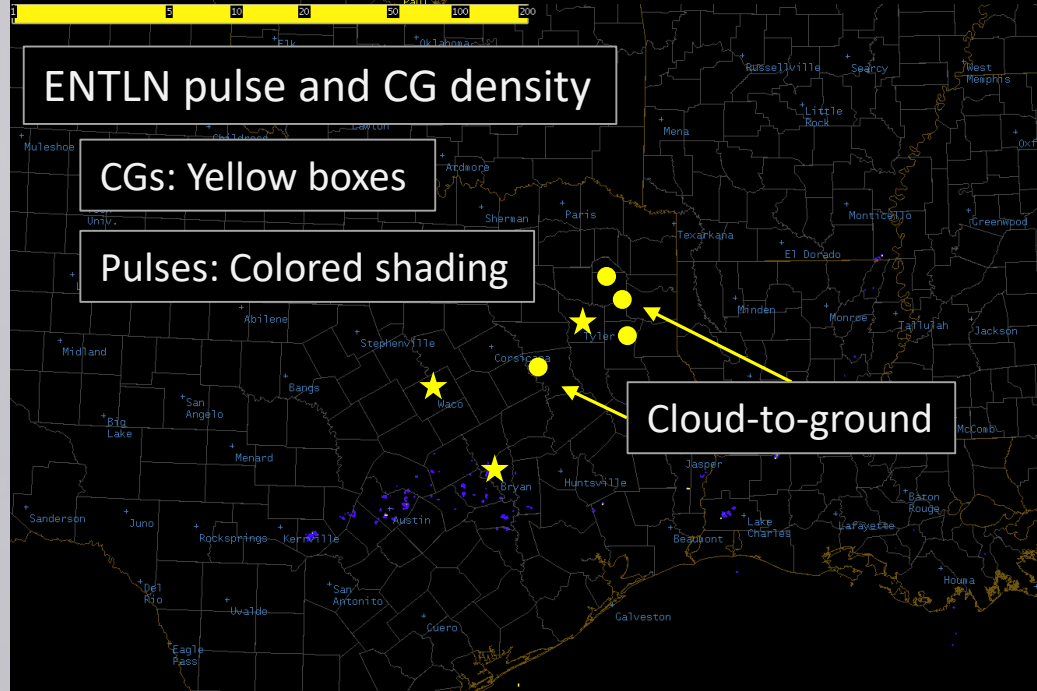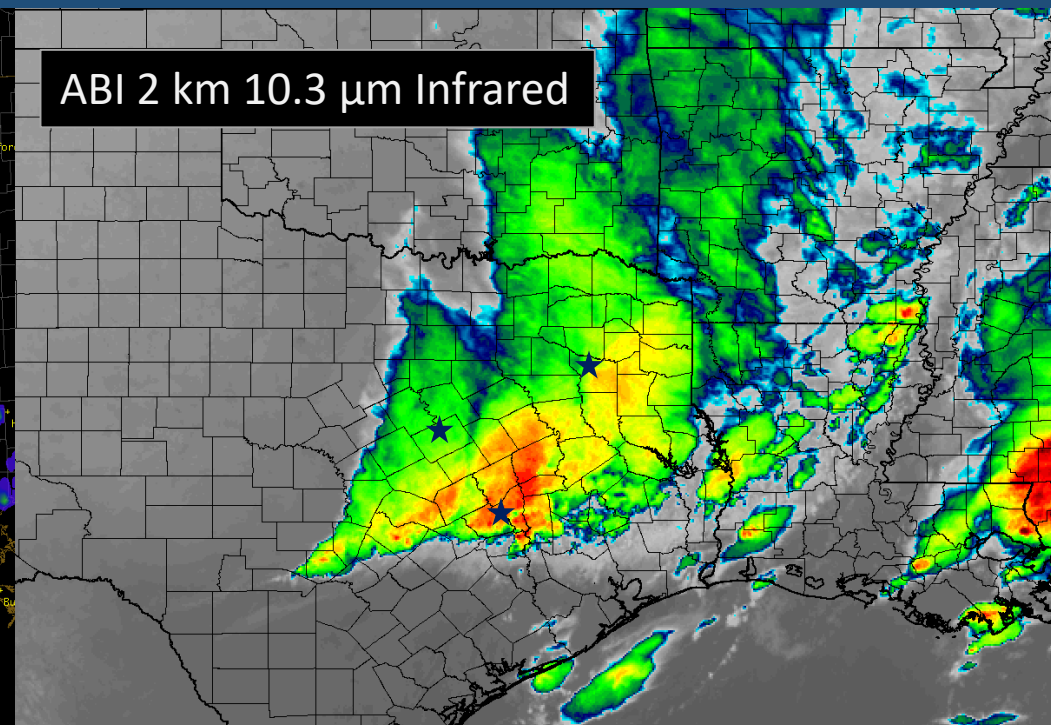 - Identify convective / non-convective
  - Monitor development

NASA

SP RT
Short-term Prediction Research and Transition Center

Data Sparse Region (Gulf of Mexico)

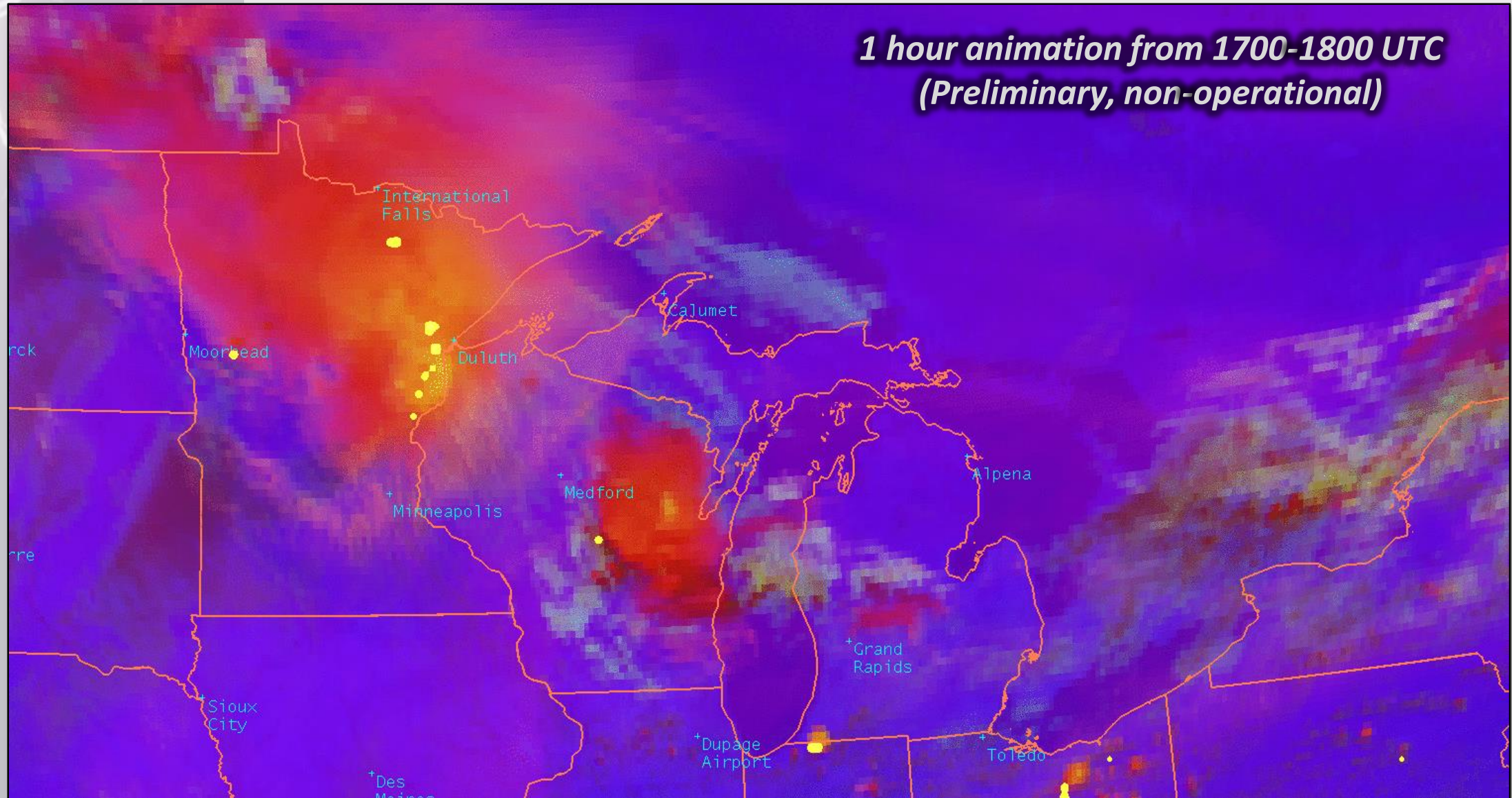**1 min, 8 km GLM Group Density with ABI 11.2 IR**

Can monitor convection beyond range of radar

Long flash behind convective line

Identify gaps in storms

(Preliminary, non-operational)

Combine with ABI RGBs too

SP☀RT
Short-term Prediction Research and Transition Center

NASA

Lightning Safety
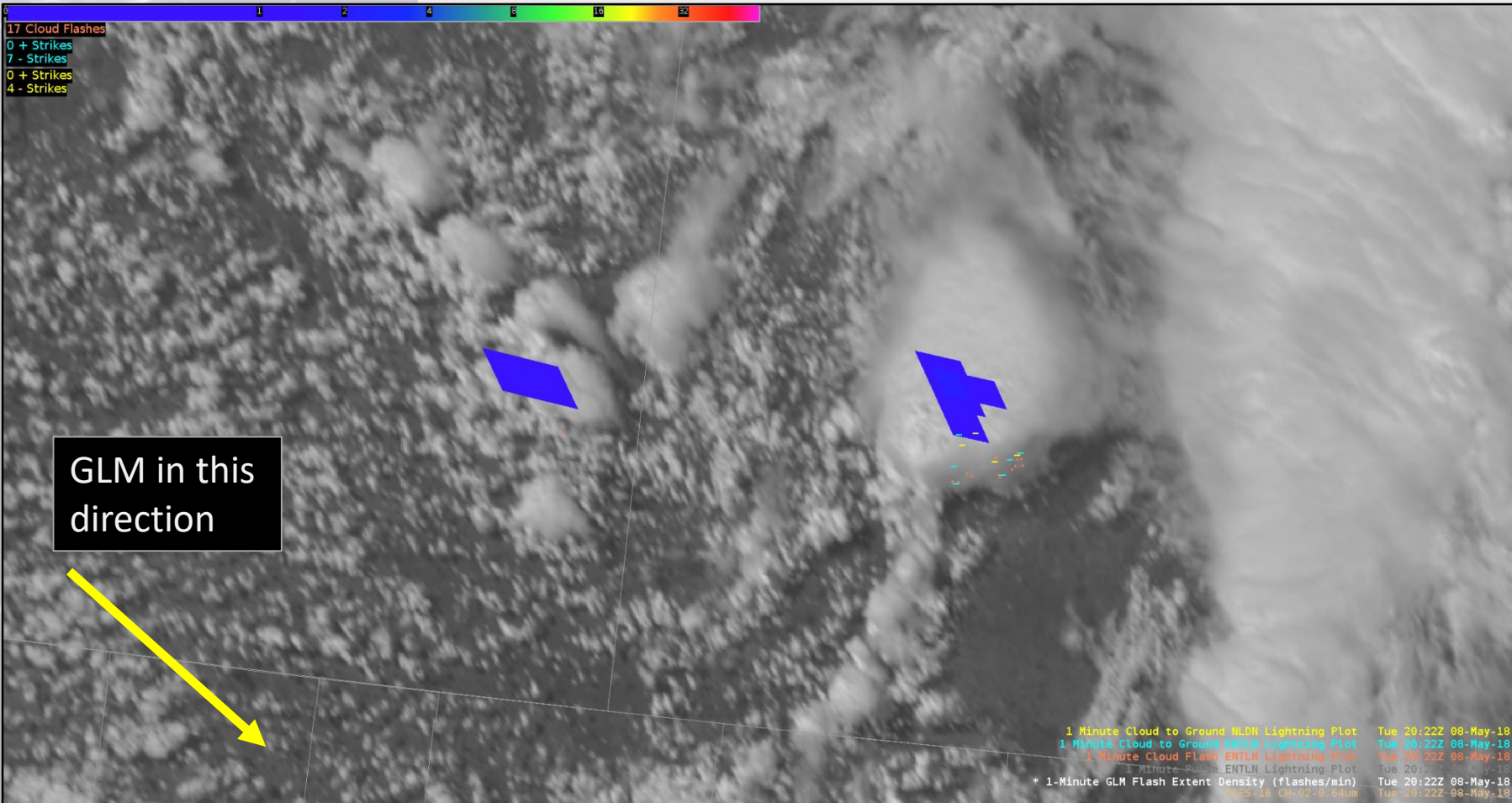
- Flash extended 100+ miles
- GLM "connects the dots" – Earth Networks individual obs part of 1 contiguous flash

GLM Event Density

ABI 2 km 10.3 μm Infrared

Tyler

Waco

Cloud-to-ground

Bryon

ENTLN pulse and CG density

CGs: Yellow boxes

Pulses: Colored shading

Cloud-to-ground

Radar Reflectivity
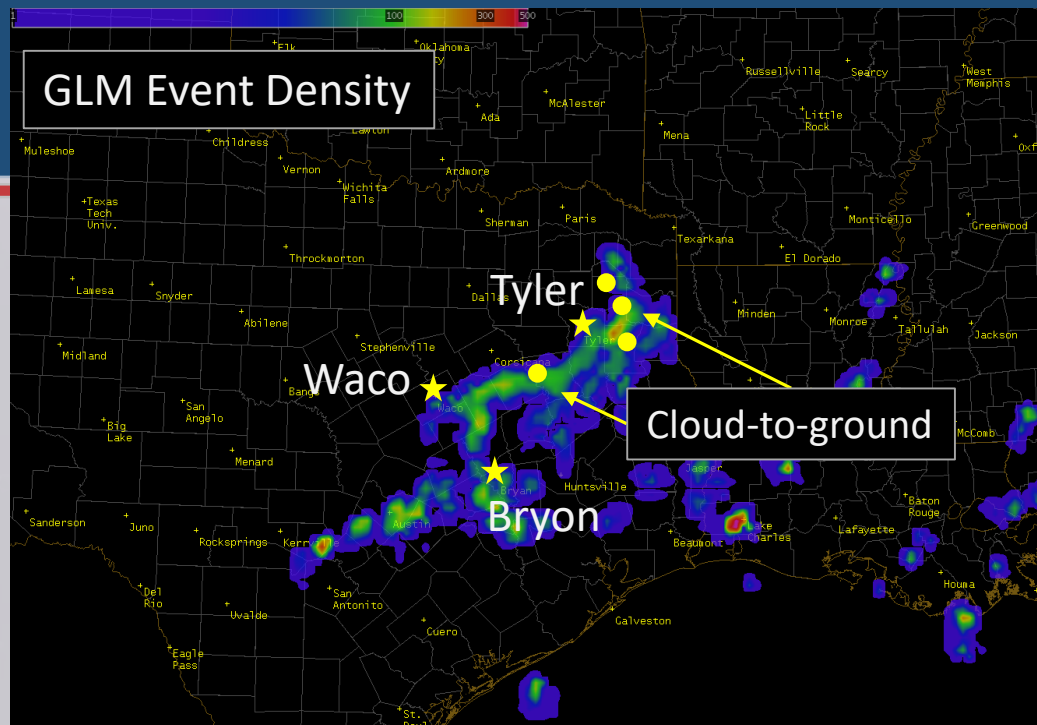
Long Flash Example Animation (Lightning Safety)

1 hour animation from 1700-1800 UTC
(Preliminary, non-operational)

Dealing with Parallax

Will need to note the difference over Ontario and Nova Scotia

GLM in this direction

One minute GLM observations with NLDN and Earth Networks over southeast Alberta and southwest Saskatchewan
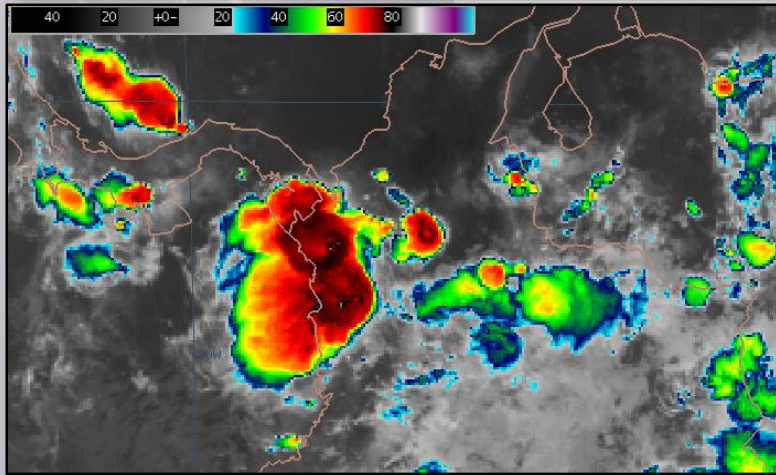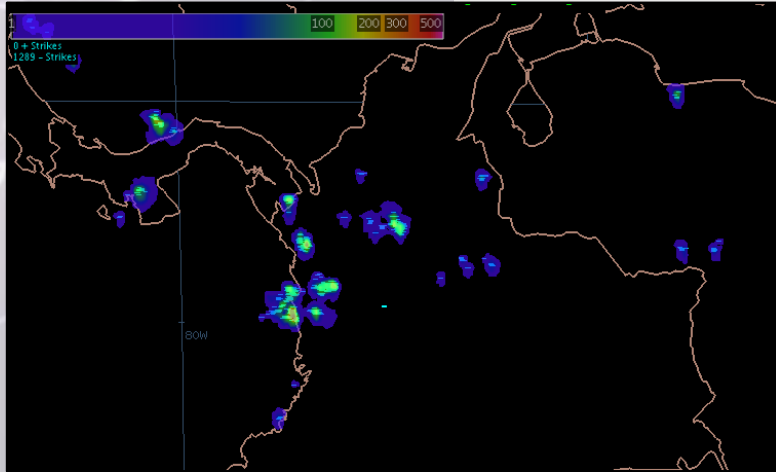
GLM Capabilities: The "stoplight" product
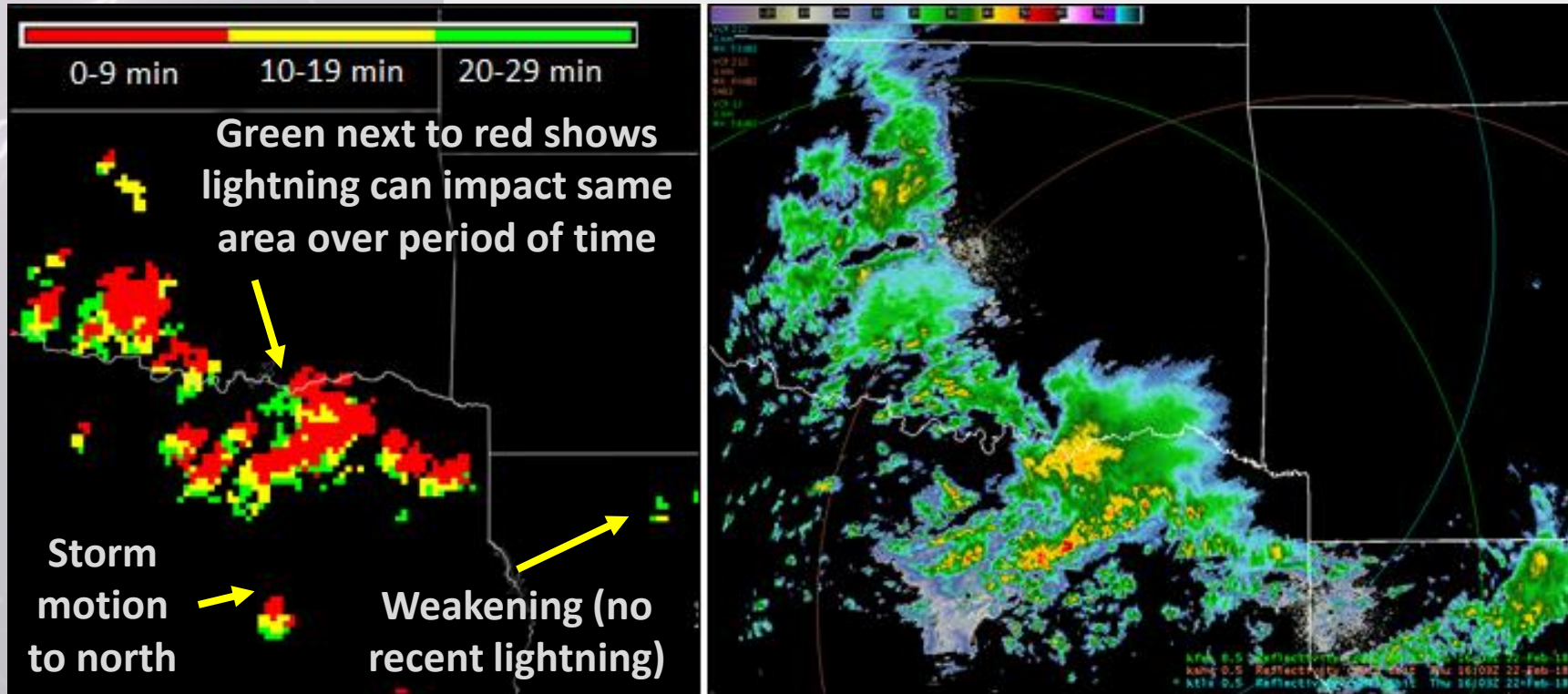
Example of the GLM stoplight product (left) with radar reflectivity covering 30 minutes from 1743-1813 UTC on 7 March 2018.

Labels on left image: 0-9 min, 10-19 min, 20-29 min; Green next to red shows lightning can impact same area over period of time; Storm motion to north; Weakening (no recent lightning)

- New SPoRT ability
- Collaboration with local emergency managers
- Based on 30 min rule
- Show location and age of lightning obs in a single image
  - 0-9 min (red)
  - 10-19 min (yellow)
  - 20-29 min (green)
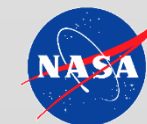- Early reviews suggest not using green (may suggest safe)
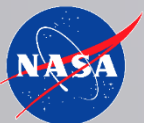
Future Activities / Acknowledgements

GLM event density with flash centroid points (top) with ABI 11.2 micron IR (bottom) (Preliminary, non-operational)

- Continue developing Proving Ground training
- Conduct GLM assessment (Summer 2018)
- Conduct assessment with local emergency managers
- Collaborate on GLM uses with aviation partners
- Develop GLM applications library examples (from forecasters!)
- New visualizations (GLM stoplight)
- Investigate using optical energy observations
- Many thanks to the GOES-R Proving Ground for funding

Questions?

Dr. Geoffrey Stano

geoffrey.stano@nasa.gov

NASA SPoRT

https://weather.msfc.nasa.gov/sport

NASA SPoRT Blog

https://nasasport.wordpress.com

GOES-R

http://www.goes-r.gov/