Examining Sub-flash Properties of lightning from GLM for tracking and intensification characterization of thunderstorms

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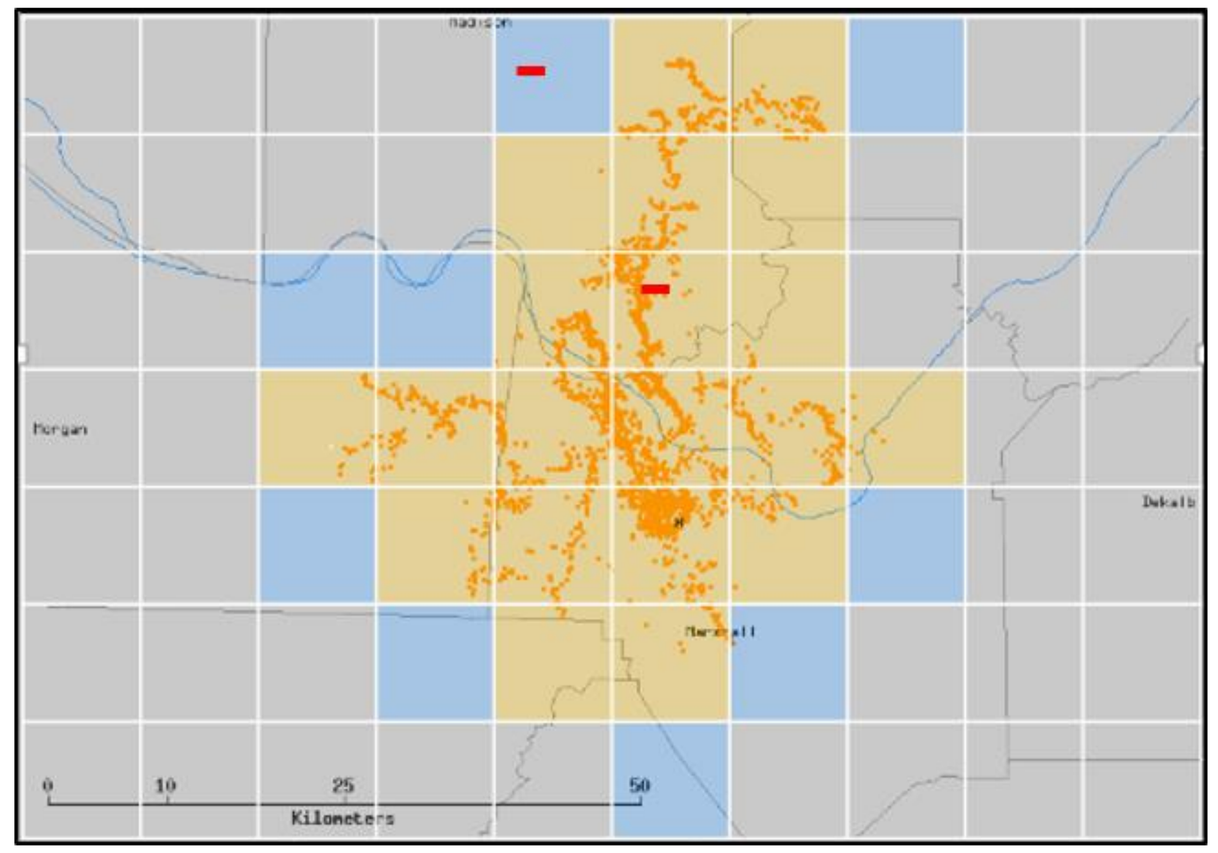
The Problem

Current methodologies for operational use of lightning are developed using ground-based networks

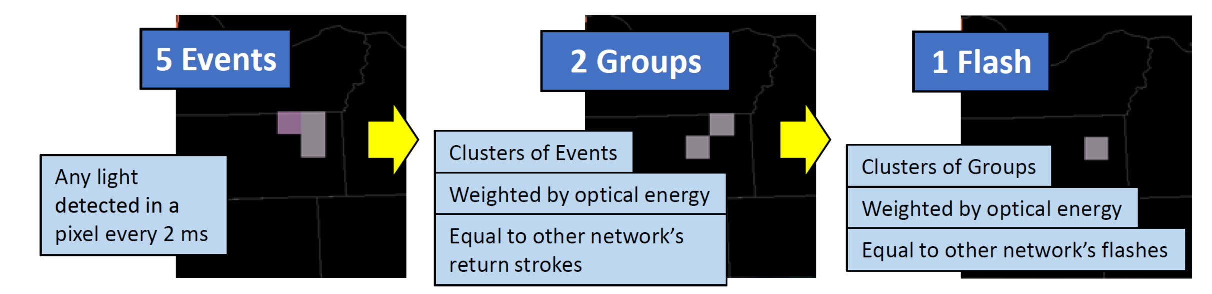
- Lightning detectors measure different characteristics of the flash, thus they don't observe the same lightning event in the same manner
  - i.e., flash rates from NLDN will typically not match flash rates from GLM (right) because each sensor is measuring different characteristics (EM radiation vs optical)
- Resolution/timeliness of space-based sensor data will change our "rules of thumb" for operational use
  - Lightning safety: how does the 2D mapping of lightning enhance lightning safety metrics?
  - Is the super-fast input of data (20s) useful for decision-makers, including (non-AWIPS-users) non-mets?



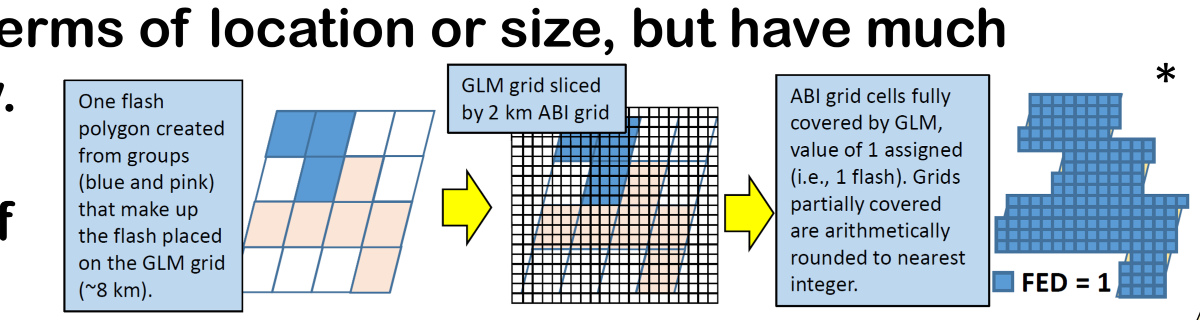
One single lightning event
Colored boxes – GLM orange dots – LMA
red minus signs NLDN/ENTLN

What are subflash characteristics?

<u>Events</u>: When light is detected in a single GLM pixel in a 2 ms window
<u>Groups</u>: Events that are close in space and time are put together as groups. Groups that are within 330 ms and 16 km are then combined into flashes.



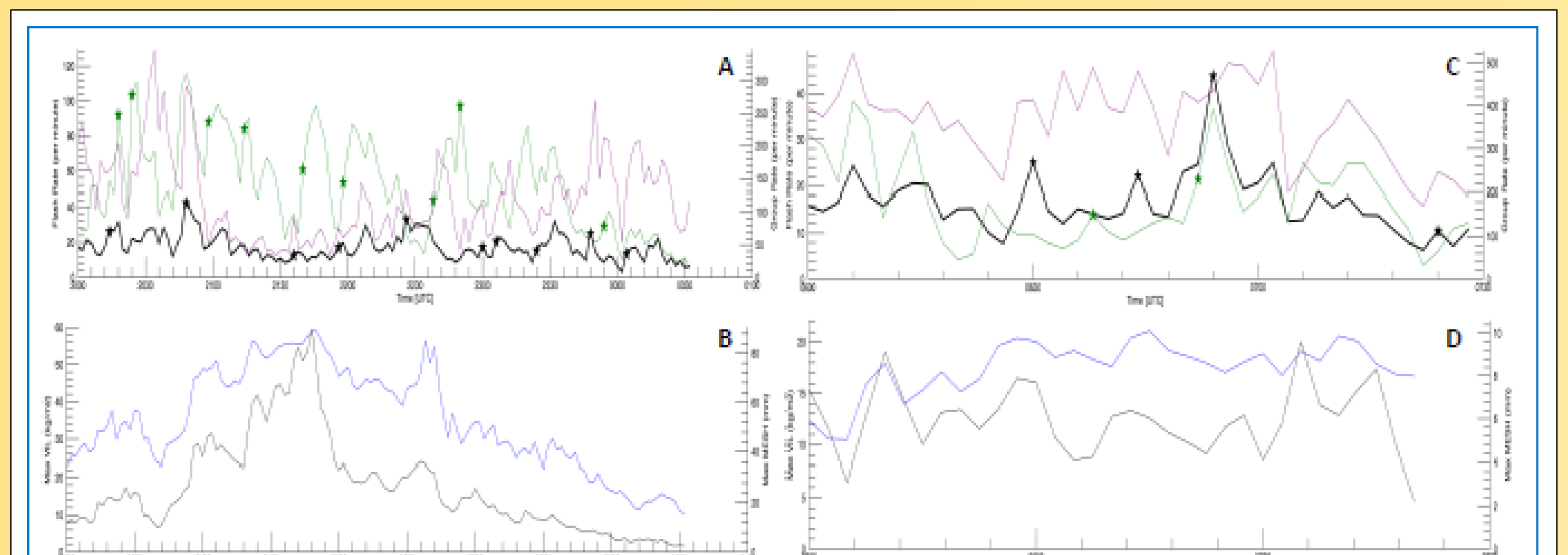
<u>Energetics</u>: The optical radiant energy measured by the CCD cells (photon collectors) onboard GLM. An event, group, or flash could look "the same" on a display in terms of location or size, but have much different associated energy.



<u>Flash area</u>: the mean size of a flash in a GLM pixel.
Provides additional information to diagnose updraft location.

*Imagery courtesy G.T. Stano

Lightning Jump Algorithm

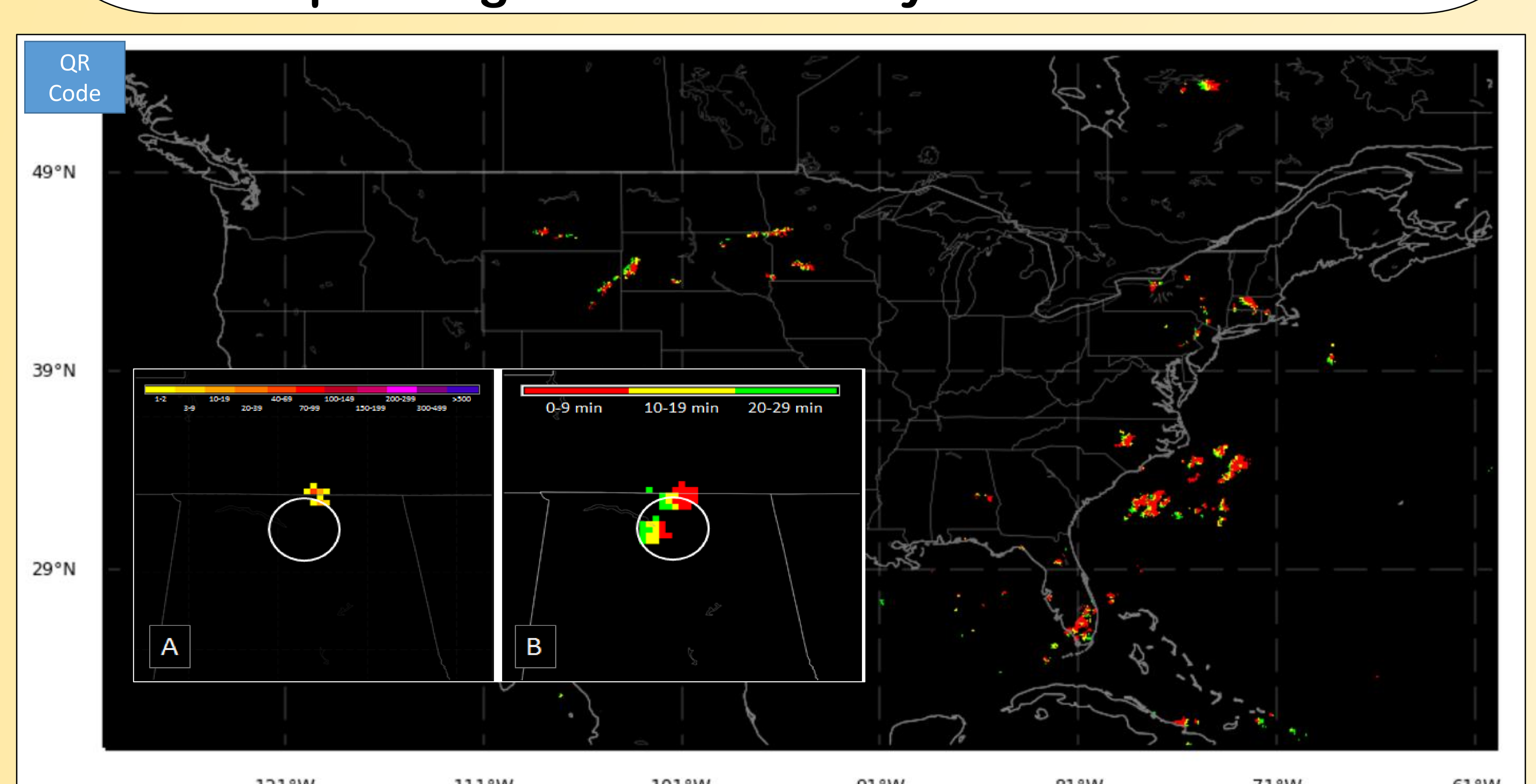


A) Skyline, AL (22 April 2017 tornadic supercell) time series (UTC) of LMA flashes (green, flashes per minute), GLM flashes (black, flashes per minute), and GLM groups (purple, groups per minute). Black (Green) stars are lightning jumps in GLM (LMA) flashes. B) Skyline, AL time series of max VIL (blue, kg/m2) and max MESH (black, mm) C-D same as A-B except for Central OK (17 May 2017 MCS).

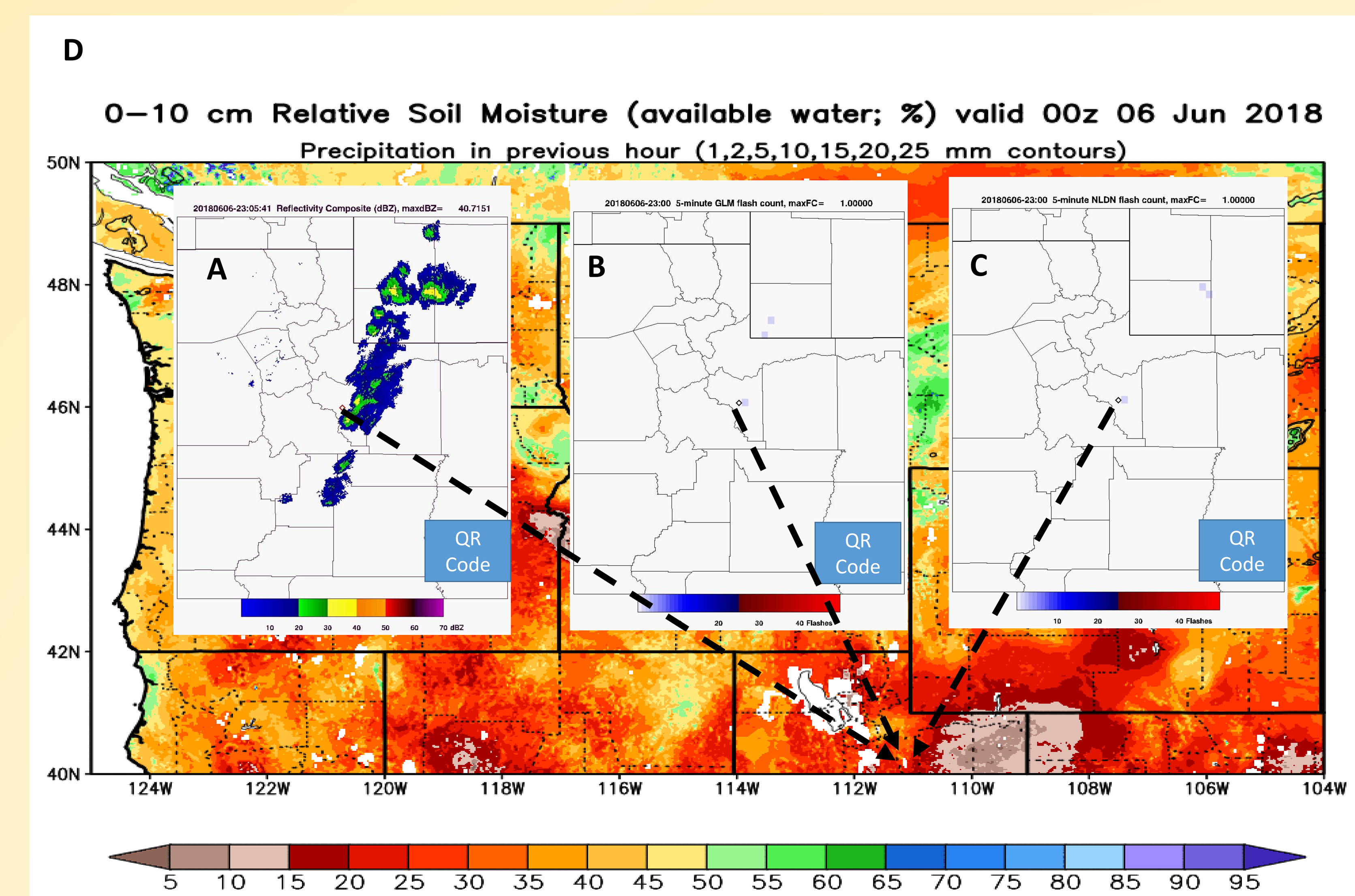
- Early results show that LMA jumps don't always match up with GLM flash jumps or GLM group jumps
- Trends in either GLM groups or flashes correspond relatively differently than LMA flashes with severe characteristics like max VIL and max MESH
- Statistical approaches may help develop new algorithms using flashes, groups, or energies
- Current work is adding the sub flash properties to utilize all measurements of storm intensity from GLM.
- Corresponding author: Nathan Curtis

Lightning Safety: The Stoplight Solution

- A clever way of utilizing 1-minute GLM group density data in a 30-minute snapshot
- Communicates risk intuitively to non-met stakeholders
- Can be updated at any timeframe
- In experimental use at local/regional emergency management offices and larger-scale formal assessment is being prepped
- Paper in progress!
- Red: 0-9 minutes old
- Yellow: 10-19 minutes old
- Red: 20-29 minutes old
- Corresponding author: Geoffrey Stano



Lightning-initiated Wildfires



Example of a lightning initiated wildfire from June 6, 2018 over northeast Utah. A) radar reflectivity, B) GLM Flash data, C) NLDN flash density, D) NASA SPoRT Land Information System 0-10 cm soil moisture.

Goal: combine precipitation, GLM flash location, energy and continuing current information with NLDN and soil moisture to identify wildfires in real –time.