Geostationary Lightning Mapper

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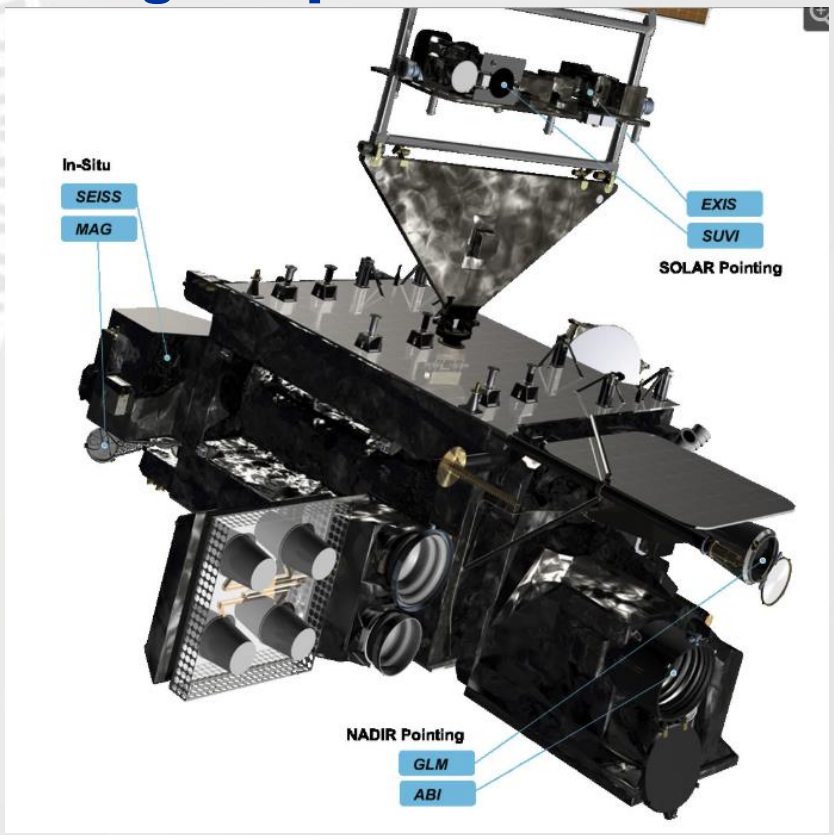
First-of-its-kind Geostationary Lightning Mapper

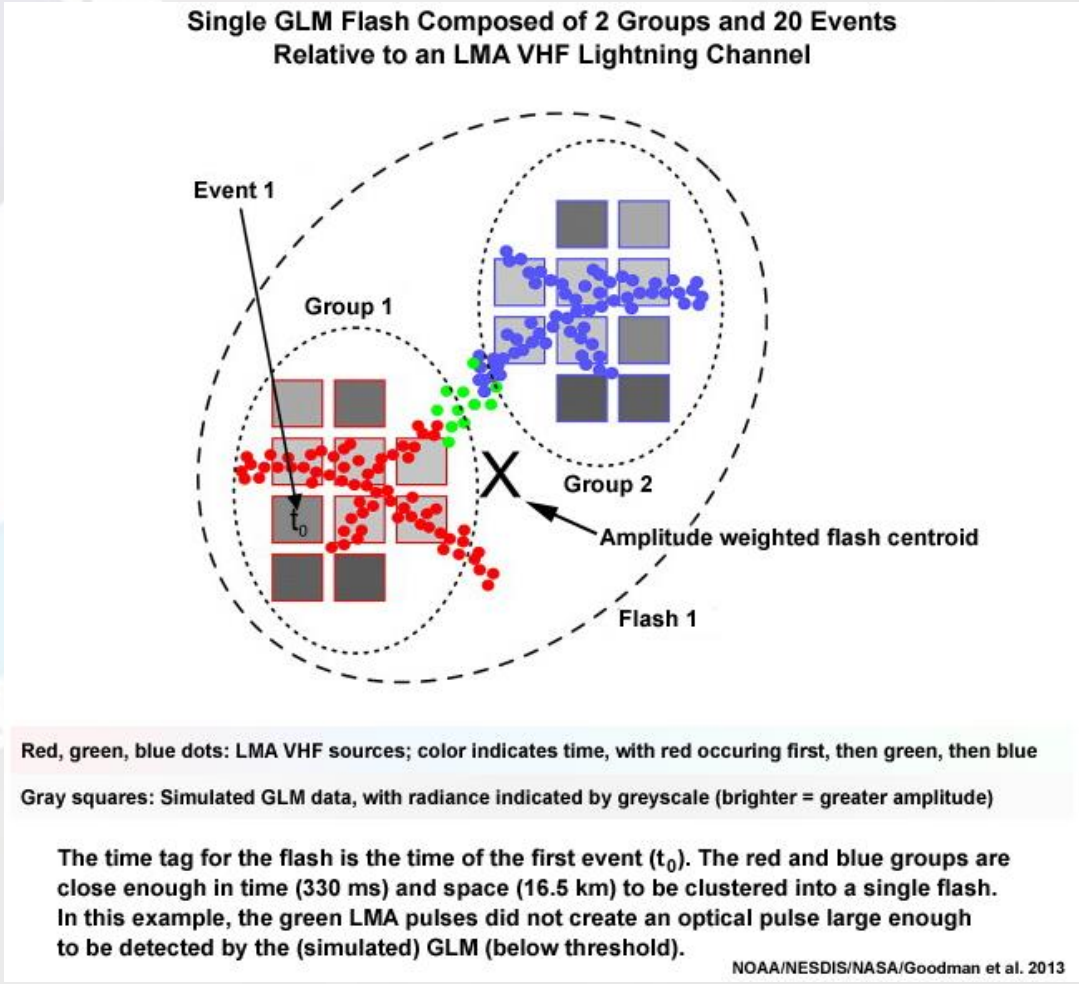
- **Launched with GOES-16 in November 2016**
- **Single Channel, near-infrared optical transient detector that can detect the momentary changes in an optical scene, indicating the presence of lightning.**
  - Detects rapid changes in optical brightness
- **Detects and maps total lightning activity continuously over the GOES-16 full disk**
- **GLM collects information such as the frequency, location, and extent of lightning discharges to identify intensifying thunderstorms and tropical cyclones.**

- **GLM on GOES-17**



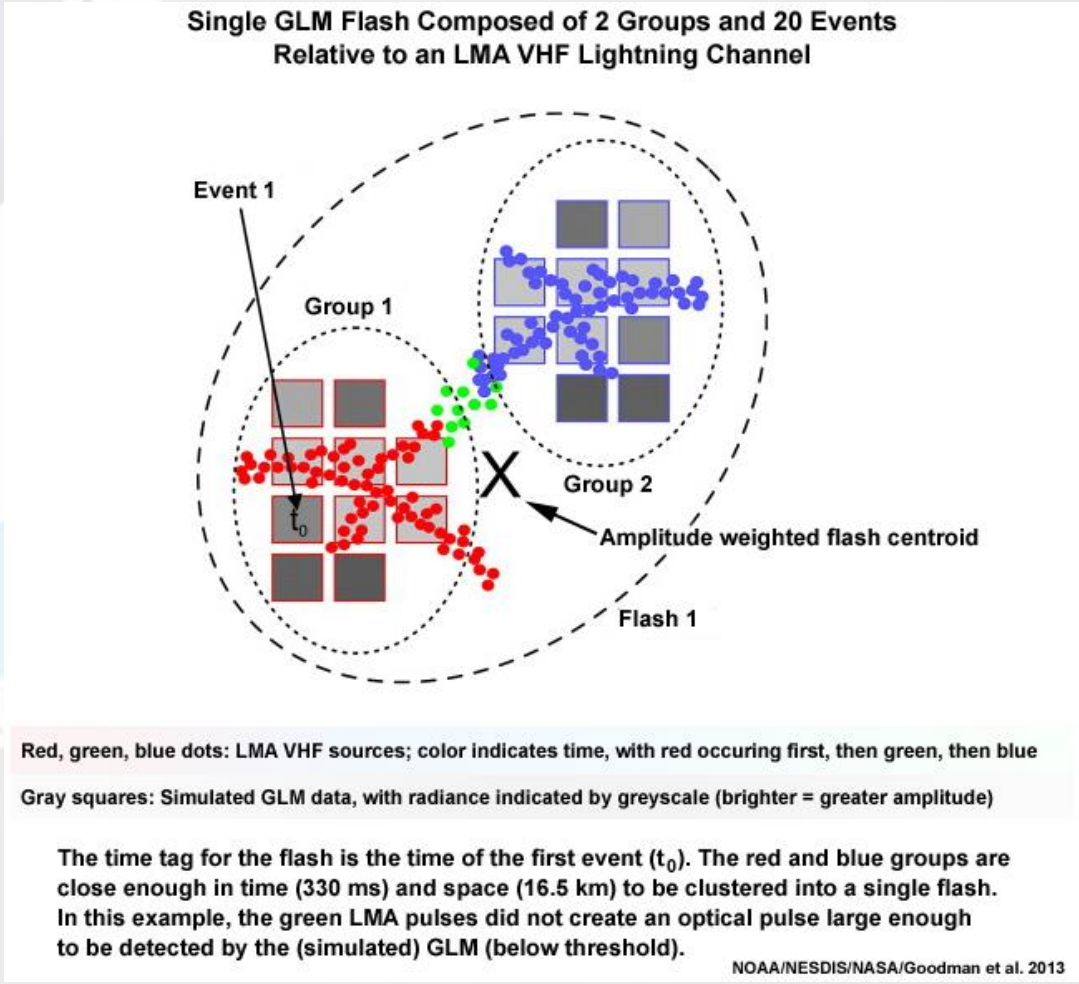
What's in a Flash?

- **GLM observes a large scene every two milliseconds and classifies the detection of each optical pulse in an 8-km grid box as a single "event".**
  - What about horizontal spread? Return Strokes?
- **Process for defining a flash:**
  1. Observes individual optical pulses as "events" every two milliseconds
  2. Events are assembled into "groups" when multiple events occur simultaneously and in adjacent pixels
  3. Processing organizes "groups" into a GLM flash if they occur within 16.5 km and 330 milliseconds of each other.
- **Once defined, GLM flashes become part of a streaming dataset that updates every 20 seconds.**



GLM Definitions

- **Events**: Individual pixels that exceed the detection threshold.
- **Groups**: Radiance weighted centroid of detected events.
- **Flashes**: Radiance weighted centroid of detected groups.



GLM vs Ground Based Networks

✈ **What's the difference???**

- **Ground based (i.e. NLDN, GLD, ENTLN)**
  - **Bottom-up view**
  - **Signal optimized to triangulate contact with the ground**
  - **Sensitivities allow for in-cloud detection**
  - **Less Data**
- **Optical**
  - **Top-down view**
  - **Can NOT see lightning hit the ground**
  - **Catches ALL optical brightness within the clouds**
  - **More Data**
  - **Critical for flight operations**

Research has found that there is ~5-10 times more cloud lightning than CG

First-of-its-kind Geostationary Lightning Mapper

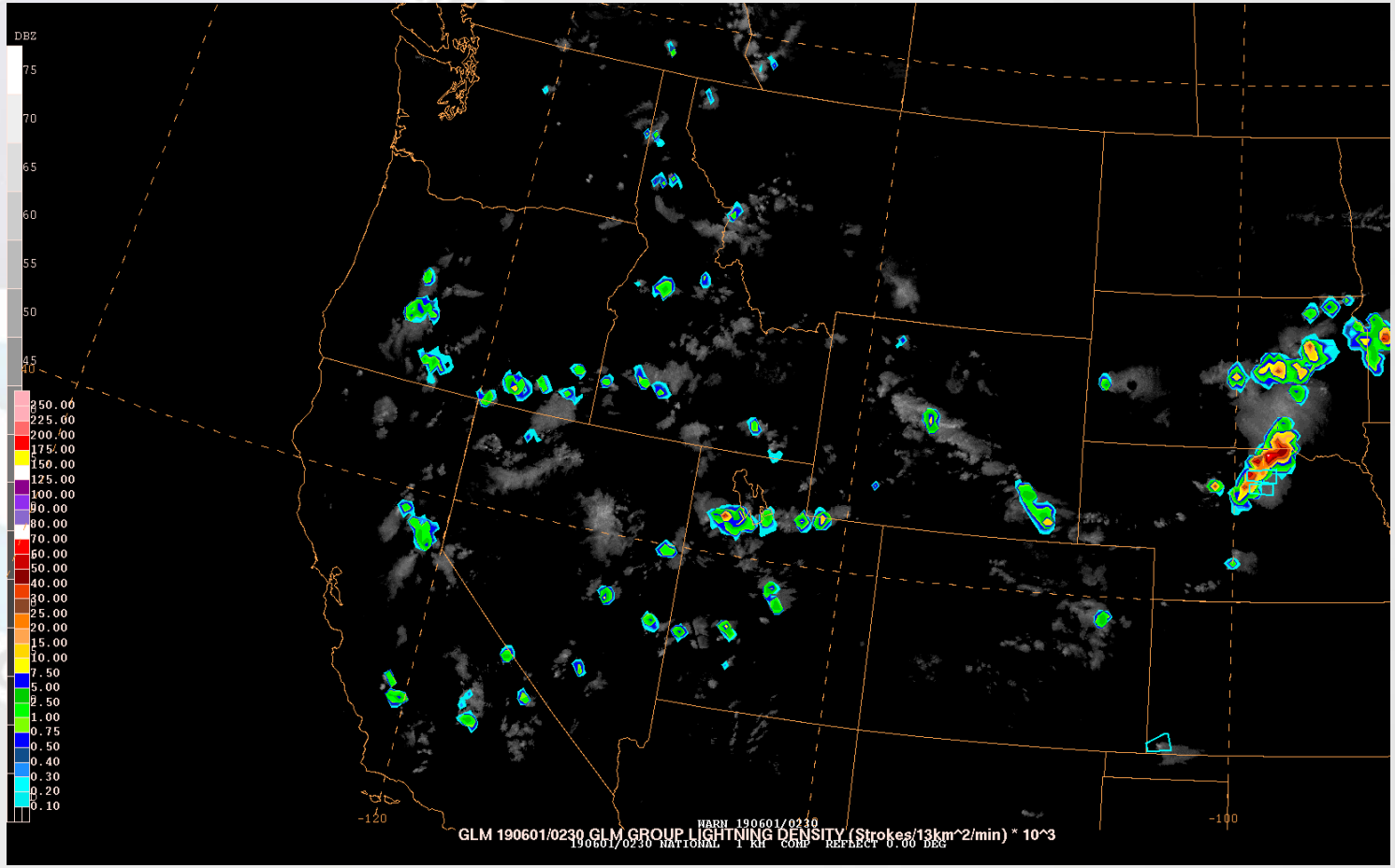
	Domain	Resolution	Frequency	Detects (Efficiency)
GLM	54° N/S	8-14 km mapped to 2 km ABI grid	20 s (1 min AWIPS)	Flash extent density, average area, total optical energy (~70% day, 90%+ night)
NLDN	CONUS + 200 km offshore	~200 m	1 min	Point location of cloud-to-ground (>95%) and polarity
ENTLN	Near Global, best over CONUS	~500 m	1 min	Point of cloud-to-ground strike (90%), intra-cloud centroid (>50%), and polarity/peak current

GLM at AWC

- The Aviation Weather Center became the first National Center to use GLM operationally (spring of 2018)
- Used primarily by the Convective SIGMET and Tropical Desks
  - GOES-16 and GLM provides 5 minute updates over the Intermountain West
  - MRMS and GLM overlay = 2 minutes
  - Full disk views important for cross Atlantic flights
    - First real look at intra-cloud lightning over the tropical Atlantic and Caribbean.
  - FACA and FAGX
- Full disk mode allows our global graphics desks to view convection over South America
  - Verification

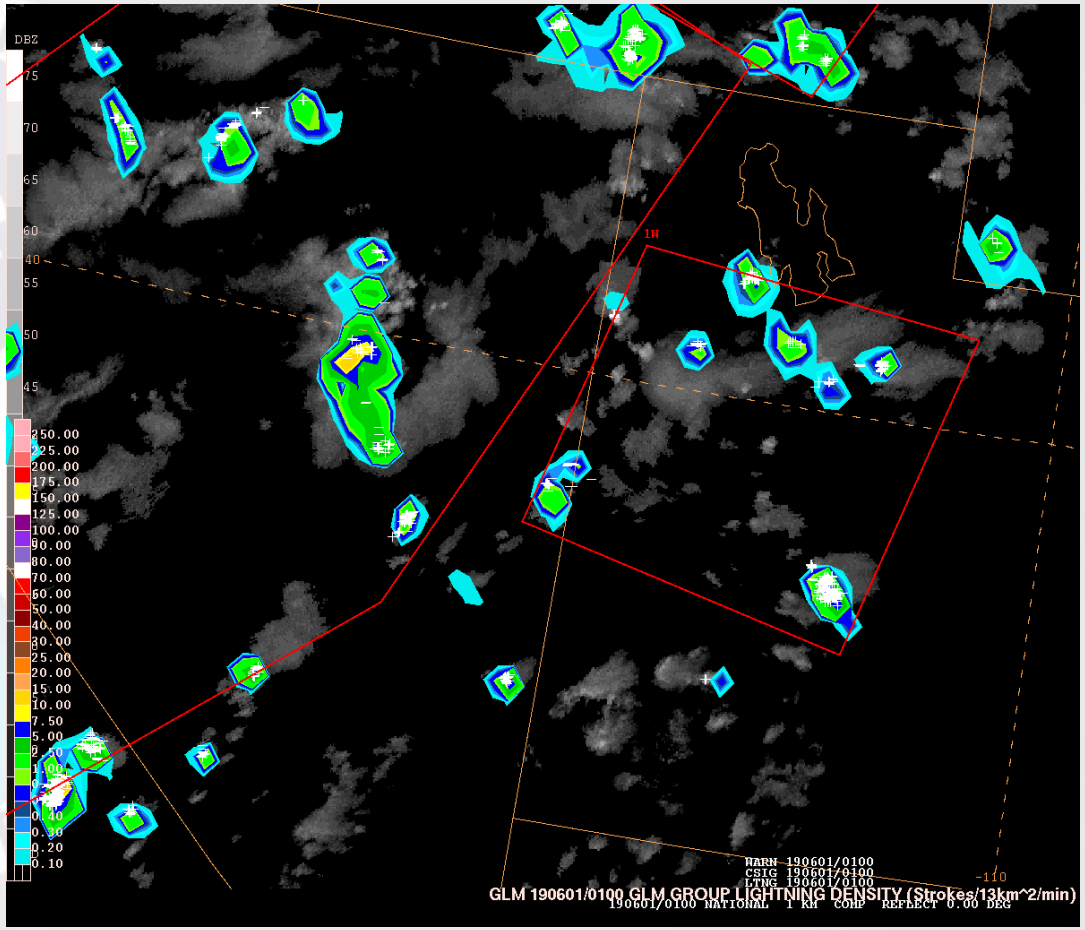
GLM at AWC

- How AWC views the data
  - NAWIPS
  - Gridded format
  - Viewable on full disk
  - 1/8th degree cylindrical lat/lon
  - Reproduced every 2-min
  - Equator:
    - 14 km grid
  - 40° North/South
    - 14 km (lat) x 11 km (lon)



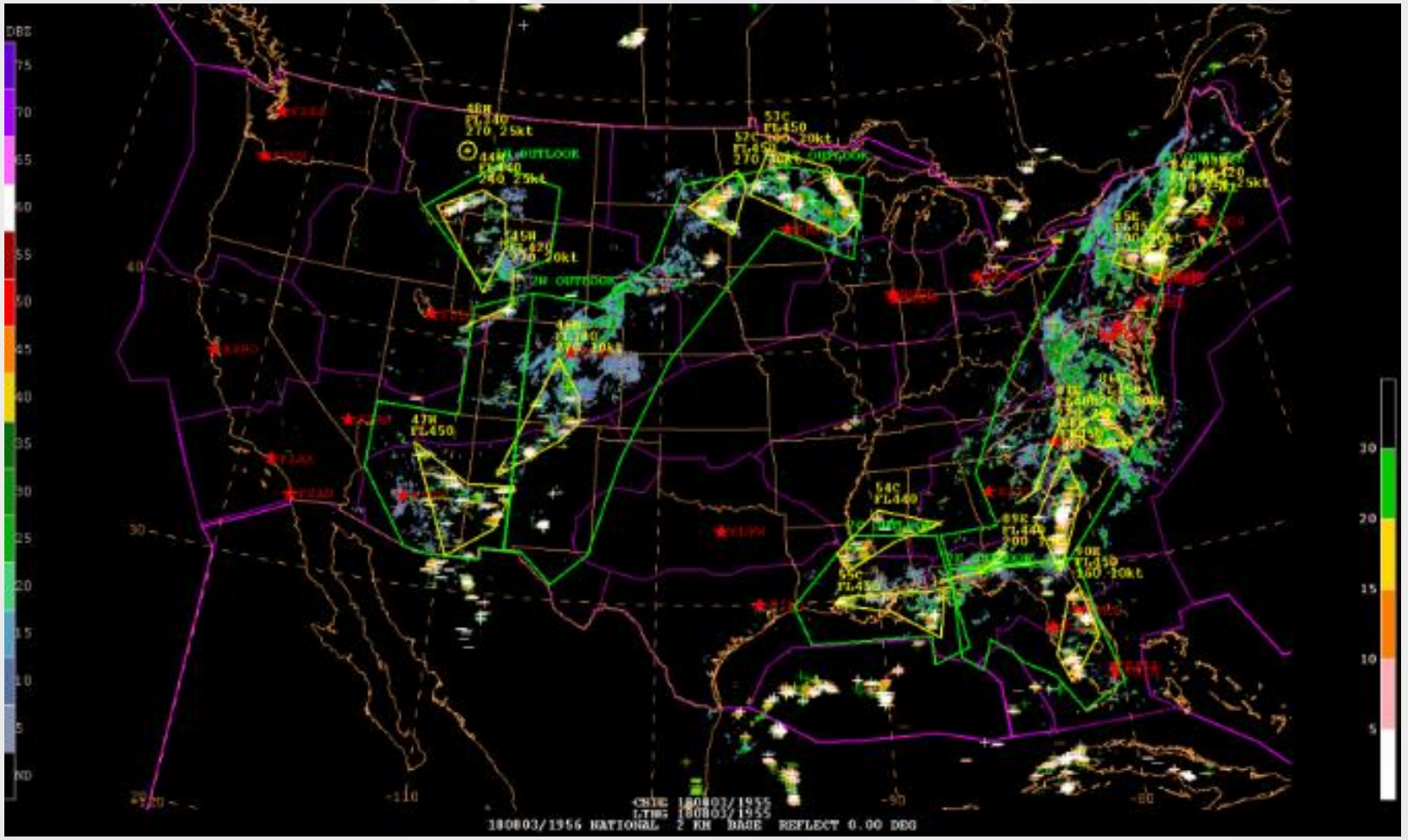
Convective SIGMET

- **Convective SIGMETs are in-flight advisories consisting of an observation, including a 2-hour trend forecast and remarks.**
- **It is a description of phenomena compiled from radar reports, satellite and lightning data, Pilot reports (PIREPS), or other reports.**



CONVECTIVE SIGMET 1W
VALID UNTIL 0255Z
UT NV
FROM 10N BVL-40NW MTU-40W HVE-30SE ELY-10N BVL
AREA TS MOV FROM 19020KT. TOPS TO FL380.

Convective Initiation in the West

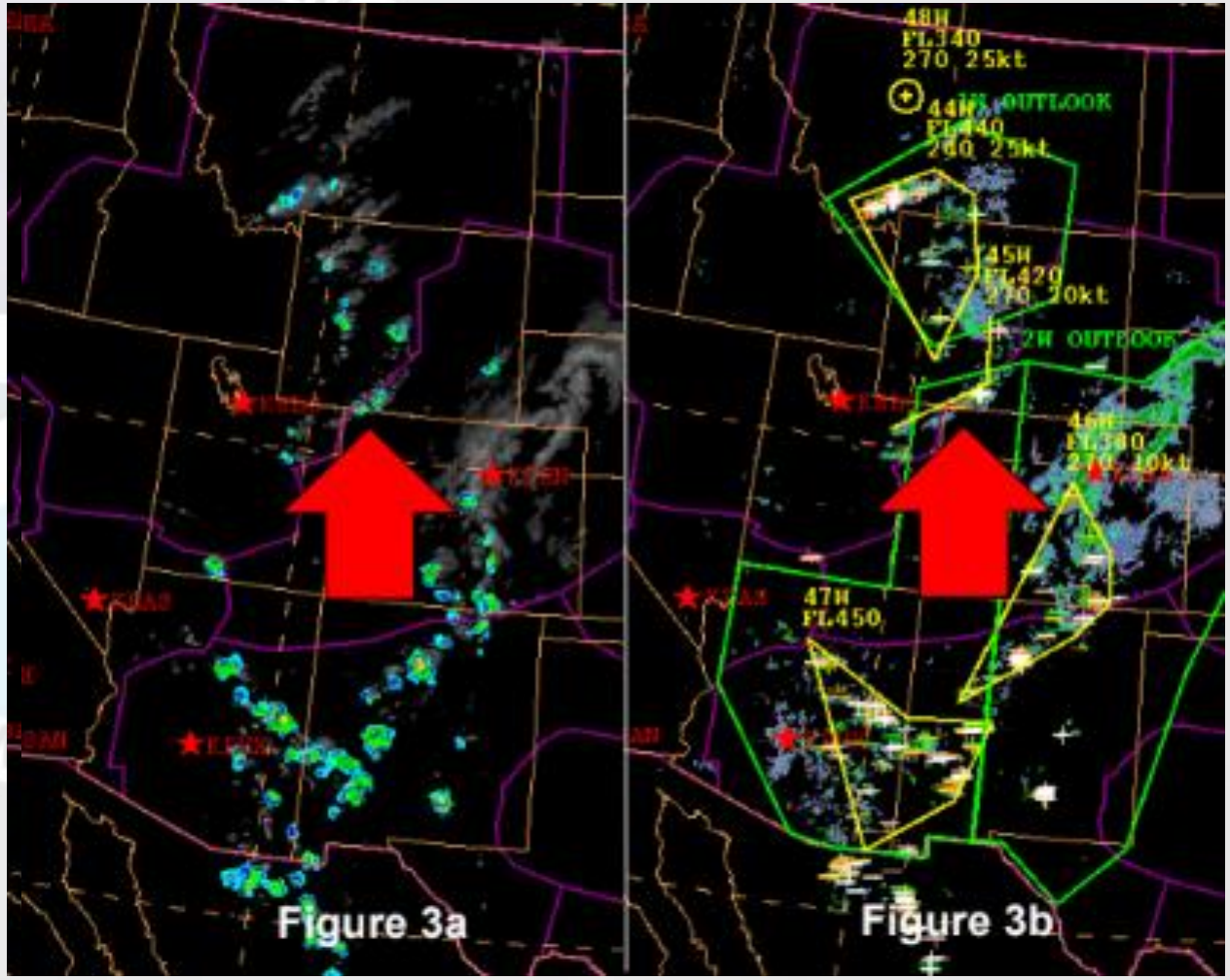


GLM out West

Aug 3, 2018 GLM grids with MRMS Composite (gray scale)

1848Z (Fig 1a)
1856Z (Fig 2a)
1952Z (Fig 3a).

SIGMETs with MRMS and NLDN at the same times (Fig 1b, 2b, 3b)



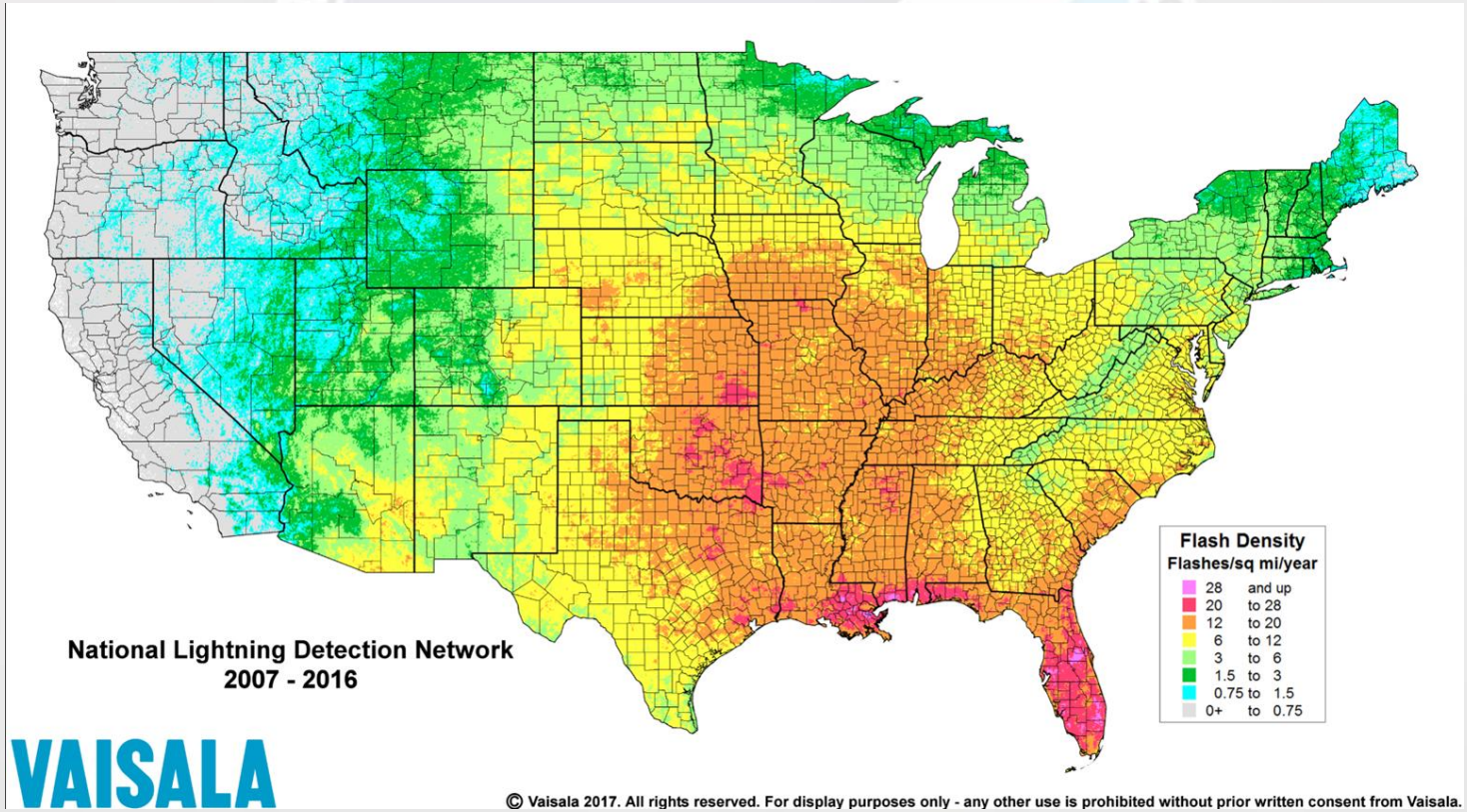
GLM out West Review

- SIGMET coverage included lightning strikes that did not occur until ~10 minutes after SIGMET issuance.
  - SIGMET issuance at HH:55Z
  - Special would require the entire West bulletin to be reissued to FAA and pilots
  - Jet Routes impacted
- In rare cases, the GLM provided lead times up to 30 minutes.

- Forecasters typically overlay MRMS composite reflectivity (gray scale) with GLM, or GOES-16 Visible with GLM
  - Able to see developing cu over the mountains before first GLM strike
  - Helps organize SIGMETs and catch developing areas before issuance

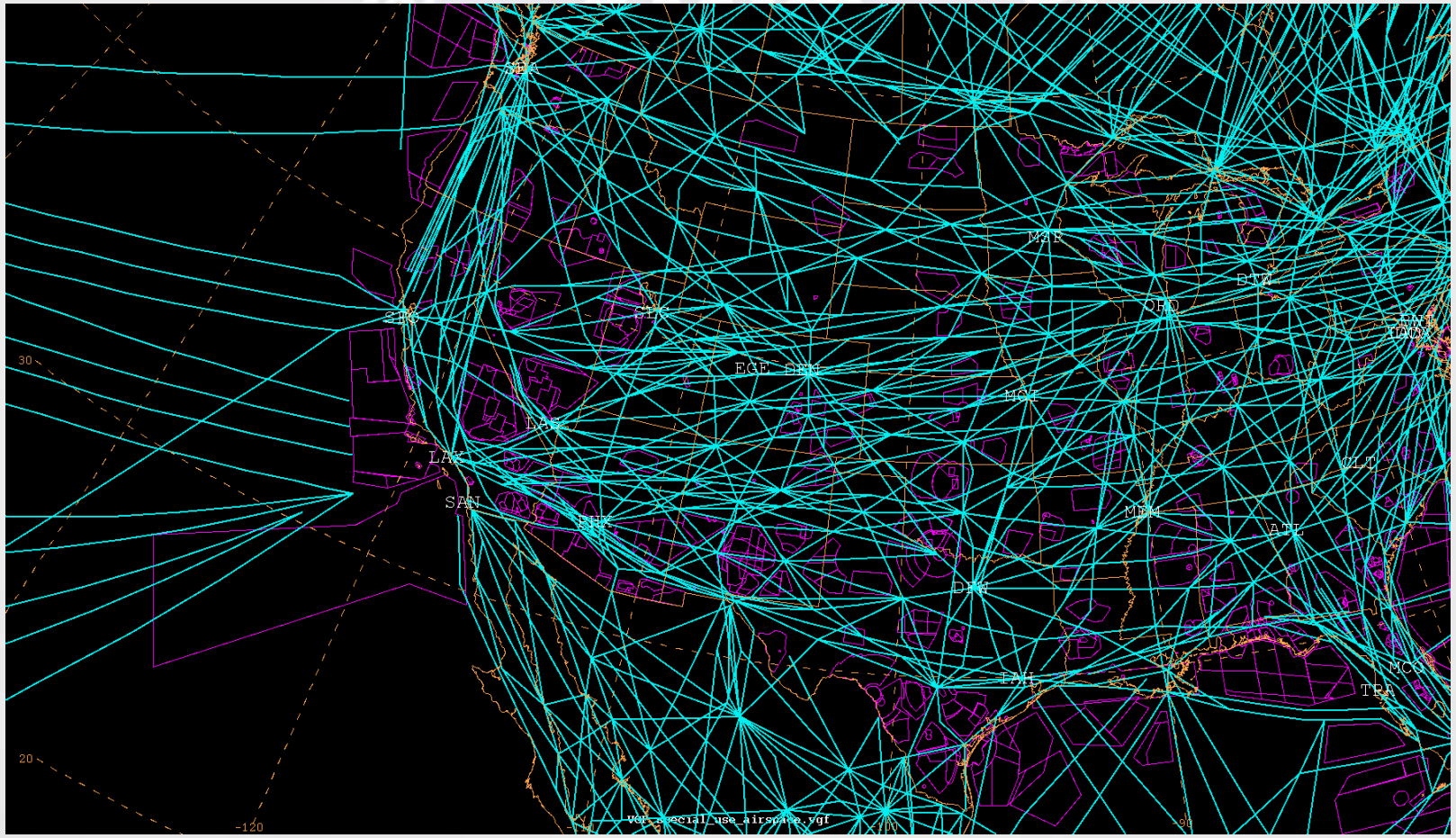
Why is Lead Time Important???

- Roughly 1,500 Convective SIGMETs issued in July 2018
- 4 Core Airports directly impacted by the Monsoon
- Airline Industry loses an estimated $2 billion each year in operating expenses due to thunderstorm related flight delays

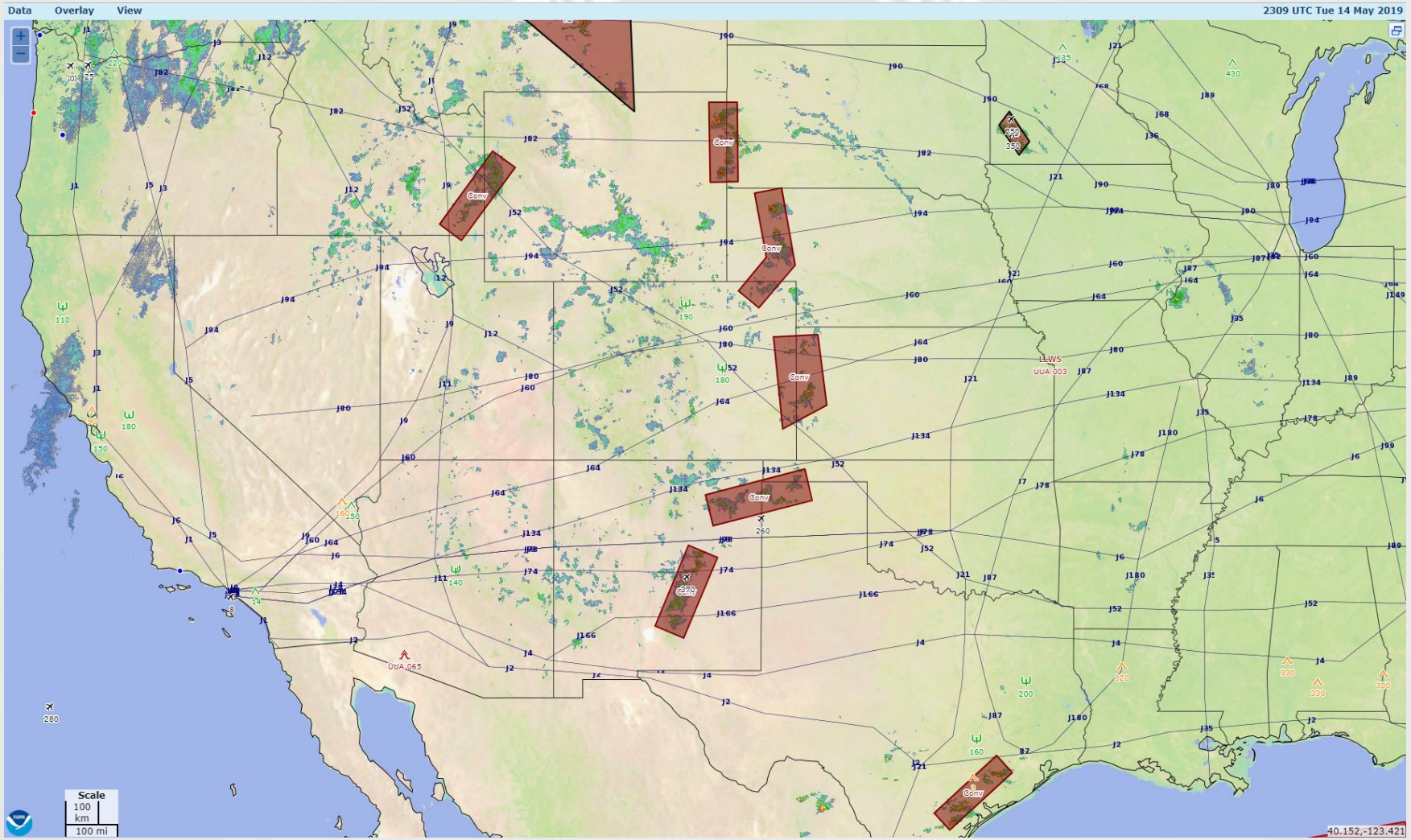


Cross Country Route Impacts

- **Widespread impacts from cross-country “J” routes**

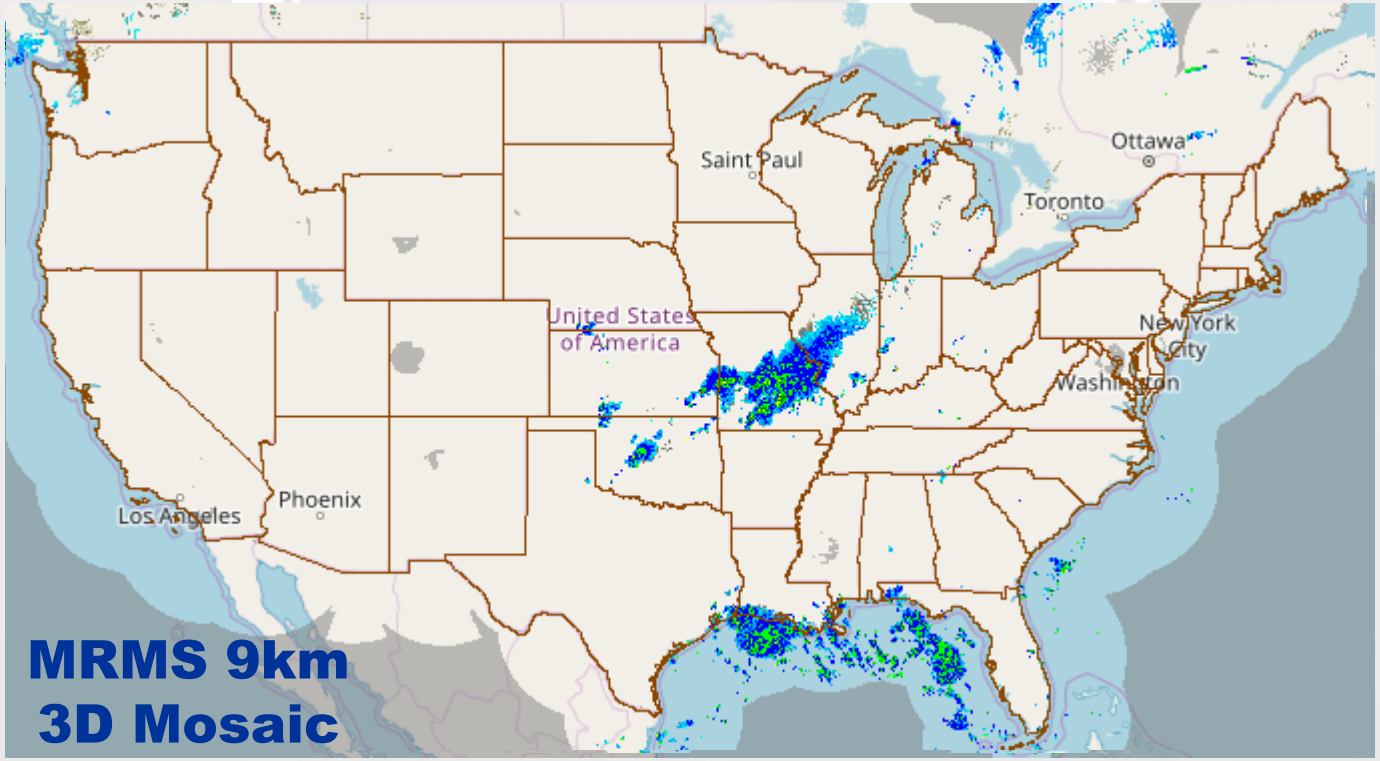


Cross Country Route Impacts

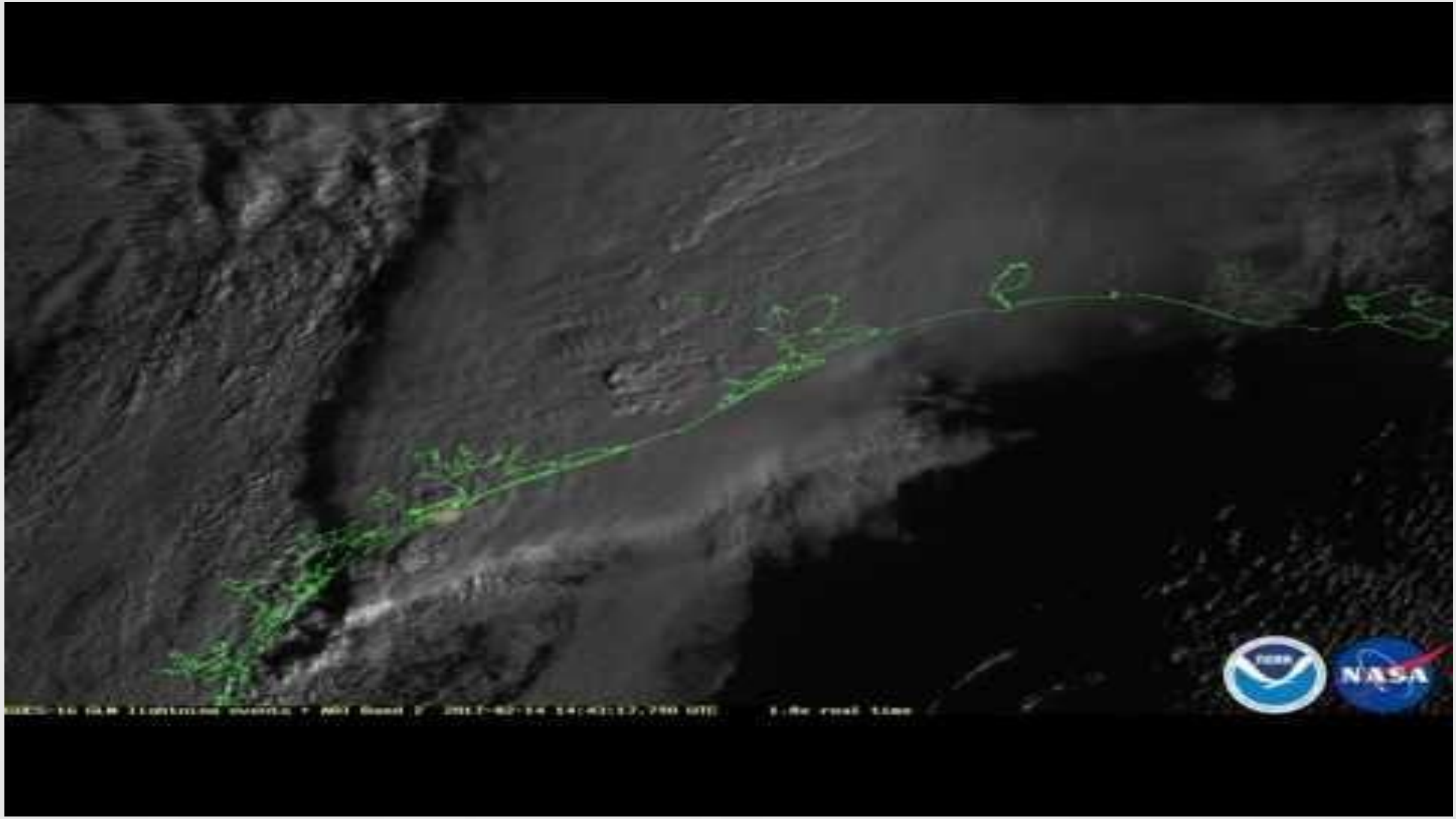


Radar Coverage, or Lack Thereof

- **Multi-Radar Multi-Sensor System (MRMS) Coverage**
  - **Uses multiple radars to create a seamless radar product**
  - **Better coverage, but. . .**



https://mrms.nssl.noaa.gov/


NASA

Thank You!!

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