



# Use of GLM Data During the Lake-Effect Electrification (LEE) Field Project

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with contributions from  
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# Overview of the LEE Project

## Collaborators

Suny - Oswego

Georgia Tech

NSSL

Texas Tech

CSWR

CIWRO at OU

UAH

NOAA

## Instrumentation / Observations

Environmental Soundings

Lightning Mapping Array Sensors

Sounders (EFM, PASIV)

LMA expertise

Snowfall Observations

DOW (Doppler on Wheels)



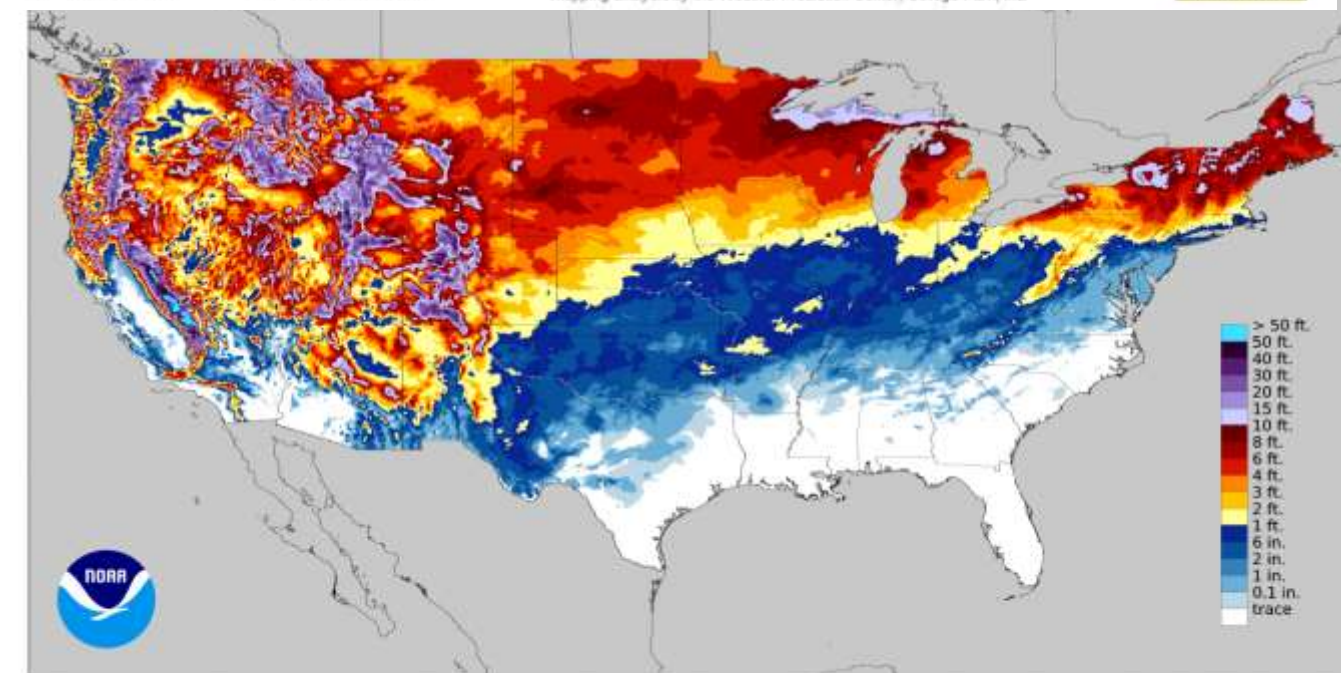
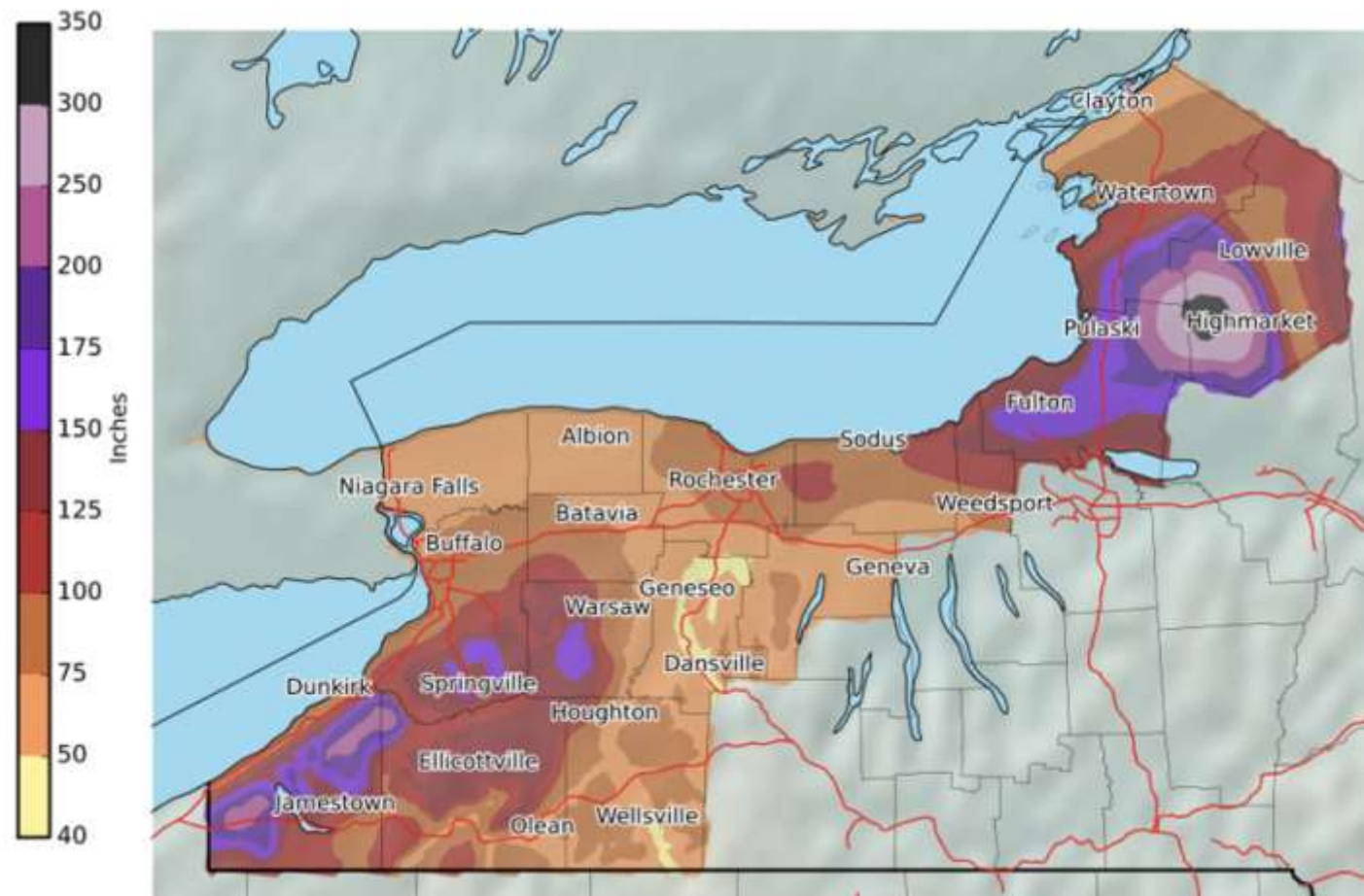
# LEE Objectives

- A three year NSF project to document, for the first time, the electrical charge structure of lake-effect snow storms (surface-based convection to stratiform precipitation process), relate to hydrometeor populations.
- Improve the understanding of turbine-initiated lightning (Maple Ridge Wind Farm: 195 turbines each 119 m high. Total of 300 Tug turbines).
- Compare LEE findings with those from sea-effect (Japan), ET cyclone (e.g., IMPACTS) electrification studies.
- Determine flash sizes and energies of lake-effect lightning.
- Electrification modeling (e.g., WRF-elect)
- Overlap with IMPACTS, involve many undergraduates
- NSF: AGS Grant 2212177

# Why the TUG?

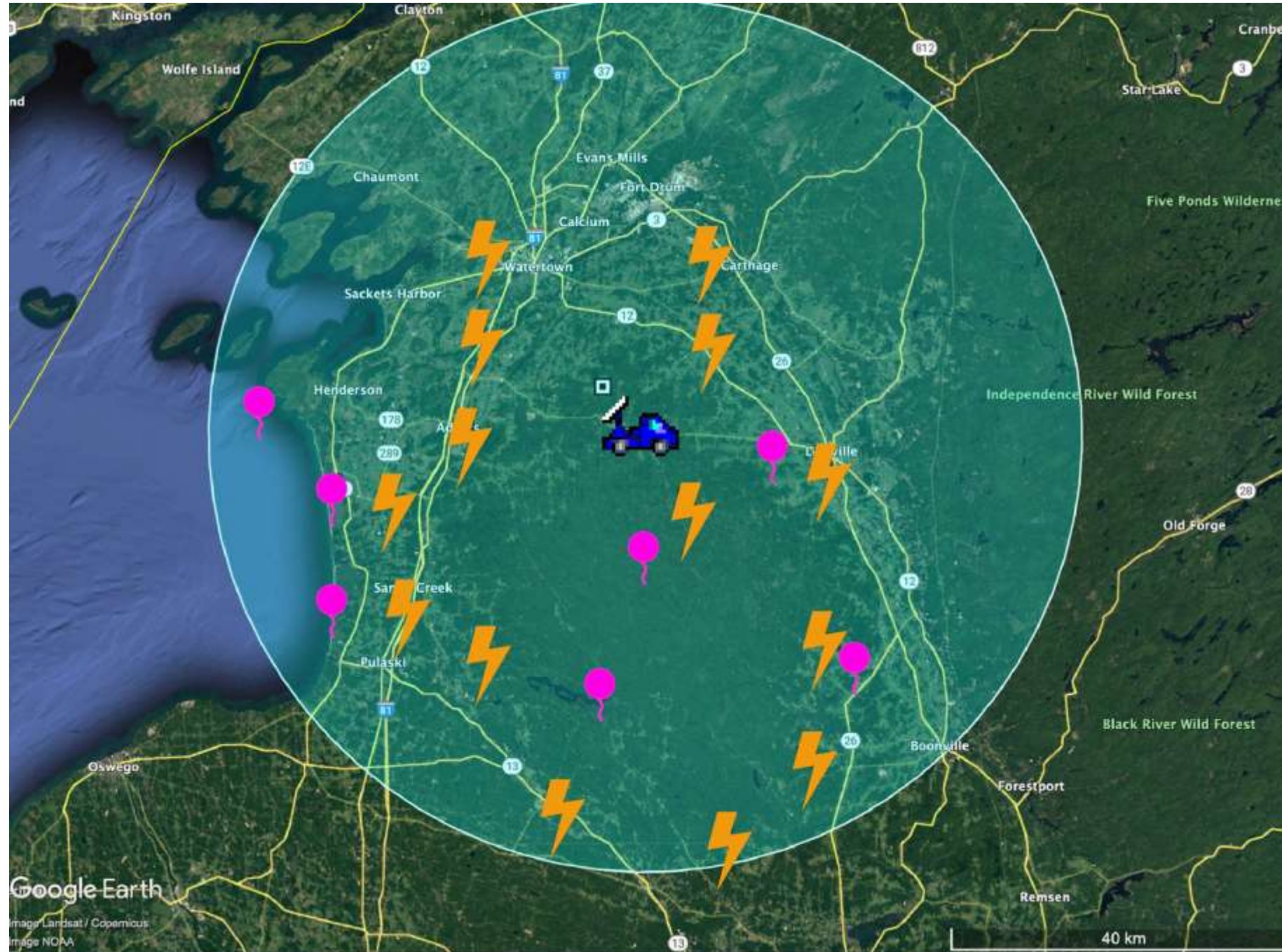
- Very high average winter snow combined with Maple Hill Wind Farm
- Of course... we had a snow drought mid-winter
- 11 total IOPs, 3 with lightning

Average Annual Snowfall



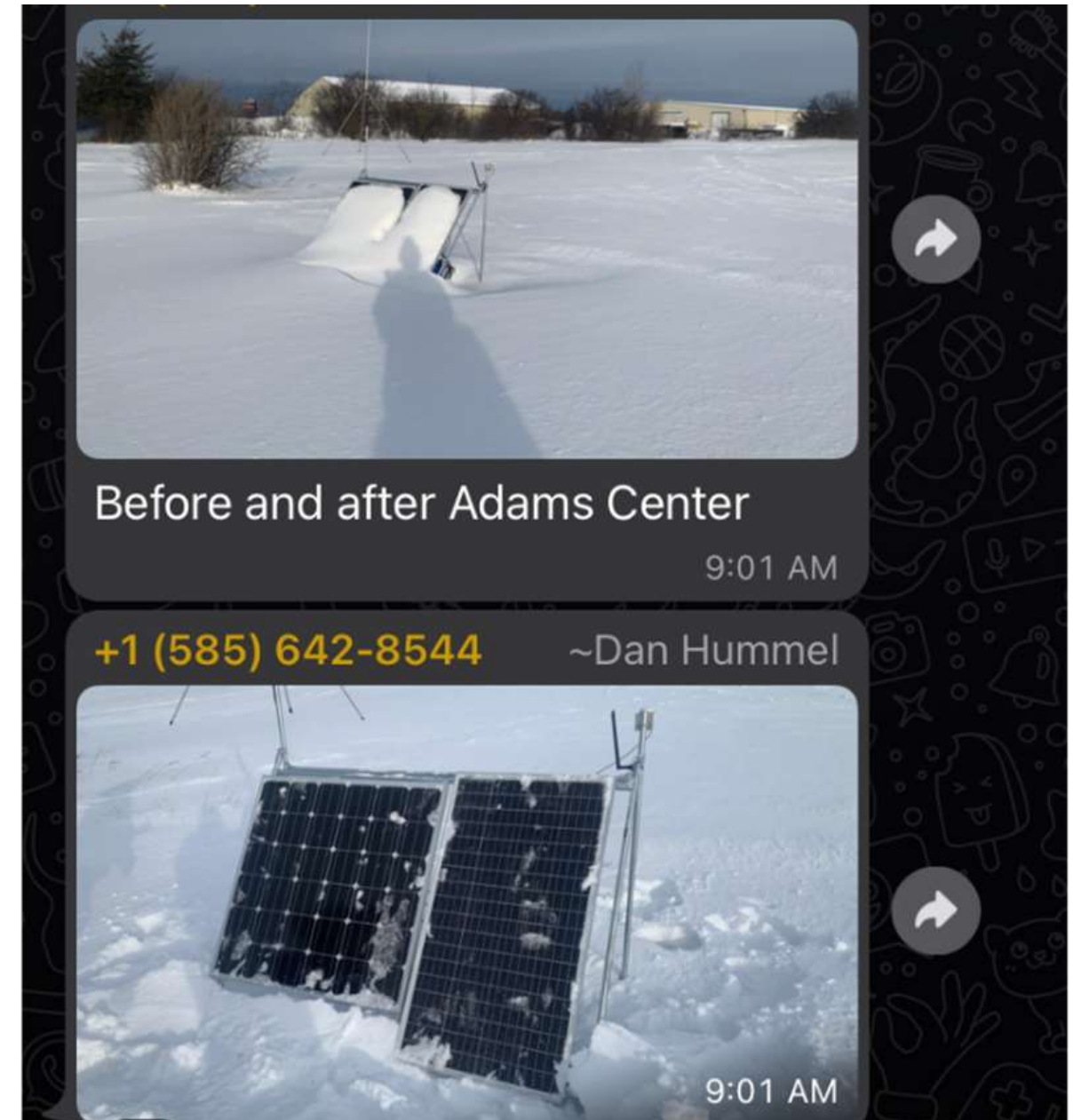
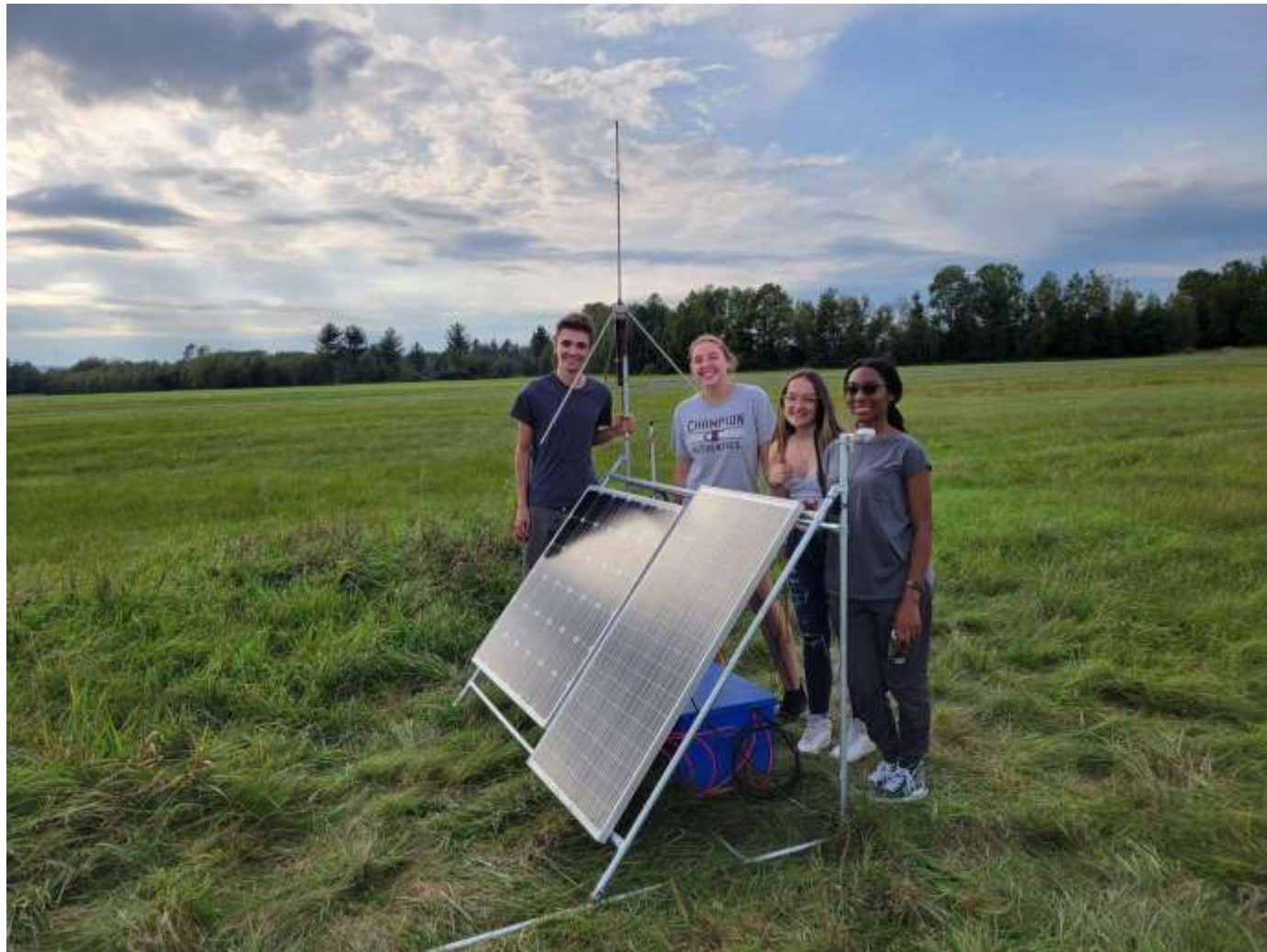
# LEE Facilities & potential set-up

Bolts=LMA sensors, Balloons=sondes (inc. EFMs and PASIV), DOW truck



# GTRI and NSSL LMAs (total of 16)

- SUNY-Oswego students needed to keep LMAs clear during IOPs



# Summary of LEE Data Collections

- IOPs with all/most instruments: 11
  - Lightning occurred during 3 IOPs
    - Number of flashes/IOP ranging from 5-58
    - Flashes included frozen precip events as well as wind turbine induced
  - Null: 8
- Events (not necessarily LES) where only LMA data was collected: 8
- Today will show comparison of a couple of hours of LMA and GLM data from two IOPs
  - LMA uses sources closer than 3000 m and 0.15 s within a 150 km radius
  - GLM flash uses groups closer than 16500 m and 0.33 s within 161 km by 194 km box (slightly larger)

# IOP 3, Nov 20, 2022: Lightning Ingredients

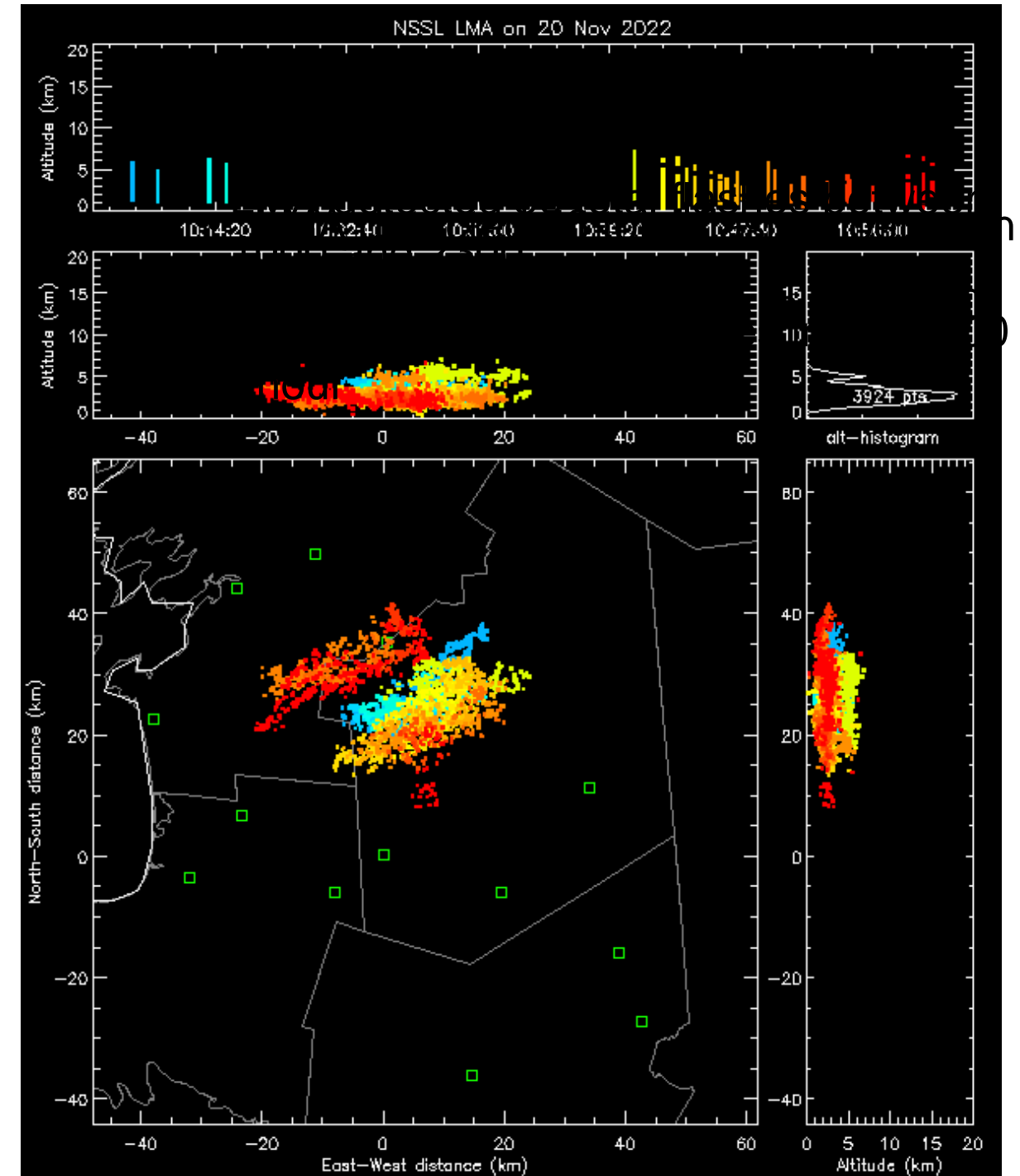


0.75" graupel!



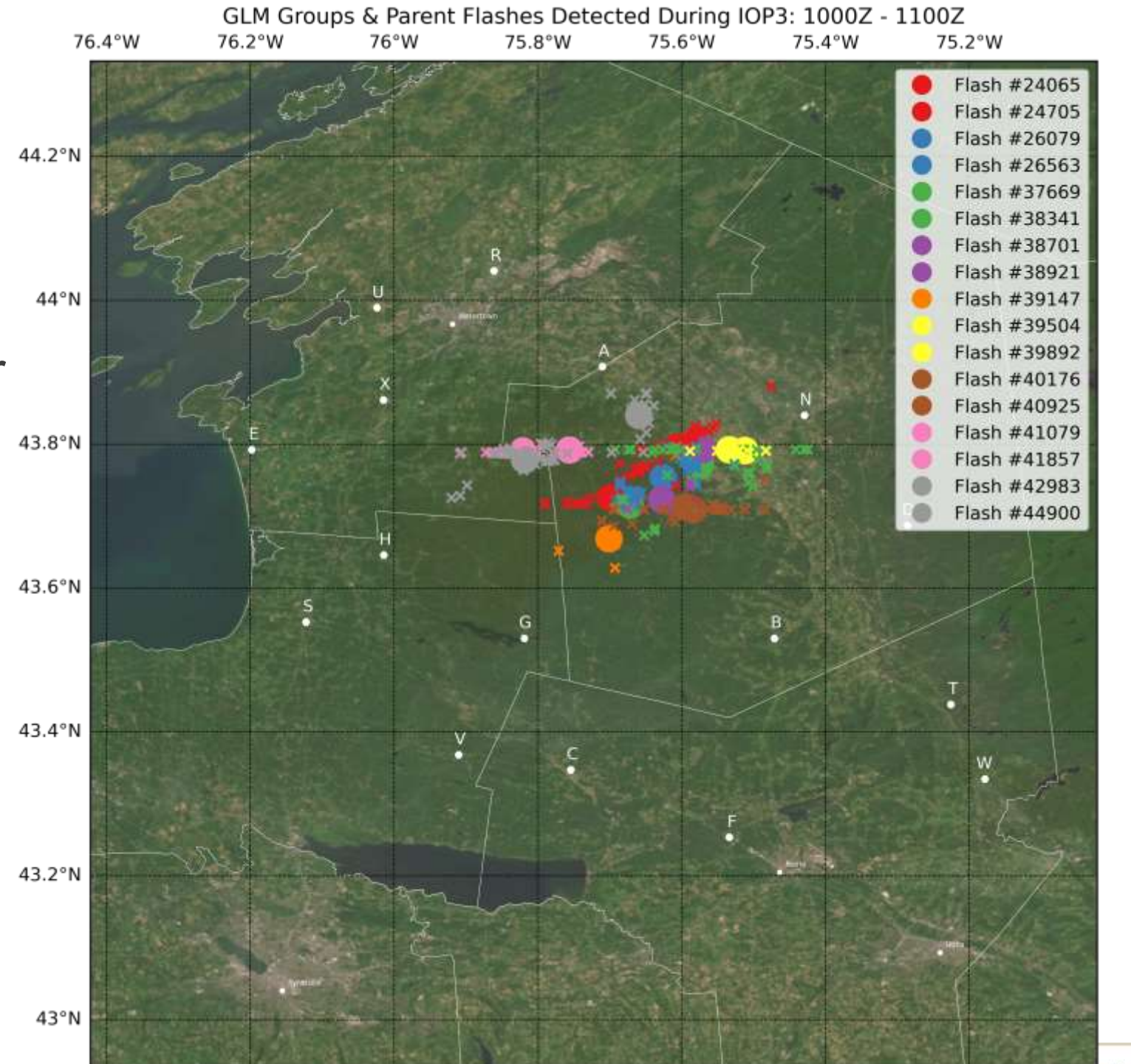
# IOP 3: LMA Data for entire 1000 hour

- About 25 flashes detected
  - 27 – 28 if we use flashes with less than 10 sources
- Well within the LMA internal area
- Concentrated over the wind turbines



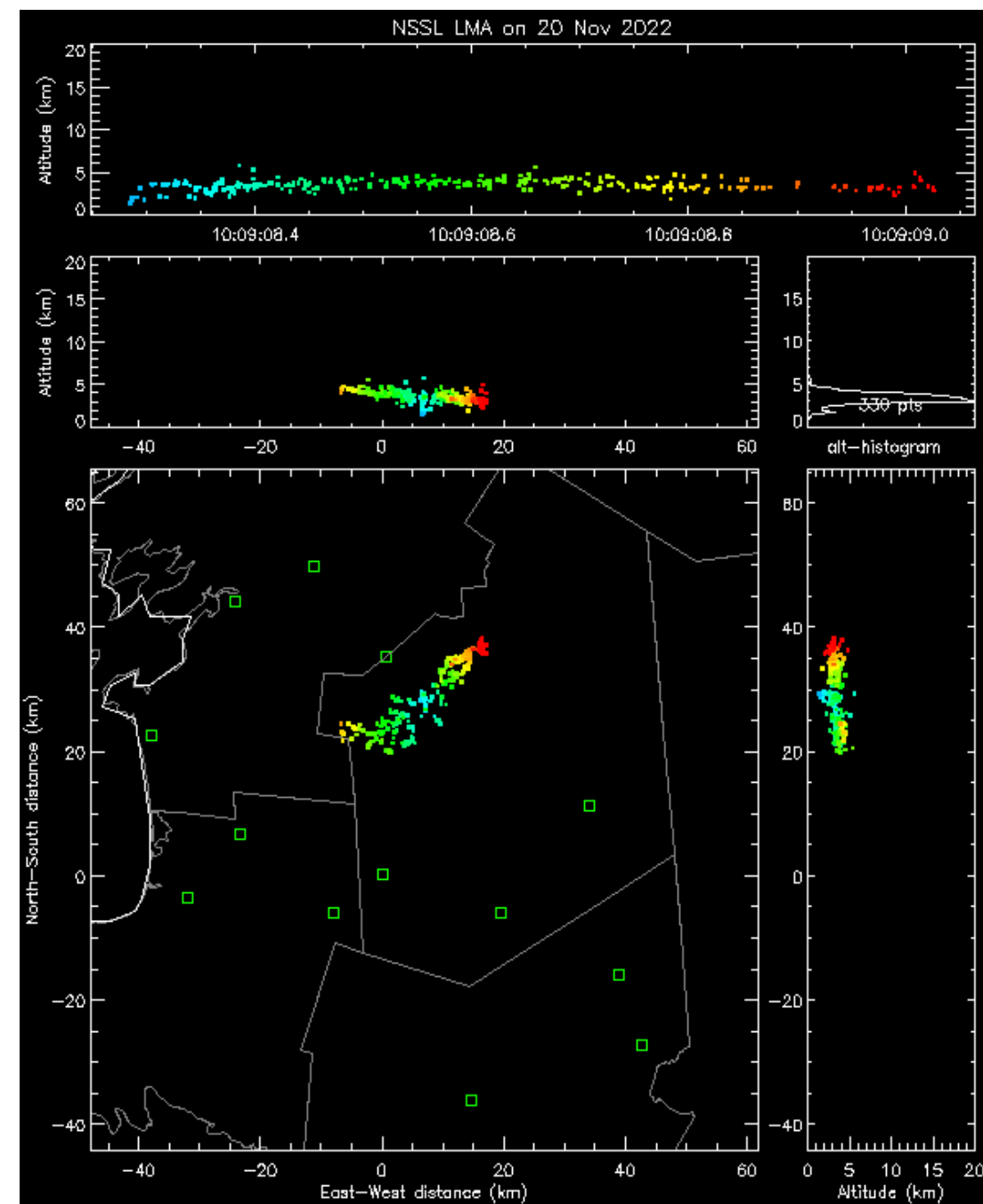
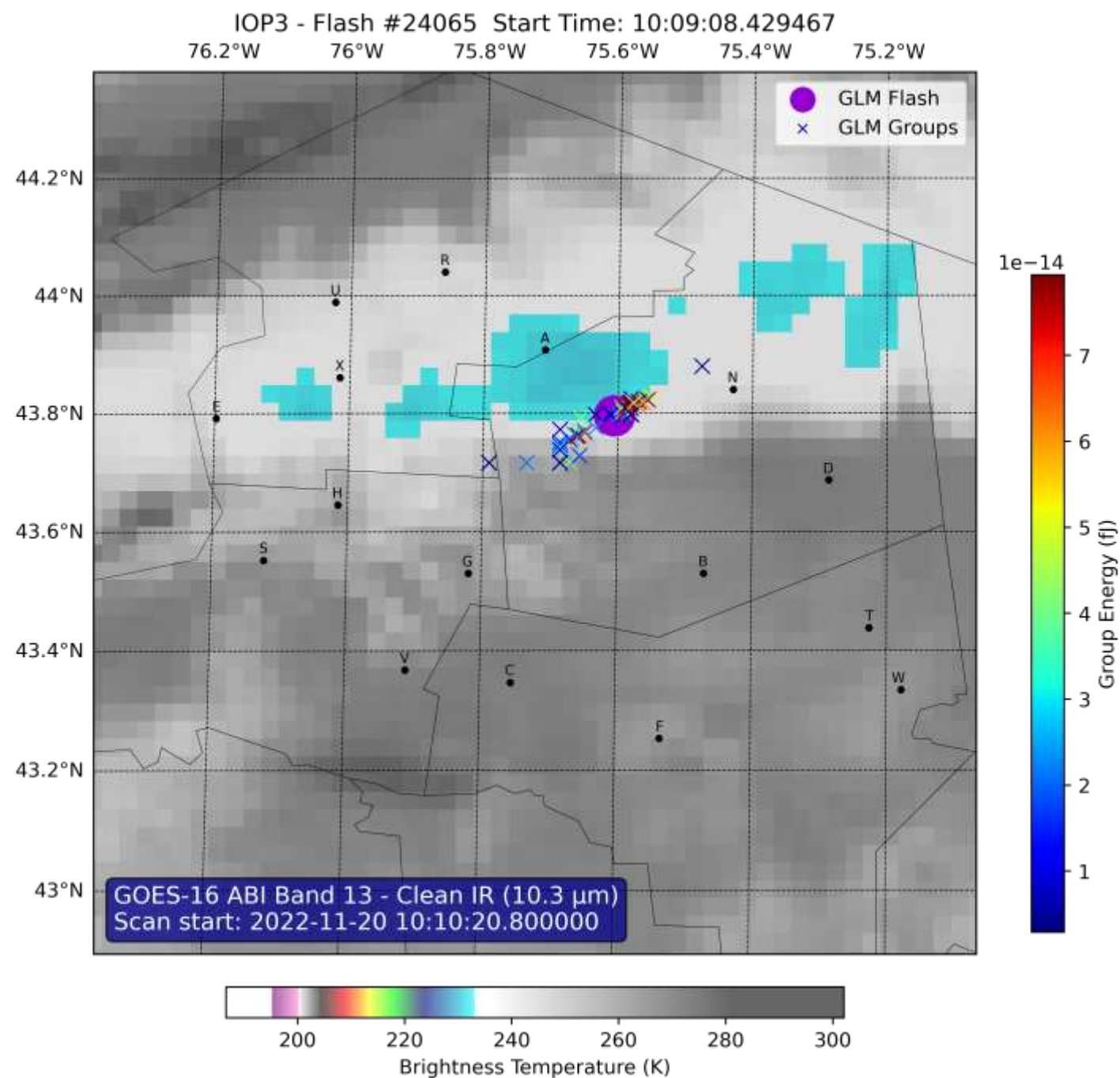
# IOP 3: GLM Data for entire 1000 hour

- GLM detected 17 flashes over 1000 hour
- Again, concentrated over the turbine area
- Look at three of these flashes



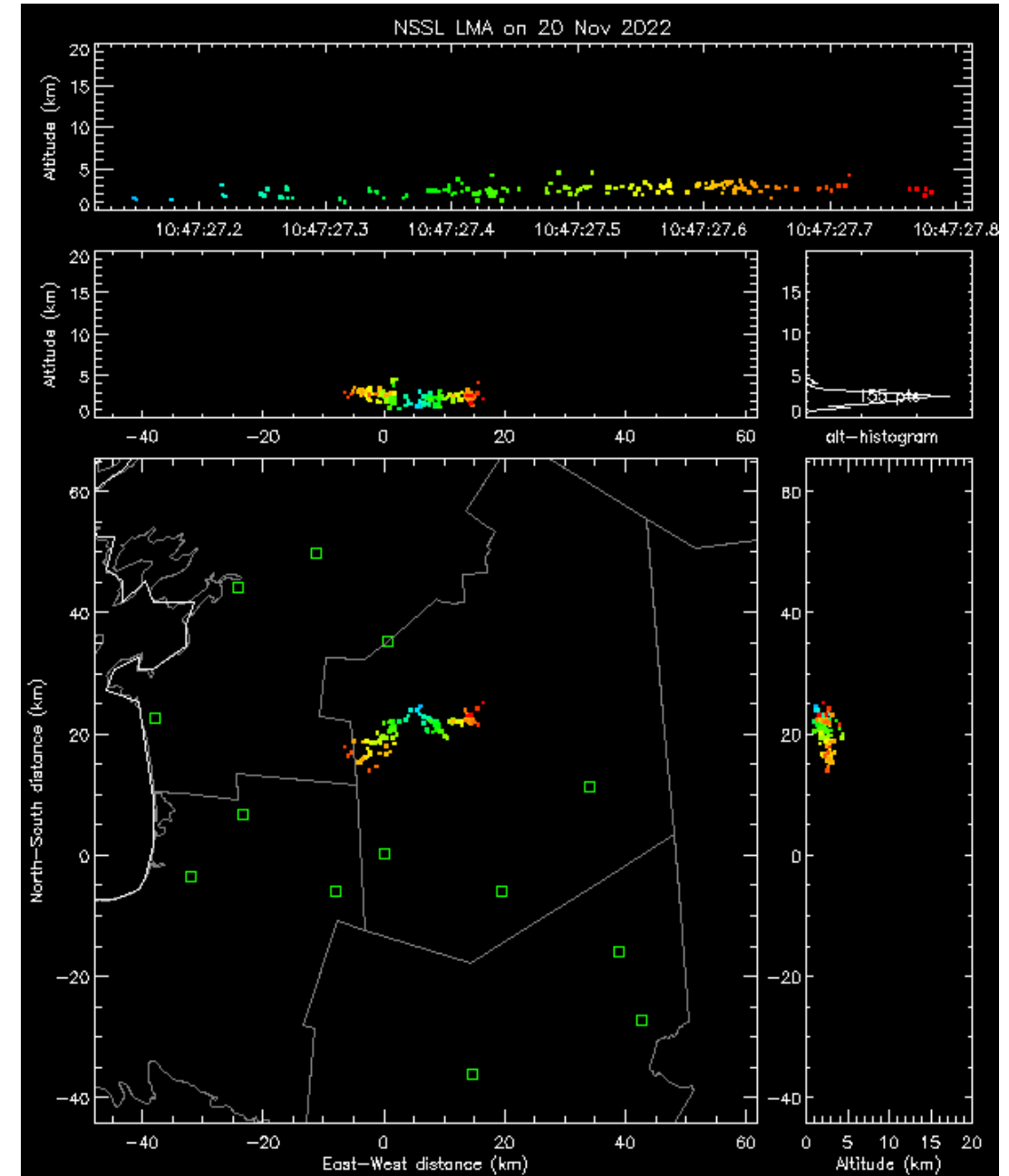
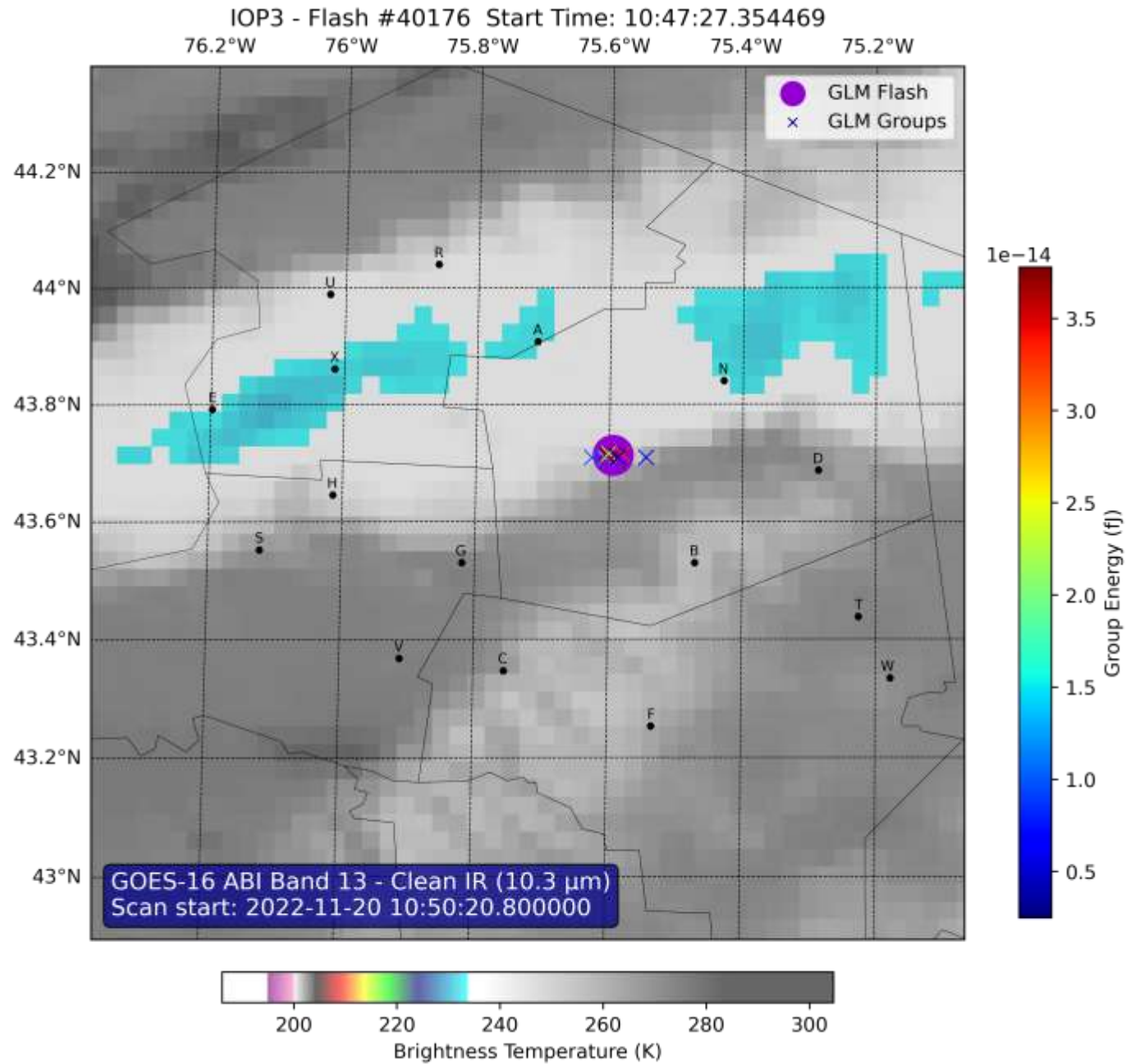
# IOP 3: LMA and GLM Data

## GLM flash 24065: 10:09:08



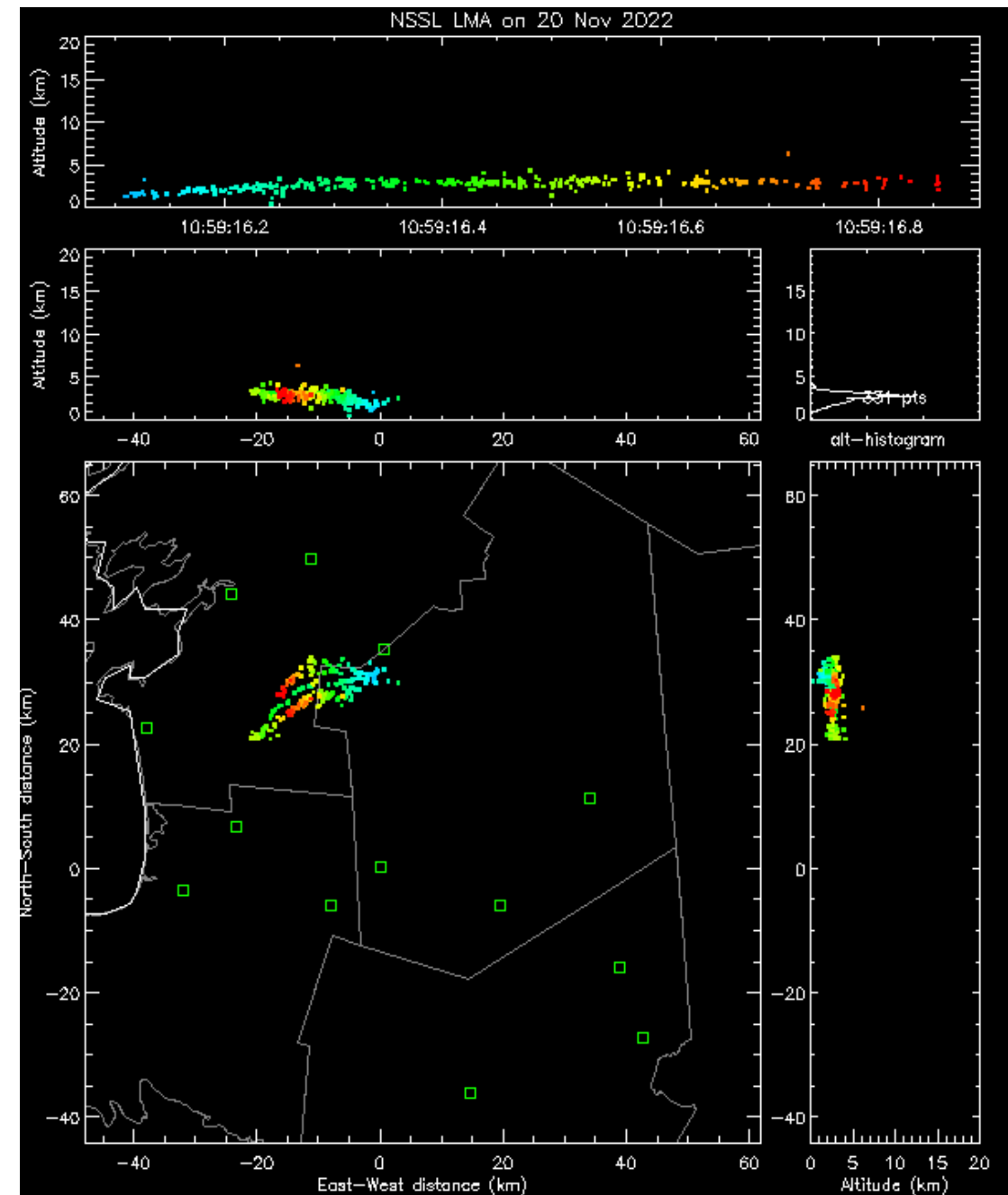
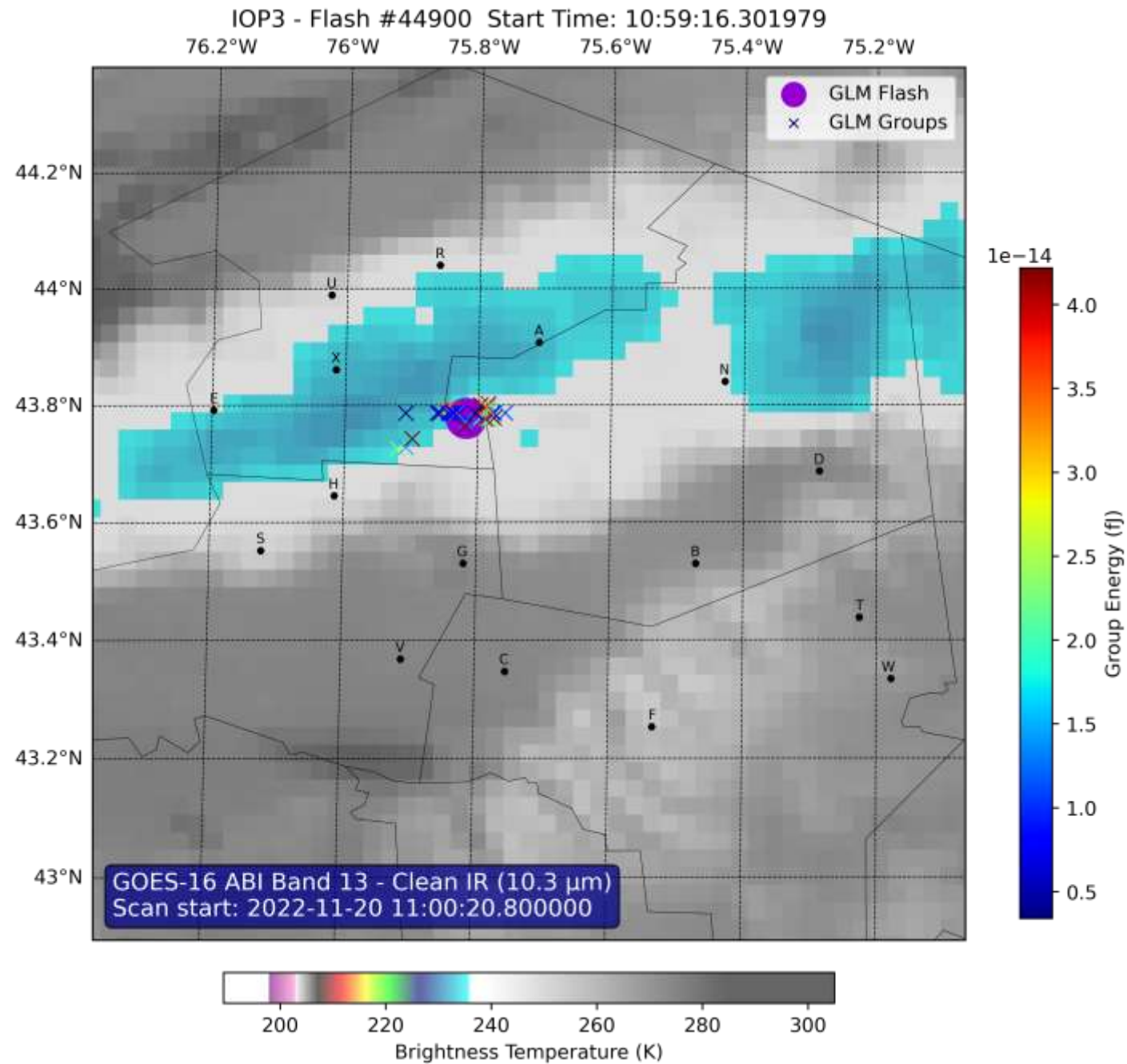
# IOP 3: LMA and GLM Data

## GLM flash 40176: 10:47:27



# IOP 3: LMA and GLM Data

## GLM flash 44900: 10:59:16

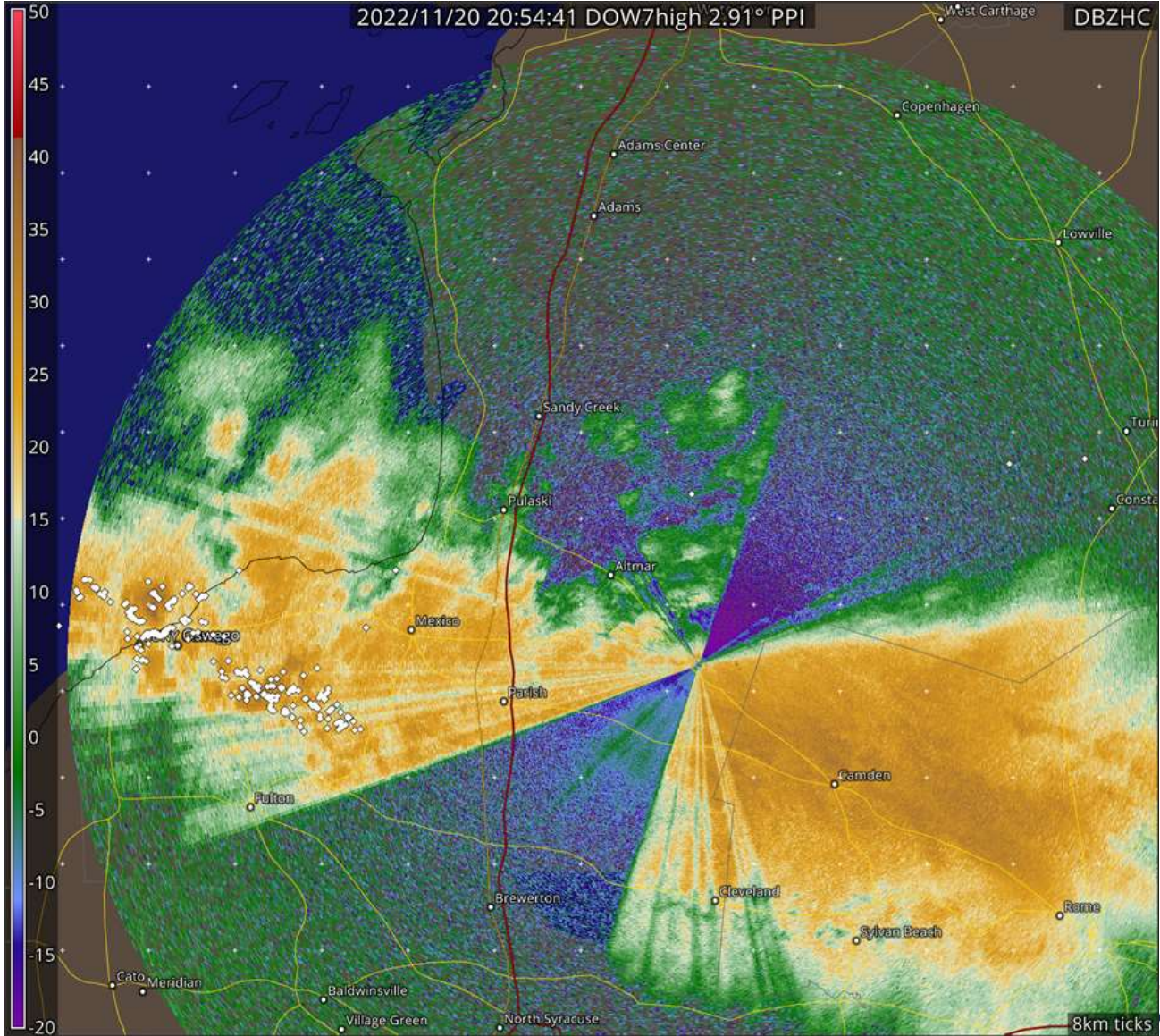


# Oswego Lightning from IOP 3

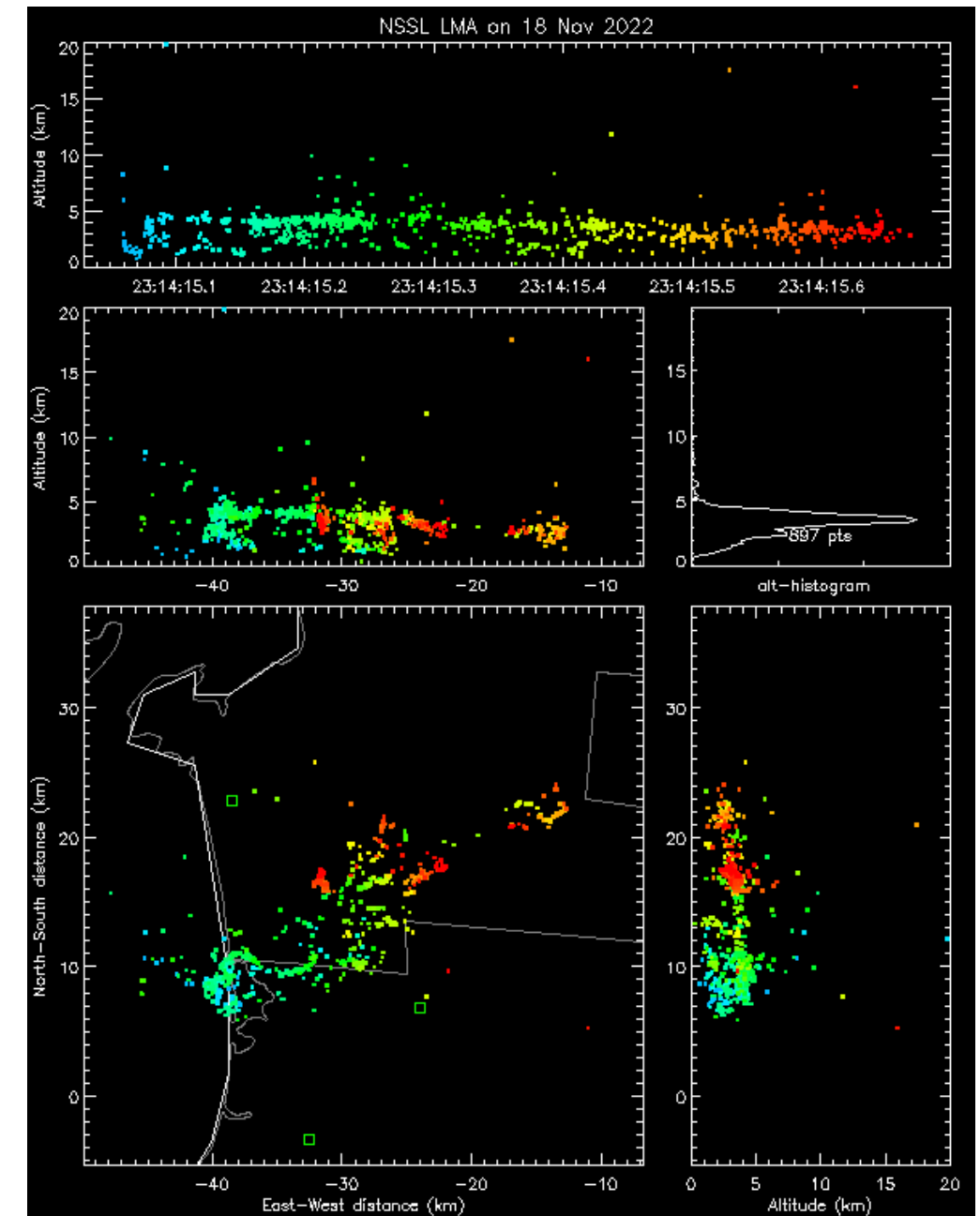
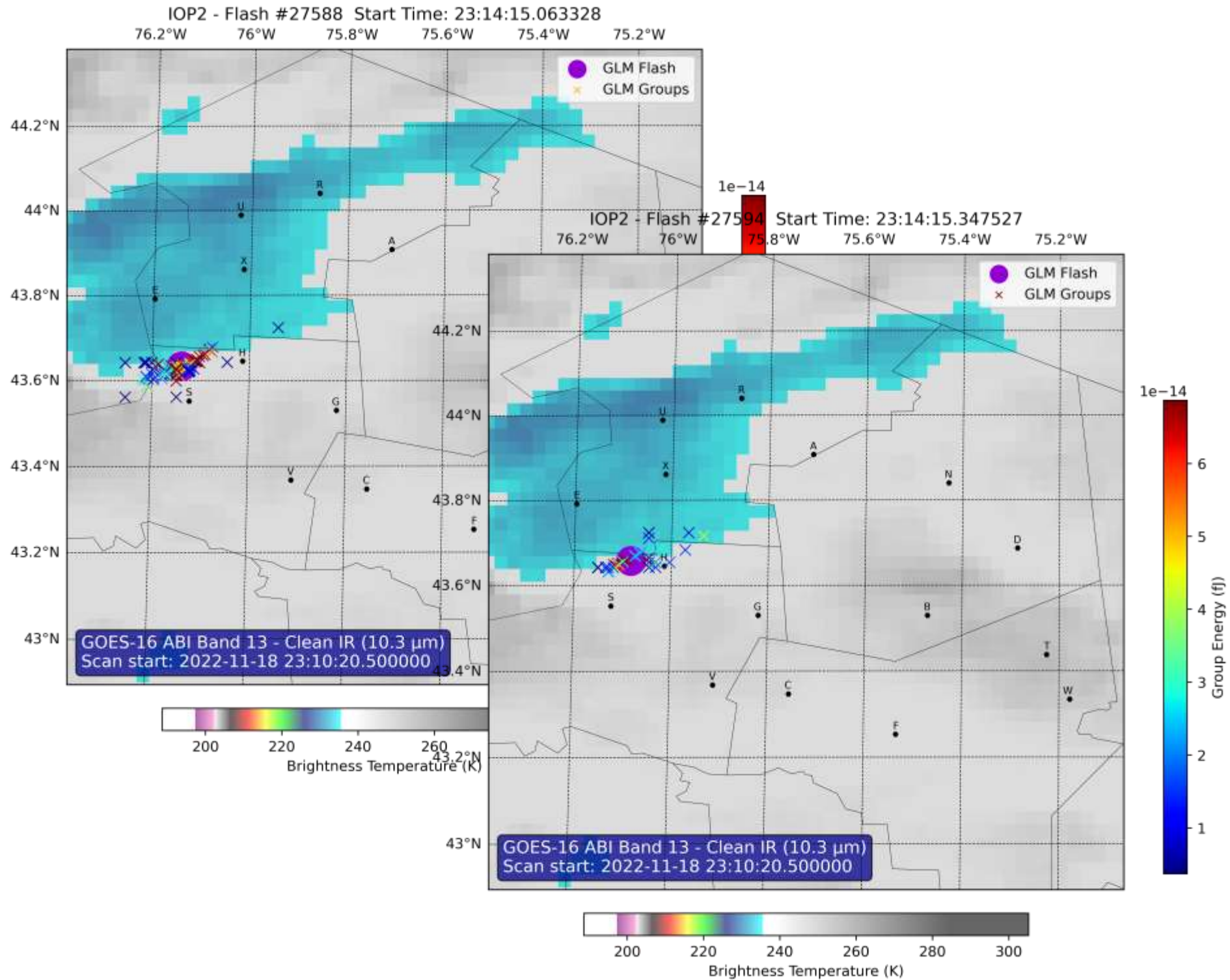
LMA Points (white) over DOW Reflectivity  
(Image courtesy Trevor White \*U. Illinois)



Video of this flash hitting stack in Oswego (K. Jesmonth, SUNY - Oswego)



# IOP 2: LMA and GLM Flashes from 2300 hour



# Summary

- Relatively good agreement between GLM and LMA measurements
- GLM typically detects slightly fewer flashes
  - LE flashes much lower than “normal”
- GLM events seem to be (relative to LMA sources)
  - Less extensive
  - Shifted slightly south
- GLM (or LMA) flashes may appear to be split due to processing differences
- Would like to overlay and animate GLM, LMA, and ABI

