

# NASA SPoRT Capabilities Briefing

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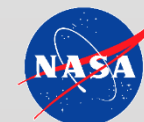
<sup>3</sup>University of Alabama in Huntsville

<sup>4</sup>ENSCO, Inc.

Airlines for America Committee Meeting

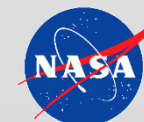
Washington, DC

16 May 2018



# Outline

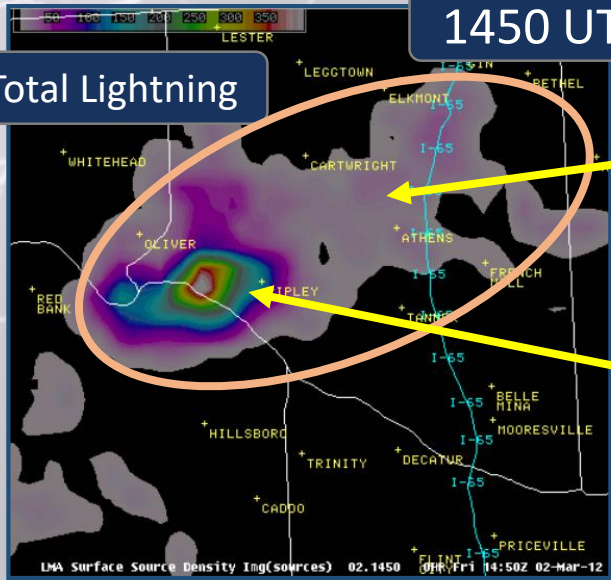
- The NASA Short-term Prediction Research and Transition (SPoRT) Center
- Primary focus on utilizing total lightning observations
- Other SPoRT capabilities



# Total Lightning

1450 UTC

Total Lightning

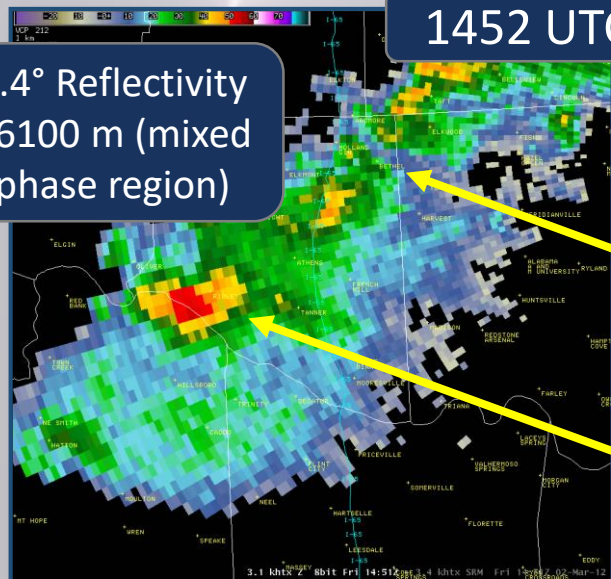


Spatial extent

Developing updraft

1452 UTC

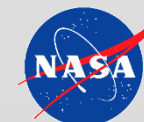
3.4° Reflectivity  
~6100 m (mixed phase region)



Lightning 10s of km from updraft

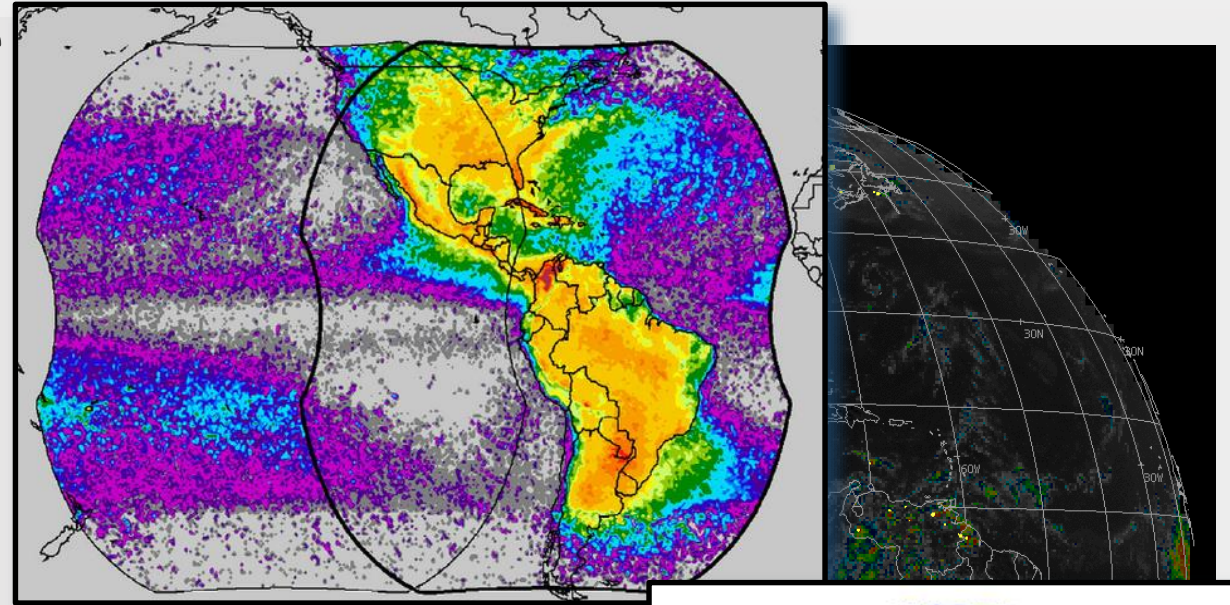
Maximum of lightning coincident with updraft

- Total lightning = 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 usually precedes first cloud-to-ground
  - Total lightning serves as proxy for storm strength
  - Monitor convective development / weakening
  - Observe the spatial extent
- How do we detect this?

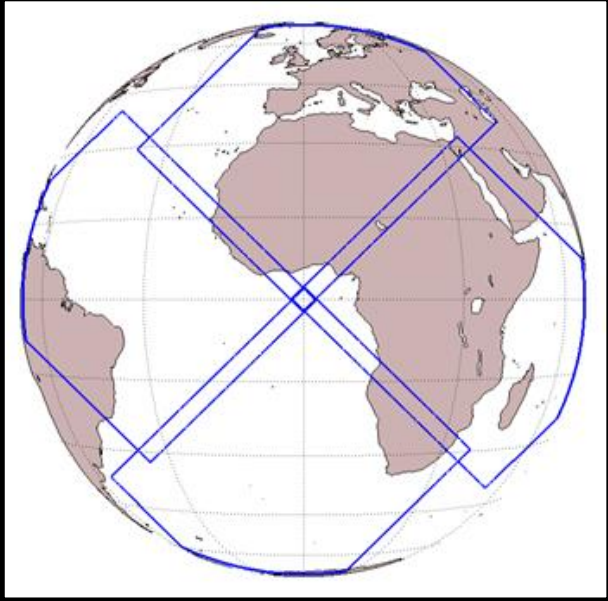


# Geostationary Lightning Mapper (GLM)

- The GLM provides near hemispheric coverage
  - Generally consistent detection efficiency over most of the field of view
  - Available in data spare regions
  - 1 minute updates
  - Not proprietary (can show in real-time)
- Compared to traditional ground networks
  - GLM observes total lightning
  - GLM provides spatial extent
  - GLM detections consistent over land and water
- GOES-17 GLM available late 2018/early 2019
- Europe to launch similar instrument ~2022

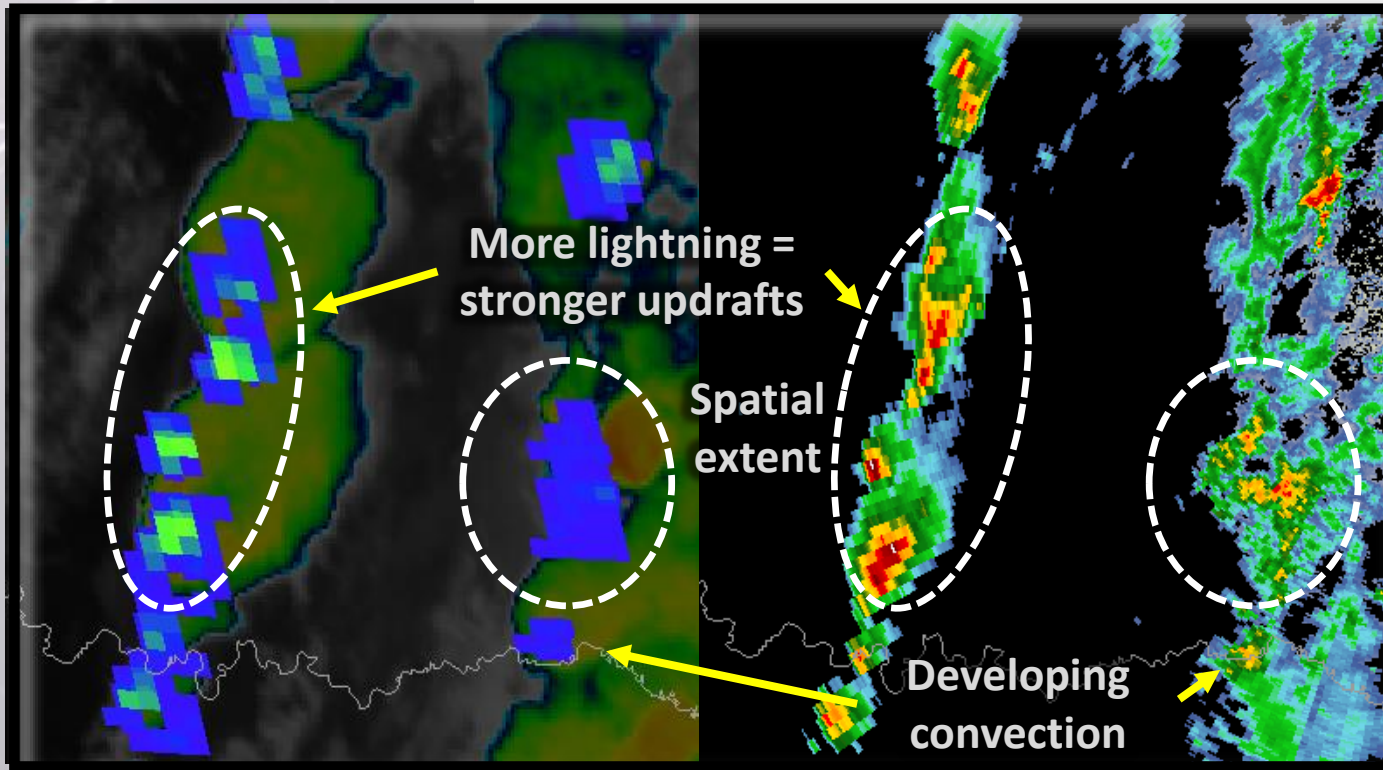


*GLM field of view for GOES-16 and -17 (above) and the corresponding field of view for the EUMETSAT Lightning Imager on Meteosat Third Generation (right)*





# GLM Capabilities: Monitor Convection

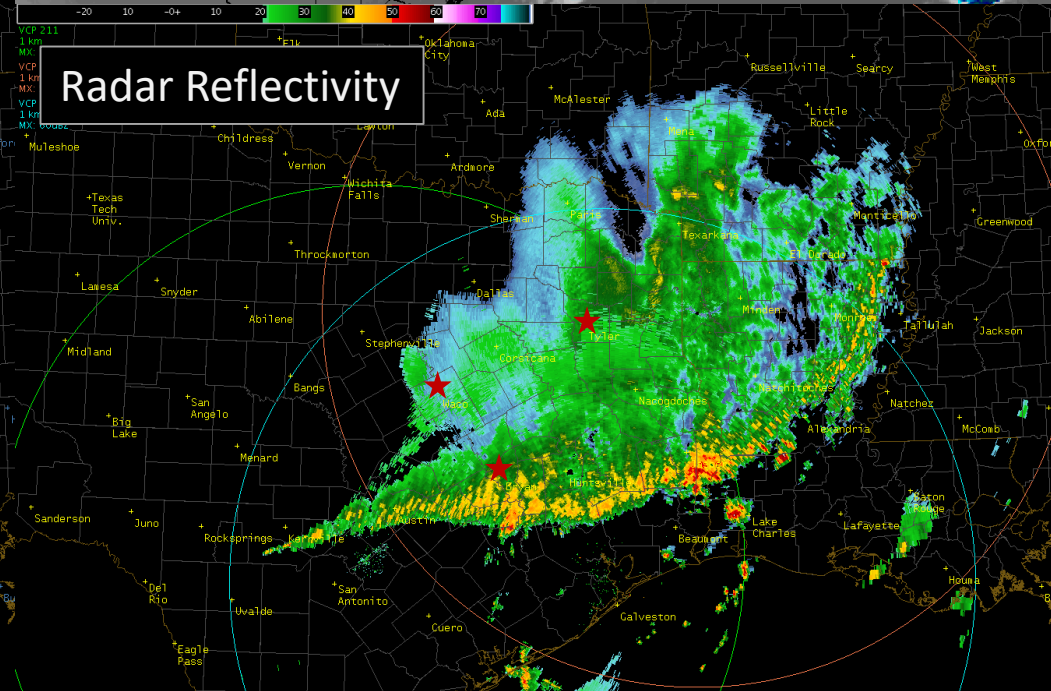
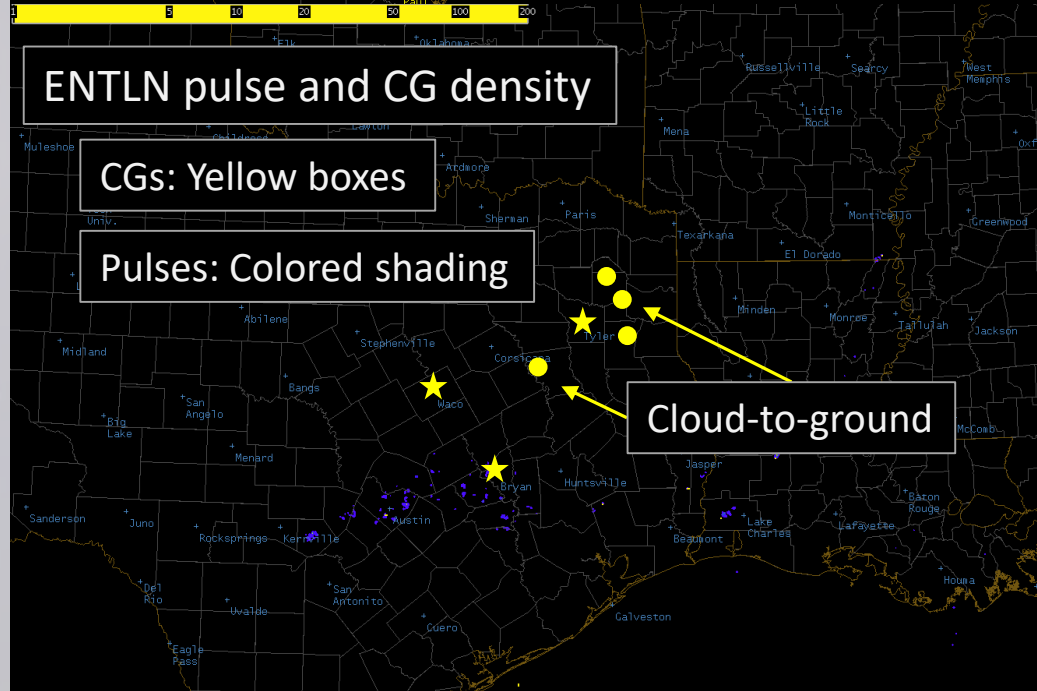
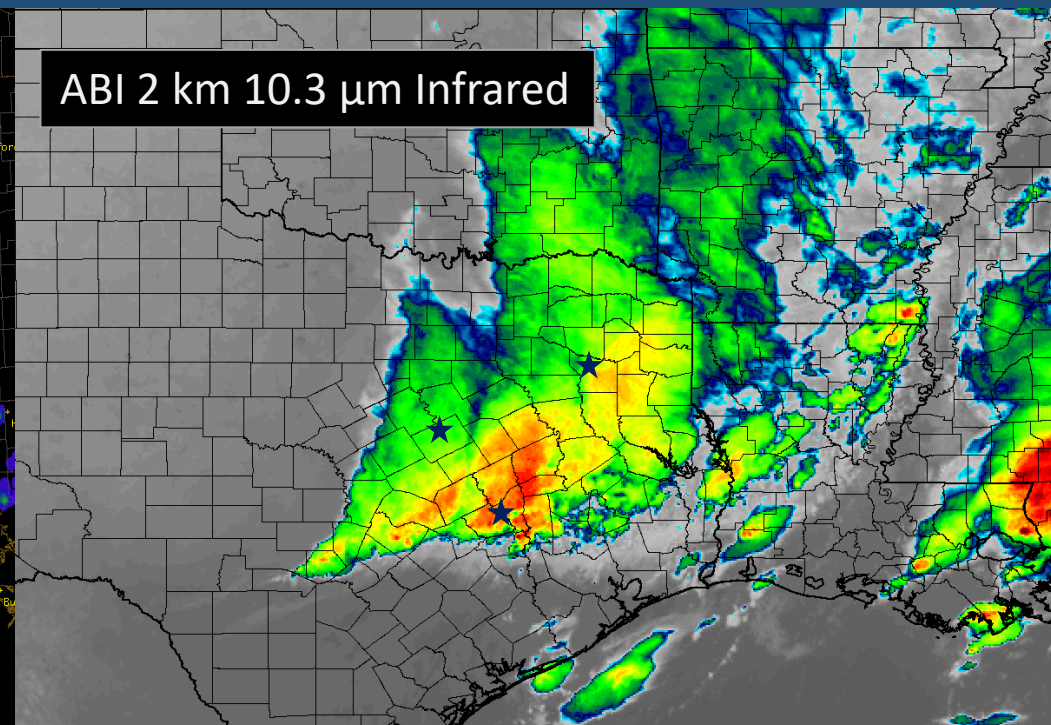
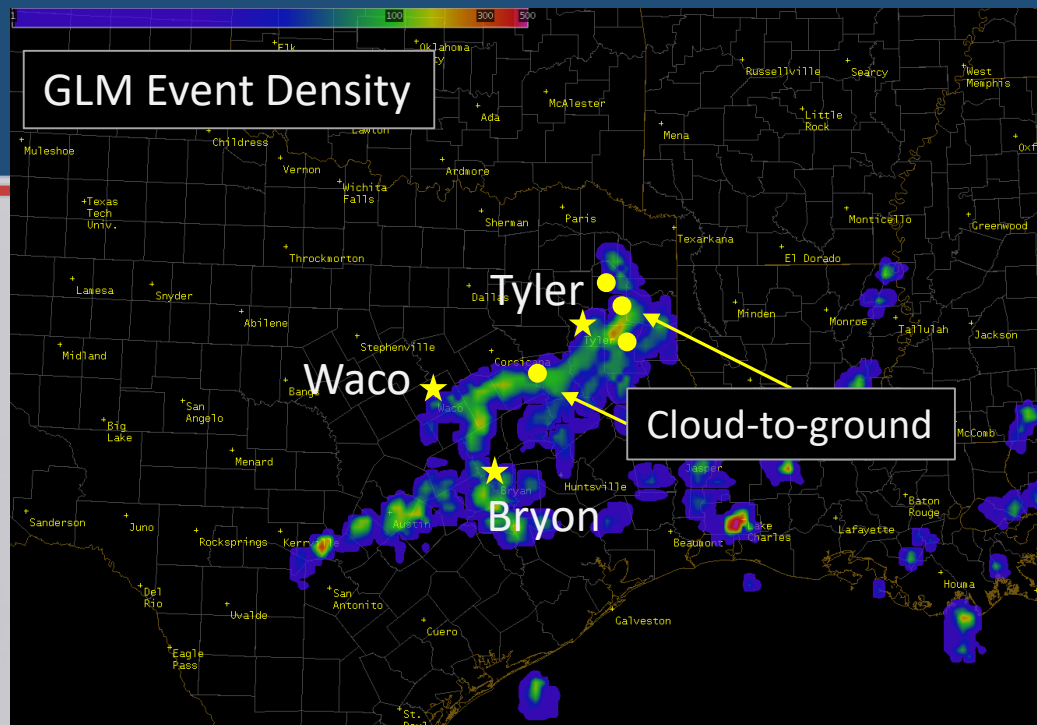


*Example of GLM flash extent density overlaid on 10.3 micron ABI IR (left) compared to radar reflectivity (right)*

- 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

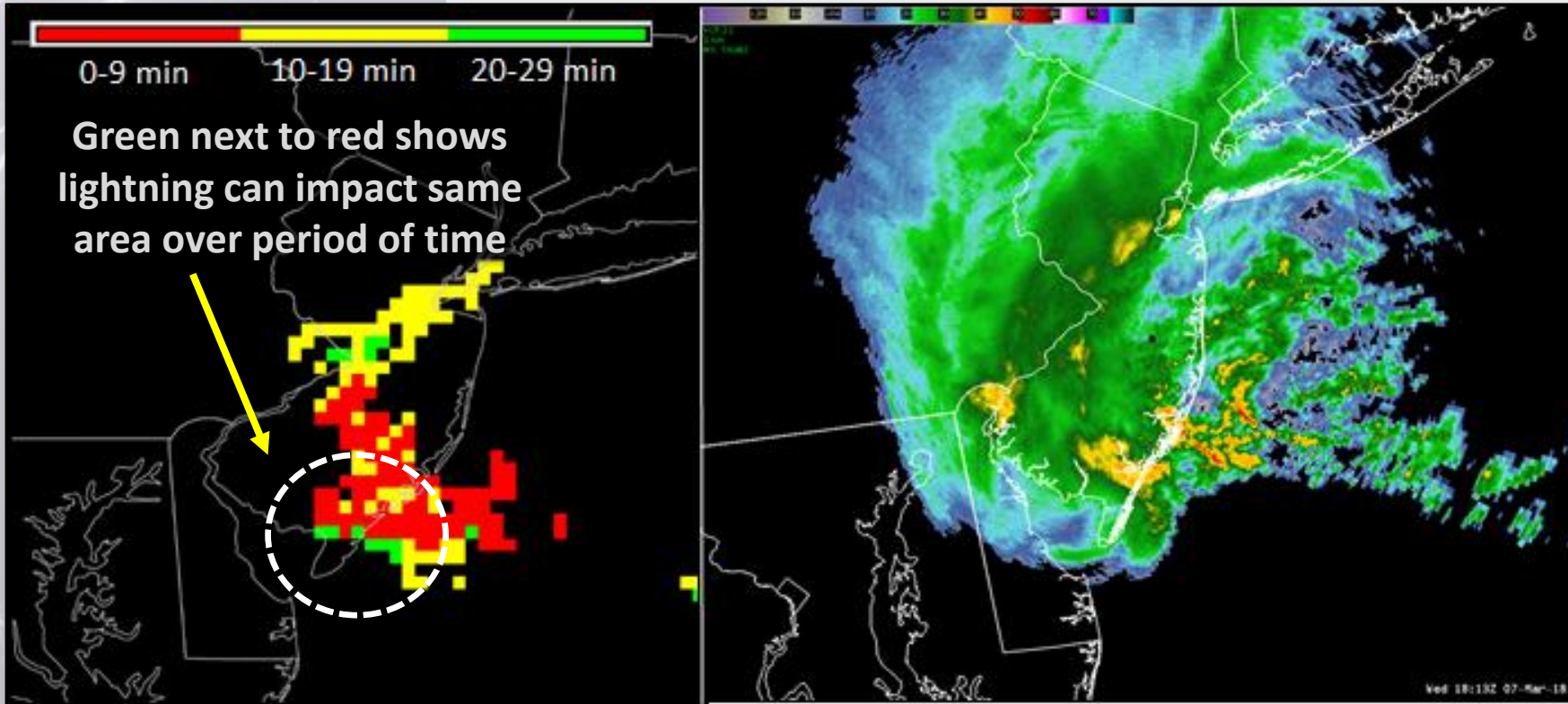
# Lightning Safety

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



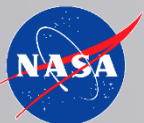


# GLM Capabilities: The “stoplight” product

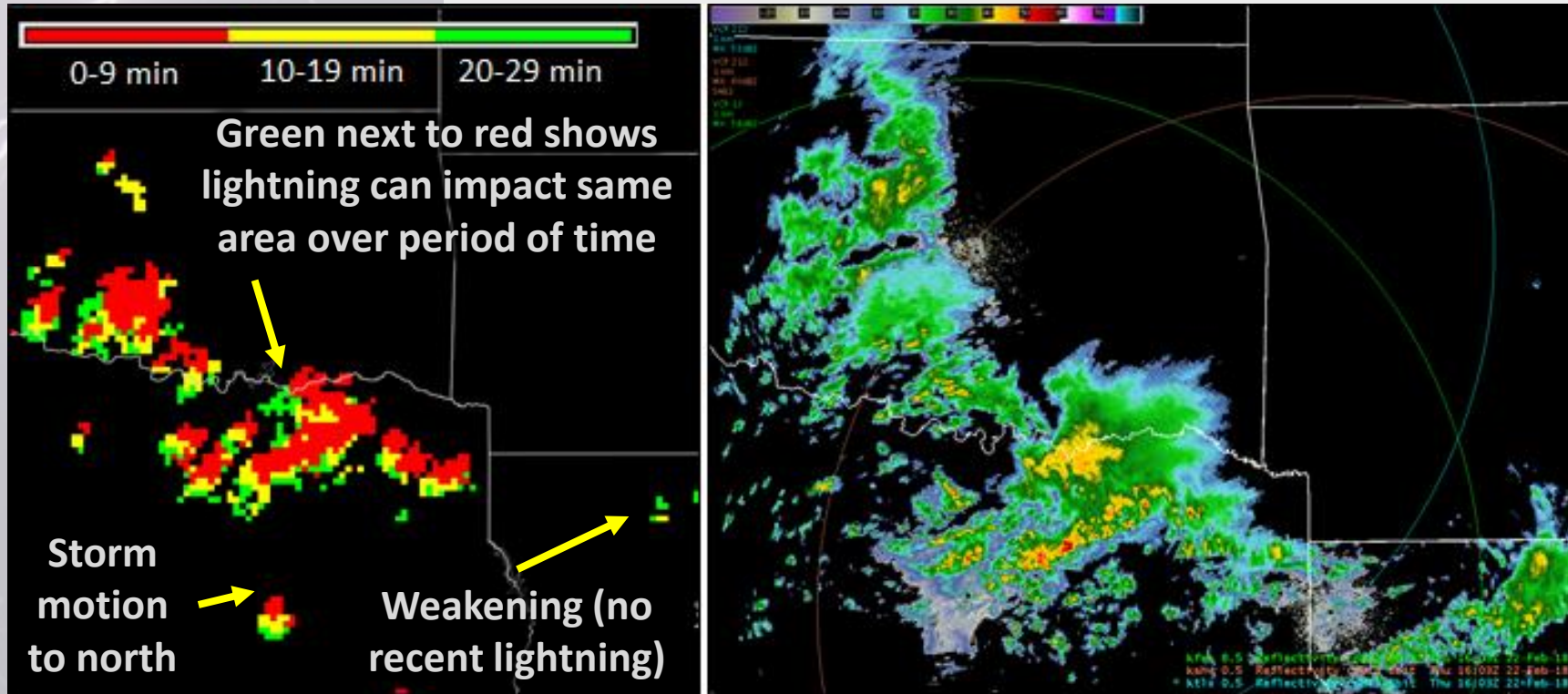


Example of the GLM stoplight product (left) with radar reflectivity covering 30 minutes from 1743-1813 UTC on 7 March 2018.

- 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)

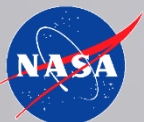


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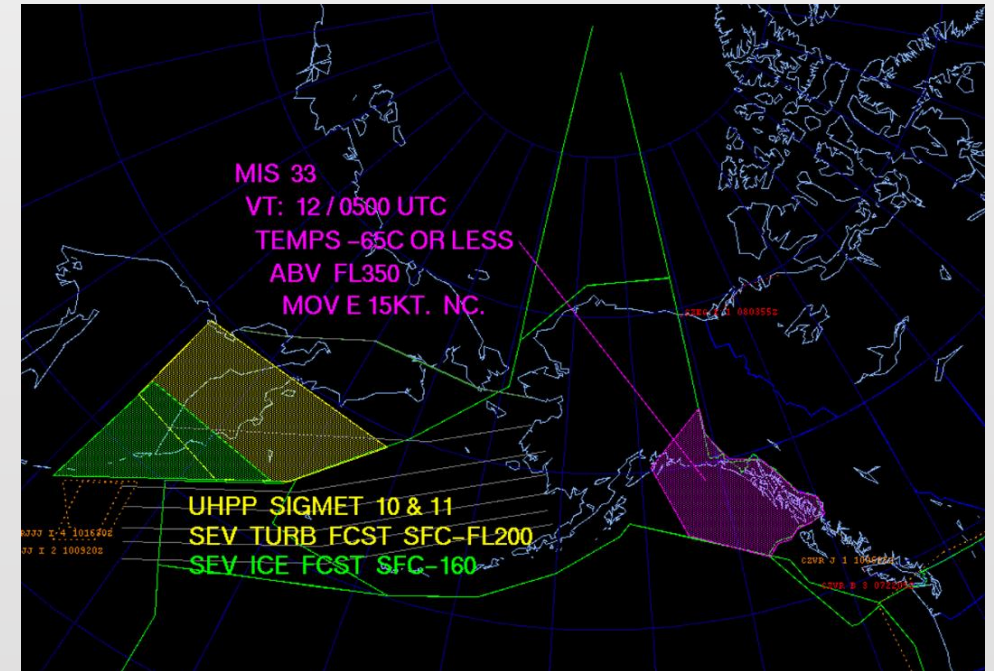




# Cold Air Aloft Aviation Hazard

- Pockets of CAA (Temperature  $\leq -65^{\circ}\text{C}$ ) can freeze airliner fuel and regularly occurs at flight level in the arctic
- The Anchorage, Alaska, Center Weather Service Unit (CWSU) provides Meteorological Impact Statements (MIS) to Air Traffic Controllers to direct flights around CAA
- In data sparse Alaska, forecasters have relied on analysis and model fields and limited radiosonde observations to guess the 3D extent of the Cold Air Aloft
- SPoRT is involved in a multi-organizational collaboration to provide satellite observations for forecasting Cold Air Aloft (CAA) events
- Use of satellite observations provides an opportunity for forecasters to observe the 3D extent of the Cold Air Aloft in real-time

*Alaska CWSU domain (green line) and warning guide for 11 January 2017. Purple hatched area is an advisory for Cold Air Aloft*



*Example text product disseminated by Alaska CWSU for Cold Air Aloft; valid 14 November 2015*

```
FAAK20 KZAN 121458  
ZAN MIS 01 VALID 121500-130300  
...FOR ATC PLANNING PURPOSES ONLY...  
COLD AIR ALOFT  
FROM 185NE SCC-65NE ORT-55SW ENN-110NW BRW-185NE SCC  
TEMPS -65C OR LESS FM FL350-400. AREA MOVG NE 40 KTS.  
CMW NOV 14
```

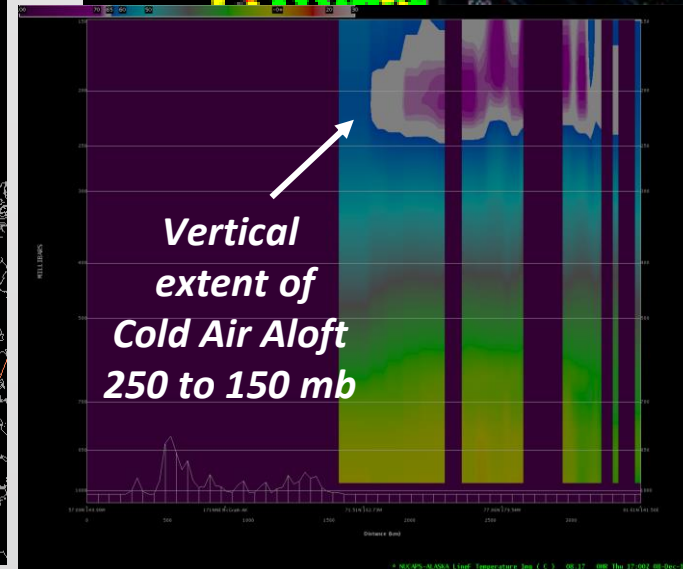
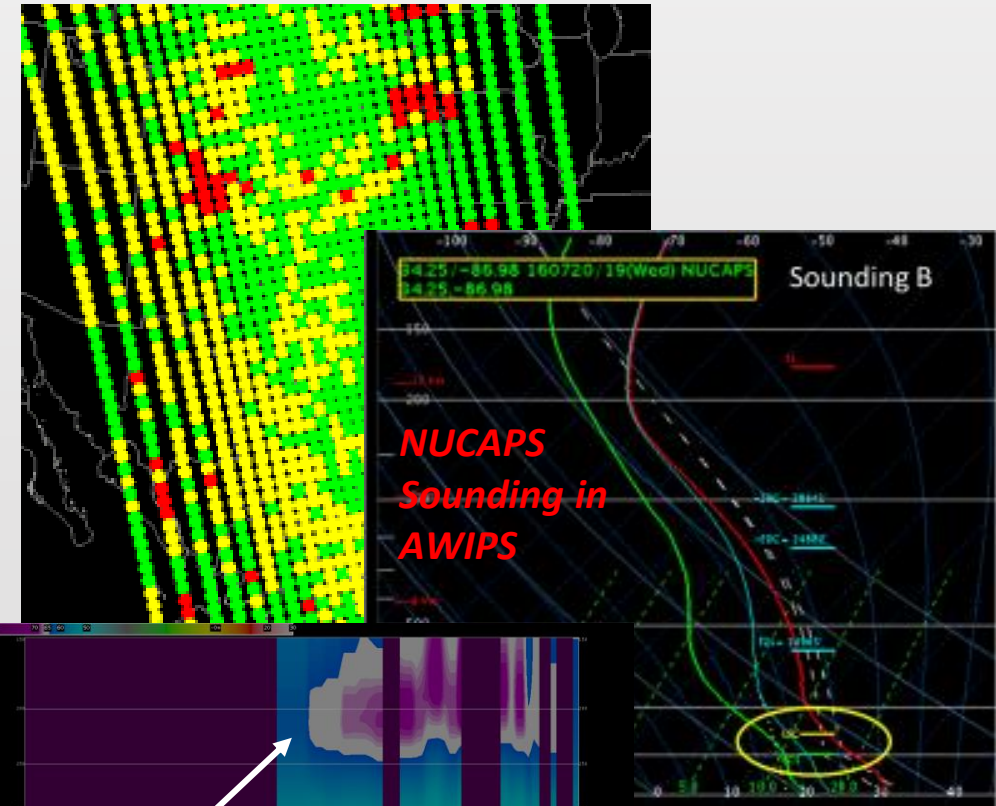
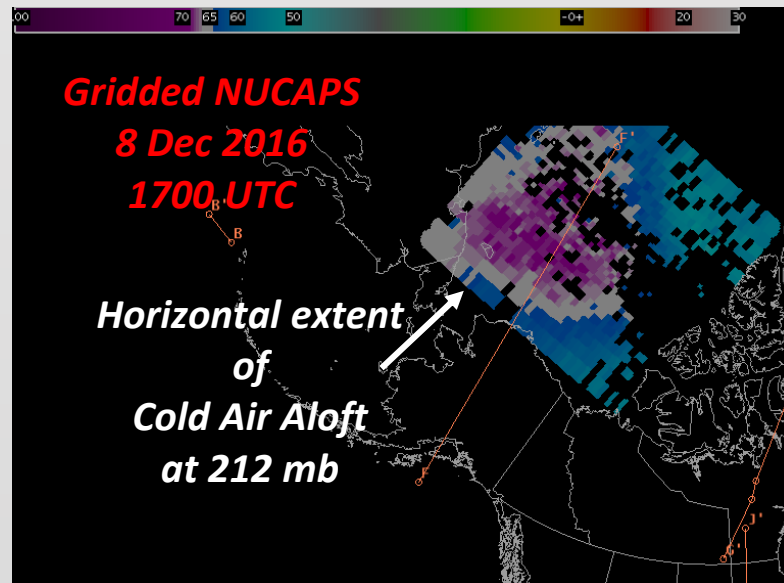
Lat/Lon Extent of Cold Air from soundings, aircraft reports, model

Vertical Extent of Cold Air from soundings/aircraft reports/model

Motion determined from model data

# Satellite Soundings

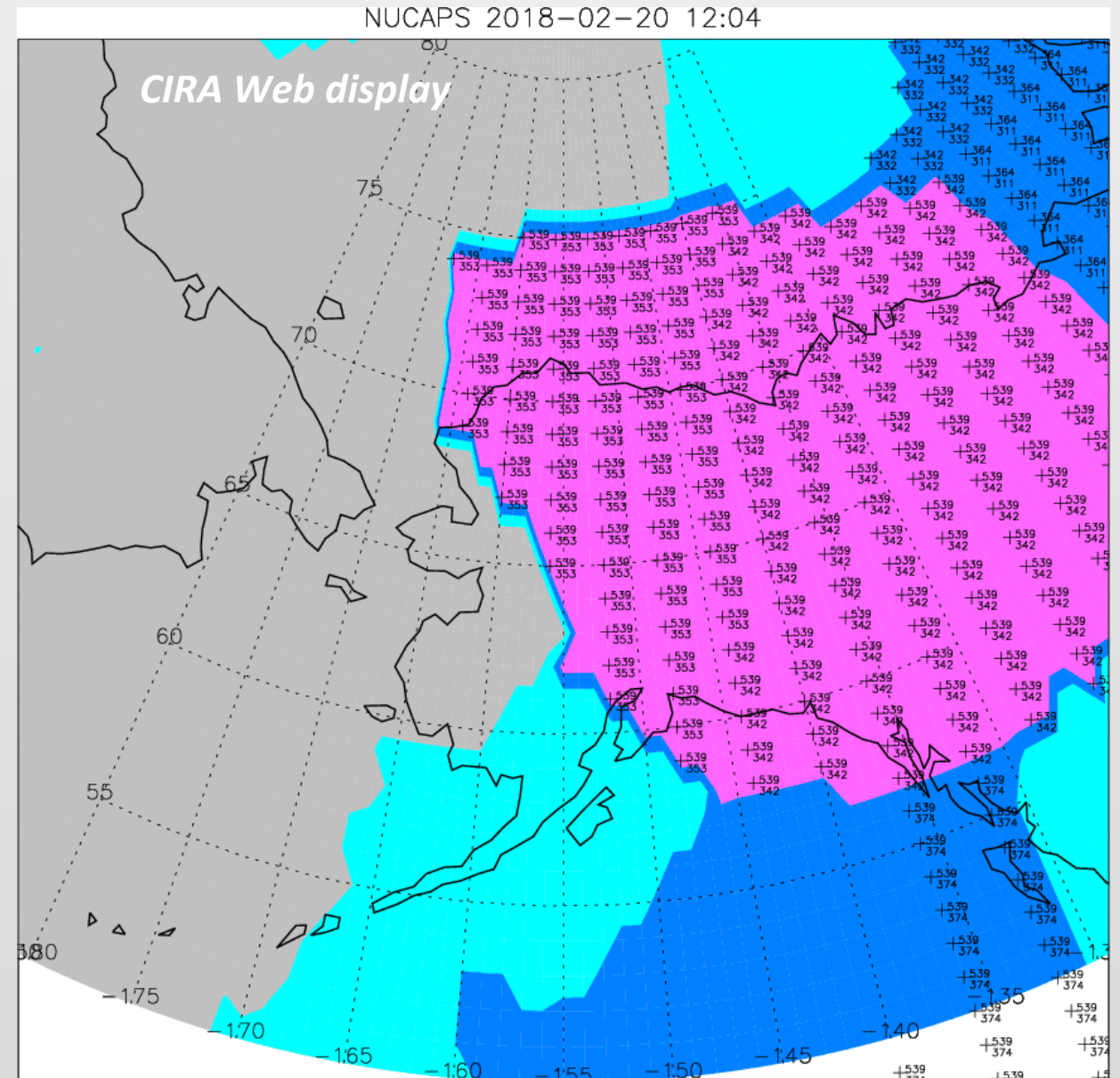
- Cross-track Infrared Sounder/Advanced Technology Microwave Sounder (CrIS/ATMS) vertical soundings processed through the NOAA Unique Combined Atmospheric Processing System (NUCAPS) are available in NWS Advanced Weather Interactive Processing System (AWIPS)
- Experimental capability to display plan view and cross section of temperature and moisture fields on millibar and flight levels (i.e. Gridded NUCAPS)





# Product Displays

- CIRA developed the first display concept:
  - Displays CAA heights in units of flight level (hundreds of feet)
  - Polar-orbiting satellite data and Global Forecast System model output available for comparison
  - Includes microwave-only data
- Website used by forecasters as a backup when AWIPS data feed is down
- Website is publically available:  
[http://rammb.cira.colostate.edu/ramsdis/online/cold\\_air aloft.asp](http://rammb.cira.colostate.edu/ramsdis/online/cold_air aloft.asp)

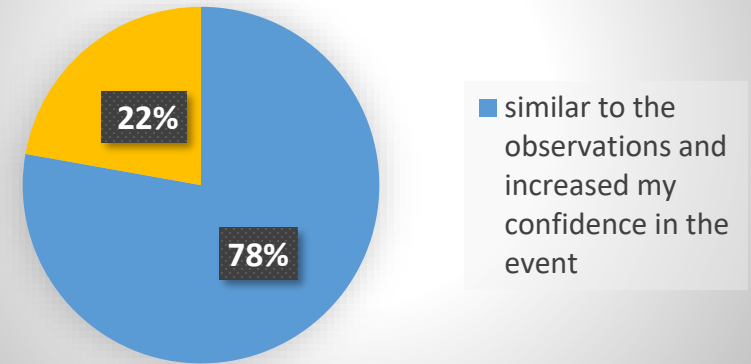




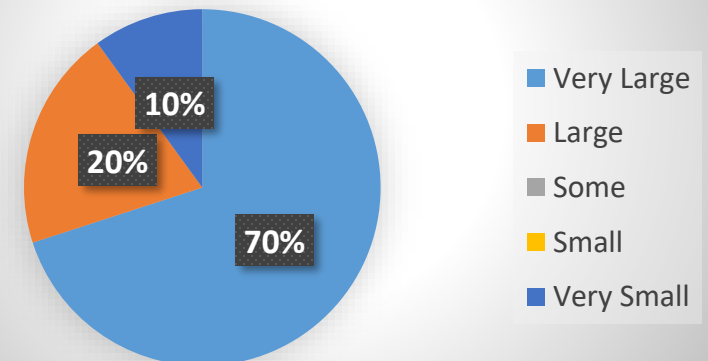
# 2018 Winter Assessment with the CWSU

- Forecasters provided feedback that the satellite observations increased confidence in CAA events and had a large to very large impact on the decision to issue a MIS
- Large scale late February CAA event pivotal in raising awareness of CWSU CAA MIS beyond intended customer
  - *“The only way the pilots hear about our weather products [CAA MIS] is when they fly through our airspace and the ZAN controllers pass on our weather products to them.” – GW*
  - CWSU Forecasters noticed a FEDEX aircraft traveling from MEM to ANC descended from FL360 to FL300 due to a freeze warning on their temperature indicator (PIREPS)
  - The CWSU CAA MIS was valid for temps < -65C above FL340 in the same area
  - ***This was one of the rare times the forecasters received feedback on aircraft in ZAN airspace changing their altitude due to CAA***

When compared to additional remote sensing or in-situ observations, the Gridded NUCAPS data were



Rank the impact of the Gridded NUCAPS on decision to issue or not issue a forecast product

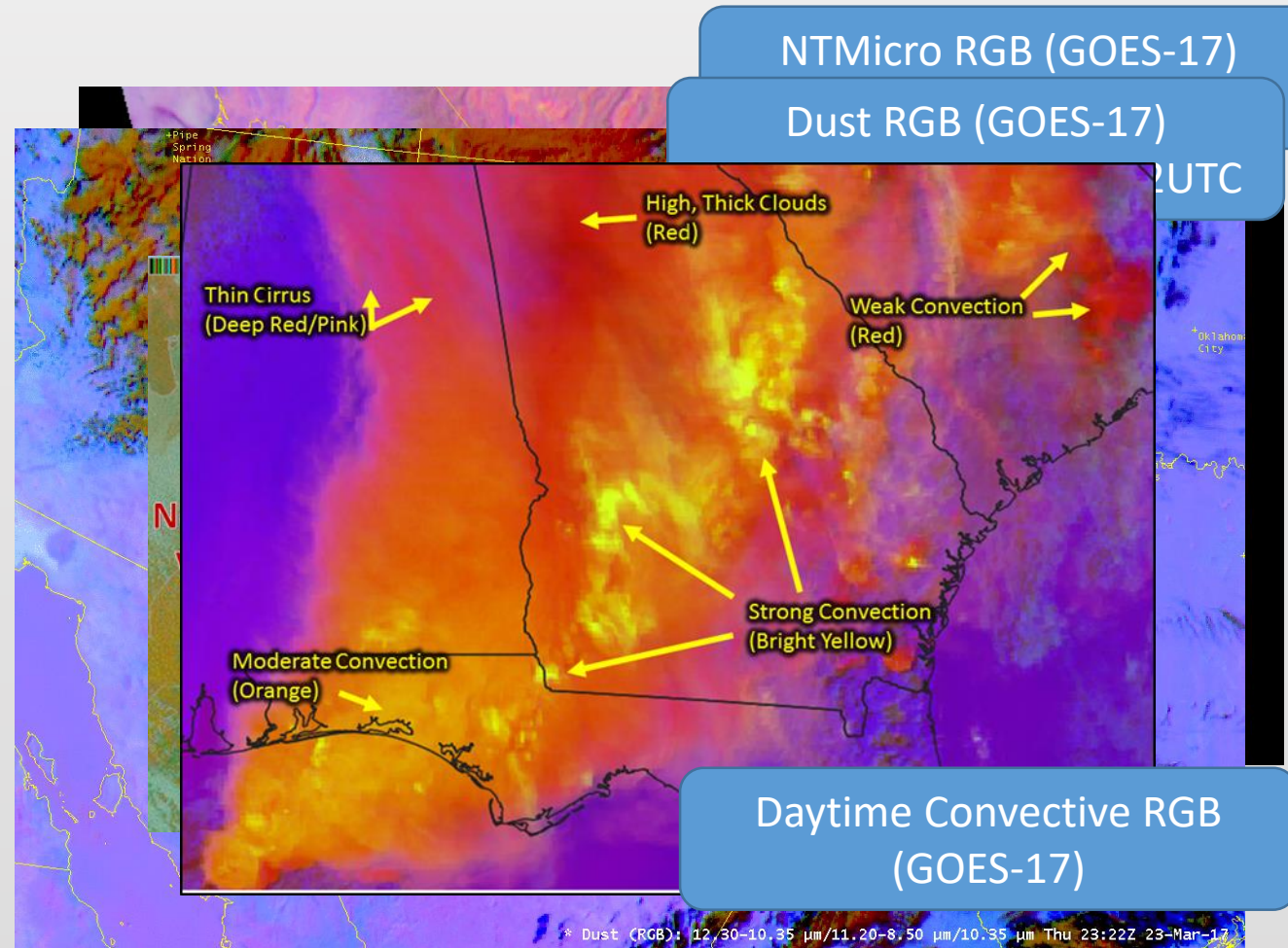


# CAA Summary

- SPoRT is part of a multi-organizational effort to provide satellite observations to increase situational awareness of hazardous CAA events that occur at high latitudes
- These satellite observations are now routinely used by aviation forecasters at the Anchorage CWSU and are a valuable dataset for issuing CAA MIS statements
- SPoRT is looking for more opportunities to provide satellite observations to airlines or other international forecasting agencies concerned with CAA

# Multispectral Satellite Capabilities

- Multispectral satellite imagery from ABI, AHI, and polar orbiting instruments
  - Combines several channels into one image to enable fast observation of changing situations
  - Some in use at AAWU, some CWSUs, and WFOs
  - Examples from our training library
    - NTMicro: microphysical obs including distinguishing btwn fog and low clouds
    - Dust
    - Volcanic Ash
    - Daytime Convective





# Conclusions

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