

NASA SPoRT Capabilities Briefing

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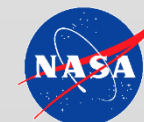
³University of Alabama in Huntsville

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Airlines for America Committee Meeting

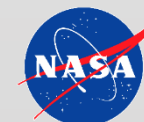
Washington, DC

16 May 2018



Outline

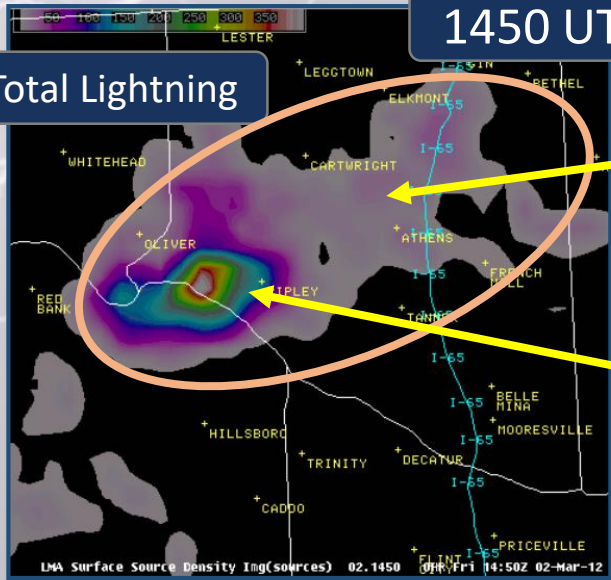
- The NASA Short-term Prediction Research and Transition (SPoRT) Center
- Primary focus on utilizing total lightning observations
- Other SPoRT capabilities



Total Lightning

1450 UTC

Total Lightning

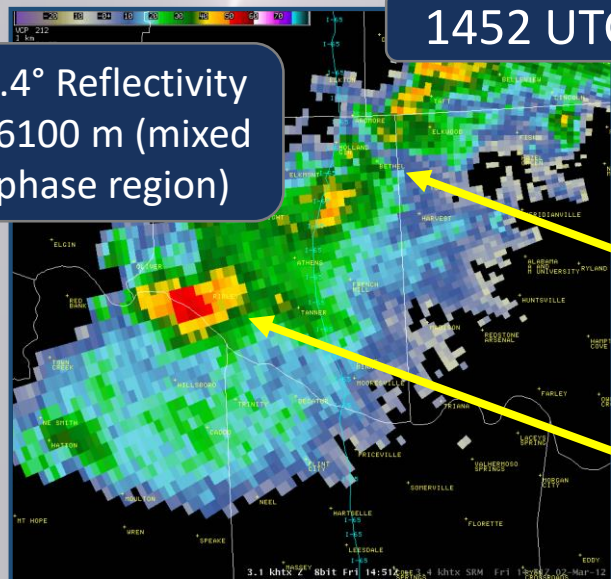


Spatial extent

Developing updraft

1452 UTC

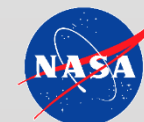
3.4° Reflectivity
~6100 m (mixed phase region)



Lightning 10s of km from updraft

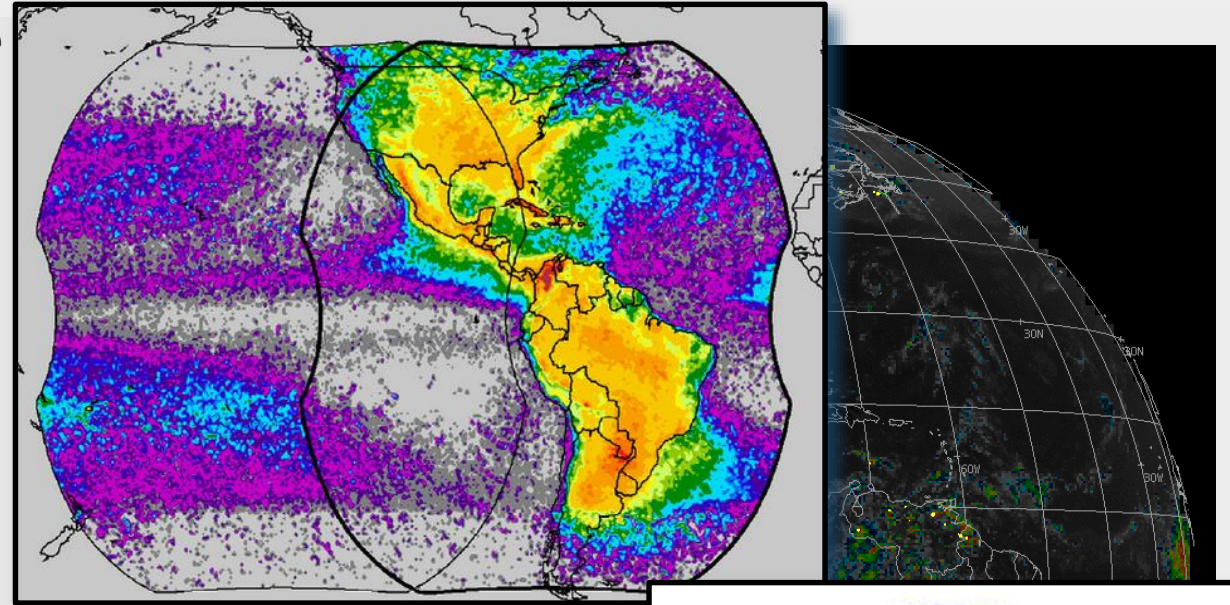
Maximum of lightning coincident with updraft

- 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?

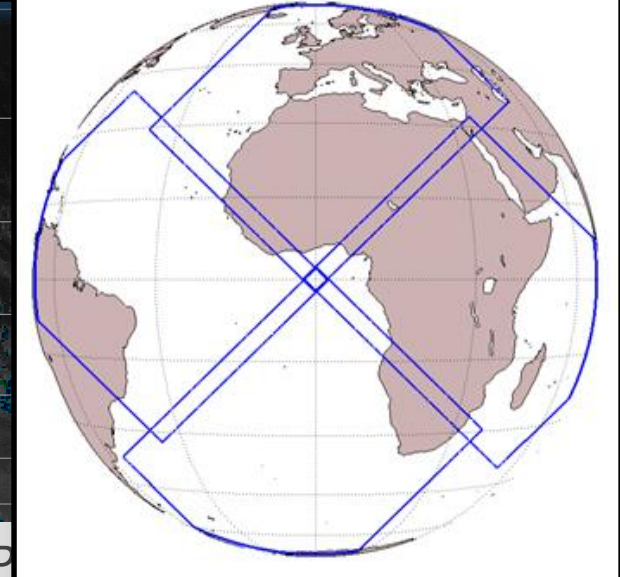


Geostationary Lightning Mapper (GLM)

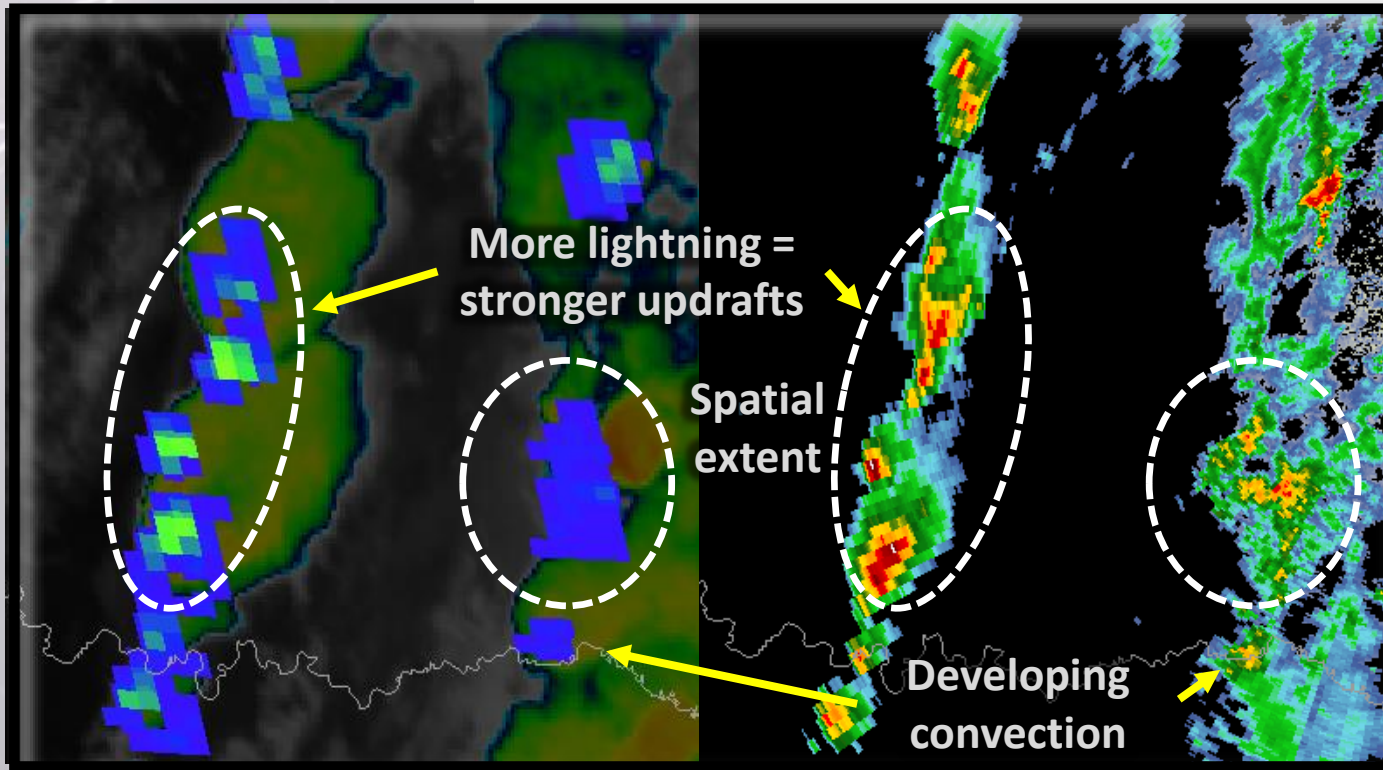
- The GLM provides near hemispheric coverage
 - Generally consistent detection efficiency over most of the field of view
 - Available in data spare regions
 - 1 minute updates
 - Not proprietary (can show in real-time)
- Compared to traditional ground networks
 - GLM observes total lightning
 - GLM provides 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

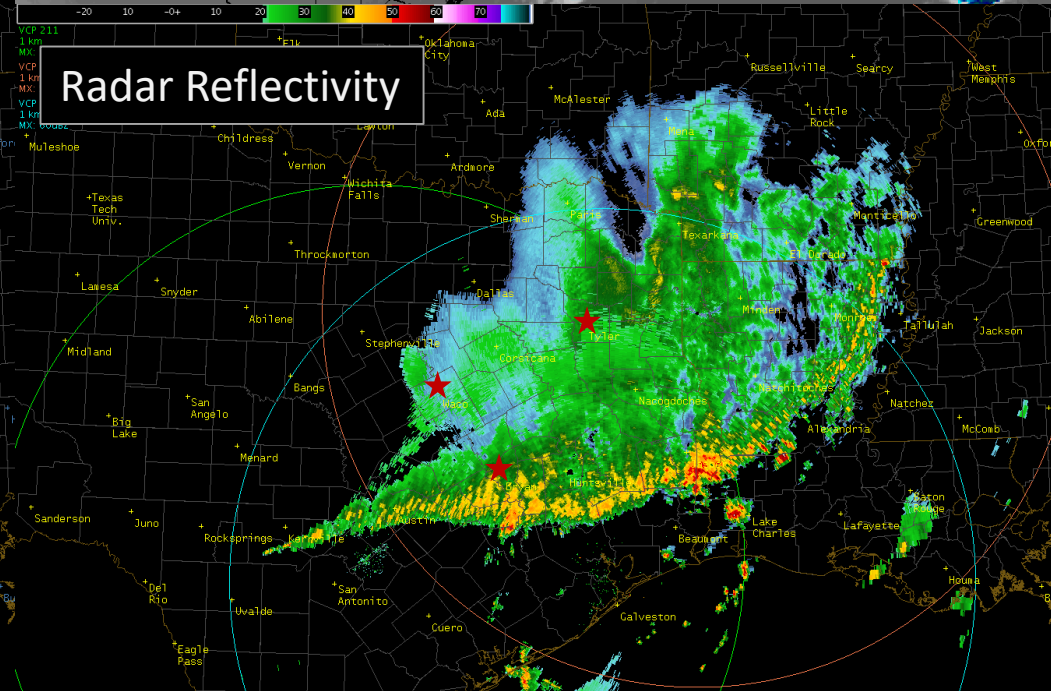
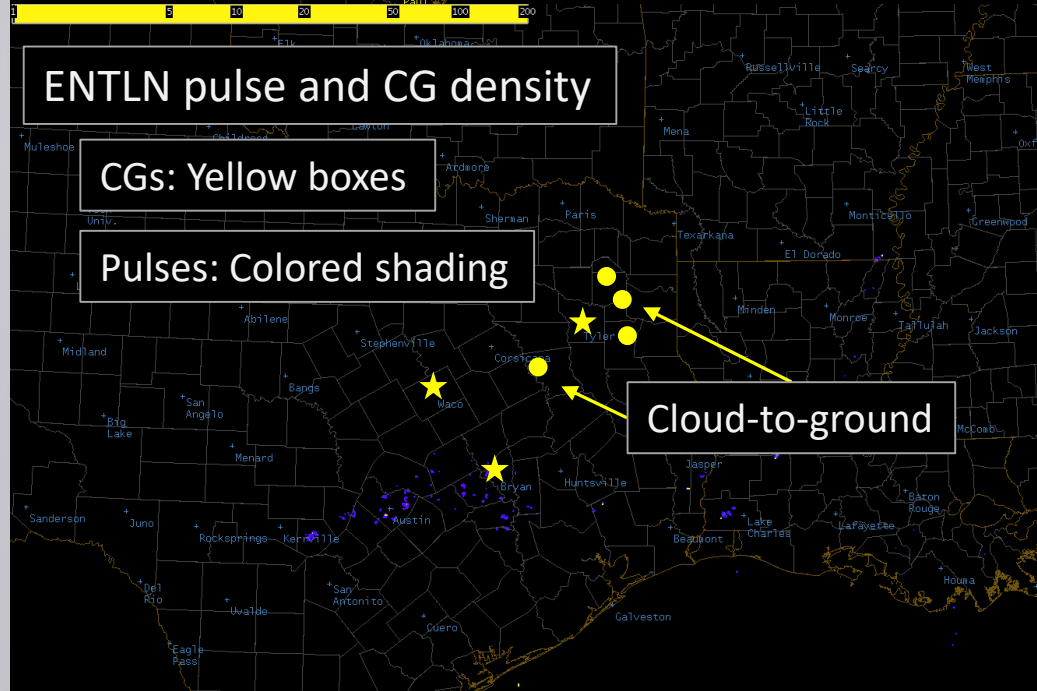
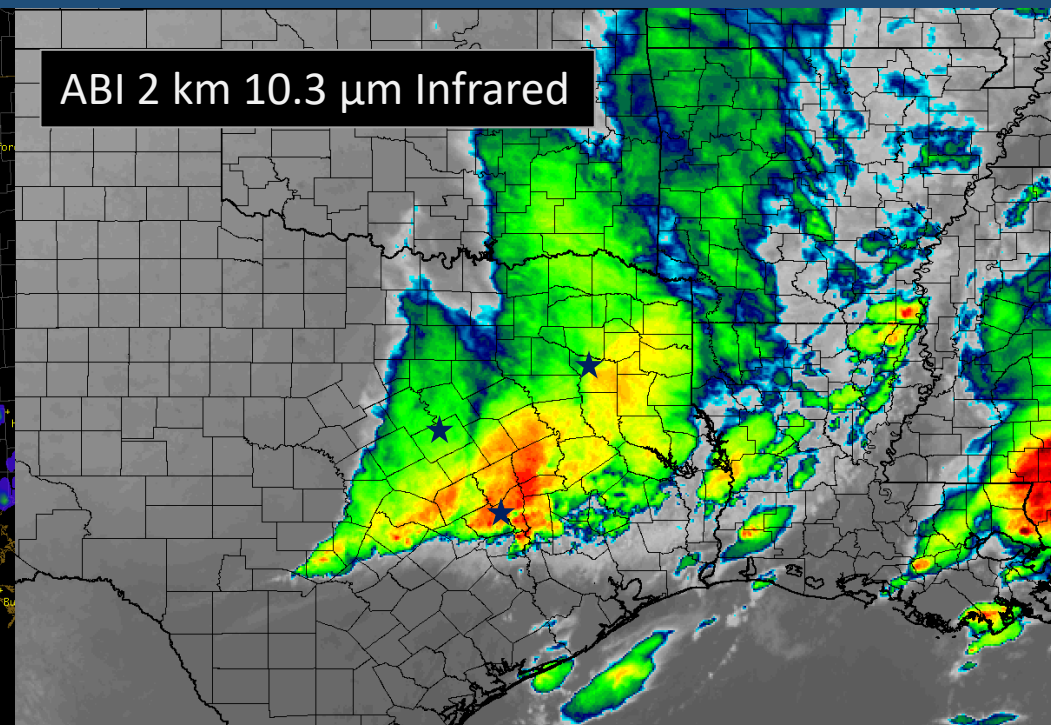
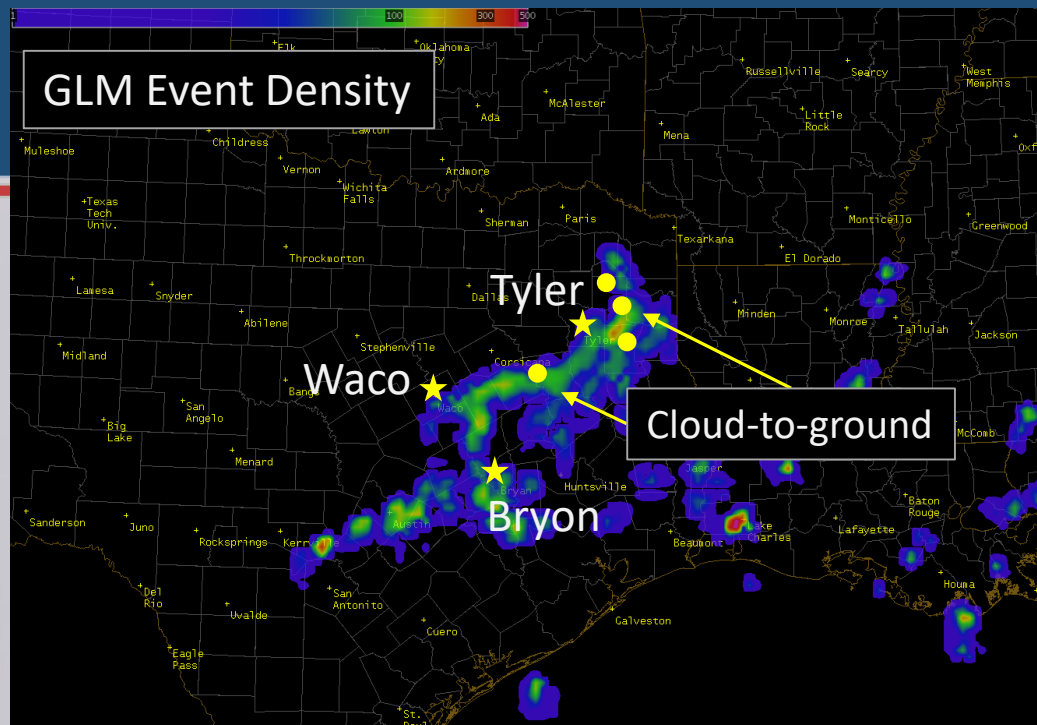


Example of GLM flash extent density overlaid on 10.3 micron ABI IR (left) compared to radar reflectivity (right)

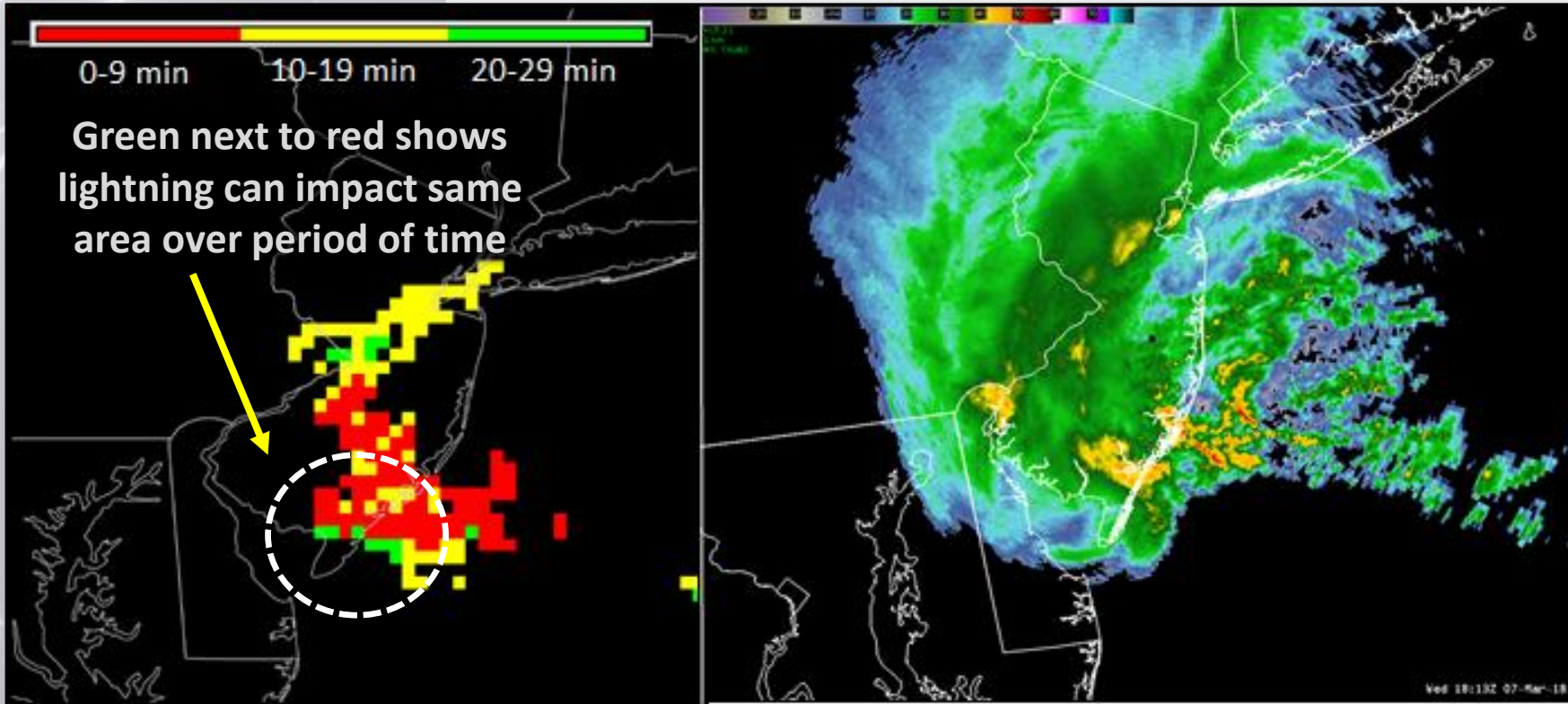
- Identify spatial extent of lightning
 - Can extend well into the stratiform region
 - Signify possible updates to convective SIGMETs?
- Monitor convective updrafts
 - Train in regions with radar to earn trust
 - Use GLM alone in data sparse regions
 - Identify convective / non-convective
 - Monitor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

Lightning Safety

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

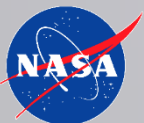


GLM Capabilities: The “stoplight” product

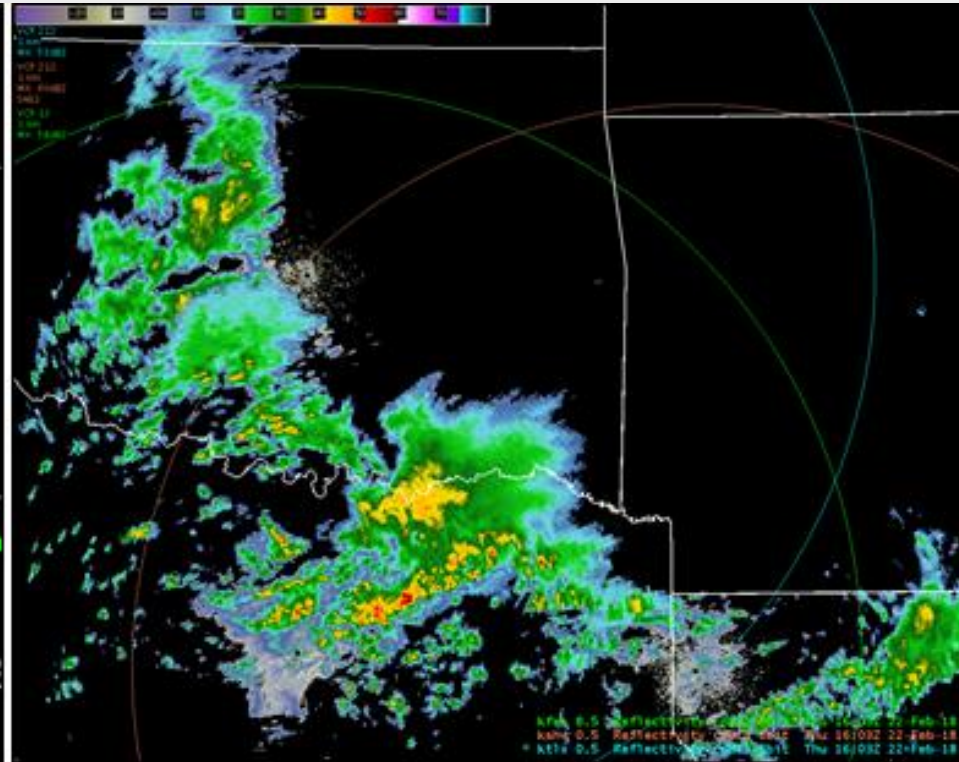
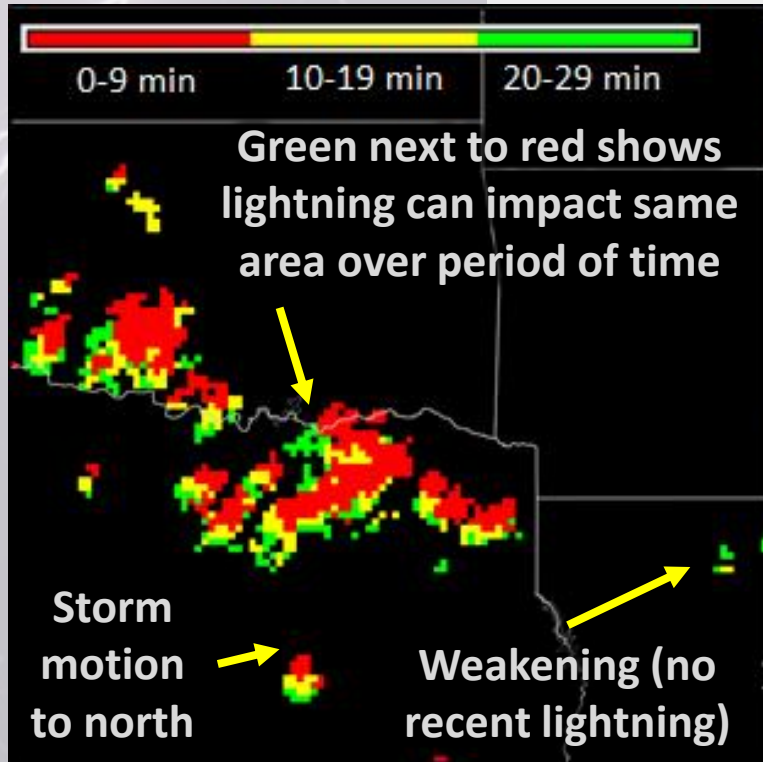


Example of the GLM stoplight product (left) with radar reflectivity covering 30 minutes from 1743-1813 UTC on 7 March 2018.

- 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)

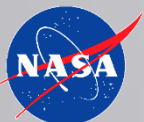


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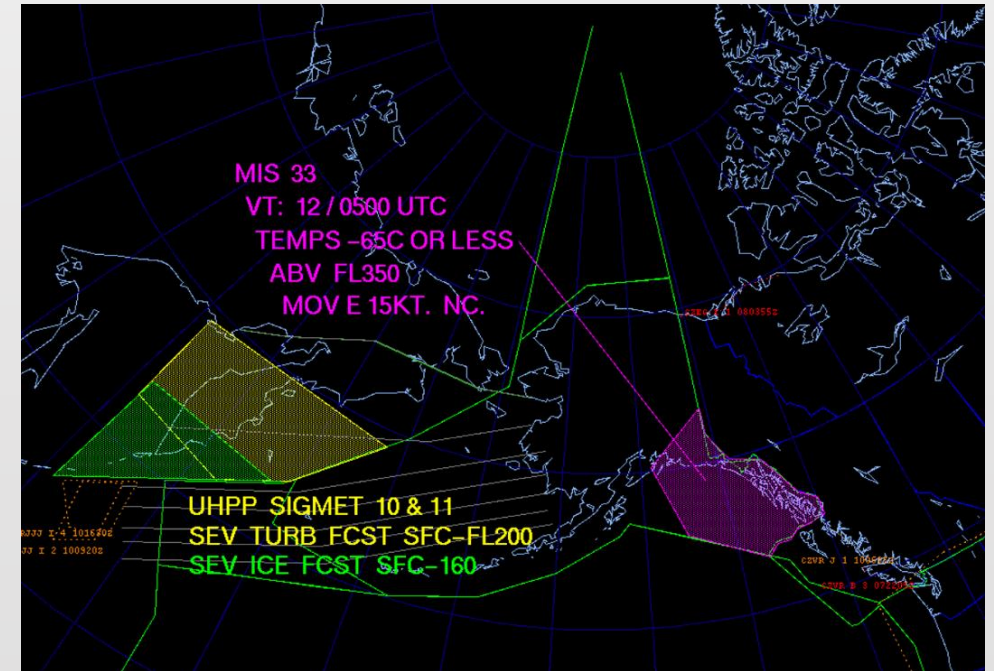
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Cold Air Aloft Aviation Hazard

- 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
```

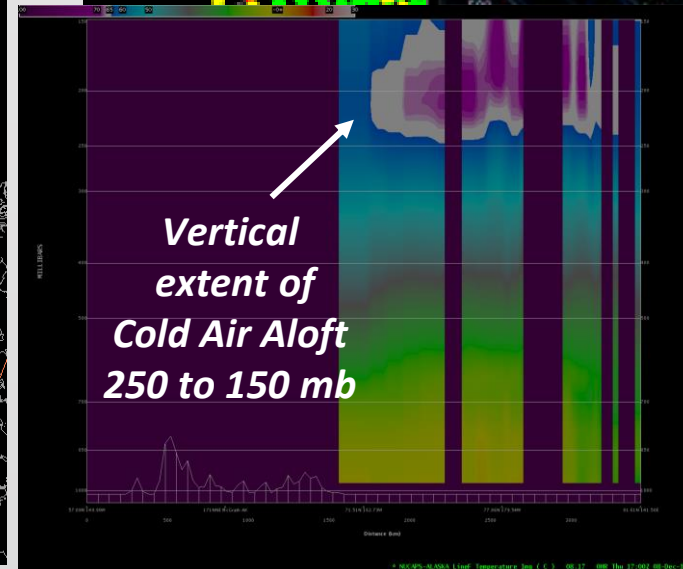
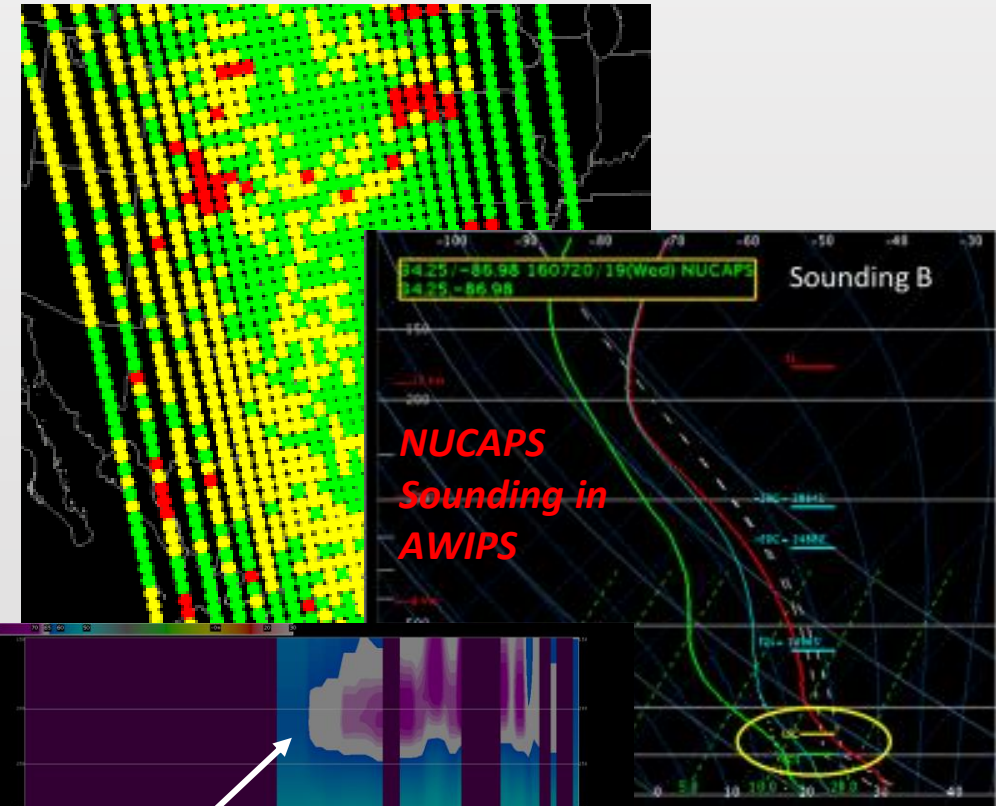
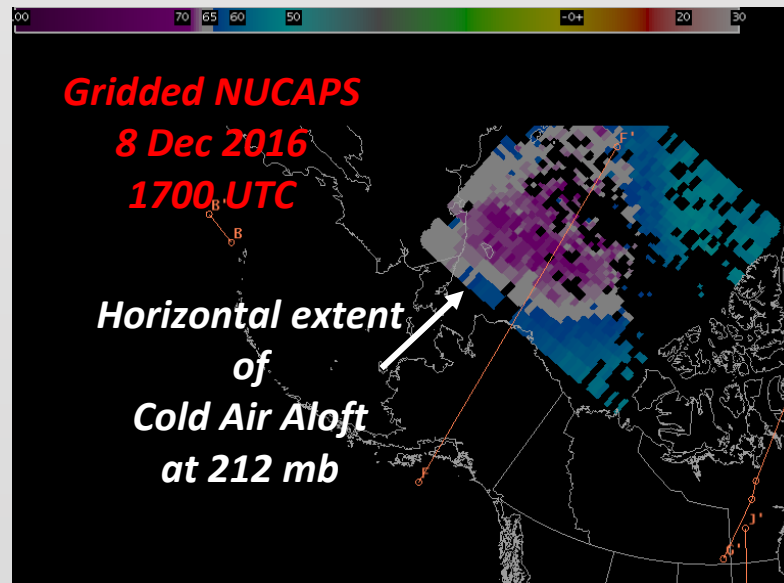
Lat/Lon Extent of Cold Air from soundings, aircraft reports, model

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

Motion determined from model data

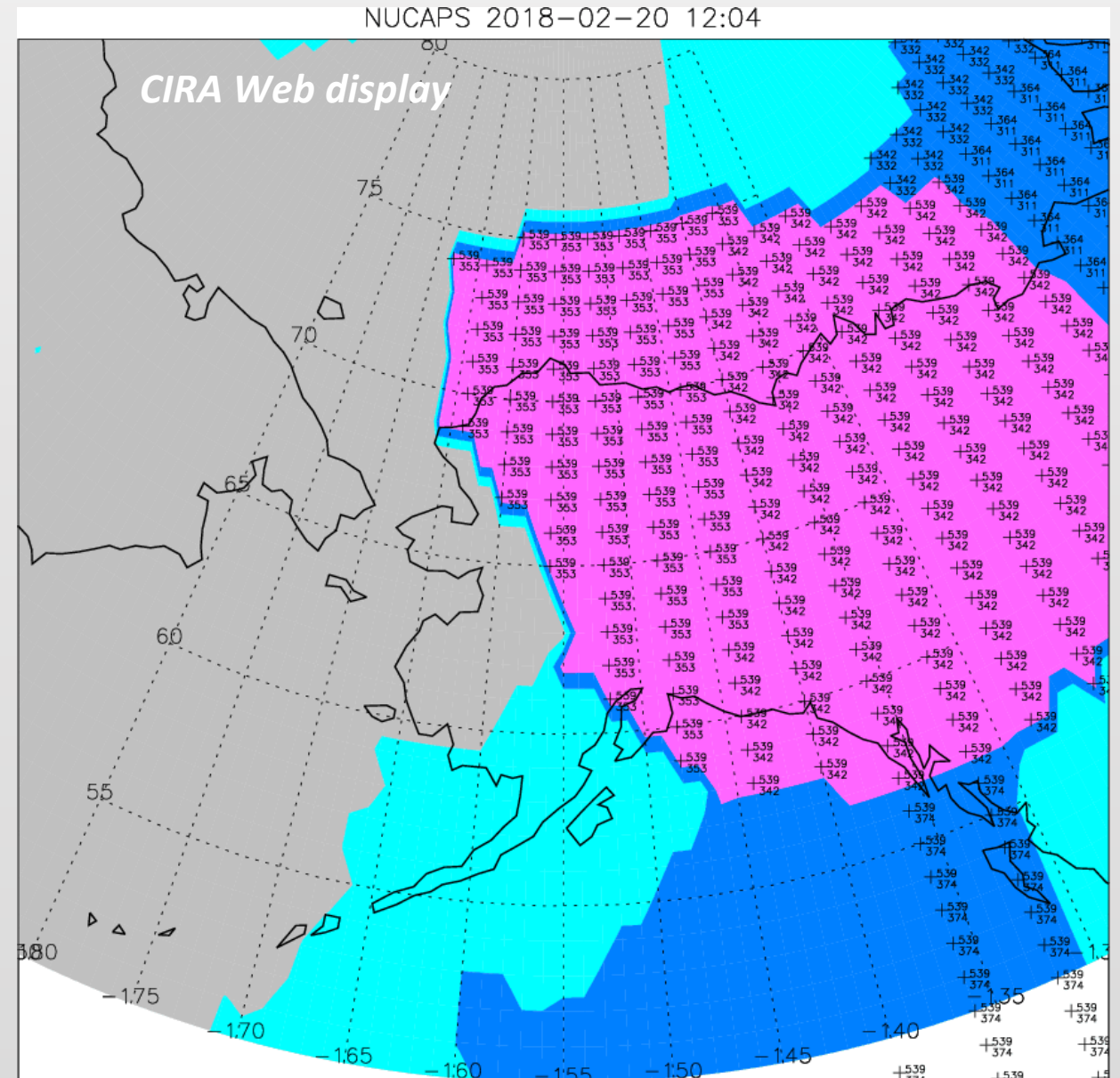
Satellite Soundings

- 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

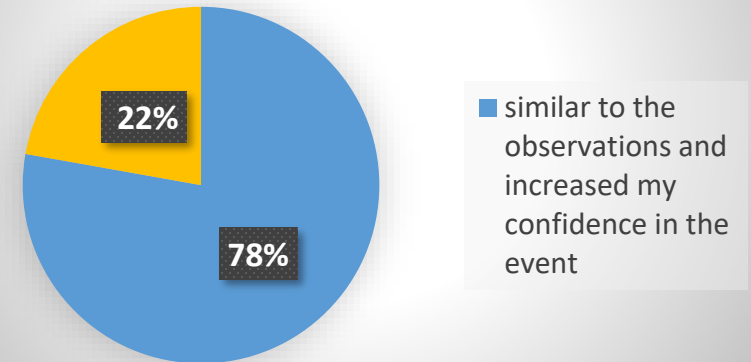
- CIRA developed the first display concept:
 - Displays CAA heights in units of flight level (hundreds of feet)
 - Polar-orbiting satellite data and Global Forecast System model output available for comparison
 - Includes microwave-only data
- Website used by forecasters as a backup when AWIPS data feed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



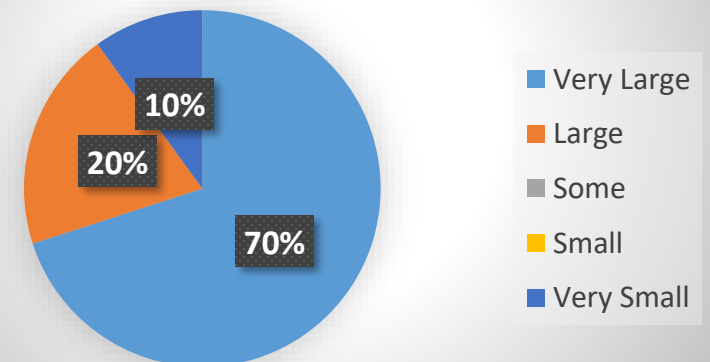
2018 Winter Assessment with the CWSU

- 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

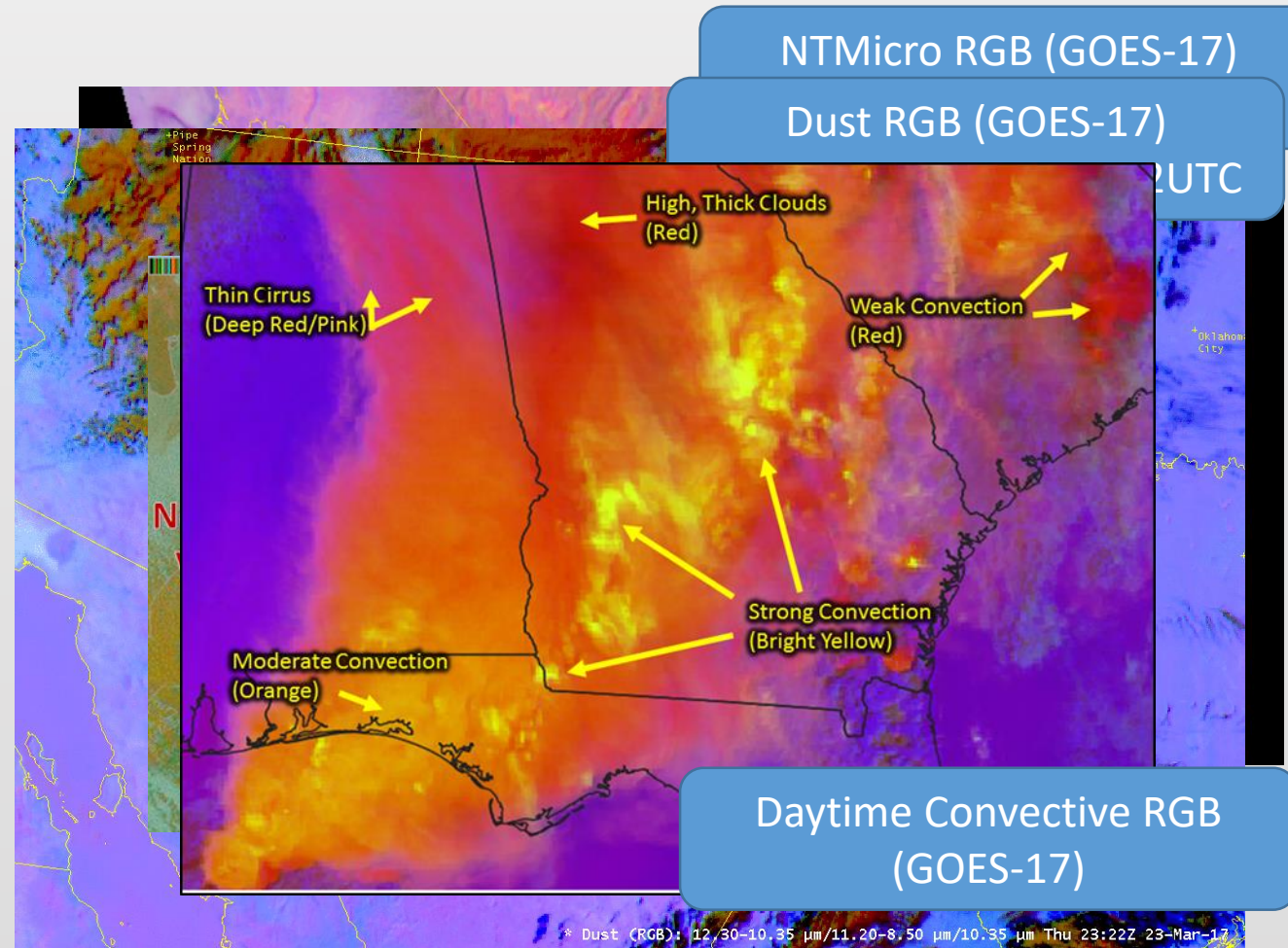


CAA Summary

- 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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