NASA SPoRT Overview

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Aviation Weather Research Review and Satellite Technical Exchange Meeting

Boulder, CO

10 June 2018

SPORT
Short-term Prediction Research and Transition Center

Outline

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

Short-term Prediction Research and Transition Center

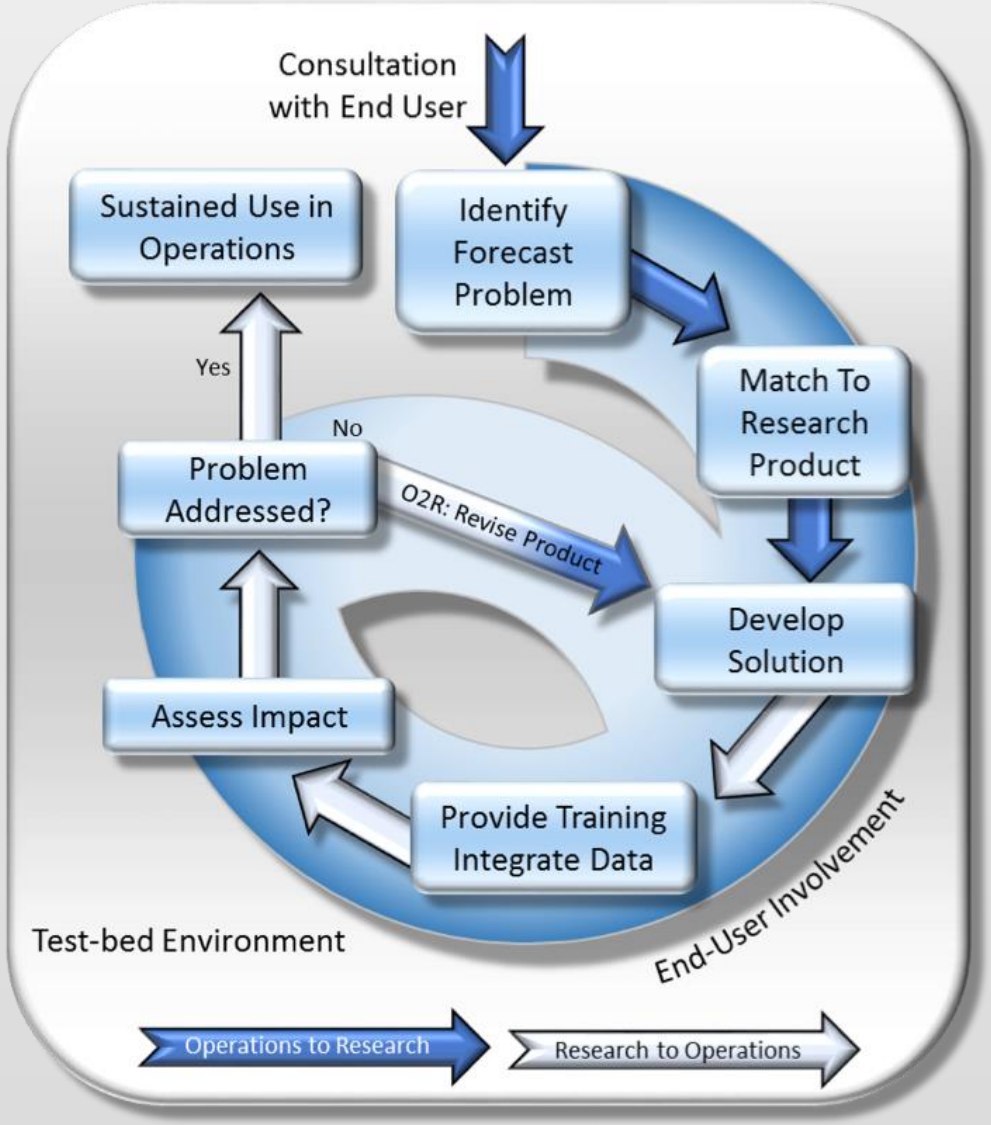
SPoRT Mission

Mission: Transition unique NASA and NOAA observations and research capabilities to the operational weather community to improve short-term weather forecasts on a regional and local scale

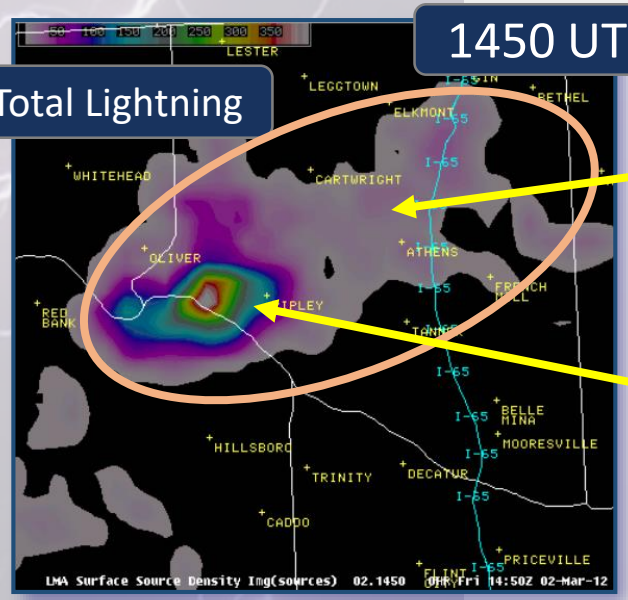
Bridge the "Valley of Death" through interactive partnership with end users and product or algorithm developers

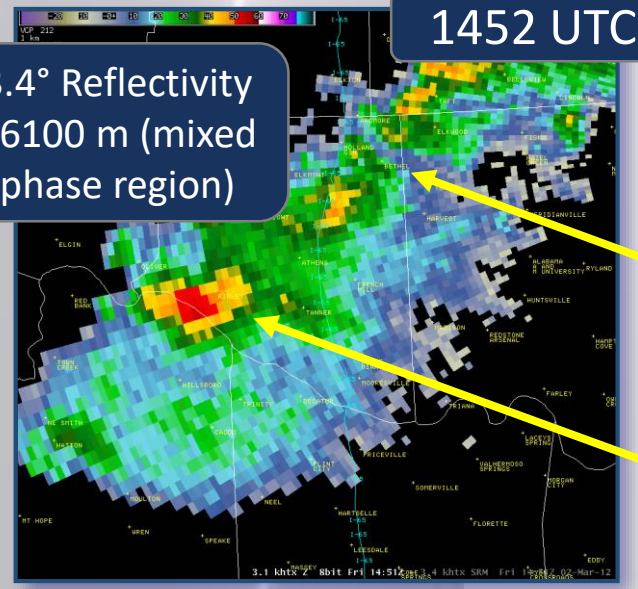
Concept has been used to successfully transition more than 40 satellite datasets to operational users for nearly 15 years

Other groups in the community have adopted this Research to Operations/Operations to Research paradigm



Total Lightning





- Total lighting = 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?

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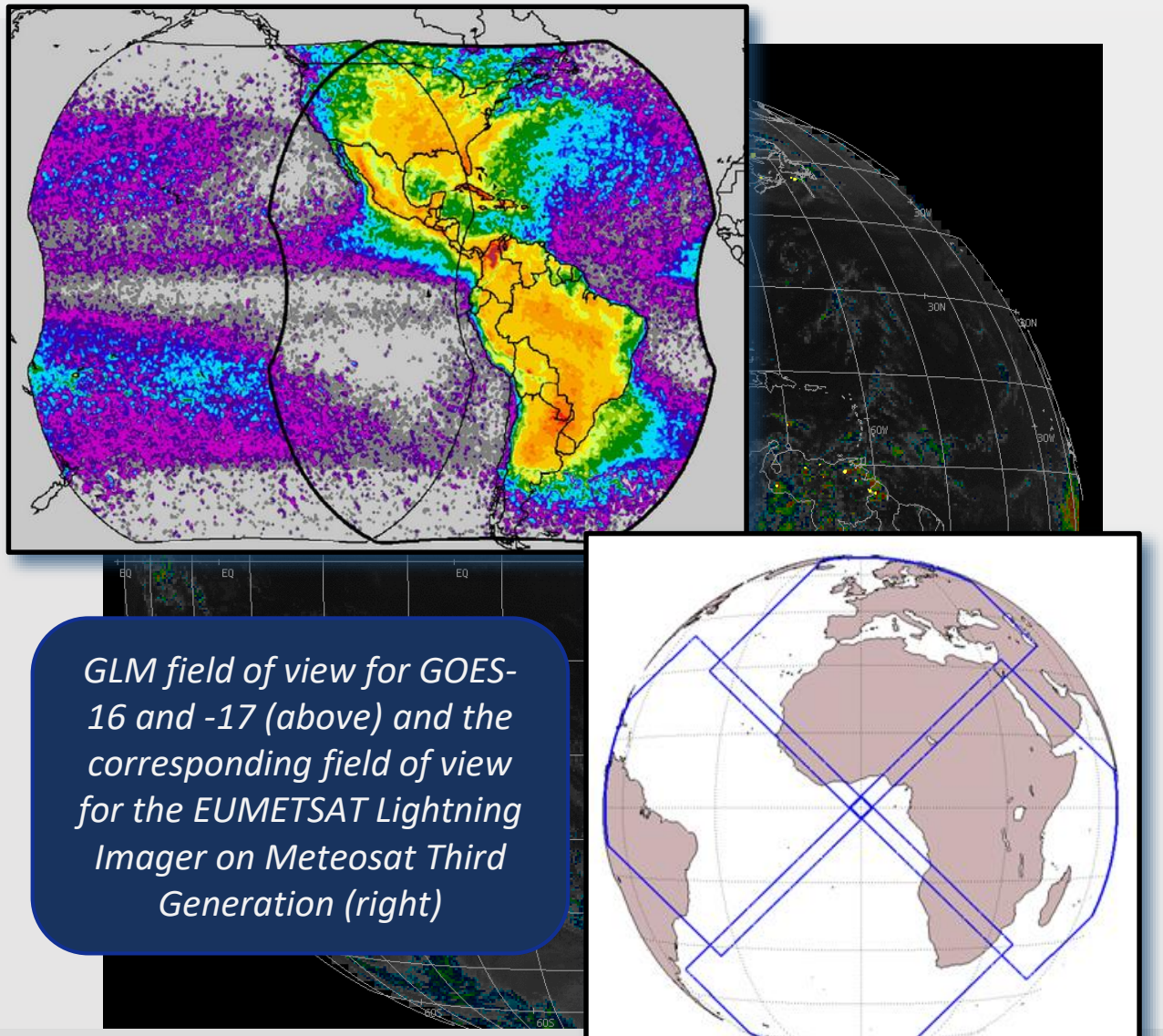
Geostationary Lightning Mapper (GLM)

- 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)

13 June 2017 from 1719-1819 UTC (P

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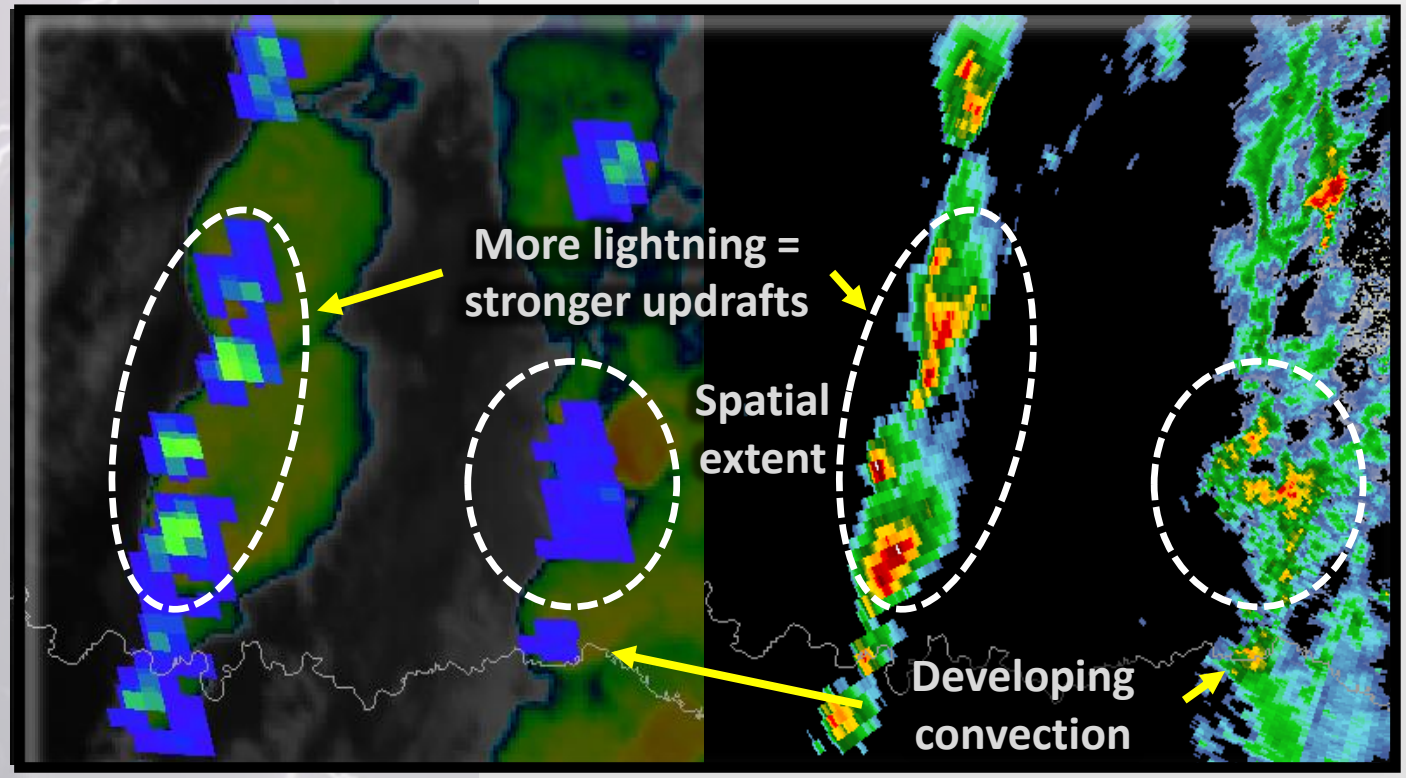
GLM Capabilities: Monitor Convection



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

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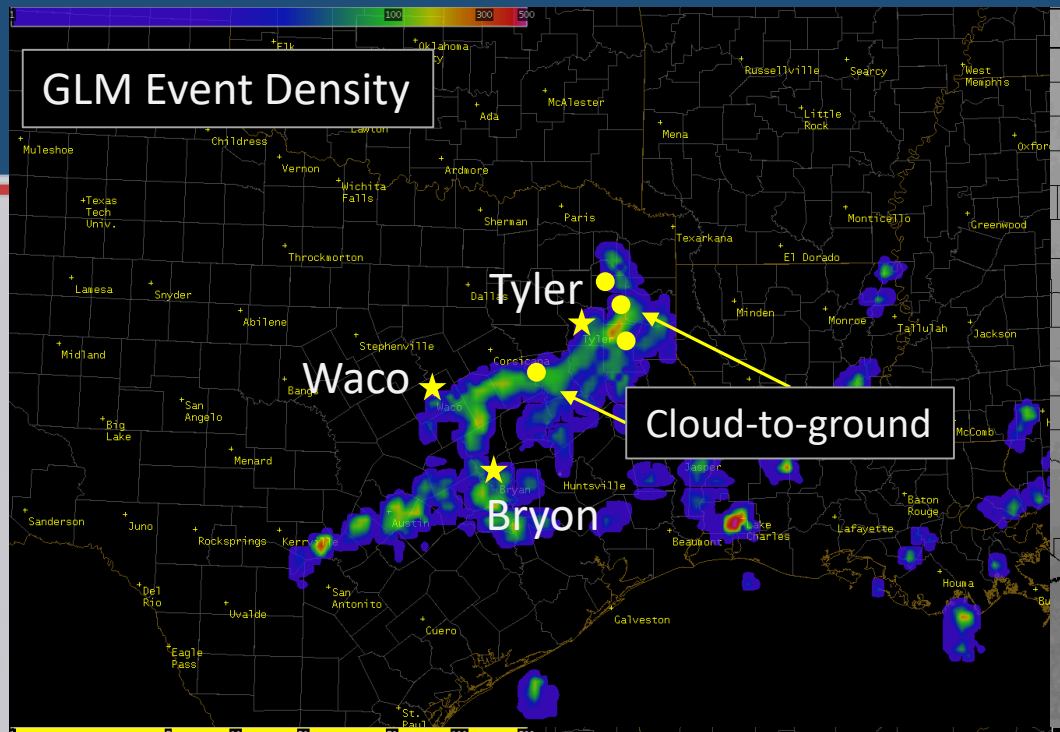
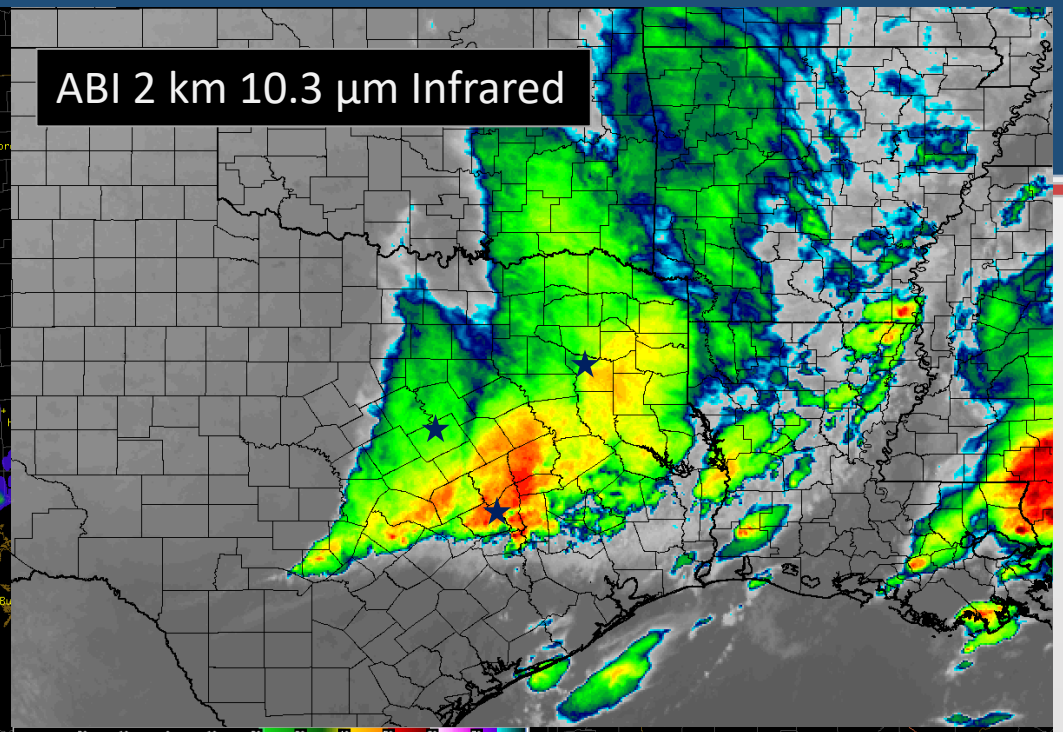
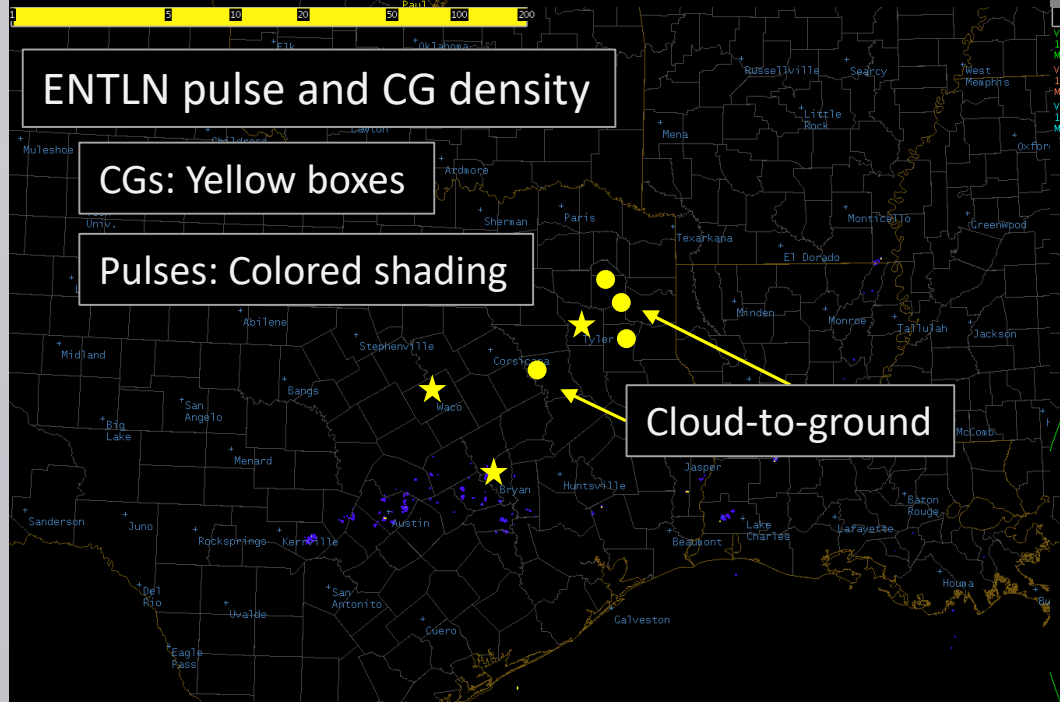
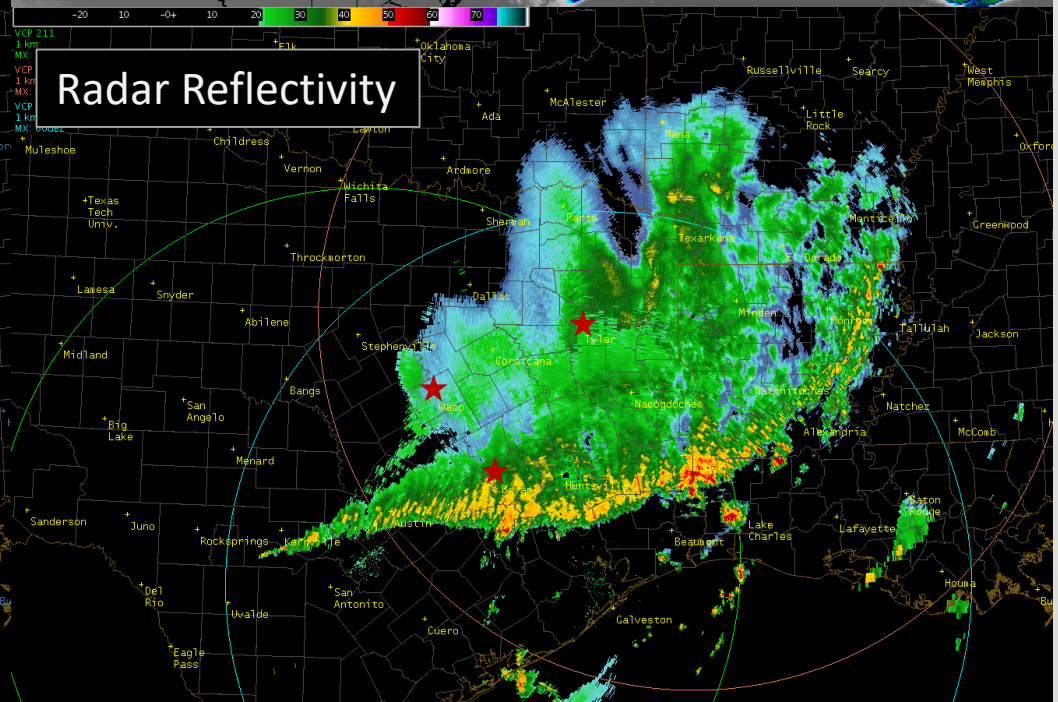
Lightning Safety

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

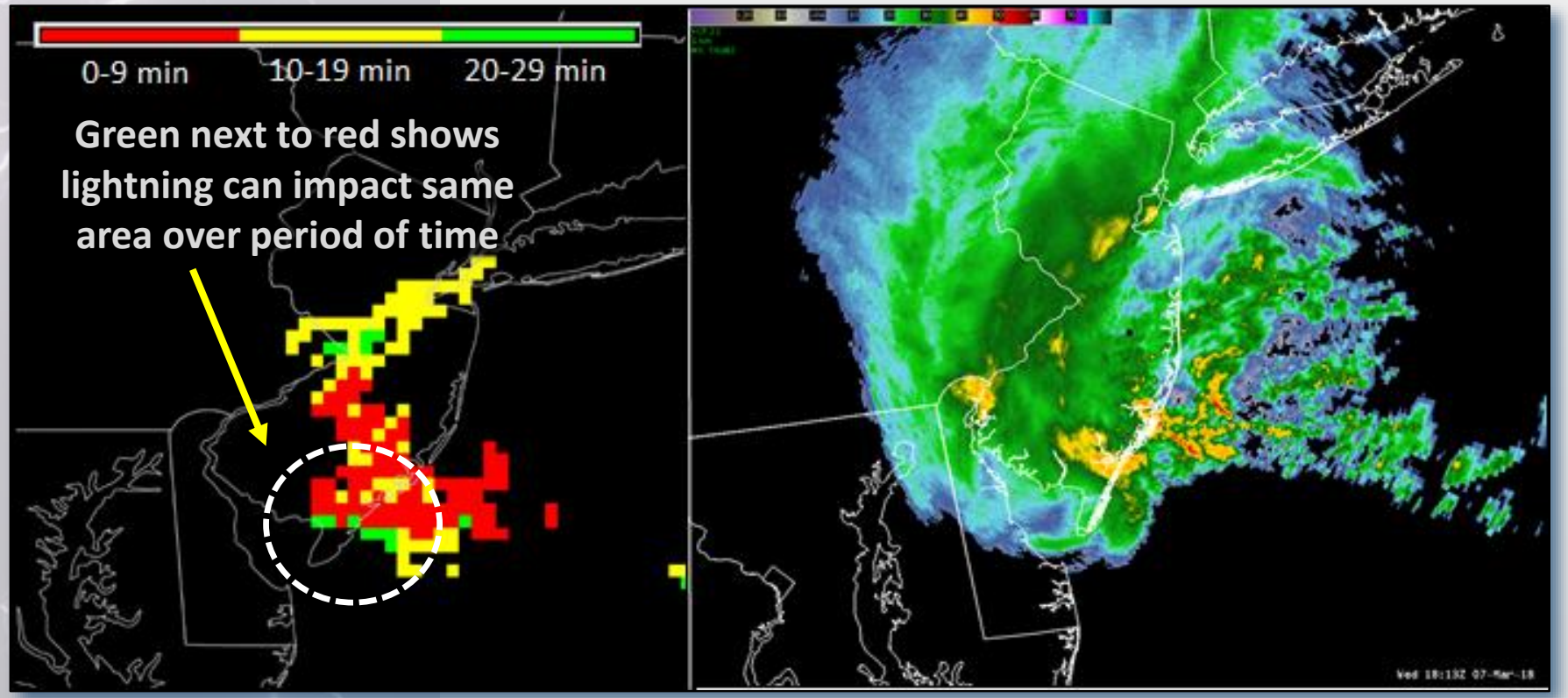








GLM Capabilities: The "stoplight" product



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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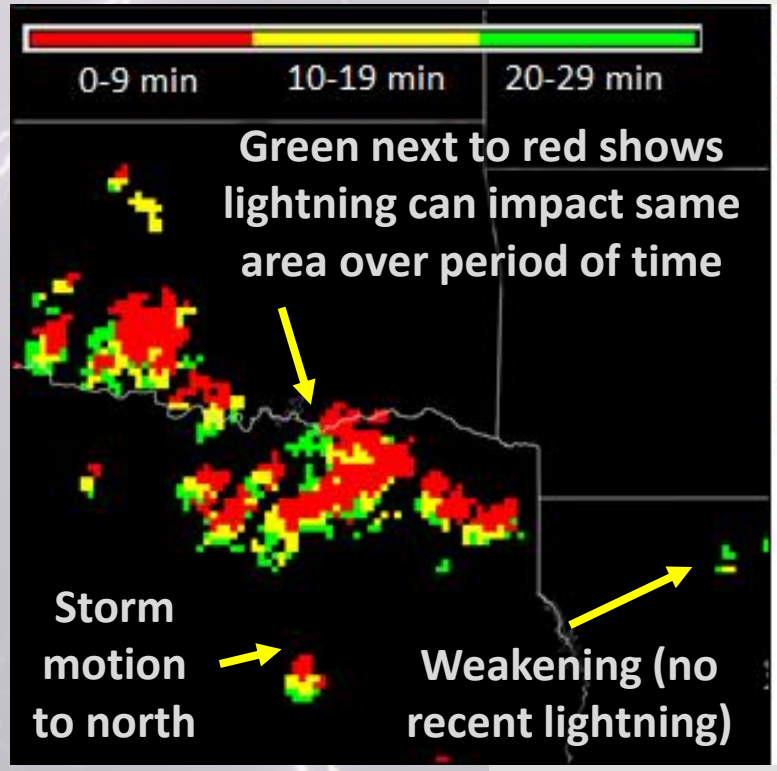

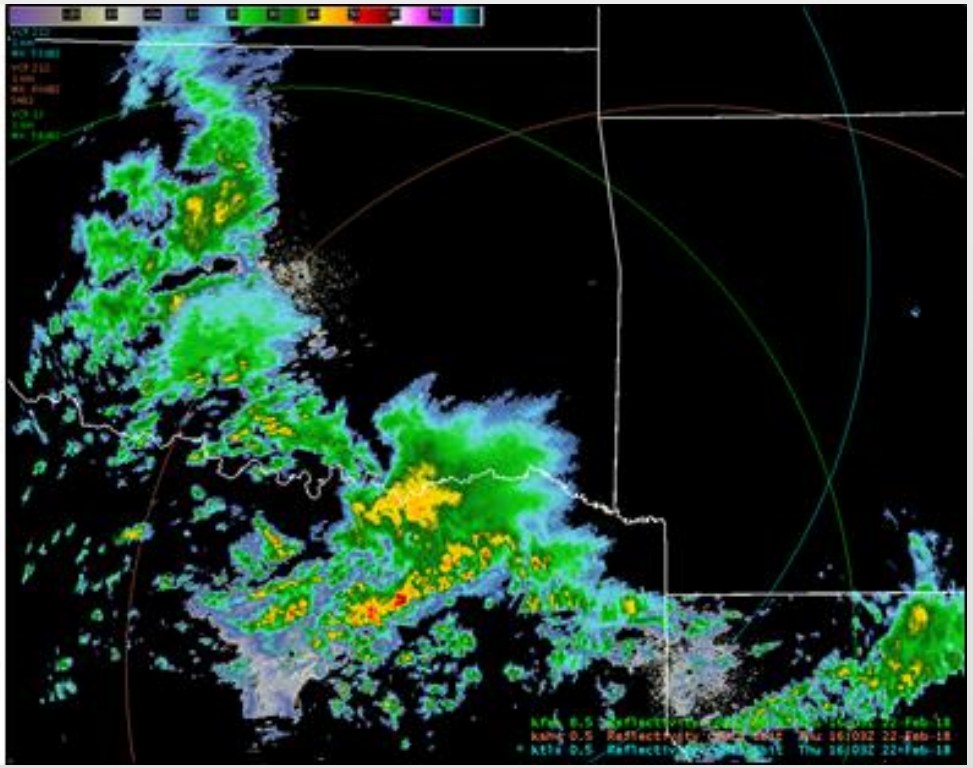

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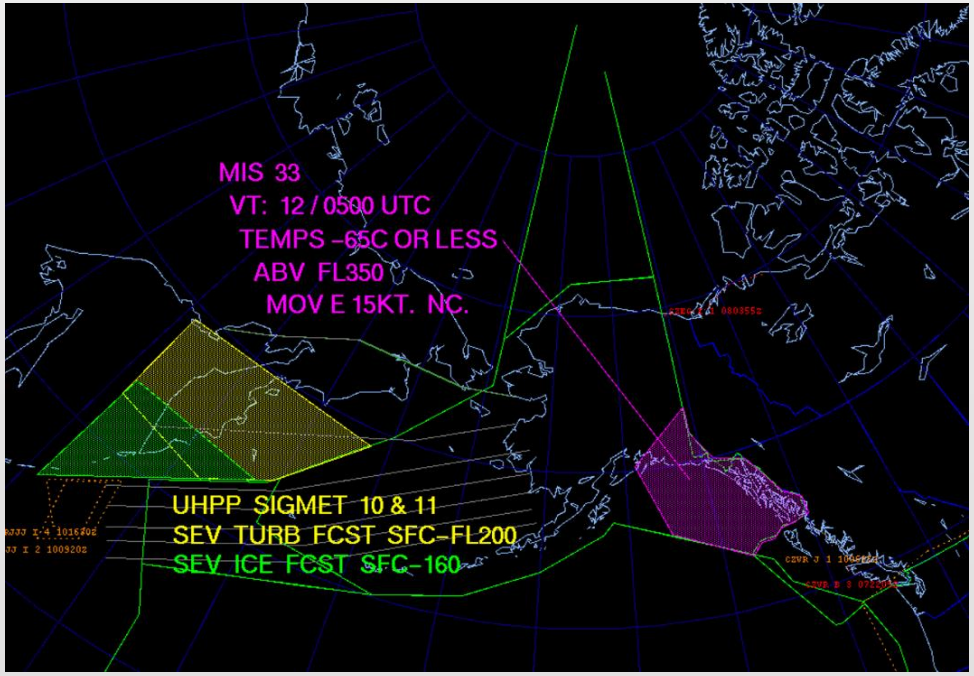
Cold Air Aloft Aviation Hazard

- Pockets of CAA (Temperature ≤ -65°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
```

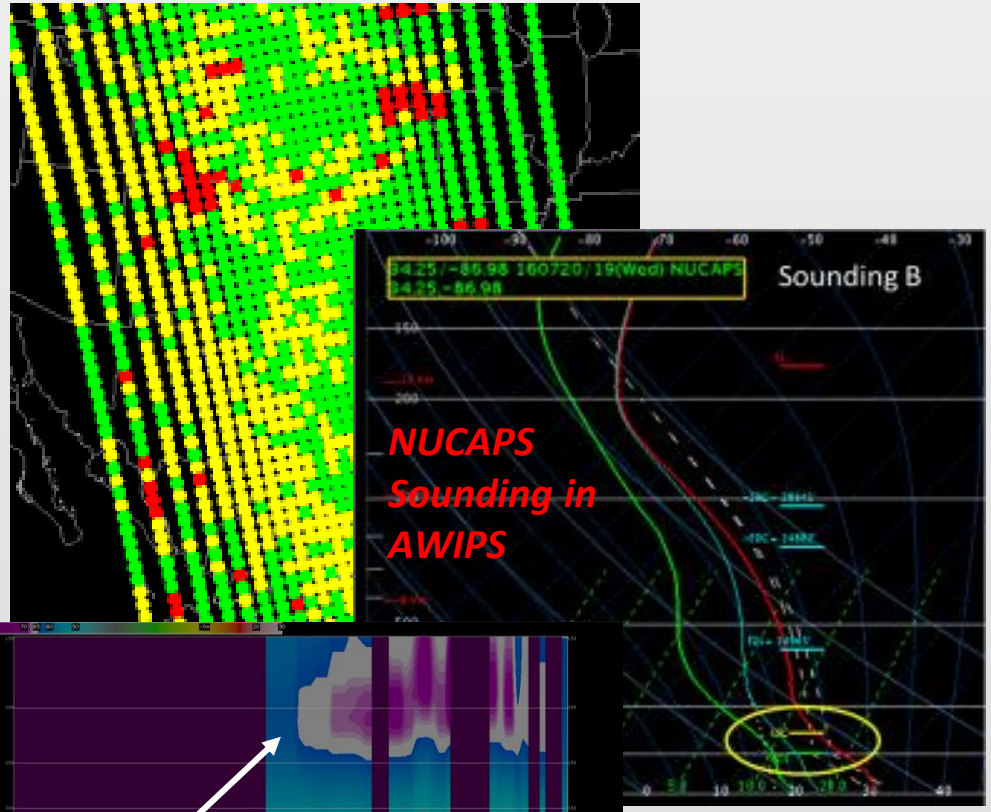
Lat/Lon Extent of Cold Air from soundings, aircraft reports, model

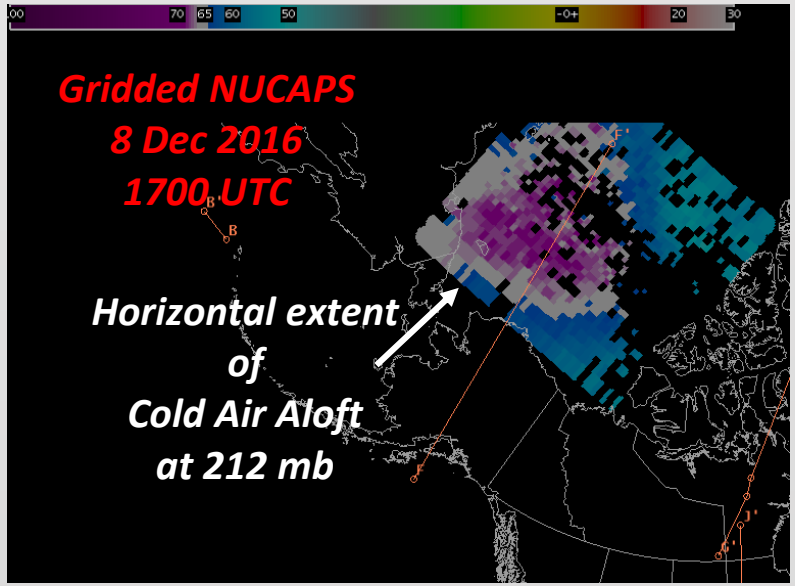
Vertical Extent of Cold Air from soundings/aircraft reports/model

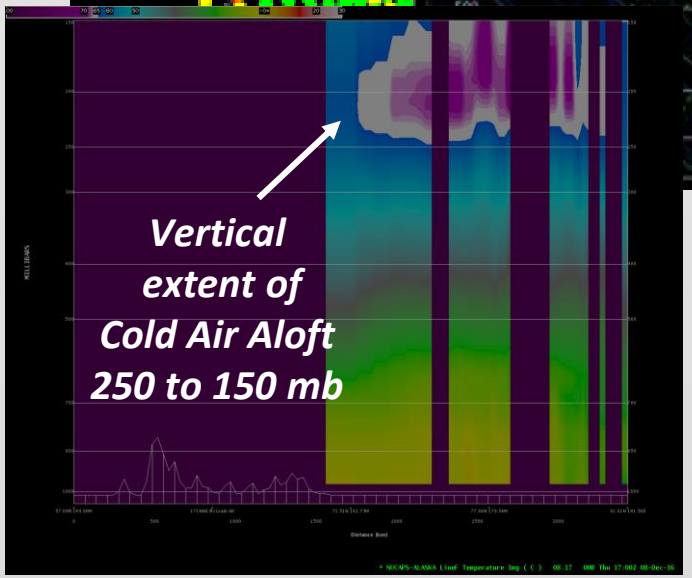
Motion determined from model data

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)

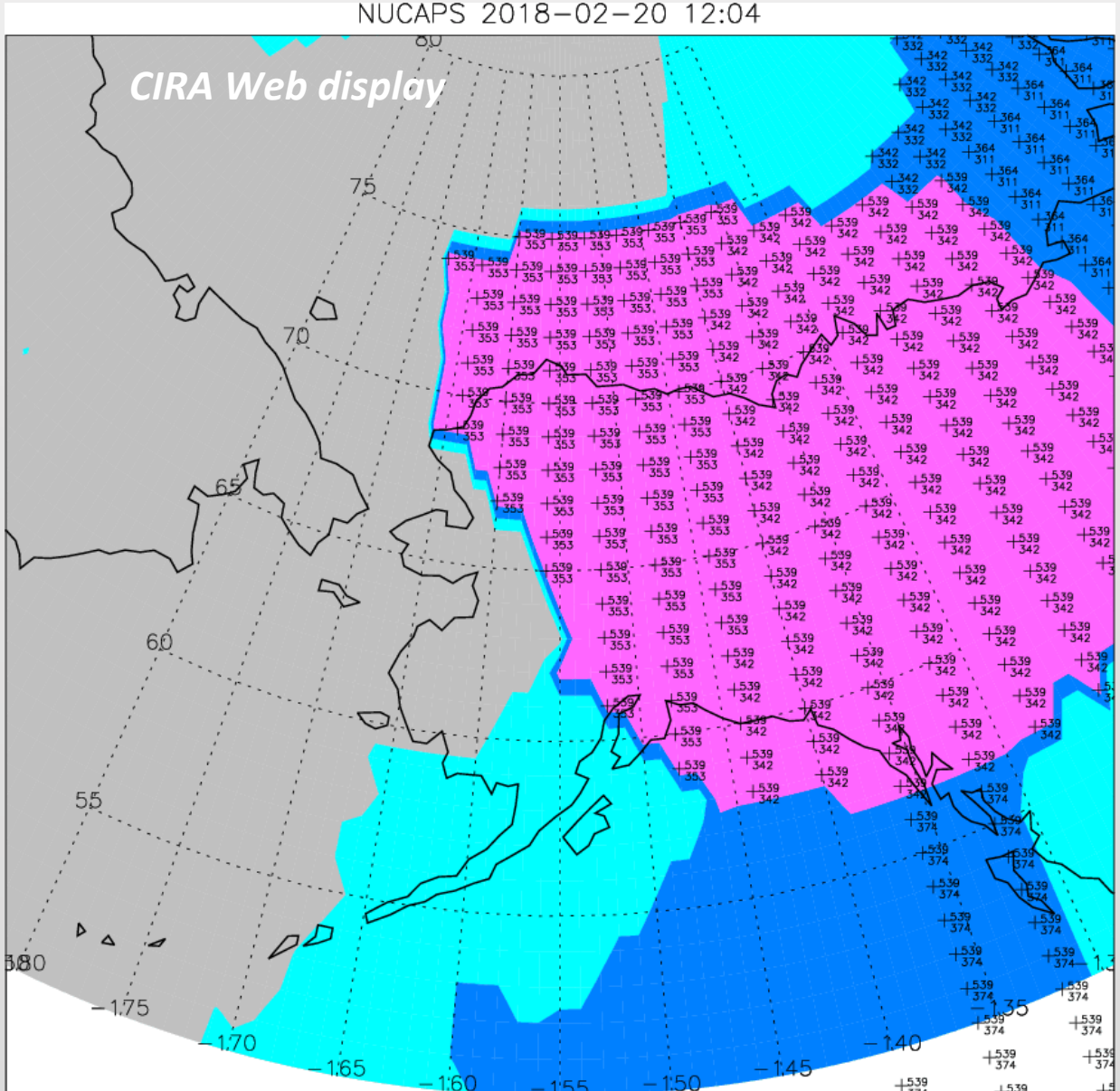






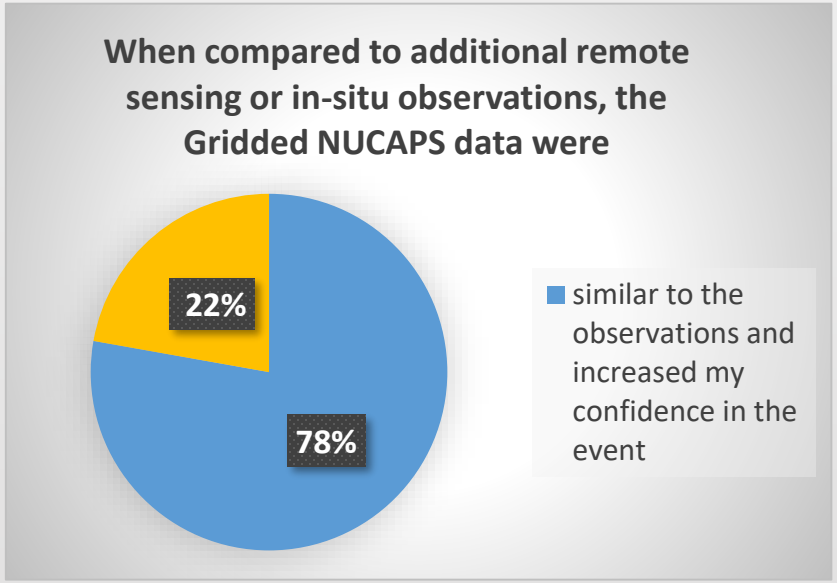
Product Displays

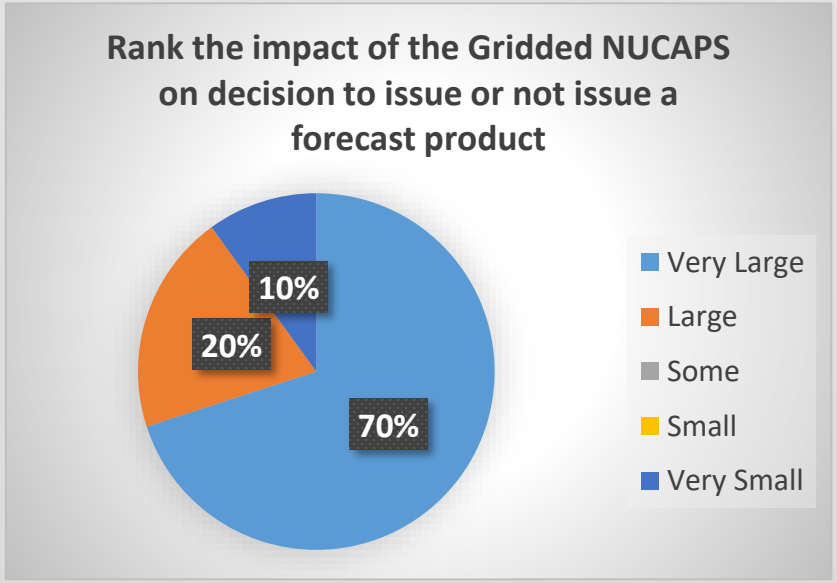
- CIRA developed the first display concept:
  - Displays CAA heights in units of flight level (hundreds of feet)
  - Polar-orbiting satellite data and Global Forecast System model output available for comparison
  - Includes microwave-only data
- Website used by forecasters as a backup when AWIPS data 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***



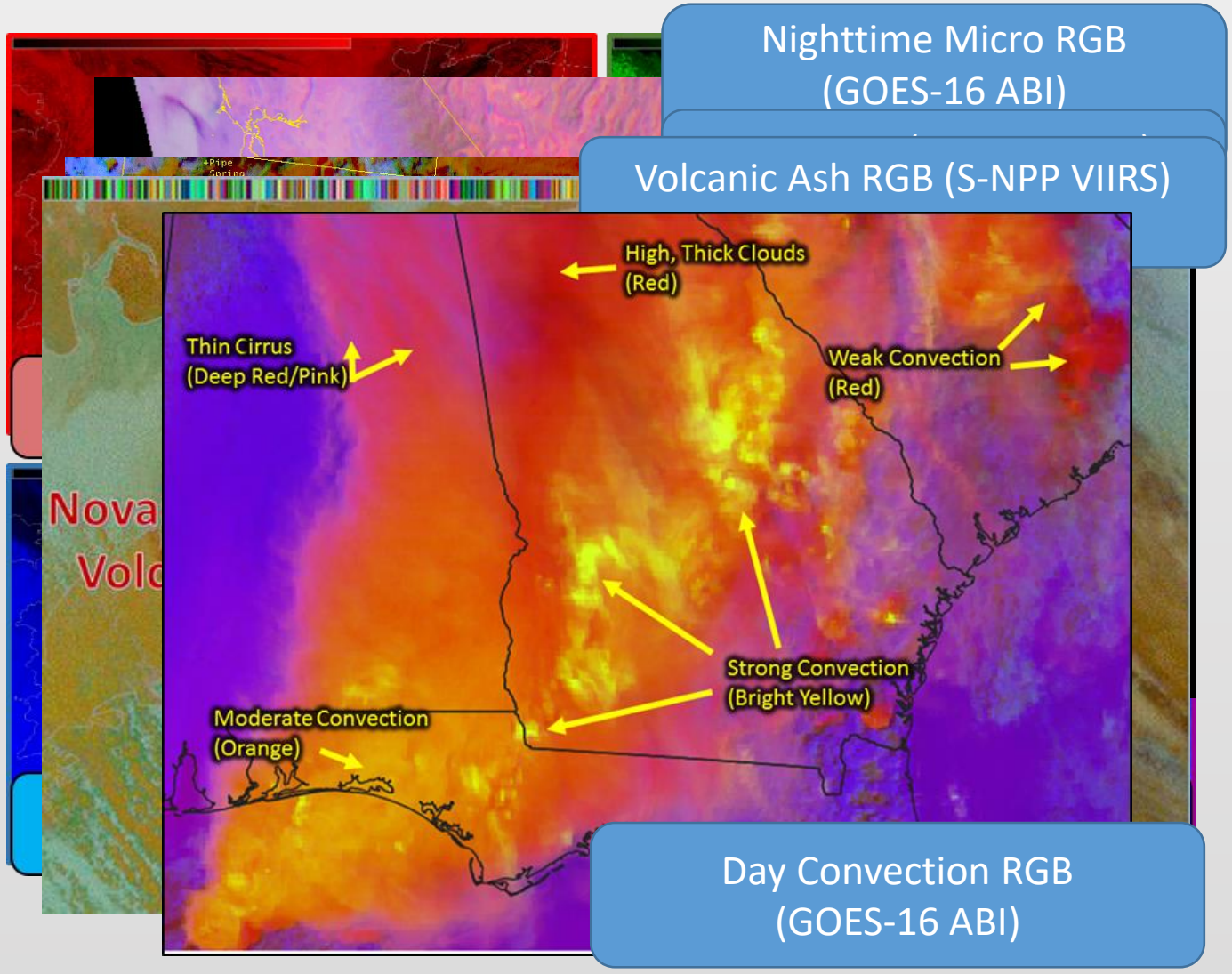


Cold Air Aloft Hazard Summary

- 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 Composites

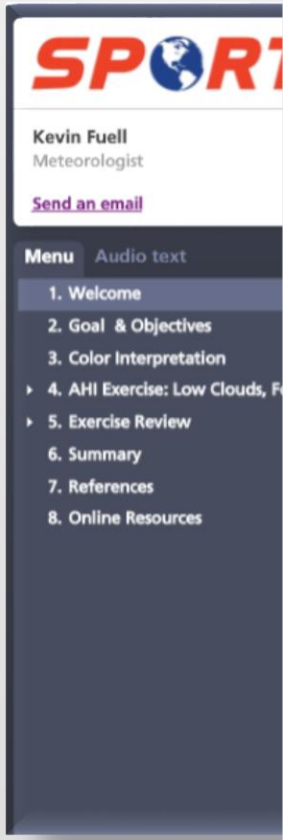
- Multispectral Composites combine several channels into one image to enable fast observation of features/hazards
- SPoRT has a history of providing MODIS, VIIRS, AVHRR, and AHI Multispectral Composites to NWS National Centers, WFOs, AAWUs, and CWSUs to prepare for GOES-R and JPSS capabilities
- SPoRT is part of the collaboration to baseline GOES-16/17 Multispectral Composites in AWIPS
- Key Multispectral Composites for Aviation hazards:
  - Day-time/Night-time Microphysics
  - Dust
  - Volcanic Ash
  - Day Convection
  - Day Cloud Phase

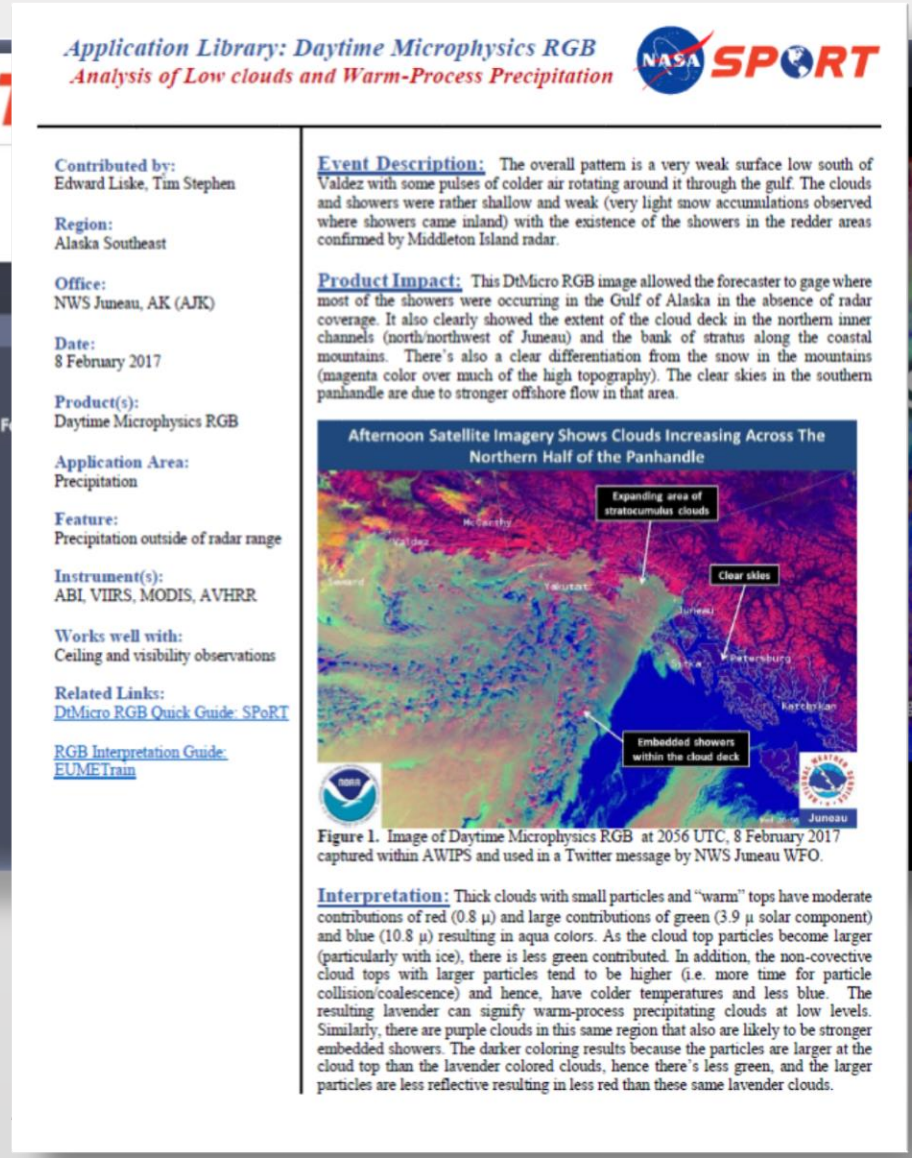


(Imagery available on SPoRT web page and Web-Mapping Server)

Multispectral Composites

- Targeted, applications based-training with a peer-to-peer emphasis
- Types of training
  - Modules
  - Micro-lessons
  - Quick Guides
  - Interactive Quick Guides
  - Applications Library
- Applications Library
  - Short examples developed in collaboration with forecasters
  - Emphasis on regionally relevant, operational examples
  - Viewable on SPoRT webpage or within AIR Tool in AWIPS





Application Library: Daytime Microphysics RGB
Analysis of Low clouds and Warm-Process Precipitation

NASA SPORT

Contributed by:
Edward Liske, Tim Stephen

Region:
Alaska Southeast

Office:
NWS Juneau, AK (AJK)

Date:
8 February 2017

Product(s):
Daytime Microphysics RGB

Application Area:
Precipitation

Feature:
Precipitation outside of radar range

Instrument(s):
ABI, VIIRS, MODIS, AVHRR

Works well with:
Ceiling and visibility observations

Related Links:
DtMicro RGB Quick Guide: SPoRT

RGB Interpretation Guide: EUMETrain

Event Description: The overall pattern is a very weak surface low south of Valdez with some pulses of colder air rotating around it through the gulf. The clouds and showers were rather shallow and weak (very light snow accumulations observed where showers came inland) with the existence of the showers in the redder areas confirmed by Middleton Island radar.

Product Impact: This DtMicro RGB image allowed the forecaster to gage where most of the showers were occurring in the Gulf of Alaska in the absence of radar coverage. It also clearly showed the extent of the cloud deck in the northern inner channels (north/northwest of Juneau) and the bank of stratus along the coastal mountains. There's also a clear differentiation from the snow in the mountains (magenta color over much of the high topography). The clear skies in the southern panhandle are due to stronger offshore flow in that area.

Afternoon Satellite Imagery Shows Clouds Increasing Across The Northern Half of the Panhandle

Figure 1. Image of Daytime Microphysics RGB at 2056 UTC, 8 February 2017 captured within AWIPS and used in a Twitter message by NWS Juneau WFO.

Interpretation: Thick clouds with small particles and "warm" tops have moderate contributions of red (0.8 μ) and large contributions of green (3.9 μ solar component) and blue (10.8 μ) resulting in aqua colors. As the cloud top particles become larger (particularly with ice), there is less green contributed. In addition, the non-covective cloud tops with larger particles tend to be higher (i.e. more time for particle collision/coalescence) and hence, have colder temperatures and less blue. The resulting lavender can signify warm-process precipitating clouds at low levels. Similarly, there are purple clouds in this same region that also are likely to be stronger embedded showers. The darker coloring results because the particles are larger at the cloud top than the lavender colored clouds, hence there's less green, and the larger particles are less reflective resulting in less red than these same lavender clouds.

Conclusions

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