User Imagery from National Weather Service WFO Fairbanks

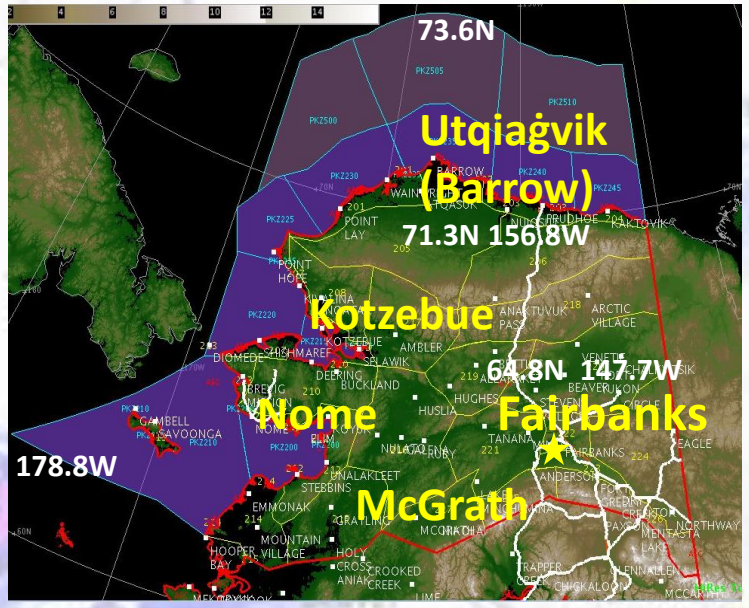
JPSS/GOES Satellite Proving Ground and Risk Reduction Summit

February 24-28, 2020

Melissa Kreller
Meteorologist In Charge
National Weather Service
Fairbanks Weather Forecast Office

Overview

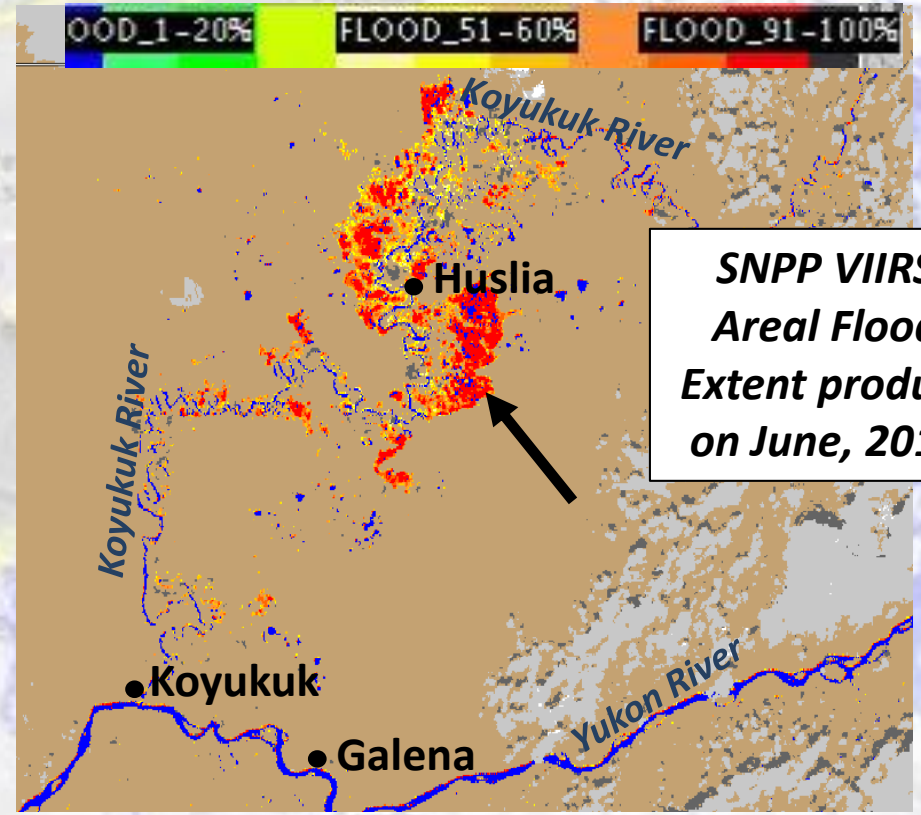
- User Perspective on Various Satellite uses:
  - River Flooding
  - Fire Weather
  - Convective Weather
  - Sea Ice
  - Winter Weather (Temperatures, Wind)
  - Aviation
  - Volcanic Ash
- Challenges



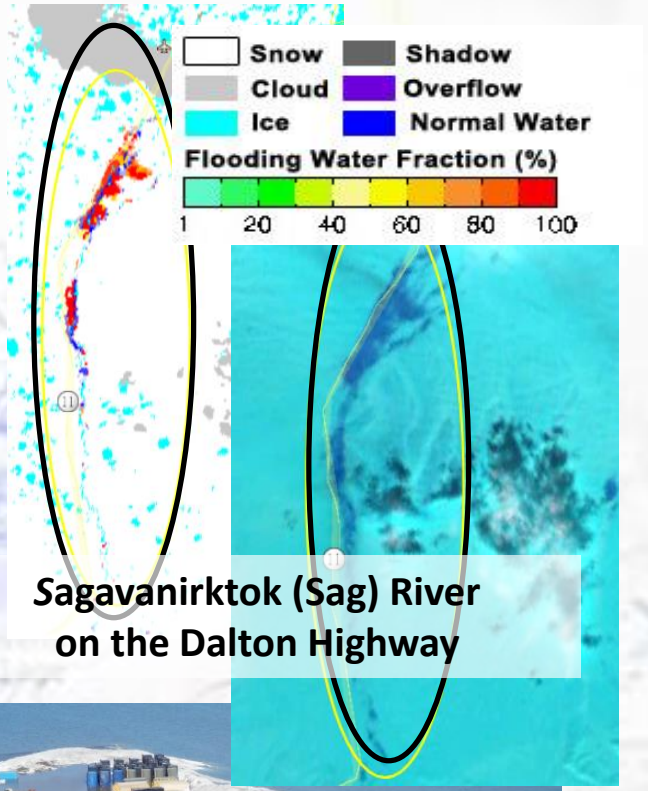
NWS Alaska Region forecast area of responsibility (AOR)

River Flooding

- **Decision Support Services (DSS) provided weekly April – June:**
  - **Yukon River Communities**
  - **Sag River (North Slope Borough EMs)**



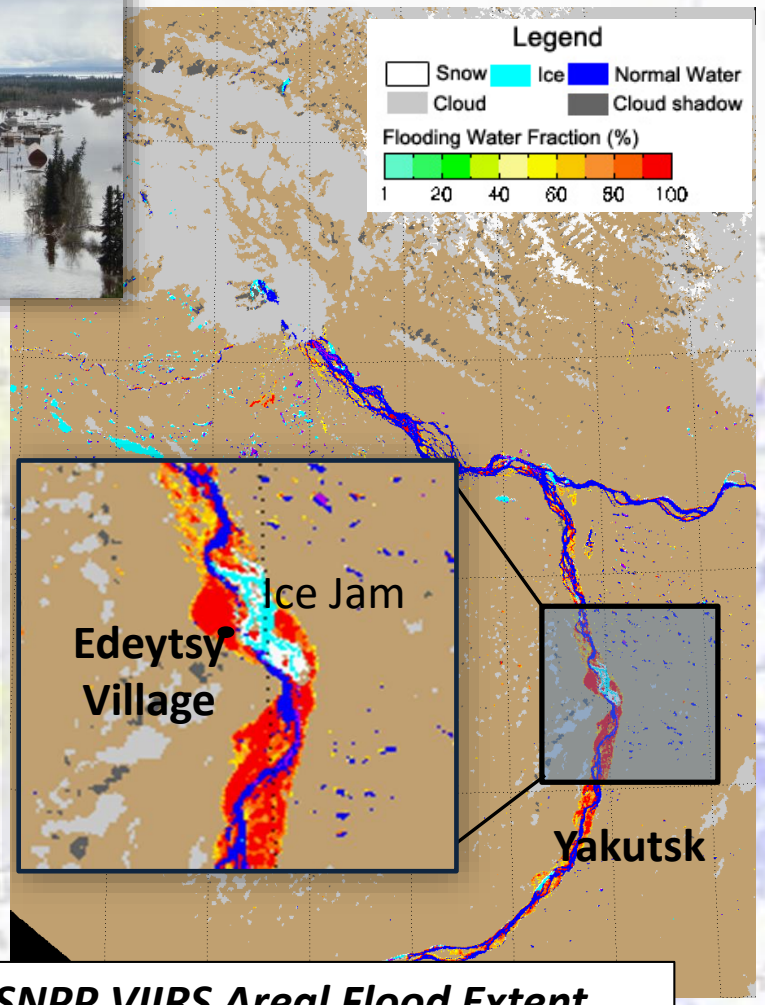
SNPP VIIRS Areal Flood Extent product on June, 2019



Sagavanirktok (Sag) River on the Dalton Highway

SNPP VIIRS River Ice and Areal Flood Extent Products on April 8, 2015 at 12:15 ADT

International Best Practices



Yakutia, Russia May 2013

US Department funded Peer to Peer Program – WCM participated

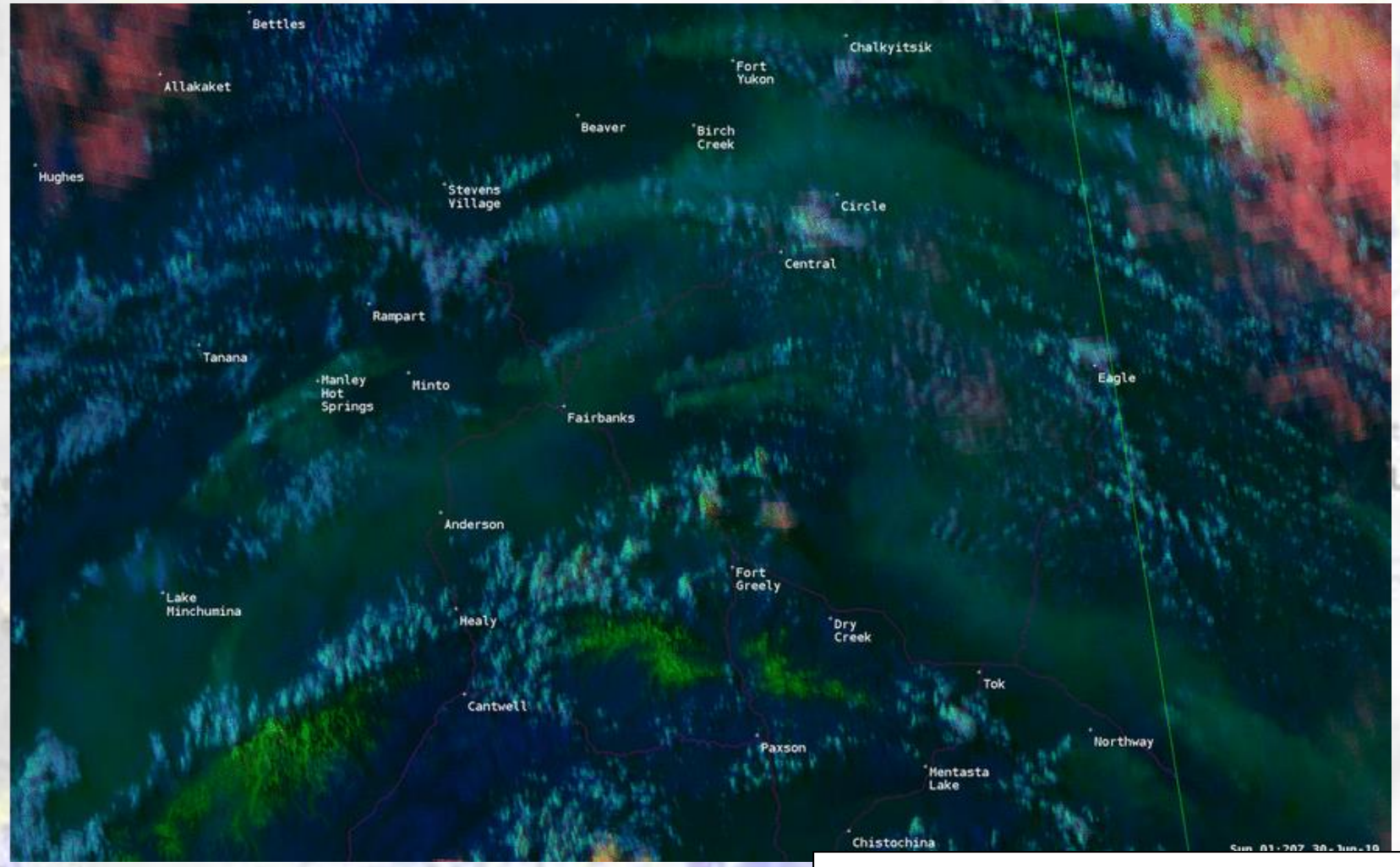
SNPP VIIRS Areal Flood Extent Product at 0134Z on May 17, 2013

Finnish Meteorological Institute (FMI) Forecaster Exchange Program January 2020

Lead Forecaster from WFO Fairbanks visited and shared best practices with Finland (Suomi)

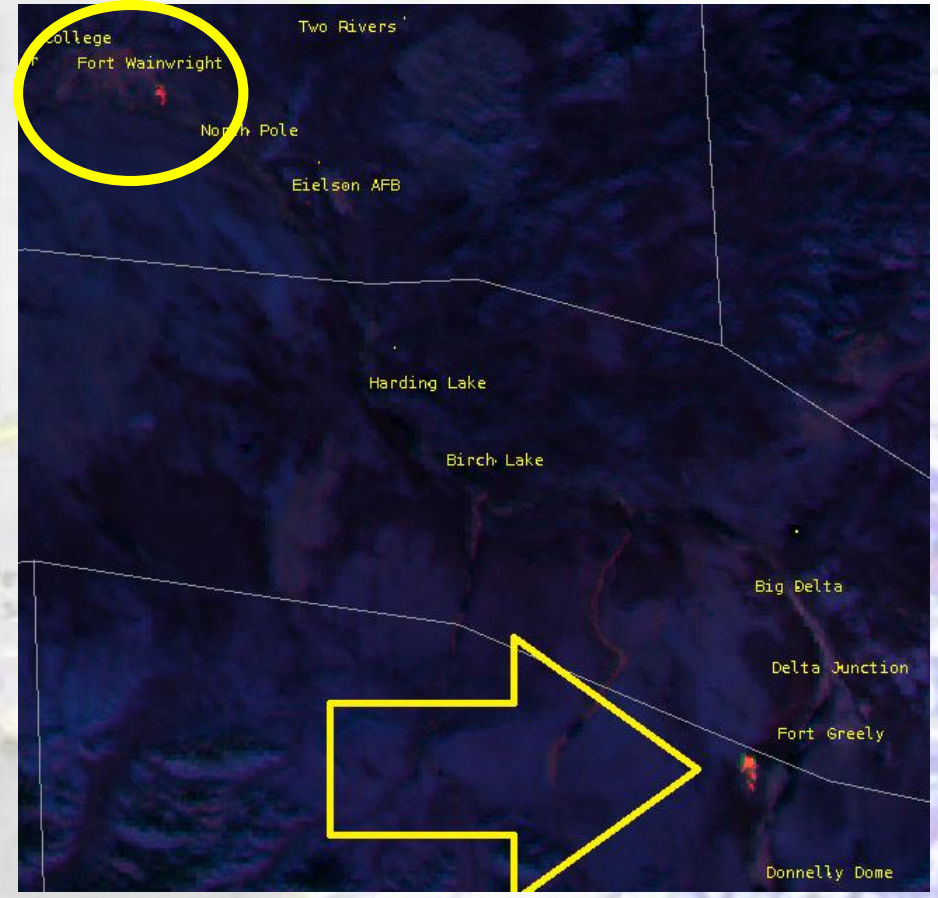
Photos courtesy Namsky District, Yakutia, Russia

Fire Weather

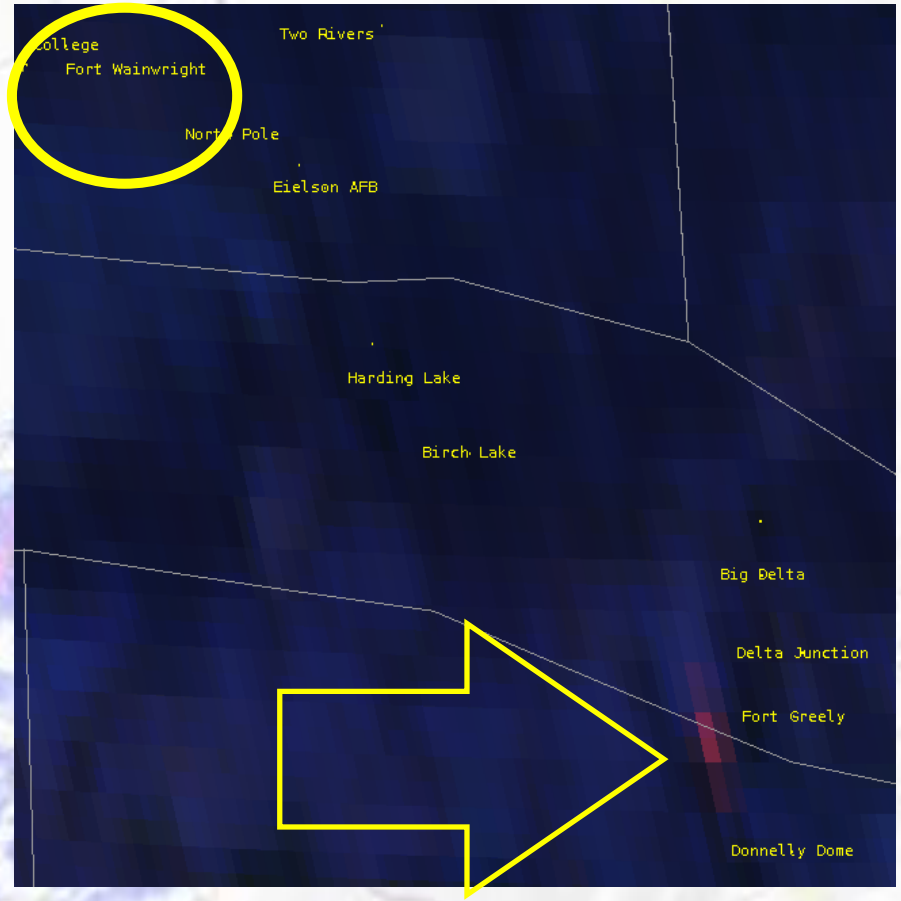


GOES 17 Day Cloud Phase Distinction RGB on June 30, 2019 at 0120z at 0105z-0120z timelapse

Fire Weather

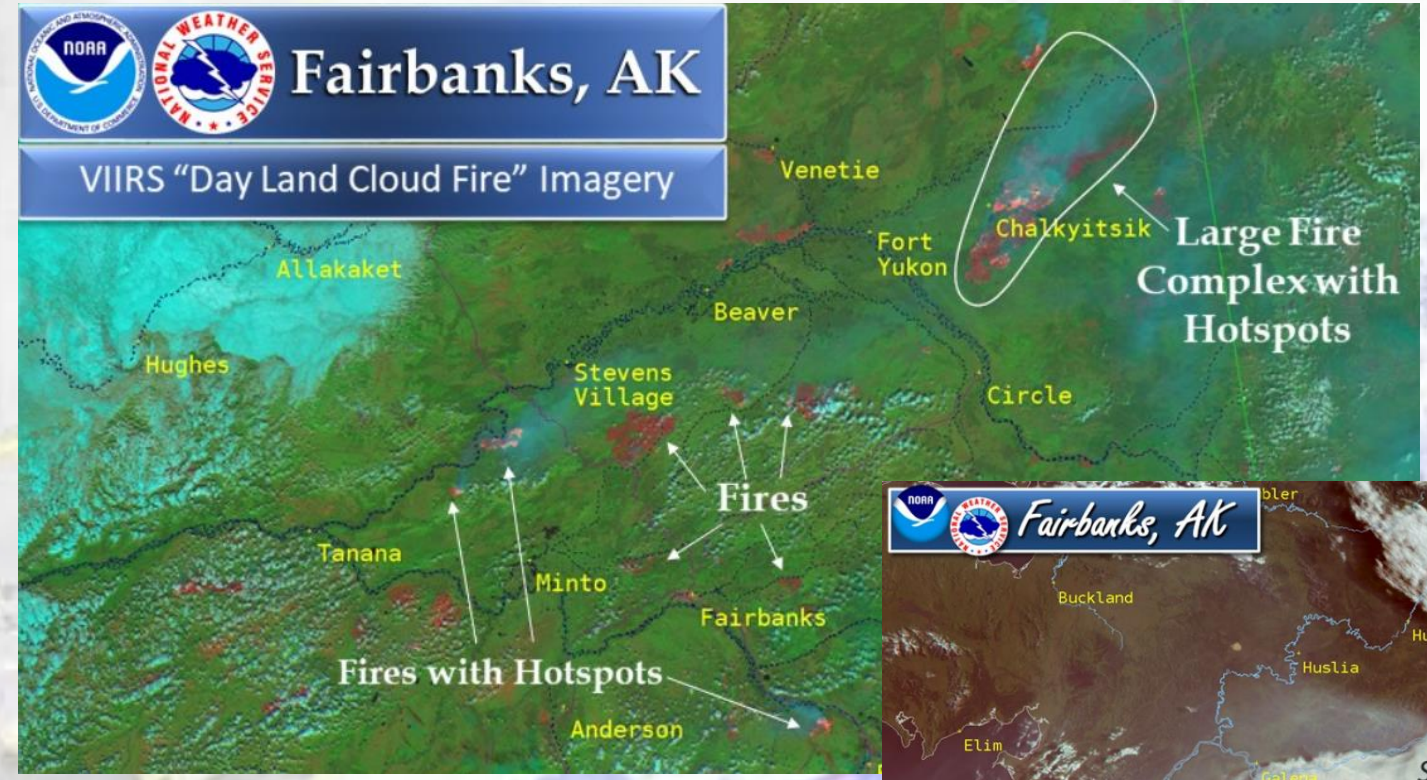


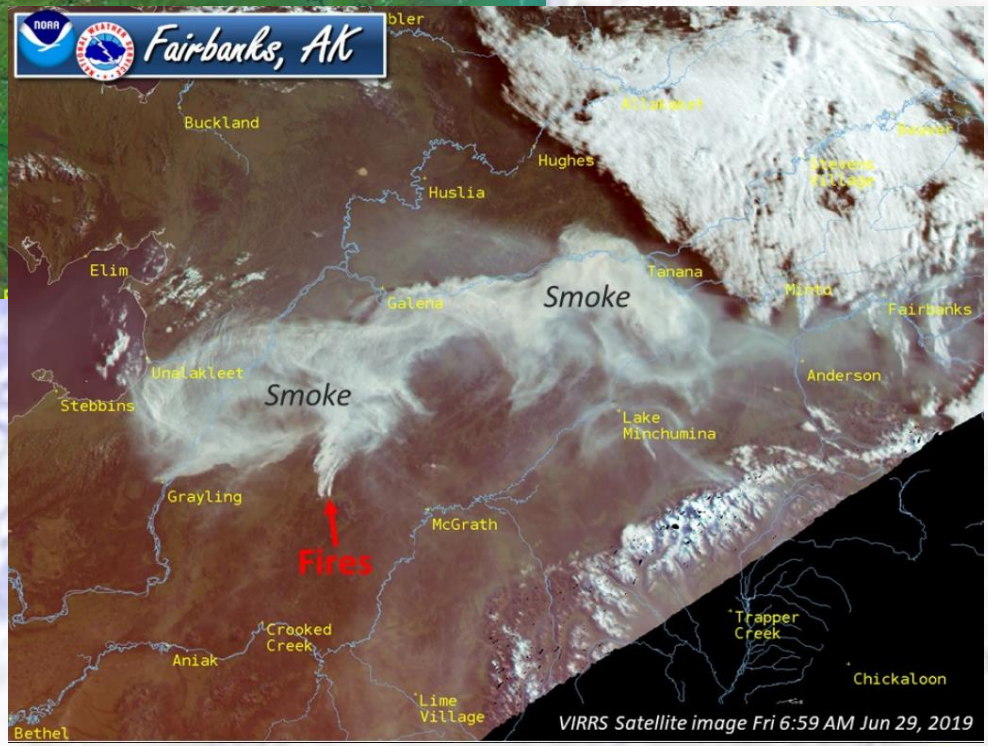
NPP-NOAA 20 Fire Temperature RGB (3.9um, 2.25um, 1.61um) on May 1, 2019 at 2120z



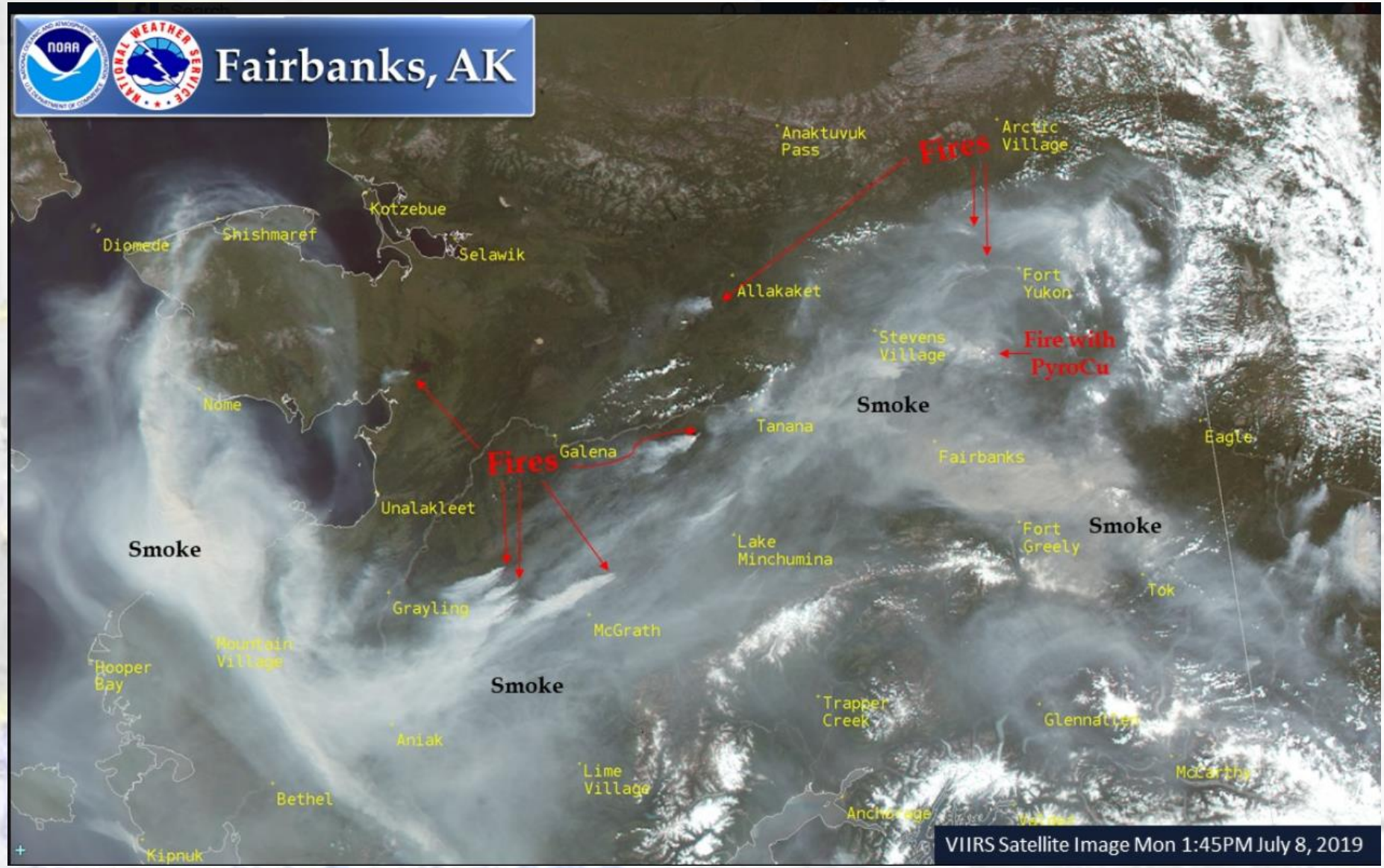
GOES 17 Fire Temperature RGB (3.9um, 2.25um, 1.61um) on May 1, 2019 at 2120z

Fire Weather/Air Quality



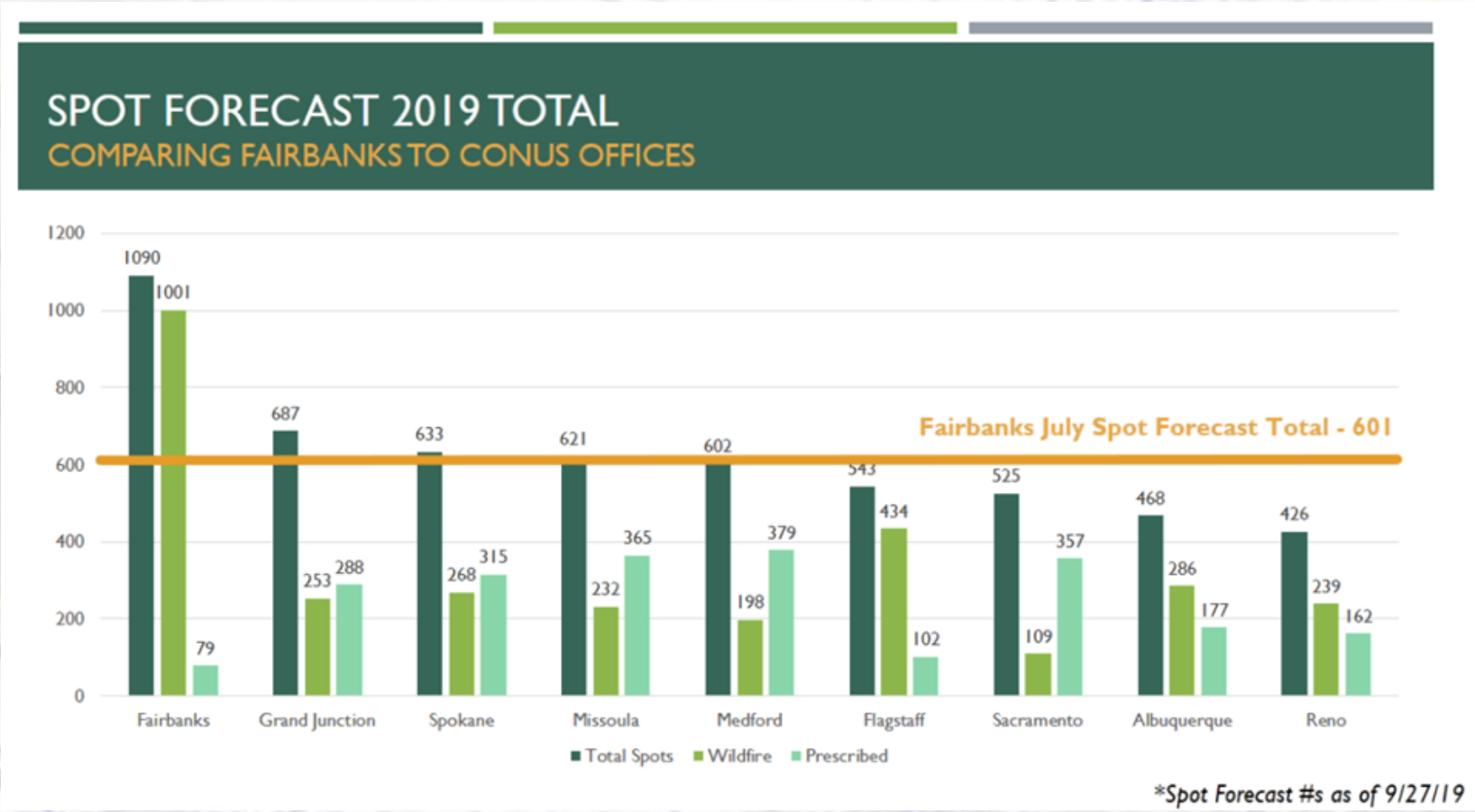


Fire Weather/Air Quality

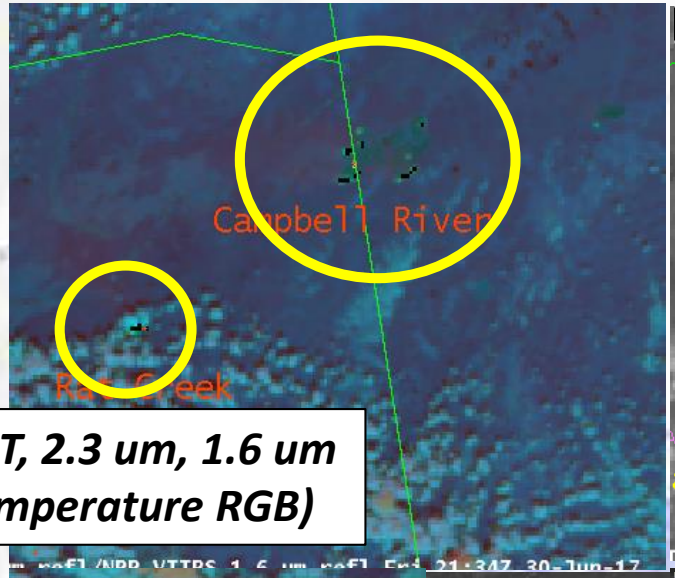


Fire Weather

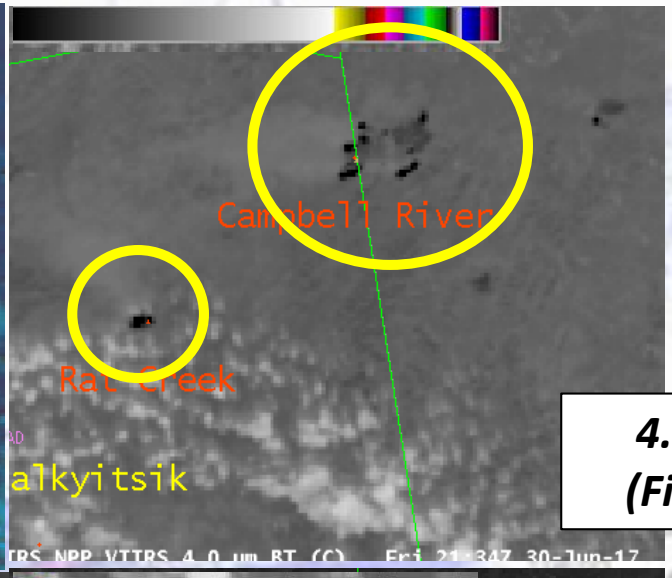
- **Daily DSS briefing calls with Alaska Fire Service**
- **2 IMETs deployed, 1 IMET at WFO Fairbanks**
  - **Fire Weather Spots (FWS) scheduled 4am-7am daily**



Fire Weather

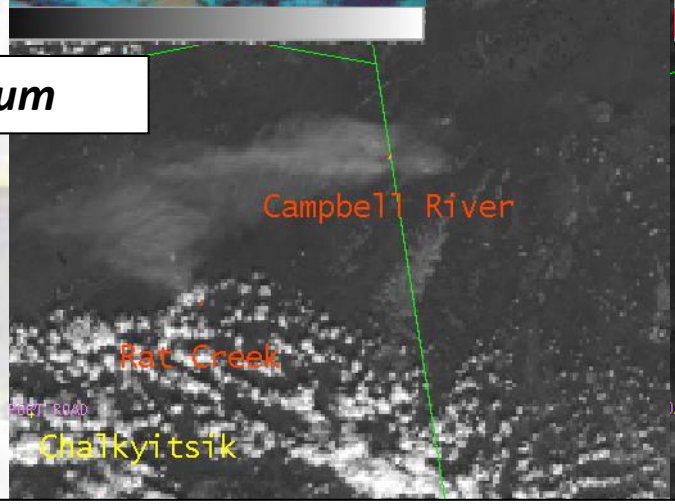


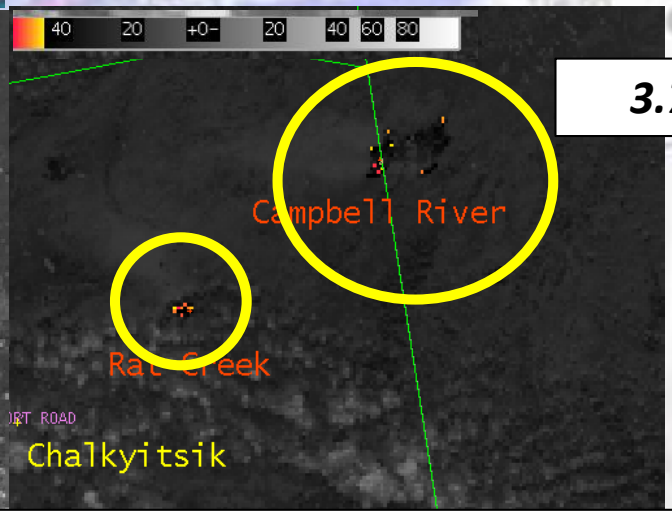
3.7 um BT, 2.3 um, 1.6 um (Fire Temperature RGB)



4.0 um BT (Fire Band)

0.64 um

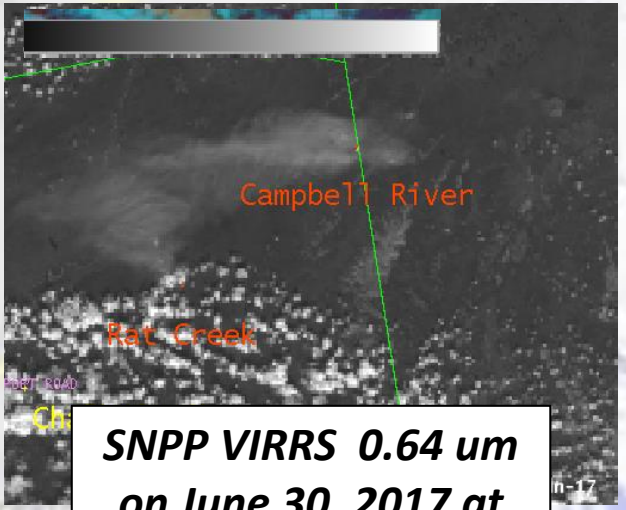




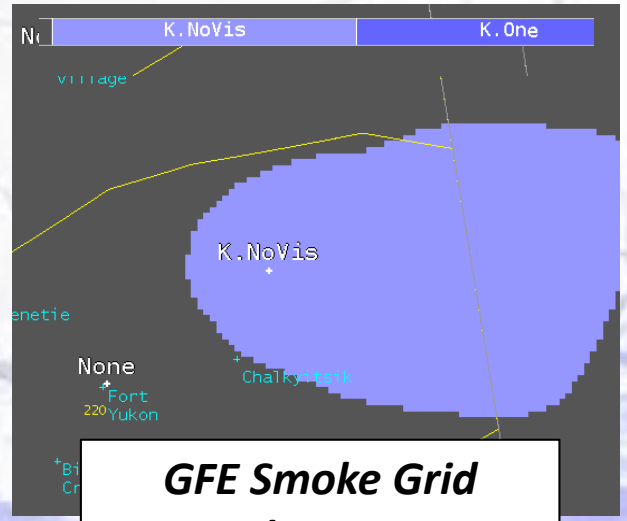
3.7 um BT

SNPP VIRRS 4 panel imagery on June 30, 2017 at 2134z. Campbell River Wildfire next to Yukon, Canada.

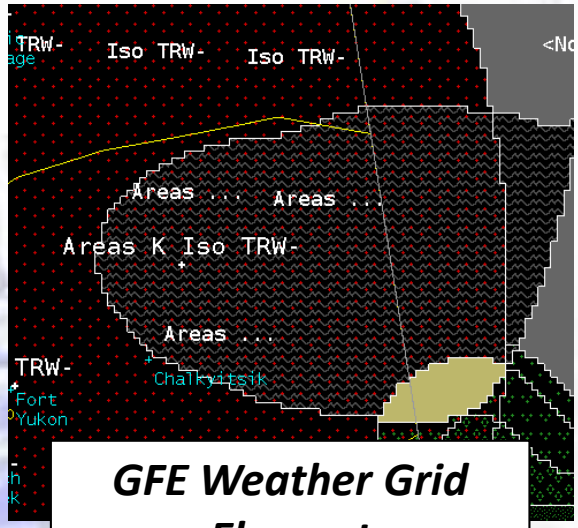
Fire Weather



SNPP VIRRS 0.64 um on June 30, 2017 at 2134z

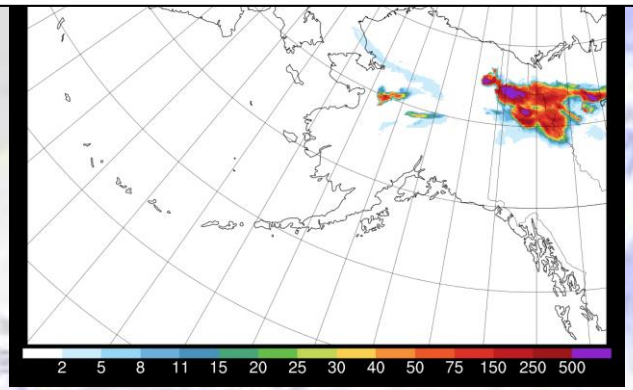


GFE Smoke Grid Element

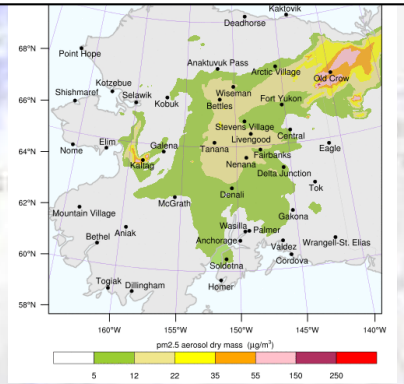


GFE Weather Grid Element

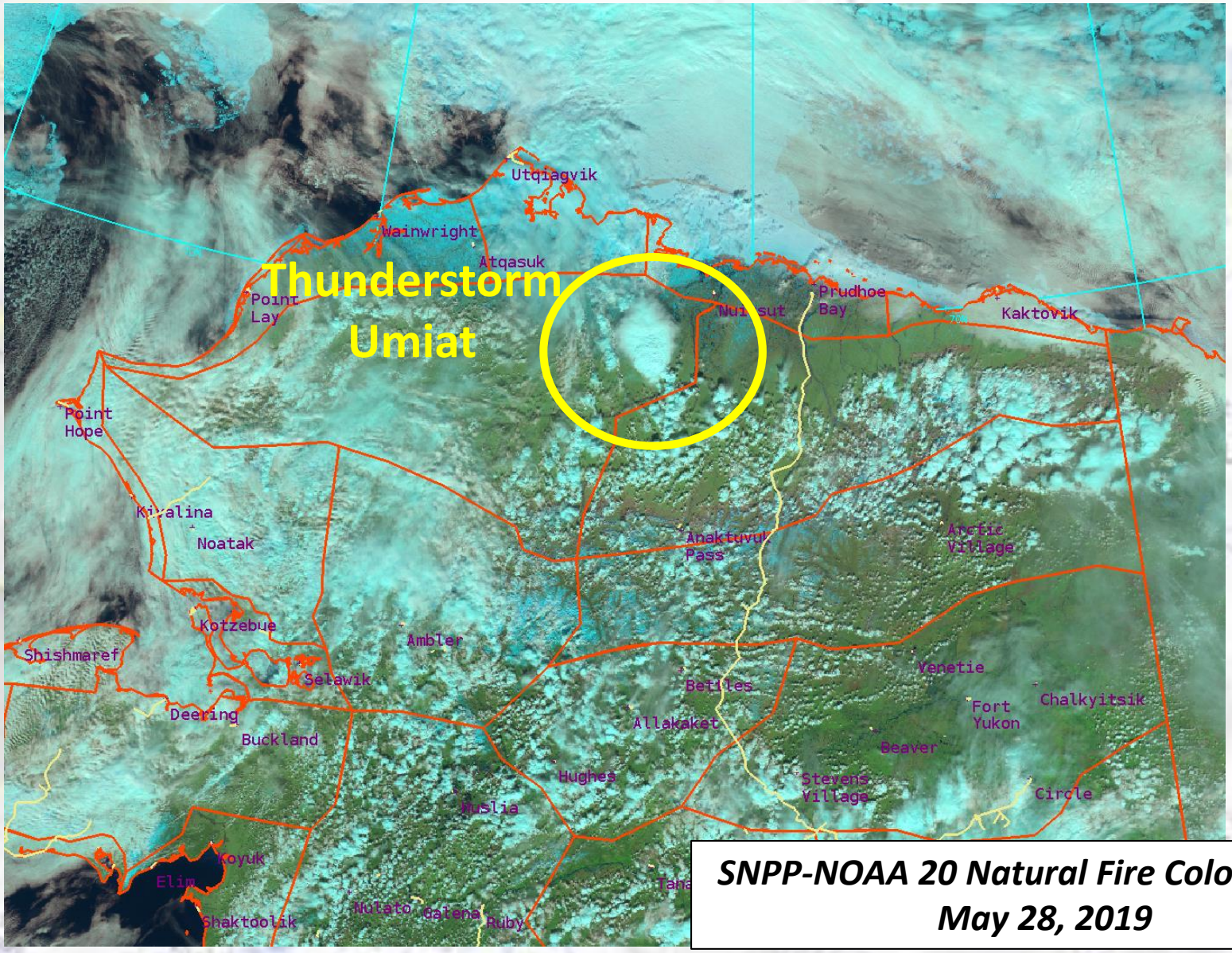
HRRR AK Smoke Vertical Integration June 30, 2017 F24hr



UAF AK Smoke Vertical Integration June 30, 2017 F24hr

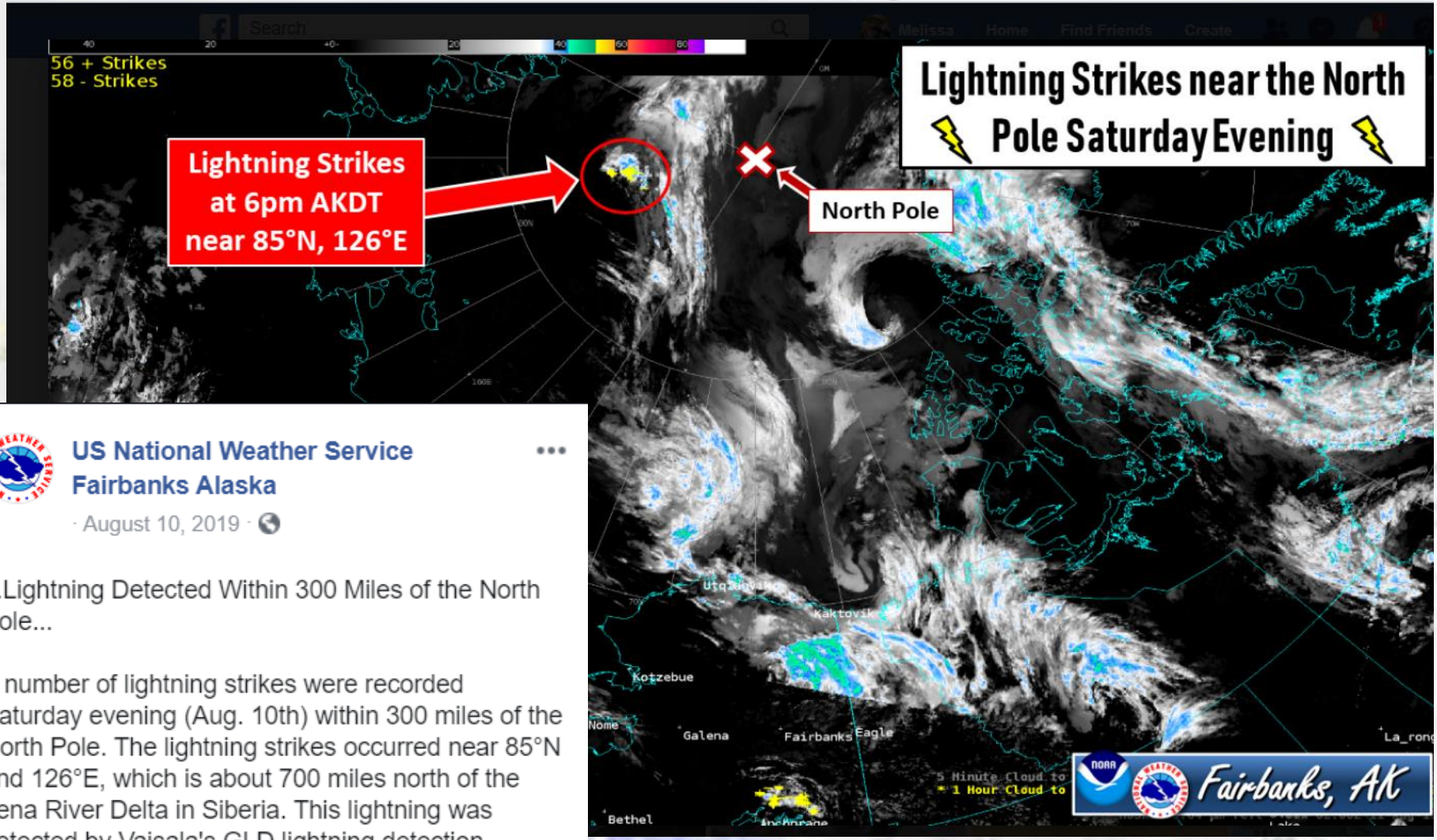


Convective Weather



SNPP-NOAA 20 Natural Fire Color RGB on May 28, 2019

Convective Weather



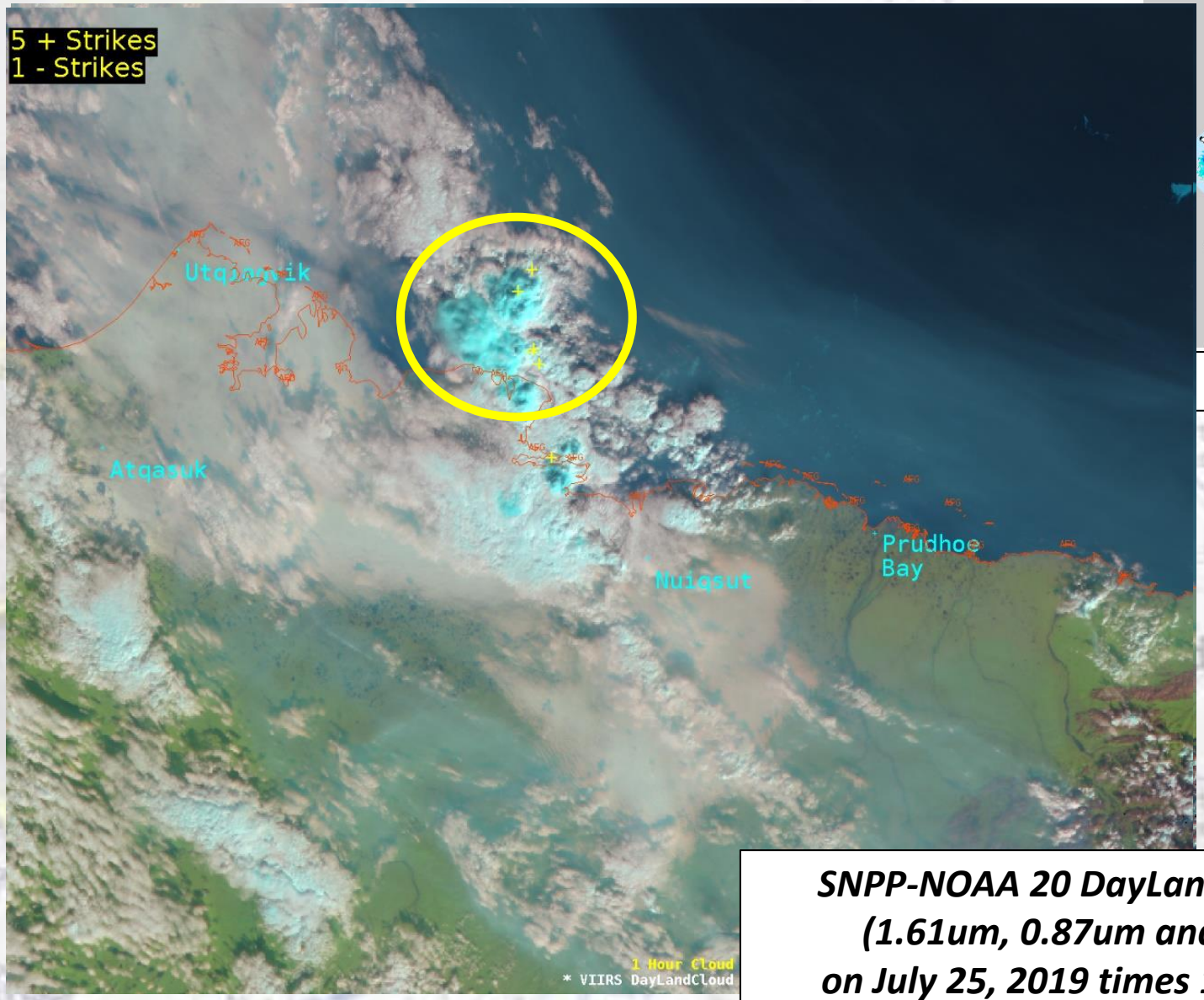
US National Weather Service Fairbanks Alaska

· August 10, 2019 ·

...Lightning Detected Within 300 Miles of the North Pole...

A number of lightning strikes were recorded Saturday evening (Aug. 10th) within 300 miles of the North Pole. The lightning strikes occurred near 85°N and 126°E, which is about 700 miles north of the Lena River Delta in Siberia. This lightning was detected by Vaisala's GLD lightning detection network.

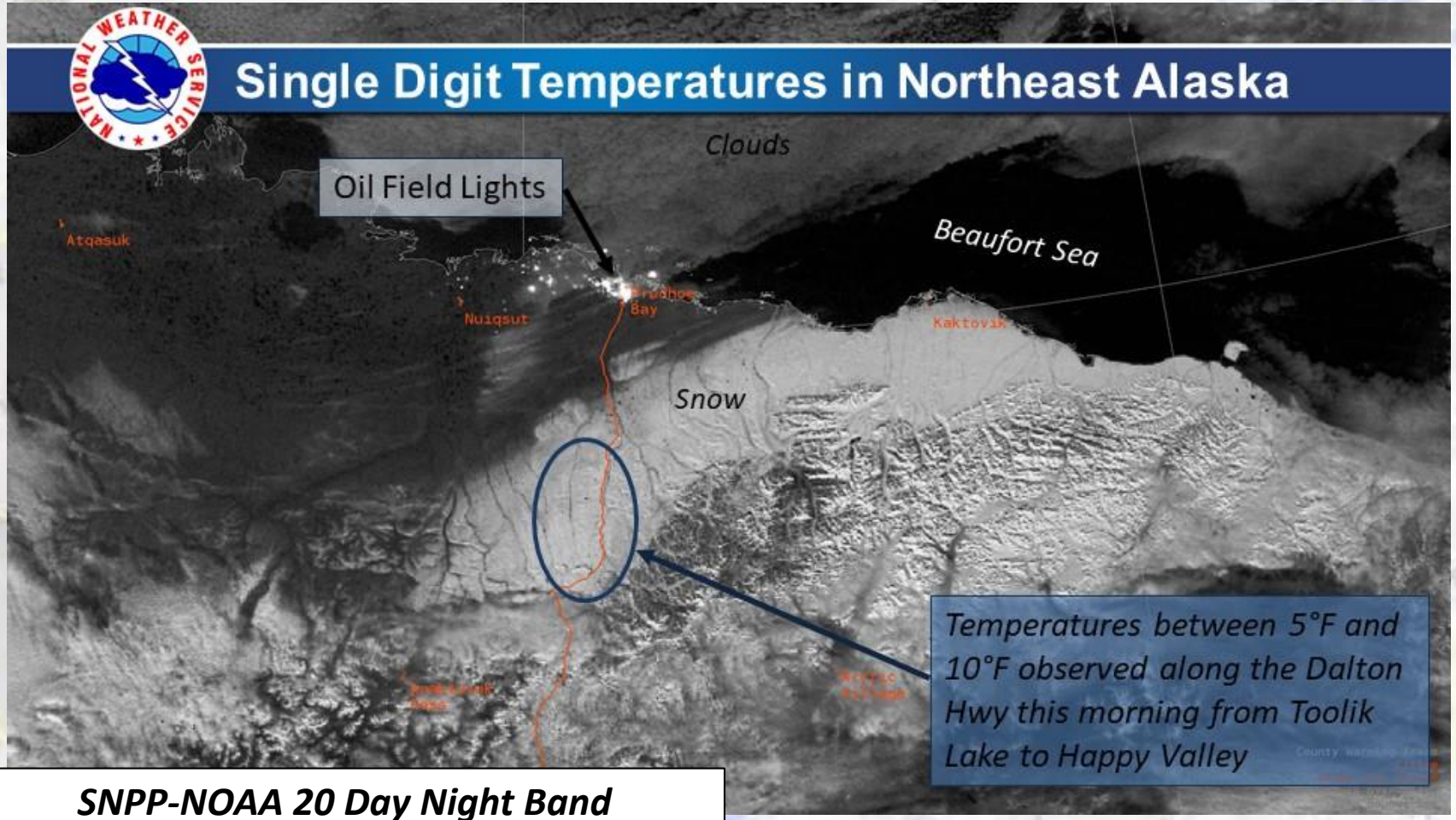
Convective Weather



Radar Coverage

SNPP-NOAA 20 DayLand Cloud RGB (1.61um, 0.87um and 0.64um) on July 25, 2019 times 1403z-1947z

Winter Weather



SNPP-NOAA 20 Day Night Band
September 6, 2018 at 1144z

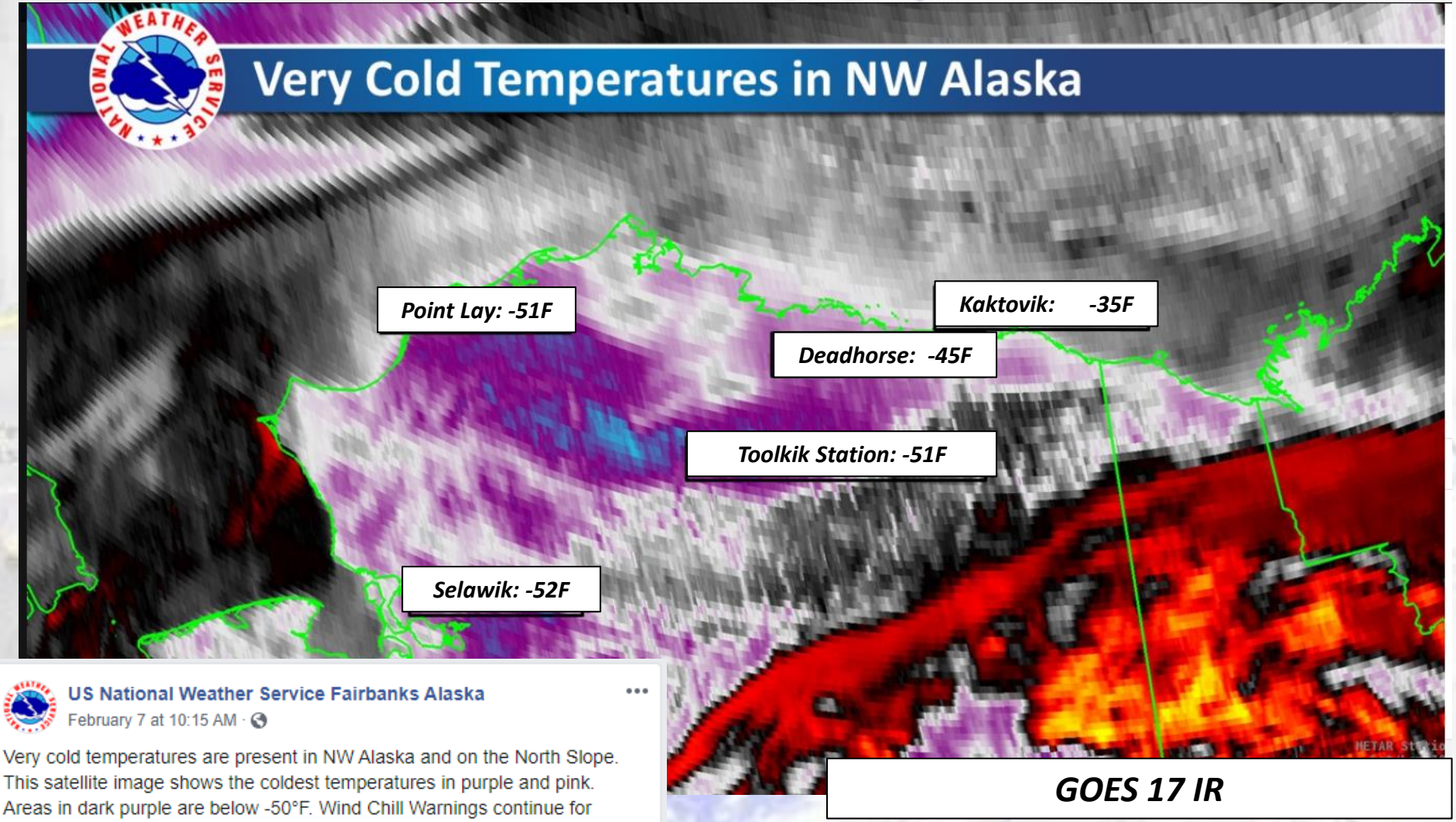
Winter Weather: Snow

US National Weather Service Fairbanks Alaska
October 14, 2019

Clear skies today has allowed us to get a nice view of snow cover advancing across the state. Much of the snow cover depicted today was picked up over the past week in many areas. What's also noteworthy in this satellite image is the lack of sea ice off of the arctic coast. Here's a list of current snow depth at select sites across northern Alaska:

Dry Creek (40mi SE of Delta Junction): 17"
Tok: ... See More

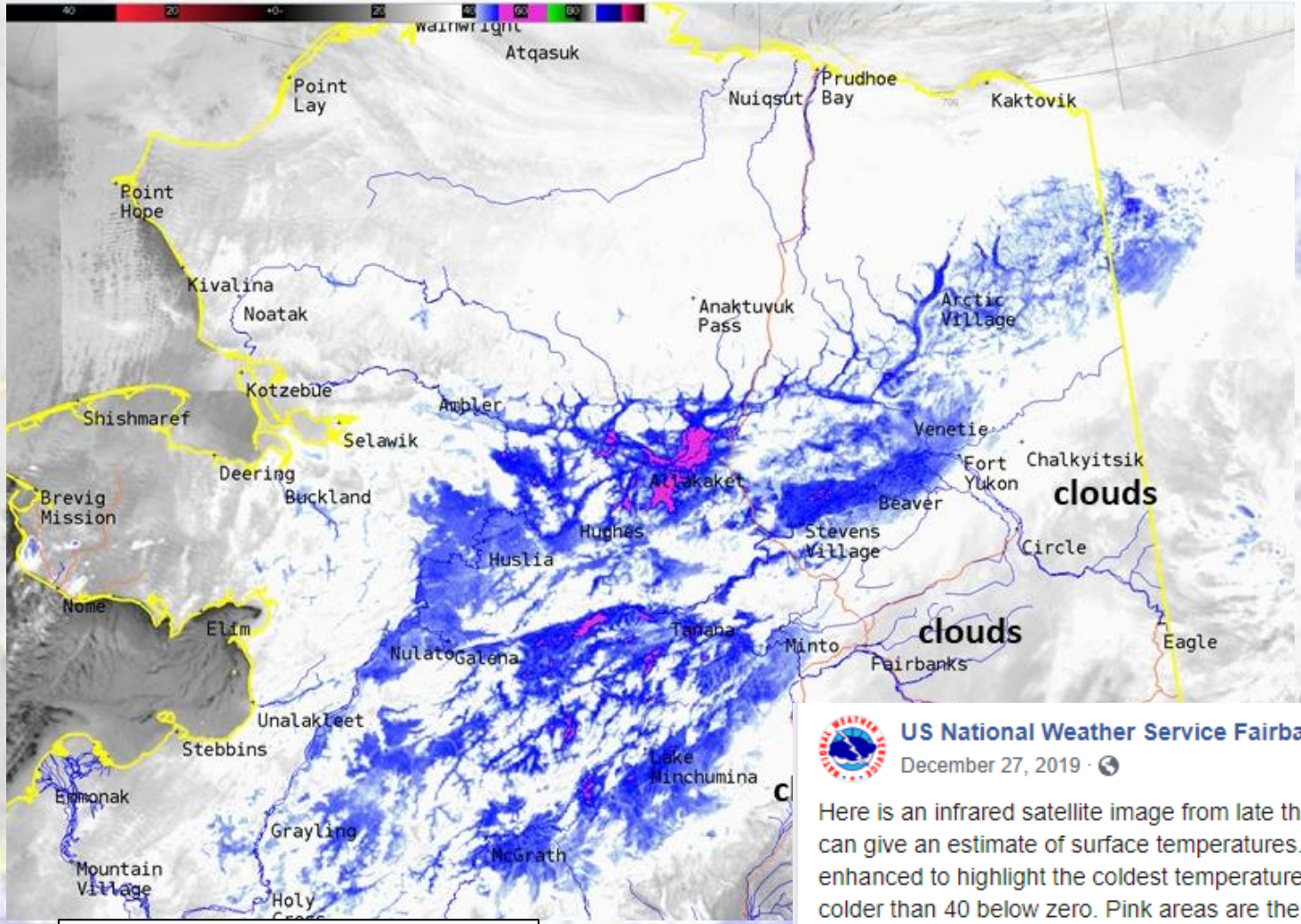
Winter: Cold Temperatures



US National Weather Service Fairbanks Alaska
February 7 at 10:15 AM ·

Very cold temperatures are present in NW Alaska and on the North Slope. This satellite image shows the coldest temperatures in purple and pink. Areas in dark purple are below -50°F. Wind Chill Warnings continue for Nuiqsut, Deadhorse, and Kaktovik where the current wind chills are -76°F, -76°F, and -66°F. #akwx

Winter: Cold Temperatures

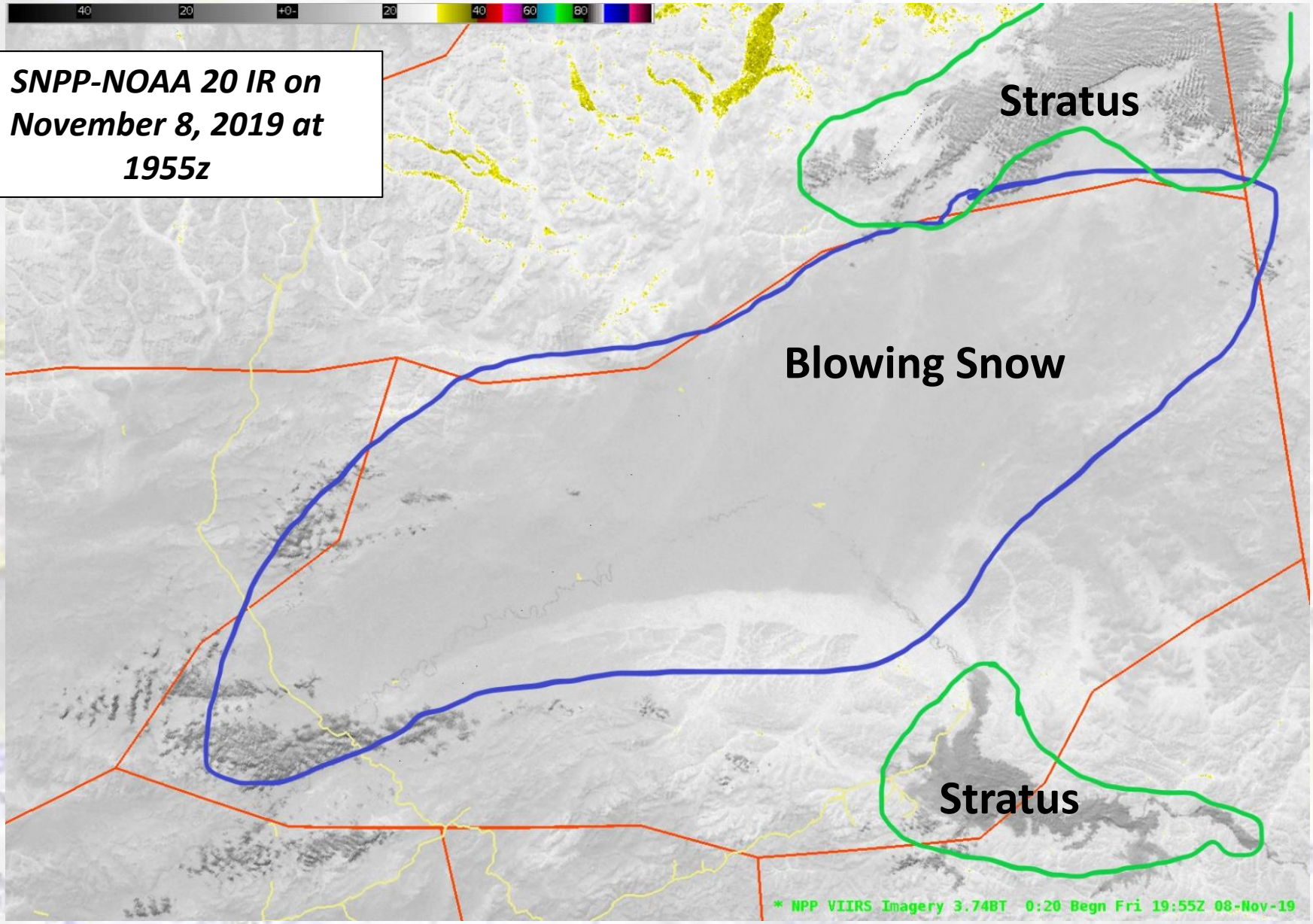


SNPP-NOAA 20 IR on December 27, 2019

US National Weather Service Fairbanks Alaska
December 27, 2019 ·

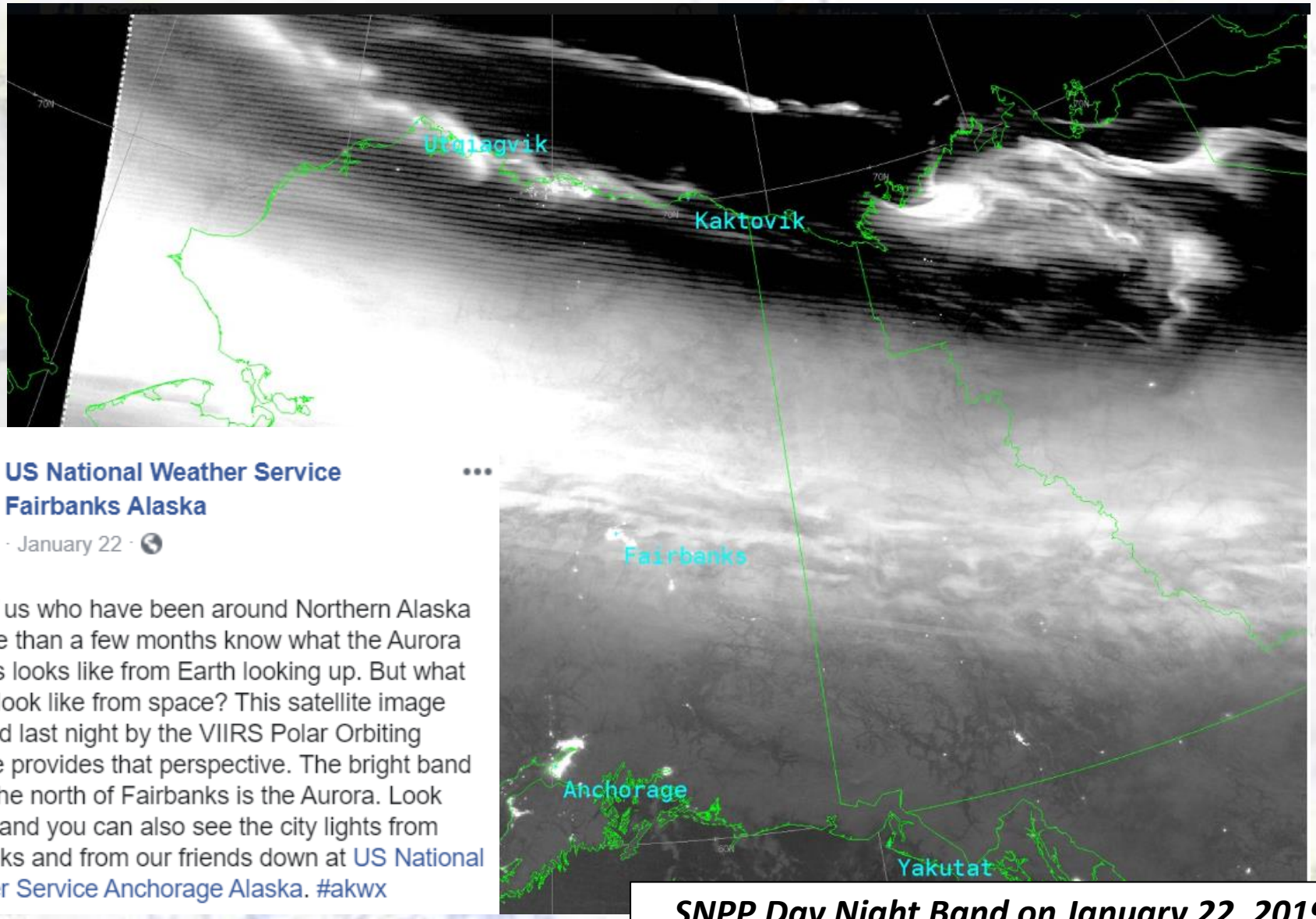
Here is an infrared satellite image from late this morning. This type of image can give an estimate of surface temperatures. The image has been enhanced to highlight the coldest temperatures. Areas highlighted in blue are colder than 40 below zero. Pink areas are the coldest valley locations with temperatures in the 60's below zero. Clouds from Fairbanks east were keeping the temperatures much warmer. Clouds cleared late this morning in Fairbanks and temperatures have now dropped into the 30's below this afternoon so far.

Winter: Blowing Snow



SNPP-NOAA 20 IR on November 8, 2019 at 1955z

Aurora



US National Weather Service Fairbanks Alaska

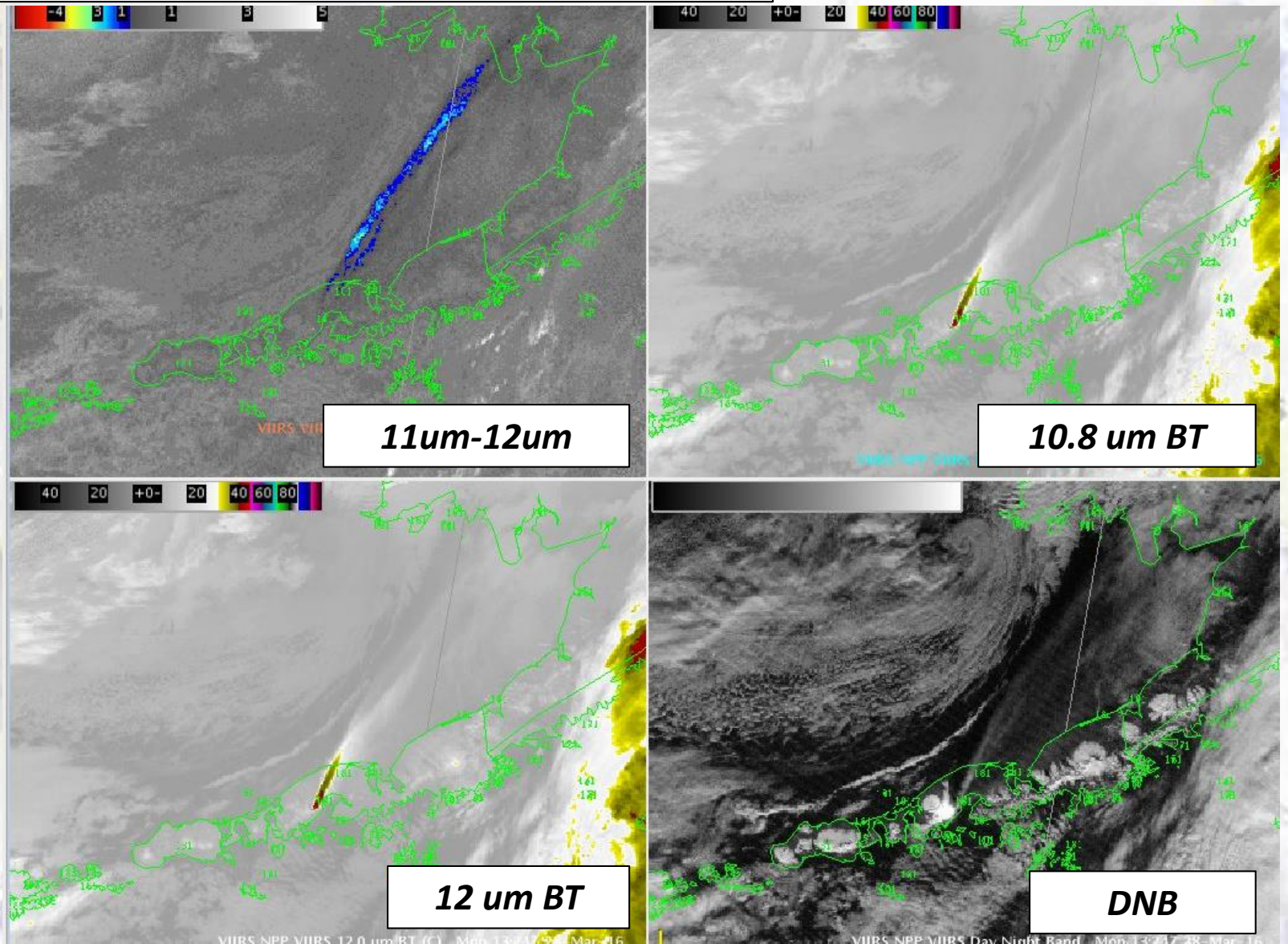
· January 22 ·

Most of us who have been around Northern Alaska for more than a few months know what the Aurora Borealis looks like from Earth looking up. But what does it look like from space? This satellite image captured last night by the VIIRS Polar Orbiting Satellite provides that perspective. The bright band just to the north of Fairbanks is the Aurora. Look closely and you can also see the city lights from Fairbanks and from our friends down at US National Weather Service Anchorage Alaska. #akwx

SNPP Day Night Band on January 22, 2019

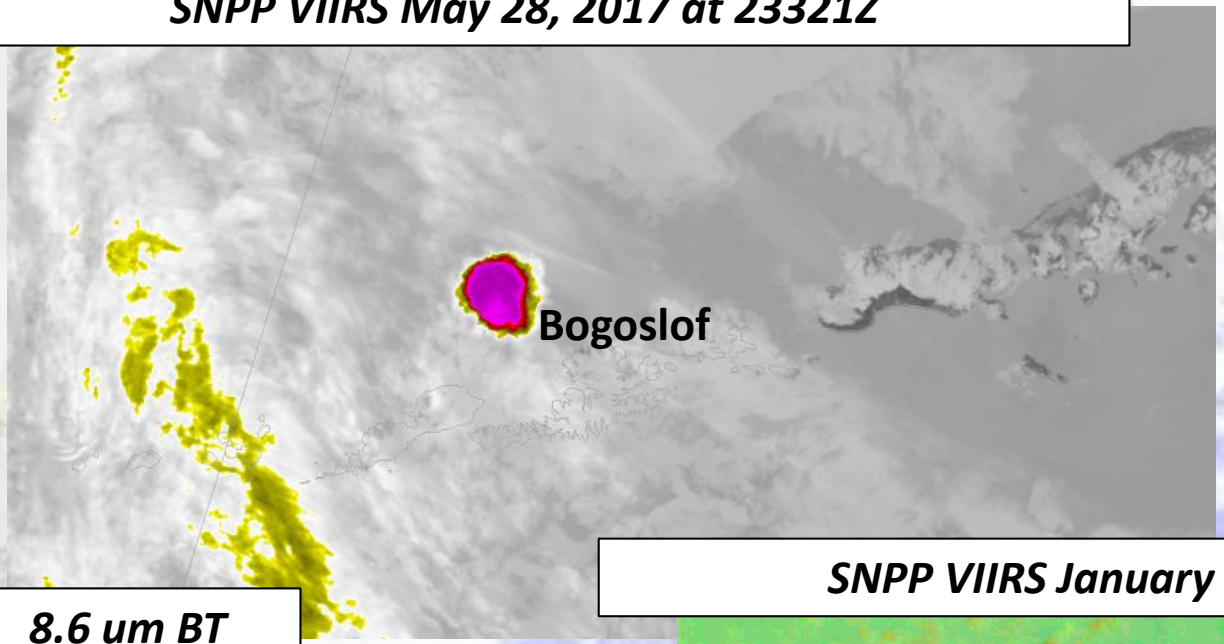
Aviation: Volcanic Ash

SNPP VIIRS March 28, 2016 Pavlof Eruption at 1321Z



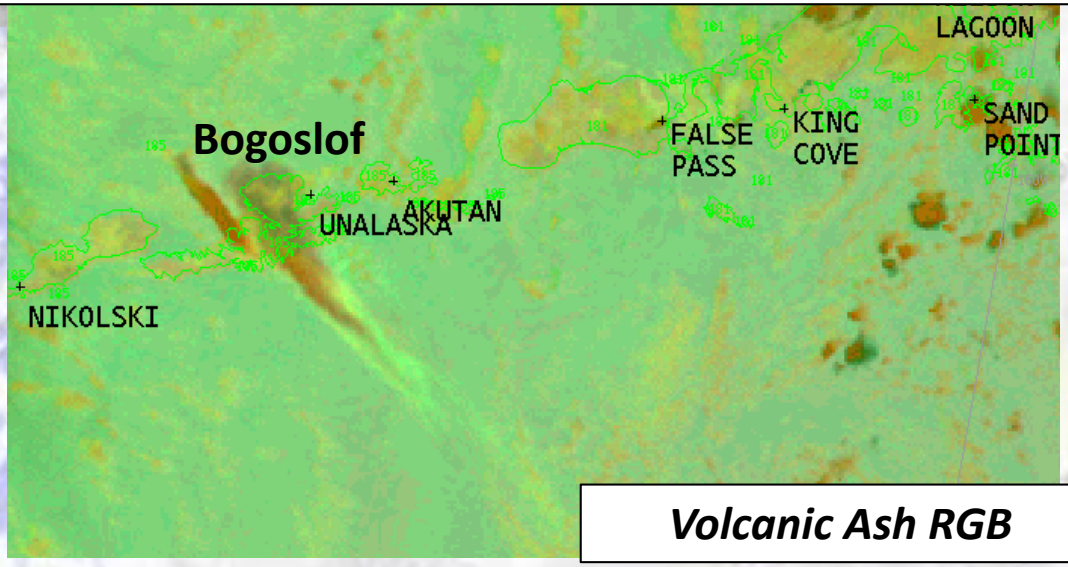
Aviation: Volcanic Ash

SNPP VIIRS May 28, 2017 at 23321Z



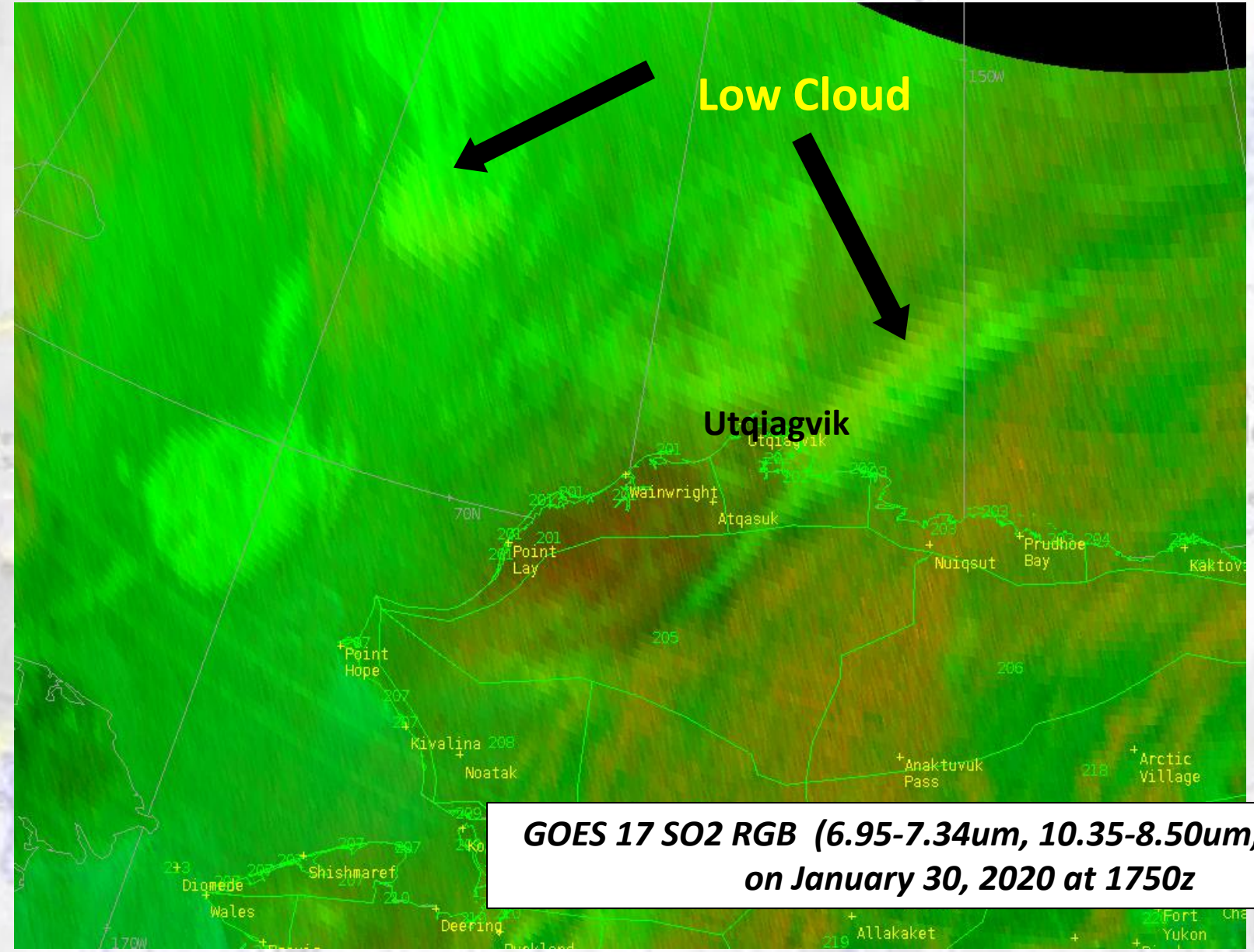
8.6 um BT

SNPP VIIRS January 31, 2017 at 1150Z



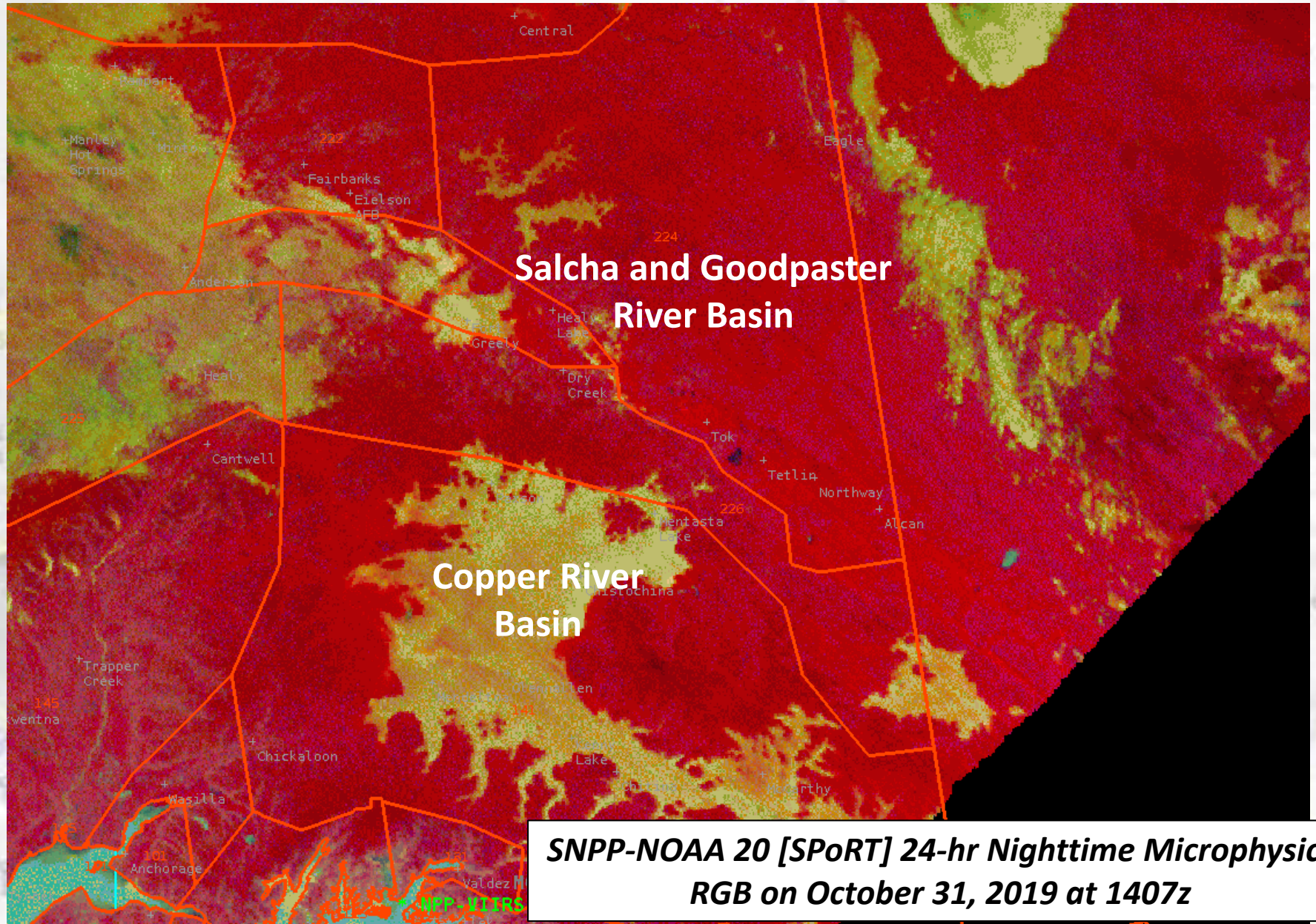
Volcanic Ash RGB

Aviation: Low Clouds



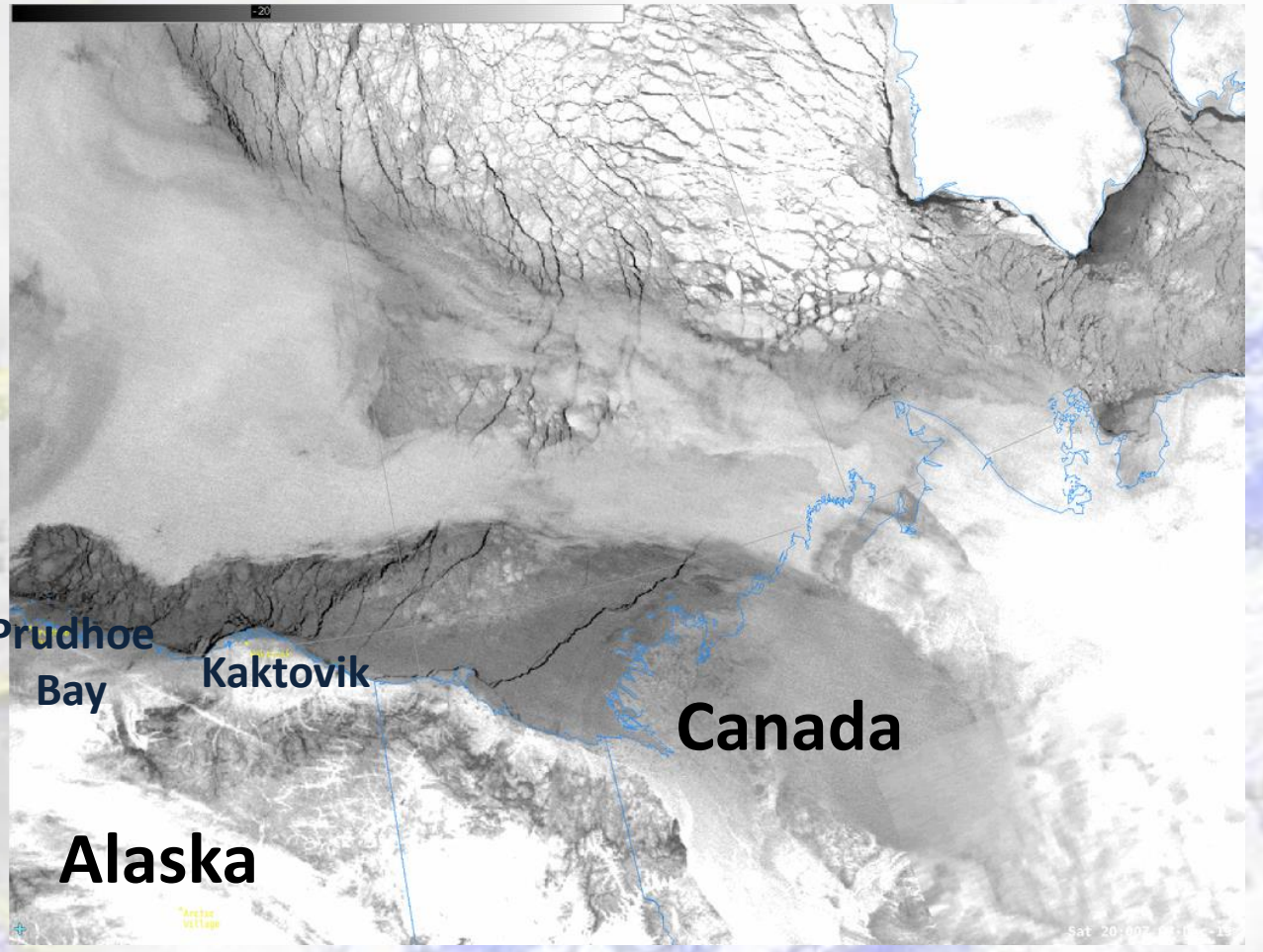
GOES 17 SO2 RGB (6.95-7.34um, 10.35-8.50um, 10.35um) on January 30, 2020 at 1750z

Aviation: Fog



SNPP-NOAA 20 [SPoRT] 24-hr Nighttime Microphysics RGB on October 31, 2019 at 1407z

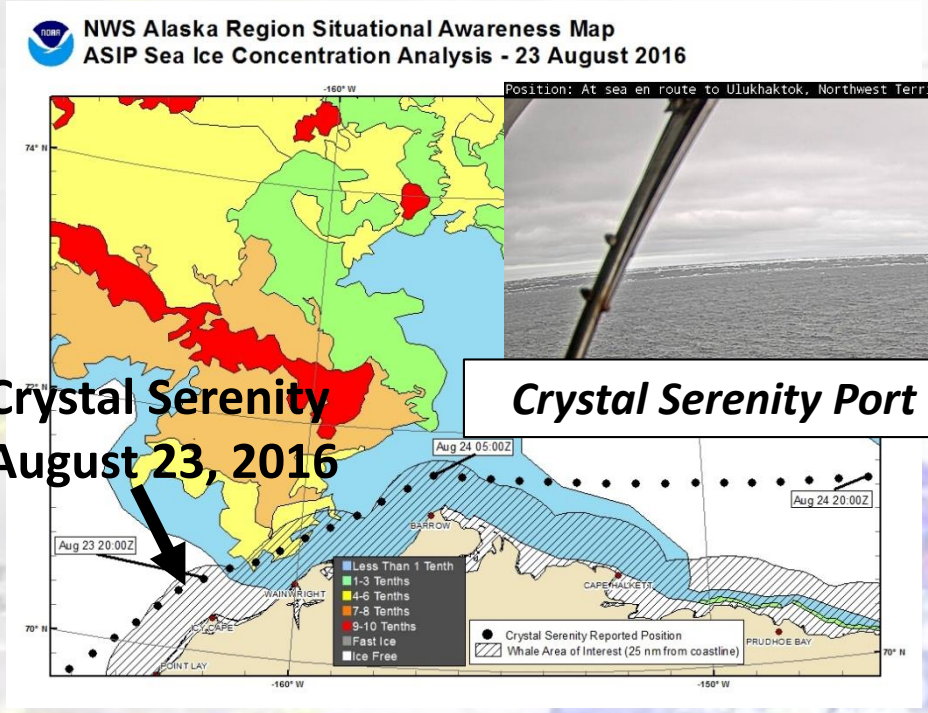
Sea Ice



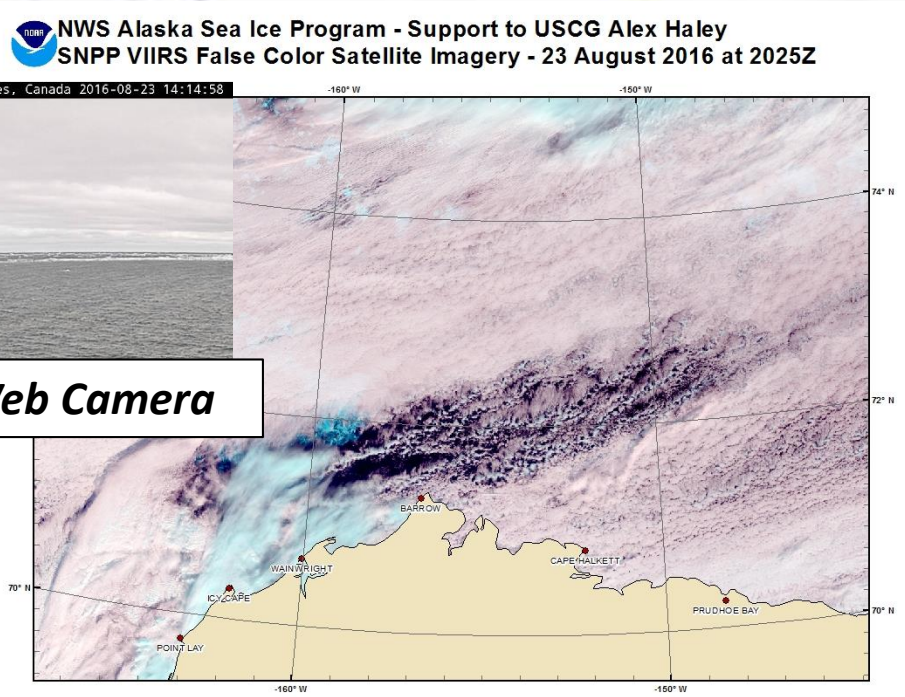
Sea Ice cracking under strong east wind

Legacy IR SNPP and NOAA-20 on December 9, 2019 from 12z-20z timelapse

Sea Ice and Winds

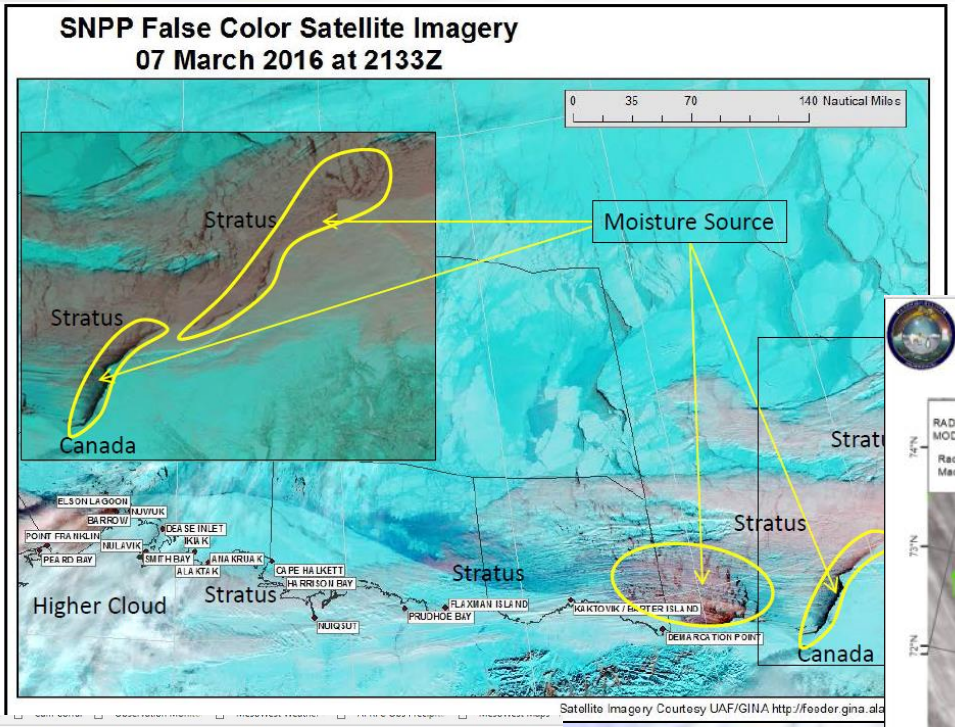


Crystal Serenity Port Web Camera

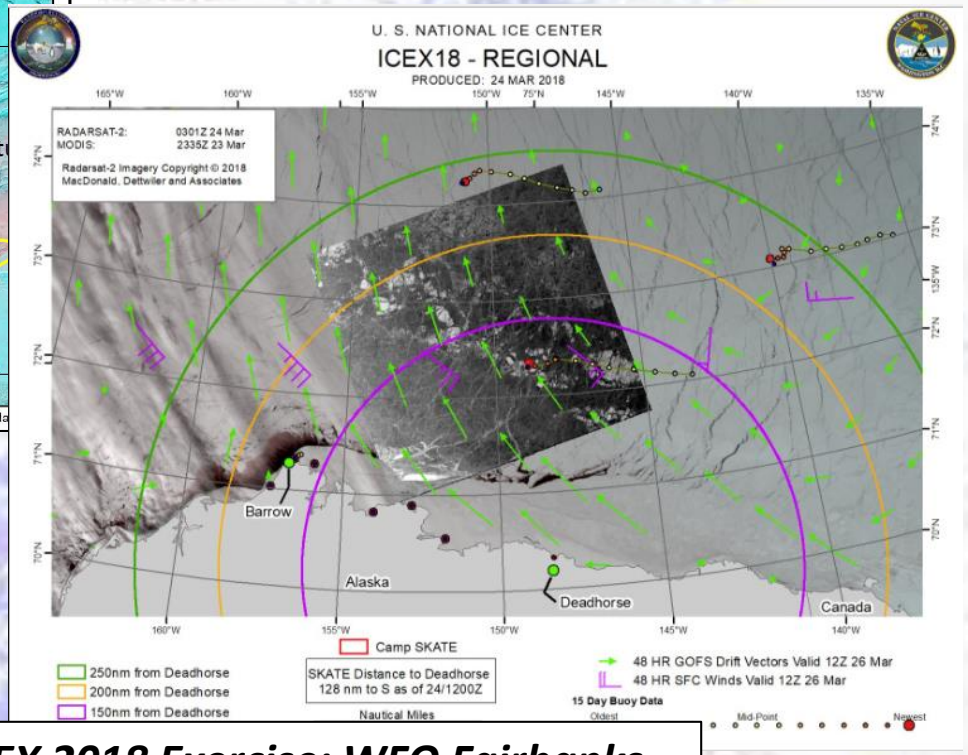


- **Decision Support Services for USCG for Cruise Ships:**
  - **Daily briefing reports to US Coast Guard Cutters: Alex Haley, Healy, and Stratton**
  - **Reports included NWS ASIP Sea Ice analysis, Fairbanks WFO wind/temp forecast and SNPP VIIRS satellite imagery**

Aviation: US Navy ICEX



US Navy ICEX 2016 and 2018 Exercise: Collaborative Decision Support Services (DSS) for Aviation and Sea Ice



US Navy ICEX 2018 Exercise: WFO Fairbanks providing daily DSS briefings February 25th - March 25th, 2018

Aviation: US Navy ICEX 2020

AVHRR Satellite Data with Heights by NWS AR

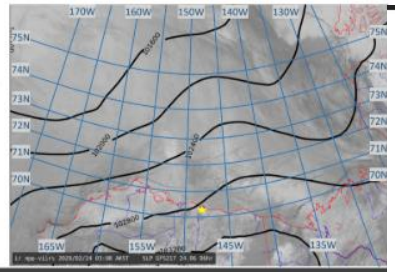
Ice Camp Forecast Monday, 24 February 2020

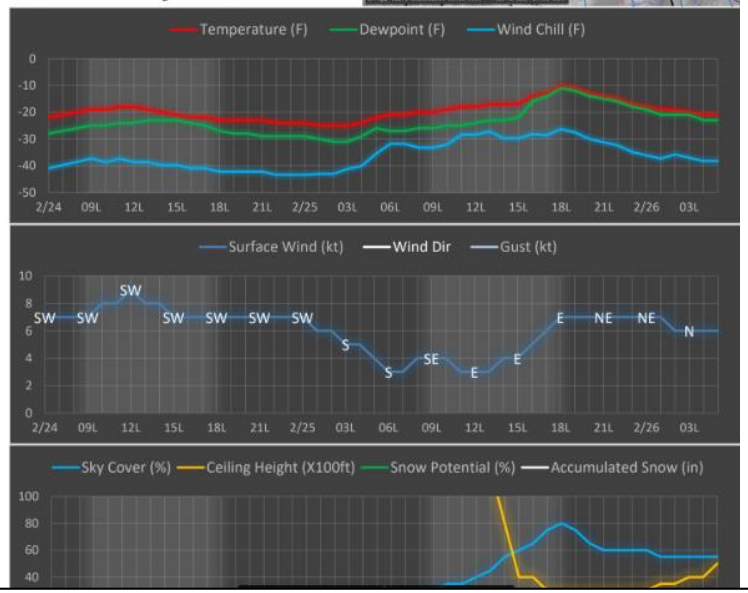
Pending establishment of Ice Camp, all information is valid for 71.1N 142.3W.

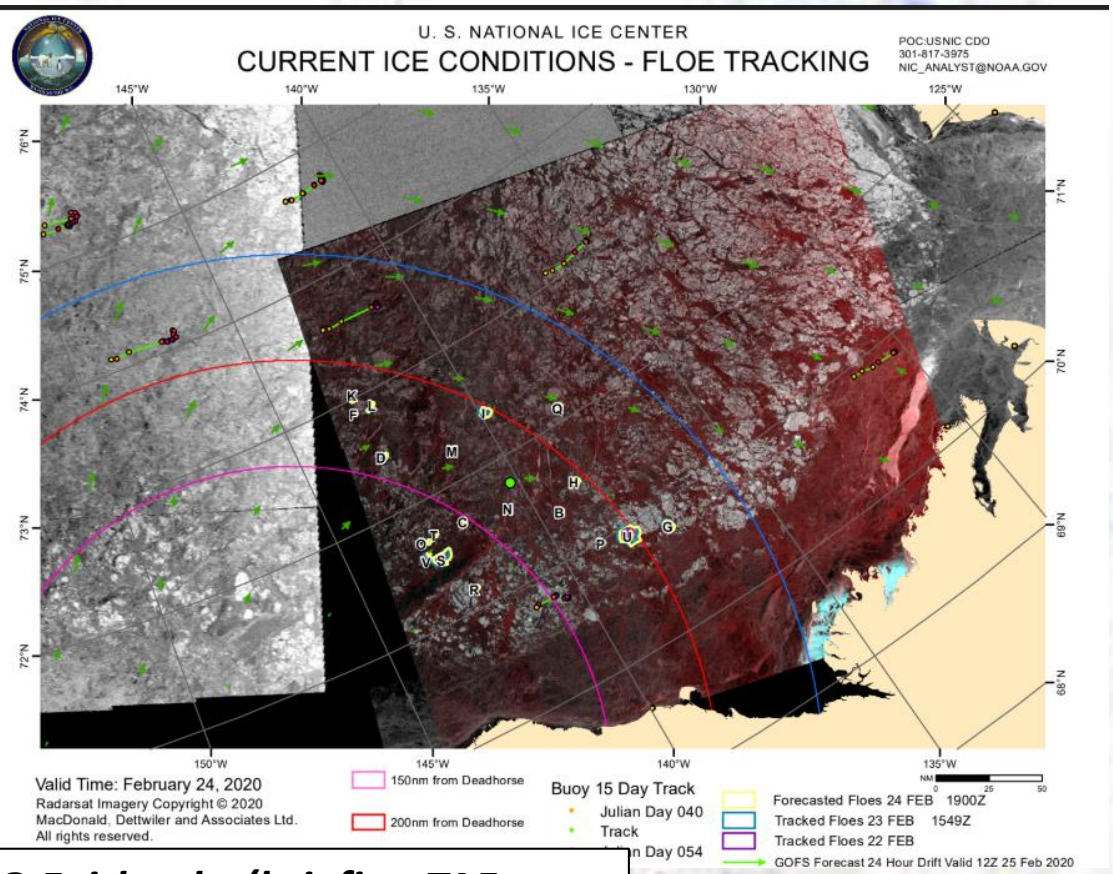
High pressure will bring favorable conditions through the day Monday. By Tuesday afternoon, a trough of low pressure will quickly move through the area, increasing cloud coverage and causing winds to shift from Southwesterly to Northeasterly.

All METOC products are available at https://www.metoc.navy.mil/fwcn/fwcn.html#!/

Sunrise: 0828 Civil twilight begin: 0720
Sunset: 1654 Civil twilight end: 1803







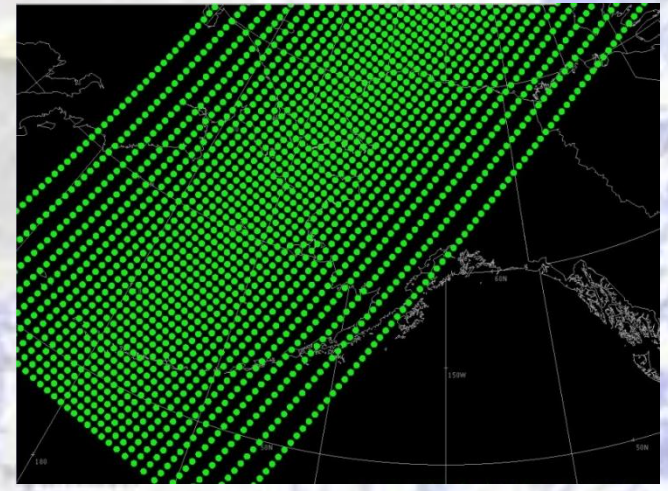
US Navy ICEX 2020 Exercise: WFO Fairbanks (briefing TAF Deadhorse) and Alaska Aviation Weather Unit (AAWU) providing daily DSS briefings

February 20th - March 20th, 2019

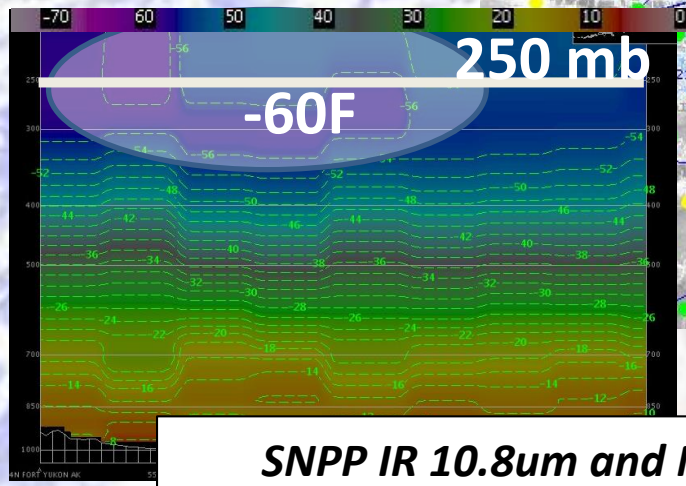
NUCAPS

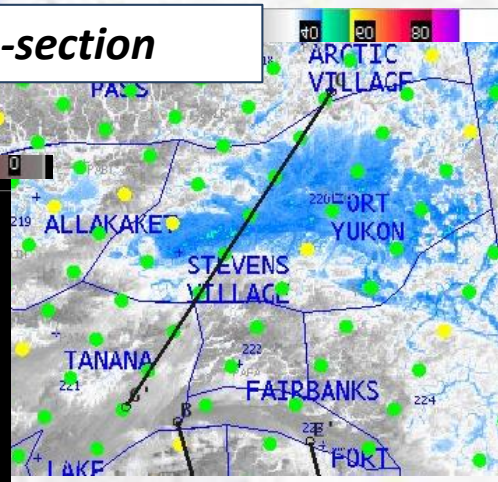
- 2016 Student Volunteer examine NUCAPS in convective season
  - Up to 2hr latency
- 2016 Alaska Aviation Weather Unit
  - Aviation hazards for Cold Air Aloft events and potential freezing fuel
- 2017 Recreational Climbing forecast - Denali
  - Used as temperature comparison for model verification

NUCAPS at 1341z on June 20, 2016



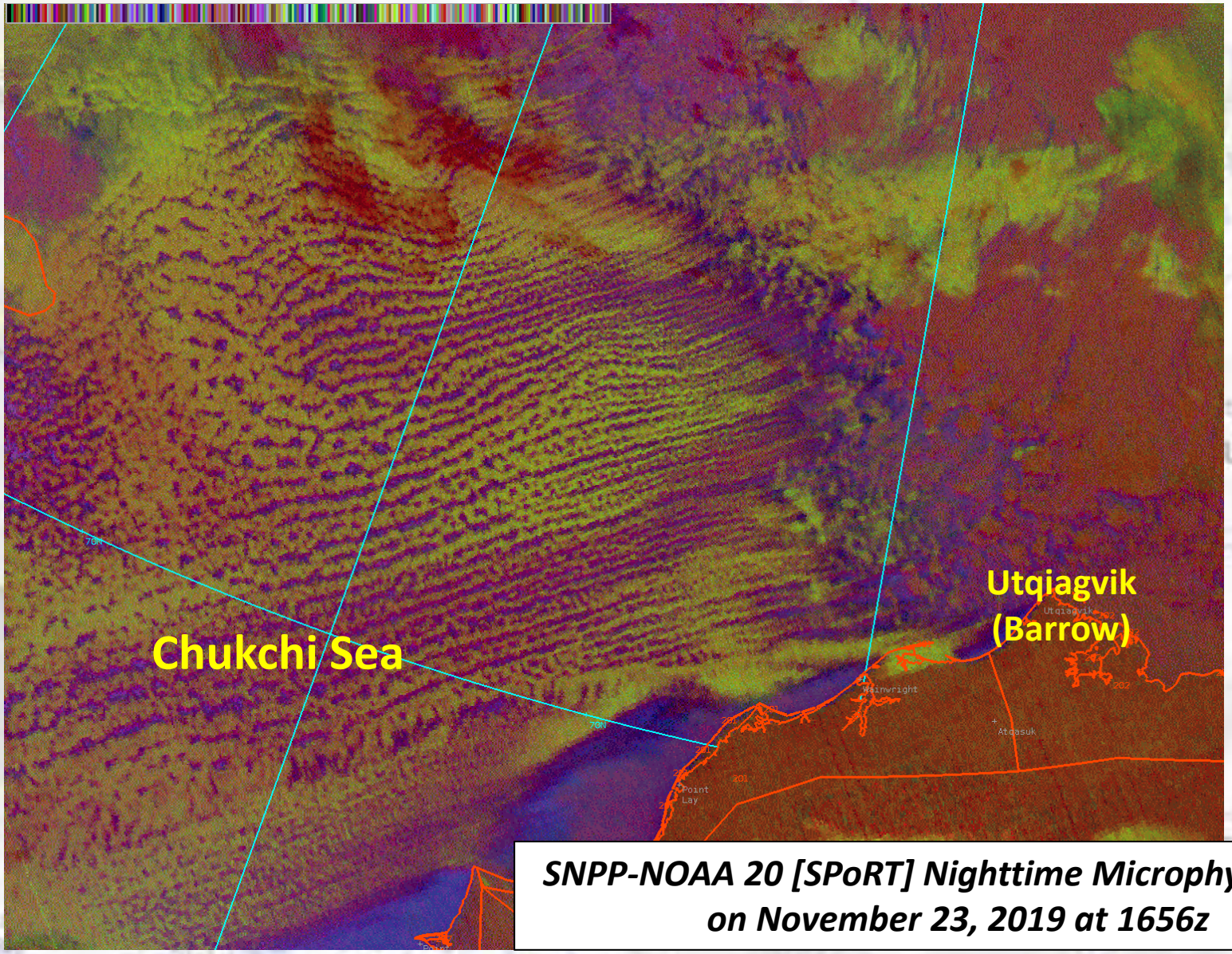
NUCAPS Temperature Cross-section





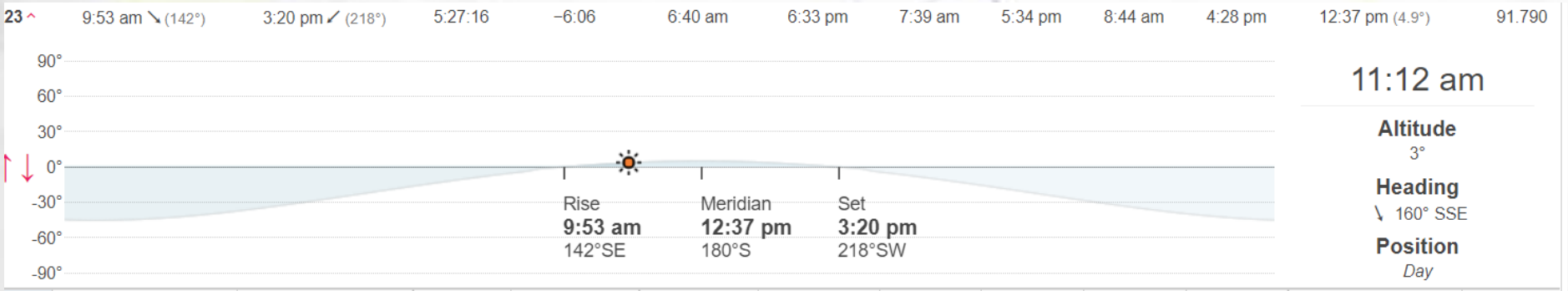
SNPP IR 10.8um and NCAPS at 1400z on December 9, 2016

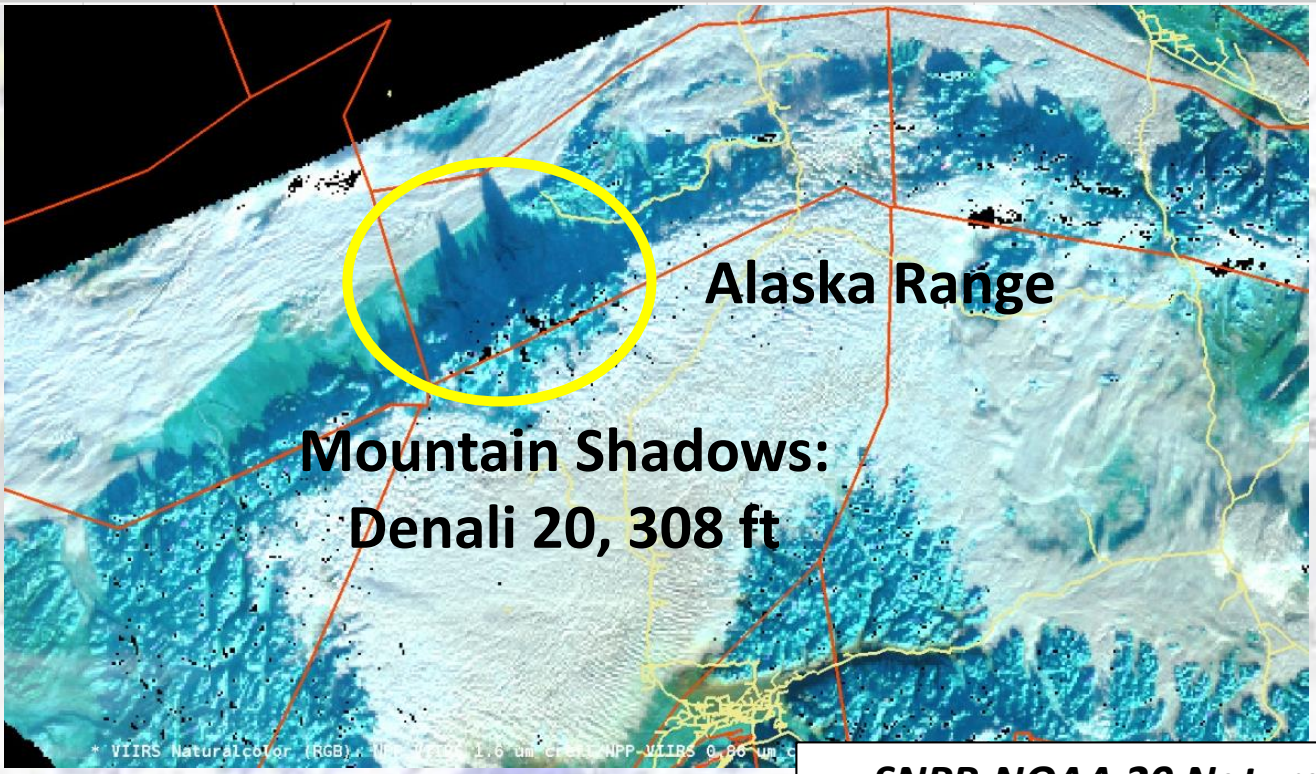
Cloud cover: street Clouds



SNPP-NOAA 20 [SPoRT] Nighttime Microphysics RGB on November 23, 2019 at 1656z

What is this?



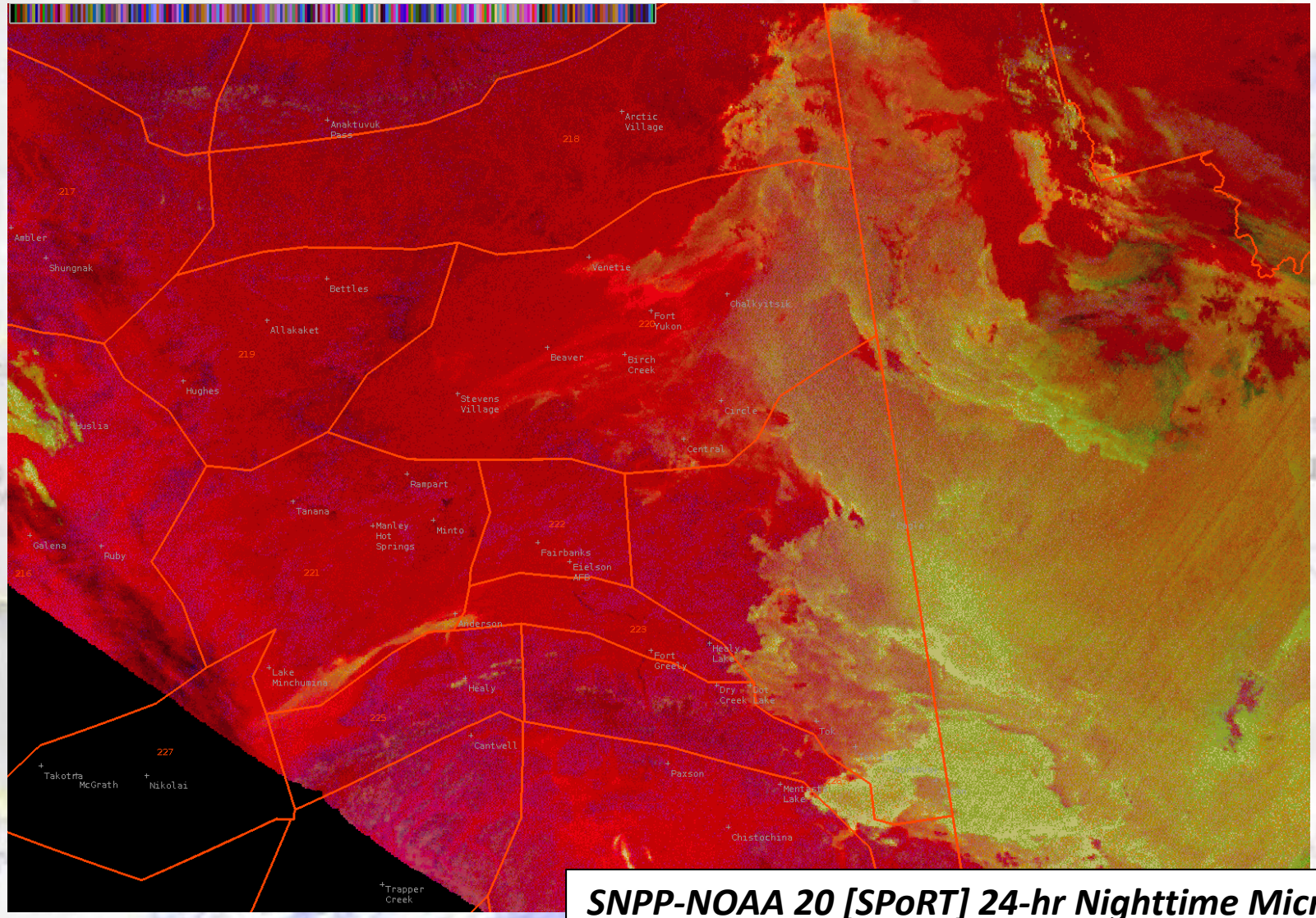


SNPP-NOAA 20 Natural Color RGB on November 23, 2019 at 2012z

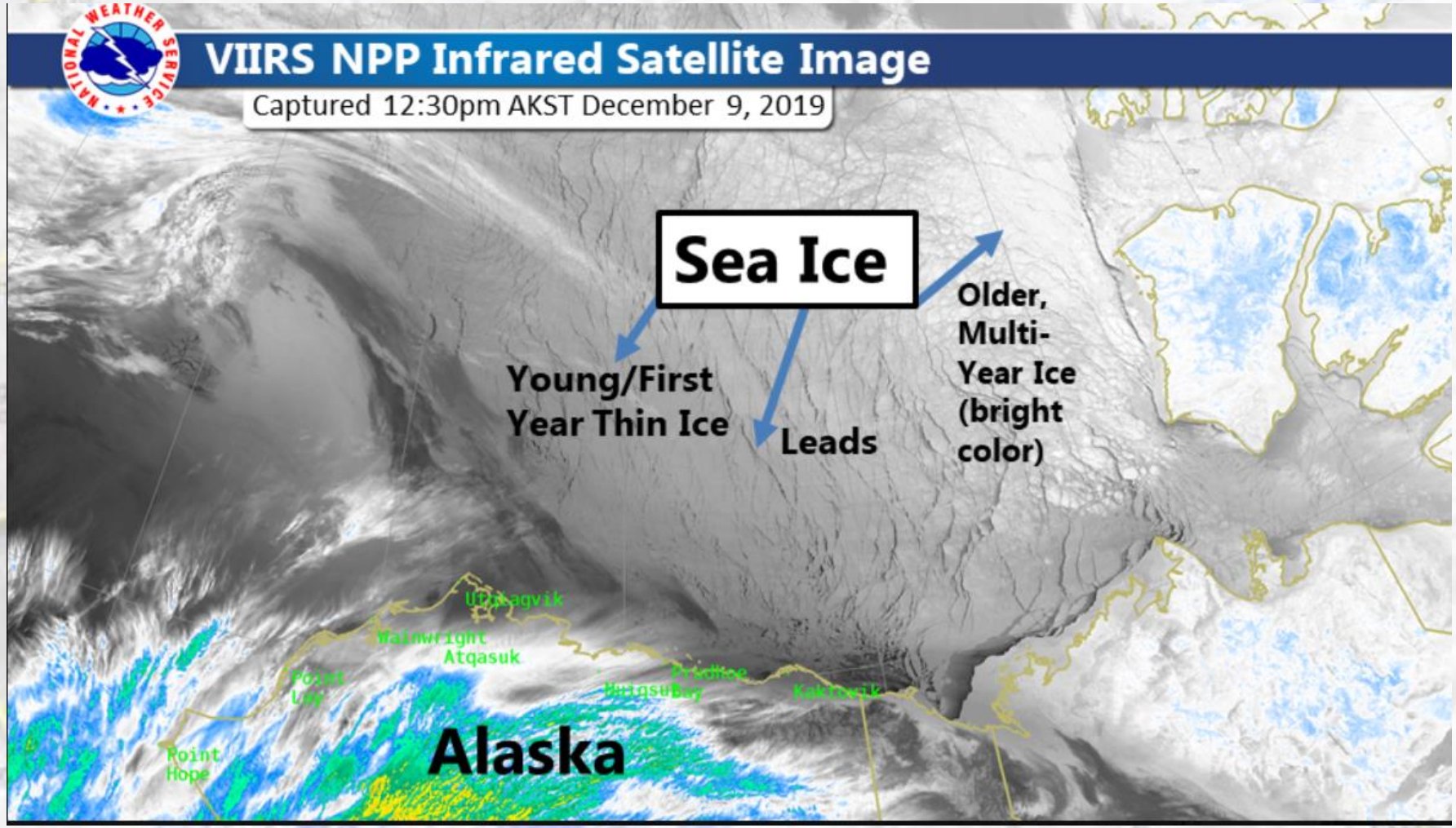
User Perspective

- **Challenges**
  - A TON of Satellite training required. Very grateful for those visited office for training and AWIPS help guides!!!
  - How to manage satellite imagery (data overload). Staff can get lost on the different types or new RGBs. Need to make decisions quickly and need satellite tools integrated and easy to understand.
  - NEED Direct Broadcast for Alaska due latency in products.
  - NUCAPS hard to examine individual soundings over large area, need to utilize gridded NUCAPS data.
  - AWIPS Thin Client issues with satellite (deployment or COOP situations)
- **Potential Development Ideas**
  - Blowing snow detection?
  - Land changes, such as coastal erosion? With AK large coastline, can satellite detect coastal changes after flooding events for storm damage survey (or year to year)?

Cloud Cover: stratus

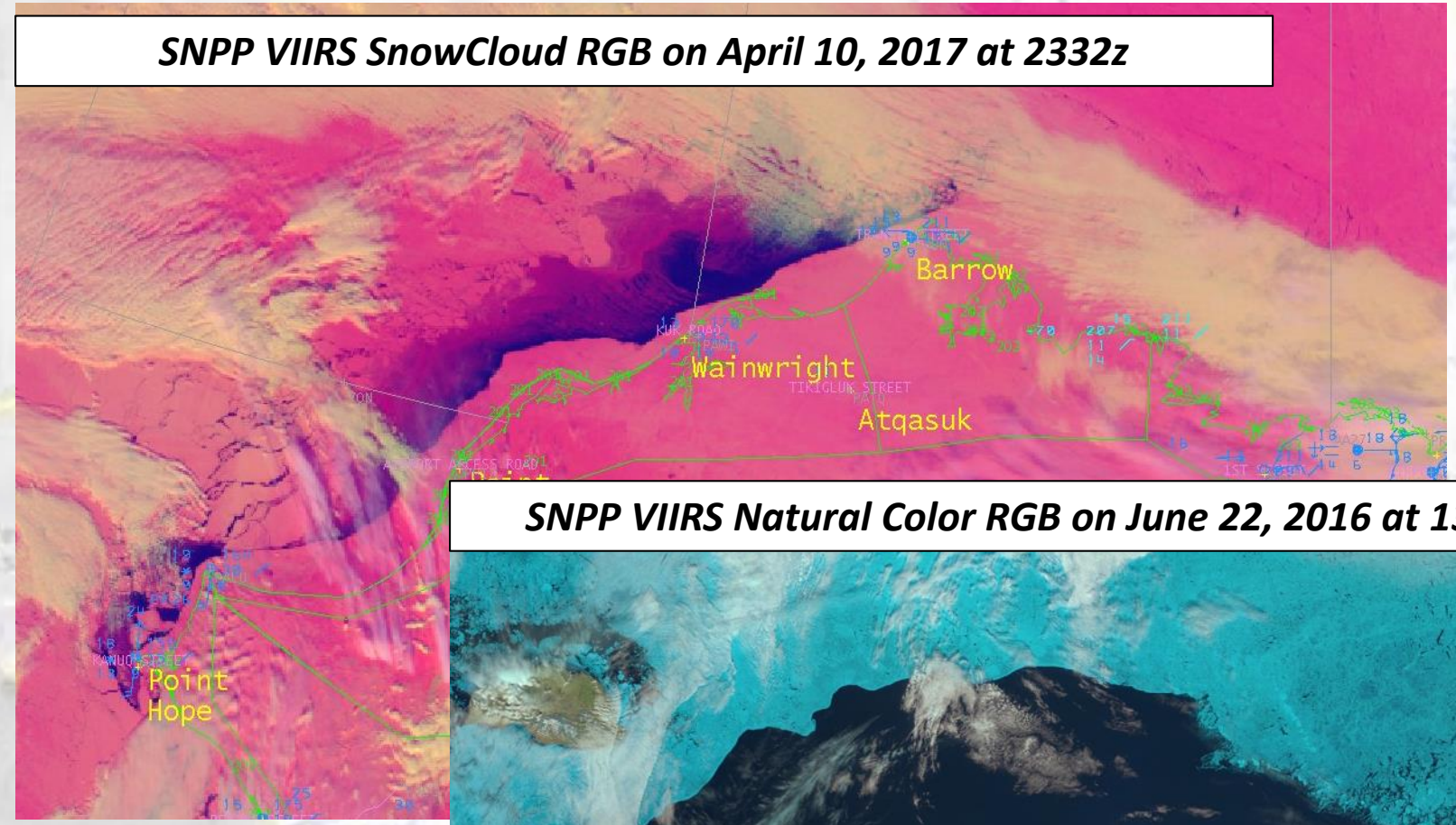


SNPP-NOAA 20 [SPoRT] 24-hr Nighttime Microphysics RGB on January 17, 2019 at 1940z

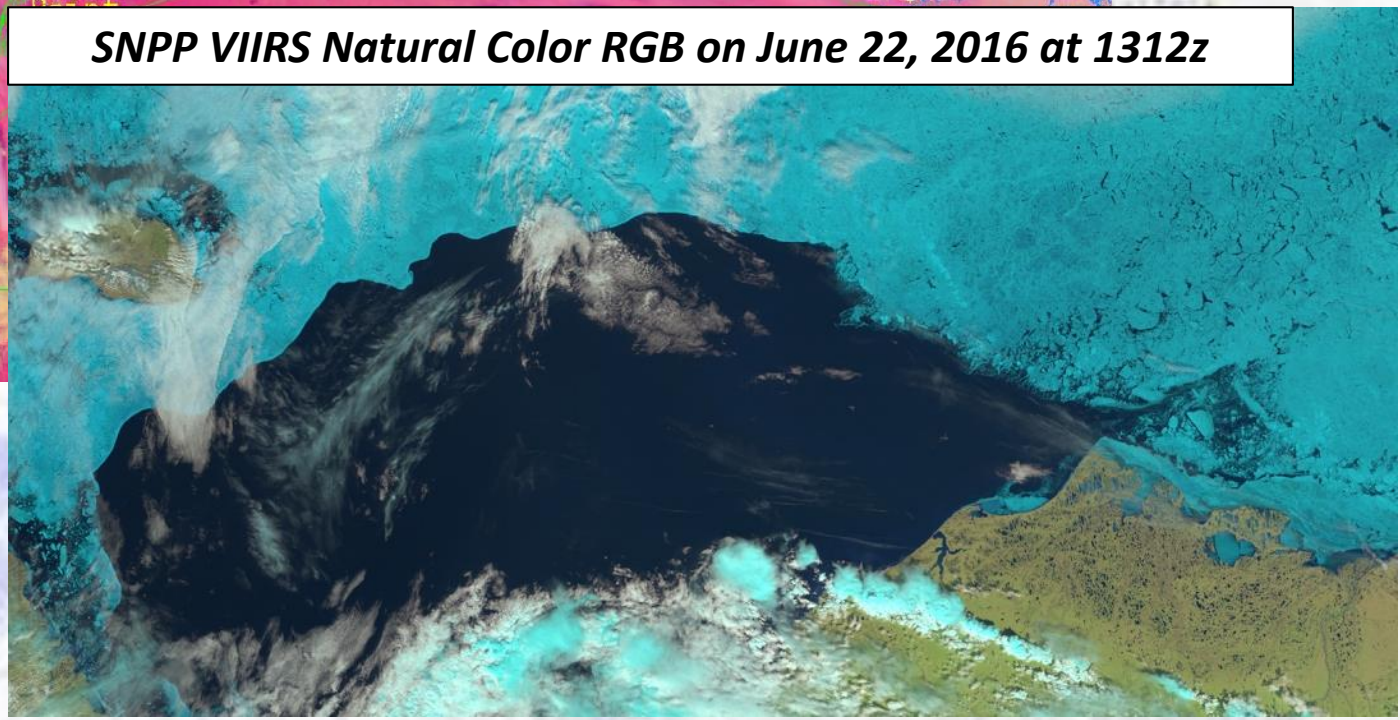

VIIRS NPP Infrared Satellite Image
Captured 12:30pm AKST December 9, 2019
Sea Ice
Young/First Year Thin Ice
Leads
Older, Multi-Year Ice (bright color)
Wainwright
Atqasuk
Point Lay
Point Hope
Prudhoe Bay
Kaktovik
Alaska

Sea Ice

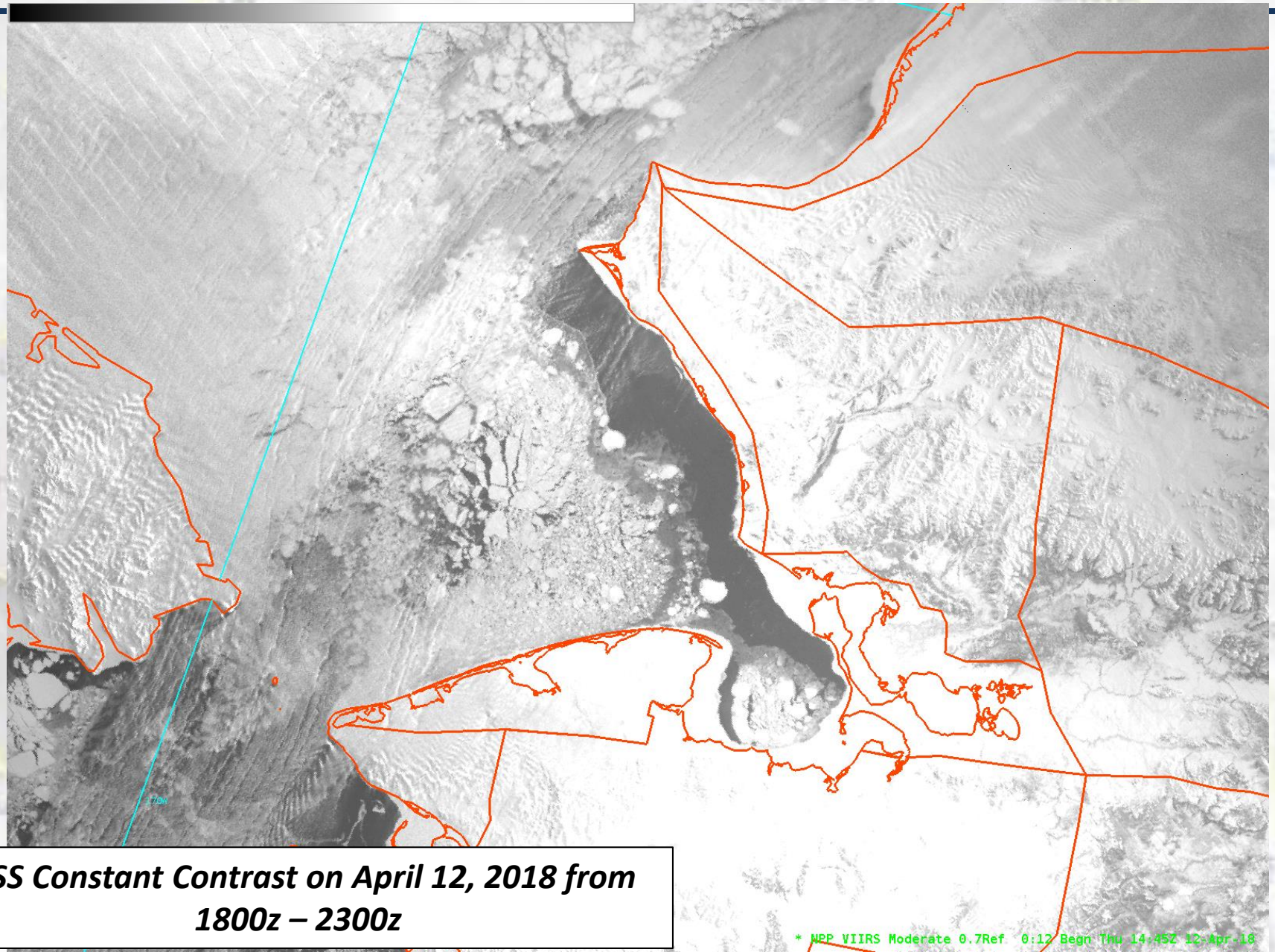
SNPP VIIRS SnowCloud RGB on April 10, 2017 at 2332z



SNPP VIIRS Natural Color RGB on June 22, 2016 at 1312z

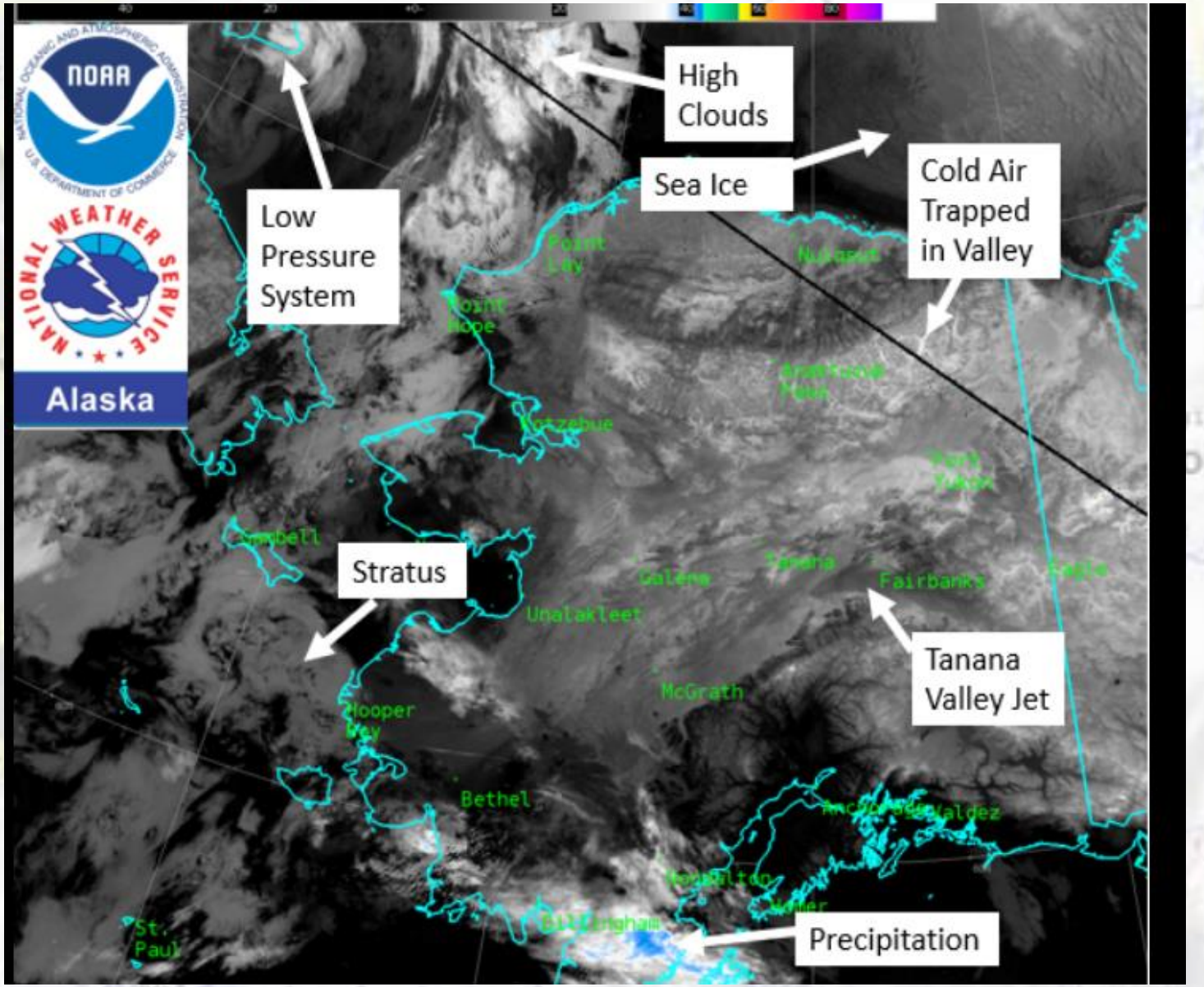


Sea Ice Movement

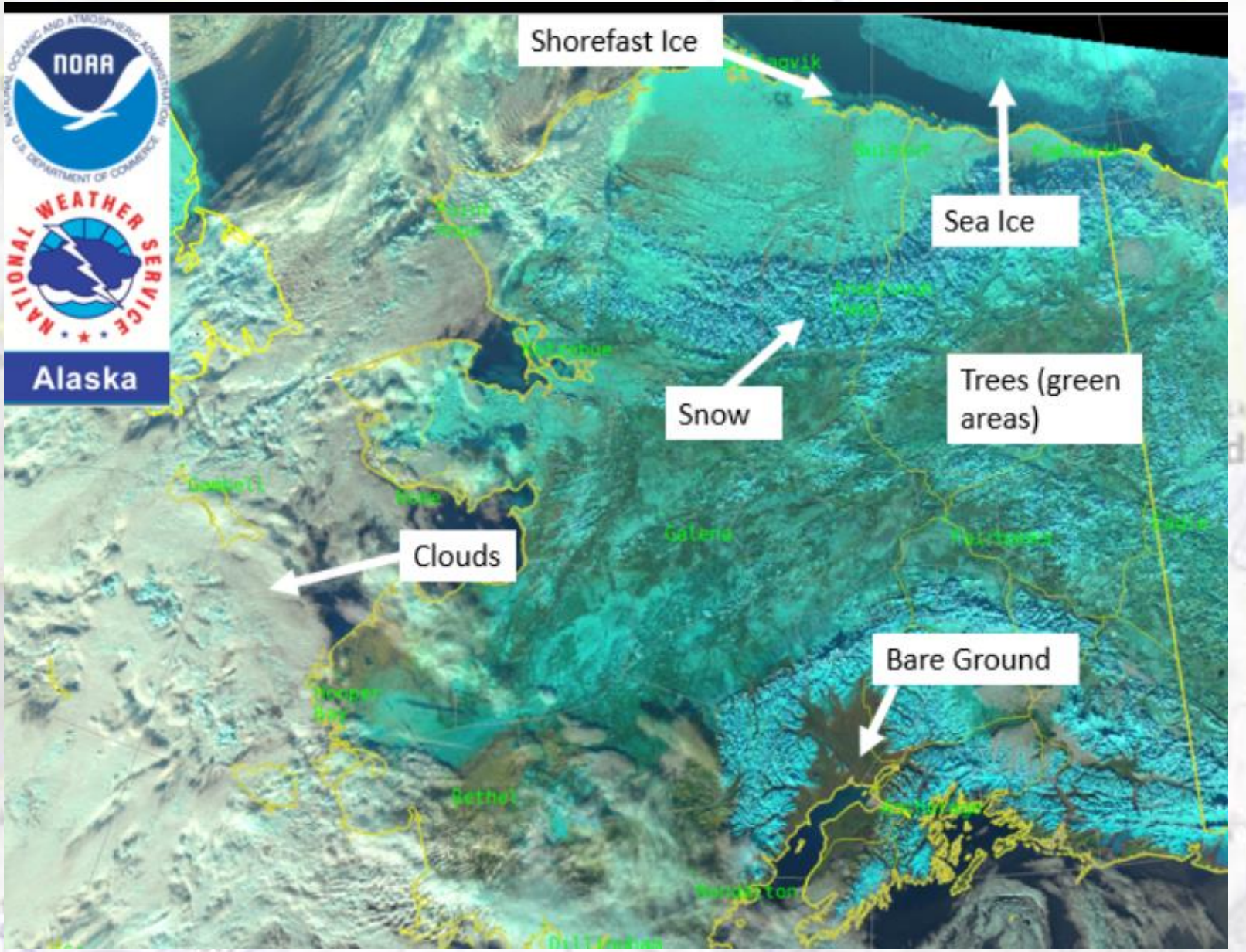


JPSS Constant Contrast on April 12, 2018 from 1800z – 2300z

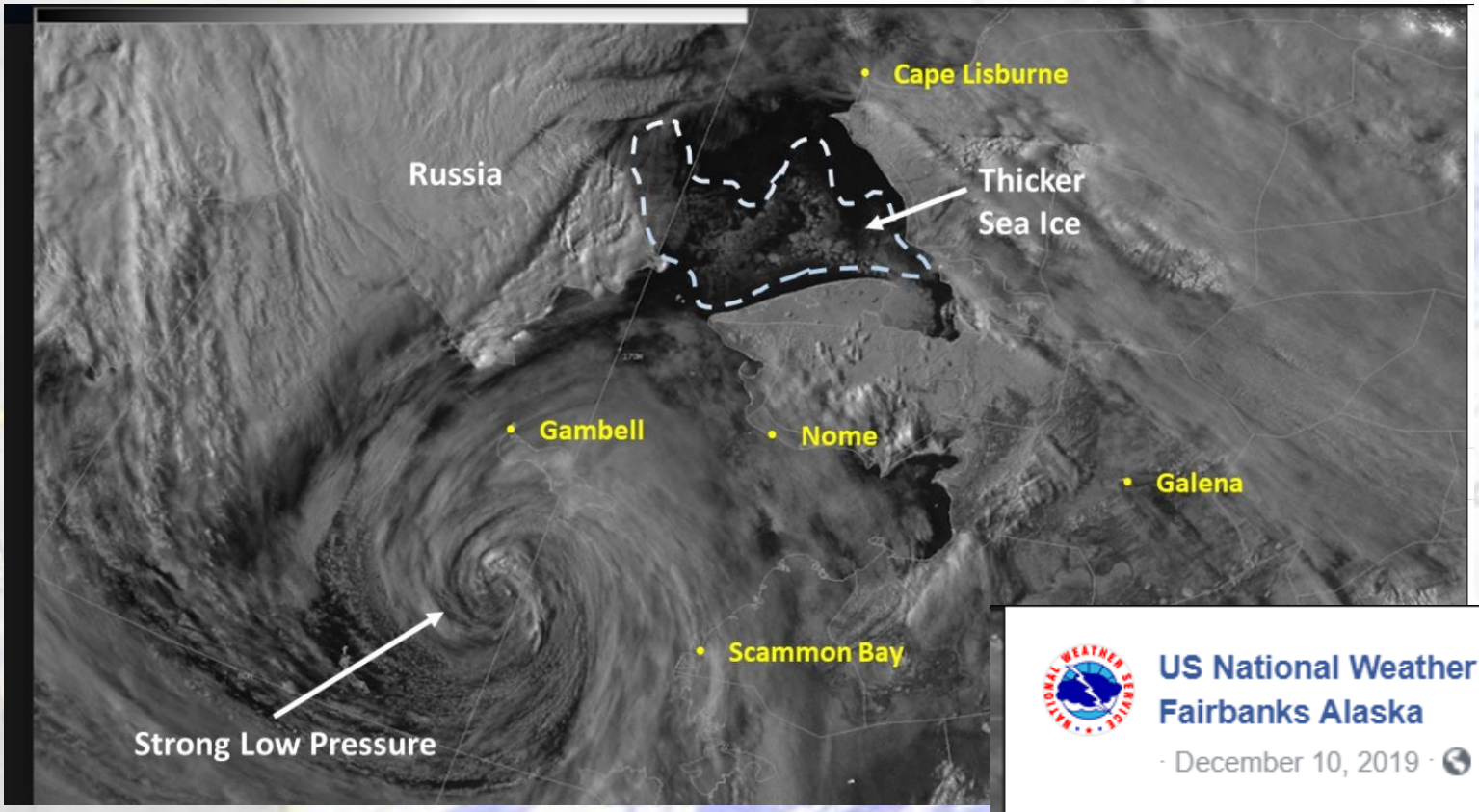
Social Media



Social Media



Social Media



US National Weather Service
Fairbanks Alaska
· December 10, 2019 ·

Here is another impressive VIIRS polar orbiting satellite image from 6 AM this morning. The spiral structure over the Bering Sea is the storm responsible for the strong winds on the West Coast as well as the widespread "warmth" spreading across much of the state. #akwx

WFO (LWX) Perspective: Satellite Imaging

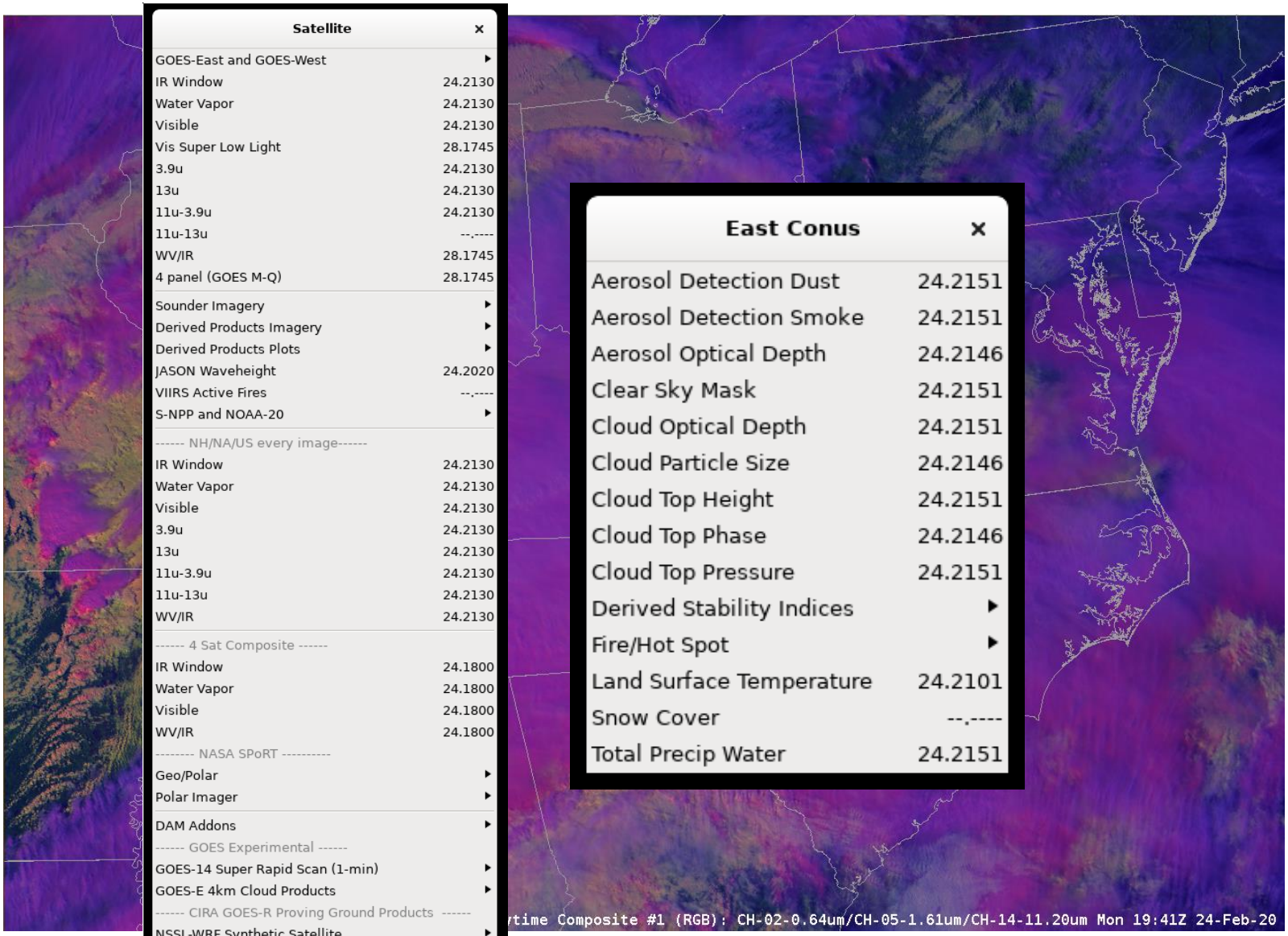
Steve Zubrick WFO Sterling, VA

For

2020 JPSS/GOES Proving Ground / Risk Reduction (PGRR) Summit

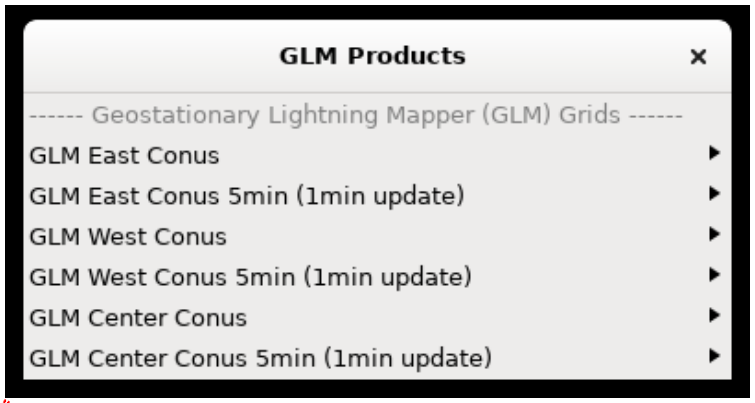
Feb 25, 2020

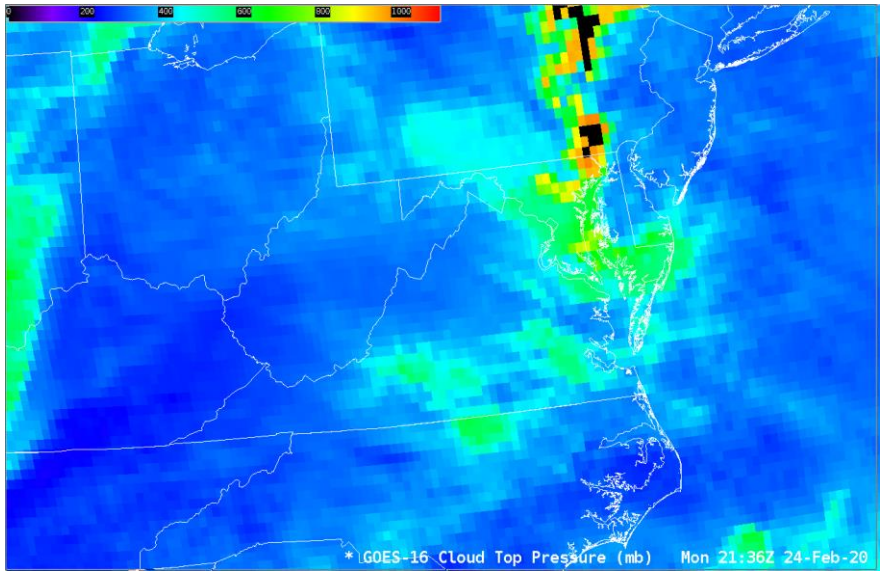
WFO LWX/Sterling – Perspective
Steve Zubrick, SOO-LWX



WFO/LWX – Satellite Imaging

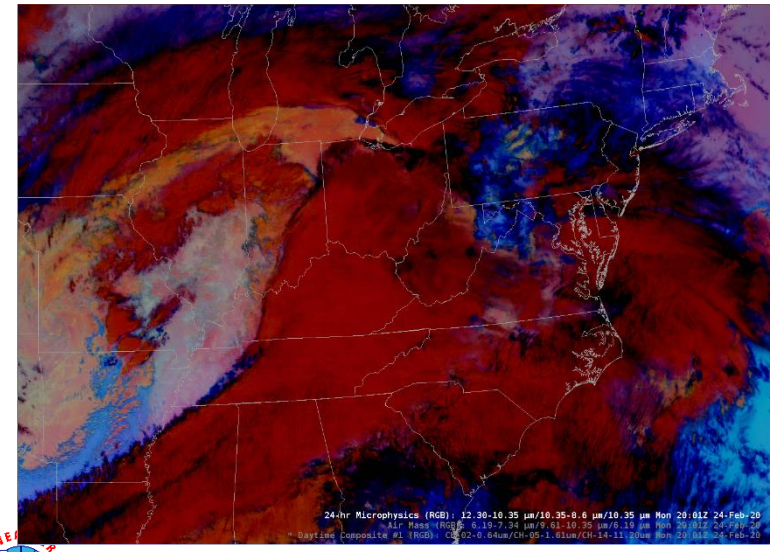
- GOES/JPSS support local Weather Forecast Office (WFO) mission in a multitude of way
- WFO/LWX uses Satellite observations to support all key mission tasks involving warning and forecast operations
- Satellite analysis is part of daily forecaster routine

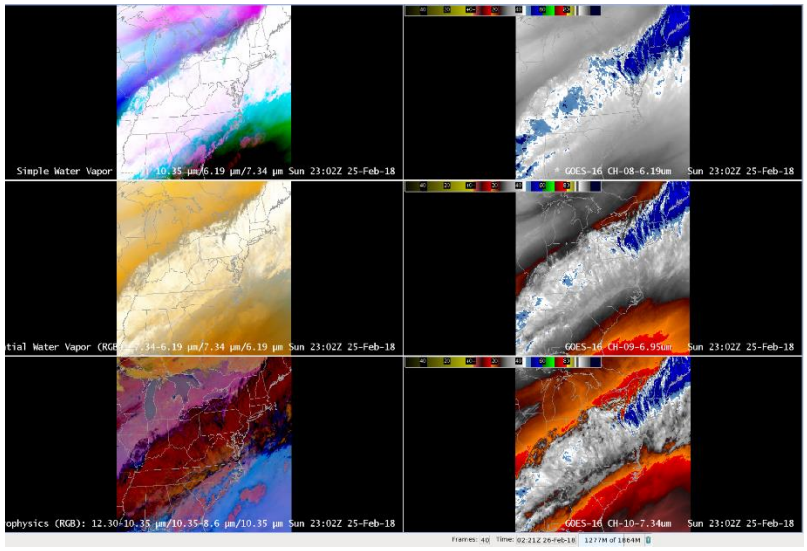




WFO/LWX – Satellite Issues

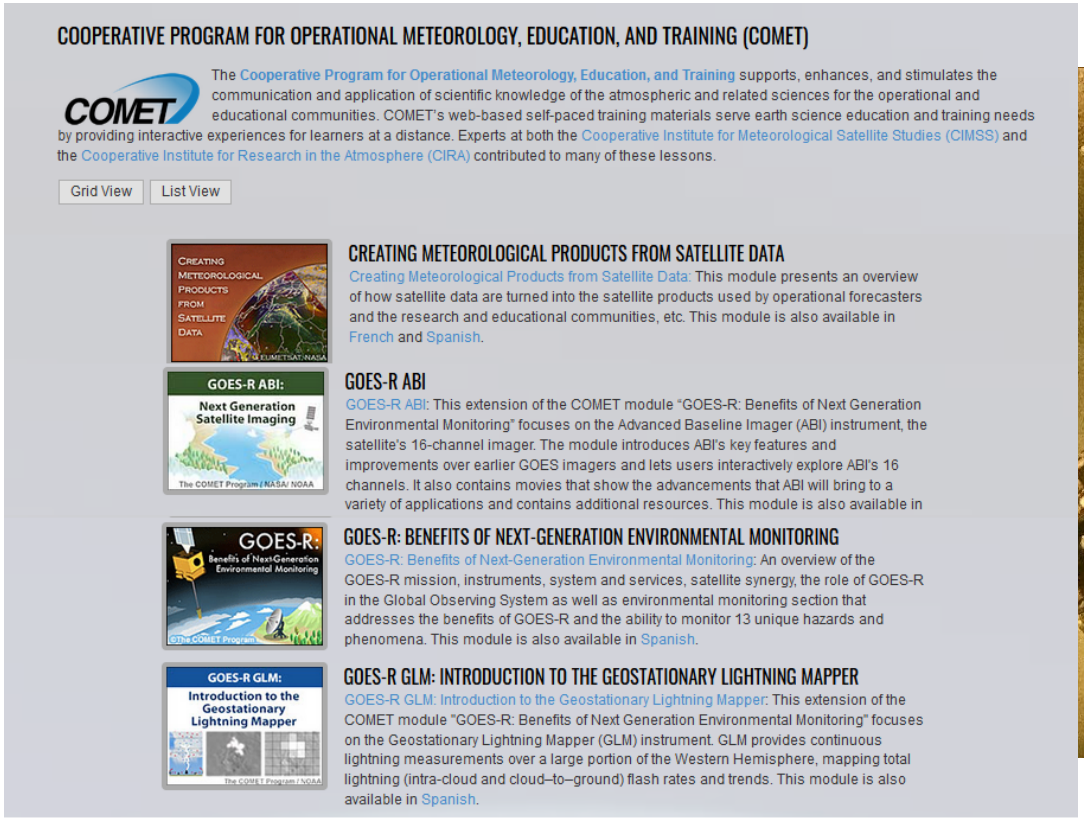
- Training (time for it!)
  - *New hires require lots of training*
- Slow response (10s sec) in AWIPS plotting complex RGB, derived, and multi-panel satellite products
  - *System lockups do occur requiring reset/reboot*

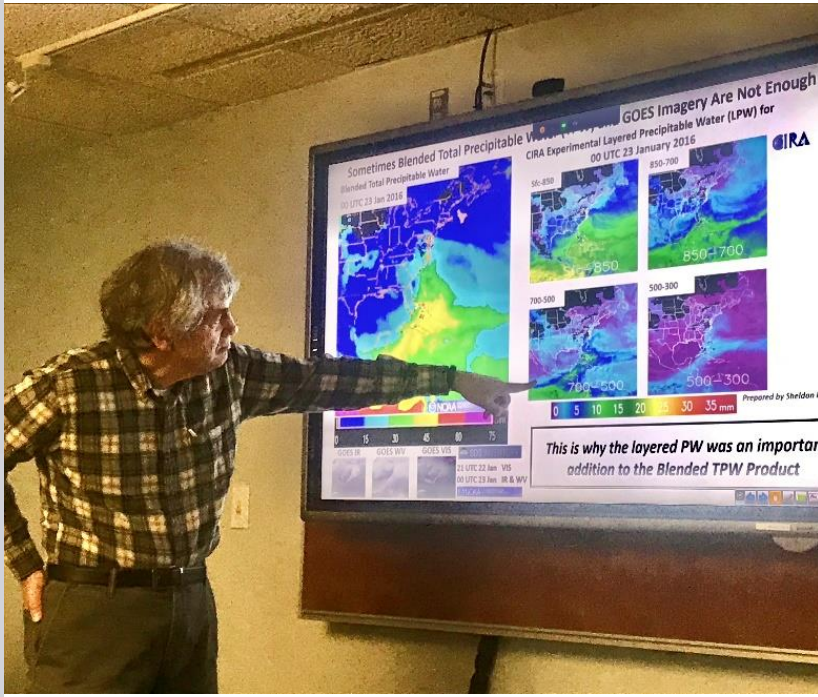




Key Issue – Satellite Training

- Satellite training is a continual (and never-ending!) process:
  - Local in-house training (Satellite Program Leader) and guest experts
  - Online resources (including CLC/COMET modules, blogs)
  - Attending conferences/workshops





WFO/LWX – Satellite Imaging: Training

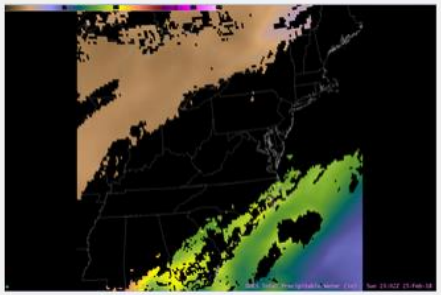
← RGBs better than single imagery alone

What is a "Sting Jet" →

Advected LPW vs Water Vapor channels

Posted on February 25, 2018 by luis.rosa

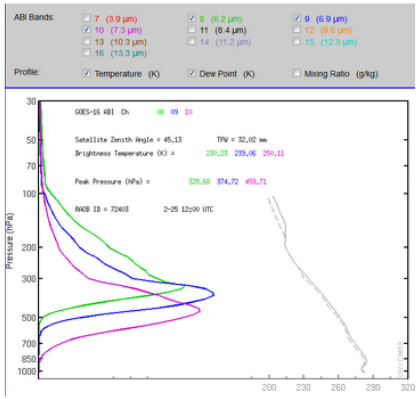
The Advected Layered Precipitable Water (ALPW) product offers a 4-dimensional structure of water vapor in the atmosphere. Retrievals of moisture and temperature are done in clear and cloudy (non-precipitating) regions using microwave sensors which can "see" through clouds. On the other hand, GOES-16 and future GOES-S do not have a sounder and can't see through clouds. This blog will illustrate the usefulness of the ALPW product when compared to single WV channels on GOES-16 and GOES Total Precipitable Water (TPW) product. Here is an image from the GOES-16 TPW product showing missing data over a large portion of the eastern United States on Sun evening Feb 25, 2018.

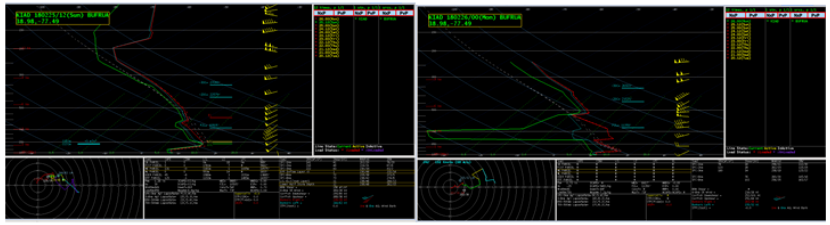


Since GOES-16 does not carry a sounder, TPW can't be calculated and shows as missing on this TPW product from Sun evening Feb 25 2018.

Here is a 6-panel display of different WV RGBs and the three GOES-16 WV single channels.

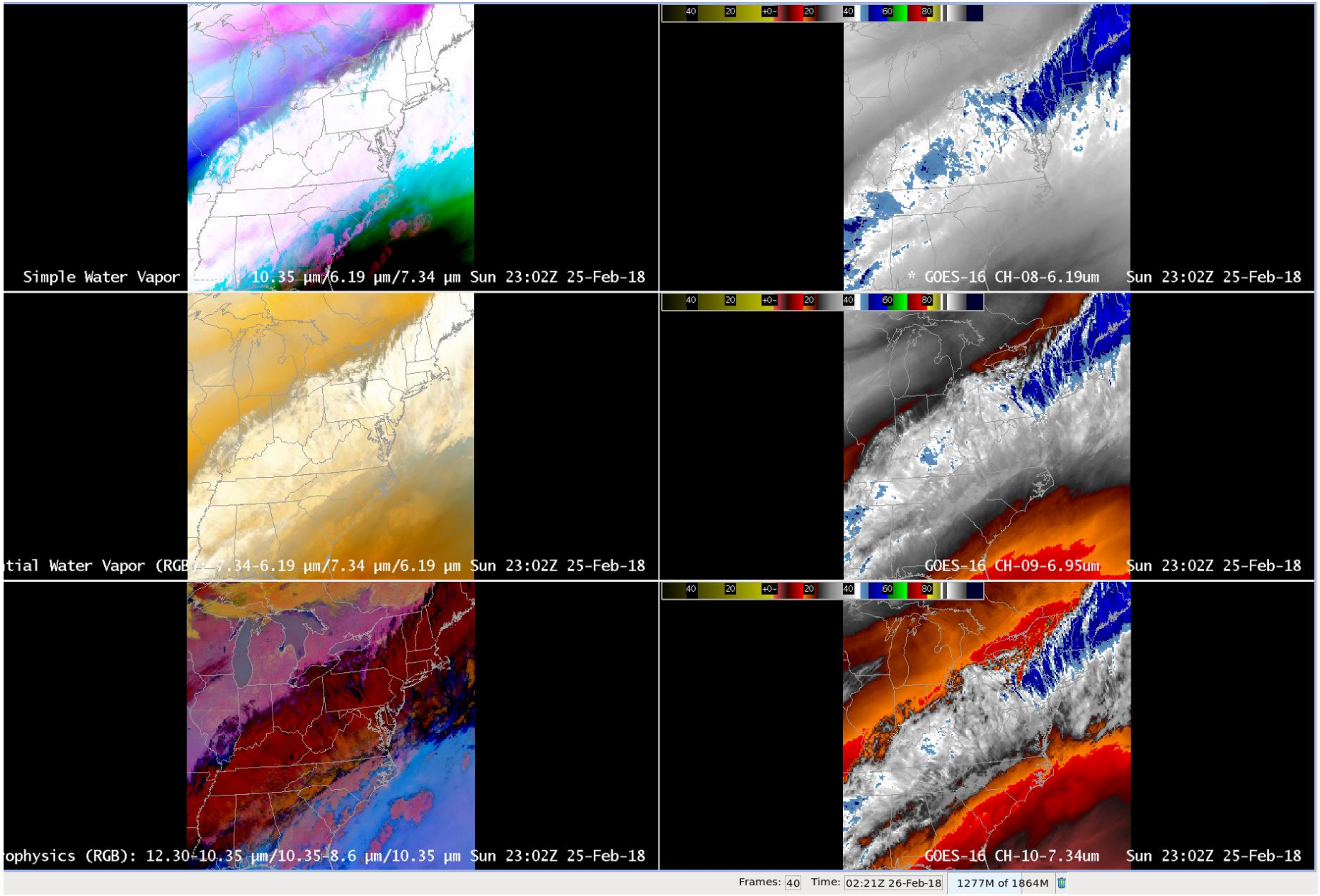
The GOES-16 weighting function profile for KIAD (below) valid 12Z Sun Feb 25 2018 showed that the three WV channels sampled a smaller portion of the atmosphere between 650 mb and 300 mb.

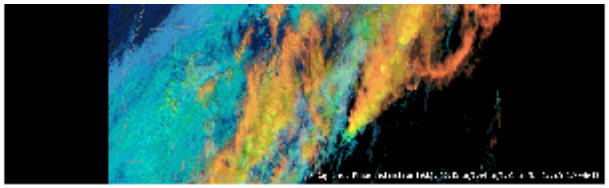




Here is animation of the ALPW product beginning 09Z Sun Feb 25 through 00Z Mon Feb 26 showing the advection of mid-level dry air on the 700-500 mb layer noted on the 00Z Mon Feb 26 IAD sounding.

WFO/LWX – Satellite Imaging: Training





On the animation above , high thin clouds like those over Lake Michigan appear as red as high clouds have a positive contribution on the “clean” window IR, but they are hard to see or have low reflectance or negative contribution on the visible and appear gray on the snow/ice band.

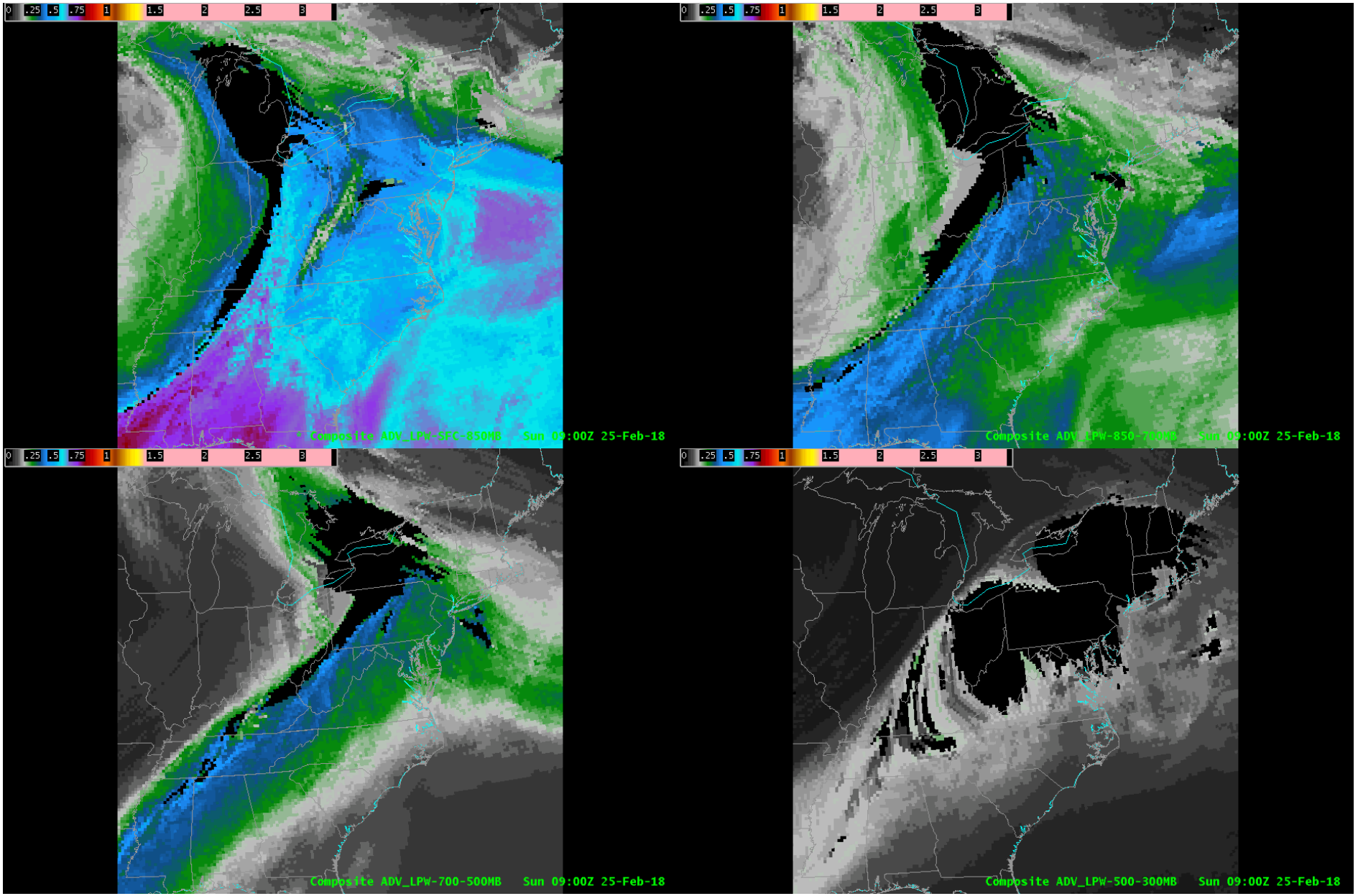
Snow and/or ice show up as green since they are both highly reflective on the 0.64 micron which makes up the green component, but have very little contribution on either the “clean”window IR and snow/ice band.

Water clouds show up as cyan (blue + green), since both are highly reflective on the visible 0.64 micron and the snow/ice band, but are hard to see or have a negative contribution on the longwave IR.

The convection offshore of the Carolinas is composed of mixed clouds (water + ice clouds) and appears as orange, a color in between yellow and red.

Bare ground (see image below) will show up as blue since bare ground is highly reflective on the snow/ice band, but is not reflective on the visible or longwave IR.

WFO/LWX – Satellite Uses

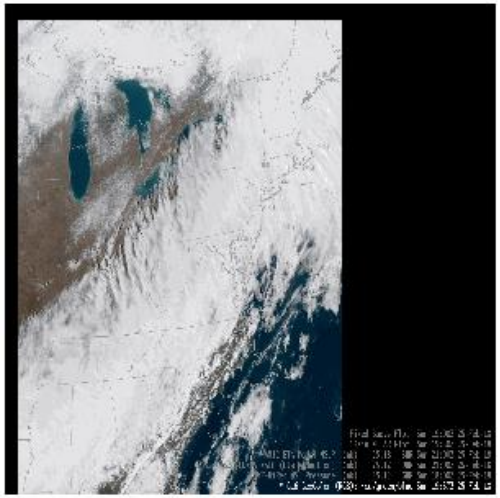


WFO/LWX – Satellite Uses: RGBs

RGBs better than single imagery alone

Posted on February 25, 2018 by luis.rosa

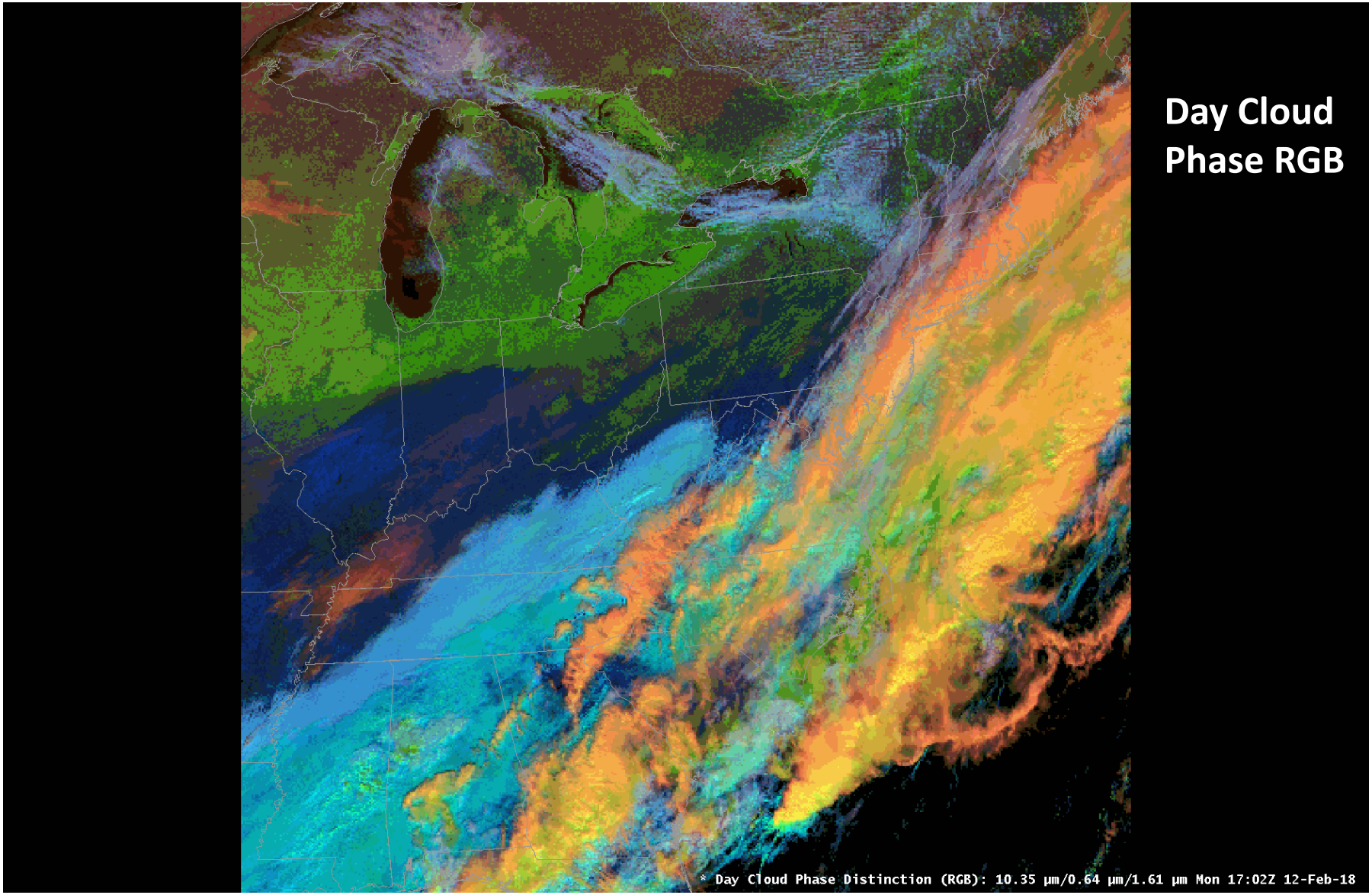
Some of the advantages of RGBs are to highlight features that are hard to distinguish with single images alone and to provide realistic products that can reduce ambiguities and simplify interpretation. In this example from Sun Feb 26 2018, I'll demonstrate that by looking at several RGBs you can tell a lot more about the type of clouds that are present and their composition. First, here is the GeoColor product (pseudo True Color) from Sun Feb 26. Widespread clouds cover a large portion of the eastern United States from New England southwest to the Gulf Coast states, but it is hard to tell about the different cloud types and their composition and whether there are single cloud layers or multiple cloud layers.



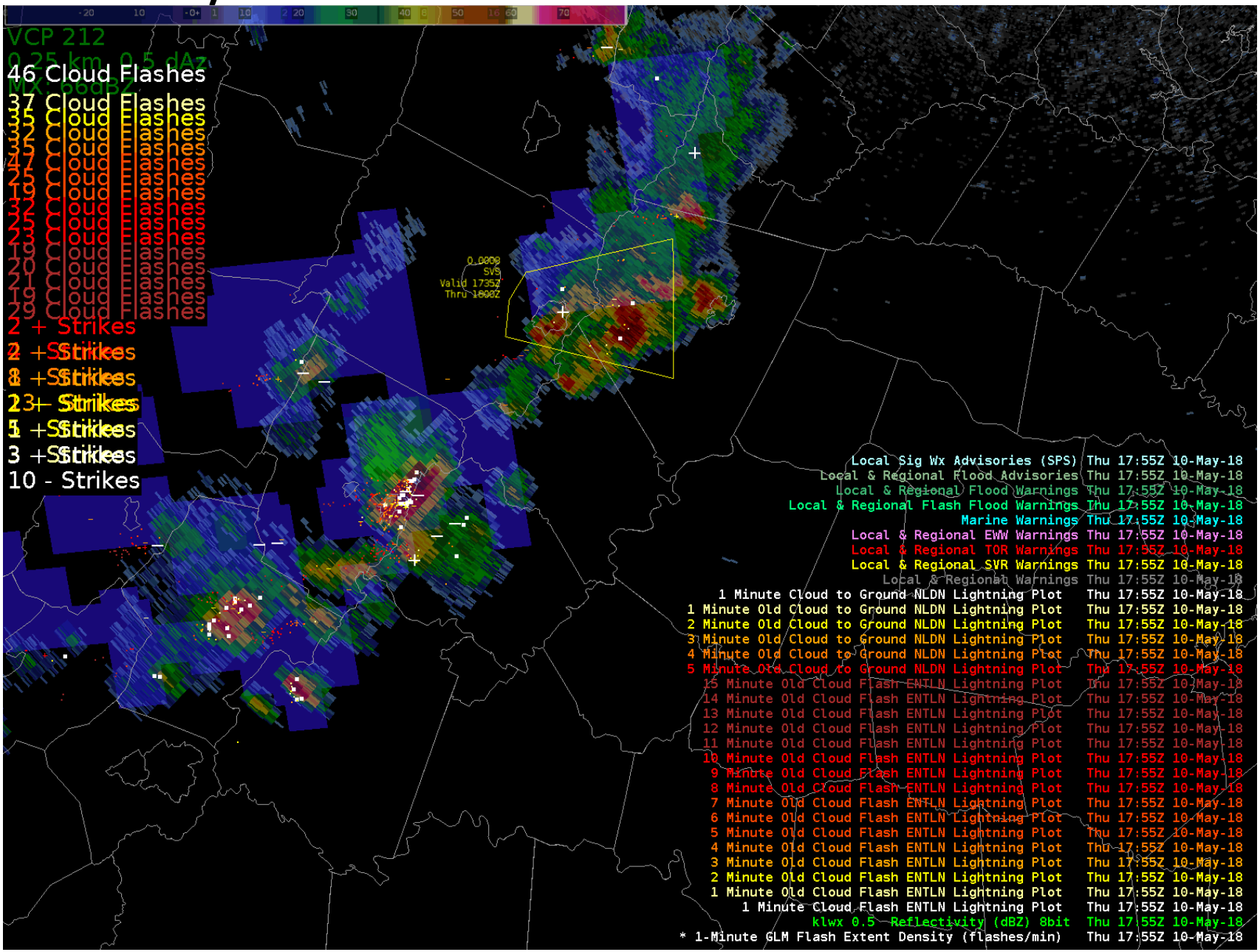
Now, by looking at a multi-panel display of different RGBs of Day Cloud Convection (top left), Cloud Phase Distinction (top right), and 24-hr microphysics (bottom left), we can tell a lot about the cloud type, their composition, and whether there are single clouds or multi-layered clouds.

WFO/LWX – Satellite Uses: Rapid Updates

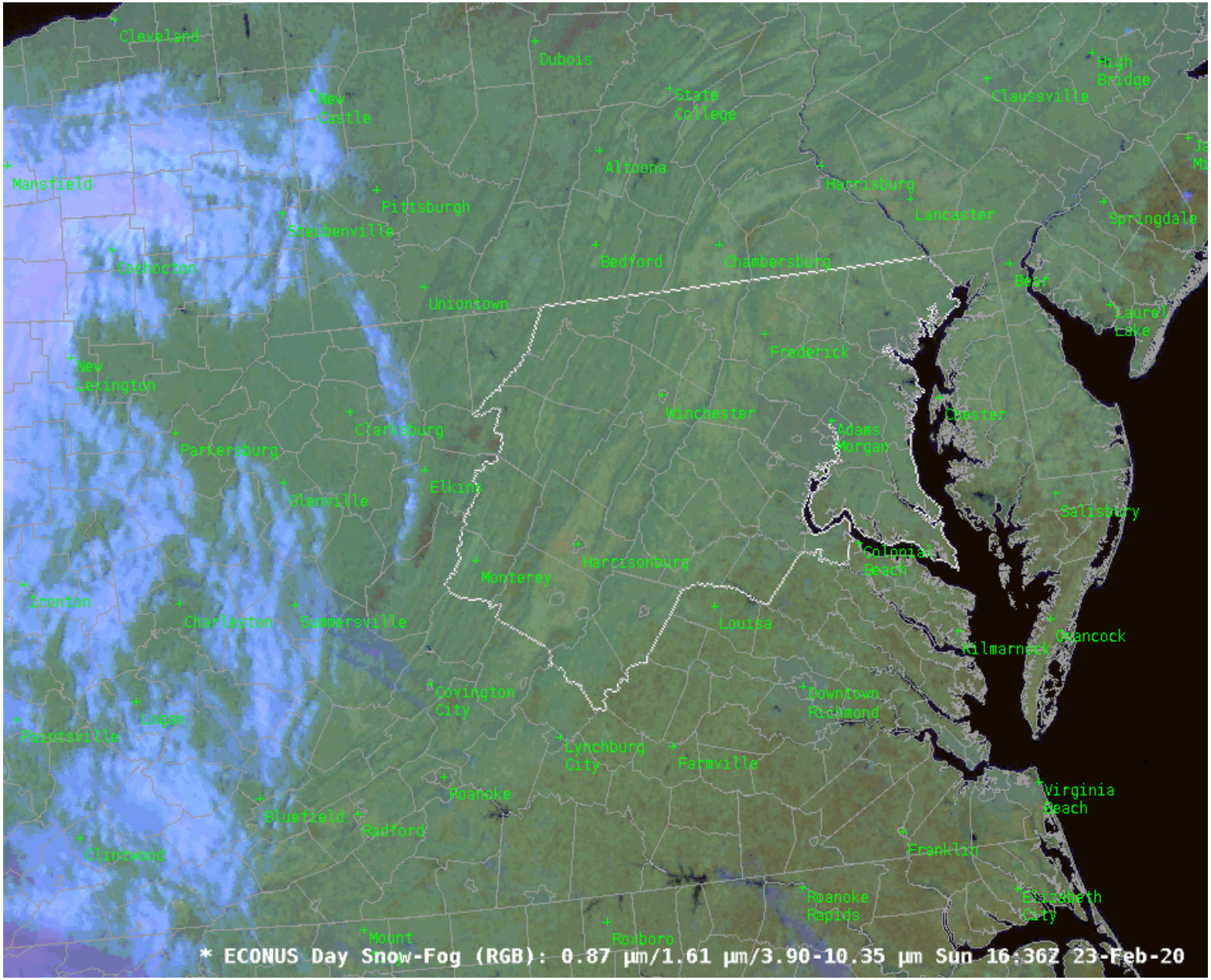
Rapid Updates (1/5 minutes)



WFO/LWX – Satellite Uses: Convection

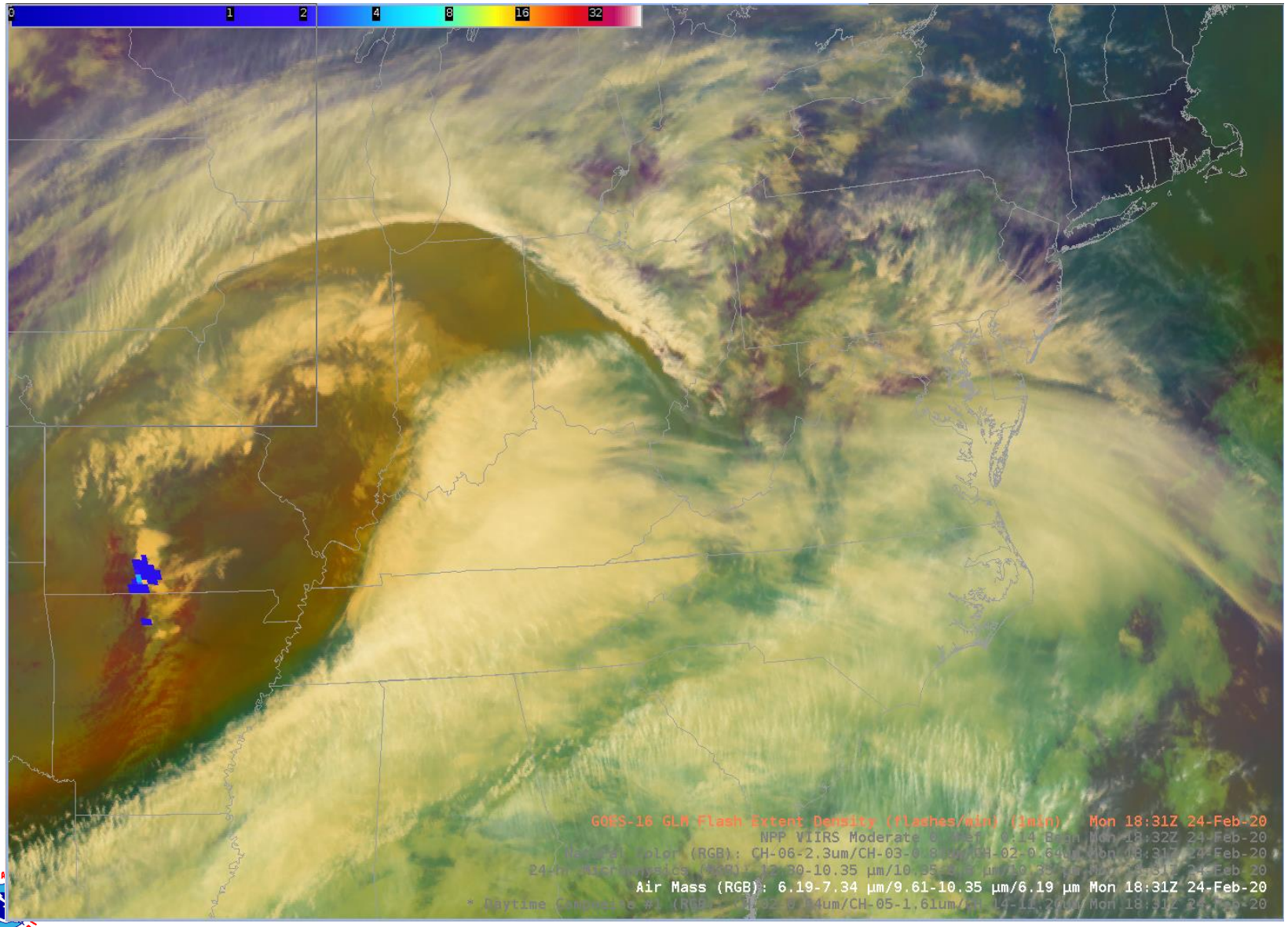


WFO/LWX – Satellite Uses: Social Media



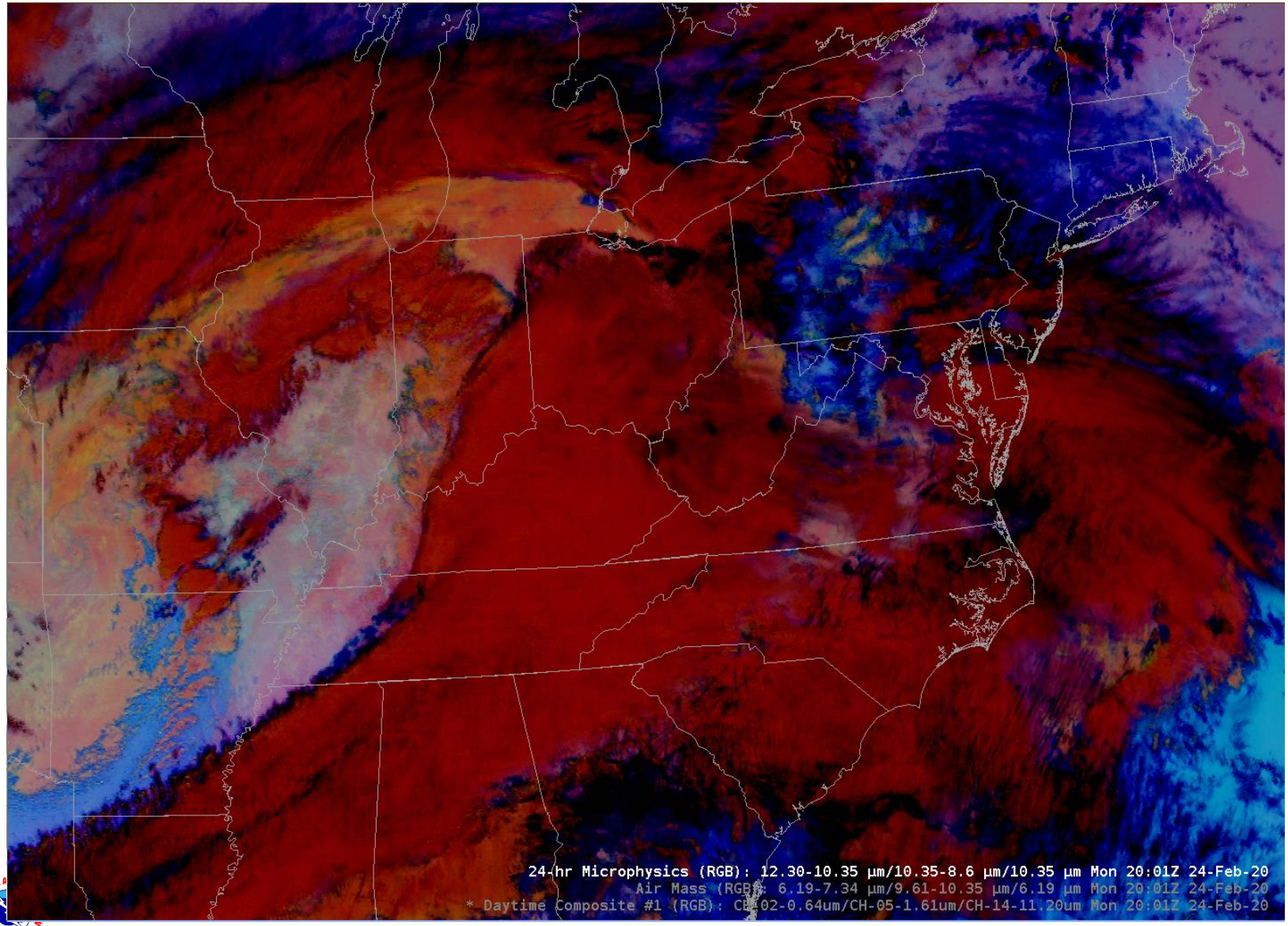
WFO/LWX – Satellite Imaging - Examples

- RGB and Derived products: Air Mass RGB and GLM FED



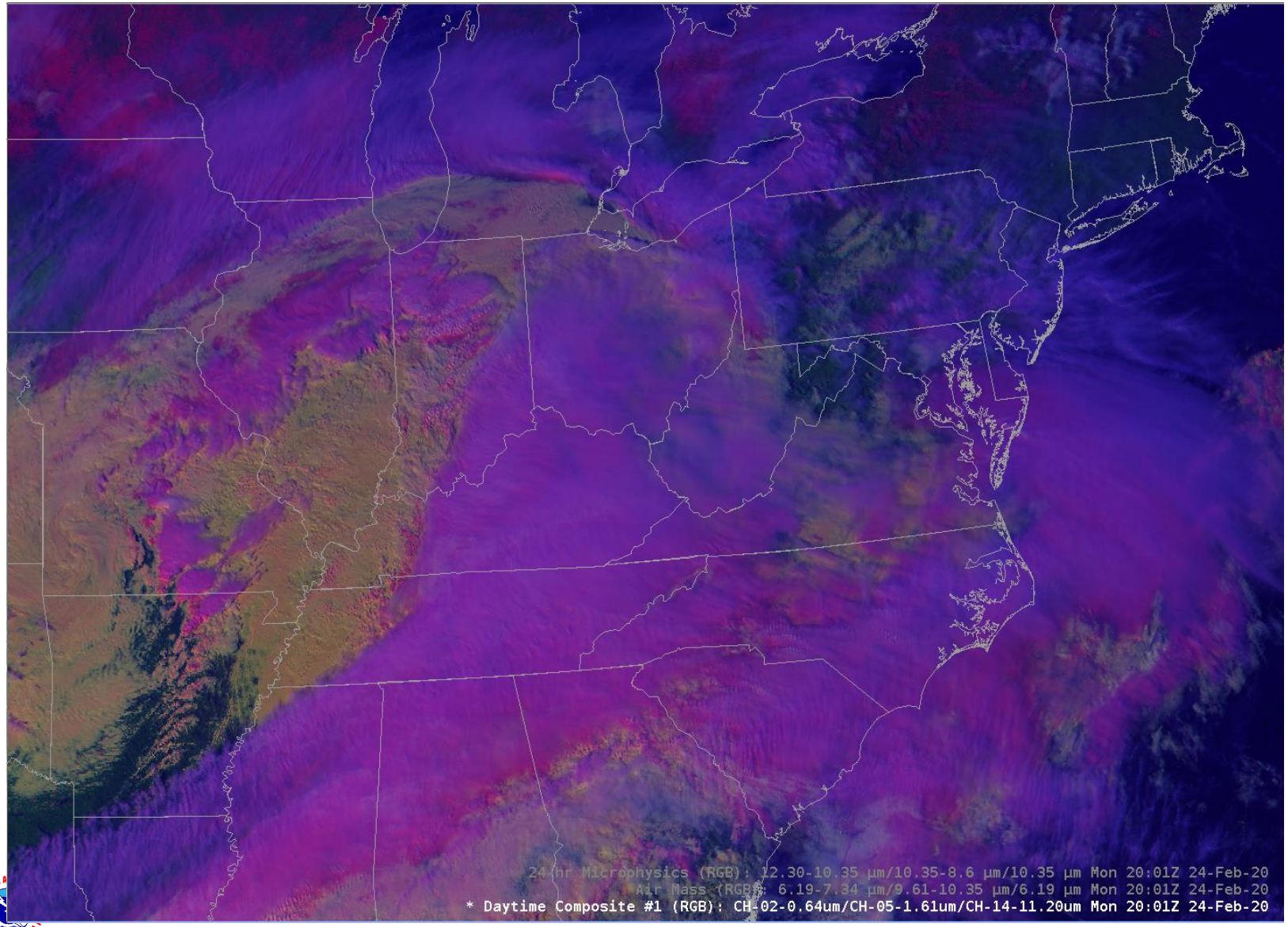
WFO/LWX – Satellite Imaging - Examples

- RGB and Derived products: 24-hr Microphysics



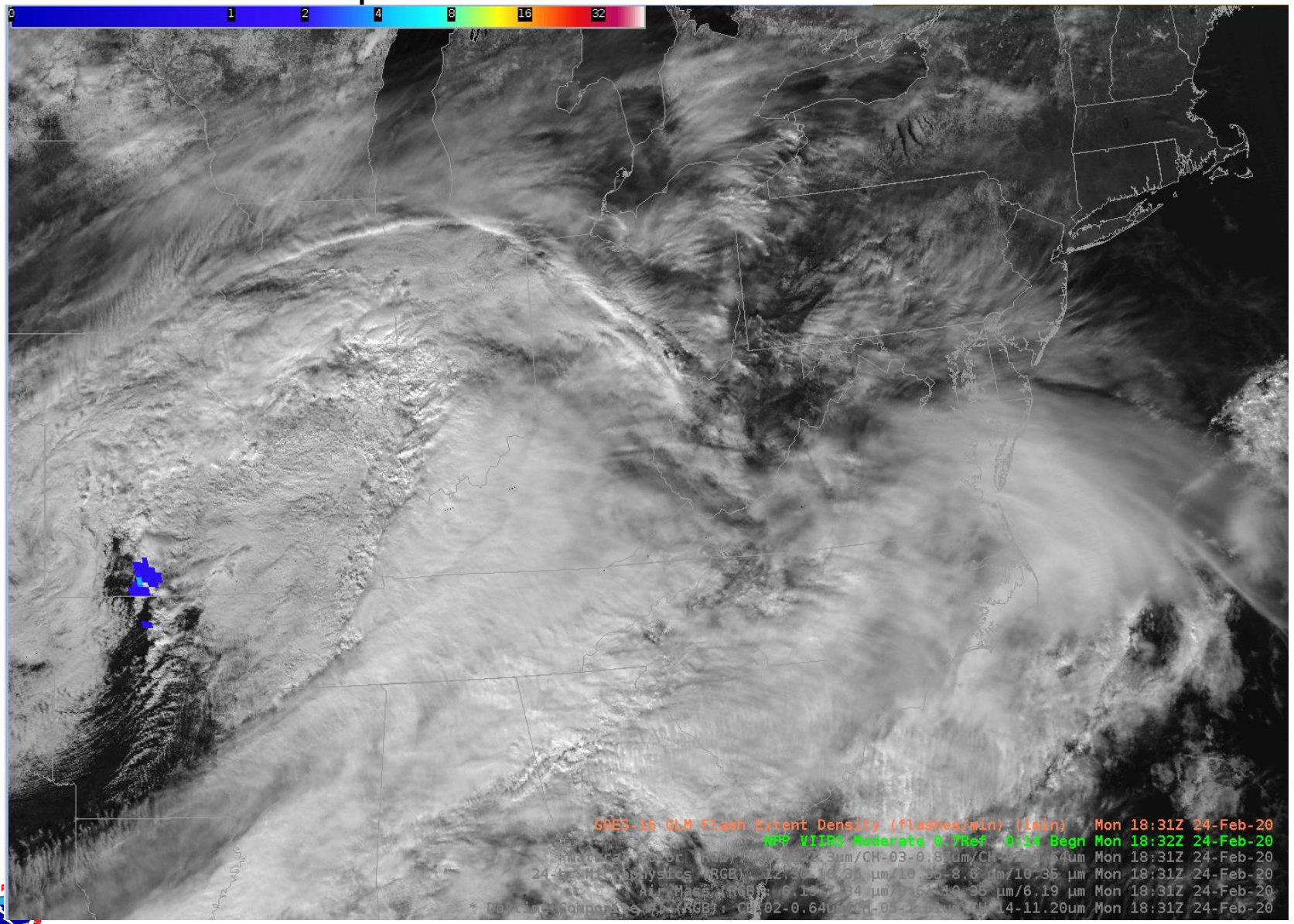
WFO/LWX – Satellite Imaging - Examples

- RGB and Derived products: Daytime Composite (#1) RGB



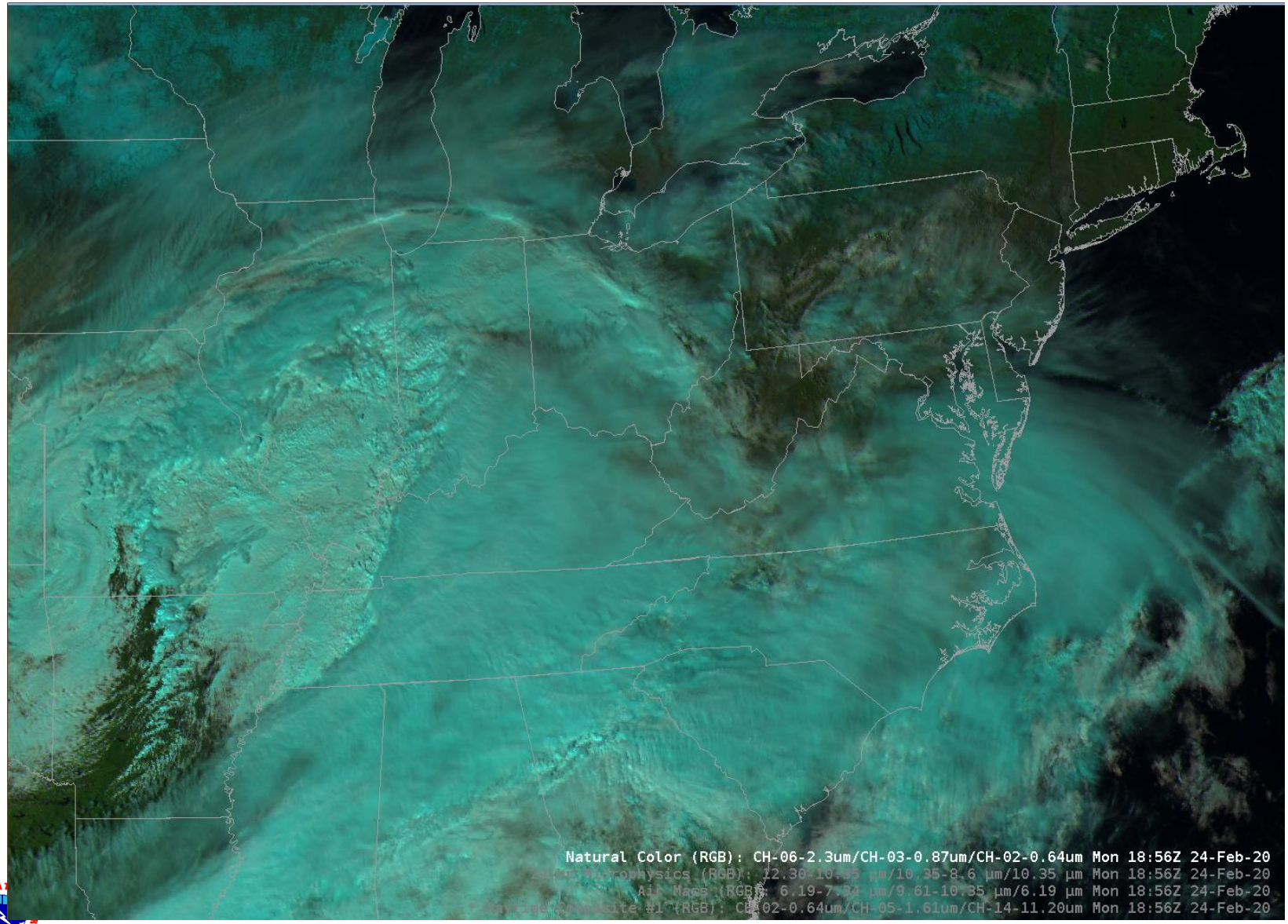
WFO/LWX – Satellite Imaging - Examples

- RGB and Derived products: NPP VIIRS Constant Contrast



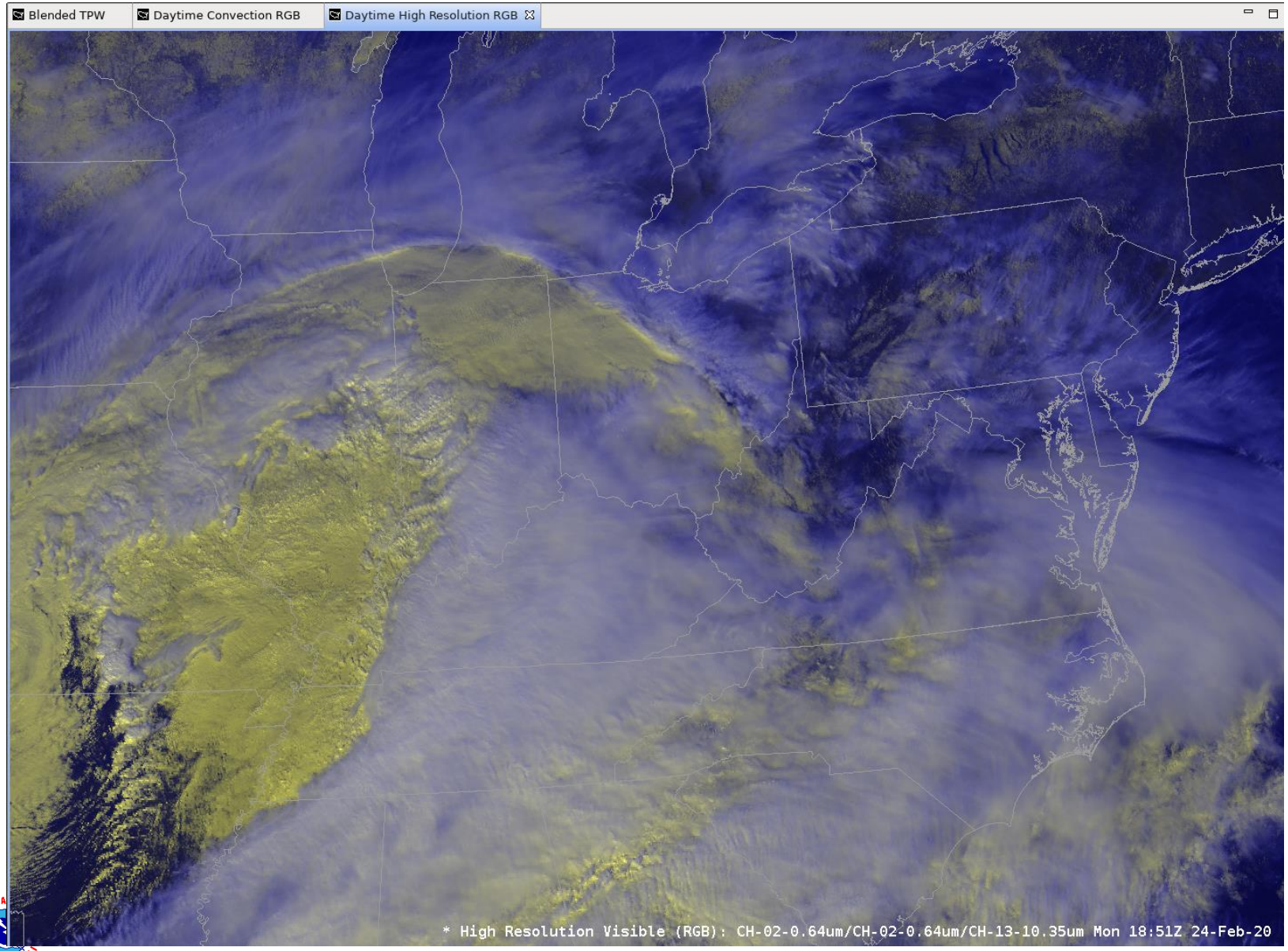
WFO/LWX – Satellite Imaging - Examples

- RGB/Derived products: Natural Color RGB (Channels 6/3/2)



WFO/LWX – Satellite Imaging - Examples

- RGB and Derived products: High Res Visible RGB

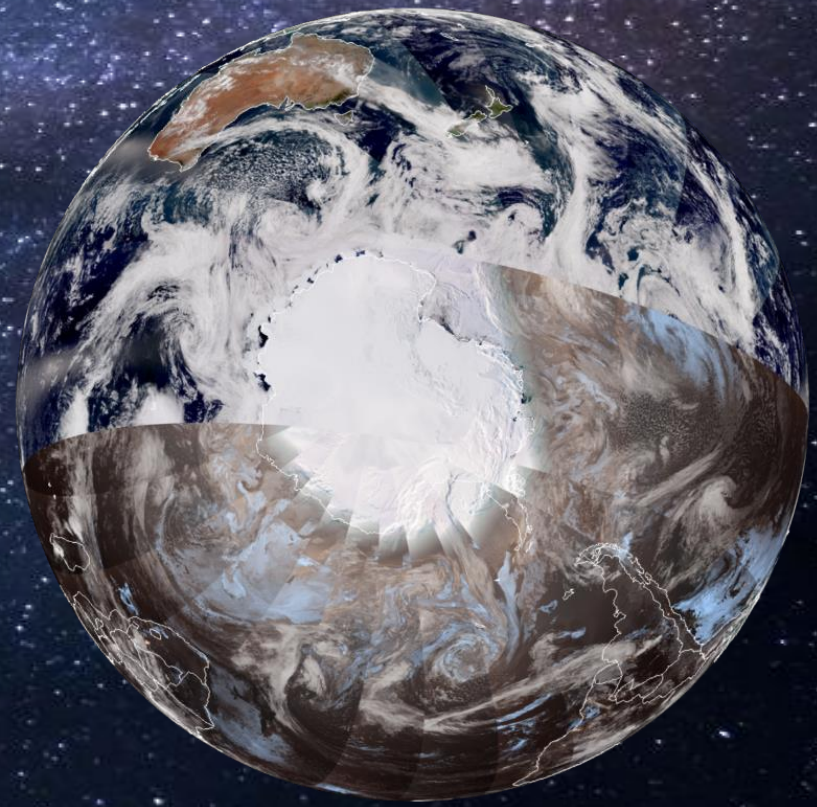


WFO/LWX – Satellite Use - Summary

- Satellite imagery vital to supporting WFO forecast and warning operations
- Time for training is a challenge in light of other training needs (e.g., IDSS, Forecast Builder, etc)
  - *Especially for new hires*
- AWIPS workstation slow response in plotting complex Sat. RGB/derived/multi-panel products needs to be addressed
  - *System lockups also occur requiring reset/reboot*

END – WFO/LWX Perspective

Satellite Imagery:
A Developer's Perspective



Steven Miller

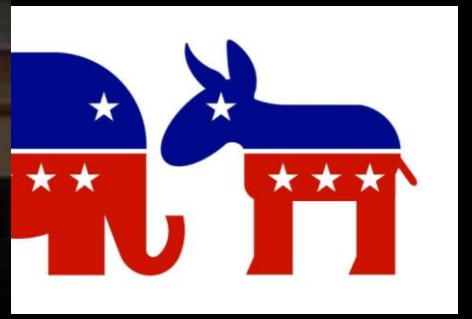
Cooperative Institute for
Research in the Atmosphere
Colorado State University

JPSS / GOES-R Proving Ground and Risk Reduction Summit
Imagery Panel Discussion: 25 February 2020
NCWCP, College Park, MD

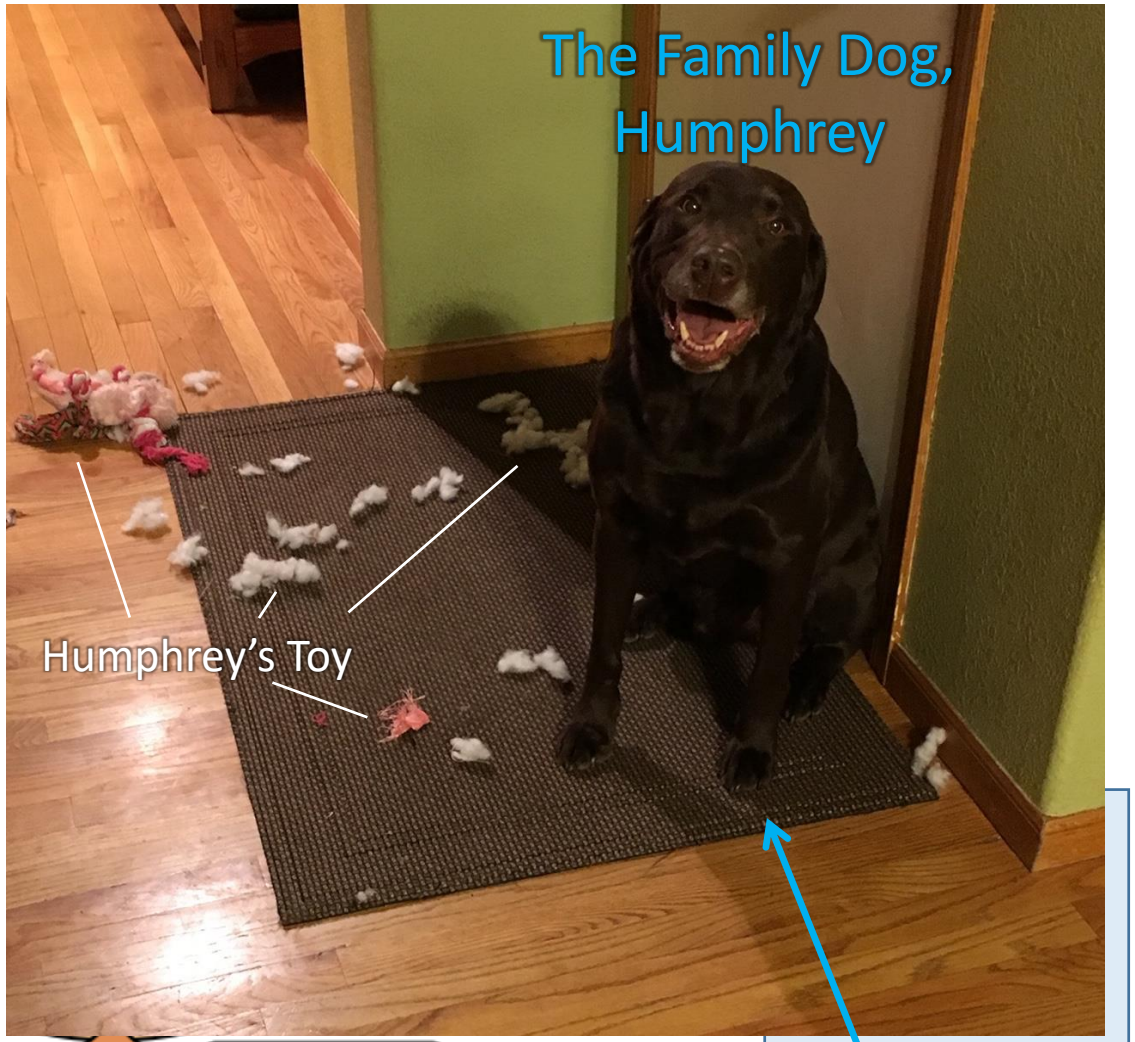
GENERAL DISCLAIMER

The views, opinions, and findings contained in this presentation are those of the presenter and should not be construed as an official National Oceanic and Atmospheric Administration (NOAA) or U.S. Government position, policy, or decision.

In fact, you might just go ahead and start checking your e-mails now…

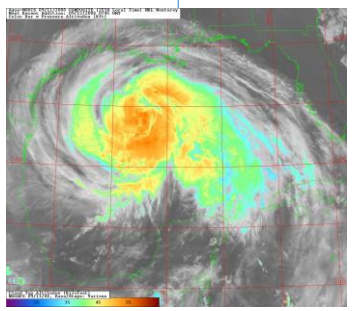


A Taxonomy of Satellite Imagery



Species → True/False Color

8-bit Preset Color Palettes



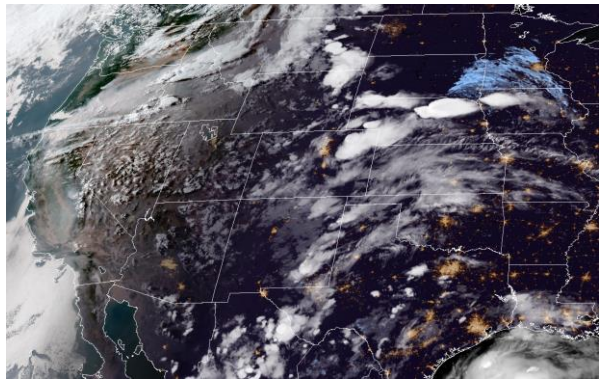
Red/Green/Blue "RGB" 24-bit (No Color Palette)

Image + Value RGB + Alpha Layer

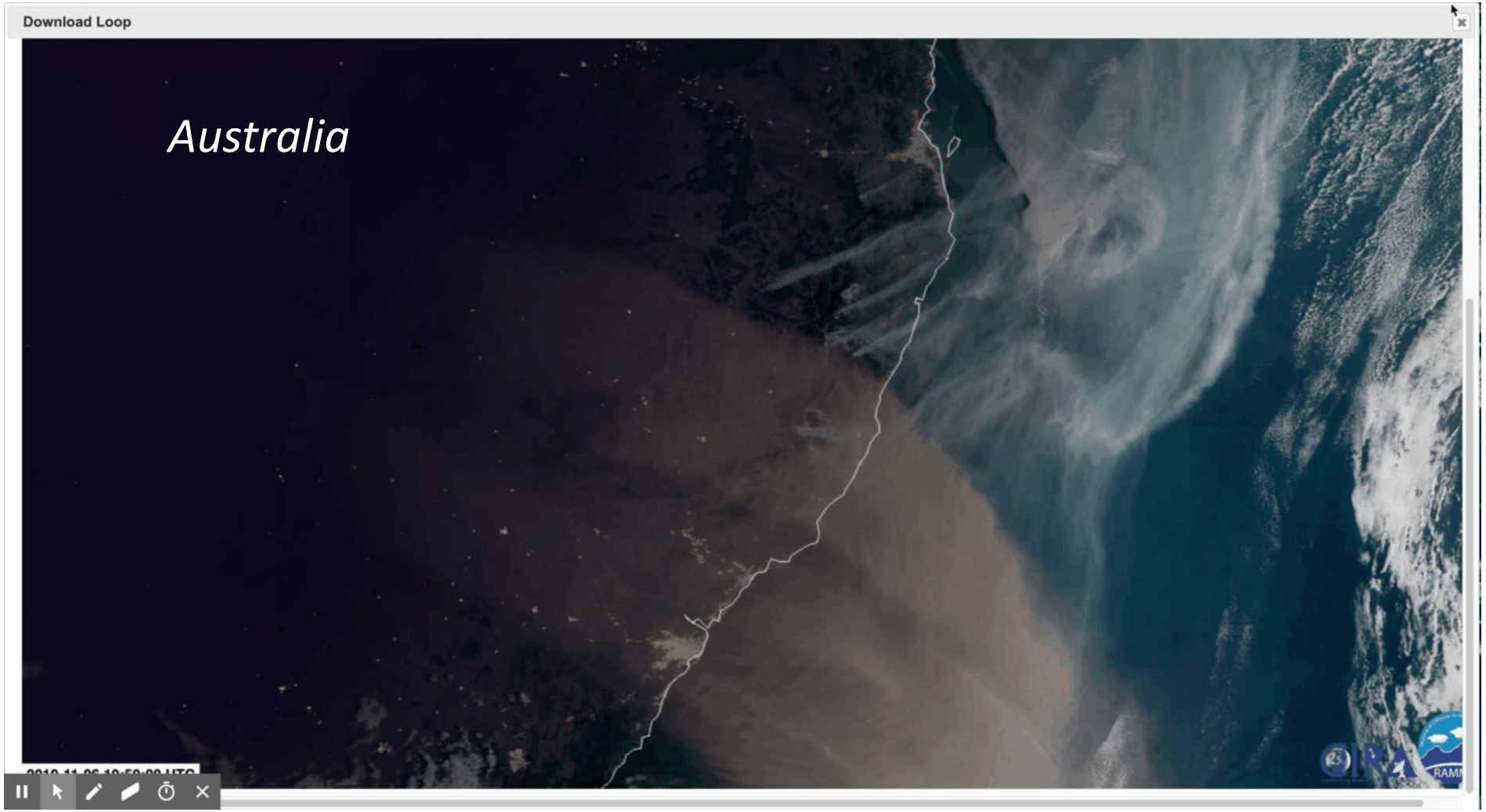
'True Color' RGB

Blended Layers *GeoColor*

'False Color' RGB



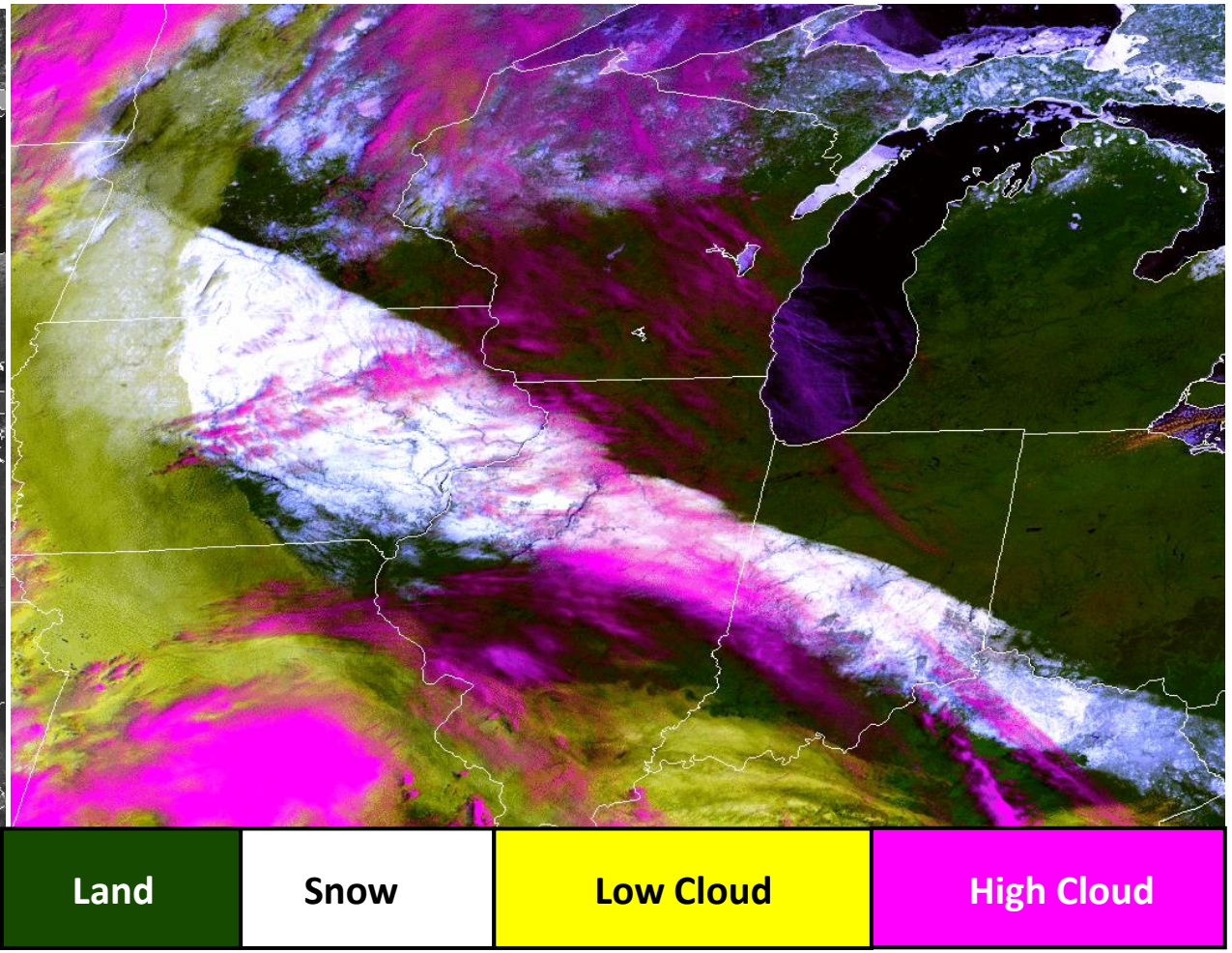
Make It Intuitive…



→ **Take advantage of our inherent interpretive capabilities to minimize training!**

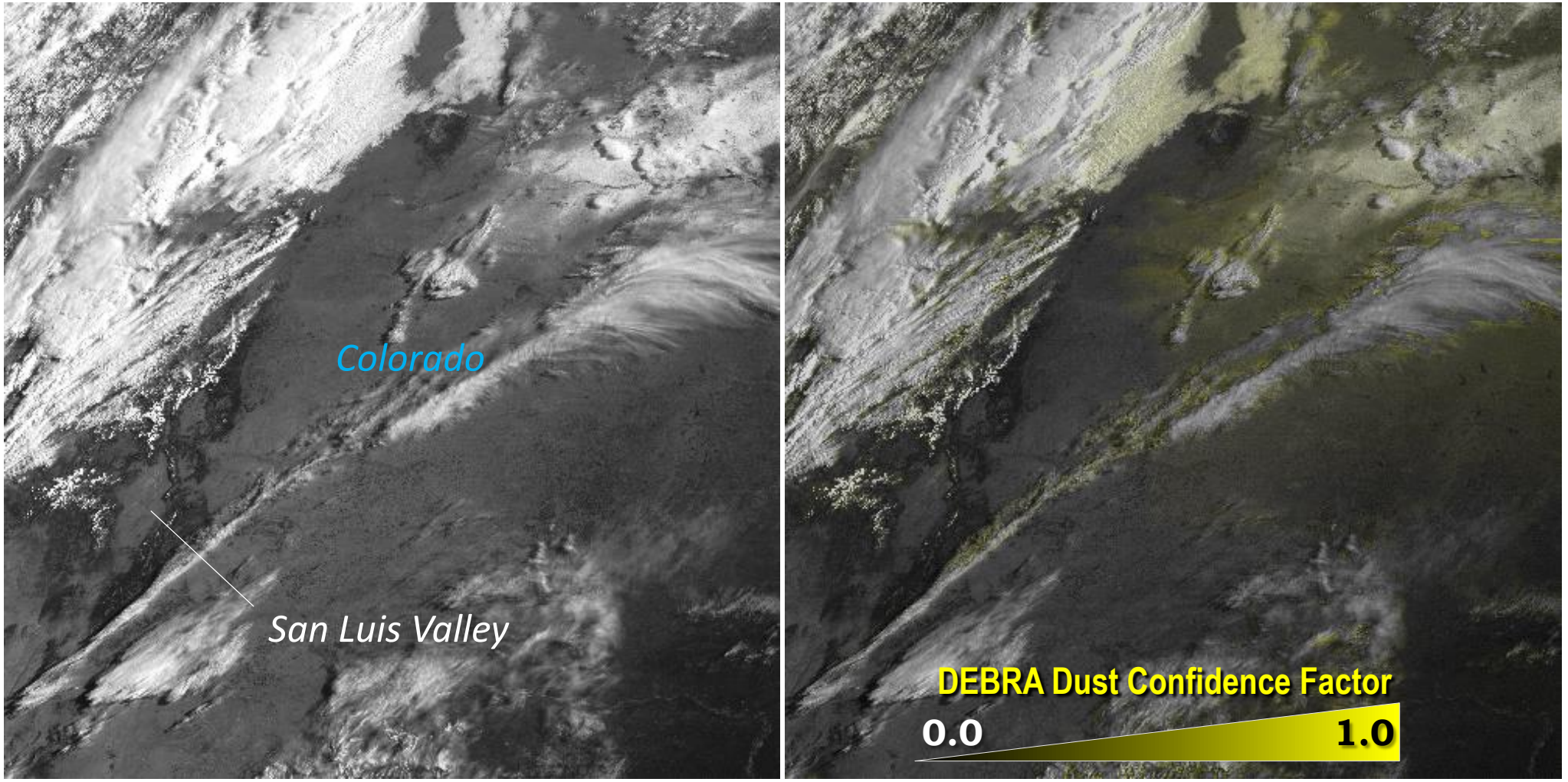
→ **Use true color as a comparative benchmark for your favorite *"color barf"* RGBs.**

Make Colors Meaningful….



→ **Enhancing snow as white can be more meaningful than other colors…**

Make It Pop….

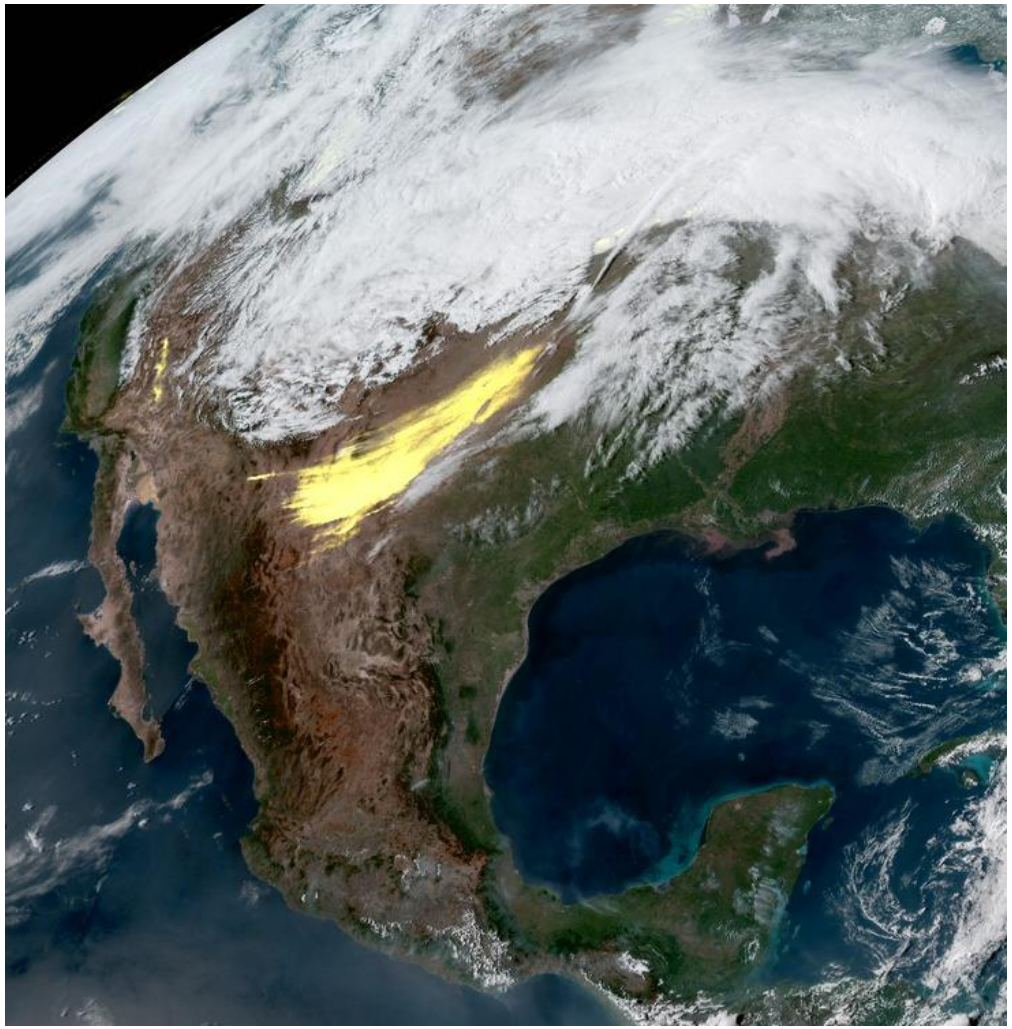


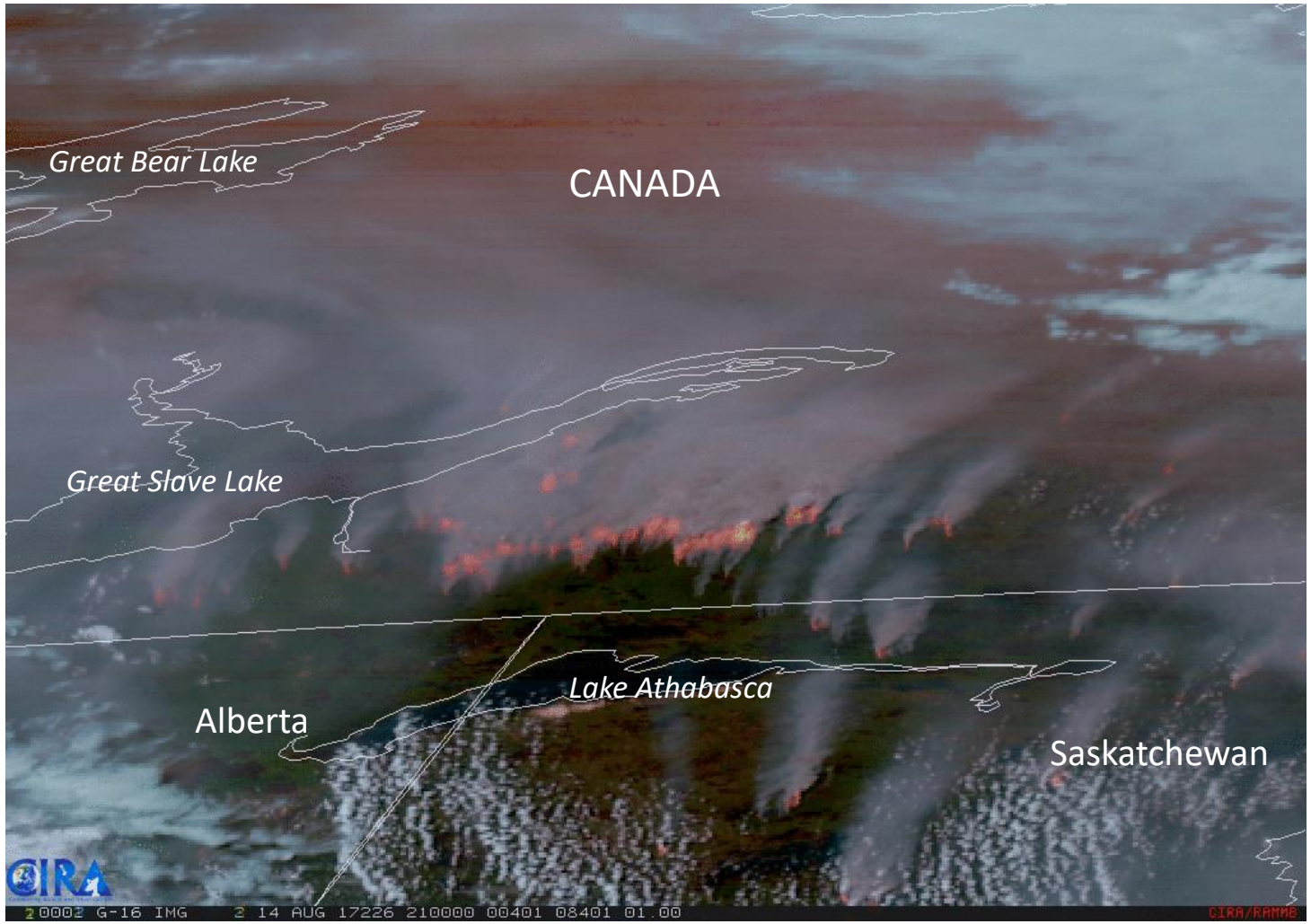
→ **Try to isolate the feature as much as possible first, *then* enhance it…**

Make it Meaningful and Pop!

Curtis Seaman (CSU/CIRA)

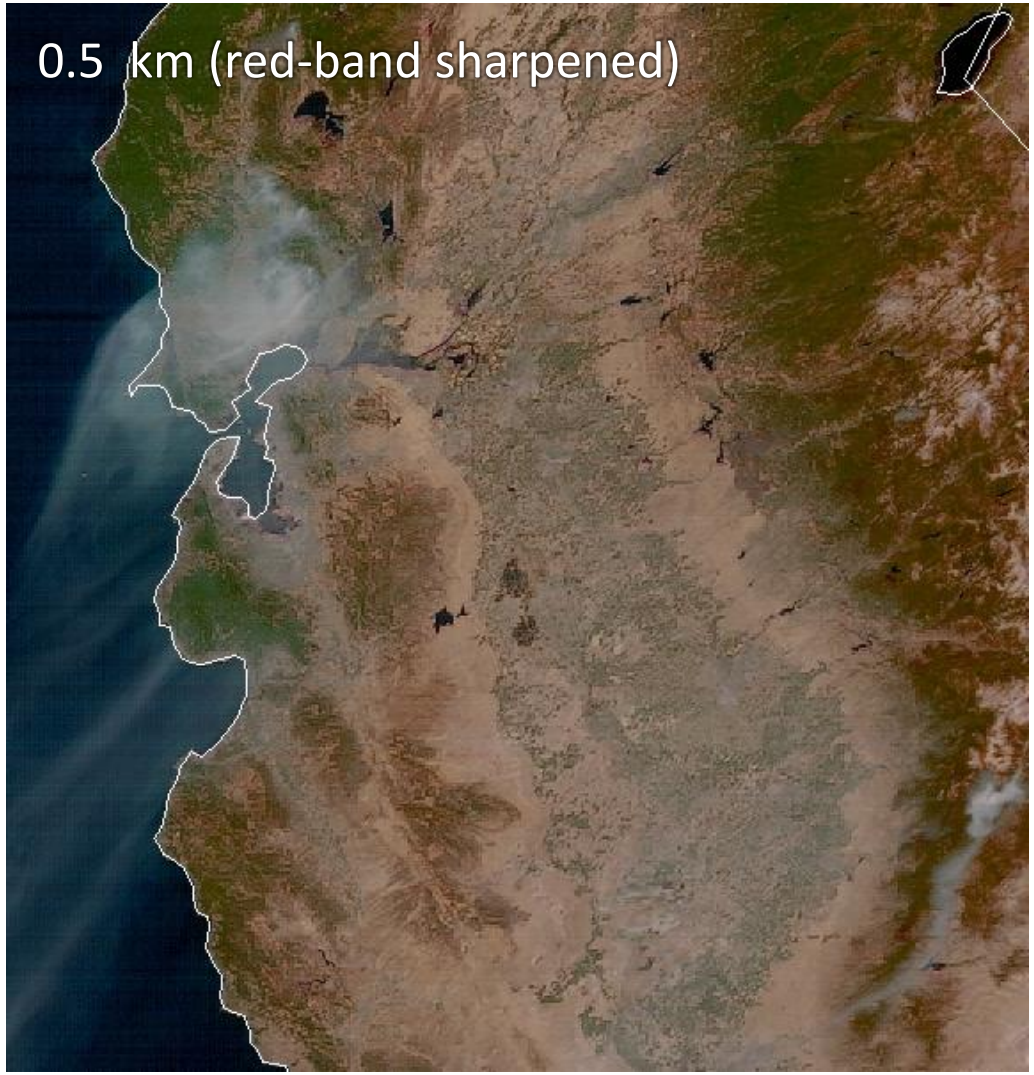
Bring Things Together…

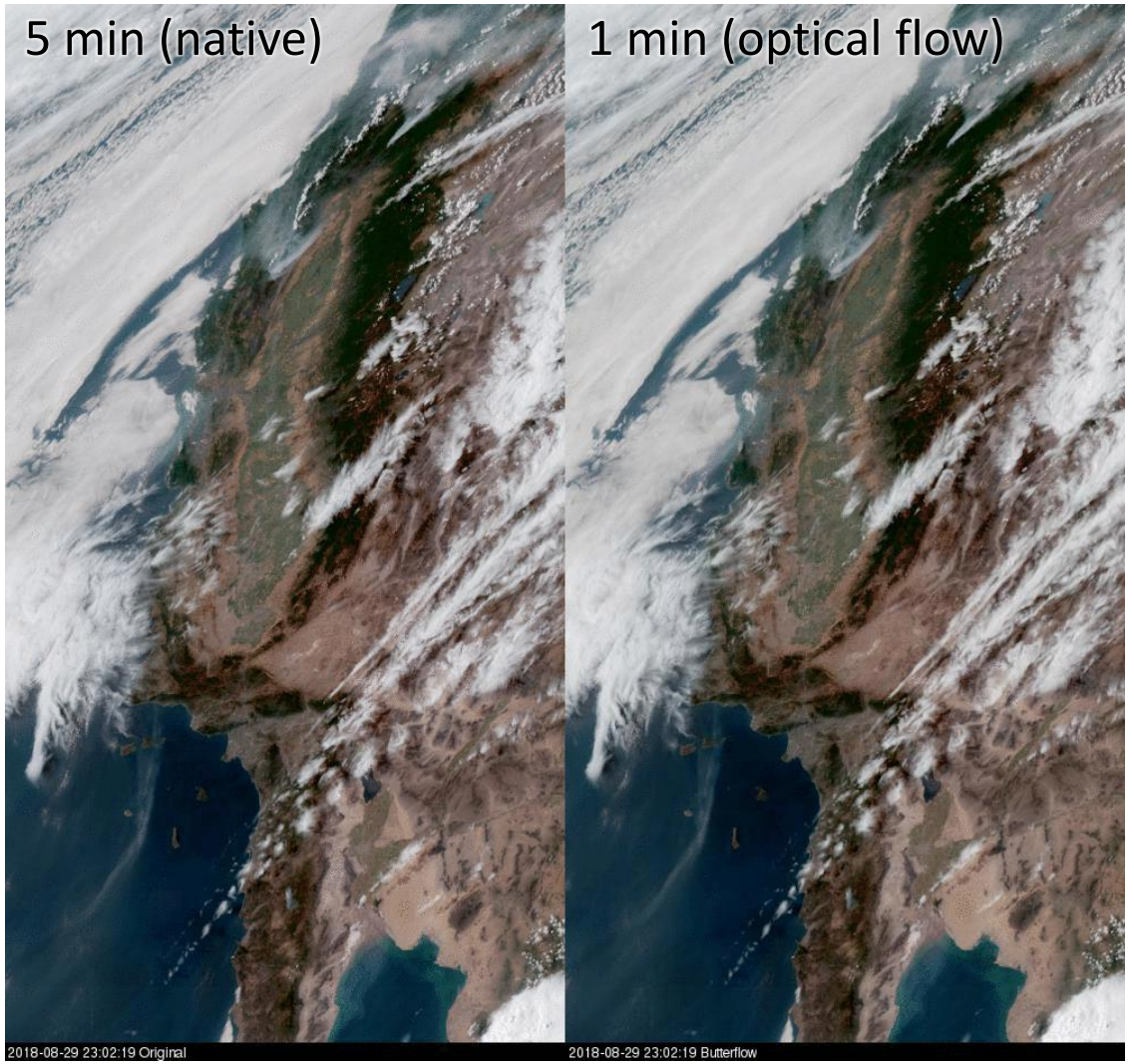




→ **Combining enhancements, when it makes sense, can save the forecasters time**

Future ABI Developments



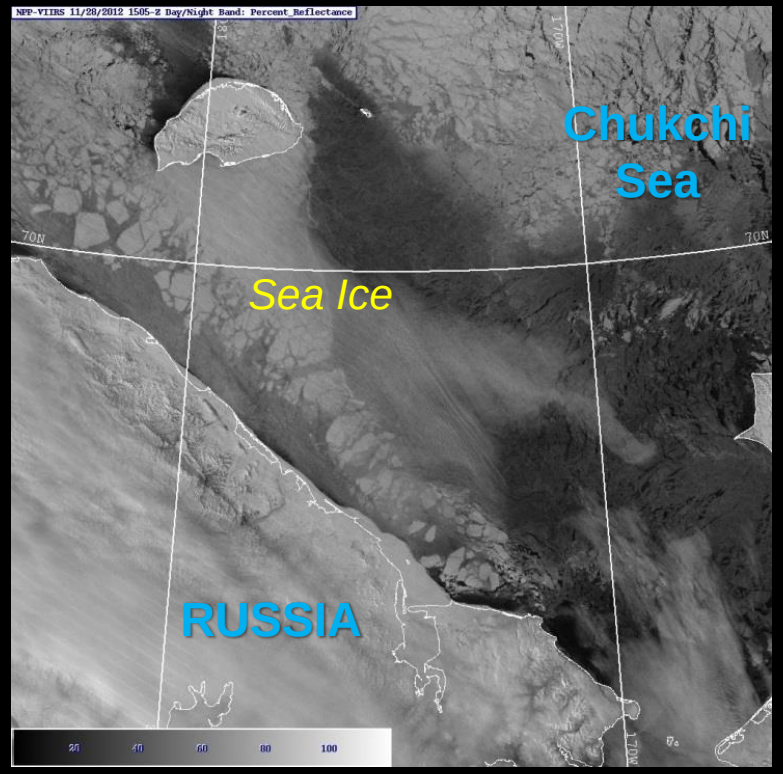


→ ***Enabling High Space/Time Resolution GeoColor "Meso-Boxes" Anywhere***

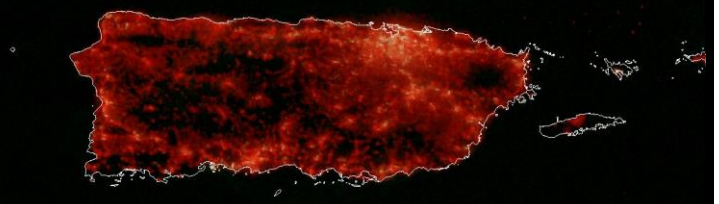
Taking Back the Night With the VIIRS Day/Night Band

https://www.mdpi.com/2072-4292/5/12/6717

Unique Information Abounds!

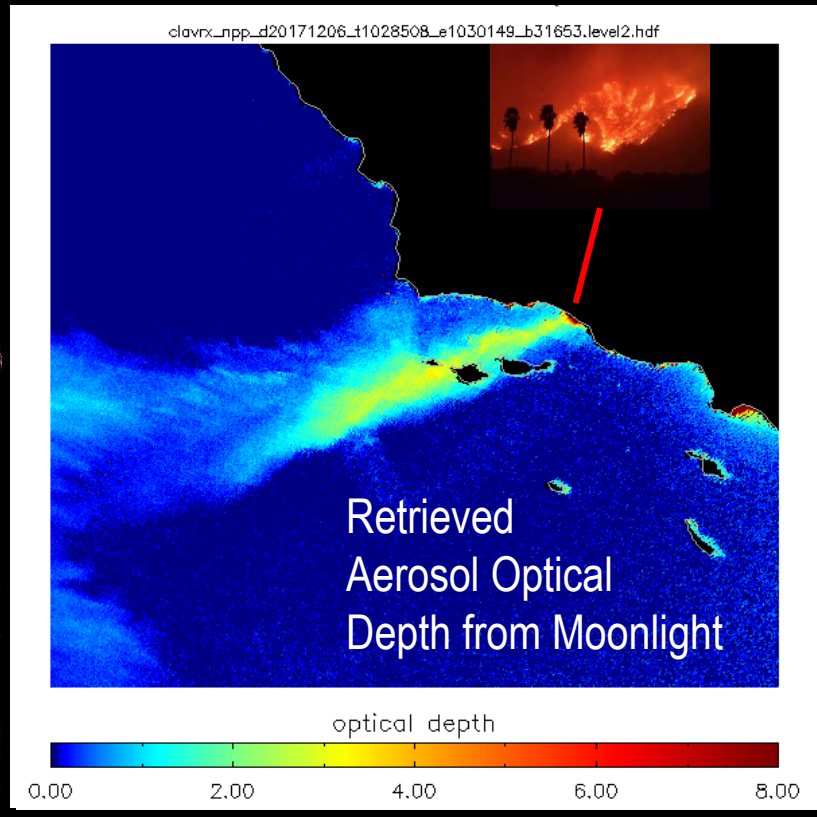


25 September 0618 UTC
Power Outage RGB



Power Outages
Stable Lights

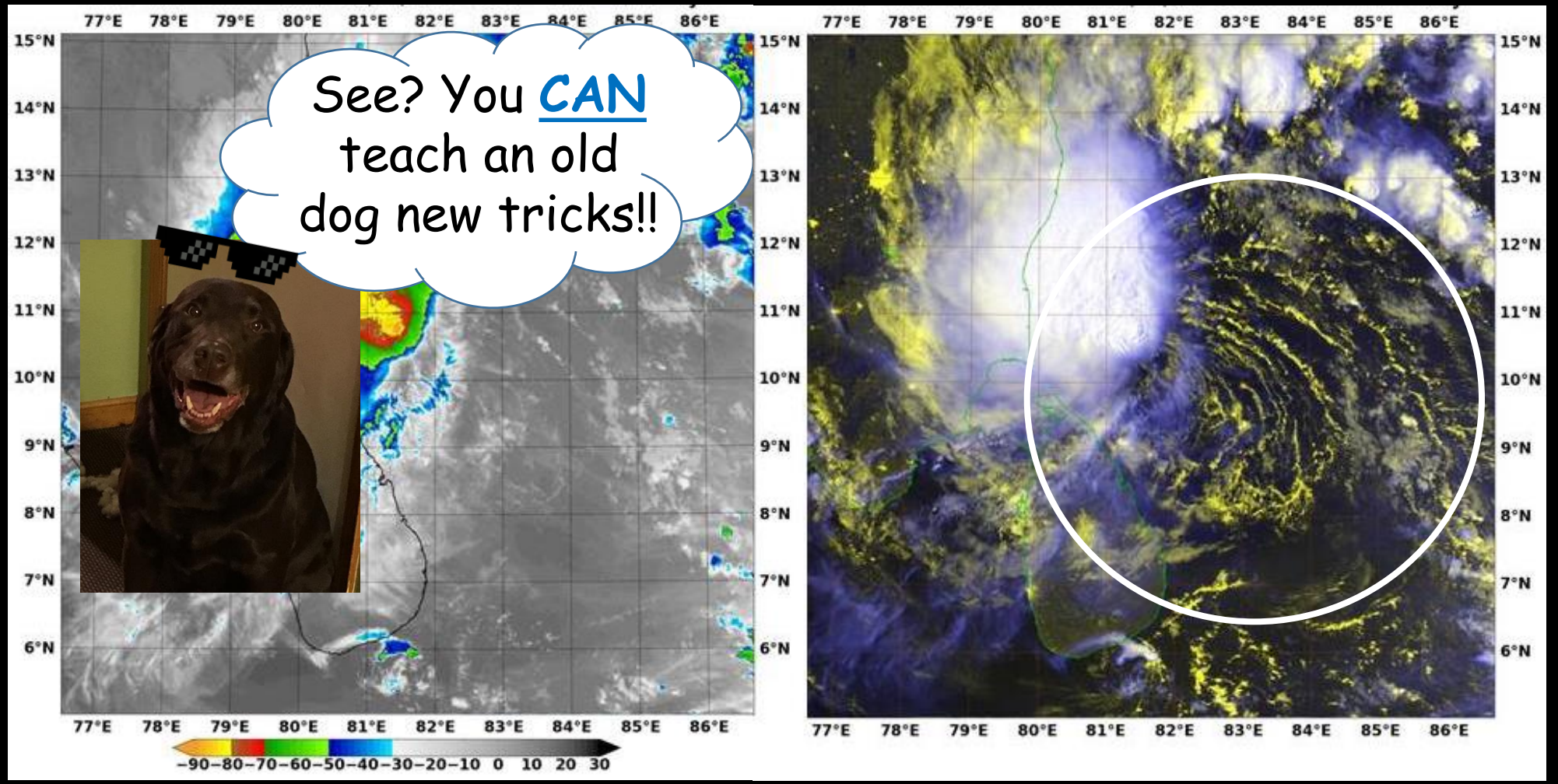
Thomas Fire



A. Walther & A. Heidinger

→ 742 m constant pixel size, unique sensitivity to atmospheric & surface properties

Tropical Cyclone Low-Level Circulation



Hawkins et al., BAM S 98(11) 2017

→ **The DNB is not just a high-latitude sensor—the benefits are *Global*!**

Future: Time-Resolved DNB

Simultaneous Nadir Overpass

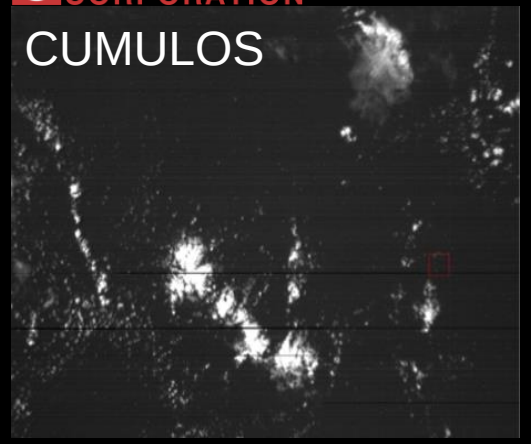
Waxing Gibbous
97% Full

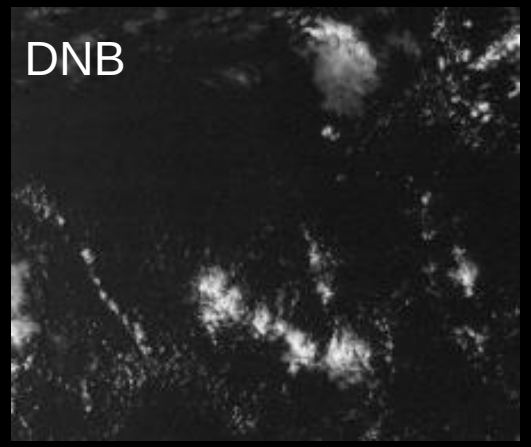
NOAA TMP 18-08

Assessing the potential of a SmallSat/CubeSat DNB solution.

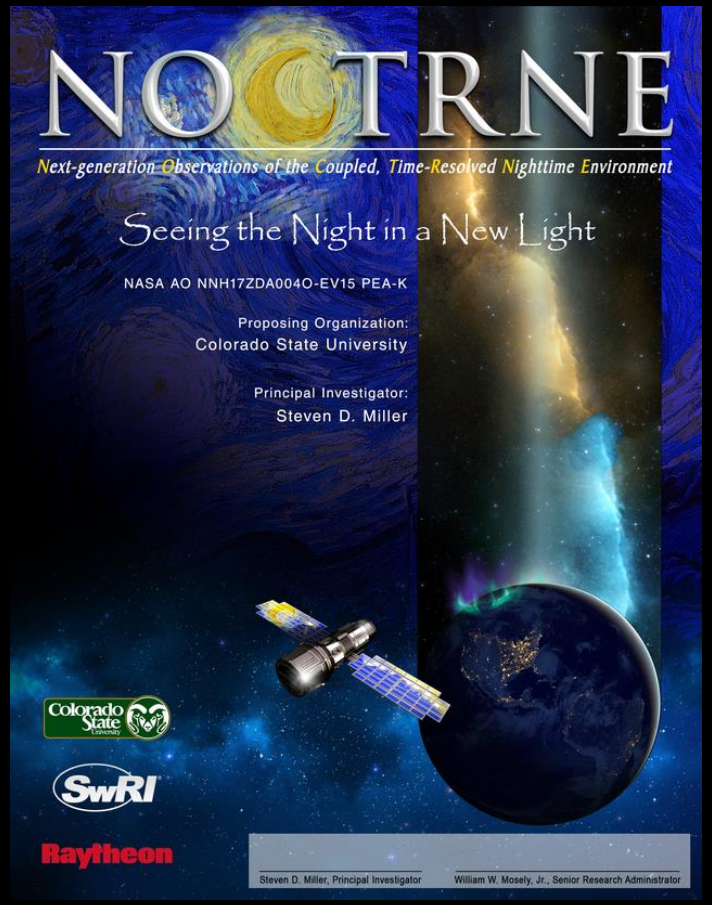
→ LEO SmallSat Swarm

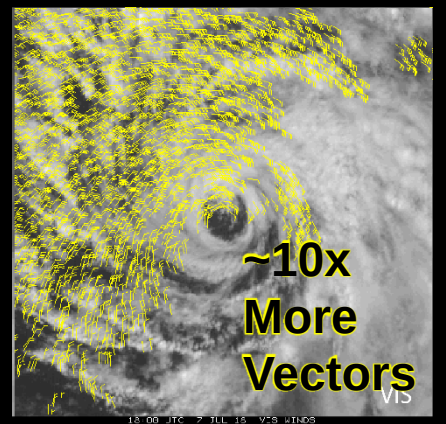
THE AEROSPACE CORPORATION

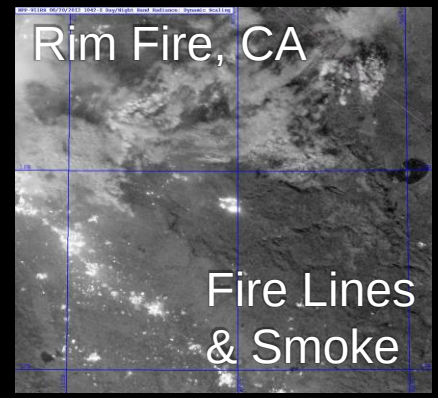




Geostationary Day/Night Band Concept







→ Consideration for a future SmallSat LEO constellation, or for next-gen GEO?

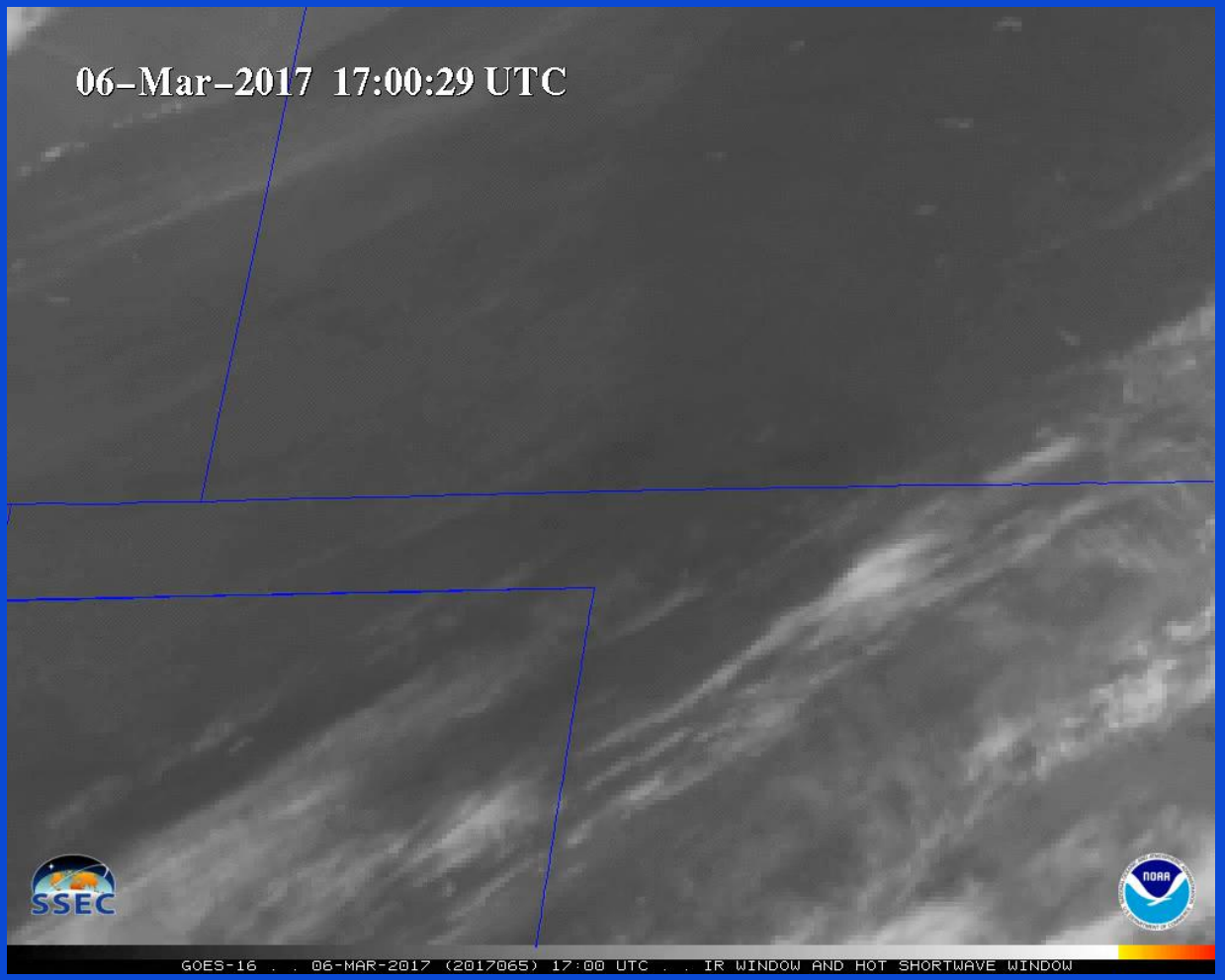
The Future is Bright,

Both Day…

and Night!

Thanks!!

Imagery panel



Tim Schmit NOAA NESDIS STAR

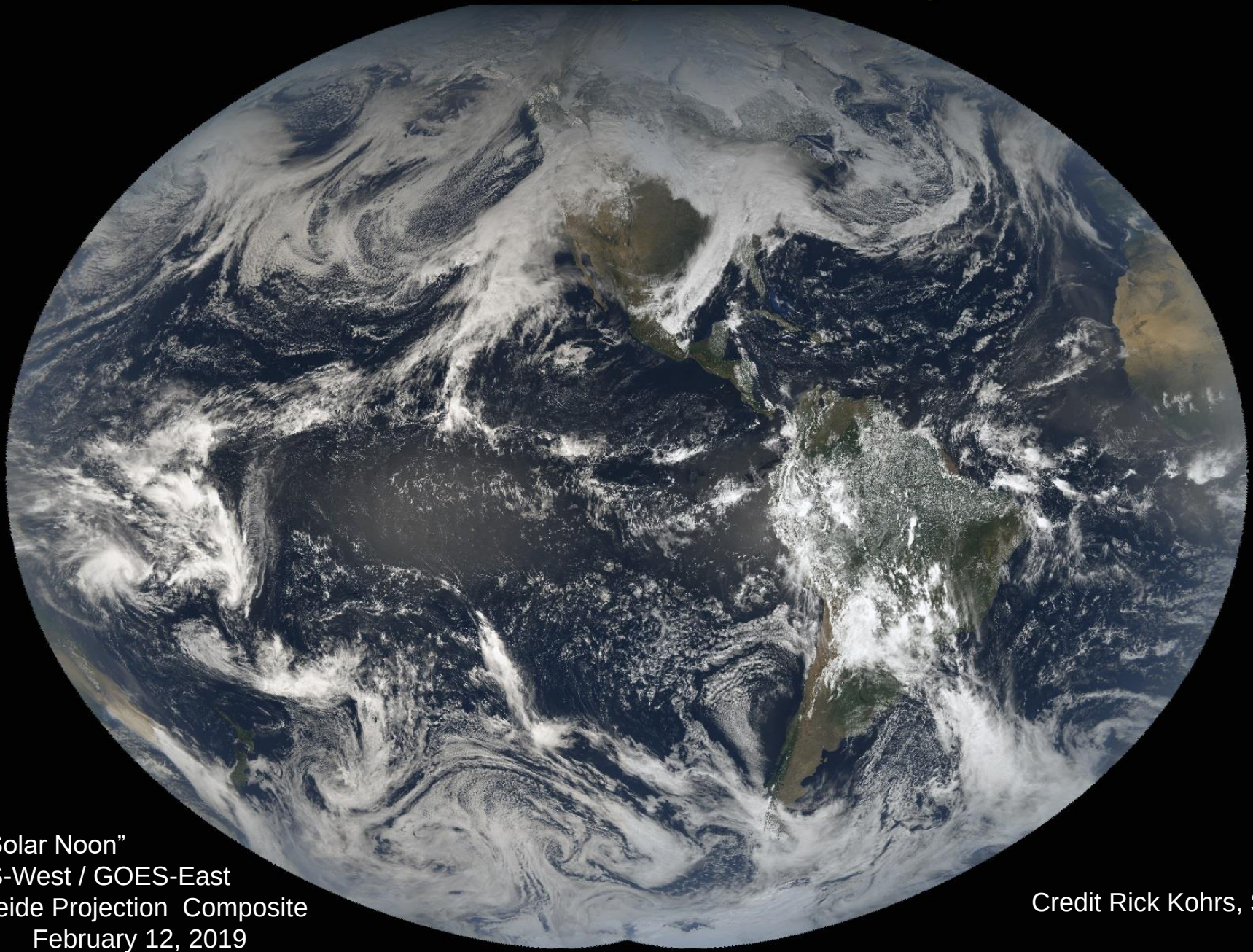
Jun Li, Mat Gunshor, Jim Nelson, CIMSS

Madison, Wisconsin

GOES ABI Imagery

- GOES Imagery is great and wonderful and useful, etc, etc.
  - Be wary of (infrequent) artifacts
- Lots of options for user workflows
  - Individual imagery bands
  - Band differences
  - Composite imagery (RGB)
  - Level 2 products
  - Combination (and other information)
- Rapid scan imagery isn't just for watching rapid scan images!
  - AMV's, fires?, etc.

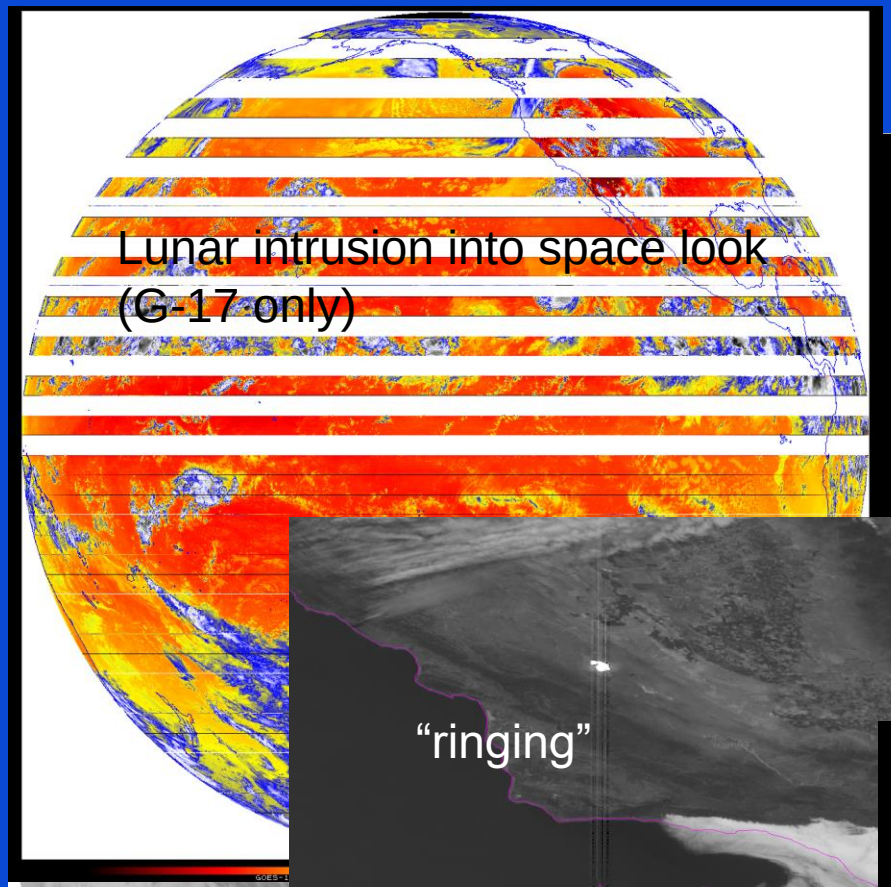
GOES-17 First Operational Day

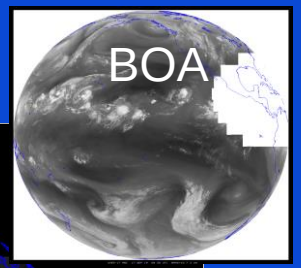


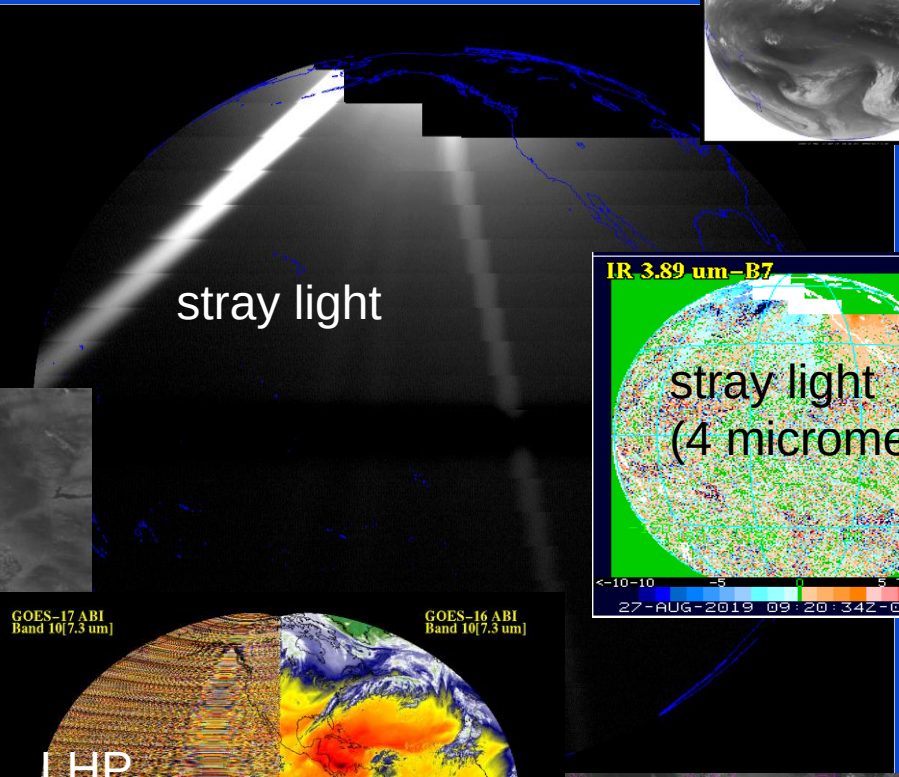
ABI “Solar Noon”
GOES-West / GOES-East
Mollweide Projection Composite
February 12, 2019

Credit Rick Kohrs, SSE

Artifacts

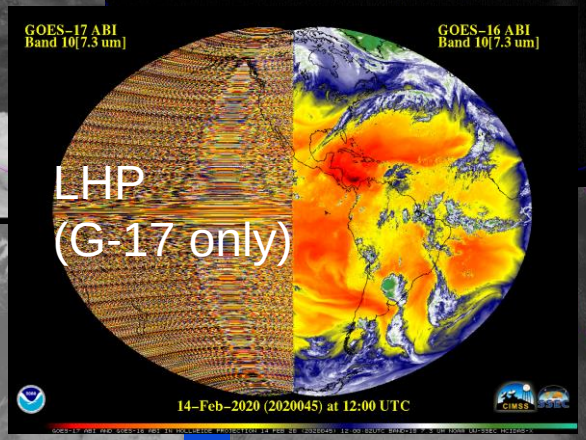

Lunar intrusion into space look
(G-17 only)


BOA

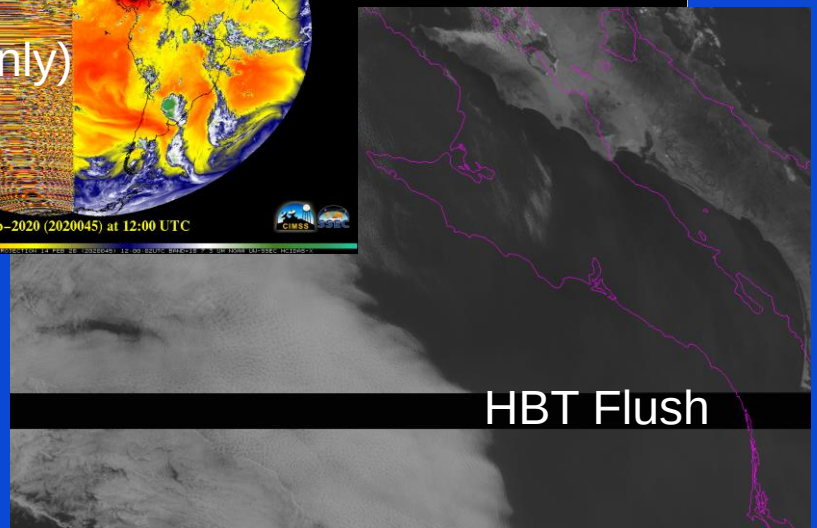

stray light

IR 3.89 um–B7
stray light
(4 micrometer)
<-10-10 -5 5 TEMP,K 10 >10
27-AUG-2019 09:20:34Z-09:10:34Z

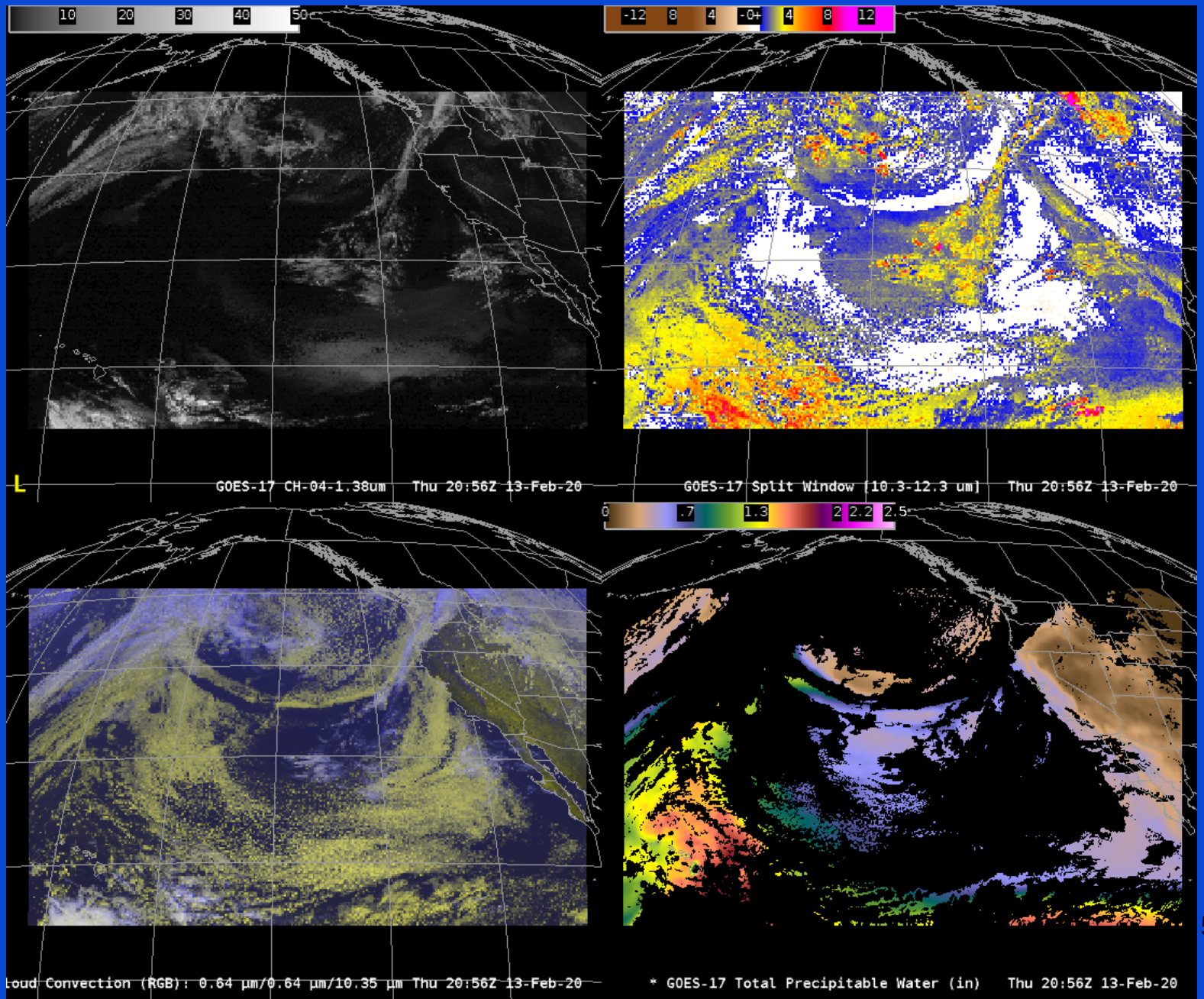
“ringing”


GOES-17 ABI
Band 10[7.3 um]
GOES-16 ABI
Band 10[7.3 um]
LHP
(G-17 only)
14-Feb-2020 (2020045) at 12:00 UTC

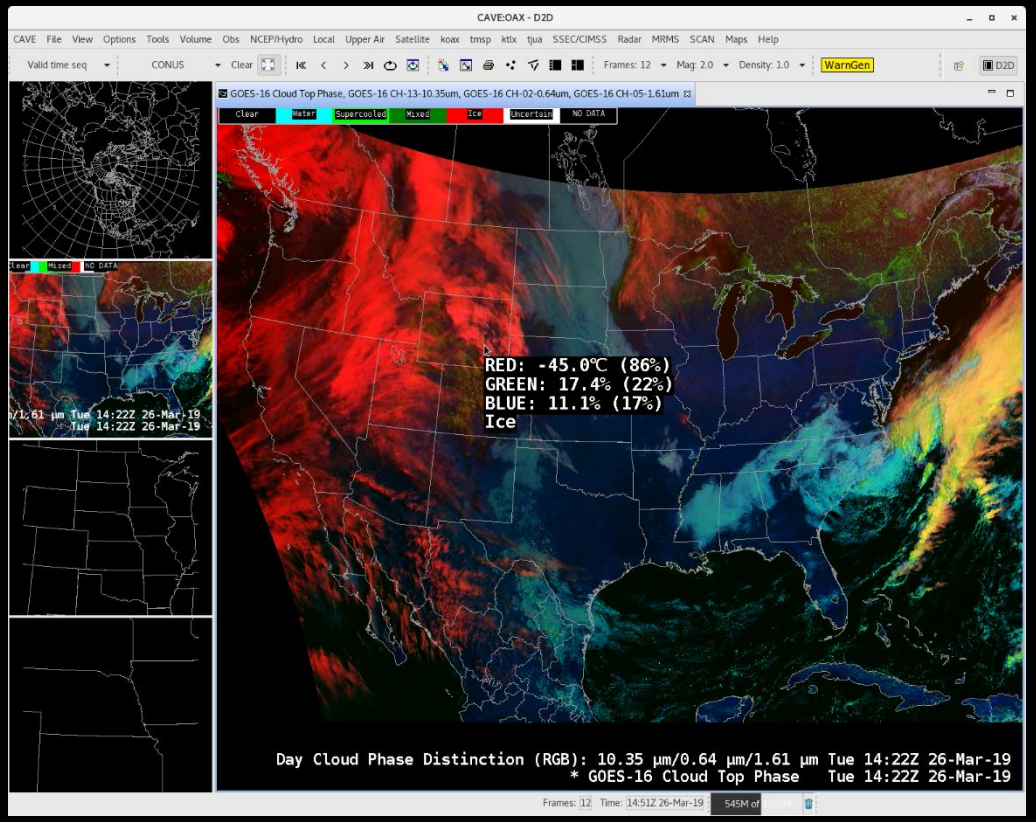

“caterpillar”
“shark fin”


HBT Flush

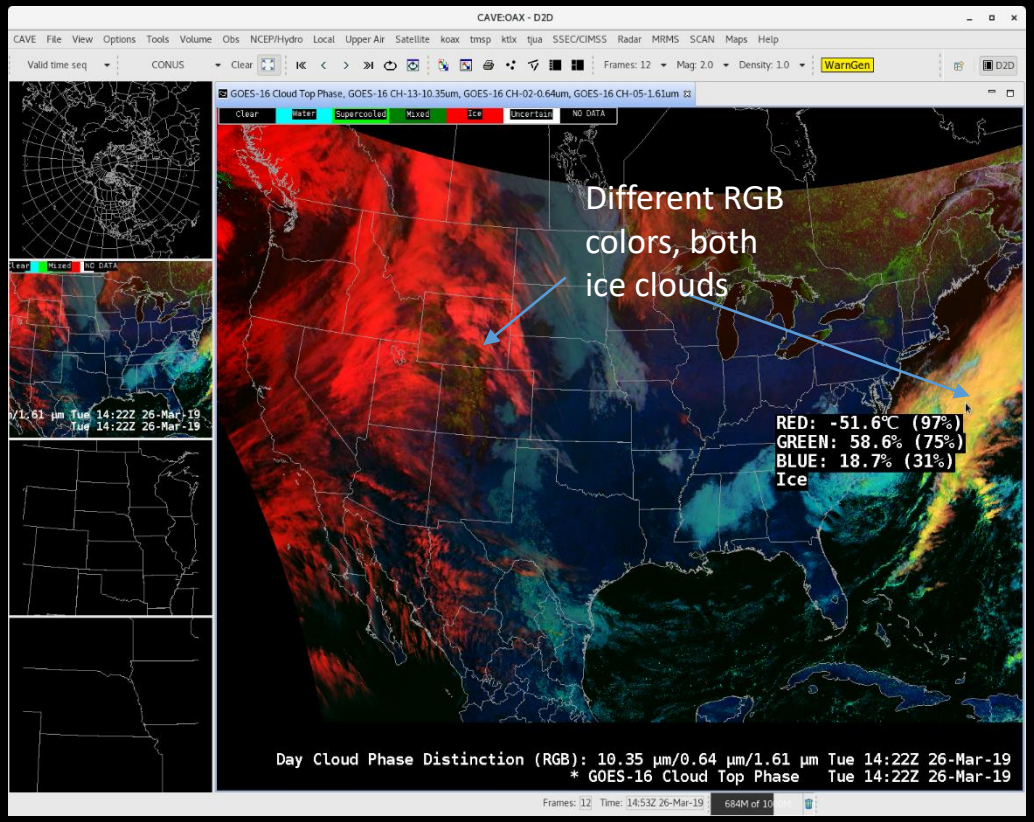
GOES-17 ABI


10 20 30 40 50
-12 -8 -4 -0+ 4 8 12
L
GOES-17 CH-04-1.38um Thu 20:56Z 13-Feb-20
GOES-17 Split Window [10.3-12.3 um] Thu 20:56Z 13-Feb-20
0 .7 1.3 2 2.2 2.5
loud Convection (RGB): 0.64 µm/0.64 µm/10.35 µm Thu 20:56Z 13-Feb-20
* GOES-17 Total Precipitable Water (in) Thu 20:56Z 13-Feb-20

AWIPS example of showing an RGB, but adding the cursor read-out from a Derived Product



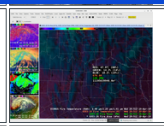
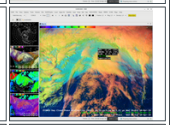
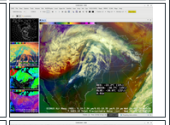
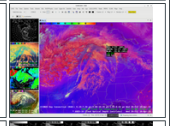
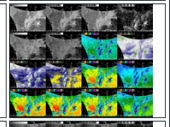
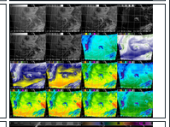
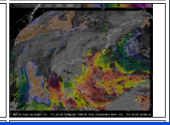
- Day Cloud Phase Distinction RGB
  - With derived Cloud Top Phase read-out



(due to different solar lightning)

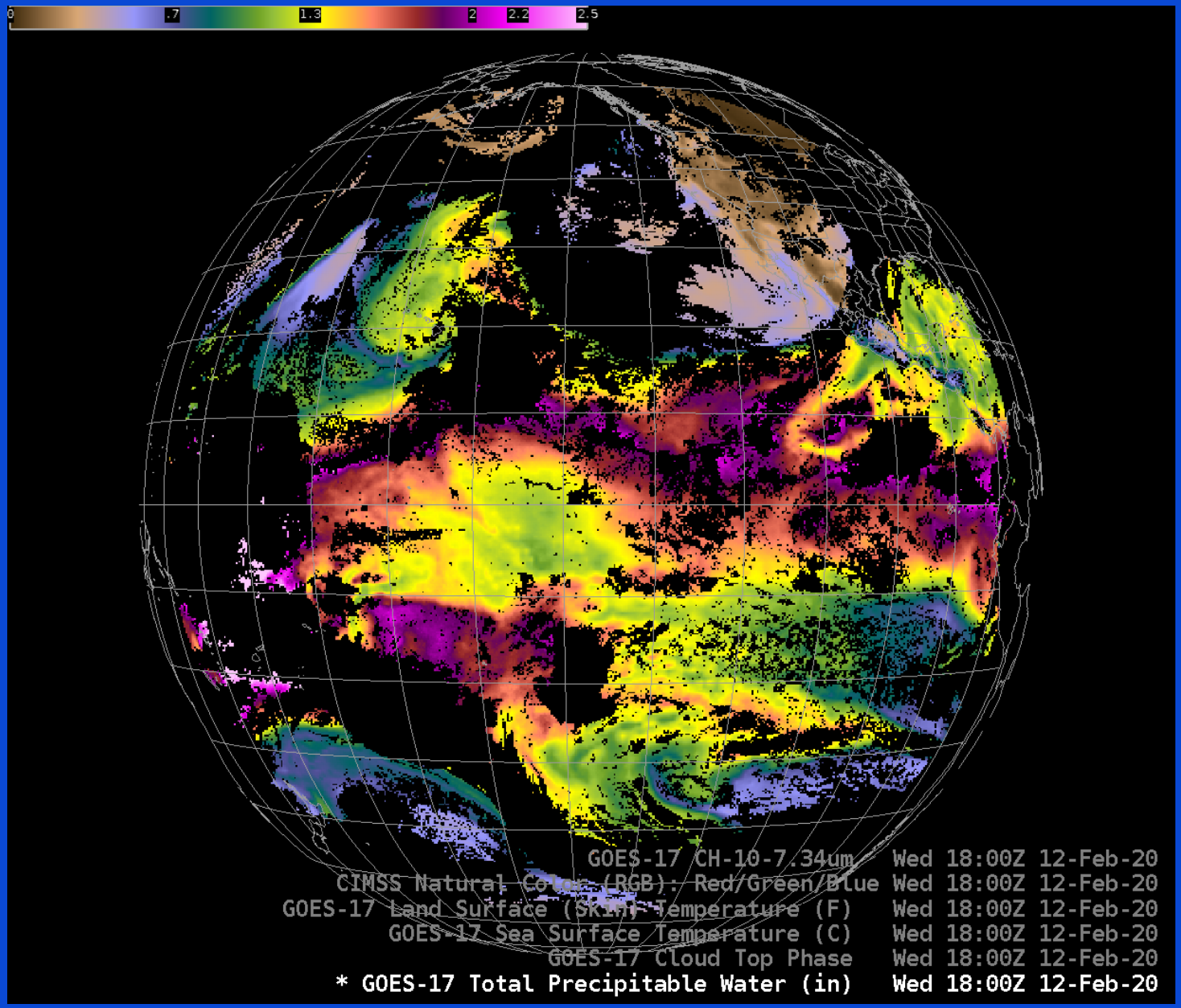
GOES Procedures in the STOR

- https://vlab.ncep.noaa.gov/group/stor/goes

Fire RGB Temp and Power Area	GOES-16 CONUS Fire Temperature RGB w Derived Information (Fire Temperature, Fire Power, Fire Area), use with the readout	4/30/19	
Day Cloud Phase Distinction RGB and Cloud Top Phase	GOES-16 CONUS Day Cloud Phase Distinction RGB with Cloud Top Phase and Temperature, use with the readout	4/30/19	
Air Mass RGB and TPW	GOES-16 CONUS Air Mass RGB with Derived TPW, use with the readout	4/30/19	
Day Convection RGB and Cloud Temp and Cloud Depth	GOES-16 CONUS Day Convection RGB with Cloud Optical Depth and Cloud Temperature, use with the readout	4/30/19	
16 Channel GOES-East	Shows all 16 channels of the ABI on one AWIPS screen	5/13/19	
16 channel GOES-West	Shows all 16 channels of the ABI on one AWIPS screen	5/13/19	
CTH and TPW products	A procedure that overlays the cloud top height on the total precipitable water product	5/13/19	

- https://vlab.ncep.noaa.gov/web/

GOES-17 TPW


0
.7
1.3
2
2.2
2.5
GOES-17 CH-10-7.34um Wed 18:00Z 12-Feb-20
CIMSS Natural Color (RGB): Red/Green/Blue Wed 18:00Z 12-Feb-20
GOES-17 Land Surface (Skin) Temperature (F) Wed 18:00Z 12-Feb-20
GOES-17 Sea Surface Temperature (C) Wed 18:00Z 12-Feb-20
GOES-17 Cloud Top Phase Wed 18:00Z 12-Feb-20
* GOES-17 Total Precipitable Water (in) Wed 18:00Z 12-Feb-20

JGR Atmospheres

RESEARCH ARTICLE
10.1029/2019JD031647

Impact of Rapid-Scan-Based Dynamical Information From GOES-16 on HWRF Hurricane Forecasts

Jinlong Li[1], Jun Li[1], Christopher Velden[1], Pei Wang[1], Timothy J. Schmit[2], and Jason Sippel[3]

[1]Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison, Madison, WI, USA, [2]Center for Satellite Applications and Research, NOAA/NESDIS, Madison, WI, USA, [3]NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, FL, USA

Key Points:

- Mesoscale atmospheric motion vectors (AMVs) have been developed from rapid scan GOES-16 ABI measurements
- Assimilation of vortex-scale rapid scan AMVs in the HWRF model results in consistent track prediction improvements for Hurricanes Harvey, Irma, and Maria; improvements are mainly from better initialization of the wind fields in the vortex-scale region and near environment
- Through high spatiotemporal sampling of targeted tropical cyclones, the new generation of geostationary satellites provides important observational data for forecast improvement

Correspondence to:
J. Li,
jun.li@ssec.wisc.edu

Citation:
Li, J., Li, J., Velden, C., Wang, P., Schmit, T. J., & Sippel, J. (2020). Impact of rapid-scan-based dynamical information from GOES-16 on HWRF hurricane forecasts. *Journal of Geophysical Research: Atmospheres*, *125*, e2019JD031647. https://doi.org/10.1029/2019JD031647

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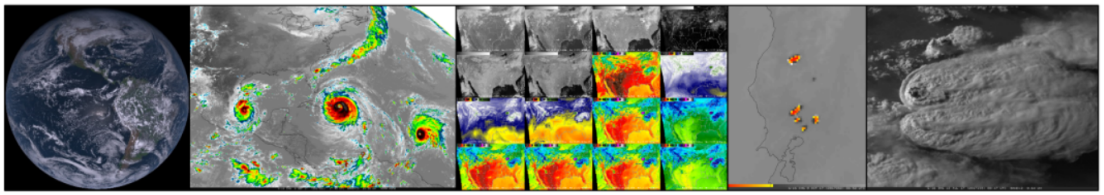
Accepted article online 27 JAN 2020

Abstract Observations of dynamical information in the upper levels of tropical cyclones at high spatiotemporal resolutions are rare but very important to the analysis and prediction of the storm evolution and landfall impacts. These observations are now becoming routinely available from the new generation of geostationary weather satellites. Understanding and optimizing the utilization of that information in numerical weather prediction models is a vital step toward simulating tropical cyclone behavior and improving forecasts. The Advanced Baseline Imager (ABI) onboard GOES-16 is providing high spatial and temporal resolution images that can be targeted on North Atlantic tropical cyclones. In addition to a full-disk scan every 10 min and a CONUS scan every 5 min, the ABI also has a flexible "mesoscale scan" mode featuring limited moving domains at 1-min intervals. The mesosector can focus on a targeted storm center with a 10°×10° domain coverage that follows the storm movement. Using this 1-min ABI imagery to track cloud motions, automated algorithms have been developed to produce enhanced, high-resolution atmospheric motion vectors (AMVs) during a targeted tropical cyclone event. These high spatiotemporal AMVs represent estimates of the wind field around the storm and can provide critical dynamical information on the targeted storm and its near environment. This information can help improve the representation of the initialized vortex in numerical model analyses. To study the impact of the enhanced AMV observations on numerical weather prediction, the Hurricane Weather Research Forecast (HWRF) model is used in a series of assimilation and forecast experiments. Three destructive Atlantic hurricane cases from 2017, Harvey, Irma, and Maria, are chosen as case studies. The results show that the assimilation of the enhanced AMVs from GOES-16 consistently improves the HWRF hurricane track and size forecasts, and have mixed impacts on intensity forecasts. These results augment previously published studies on optimizing the quantitative use of new generation geostationary satellite rapid-scan observations for improving high impact weather forecasts.

GOES-R Series web sites



These are links for NOAA's GOES-16 (-17) imagery

GOES ABI (Advanced Baseline Imager) Realtime Imagery

- NOAA STAR ABI Image Viewer *(can save animated gif)* **GOES-16 GOES-17**
- SSEC Geo Browser All bands, Meso1 Meso2 and CONUS and Full Disk, plus a "spectral" (all channels) loop *(can save animated gif)* and **GOES-17**
- geo imagery (SSEC Real Earth TM) All bands, CONUS and Full Disk and both meso-scale sectors *(can save animated gif or mp4)* and **GOES-17**
- UW-Madison AOS Many sectors (including Southern Wisconsin) and several enhancements and **GOES-17**
- RAMMB Slider GeoColor, all bands and all sectors *(can save animated gifs, etc.)* and **GOES-17**
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- College of DuPage Select bands for the three domains, plus sub-regional and localized sectors *(can save animated gif)* **GOES-17**
- weather.us US view, several options
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- SMN (Mexico) Several sectors.
- UNAM (Mexico) Several sectors.
- NASA's Marshall Space Flight Center CONUS and Full Disk sectors. **GOES-17**
- NOAA NESDIS Full Disk view .
- Embry-Riddle Aeronautical University - Daytona Beach Meteorology Many sectors, several bands.
- Tropical Tidbits Many sectors (including Alaska) and Central Pacific **GOES-17**
- SSEC Geo Browser GOES-16 and -17 in the Mollweide projection *(can save animated gif)*

GLM (Geostationary Lightning Mapper)

- GLM realtime data (SPORT)
- GLM and ABI realtime data (SSEC Real Earth TM) for Groups and Group Density
- Weathernerds ABI (2 bands) and GLM (including gridded products), *can save animated gifs*.
- 2017 GOES-16 paper by S. Rudlosky et al. 2018 GOES-16 paper by S. Rudlosky et al.
- GLM Ground System Status and Product Performance Guide for Data Users.

GOES Calibration

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- GOES-16 and GOES-17 ABI Clear-sky Weighting functions both static and realtime

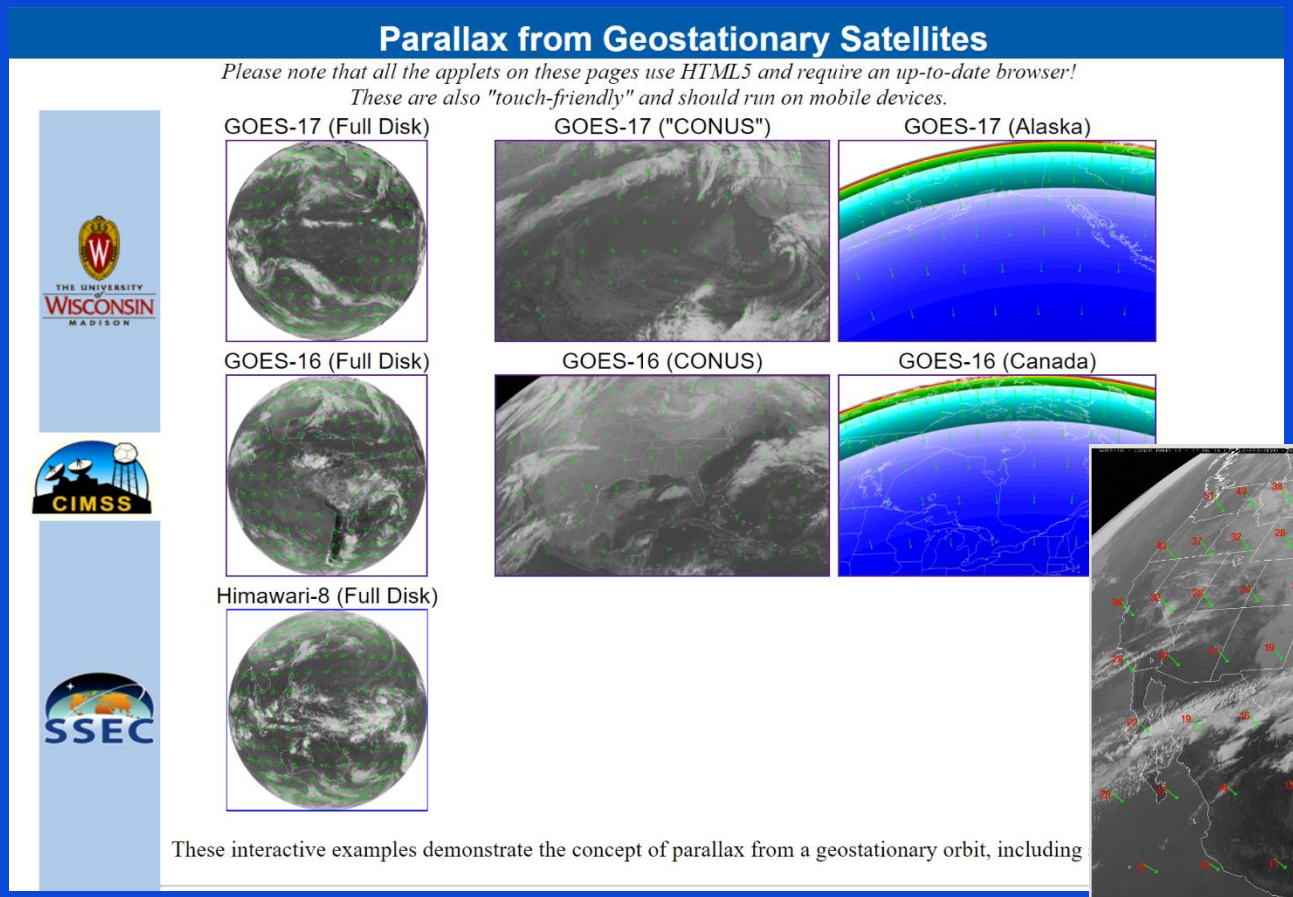
Imagery
GLM
Calibration
GOES-16/17 ABI Data
(Free) Software (+ webapps)
(Free) Phone apps
ABI Training and Info
Education (2020 Virtual Science Fair)
Level 2 -- Derived Products, etc.
Space Weather

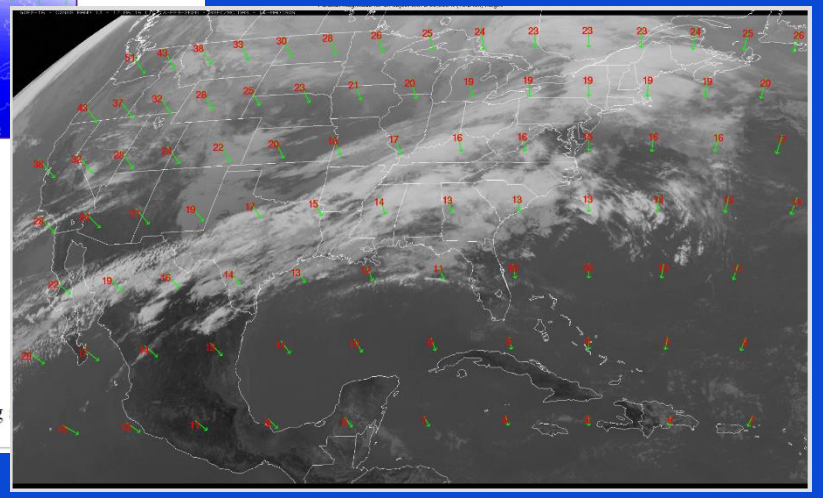
http://cimss.ssec.wisc.edu/goes/goesdata.html

Parallax

Interactive webapp for the concept of parallax from geostationary satellites:

- *http://cimss.ssec.wisc.edu/goes/webapps*





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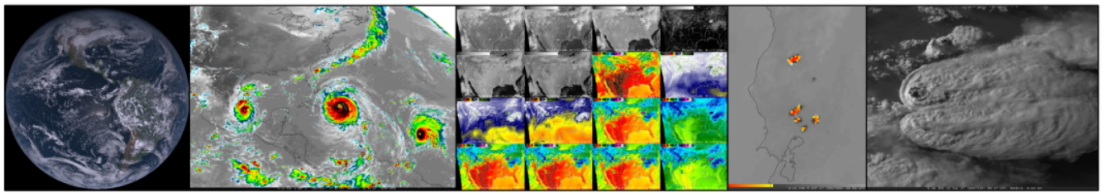

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Imagery
GLM
Calibration
GOES-16/17 ABI Data
(Free) Software (+ webapps)
(Free) Phone apps
ABI Training and Info
Education (2020 Virtual Science Fair)
Level 2 -- Derived Products, etc.
Space Weather

http://cimss.ssec.wisc.edu/goes/goesdata.html

Imagery: Global coverage, product generation, and distribution

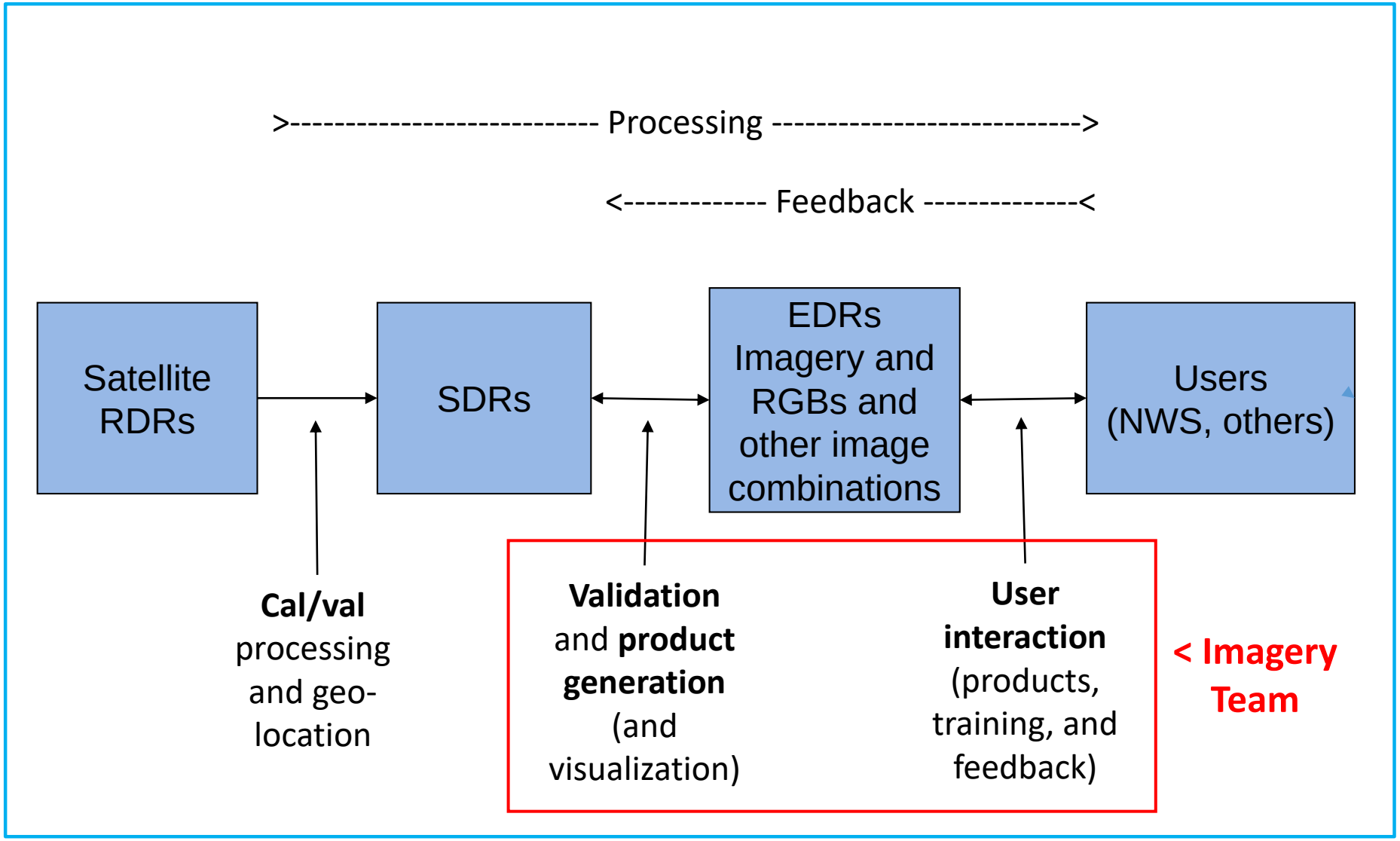
Don Hillger, PhD
don.hillger@noaa.gov
StAR Imagery Lead
With contributions from many!

JPSS/GOES-R Summit
NCWCP
2020-02-25

Imagery Outline

- **Imagery sources/instrumentation**
  - Geosynchronous
  - Polar-orbiting
  - Other (DSCOVR)
- **Imagery validation and product generation (StAR meteorologists/physical scientists)**
- **Imagery and image product distribution**
  - Internet/websites/blogs (including SLIDER, Real Earth, etc.)
  - Social media (shorter items)
- **Users**
  - NWS CONUS (thru SBN and Internet)
  - NWS Alaska (Alaska region/direct-broadcast)
  - Numerous commercial/secondary/private users

The life cycle of Imagery and image products

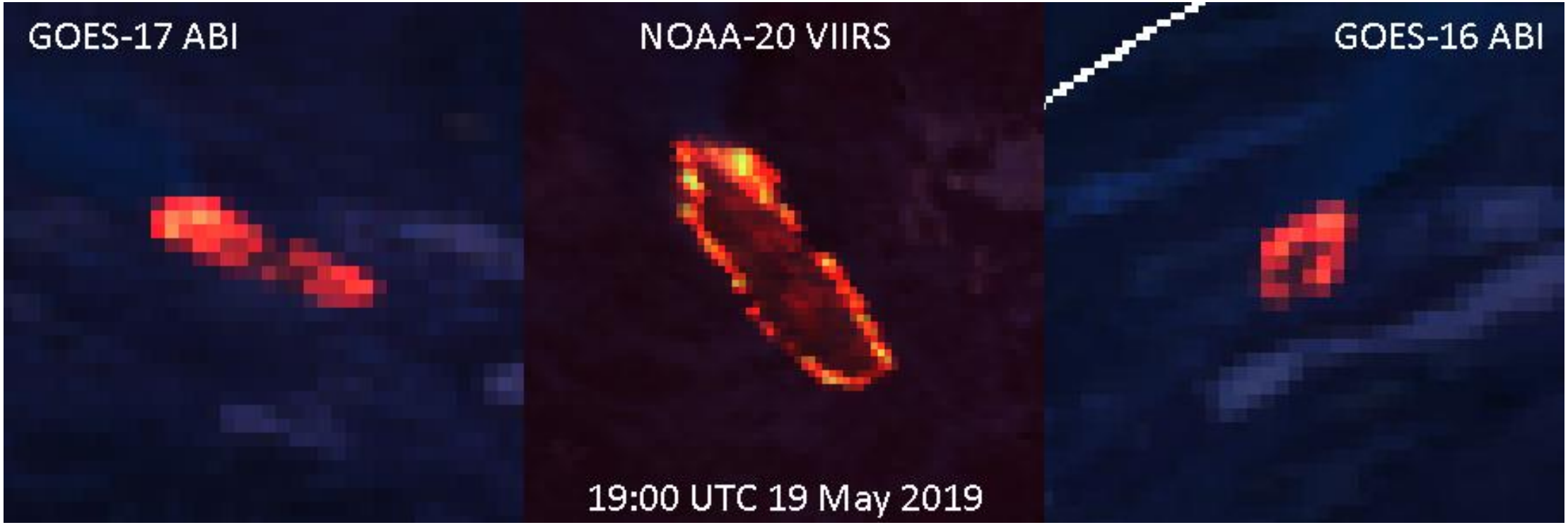


What are the advantages of geo vs polar orbiting imagery?

- Geosynchronous
  - Better temporal resolution overall (500 m ABI, AHI, and AMI)
  - Better for non-polar regions, as long as there's a geo at a longitude within view
- Polar-orbiting
  - Better spatial resolution (375 m and 750 m VIIRS)
  - Better polar region coverage (quasi-geo)

“A four-birds-eye view of fires in Alberta” blog - 2019

http://rammb.cira.colostate.edu/projects/alaska/blog/ (C. Seaman, CIRA)



Comparison between GOES-17 ABI, NOAA-20 VIIRS, and GOES-16 ABI Fire Temperature RGB images (1900 UTC, 19 May 2019) zoomed in at 400%

“A four-birds-eye view of fires in Alberta” blog - 2019

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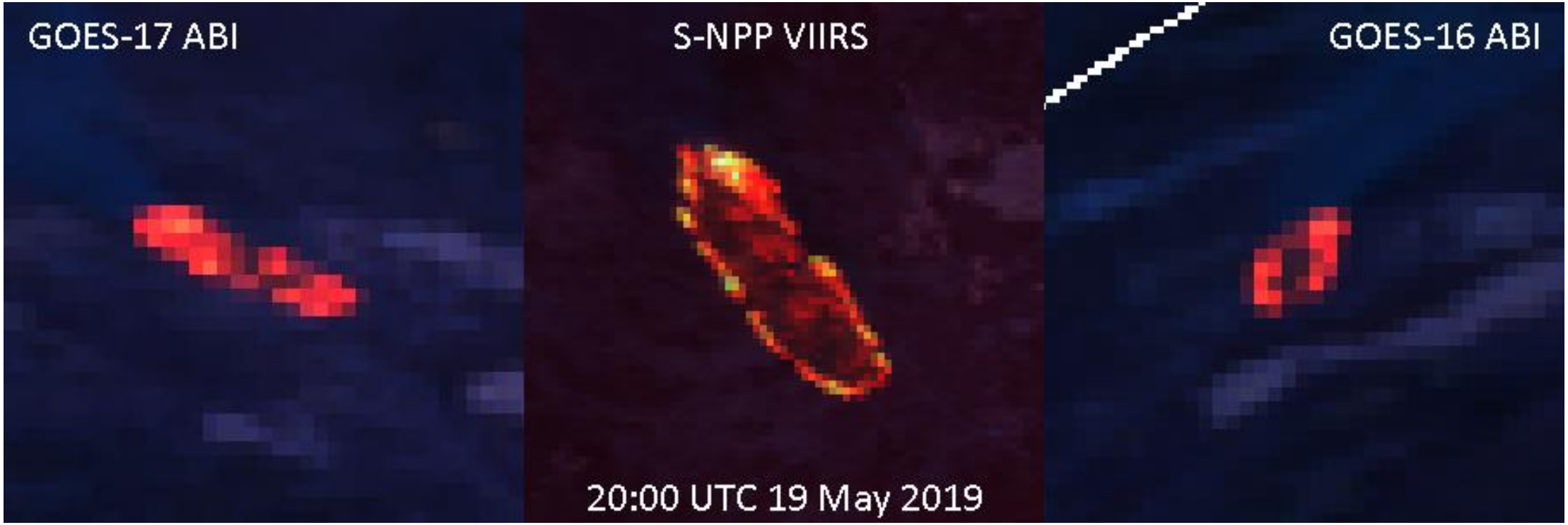
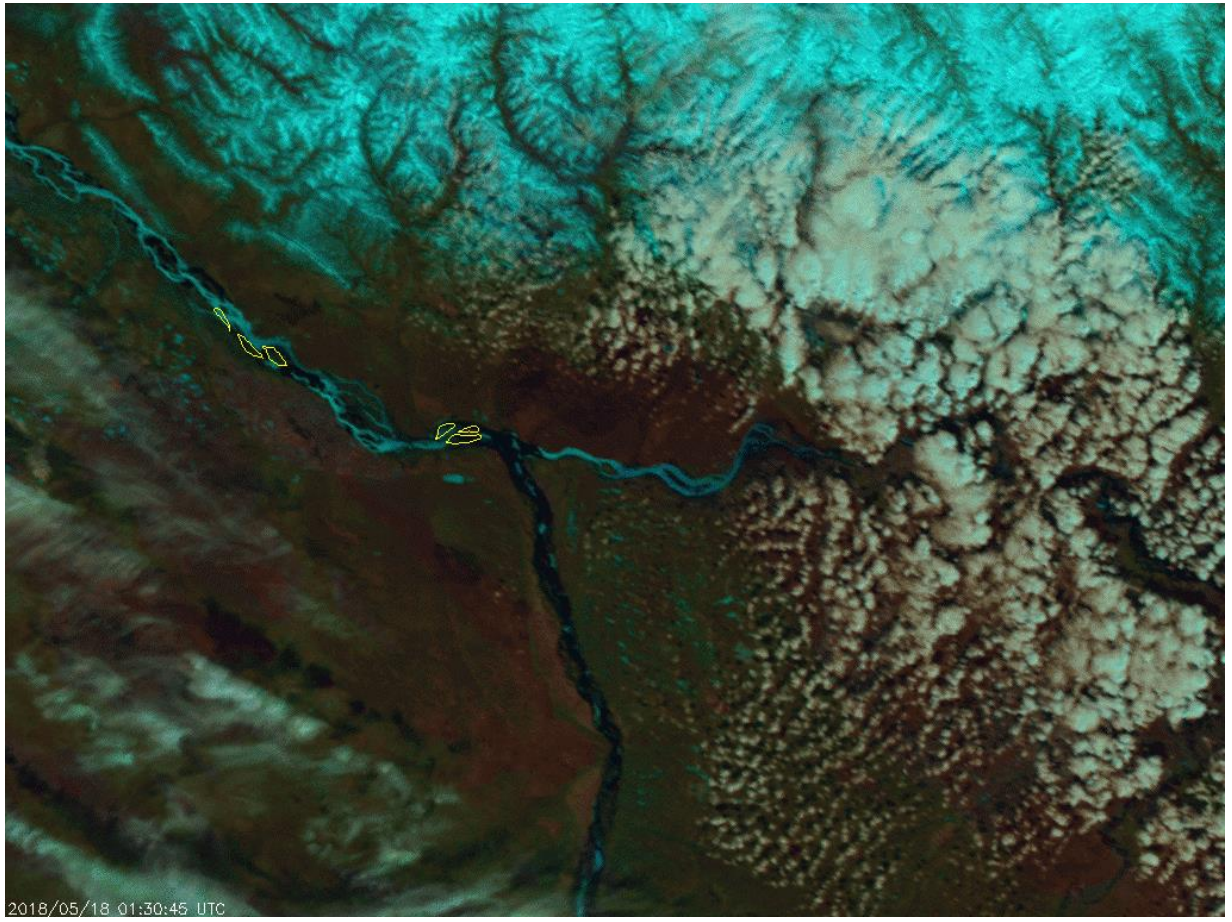


Comparison between GOES-17 ABI, S-NPP VIIRS, and GOES-16 ABI Fire Temperature RGB images (2000 UTC, 19 May 2019) zoomed in at 400%

“Rivers of Ice” blog – 2018 (C. Seaman, CIRA)

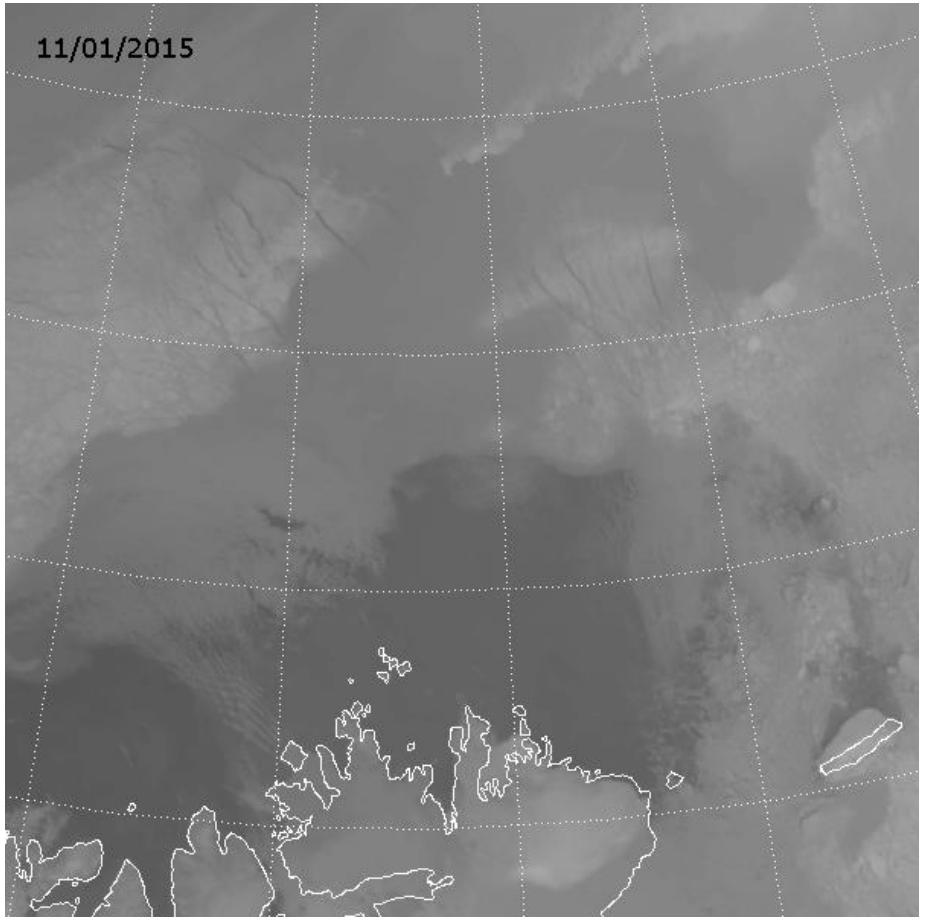
http://rammb.cira.colostate.edu/projects/alaska/blog/index.php/uncategorized/rivers-of-ice/



Animation of VIIRS Natural Color RGB composite of channels I-1, I-2 and I-3 (18 May 2018)

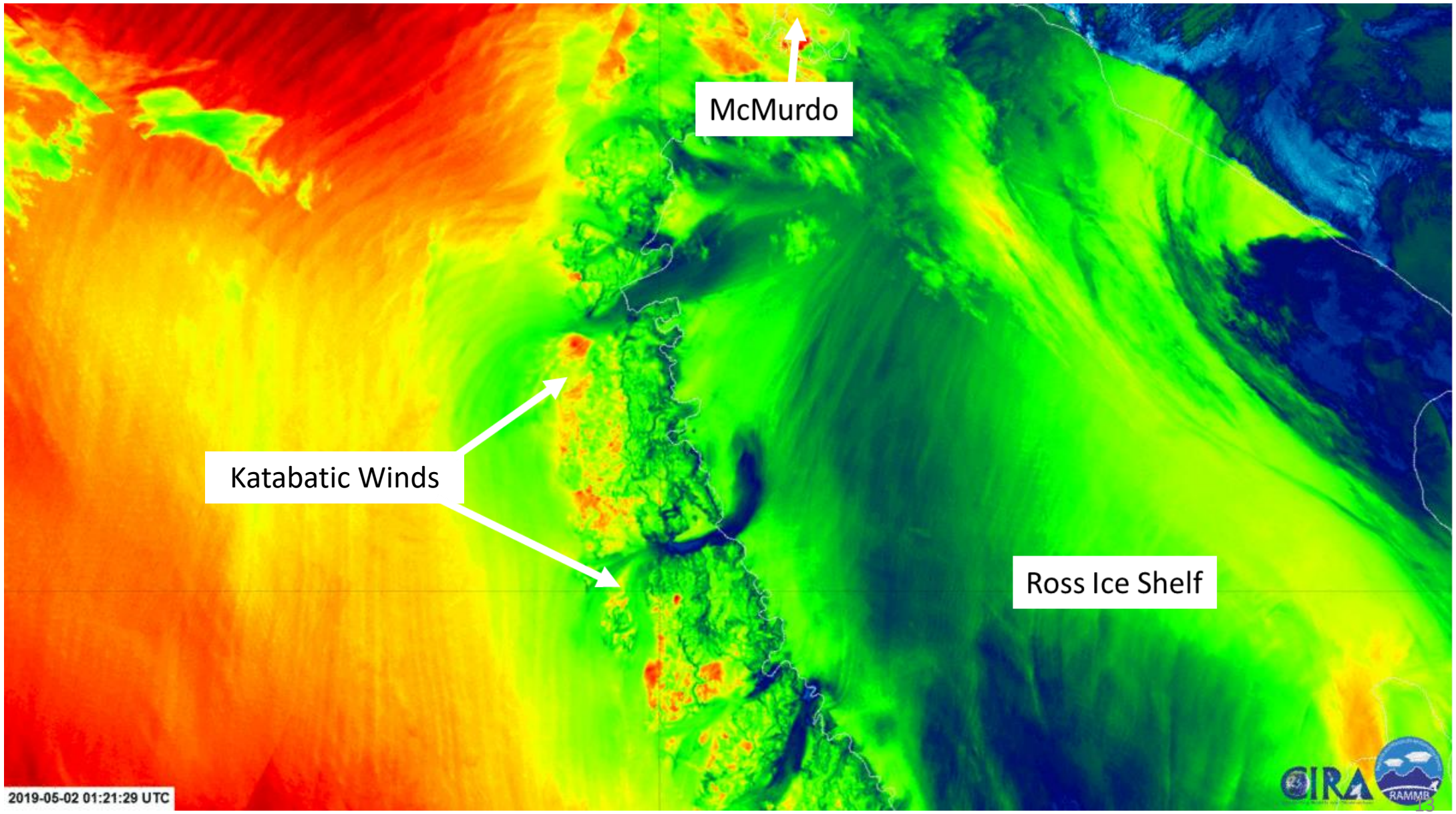
“The nice (and dedicated) people of N-ICE” (field experiment) – 2015 (C. Seaman)

http://rammb.cira.colostate.edu/projects/alaska/blog/index.php/uncategorized/the-nice-and-dedicated-people-of-n-ice/



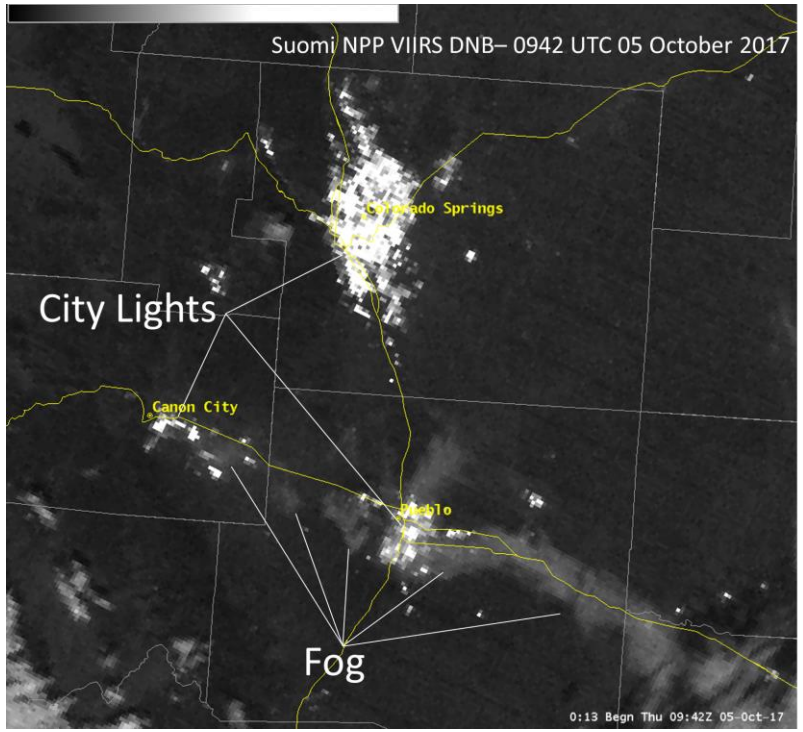
Animation of VIIRS IR (M-15) images from 11 January to 28 February 2015. These images cover the area of the N-ICE field experiment, north of Svalbard.

Katabatic winds from VIIRS in Antarctica – 2019 (L. Grasso, SLIDER @ CIRA)

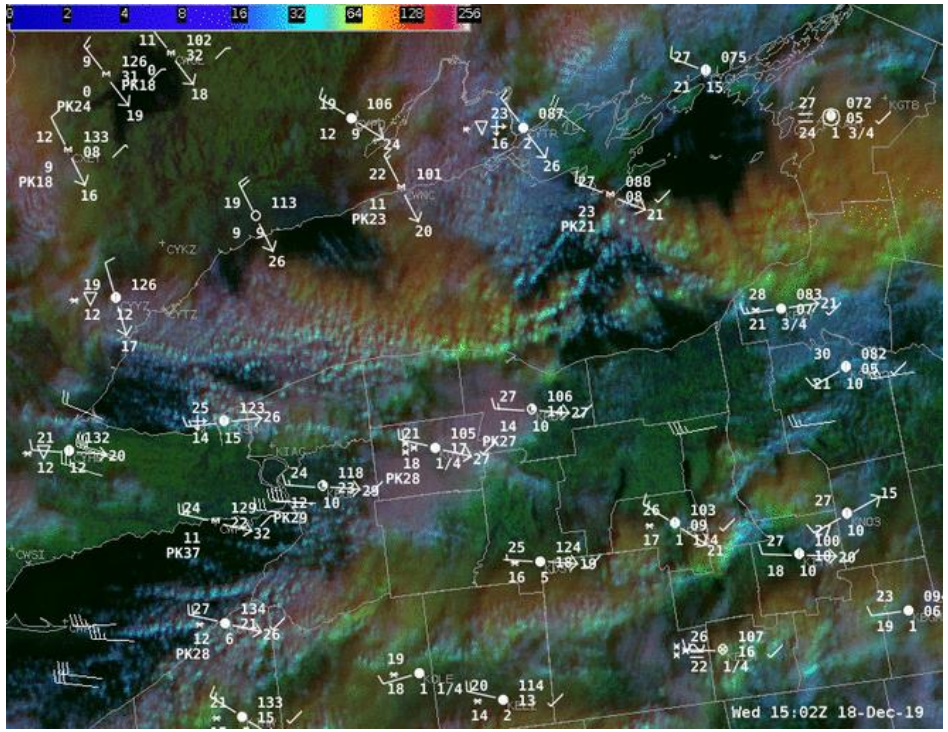


Satellite Liaison Blog

- Provides a user perspective on satellite applications during forecast and warning operations
  - How satellite data were used (or could have been used) to address a given forecast challenge
  - Best practices for using satellite data alongside other datasets and in AWIPS
  - Examples are typically from very recent events, and include GEO/LEO single-band and multi-spectral imagery, and derived products
- Contributors include satellite liaisons and NWS forecasters
- NWS forecasters make up a large portion of the audience
  - Forecasters enjoy learning through recent use examples and from fellow forecasters



5 Oct 2017 SNPP VIIRS DNB/NCC and GOES-East Nighttime Microphysics RGB. Shows how higher resolution VIIRS imagery was used to highlight full extent of fog.
https://satelliteliaisonblog.com/2017/10/05/using-suomi-npp-viirs-dnb-to-track-fog/

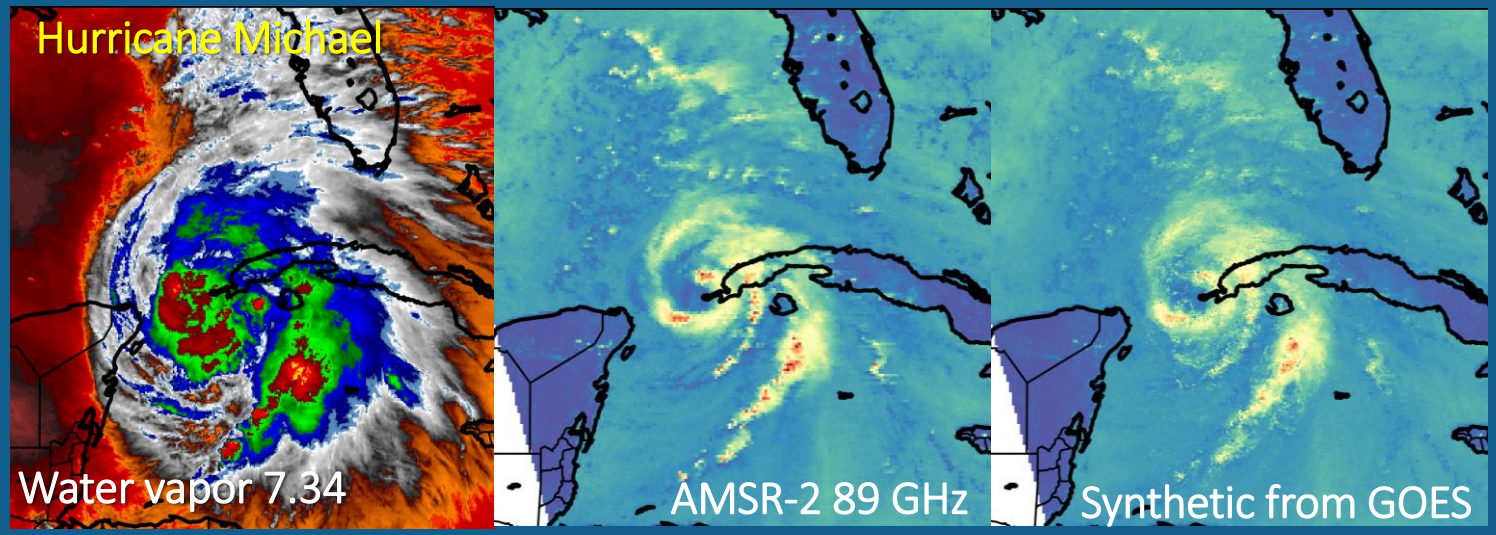


18 Dec 2019 GOES-East 1-min Day Cloud Phase Distinction RGB. Shows utility of this particular RGB for detecting snow squalls with or in the absence of quality radar data.
https://satelliteliaisonblog.com/2019/12/18/18-dec-2019-ny-snow-squall/

AI & Satellites – improving tropical cyclone representation & forecasts

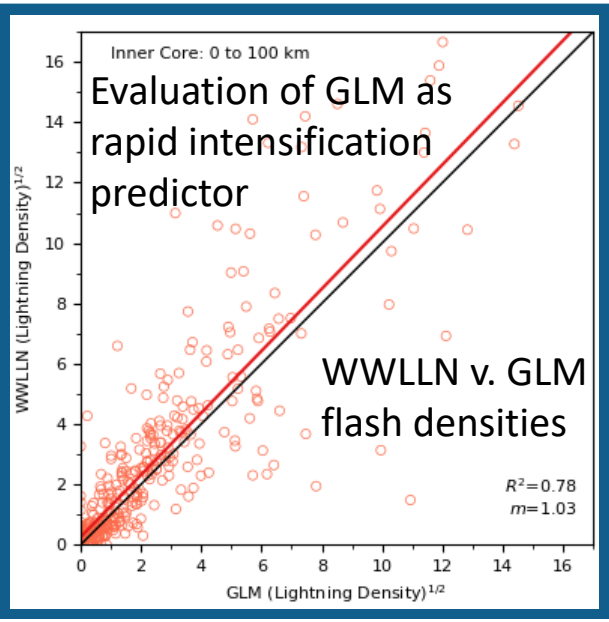
Synthetic imagery from geostationary

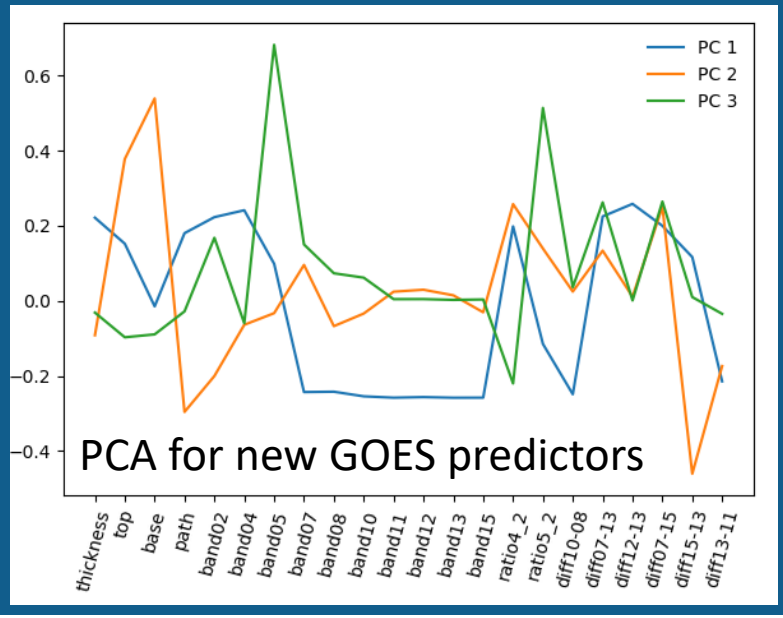
- Leverage LEO imagery to generate more utility from GEO
- Provide routinely available synthetic channels from GOES-R services ABI
- Existing L2+ products can be generated off of synthetic channels



Improving short-term forecasts

- New AI techniques + L2+ products from GEO/LEO offer the potential to improve short-term forecasts
- Satellite data provides current structure and "health" information that is critical in the near/short term





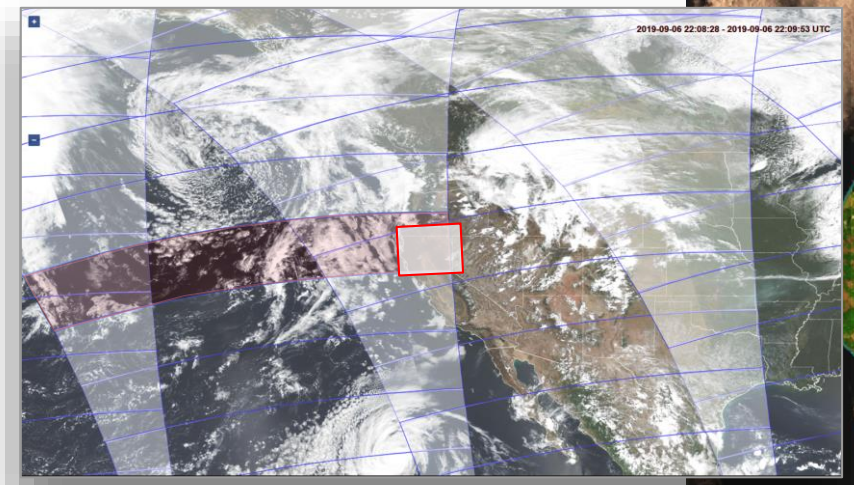
GOES/JPSS Training links for NOAA and Non-NOAA Users

- Satellite Foundational Courses for GOES-R (SatFC-G) and JPSS (SatFC-J)
  - Comprises GOES/JPSS satellite training modules for users http://rammb.cira.colostate.edu/training/visit/training_sessions/satfc-g.asp
  - http://rammb.cira.colostate.edu/training/shymet/training_sessions/satfc-j.asp
- VISIT: Meteorological Interpretation Blog
  - Highlights to users the utility of GOES/JPSS products and applications for various atmospheric events.
  - http://rammb.cira.colostate.edu/training/visit/blog/
- GOES/JPSS Quick Guides
  - 1-2 page product reference materials for users
  - https://vlab.ncep.noaa.gov/web/stor/goes2
  - https://vlab.ncep.noaa.gov/web/stor/polar2
  - http://rammb.cira.colostate.edu/training/visit/quick_guides/
- GOES/JPSS Quick Briefs
  - 3-5 minute product application videos for users
  - https://vlab.ncep.noaa.gov/web/stor/polar3
  - https://vlab.ncep.noaa.gov/web/stor/goes3
  - http://rammb.cira.colostate.edu/training/visit/quick_briefs/
- Teletraining for National Weather Service (NWS) Users
  - Current JPSS/GOES Teletraining Topics Covered:
    - Near-Constant Contrast (NCC)
    - Advected Layered Precipitable Water (ALPW)
    - NUCAPS
    - TROWAL Identification
    - GOES Fog/Low Stratus
    - Tracking EML and other topics
  - http://rammb.cira.colostate.edu/training/visit/calendar.asp

Quantifying parallax shifts: 1. NE California (TC / non-TC animation)

Use Slide Show mode to view this slide!

A comparison of TC and non-TC images from a single granule shows parallax shifts of several km in higher altitudes near edges of scan



"Natural Color" composite of VIIRS Imagery EDR Bands 3, 2, 1

Mt. Shasta
elev. 3,765 - 4,316 m
4.0 km
8.4 km

Lake Almanor
(elev. 1,373 m)
1.3 km
3.8 km

Walker Fire
(elev. 1,600 – 1,700 m)
1.5 km
4.7 km

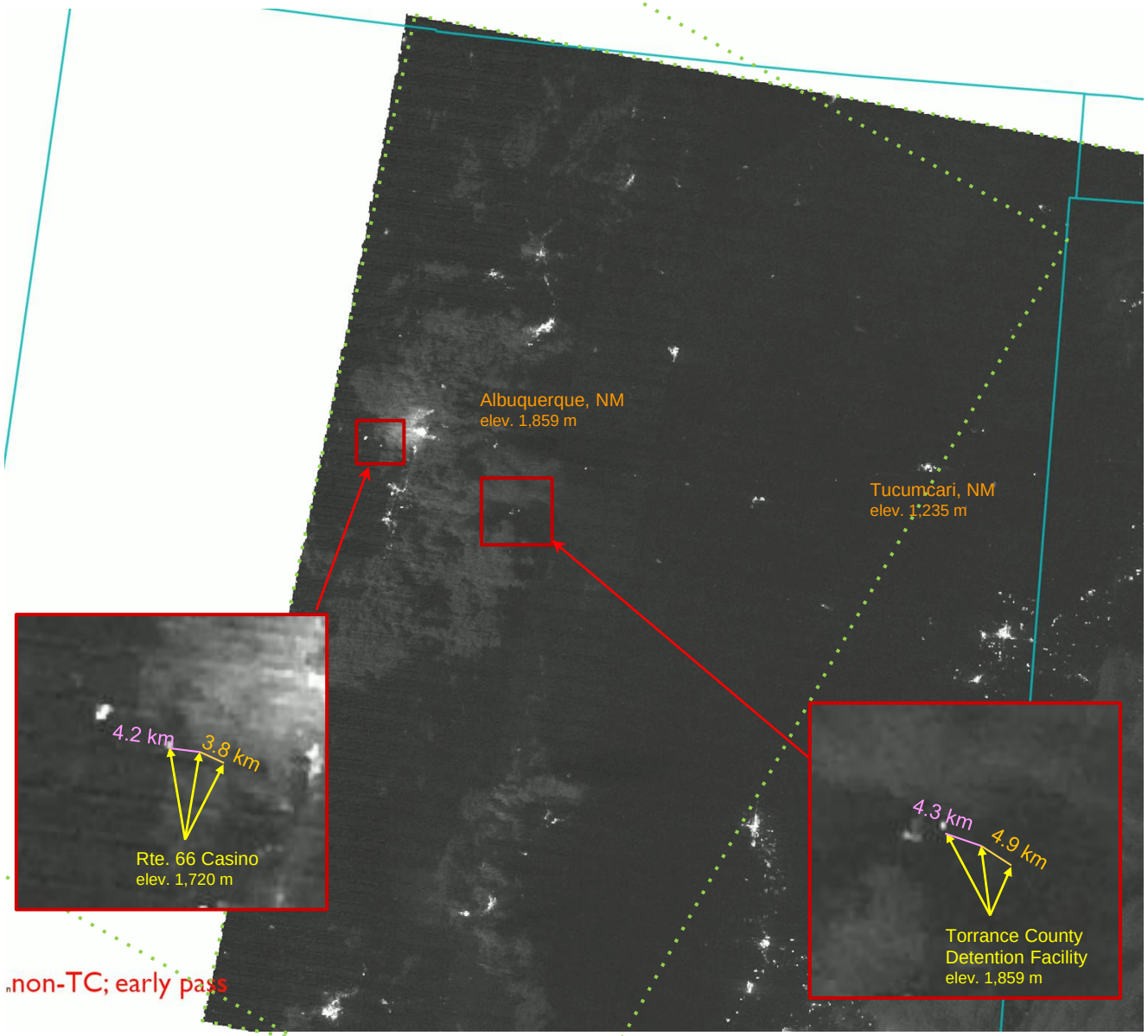
Non-TC; early pass

S-NPP 2019-09-06 @ 21:27 & 22:08 UTC

Quantifying parallax shifts: 2. New Mexico (TC / non-TC animation)

Use Slide Show mode to view this slide!

TC and non-TC images from 2 overlapping granules show surface positional errors of several km in higher altitudes near edges of scan

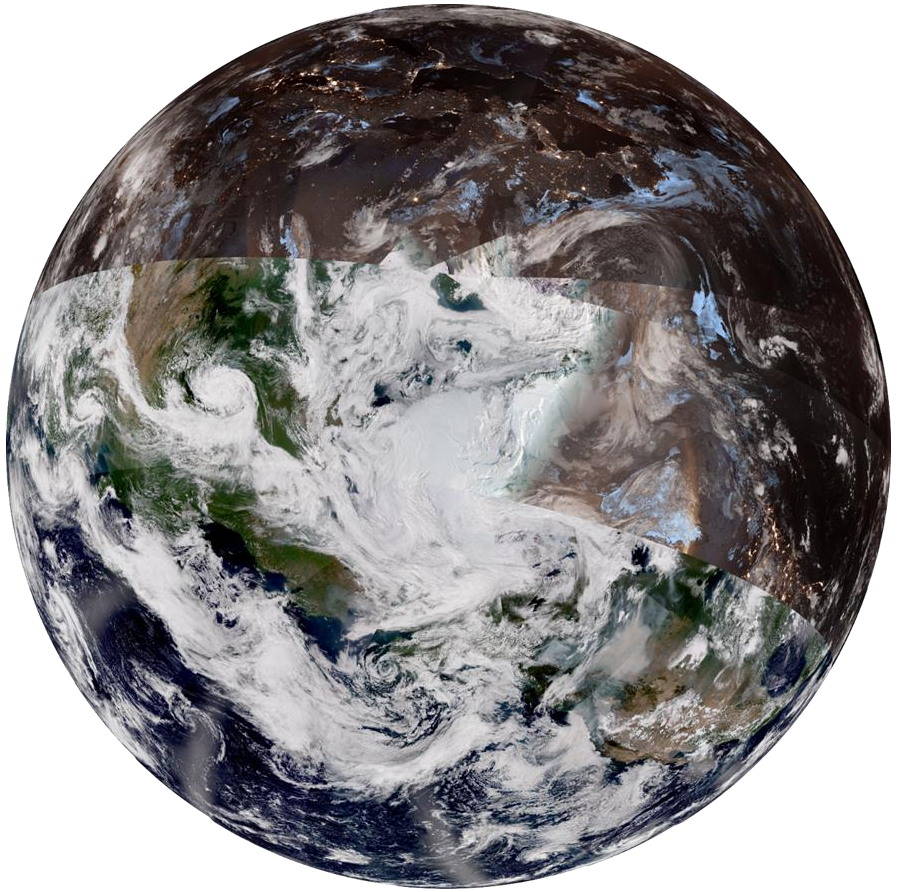


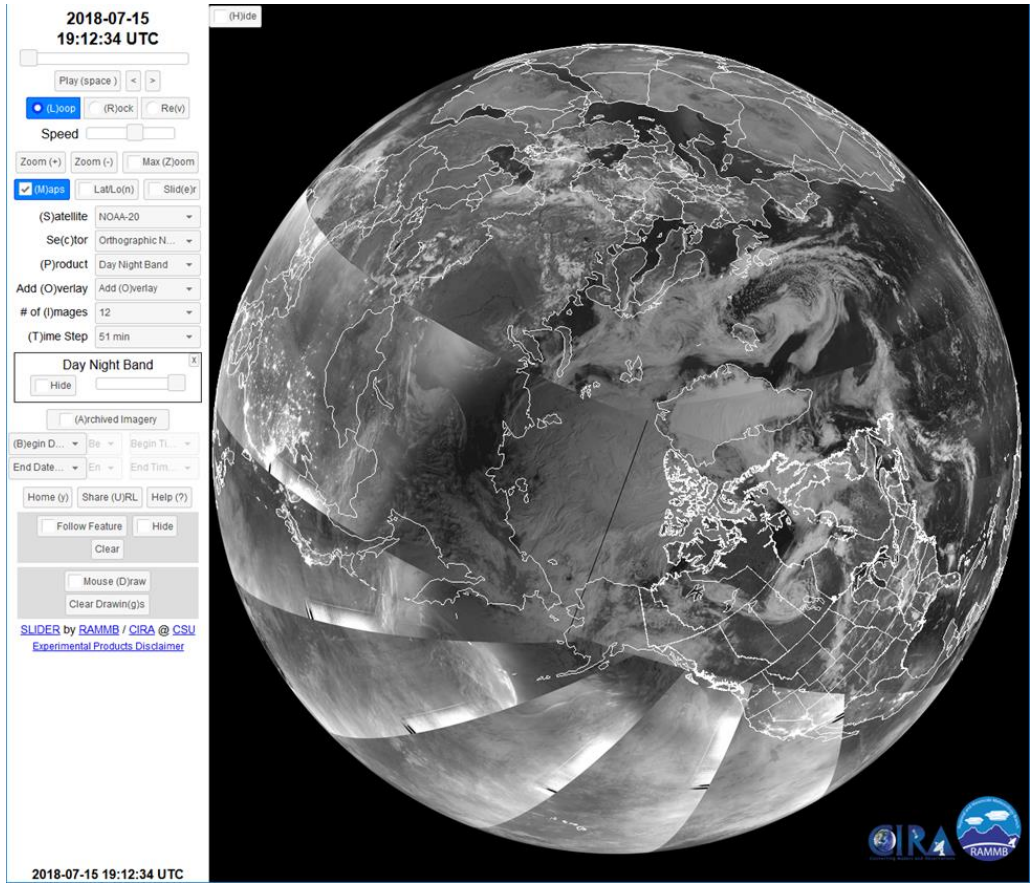
S-NPP NCC EDR
2019-09-10 @ 07:50Z

NOAA-20 NCC EDR
2019-09-06 @ 09:54Z

VIIRS Near-Constant Contrast granules

VIIRS GeoColor (Enhanced True Color) in CIRA's SLIDER – centered on North Pole (http://rammb-slider.cira.colostate.edu)






NASA • DoD • NOAA
THREE AGENCIES
ONE MISSION
S-NPP
SUOMI NATIONAL POLAR-ORBITING PARTNERSHIP


GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R-SERIES
GOES R
NOAA ~ NASA

Questions?


JOINT POLAR SATELLITE SYSTEM
JPSS-1
NOAA • NASA


GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE-R SERIES
GOES S
NOAA – NASA