Use and Assessment of Multi-Spectral Satellite Imagery in NWS Operational Forecasting Environments

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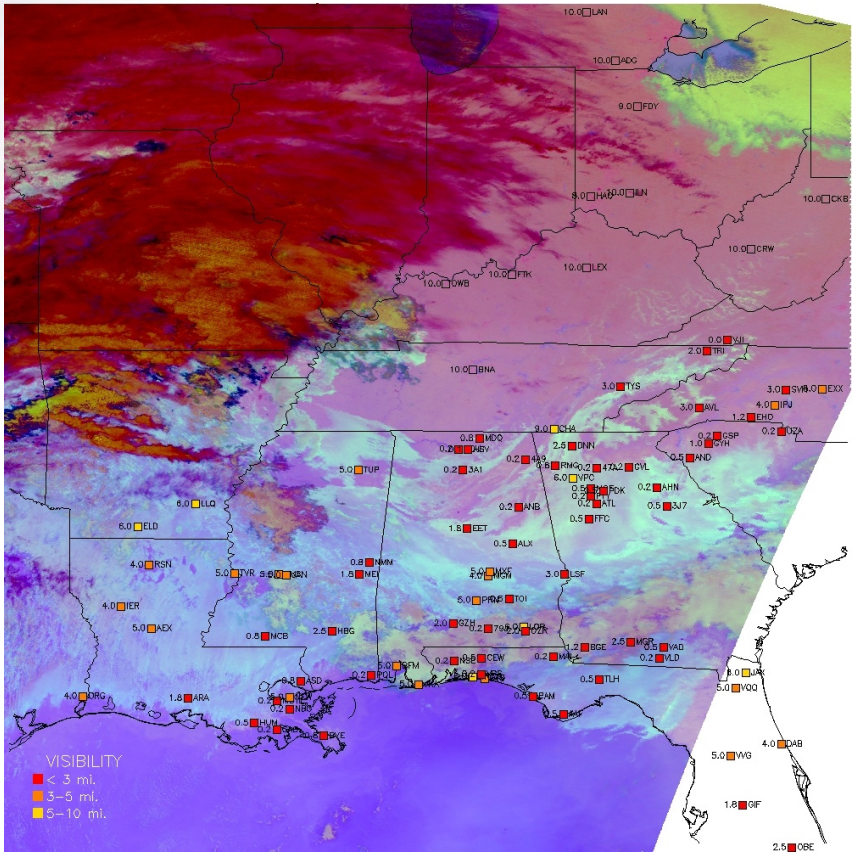
Overview

- NOAA's Satellite Proving Grounds have established partnerships between product developers and NWS WFOs for the evaluation of new capabilities from the GOES-R and JPSS satellite systems.
- SPoRT has partnered with various WFOs to evaluate multispectral (RGB) products from MODIS, VIIRS and Himawari/AHI to prepare for GOES-R/ABI.
  - Assisted through partnerships with GINA, UW/CIMSS, NOAA, and NASA Direct Broadcast capabilities

False Color (RGB) Composites

- The GOES-R ABI will have additional spectral bands, allowing for new false color composites, which assist with image classification and feature detection.
- SPoRT provides these products in AWIPS for evaluation and testing.
- Similar products from SEVIRI have been used extensively by the National Centers.

"Night Microphysics" – Fog Detection



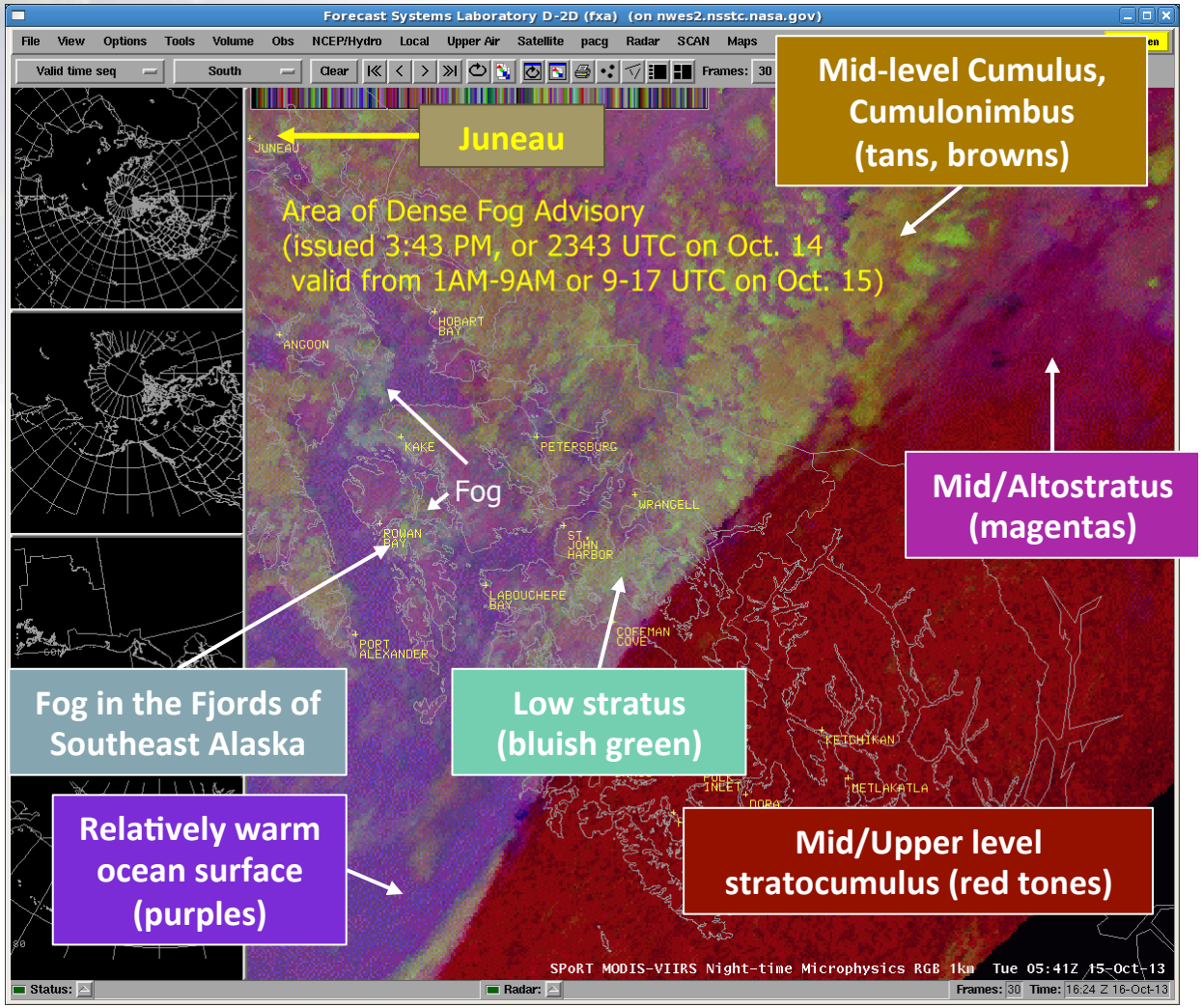
R: 12-11 µm, G: 11-3.9 µm, B: 11 µm

Combines 3 channels of information.

RGB Imagery Assessment: High Lat. 2014

(Focus: Aviation Hazards and Cloud Analysis)

- Jan/Feb 2014
- Nighttime Microphysics and Day-Night Band RGBs
- Compare to traditional GOES 11-3.9µ difference, in hybrid GEO/LEO form
- 32 Evaluated events from AK WFOs and Medford/ Great Falls
- Objectives:
  - Expose users to RGB imagery and test value
  - Can RGBs help to differentiate low cloud features?
  - Are TAFs impacted?

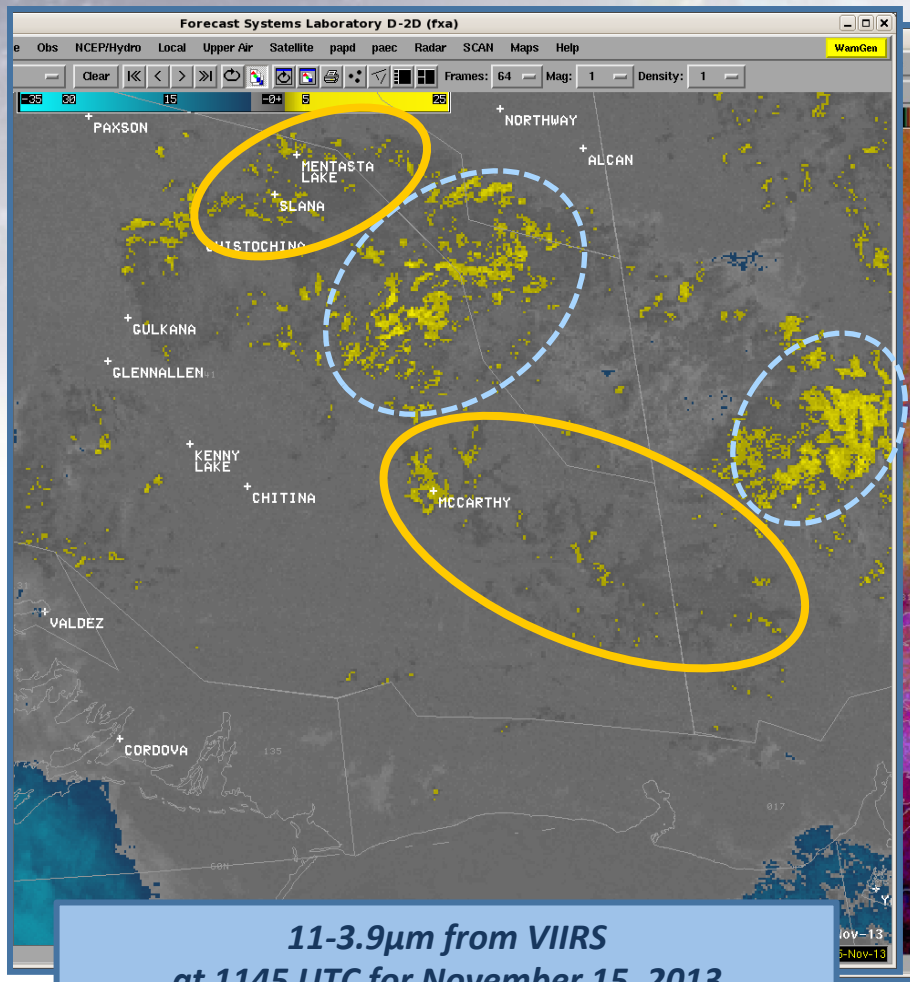


VIIRS Night-time Microphysics RGB from 0541 UTC on October 15, 2013

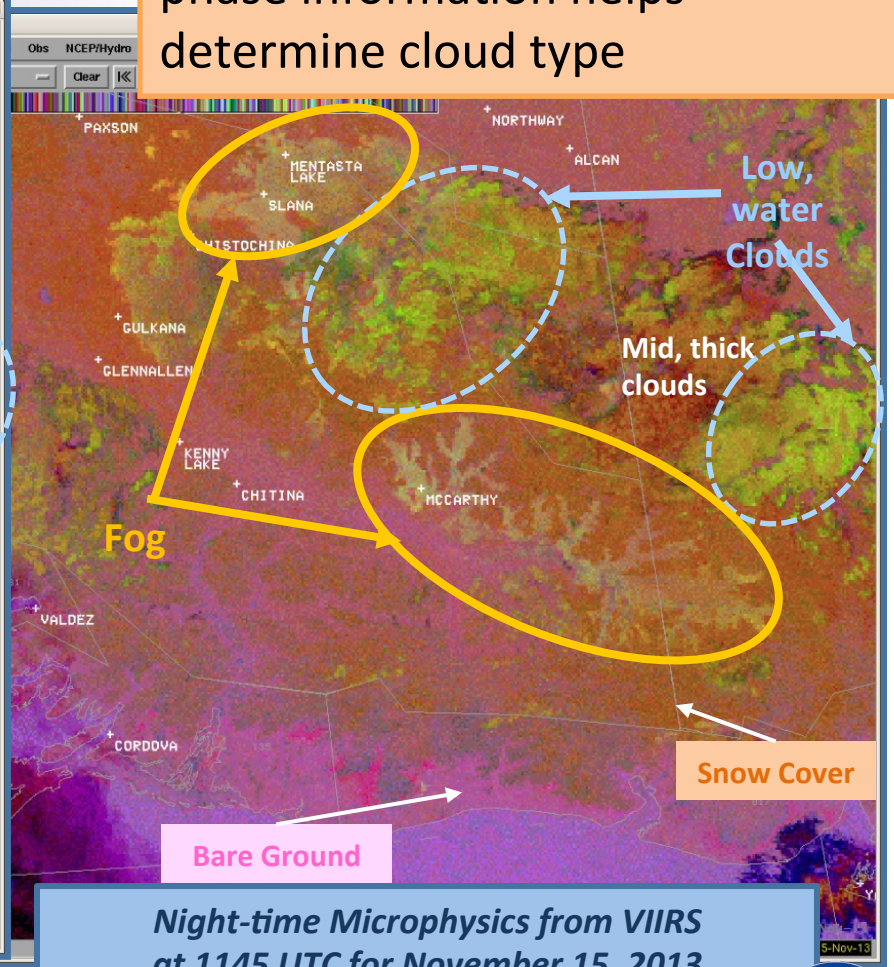
McCarthy, AK Training Module Example:

Low Cloud vs. Fog

Additional thermal and particle phase information helps determine cloud type



11-3.9µm from VIIRS at 1145 UTC for November 15, 2013



Night-time Microphysics from VIIRS at 1145 UTC for November 15, 2013

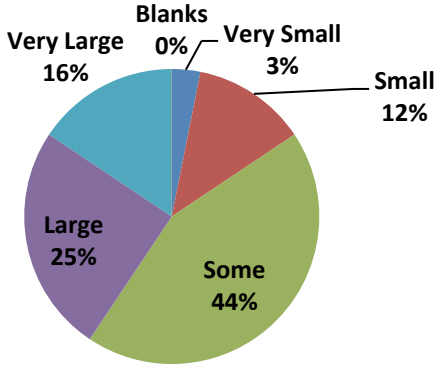
User Comments on RGB Products

- *"[…]Using the [NtMicro] RGB in conjunction with the Hybrid 11-3.9 µm imagery* ***provided a clearer picture*** *on which was fog/stratus and which was mid-level."*
- *"…the* ***microphysics image was very helpful*** *in picking out where the fog and low clouds were in the complex terrain"*
- *"…the* ***microphysics image was very helpful*** *with figuring out fog for zone and marine forecasts."*
- *"Tonight, was able to discern the low clouds from the fog using the RGB imagery. This also allowed me to* ***narrow my area for the dense fog advisory*** *for this morning"*

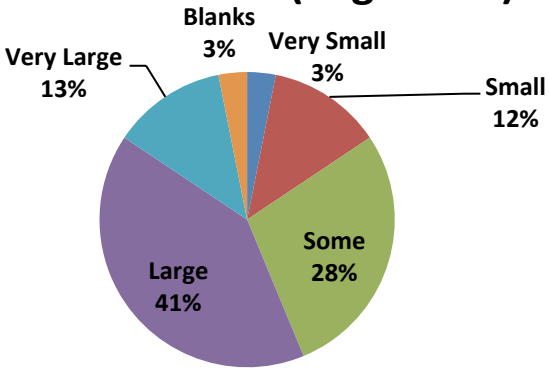
Summary of Assessment Results

High Latitude 2014

Impact of NtMicro RGB to Differentiate Fog from Low Cloud



Impact of NtMicro RGB to Aviation Forecast Issues (in general)

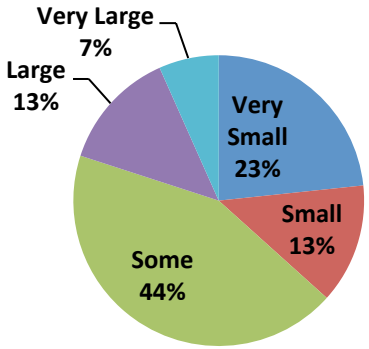


Other issues:

- In scenes with -20C, stratus and fog appeared similar
- Availability of RGBs was infrequent and NtMicro will be limited during AK summer

Hence, 24hr Micro RGB for 2015

Impact of VIIRS DNB RGB to Aviation Forecast Issues (in general)

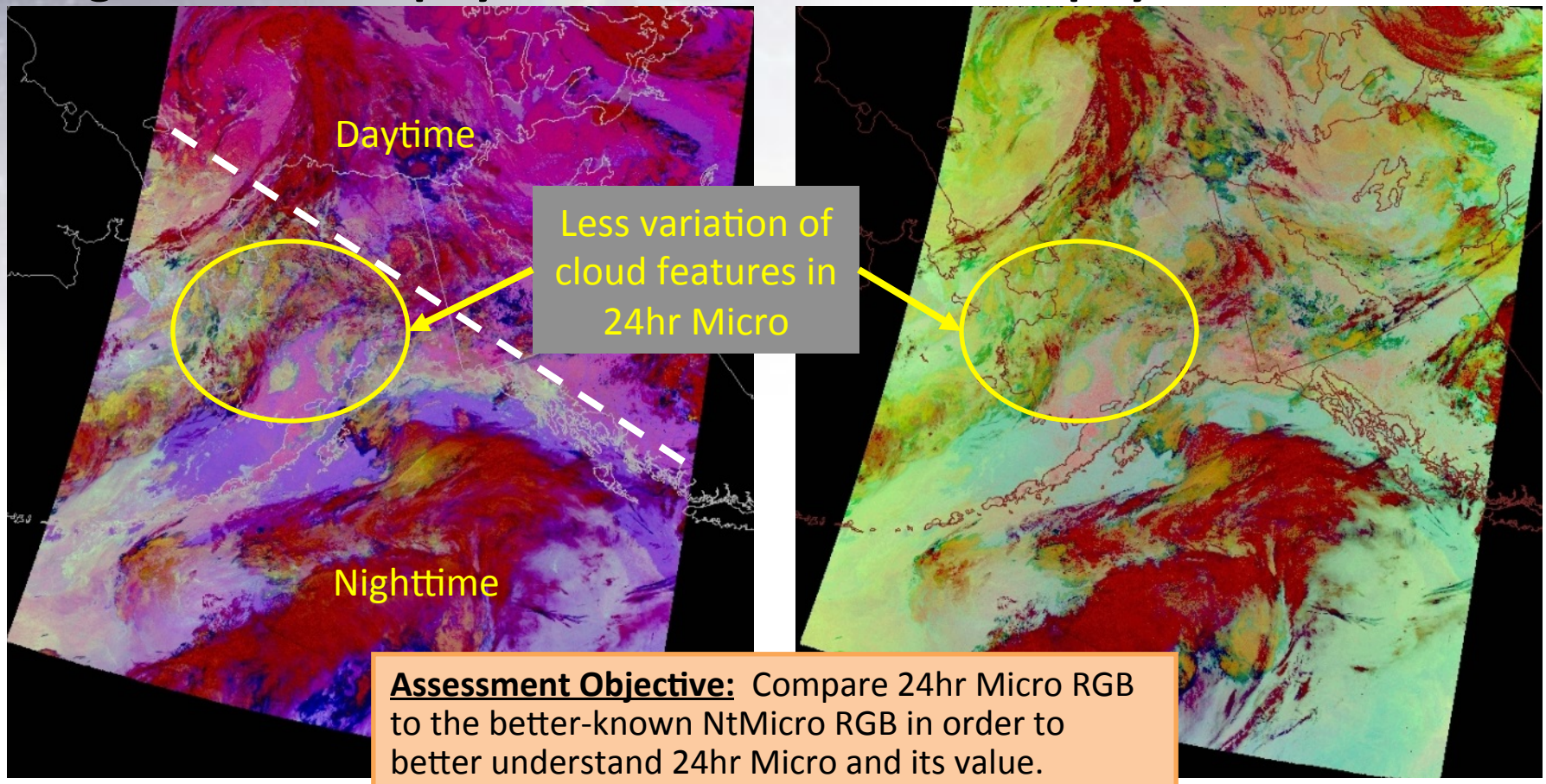


Winter 2015 RGB Assessment in AK

(Focus: Aviation Hazards and Cloud Analysis)

Nighttime Microphysics

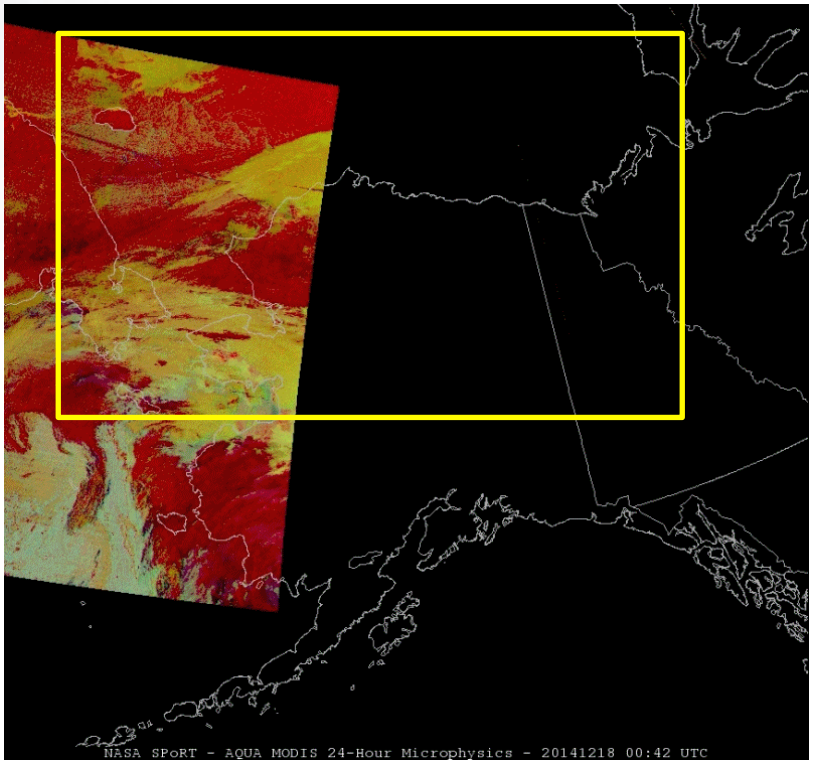
24-hr Microphysics



<u>Assessment Objective:</u> Compare 24hr Micro RGB to the better-known NtMicro RGB in order to better understand 24hr Micro and its value.

24hr Micro RGB at High Latitudes
(Winter 2015)

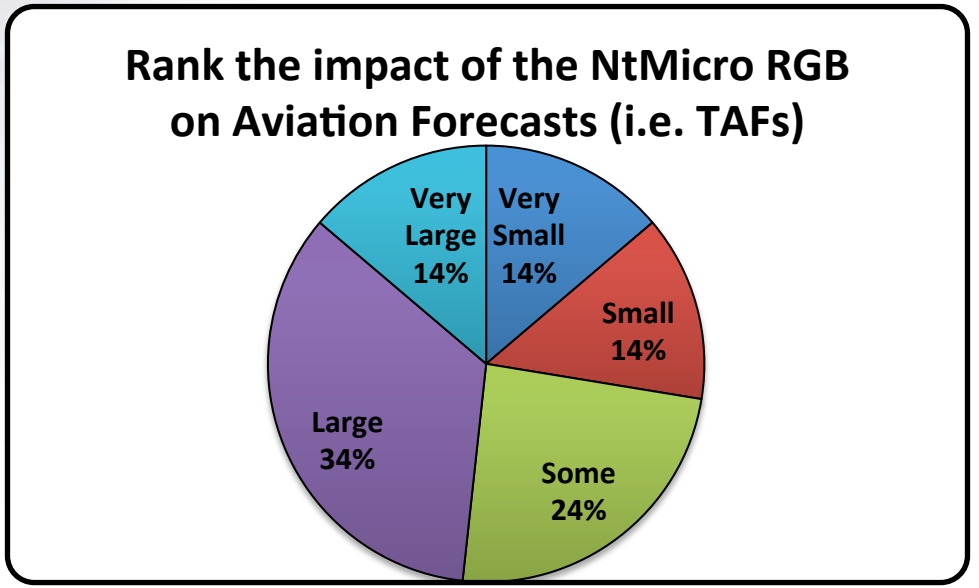
- Product allows for use imagery both day and night.
- Frequency of polar orbiter data in AK provided coherent imagery for weather systems (Focus on region inside yellow outline)
- 24 hours of data shown using both VIIRS and MODIS
- Cloud objects can be tracked and anticipated to impact TAF sites (user input)

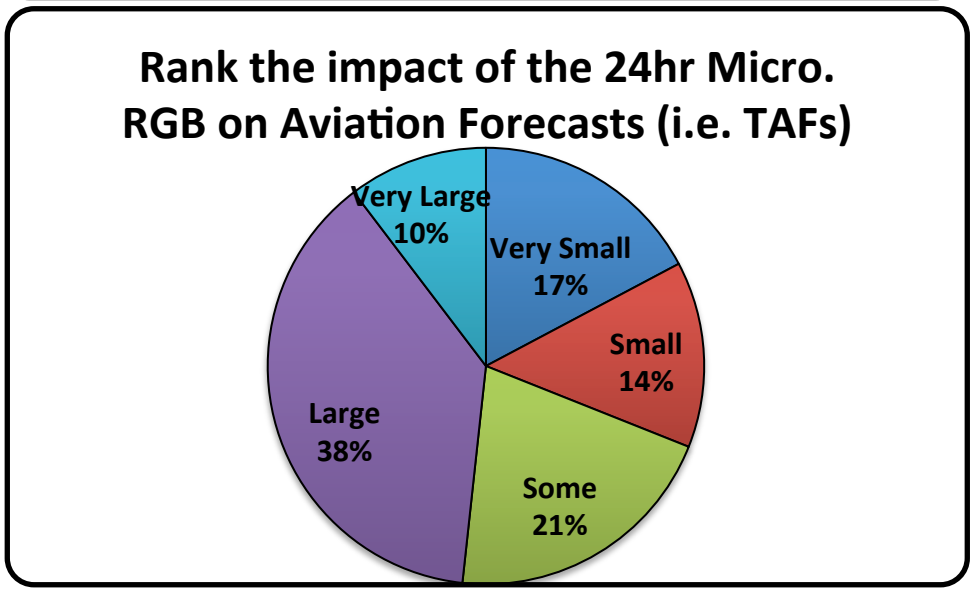


Winter 2015 Assessment Results

Nighttime vs 24hr Micro. RGB in AK

- User feedback indicated similar impacts. Therefore, 24hr Micro. may have analogous value and be used in place of NtMicro.
- ~28 submitted user evaluations
- Several user comments indicated TAF adjustments were made based on imagery use.
- Fairbanks forecaster uses imagery during briefing to next shift and regularly sites it in AFD
- At times 24hr RGB lacks contrast to other clouds/sfc





24hr Micro RGB Impact on TAF

1/28/15 User Feedback Example for Bethel, AK

- "Two images of the 24-hr microphysics clearly delineated the cloud deck and gave some idea of its movement."
- "Based on this knowledge, simply added a TEMPO group to the Bethel TAF for MVFR conditions."

Verification of MVFR ceiling

```
PABE  AA 28 2153Z FEW041 BKN110          10      -1  -8 01022G27  018  71% -26  27
PABE  MP 28 2248Z BKN029 BKN110          10      -2  -9 02024G28  020  71% -28
PABE  AP 28 2248Z BKN029 BKN110          10      -2  -9 02024G28  020  71% -28  28
PABE  AA 28 2253Z BKN029 BKN110          10      -2 -10 02019     019  68% -25
PABE  MP 28 2324Z BKN034 BKN120          10      -2  -9 02020G26  019  71% -26
PABE  AP 28 2324Z BKN034 BKN120          10      -2 -10 02020G26  019  68% -26  26
PABE  AA 28 2353Z BKN038 BKN120          10      -2 -10 02017     020  68% -24
PABE  AA 29 0053Z SCT039 BKN120          10      -2 -10 01017     021  68% -24
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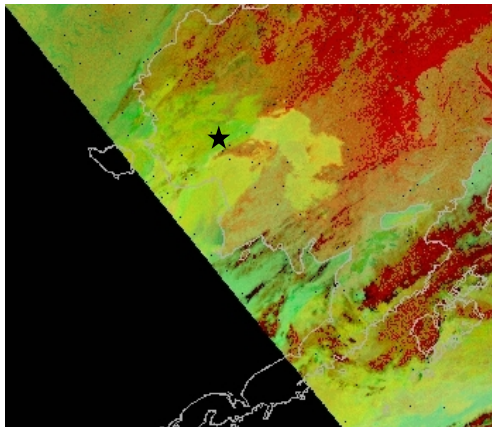
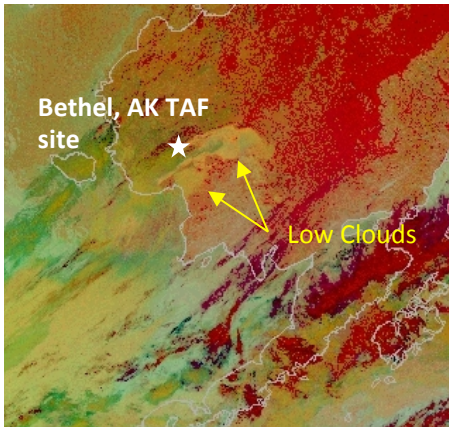
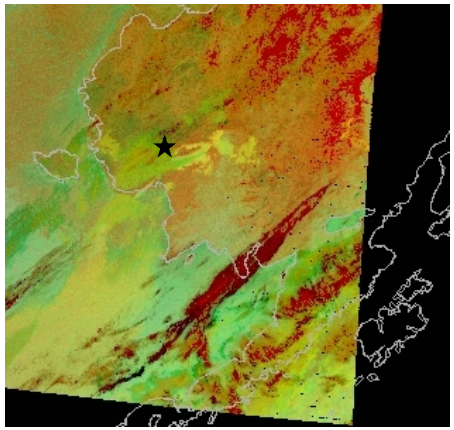


2115 UTC



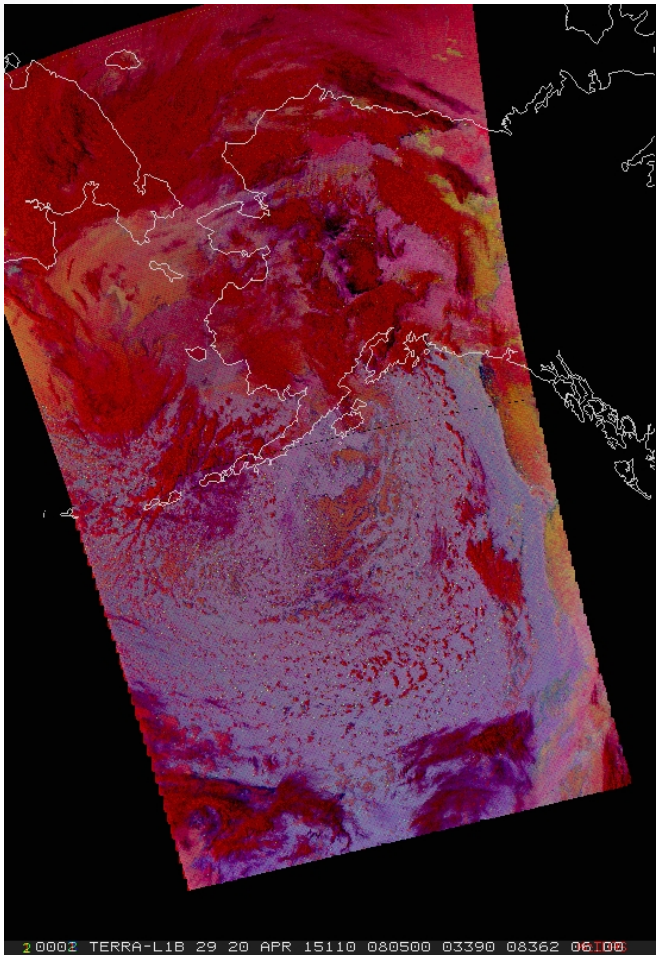
2254 UTC



0038 UTC

Upcoming: Summer 2015
24hr Micro RGB Assessment in Alaska

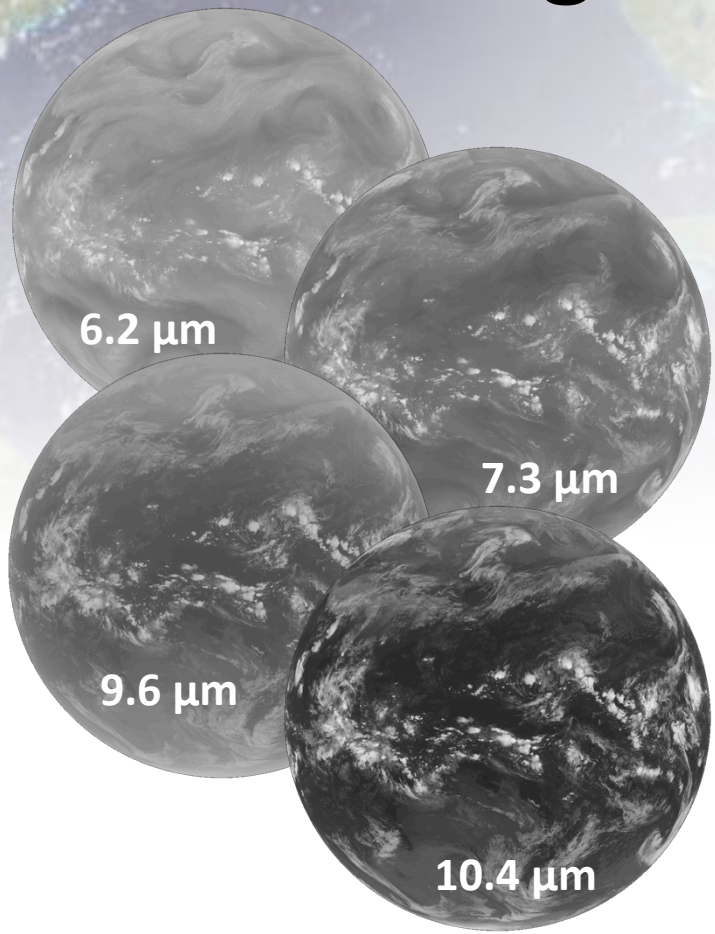
- 24hr Micro RGB more applicable than NtMicro RGB in extended daylight hours of Alaskan summer
- New stretch of the "green" component improves contrast between low clouds and ground features, and new limb/bias corrections improve match between MODIS and VIIRS
- Objective: Test if improved 24hr Micro RGB provides value to Aviation applications in high-latitude summer regime.

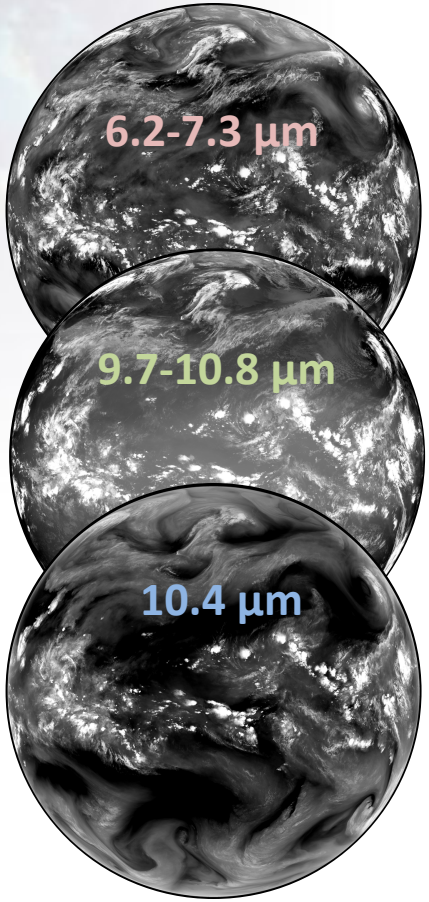


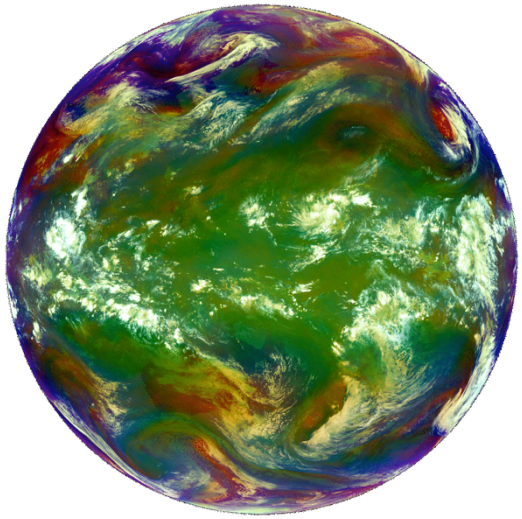
RGB Capabilities via EPDT

- As part of the Experimental Products Development Team (EPDT) activity, collaborations led to modifications of the Raytheon AWIPS II capabilities
- Now permits creation of 24-bit RGBs “on the fly” from AWIPS-II data streams, via localizations, rather than additional plug-in development.
- Supports SPoRT initiatives dating to 2011-2012, to allow greater flexibility in creating RGBs (i.e. local adjustments, new products) and visualizing from NRT data.
  - Extends beyond GOES-R/JPSS/PG efforts by including passive microwave data from NASA/GPM calibrated suite.

Single Channel to RGB





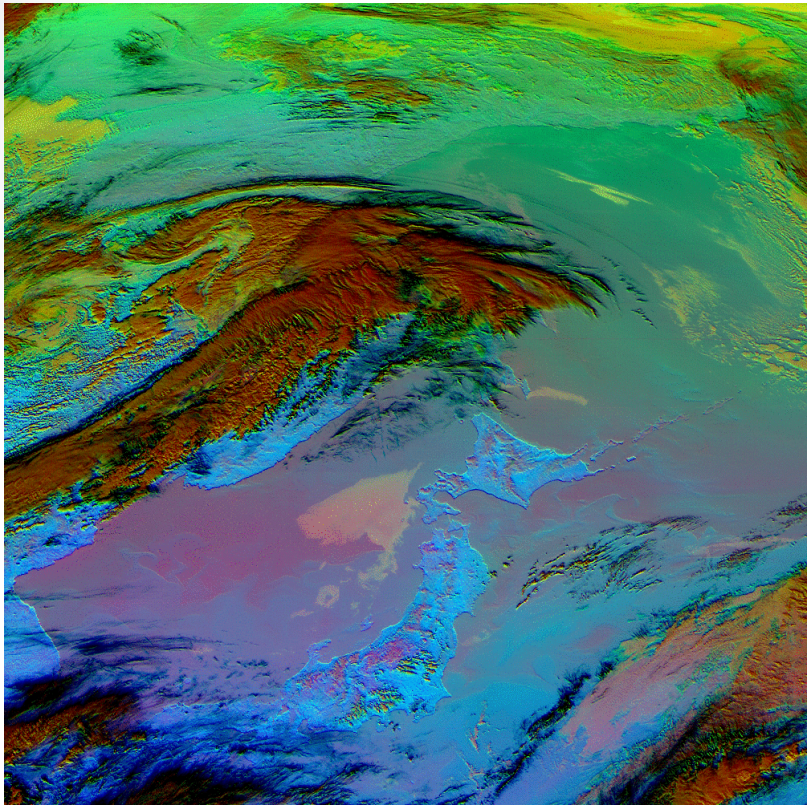


EUMETSAT Air Mass RGB

Single-band information and texture, spectral signatures of features, and interpretation

Evaluation of Himawari RGB Imagery

- Partnering with OPG in Fall 2015 to evaluate the following:
  - 24-bit "on the fly" product generation from within AWIPS II, using AHI data
  - Forecaster understanding of single band usage, band differences, and spectral signatures for feature identification in RGBs
  - Explore forecaster refinement and adjustment of inputs.
  - Selected RGBs focused on specific forecast challenges.



Prototype AHI "24-Hour Microphysics" RGB from April 23, 2015.

Conclusions

- SPoRT collaborations have led to training of OCONUS and National Centers users on new capabilities available from PG products and new multispectral capabilities
- Resulting, informative assessments demonstrate the value of these products to forecasters, but also opportunities for improvement and further training
- New AWIPS-II capabilities for multispectral products will help to achieve the original goal of improved products, local product generation, and greater flexibility to the end user
- SPoRT looks forward to continued partnerships and assessments with our regional partners and National Centers