Applications and Assessments of Multi-Spectral VIIRS and MODIS Products in NWS Operational Forecasting Environments

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What is an RGB or Multi-Spectral Image?

- Current and future satellite instruments, such as MODIS, VIIRS, Himawari AHI, and GOES-R ABI sense diverse wavelengths.
- RGB composite imagery assign individual wavelengths or channel differences to the intensities of the red, green, and blue components of a pixel color.
- Each red, green, and blue color intensity is related to physical properties within the final composite image.
- Final color assignments are therefore related to the characteristics of image pixels.
- Products may simplify the interpretation of data from multiple bands by displaying information in a single image.

Product	Instruments	Purpose
Air Mass	SEVIRI, MODIS GOES Sounder, AHI	Discriminate between air mass types and identify stratospheric intrusions
Dust	SEVIRI, MODIS, VIIRS, AHI	Identify blowing or suspended dust
Fog and Low Clouds	SEVIRI, MODIS, VIIRS, AHI	Identify fog and low clouds
Natural Color	SEVIRI, MODIS, VIIRS, AHI	Smoke, burn scars, and fires
True Color	MODIS, VIIRS, AHI	True color, photograph image
False Color Snow	MODIS, VIIRS, AHI	Discriminates clouds from snow
Passive Microwave	DMSP via SSMI and SSMI/S GPM, TRMM	Tropical cyclone characteristics Midlatitude cyclones and precipitation
Day-Night Band	DMSP and VIIRS	Visible (moonlit) imagery provides cloud texture and city lights

End-User Training and Support

- The SPoRT Center has developed various styles of training to meet the needs of operational forecasters, building upon other foundational training provided by partners such as COMET.
- These include narrated presentations that are provided through a web browser, or shorter "Quick Guides" that can be printed for quick reference during the forecast process.
- In some cases, training and Quick Guides are customized to address unique forecast challenges or product use cases in a specific region – for example, specific Quick Guides have been established to support uses in Alaska that differ from CONUS.

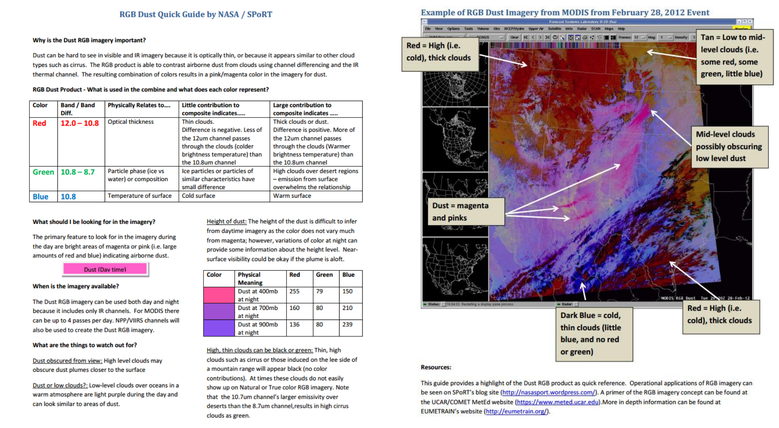


Figure 1. An example of a Quick Guide developed for use and interpretation of an RGB product for dust, available from MODIS, VIIRS, SEVIRI, and Himawari-AHI observations.

End-User Testbeds and Assessments

- Targeted training, use, and assessment periods are used by SPoRT to gauge the effectiveness of products used in real-time operations and identify opportunities for further improvements.
- These activities focus in two areas:
  - ***Testbed*** – a transition of a product to a small group of users, to obtain initial feedback on use and potential value. This allows SPoRT to make minor adjustments and gather use case examples.
  - ***Assessments*** – a broader evaluation of a product with a wider audience, typically consisting of multiple WFOs, to determine the level of value to the forecast challenge. These result in broad R2O and O2R feedback and advance application readiness.

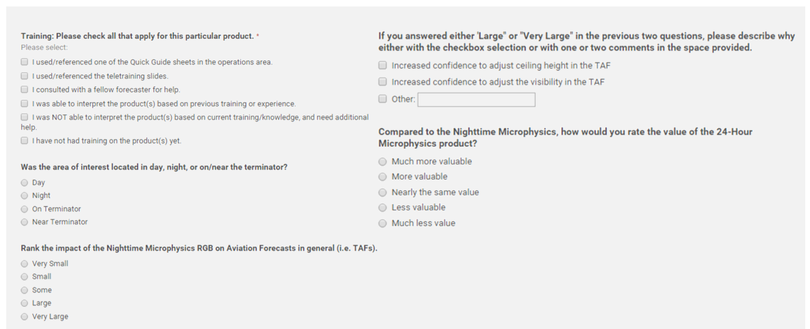
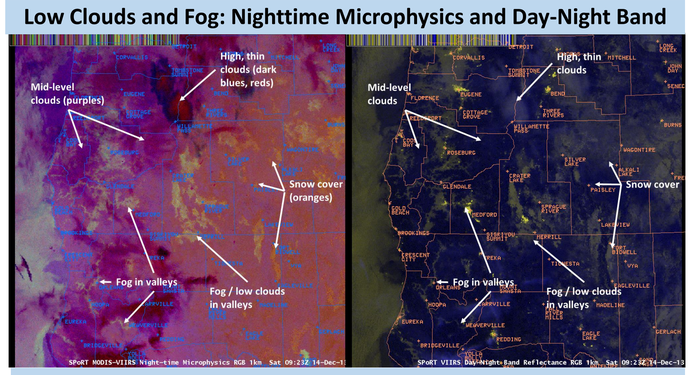


Figure 2. An example of questions asked of forecasters when providing input regarding the use of the 24-hour microphysics product during a recent assessment of the product in Alaska.

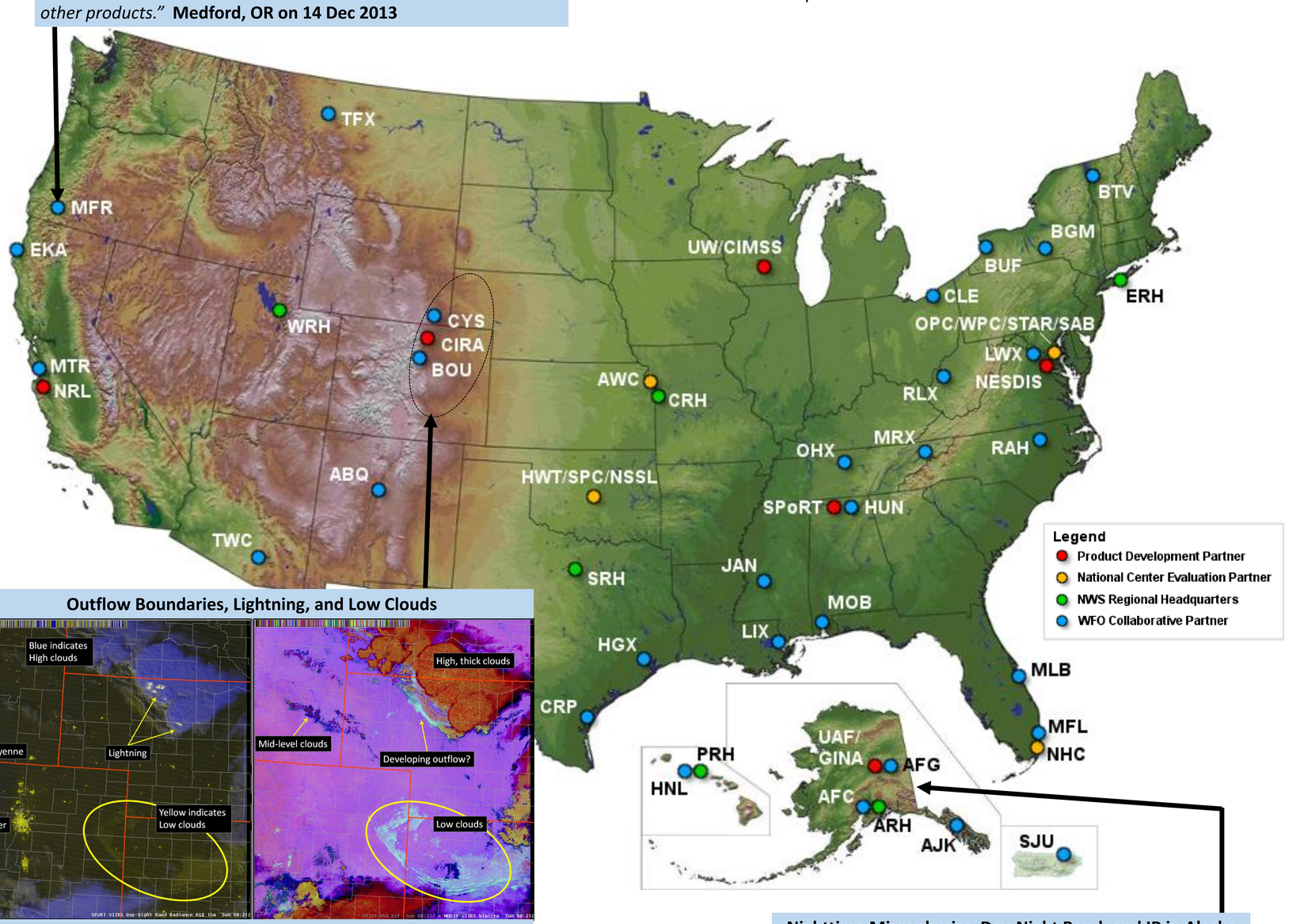
Recent Assessments and Results

Low Clouds and Fog: Nighttime Microphysics and Day-Night Band



Forecaster Feedback: *"Valley low cloud and fog simply jumps off the screen in all of these products tonight. […] Was able to discern that low cloud/fog was more widespread in the valleys than with any other products."* **Medford, OR on 14 Dec 2013**

- SPoRT has partnered with several NOAA/NWS WFOs in CONUS and Alaska to solicit feedback on the use of multispectral products in forecast operations. These included:
- Use of RGBs to Address Low Clouds and Fog for Aviation
  - Front Range Collaborators (Summer 2013)
  - Southern / Eastern Region Inland (Fall 2013)
  - Southern Region Coastal WFOs (Winter 2013)
  - High Latitude (Winter 2013/2014)
- Forecasters examined traditional IR imagery, spectral difference fog products (e.g. 11-3.9), VIIRS and MODIS Nighttime Microphysics products, and the VIIRS DNB for moonlit periods.
- Forecasters provided feedback through online surveys, raised questions in near real-time to SPoRT developers for product clarification, and communicated use cases through blog articles or mentions of product use in Area Forecast Discussions.

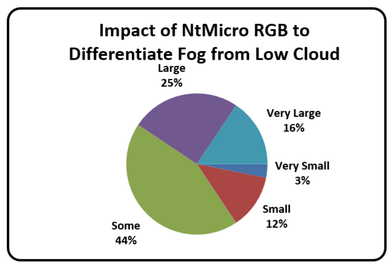


Outflow Boundaries, Lightning, and Low Clouds

Front Range Collaboration: Outflow Boundaries in July 2013
A day-night band RGB using VIIRS IR (left) shows low (warmer) features as yellow and high (cooler) features as blue. The NtMicro RGB combines VIIRS channels to discriminate cloud height, thickness, and fog. Low clouds resulting from outflow of storms are more efficiently analyzed.

Forecaster Feedback

Forecaster feedback indicated that these types of products are beneficial in addressing the challenge of low cloud and fog detection with the majority of responses indicating at least "some" or greater impact, and many responses including "large" to "very large" impacts.



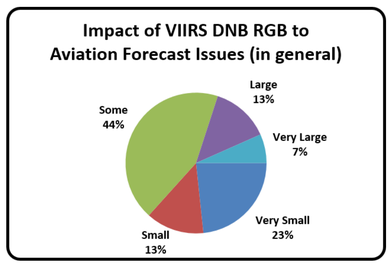
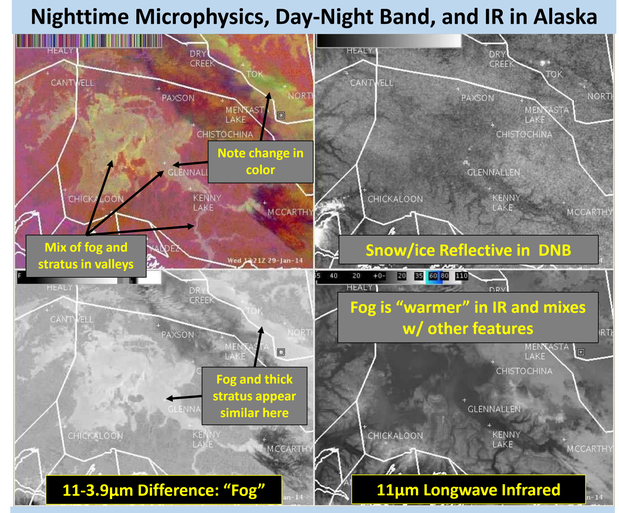


Figure 3. Results of surveys acquired during various assessments of multispectral nighttime microphysics products for low cloud, fog, and aviation applications.

Nighttime Microphysics, Day-Night Band, and IR in Alaska

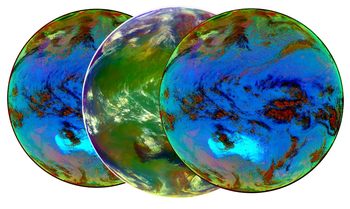


SPoRT Blog from Alaska: *Copper River Basin to the Northeast of Anchorage. Fog is more easily identified in NtMicro RGB compared to traditional 11-3.9µm difference. Variations in fog and stratus thickness are also more evident.*

Summary and Next Steps

- Successful transitions of research products require a close relationship with end users, which takes time and energy to develop and sustain. SPoRT will continue partnerships focused on product assessment and develop assessments in other areas.
- Users find value in the Nighttime Microphysics imagery and use today prepares them for GOES-R and other instruments such as Himawari-8 AHI and Meteosat-10 SEVIRI.
- Future work will refine surveys to solicit additional information on how the forecast process was impacted (e.g. what was changed?) and develop a case study library.

Coming Soon: Himawari-8 AHI



SPoRT is developing RGB composites from Himawari-8 AHI and will perform assessments with Pacific Region and National Centers.