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 assigns 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 characteristics of image pixels.
- Final color assignments are therefore related to the characteristics of a single image.
- Products may simplify the interpretation of data from multiple bands by displaying information in a single image.

Product | Instruments | Purpose
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Air Mass | SEVIRI, MODIS | Discriminates between air mass types and identifies atmospheric inversions.
Dust | SEVIRI, MODIS, VIIRS, AHI | Identifies blowing or suspended dust.
Fog and Low Clouds | SEVIRI, MODIS, VIIRS, AHI | Identifies fog and low clouds.
Natural Color | SEVIRI, MODIS, VIIRS, AHI | Identifies bright, burned scars, and fires.
True Color | MODIS, VIIRS, AHI | True color, photographic image.
False Color Snow | MODIS, VIIRS, AHI | Discriminates snow from other surface types.
Passive Microwave | DMSP via SSMI and SSMI/S | Discriminates clouds from snow.
Day-Night Band | DMSP and VIIRS | Visible (moonlit) imagery provides cloud detection 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.

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 challenges. These result in broad R2O and O2R feedback and advance application readiness.

Recent Assessments and Results
- **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/Rain 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 moonlight 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.

**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.

**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.

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

**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.

**Outlook Boundaries, Lightning, and Low Clouds**
- Forecast 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 a “some” or greater impact, and many responses indicating “large” to “very large” impacts.

**Figure 4.** 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 Himawari RGB combines VIIRS channels to discriminate cloud height, thickness, and fog. Low clouds resulting from outflow of storms are more efficiently analyzed.

**Figure 5.** 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 moonlight periods.

**Figure 6.** 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.

**Figure 7.** Summary and Next Steps.