What is the DayNightCloudMicroCombo?

The STAR GOES Imagery Site team has developed the “Day Night Cloud Micro Combo” product in order to more efficiently deliver the observational value of both the Day Cloud Phase Distinction & Nighttime Microphysics RGB products. The Day Cloud Phase Distinction RGB provides important cloud information during the day, but produces empty images at night. Meanwhile, the Nighttime Microphysics RGB produces images of limited use during the day, but contributes valuable cloud information at night. By combining the two RGBs, we are able to deliver the same utility to users, while consuming half the processing and storage bandwidth as when both products are made individually. Further, users will not need to switch between the two products during the day/night transition.

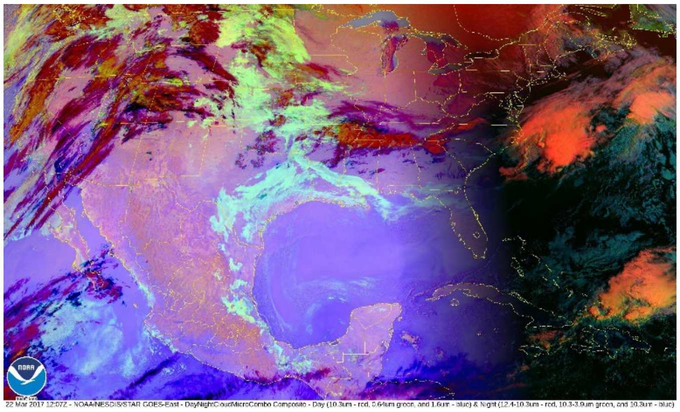
How will it be produced?

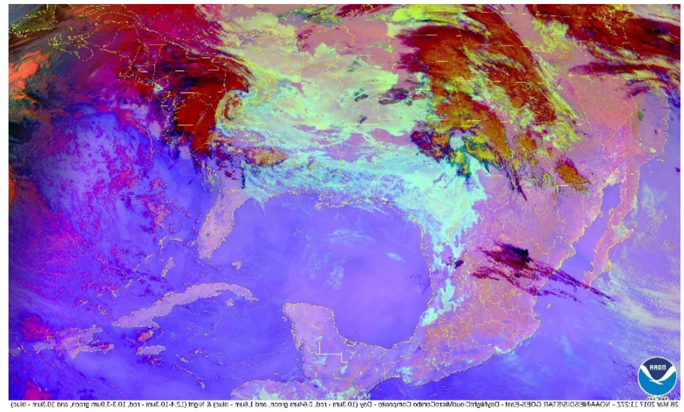
The GOES imagery site will produce the Day Cloud Phase product during daylight hours, and transition to the Nighttime Microphysics product at night, rendering the output into a single image stream. The documentation for the individual products should be applied as guidance for using the output, based on time of observation. See the attached guides for specifics.

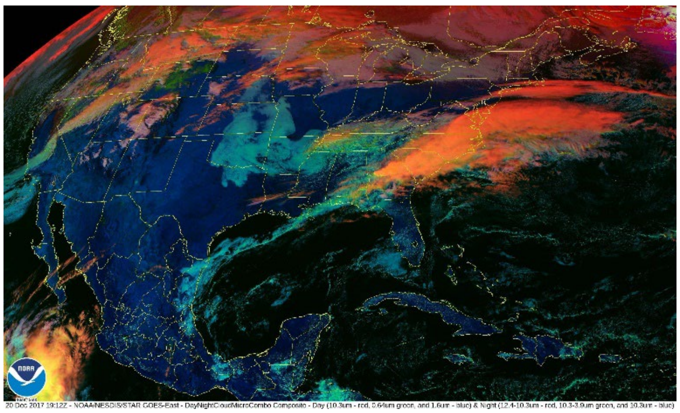
More information

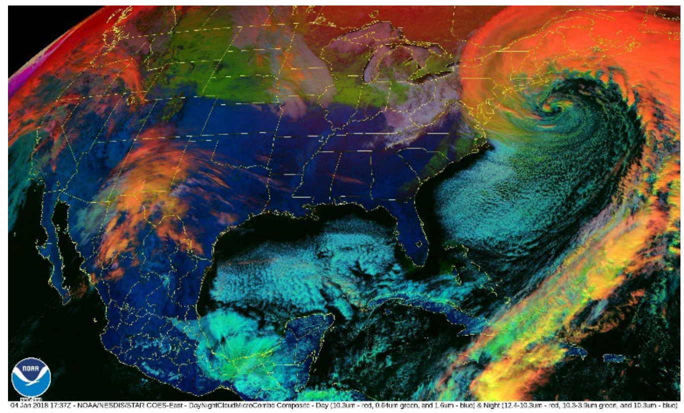
For technical information about how we produce this combination product, please contact Matthew.Jochum@noaa.gov.

Sample Product Images









Sample product images for DayNightCloudMicroCombo over CONUS from March 2017 – January 2018.

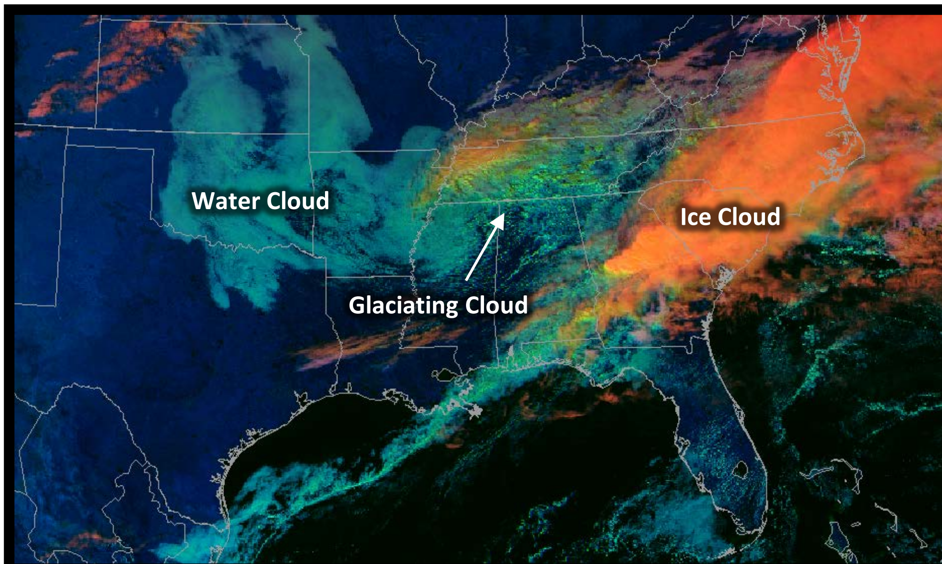
Day Cloud Phase Distinction RGB

* Interpretation still under investigation

Quick Guide

Why is the Day Cloud Phase Distinction RGB Important?

This RGB is used to evaluate the phase of cooling cloud tops to monitor convective initiation, storm growth, and decay. It can also be used to identify snow on the ground. The Day Cloud Phase Distinction RGB takes advantage of cloud reflectance differences between the visible and near infrared channels and temperature variances between land and clouds in the infrared to provide increased contrast between background surfaces and phases of clouds (i.e. water vs. ice).



Day Cloud Phase Distinction RGB from GOES-16 ABI at 1912 UTC, 20 Dec 2017

Day Cloud Phase Distinction RGB Recipe

Color	Band (µm)	Min to Max Gamma	Physically Relates to…	Small contribution to pixel indicates…	Large Contribution to pixel indicates…
Red	10.3 (Ch. 13)	7.5 to -53.5 °C 1	Surface or cloud top temperature	Warm: land (seasonal), ocean	Cold: land (winter), snow, high clouds
Green	0.64 (Ch. 2)	0 to 78 % albedo 1	Reflectance of clouds and surfaces	Water, vegetation, land	Cloud, snow, white sand
Blue	1.6 (Ch. 5)	1 to 59 % albedo 1	Reflectance, particle phase	Ice particles	Water particles, land surface

Impact on Operations

Primary Application

Convective initiation: Used to monitor when clouds are breaking the stable capping layer. Cumulus transitioning from light shades to bolder green and yellow shades indicates vertical development and increasing cloud ice seen with strong storms. Signs of updrafts and overshooting tops help to evaluate how a storm is evolving.

Snow squalls: Preliminary comparisons with radar indicate glaciated cloud bands are associated with heavy precipitation snow events.

Limitations

Daytime only application: The 0.64 µm (VIS) and 1.6 µm (NIR) bands rely on reflected visible solar radiation.

Solar angle and limb effect: For low solar angles (i.e. sunrise and sunset, and during winter) the reflectance values of the VIS and NIR (green and blue components) are decreased. For cold winter scenes and also for viewing at high latitudes (limb cooling effect) the 10.35 µm IR (red component) is skewed towards cold temperatures. Both these effects result in a “reddish” scene.

Contributors: Bernie Connell, Erin Dagg CSU/CIRA https://www.cira.colostate.edu/
Michael Bowlan: NOAA/NWS/SPC http://www.spc.noaa.gov/ and OU/CIMMS http://cimms.ou.edu/

Day Cloud Phase Distinction RGB

*interpretation still under investigation

Quick Guide

RGB Interpretation

1 **Low level clouds with water droplets** *(cyan, lavender)*

2 **Glaciating clouds** *(green)*

3 **Snow** *(shades of green)*

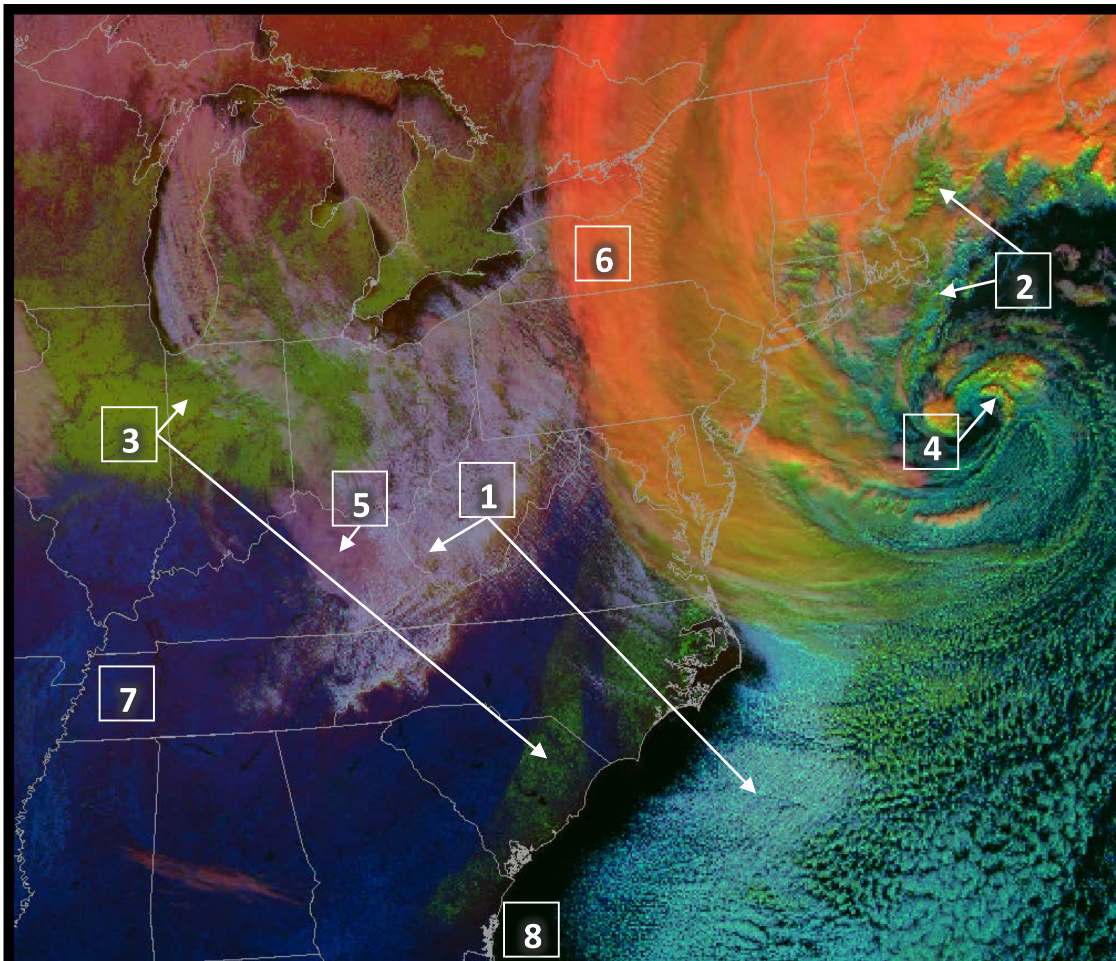
4 **Thick high level clouds with ice particles** *(yellow)*

5 **Thin mid level clouds with water droplets** *(magenta)*

6 **Thin high-level clouds with ice particles** *(red-orange)*

7 **Land surface** *(shades of blue)*

8 **Water surface** *(black)*

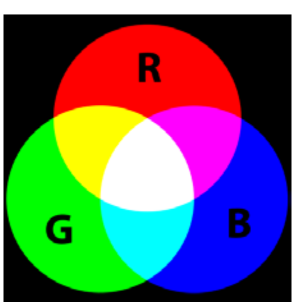


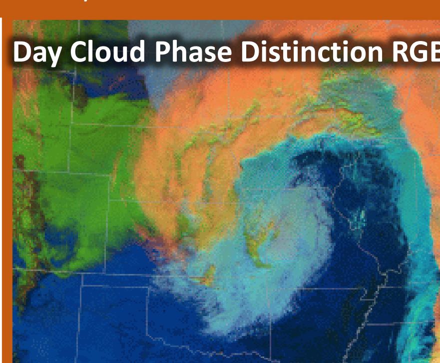
Day Cloud Phase Distinction RGB from GOES-16 ABI at 1735 UTC, 04 January 2018.

Note: colors may vary diurnally, seasonally, and by latitude. Since the 10.35 µm IR band is one of the RGB components, the color of a particular feature will vary seasonally, particularly for warm/cold surface temperatures and thin cloud features. The JMA developer identifies thin high level cloud as magenta whereas in the image above, a similar color cloud presents as a mid level cloud (5). In an animation, the long dark magenta colored feature in central Alabama is thin high level ice cloud (cirrus).

Comparison to visible imagery: The Day Cloud Phase Distinction RGB is beneficial for observing rapidly developing cumulus. Compared to traditional visible imagery, it provides greater contrast for distinguishing between ice and water clouds and background features. Imagery from https://satelliteliaisonblog.com/2018/01/21/storm-system-brings-snow-severe-weather-and-blowing-dust-to-central-us/

RGB Color Guide





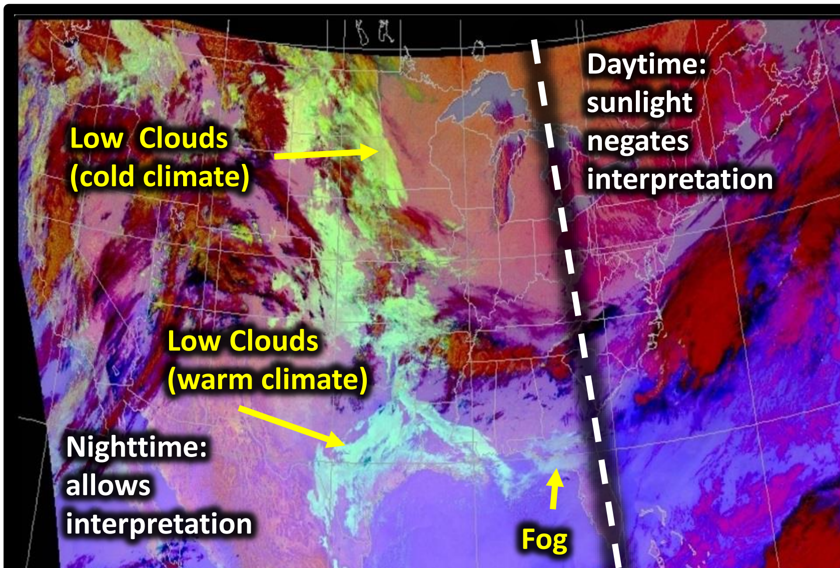
Note: This RGB composite was developed by the Japan Meteorological Agency (JMA) for Himawari-8. Interpretation is still under investigation.

Nighttime Microphysics RGB

Quick Guide

Why is the Nighttime Microphysics RGB Imagery Important?

The distinction between low clouds and fog in satellite imagery is often a challenge. While the difference in the 10.4 and 3.9 µm channels has been a regularly applied product to meet aviation forecast needs, the Nighttime Microphysics (NtMicro) RGB adds another channel difference (12.4- 10.4 µm) as a proxy to cloud thickness and repeats the use of the 10.4 µm thermal channel to enhance areas of warm (i.e. low) clouds where fog is more likely. The NtMicro RGB is also an efficient tool to quickly identify other cloud types in the mid and upper atmosphere.



NtMicro RGB from GOES-16 on 22 March 2017 at 1207 UTC

NtMicro RGB Recipe

(Note: this applies best to opaque clouds. Semi-transparent clouds are influenced by underlying surface)

Color	Band / Band Diff. (µm)	Min – Max Gamma	Physically Relates to…	Small contribution to pixel indicates…	Large Contribution to pixel indicates…
Red	12.4 – 10.4	-6.7 – 2.6 C 1	Optical Depth	Thin clouds	Thick clouds
Green	10.4 – 3.9	-3.1 – 5.2 C 1	Particle Phase and Size	Ice particles; surface (cloud free)	Water clouds with small particles
Blue	10.4	-29.6 – 19.5 C 1	Temperature of surface	Cold Surface	Warm surface

Impact on Operations

Primary Application

Low clouds & fog analysis: Low clouds and fog are aqua in warm regimes, but become more yellow to light green in cold regimes (i.e. decrease in blue component).

Differentiate fog from low clouds: Fog tends to appear "washed out" compared to low clouds. So, look for fog to have a less bright or near gray coloring.

Efficient Cloud Analysis: The multi-channel approach of the RGB allows for easy and quick discrimination of cloud types across the imagery.

Secondary Applications: Cloud height and phase, fire hot spots, moisture boundaries

Limitations

Nighttime only application: The shortwave IR band is impacted by solar reflectance during the day which impacts the 10.4 – 3.9 difference relationship.

Thin fog blends with surface: Thin radiation fog is semi-transparent allowing surface emissions to impact pixel color. Fog often has less blue than low clouds.

Variable land/surface coloring: The color of cloud free regions will vary depending on their temperature, surface type, and the column moisture.

Shortwave IR noise in extreme cold: Speckled yellow pixels appear in very cold clouds (~<-30°C)

Contributor: Kevin Fuell NASA SPoRT https://weather.msfc.nasa.gov/sport/

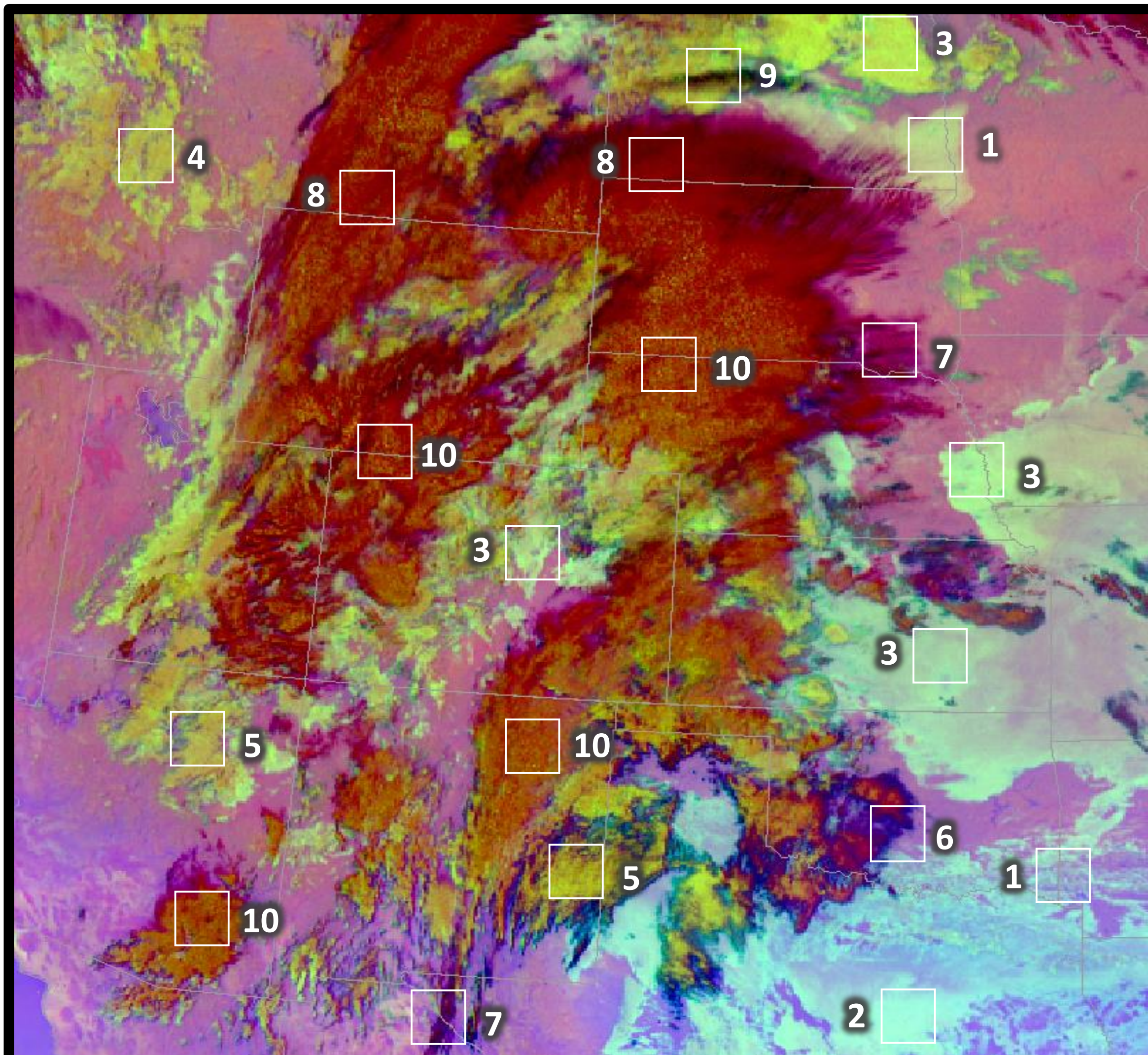
Nighttime Microphysics RGB

Quick Guide

RGB Interpretation

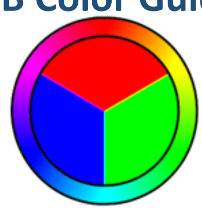
1	**Fog** *(dull aqua to gray)*
2	**Very low, warm cloud** *(aqua)*
3	**Low, cool, cloud** *(bright green)*
4	**Mid water cloud** *(light green)*
5	**Mid, thick, water/ ice cloud** *(tan)*
6	**High, thin, ice cloud** *(dark blue)*
7	**High, very thin, ice cloud** *(purple)*
8	**High, thick cloud** *(dark red)*
9	**High, thin cloud** *(near black)*
10	**High, thick, very cold cloud** *(red/yellow, noisy)*

Note:, colors may vary diurnally, seasonally, and latitudinally



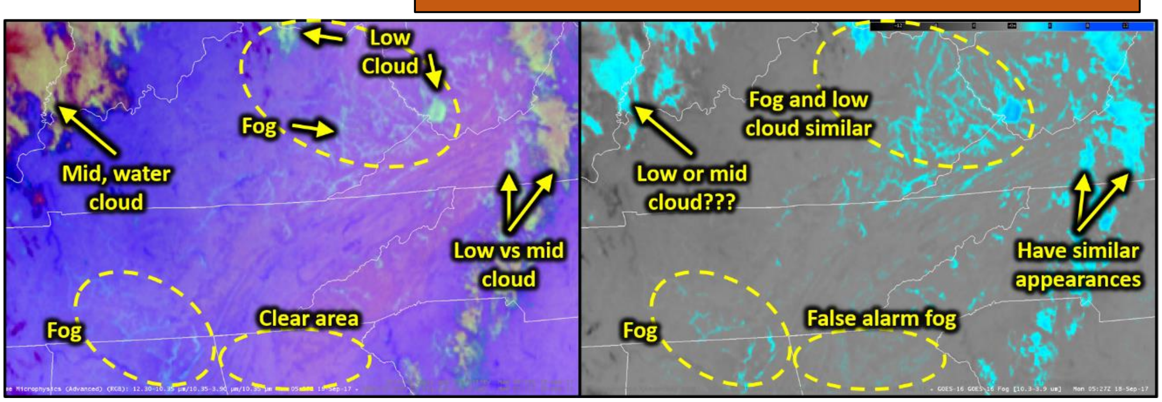
NtMicro RGB from GOES-16 ABI at 1127 UTC, 28 March 2017.

RGB Color Guide



Comparison to Other Products (below)

The NtMicro RGB (left) helps to distinguish fog from clouds and “false alarm” features seen in the legacy “Fog” or 10.3-3.9 µm channel difference (right). Recall the 10.3-3.9 µm is also in the RGB.



Resources

UCAR/COMET

Multispectral Satellite Applications: RGB Products Explained

NASA/SPoRT

Nighttime Microphysics RGB Module

EUMETrain

RGB Interpretation Guide

Hyperlinks not available when viewing material in AIR Tool