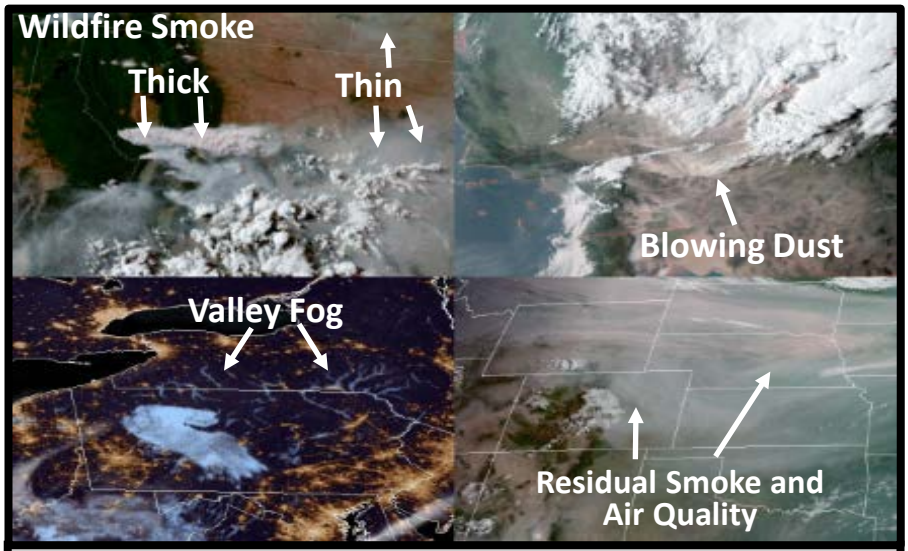
GeoColor Product Quick Guide

Why is the GeoColor Product Important?

GeoColor imagery provides as close an approximation to daytime True Color imagery as is possible from the GOES-R series, allowing for intuitive interpretation of meteorological and surface-based features. At night, instead of being dark like in other visible bands, IR bands are utilized with different methods over land and ocean to differentiate between low liquid water clouds and higher ice clouds. A static city lights database derived from the VIIRS Day Night Band is provided as the nighttime background for geo-referencing. The 5-min imagery is available over the Continental U.S. in AWIPS.



Four examples of operational applications of the GeoColor product. The valley fog example is nighttime, and the other three are daytime.

How is the GeoColor Product Created?

GeoColor uses a total of six channels from the GOES-R ABI. For the daytime imagery, channels 1, 2, and 3 (0.47 µm - blue, 0.64 µm - red, and 0.86 µm - near IR) are first corrected for Rayleigh scattering; this is a key step in order to maximize the contrast between clear sky and clouds, and it results in vibrant colors. Next, the green component is simulated using a lookup table that was built using data from Himawari-8 AHI, which does have a green channel at 0.51 µm. Finally, the red, green, and blue components are combined to create the pseudo-true color RGB. At night, over land (including lakes), the window IR channel 13 (10.3 µm) and the traditional fog product (10.3-3.9 µm) are used to identify both ice and liquid water clouds, and they are made partially transparent and placed atop a static city lights background. Over oceans, ProxyVis (bands 3.9, 10.3, 12.3 µm) is used to define low clouds at night.

Impact on Operations

Primary Applications

Daytime Aerosol Detection: Identify smoke, blowing dust, smog, and anything that has a unique color property.

Nighttime Cloud Detection: Differentiate low liquid water clouds from higher ice clouds at night.

Nighttime Geo-Location: City lights aid in geo-referencing by helping to determine whether clouds (such as fog) are affecting populated areas.

Intuitive Interpretation: Since the colors of features in the daytime are what we intuitively expect them to be, the product requires little to no training, and has proven to be excellent for social media posts.

Limitations

Shallow Water Colors: Since a lookup table is used for the green component, sometimes shallow water colors show up as noisy or incorrect.

Thick vs. Thin Clouds at Night: The nighttime cloud layer is made partially transparent, and the amount of opacity is a function of the cloud top temperature. Sometimes optically thick clouds in the lower atmosphere may show up as partially transparent (including precipitating convection).

Sunrise/Sunset: Near sunrise and sunset, the daytime and nighttime portions are blended, which may cause certain clouds (e.g., the blue low cloud enhancement) to briefly change colors or disappear.

Power Outages Not Shown at Night: City lights make use of a static dataset and will not indicate power outages at night.

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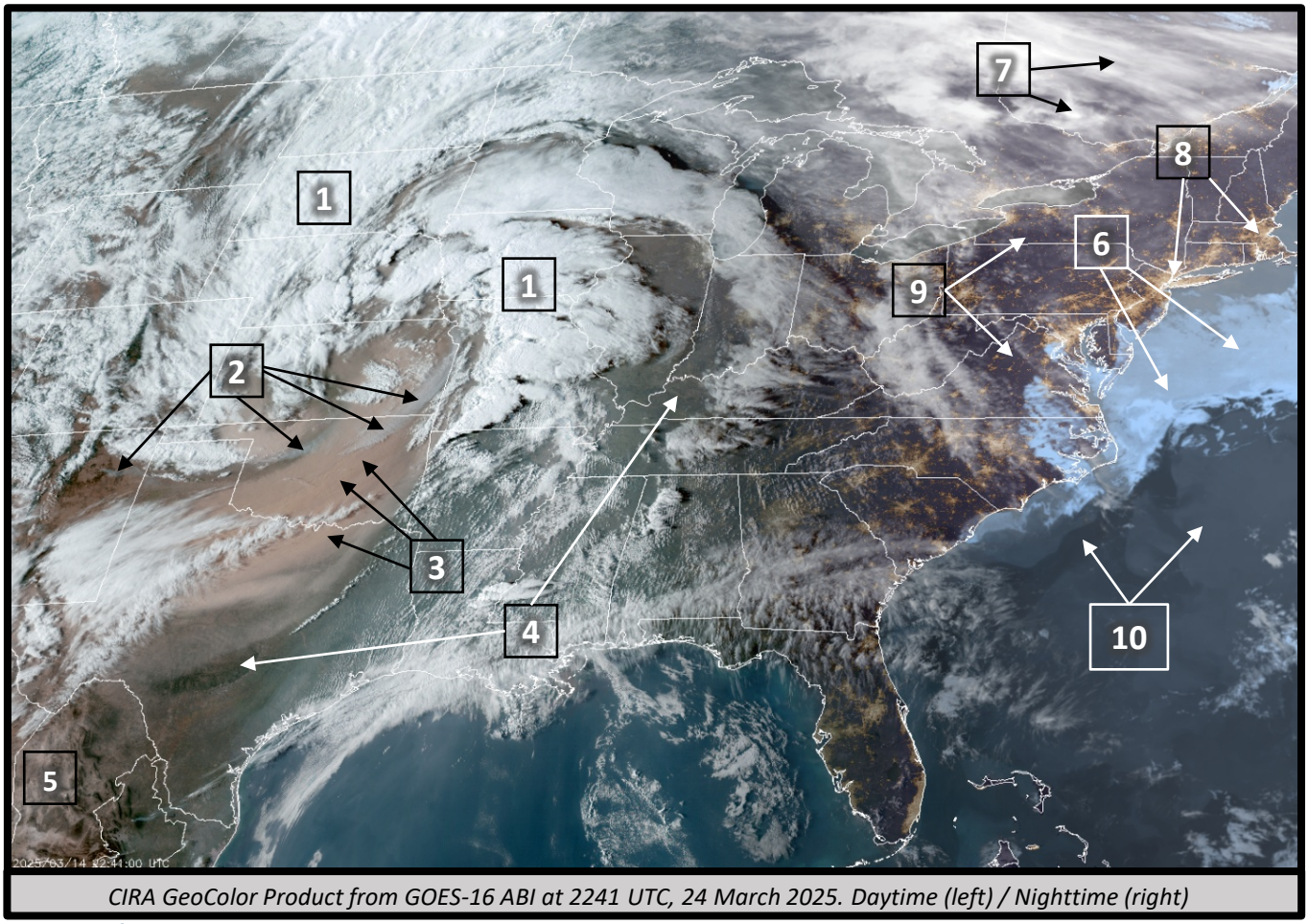

CIRA GeoColor Product from GOES-16 ABI at 2241 UTC, 24 March 2025. Daytime (left) / Nighttime (right)

Interpretation

- 1 **High/Thick Clouds** *(bright white)*
- 2 **Smoke** *(bluish gray)*
- 3 **Blowing Dust** *(light brown/tan)*
- 4 **Vegetation/Forest** *(shades of green)*
- 5 **Dry/Desert** *(shades of brown)*
- 6 **Low-Level Water Clouds** *(light blue)*
- 7 **Mid-Level and Cirrus Clouds** *(grayish white)*
- 8 **City Lights (from Day/Night Band)** *(gold)*
- 9 **Clear Sky Land** *(dark purple)*
- 10 **Ocean Surface** *(shades of blue, lighter for cooler SST)*

2025 Updates:

- Modification of the transition between the daytime and nighttime narrows the bounds of the "twilight zone" and extends the daytime side of GeoColor. This makes the apparent "sunrise" appear earlier and the apparent "sunset" appear later, up to an hour compared to the original GeoColor algorithm.
- Nighttime imagery over land remains the same (legacy fog product), however it now uses ProxyVis over the ocean. Multiple IR bands with a simple machine learning algorithm define the low cloud layer at night (trained on VIIRS Day/Night band imagery). The result is improved detection of low clouds over the ocean. For SST < 20 ˚C, ocean surface appears with a bluish tint and SST gradients can be seen.

Resources:

GeoColor in AWIPS

GeoColor on CIRA SLIDER

SBC Webinar