GOES-R
Aerosols/Air Quality Applications

FACT SHEET

Smoke plume from fire near Yosemite National Park, seen from ~25,000 feet on August 5, 2018. The smoke caused such poor air quality that emergency managers were forced to evacuate and close areas of the park. Credit: NOAA

Why is it important to monitor aerosols?

Aerosols are solid and semi-solid particles suspended in the air that have harmful impacts on human health and the environment. Aerosols are a key component of urban/industrial photochemical smog that leads to deteriorated air quality. They are also the primary pollutant in natural environmental disasters such as volcanic eruptions, dust outbreaks, biomass burning associated with agricultural land clearing, and forest fires. High concentrations of aerosols, when inhaled, lead to upper respiratory diseases including asthma. They decrease visibility and lead to unsafe conditions for transportation. The American Lung Association estimates that more than 133.9 million people in the United States live in areas of poor air quality. Aerosols are also a major climate-forcing component. They affect the radiative balance of Earth, cooling or warming the atmosphere (depending on aerosol composition).

How do GOES-R Series satellites detect aerosol hazards?

When present in high concentrations, aerosols are easily visible in satellite imagery. For routine detection and quantitative retrieval of aerosol amounts, the challenge is to separate the aerosols from clouds and bright surfaces. This can be done by comparing values from multiple wavelengths in the visible light and thermal infrared portion of the electromagnetic spectrum, using the GOES-R Series **Advanced Baseline Imager (ABI)** instrument.

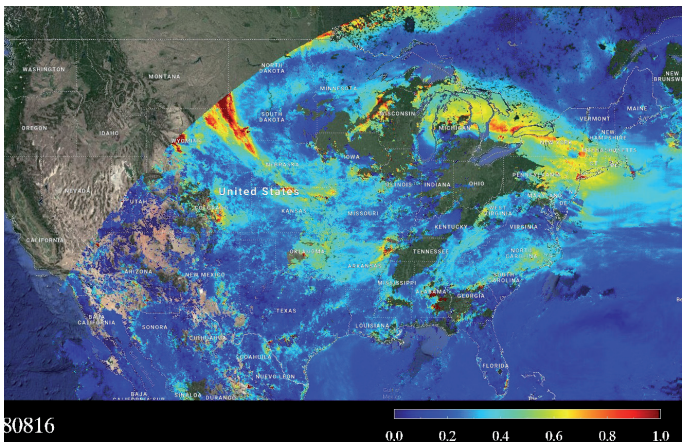
ABI has 16 channels (or bands) that measure light. The "cloud particle size" band is a near-infrared channel that is transparent to most aerosols. A suite of infrared channels is used to detect clouds. The presence of aerosols can be detected by comparing differences in the signal between two of the ABI's longwave infrared bands.

Once a surface is characterized and cloudy pixels are identified, aerosols are retrieved through ABI-measured radiances in the visible bands using precomputed lookup tables.

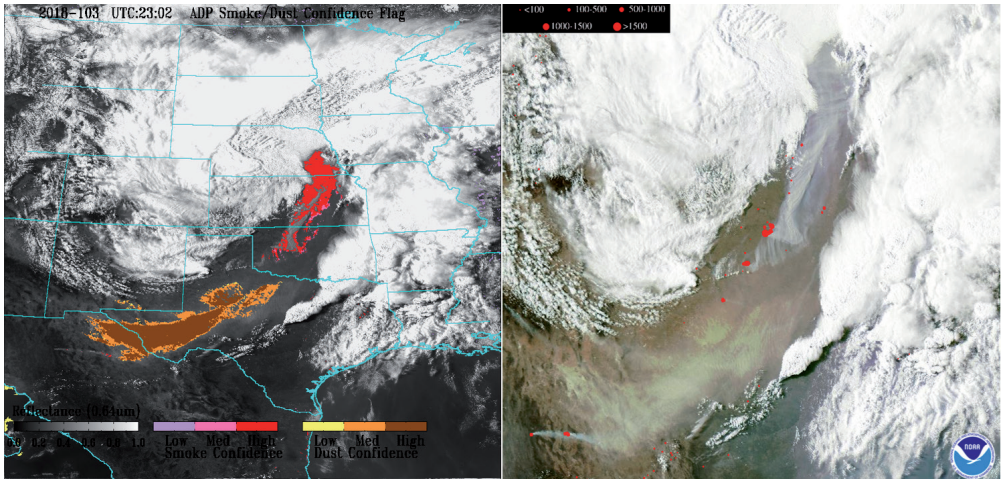
The **aerosol optical depth (AOD)** data product is a quantitative measure of the solid and/or liquid particles suspended in the air including dust, sand, volcanic ash, smoke, and urban/industrial aerosols. AOD measures the amount of light lost due to the presence of aerosols on a vertical path through the atmosphere.

The **aerosol detection product (ADP)** is a qualitative product that indicates the presence of aerosol (dust and/or smoke) for each pixel in the satellite image area. This can be used to quickly identify locations of dust and smoke plumes.

GeoColor imagery approximates how the human eye would see Earth from space during daylight hours, and is created by combining several of the spectral channels from the ABI. The wavelengths of reflected sunlight from the red and blue portions of the spectrum are merged with a simulated green wavelength component, creating RGB (red-green-blue) imagery. In GeoColor images during the daytime, clouds are white, water is blue, vegetation is green, and soil is brown. At night, infrared imagery shows high clouds as white and low clouds and fog as light



GOES-16 ABI daily composite AOD on August 16, 2018. Credit: NOAA



GOES-16 imagery showing dust and smoke events on April 13, 2018. The left panel shows the ADP product overlaid on ABI visible imagery. The dust is shown in orange/brown and smoke in pink/red. The GeoColor image on the right shows dust and smoke visible to the eye; dust has yellow color and smoke grayish white, which is much lighter and distinguishable from clouds. Fire hot spots are also shown on the GeoColor image in red. Credit: NOAA

blue. GeoColor imagery helps forecasters easily identify smoke and dust.

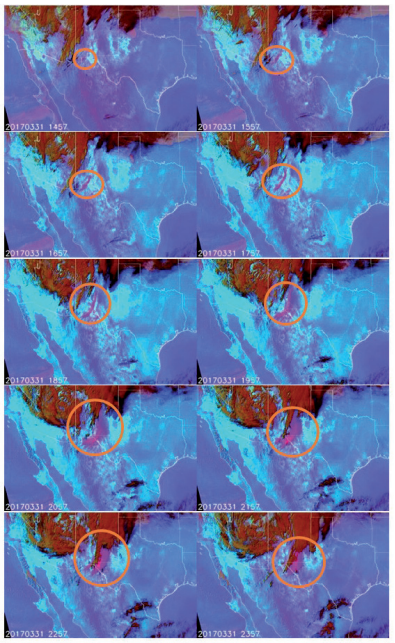
It is sometimes difficult to distinguish airborne dust near source regions, especially when the dust is suspended too close to the surface. **Dust red-green-blue (RGB) imagery** is able to contrast airborne dust from bright surfaces and clouds by combining multiple ABI channels and using brightness temperature differences. The resulting combination of colors identifies dust as a pink/magenta color in the imagery.

What are the benefits of the GOES-R Series aerosol applications?

The GOES-R Series ABI provides a host of aerosol imagery and quantitative retrieval products for air quality monitoring and forecasting applications. GOES-R Series aerosol products are more accurate than previous GOES products. Observations of AOD are now available every five minutes instead of 30 minutes. More frequent imaging, as well as improved spatial resolution, increases the value to forecasters. Additionally, compared to legacy GOES, the GOES-R ABI provides not only AOD, but also aerosol detection (smoke and dust mask), and various multispectral imagery like GeoColor and dust RGB to help forecasters interpret aerosol events such as dust storms and smoke transport in real time.

ADP enables forecasters to better monitor areas of smoke and dust, which can be critical factors in visibility and air quality forecasts. In addition to short-term prediction, this product also enables better monitoring of long-term trends in aerosol quantities and distribution throughout the atmosphere.

The information provided by AOD aids meteorologists and others in making critical air quality, visibility, and aviation forecasts. In addition, the AOD product provides valuable data for climate models and helps climate scientists monitor and predict climate change.



Hourly GOES-16 ABI dust RBG imagery for March 31, 2017. The series of images show a dust storm (circled) that formed in Mexico and moved into southwestern Texas. The dust plume is easily discernible with a good contrast of the light pink to cyan-white colors of surface. Credit: Shobha Kondragunta/NOAA

Contributors: Shobha Kondraunta (NOAA/NESDIS/STAR), Istvan Laszlo (NOAA/NESDIS/STAR), Hai Zhang (IMSG), Pubu Ciren (IMSG), and Amy Huff (Pennsylvania State University)

Related links:

NOAA/NESDIS AerosolWatch: https://go.usa.gov/xmV9T
ADP information: https://go.usa.gov/xmV9b
ADP validation and data access: https://go.usa.gov/xmV9j
ADP operational quick guide: http://bit.ly/ADPquickguide
AOD information: https://go.usa.gov/xmV9D
AOD validation and data access: https://go.usa.gov/xmV9B
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