

Overview of Multi-Sensor Research and Applications at NASA SPoRT

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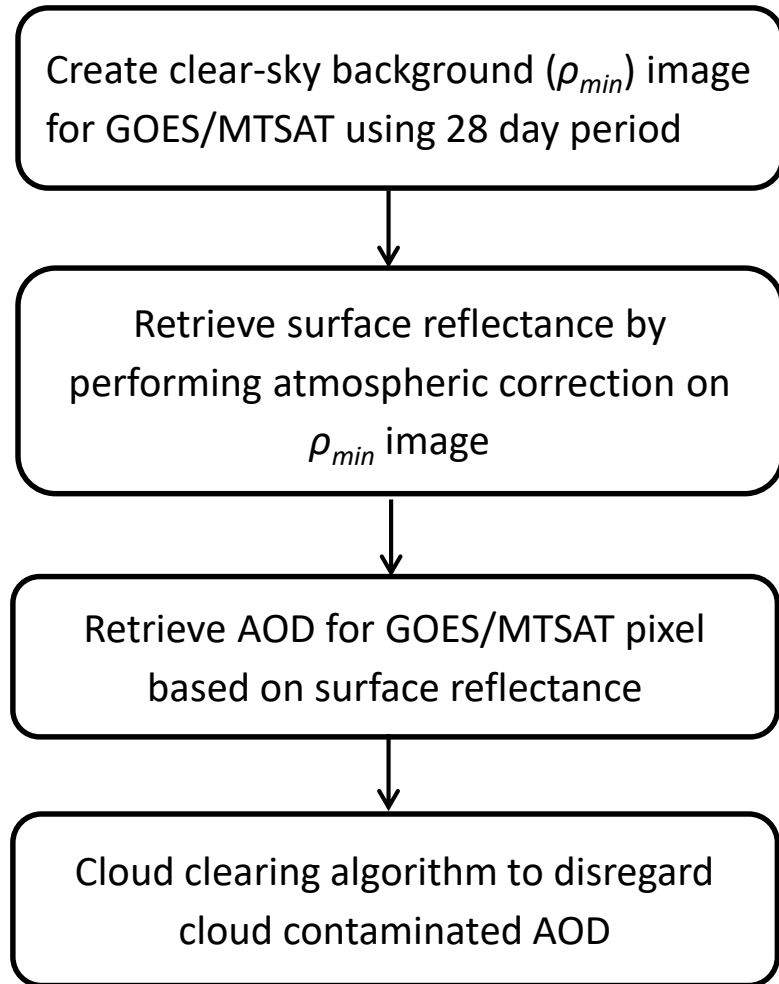
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Previous Development of AOD Composite Product



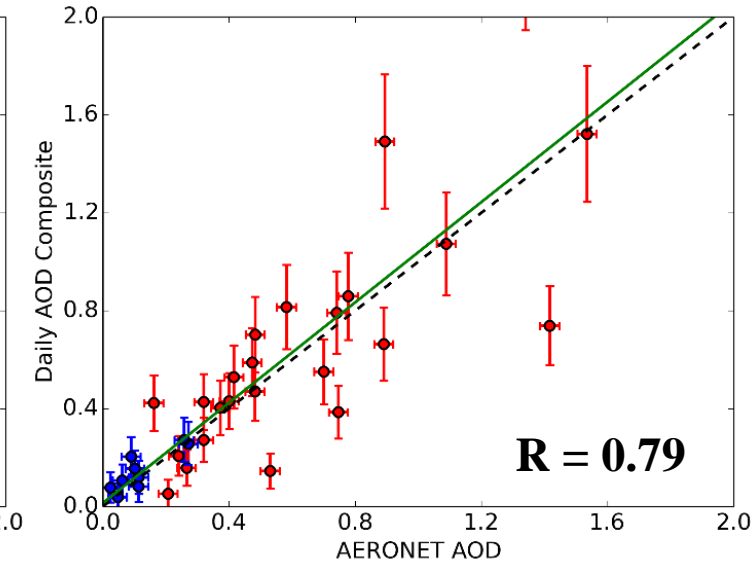
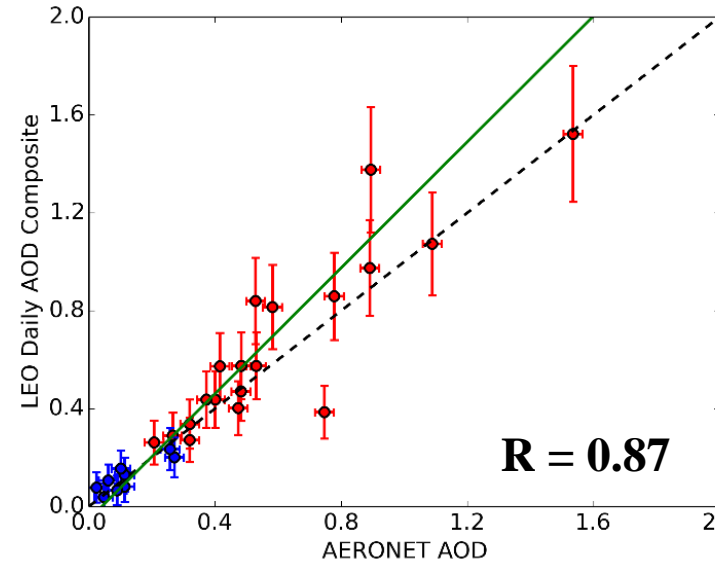
Four major steps involved in the GOES and MTSAT AOD retrieval algorithms.

- Product merged aerosol retrievals from LEO and GEO satellite sensors (including MODIS, VIIRS, MTSAT, and GOES-15).
 - MODIS and VIIRS AOD were acquired from LANCE-MODIS and NOAA CLASS systems, respectively.
 - We developed our own retrieval algorithms for the GEO sensors based on the raw satellite data.
- Previous GEO AOD retrieval was based on a rather simplified algorithm based on past geostationary sensors (e.g., GOES-15, MTSAT).
 - Cloud masking technique based on limited number of channels (5)
 - Use of only two aerosol models (i.e., continental and dust) based on predefined aerosol properties in 6SV RTM
 - Surface reflectance was defined by 2nd lowest reflectance over a 28-day period for each hour
- Goal of product is to provide end users with a comprehensive tool to monitor and track aerosols that can aid in forecasting and air quality applications.

Naeger et al. (2016)

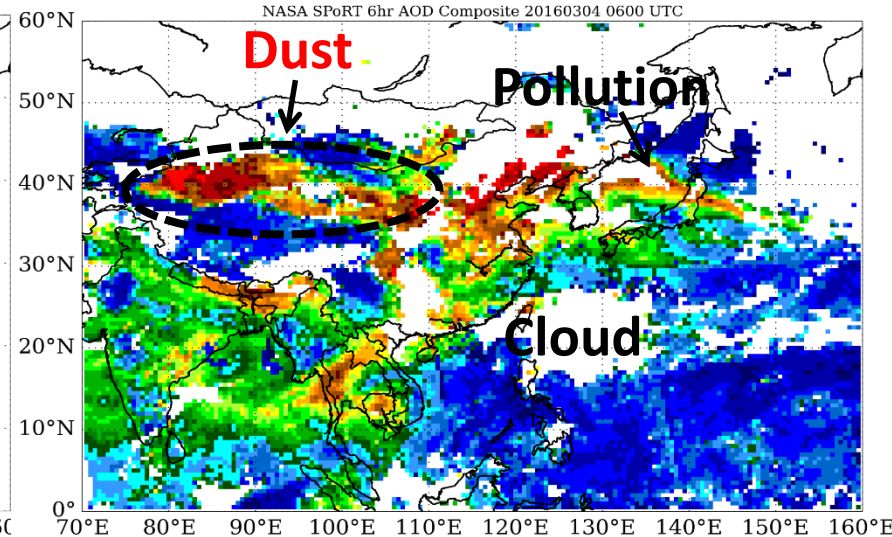
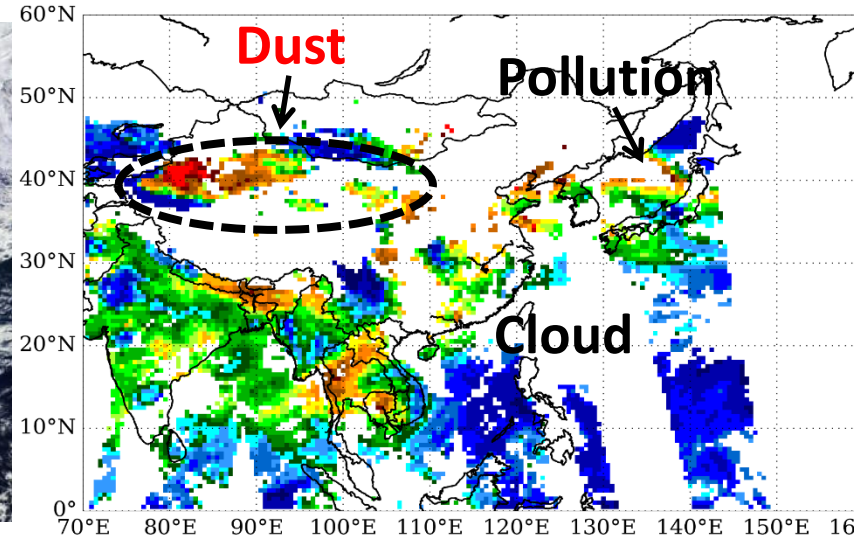
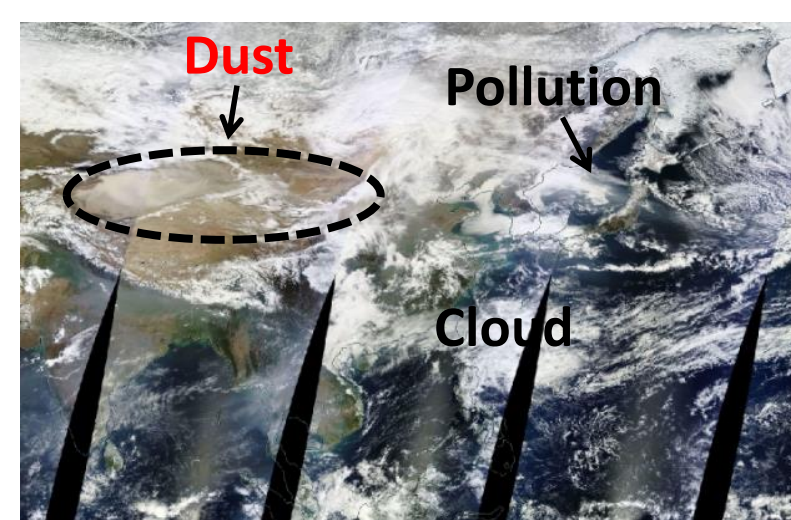
Previous Development of AOD Composite Product

- GEO helped fill gaps in the LEO AOD coverage as the high temporal resolution allowed for an increase in cloud-free retrievals
- GEO retrievals showed adequate performance over Asia and U.S., but as expected contributed to larger errors in the AOD Composite product.

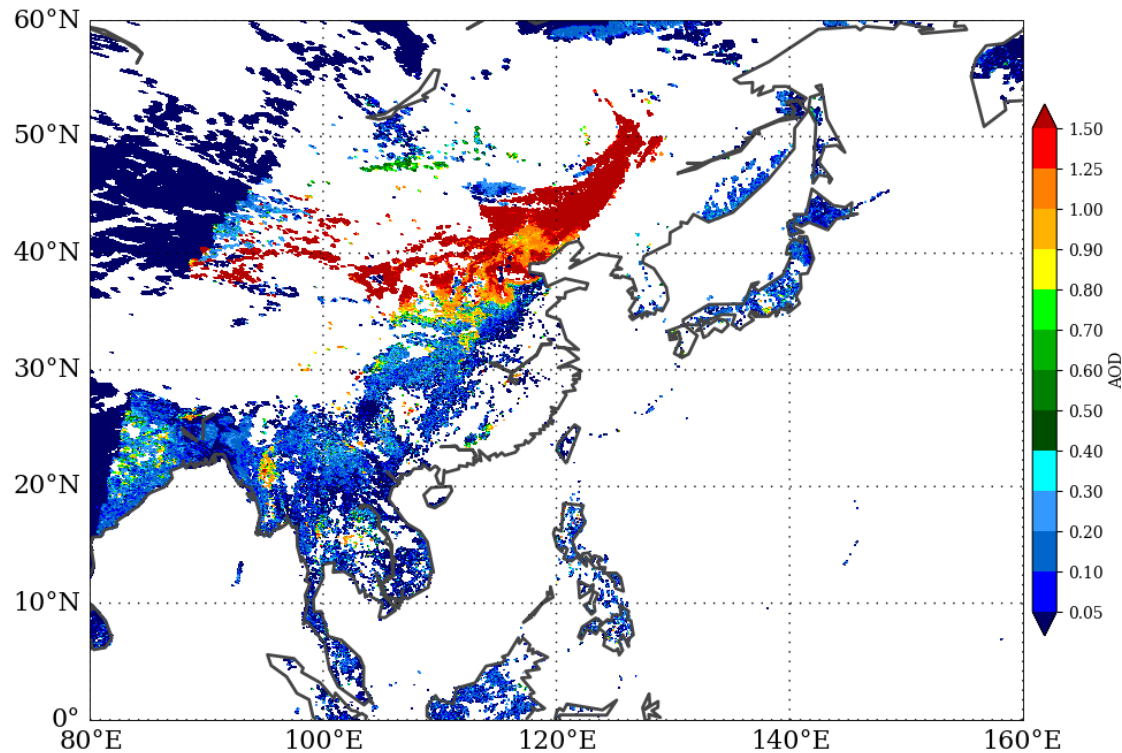


(Bottom) 6-hr AOD composite with only LEO (middle) vs LEO and GEO AOD composite (right) for 4 March 2016

(Top) AOD retrieval validation conducted during March 2014 for AERONET sites over Asia (red) and U.S. (blue)



Recent Developments of AOD Composite Product



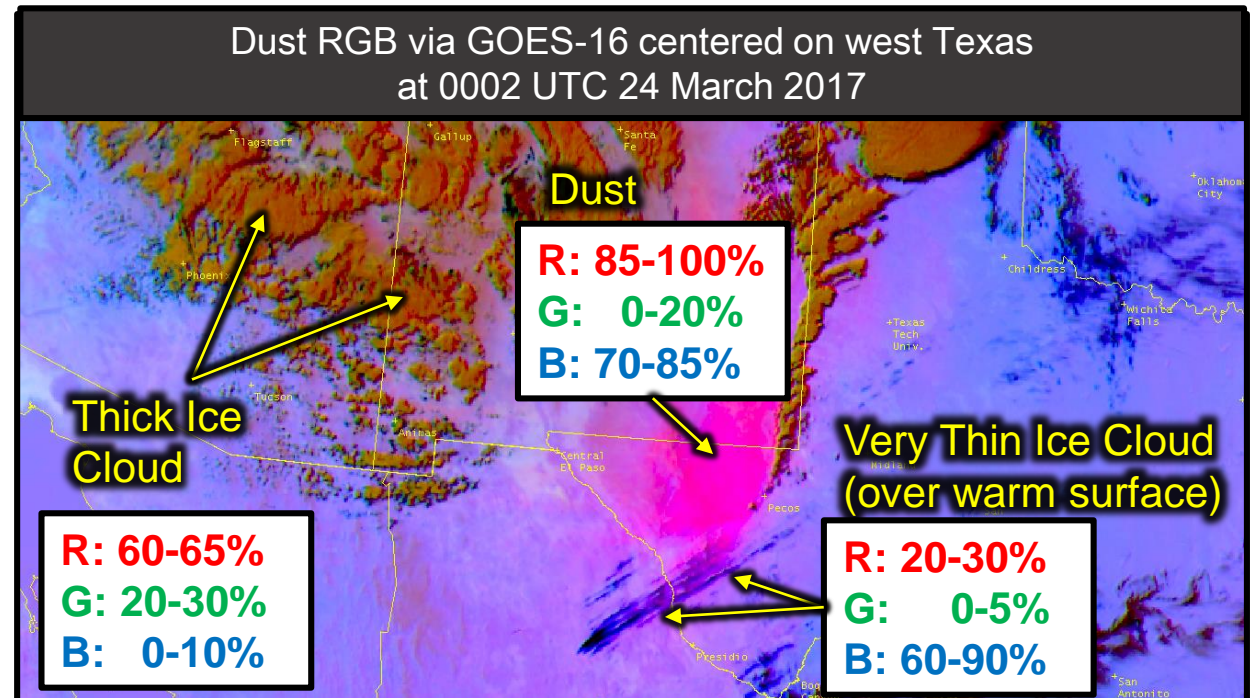
- Complete overhaul of the previous GEO retrieval algorithm to account for drastic improvement in new generation of geostationary sensors.
- Processed AERONET data throughout AHI FOV to update aerosol models within the retrieval algorithm
- Used both ‘supervised’ and ‘unsupervised’ methods to choose most appropriate aerosol models for the region
- Updated surface reflectance retrieval based on conducting 6SV RTM calculations on AHI and AERONET matchups
- Refined cloud masking technique using additional channels available from AHI

Dust RGB Recipe & Product Basics

Color	Band/Band Diff. (μm)	Physically relates to...	Small contribution to pixel indicates...	Large contribution to pixel indicates...
Red	12.3-10.3	Optical depth/cloud thickness	Thin clouds	Thick clouds, dust plume
Green	11.2-8.4	Particle phase	Ice and particles of uniform shape (dust)	Water particles or thin cirrus over deserts
Blue	10.3	Surface temperature	Cold surface	Warm surface

Dust RGB Product

- 12.3 μm is semi-transparent to dust
 - large red intensity compared to clouds
- “Warm” dust at low levels
 - large blue intensity
- Dust plume resulting color: **magenta**
- Dust RGB valid day and night
(benefit over typical use of visible or true color imagery to analyze dust plumes)



Forecast Issue and Hypothesis

Challenge: Detection and Analysis of Blowing Dust for Aviation & Public

- Impact to ceiling and visibility criteria at airports
- Reduced visibility along roadways
- Difficult to detect in satellite imagery when clouds present/mixed
- Dust color similar to dry land surface in True Color imagery
- Can not track plume at night

Hypothesis:
EUMETSAT Dust RGB via MODIS/VIIRS increases forecast lead times via greater efficiency in analysis both day and night

MODIS/VIIRS Dust RGB prior to GOES

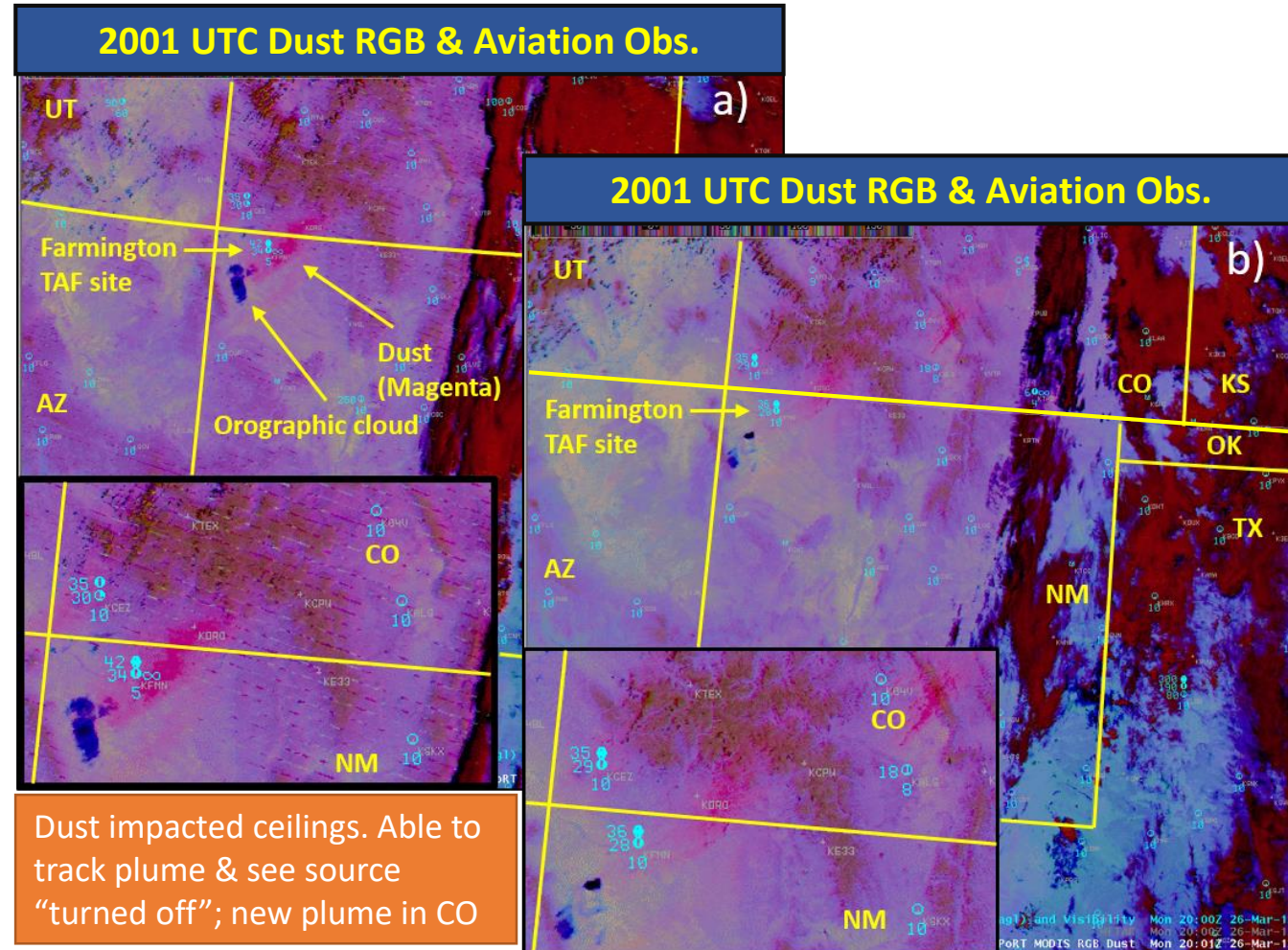
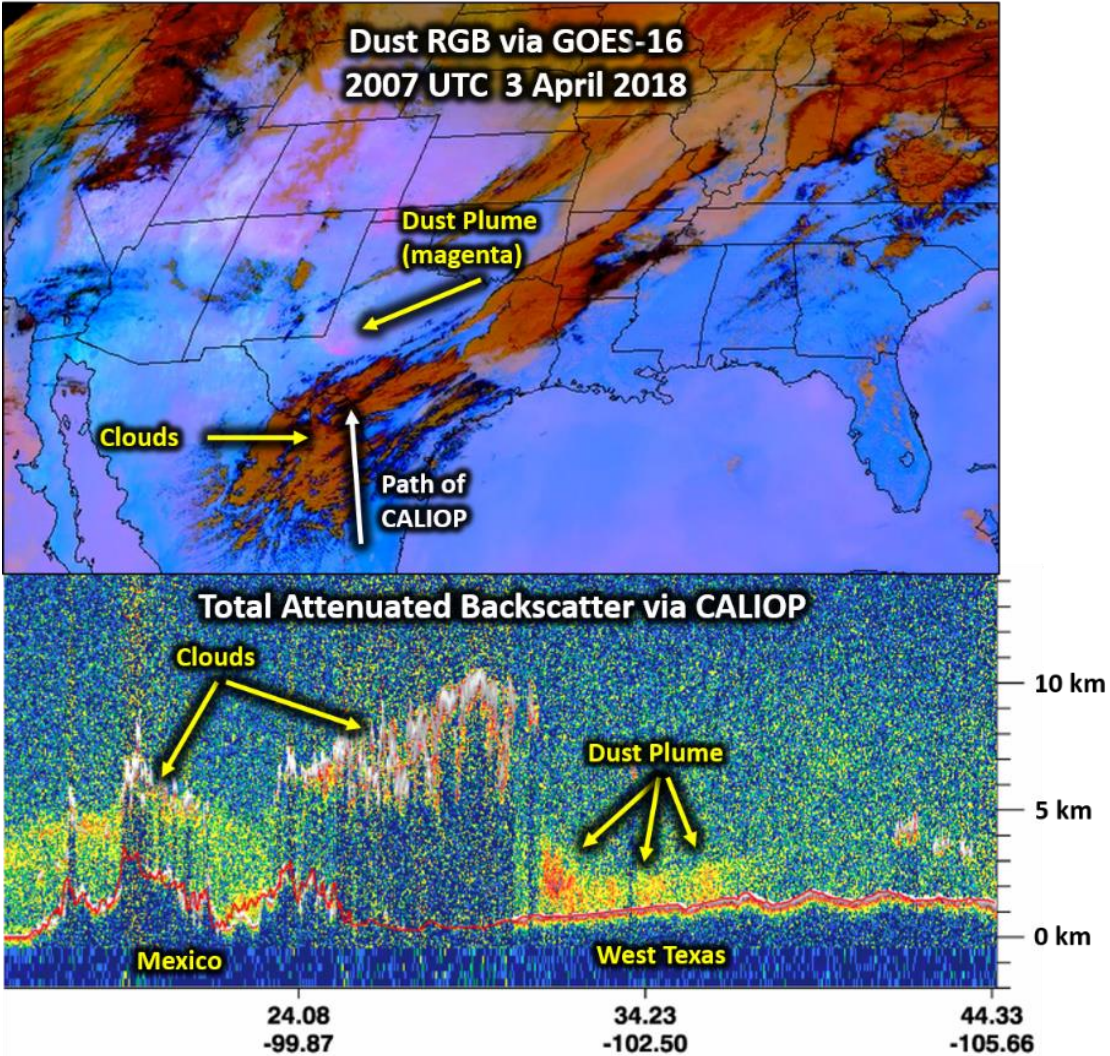
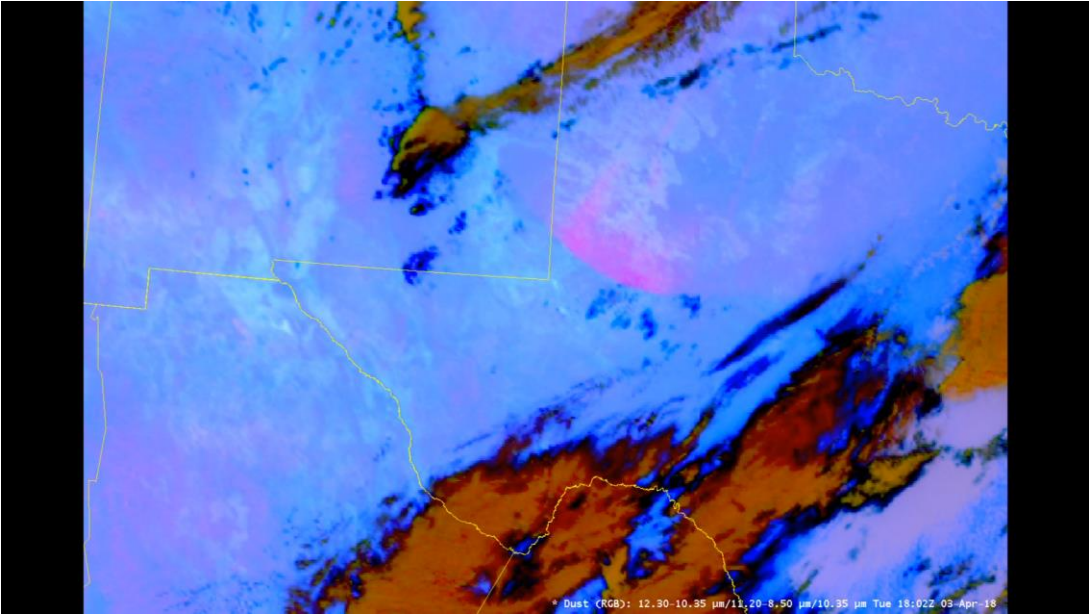


Figure 4 from Fuell et. al. 2016

Dust RGB via GOES-16 / ABI: User Assessment



Dust RGB via GOES-16; 03 Apr. 2018



Forecaster at ZAB (i.e. CWSU) sent feedback indicating Dust RGB caused collaboration between WFO Midland and AWC resulting in issuing a Center Weather Advisory at 1945Z for IFR visibility in widespread BLDU.

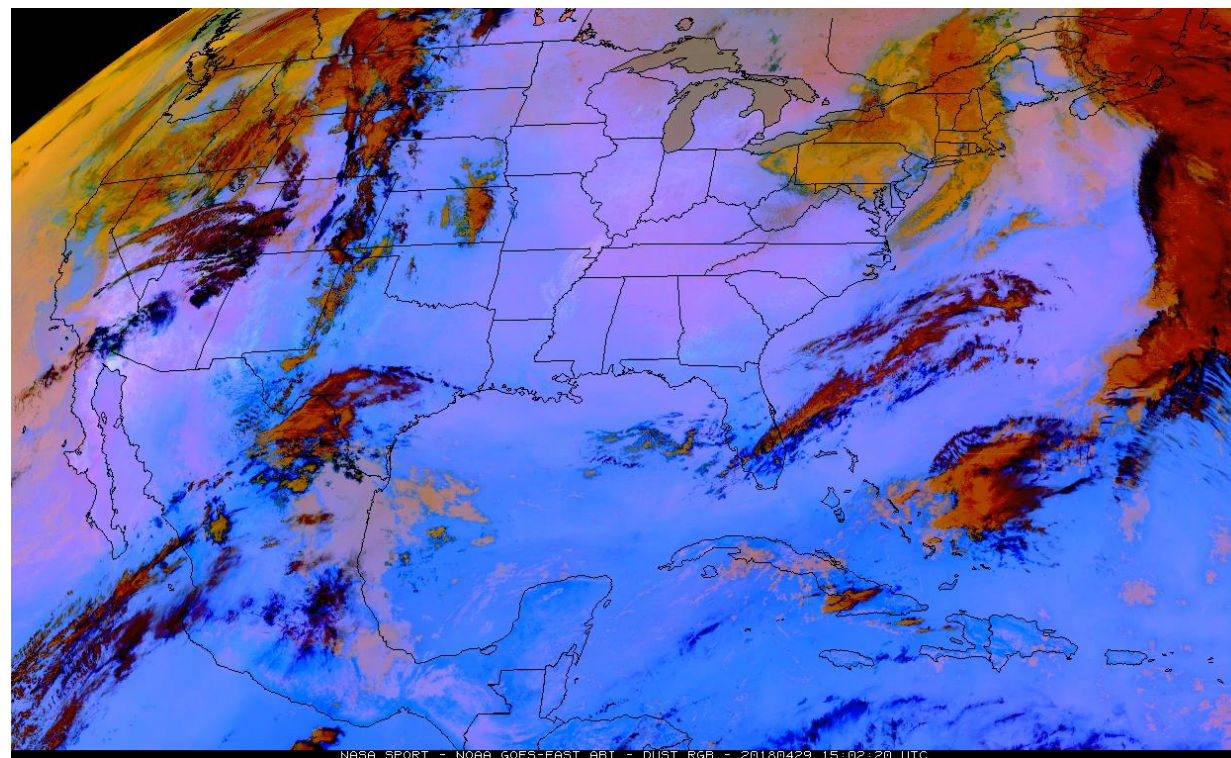
Highway Incident/Closure: Nebraska 4/29/18

Dust RGB Limitations

- Very shallow dust event
- Clouds at High/Mid-levels block view
- AOD product could potentially help identify these “missed” events

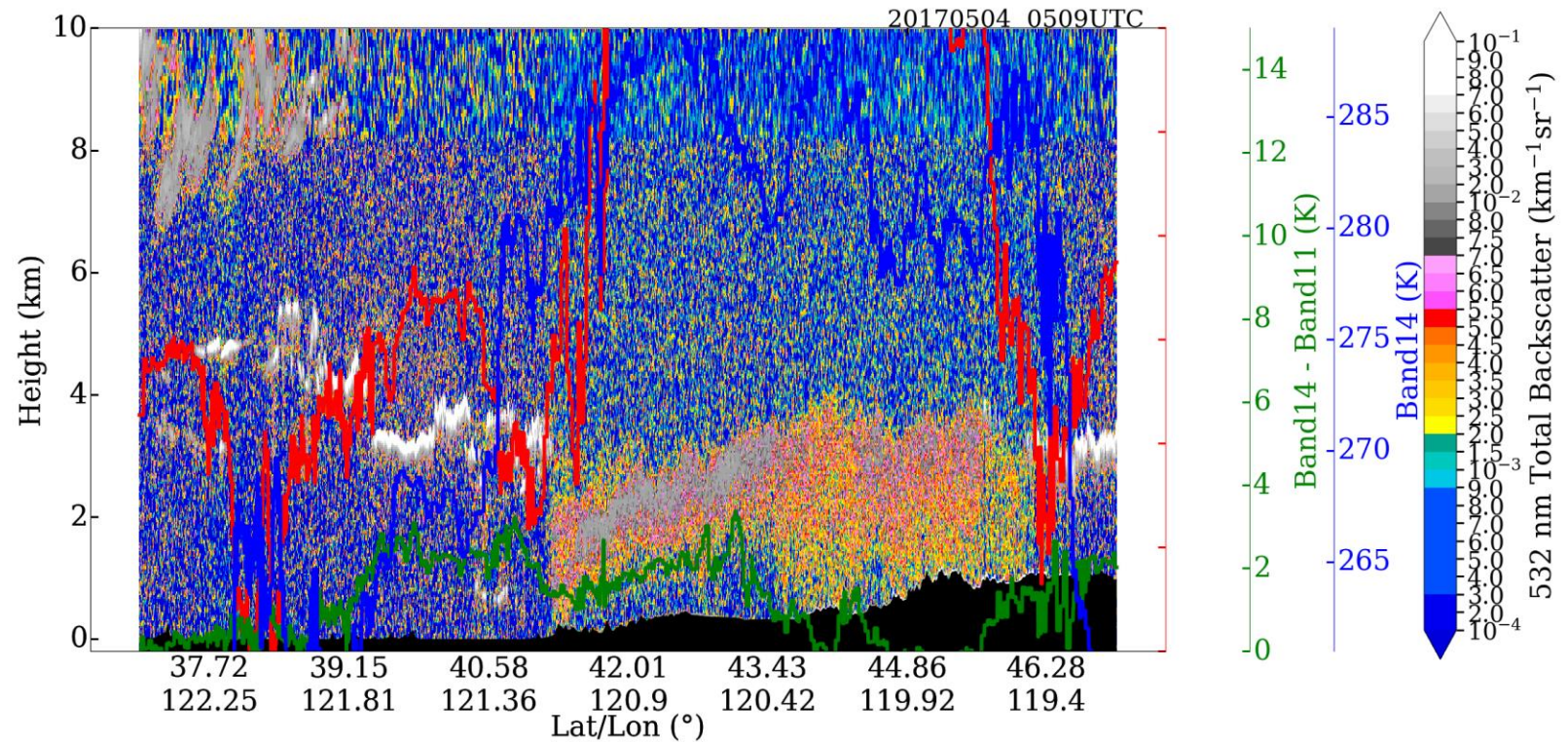
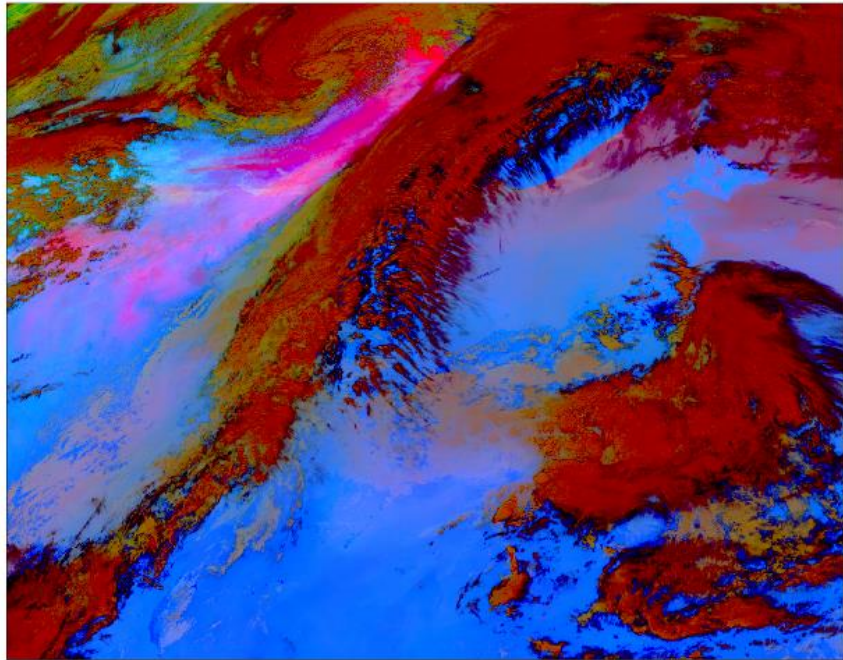


Dust RGB via GOES-16: 29 Apr 2018 from 1500 – 0400 UTC



NASA SPOC - NOAA GOES-EAST ABI - DUST RGB - 20180429 15:02:20 UTC

CALIOP and variations in channels/differences



- CALIOP and/or CATS active lidar measurements can help validate the dust RGB product

Summary and Future Work

- Implementing significant refinements in GEO AOD retrieval algorithms with current focus on AHI, which will be completed in the next couple months
- The AHI algorithm will be adapted to GOES in order to provide total coverage of aerosols from Asia to CONUS
- Validate and potentially improve the dust RGB capabilities by utilizing active lidar sensors
- Merge the dust RGB and AOD Composite products for improving the ability of detecting and monitoring near surface and low-level dust plumes