Development and Validation of the SPoRT AOD Composite product for Data Assimilation

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Background and Development

- The goal of the SPoRT aerosol optical depth (AOD) Composite product was to generate a near-global comprehensive representation of the aerosol spatial distribution through merging aerosol retrievals from multi-satellite sensors.
- The use of aerosol retrievals from single satellite sensors alone can provide an incomplete representation of the aerosol spatial distribution due to cloud cover, sun glint, and sensor limitations (e.g., spatial resolution, scan coverage).
- The SPoRT AOD composite product merges aerosol retrievals from low-earth orbit (LEO) and geostationary earth orbit (GEO) satellite sensors, which currently includes the MODIS, VIIRS, AHI, and GOES-15 Imager.
- Near-real time AOD retrieval products for MODIS and VIIRS are downloaded via the Land, Atmosphere Near real-time Capability for EOS system and NOAA Comprehensive Large Array-Data Stewardship System, respectively.
- We develop our own AOD retrieval algorithms for GOES-15 and AHI, which are based on comparing the observed TOA reflectances to a look-up tables of simulated TOA reflectances from the 6SV continental and dust aerosol models.

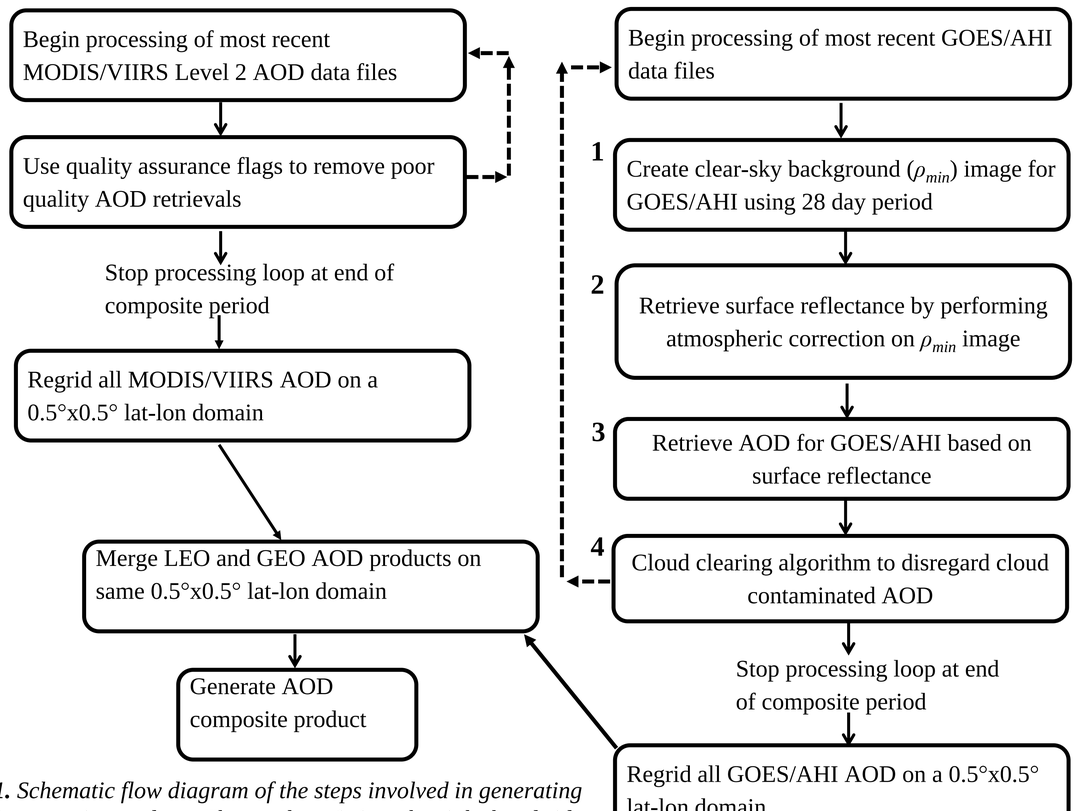


Figure 1. *Schematic flow diagram of the steps involved in generating the AOD composite product. The numbers 1-4 on the right-hand side of the schematic highlight the four major steps involved in the GEO AOD retrieval algorithms.*

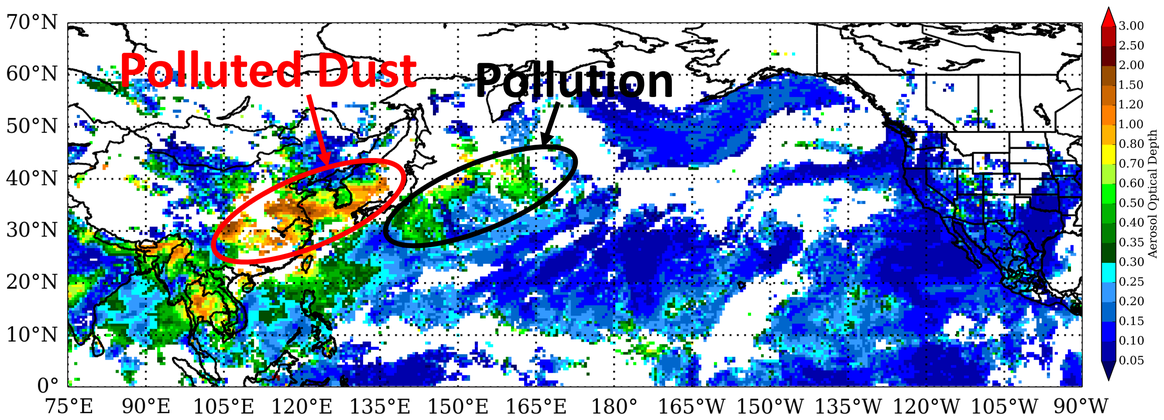


Figure 2. *Example of daily AOD composite with central time of 00 UTC on 18 March 2014. High concentrations of pollution and polluted dust aerosols were across eastern Asia and the western Pacific.*

Applications

- Our near-real time SPoRT AOD Composite product was initially developed to provide end users with a comprehensive tool to monitor and track the long-range transport of aerosols that impact forecasting applications.
- Our composite product was used to assist with aerosol forecasting activities during the NOAA-led CalWater 2 field campaign set over northern California from January to March 2015.
- We also plan to use our product for data assimilation activities such as improving the assimilation of aerosol-affected satellite radiances into operational forecast models.

Results and Validation

- A complicated scene of clouds and aerosols existed over Asia and the western Pacific on 4 March 2016.
- Dust was being transported from the Taklimakan desert source region to over central and eastern China.
- Pollution aerosols were abundant across Southeast Asia and the western Pacific.
- There are large gaps in the spatial coverage of AOD when utilizing MODIS AOD retrievals alone.
- In particular, the dust aerosol transport from the Taklimakan desert is poorly represented.
- The 6-hourly SPoRT AOD Composite product depicts the dust transport across China.
- The pollution over Southeast Asia and the western Pacific is also better represented by our product.

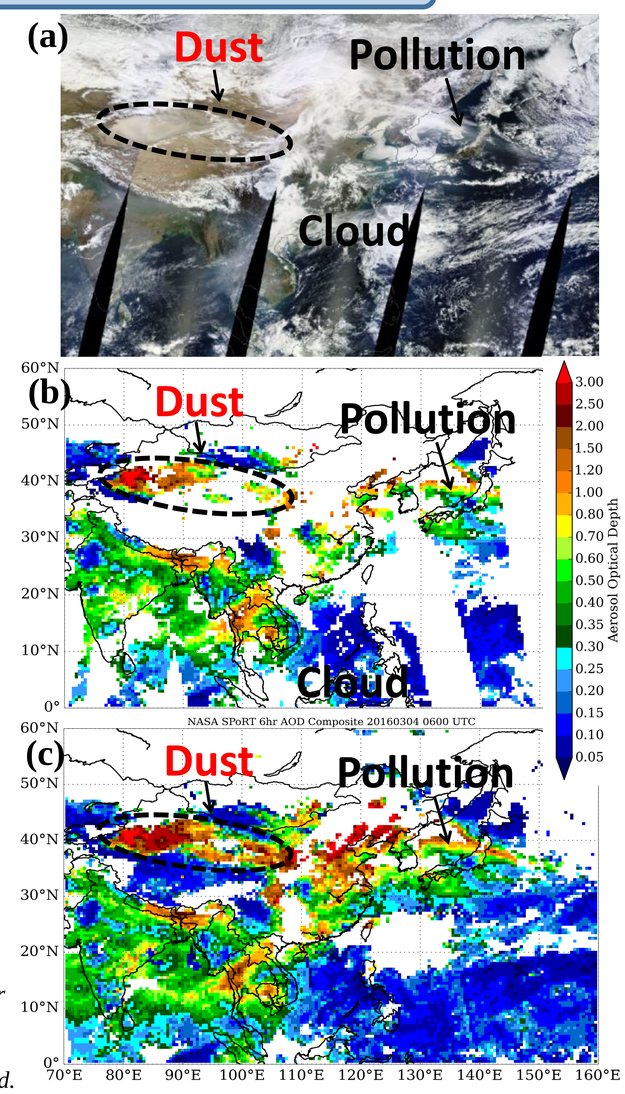
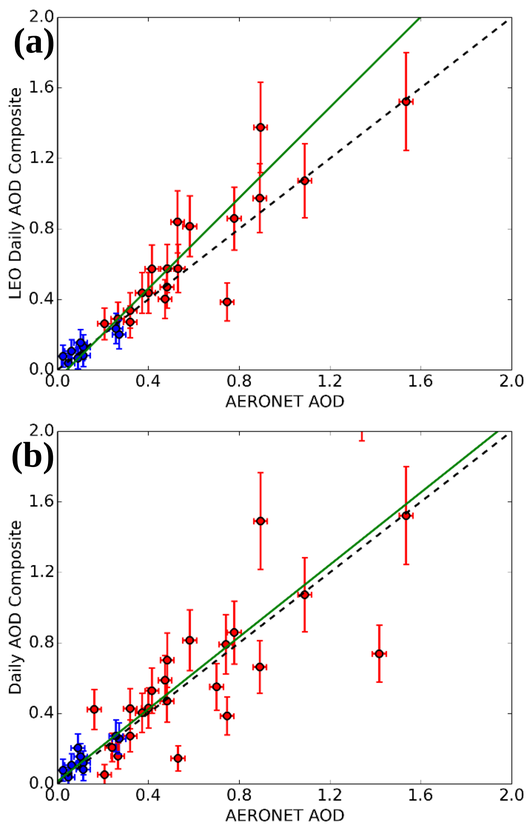


Figure 3. *(a) MODIS true-color RGB composite image over eastern Asia on 4 March 2016. (b) Aqua and Terra MODIS AOD retrievals from 03-09 UTC on this same day. (c) 6-hourly SPoRT AOD Composite product for same time period.*



- A high correlation (R = 0.87) exists between AERONET AOD and daily AOD composites including only LEO satellite retrievals (MODIS and VIIRS).
- Slope linear regression line indicates a high bias of about 0.1 with the LEO retrievals.
- Slightly lower correlation (R = 0.79) between AERONET AOD and our daily SPoRT AOD Composite.
- Overall, the inclusion of the GEO AOD retrievals does not lead to a significantly degraded product.

Figure 4. *(a) Daily average of level 1.5 AERONET 550 nm AOD retrievals versus the daily AOD composite including only LEO (MODIS and VIIRS) satellite retrievals for a six day period from 18-23 March 2014. (b) Same as (a) except AERONET AOD versus our SPoRT AOD Composite product. AERONET sites across East Asia (red) and the western United States (blue) are shown. Error bars are based on ±0.015 uncertainty for AERONET AOD retrievals, ±0.05 ± 0.15*AOD for LEO retrievals, and 25% uncertainty for our daily AOD composite product.*

Future Development

- Our current version of the AHI retrieval algorithm is based on our original MTSAT-2 algorithm; therefore, we plan to implement an improved version in the coming months that utilizes the additional spectral bands onboard AHI.
- The additional spectral bands will allow for a more robust cloud clearing procedure and surface reflectance retrieval along with an improved separation between aerosol types.
- Use our improved AHI retrieval algorithm to develop an algorithm for the Advanced Baseline Imager (ABI) that will fly on the GOES-R and –S satellites.

References

Naeger, A. R., P. Gupta, B. Zavodsky, and K. M. McGrath (2016), Monitoring and tracking the trans-Pacific transport of aerosols using multi-satellite aerosol optical depth composites, *Atmos. Meas. Tech.*, In press.