Aerosol absorption retrievals from base-line OCI observations

Lorraine Remer, UMBC
Shana Mattoo, NASA GSFC
Robert Levy, NASA GSFC
Omar Torres, NASA GSFC
Zia Ahmad, NASA GSFC
Vanderlei Martins, UMBC
Pawan Gupta, NASA GSFC
The objectives of the proposed work are to:

- Explore opportunity to retrieve aerosol AOD over ocean and land, as a continuation of the 15+ years of MODIS Dark Target products

- Develop algorithms that identify and quantify aerosol absorption using the base-line configuration of OCI.

Retrieve absorption when aerosol loading is high,

Identify absorption when aerosol loading is low
Continuation of the MODIS 15+ year Dark Target aerosol record

MODIS-like retrieval for retrieving global AOD from VIIRS. Although currently offset by ~20% (0.03) over ocean, this is likely due to resolvable calibration differences. (Levy et al., 2015)
Retrive absorption when aerosol loading is high

MODIS Dark Target (MDT)  New OCI addition (DT+UV)

INPUT: 6 OCI wavelengths (0.55 µm to 2.1 µm)

Apply standard MODIS Dark Target ocean aerosol retrieval

OUTPUT: AOT at 0.55 µm, choice of fine and coarse non-absorbing model and fine mode fraction

INPUT: AOT at 0.55, choice of non-absorbing model plus 2 OCI wavelengths in the UV (0.354 µm and 0.388 µm)

Match measured UV reflectances to LUT consisting of four new models: Non-absorbing (NA), Dust (Du), and 2 types of combustion (C1 and C2)

OUTPUT: (1) Choice of ONE of the 4 types of absorbing aerosol models

OUTPUT: (2) Interpolation of Single Scattering Albedo (SSA) from the values of the two closest absorbing models
The key is to fit to different *spectral* absorption models.
(1) Chlorophyll perturbations from 0.3 mg/m³ to 2.0 mg/m³ (not shown graphically)
For AOT = 0.0, $\Delta \rho_{\text{TOA}} = 8.5\%$.
For AOT = 0.2, $\Delta \rho_{\text{TOA}} < 5\%$.
For AOT = 0.5, $\Delta \rho_{\text{TOA}} < 1.5\%$.

(2) Spectral ocean color surface perturbation.
Increased UV to red surface reflectance by 0.005. (Left in blue) Sensitive, but only for AOT < 0.30.

(3) Change in aerosol height from 2 km to 6 km.
(Left in red) Sensitive in at least 25% of the aerosol AOT combinations.
Smoke example
AOT 550 nm
Single scattering albedo 388 nm

Dust example
AOT 550 nm
Single scattering albedo 388 nm
SKYNET at Seoul:
AOT550 = 0.79±0.06;  SSA400 = 0.92±0.025

SKYNET at Kasuga:
AOT550 = 0.31±0.02;  SSA380 = 0.95±0.025
SKYNET at Kasuga:
AOT550 = 0.42±0.02; SSA380 = 0.84±0.004
Zia Ahmad can identify absorbing aerosols.

The graph shows the relationship between the DLER (Delta Linear Extinction Ratio) of $R_{340} - R_{380}$ and the LER (Linear Extinction Ratio) of $R_{380}$ for different Chl and τ values. The graph includes non-absorbing aerosols (Marine 0.79) and absorbing aerosols (Dust 0.40) with varying Chl and τ values. The SZA is set at 30°, and the angle $\theta$ is 0° (Nadir View).
Conclusions

1. An OCI-only continuation Dark Target aerosol product at PACE launch is definitely possible.
2. In addition,
   a. retrievals of SSA at 380 nm over ocean
   b. not sensitive to ocean color for AOT550 > 0.40.
   c. is sensitive to aerosol height.
3. Solving the height issue within this context and extending SSA to midvisible will be the focus during the last year.
4. Zia has a solution to Identify absorbing aerosol when loading is low.