Advanced ocean color sensor observations for retrieval of cloud, aerosol and water vapor properties

Lorraine A. Remer
And the PACE Atmospheric Correction Science Team

Image from NASA Worldview
Aqua-MODIS Chlorophyll-a

Image from NASA Worldview
Aqua-MODIS column water vapor

Image from NASA Worldview
Aqua-MODIS cloud optical thickness

Image from NASA MODIS Atmospheres Web Page
Aura-OMI AOD

Image from NASA Worldview
OMI and MODIS spectral coverage of reflective bands

**OMI**

**MODIS**
OMI and MODIS spectral coverage of reflective bands

OMI absorbing aerosol
From UV bands

MODIS AOD
From VIS-SWIR bands
OMI and MODIS spatial resolution

OMI spatial resolution: 13 x 24 km
MODIS spatial resolution: 0.25 to 0.50 km
OMI and MODIS spatial resolution

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MODIS spatial resolution: 0.25 to 0.50 km

MODIS aerosol product is more robust, less cloud affected and has information on particle size. OMI can offer information on aerosol absorption.
OMI, MODIS and OCI spectral coverage of reflective bands

OCI (Ocean Color Instrument) is a proposed design for the PACE mission
OMI, MODIS and OCI spectral coverage of reflective bands

UV down to 350 nm

Water vapor channels

Cirrus channel
From the oceanic perspective

Current capabilities: Chlorophyll

Goal: Open new vistas in aquatic biogeochemistry
From the atmospheric perspective

Here aerosol retrievals of both AOT and aerosol absorption
OCI will be the first instrument with wavelengths spanning UV to SWIR

..... And the first with UV capability ~ 1 km spatial resolution
Retrieved absorption model

NA  Du  C1  C2

AOD

FMF

0.00  0.30  0.60  0.90  1.20  1.50

0.20  0.36  0.52  0.68  0.84  1.00
Atmospheric perspective

Enhanced capabilities to exploit:

• UV-SWIR at moderate spatial resolution: aerosol characterization
• Oxygen-A band: aerosol and cloud heights
• Broad spectrum and hyperspectral: water vapor, trace gases and advanced atmospheric correction

Climate continuity (MODIS and OMI continuation): aerosols and clouds over ocean and land
An advanced ocean color sensor still looks at each scene with one view angle and measures only intensity.

Information content is limited.

We are looking at incremental advances in atmospheric retrievals.
Multiangle polarimetry increases information content considerably.

Introduces whole new dimensions for atmospheric and oceanic retrievals.
Polarimetry and atmospheric correction

Retrievals from data with ground truth

Olga Kalashnikova and the PACE ST
Back up
Conclusion:

PACE with OCI and a polarimeter will add significant capability.

- Broad spectral range
- Hyperspectral subrange
- Moderate resolution pixels
- Multiples wavelength multiangle imaging polarimeter

- Take aquatic biogeochemistry into new territory
- Will advance atmospheric correction to support aquatic goals
- And will advance characterization of atmospheric properties at no cost to the aquatic component
Polarimeter and retrieval of hydrosols

Clear water (blue)
Biologically productive water (green)
Productive water with CDOM (brown)
November 2007 monthly mean chlorophyll concentration in mg/m³ (top) from SeaWiFs and AOD at 550 nm from Terra MODIS.
What can we do with PACE expanded capabilities? OCI broad spectral range

Retrieval aerosol absorption information

**MODIS Dark Target (MDT)**
- **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

**New OCI addition (DT+UV)**
- **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:** Choice of one of the 4 types of absorbing aerosol models
NA = non-absorbing
Du = Dust
C1 and C2 are combustion aerosol models with different spectral absorption in the UV

Mattoo et al. (poster)
Sample Retrieval Results From PRISM Data & Comparison with Ground Measurements

(a) West LOBO Buoy  
(b) Seal Bend Dense Eelgrass  
(c) East LOBO Buoy
Aqua-MODIS Cloud top temperature

Image from NASA Worldview
Aura OMI total column ozone

Image from NASA Giovanni
Aura-OMI Sulfur Dioxide

Image from NASA Worldview