

The Co-location of Aqua/MODIS Observations and GEOS-5 Assimilated Data onto the Aura/OMI Pixel:

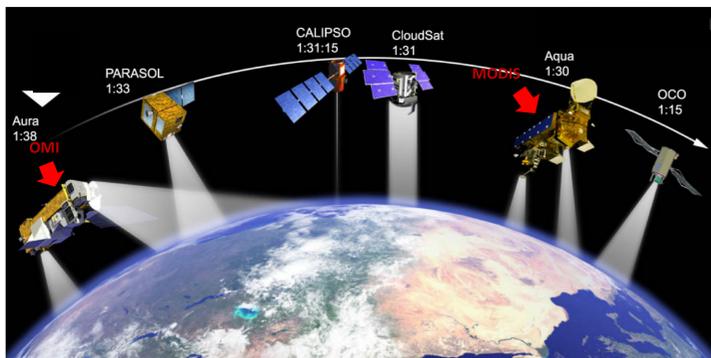
A New Suite of OMI Data Products for the Science Community

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Introduction

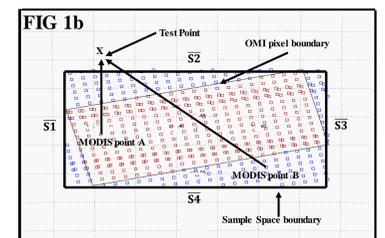
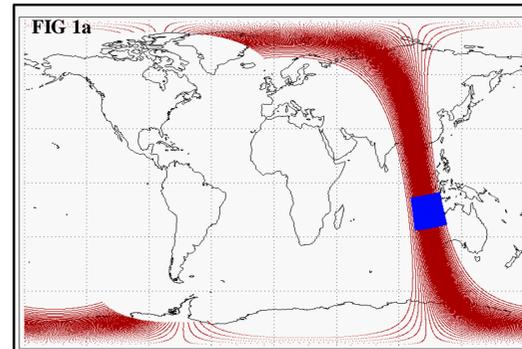
The OMI science team is releasing several new products for the science community, which provide co-located atmospheric data for the Dutch-Finnish Ozone Monitoring Imager (OMI) on Aura and other instruments in the NASA A-Train. The A-Train, shown in the figure below, is a constellation of polar orbiting sun-synchronous, Earth-observing satellites that fly on similar orbital flight paths with local equator crossing times at approximately 1:30 pm. When combined, the near-coincident observations of the Earth-atmosphere system from the various sensors in the A-train provide synergistic opportunities for scientific research and satellite retrieval development. Two co-located A-train products, OMMYDCLD and OMMYDAGEO, map geophysical and coordinate information from the Moderate Resolution Imaging Spectroradiometer (MODIS) on Aqua onto the OMI pixel. MODIS Level 2 data products have much higher spatial resolution than OMI products and therefore can provide important sub-pixel information about the OMI retrieval. The OMI core team is also developing another series of products that provide assimilated data fields from the Goddard Earth Observing System Model (GEOS-5) Data Assimilation System (DAS) to support future OMI research and algorithm development. GEOS-5 data are interpolated in time and space to each OMI field-of-view (FoV). All products will be released to the public through the Goddard Earth Sciences Data and Information Services Center.



Product	Short Name	MODIS/GEOS-5 Input	Platforms	Release Date
OMI-MODIS Cloud parameters	OMMYDCLD	MYD06_L2	Aura/Aqua	September 2015
OMI-MODIS Aerosol Co-location geo-coordinates	OMMYDAGEO	MYD04_L2, MYD04_3K	Aura/Aqua	Fall 2016
OMI-GEOS-5 Standard Atmospheric parameters	OMVFPT3NVASM	DFPIT3NVASM/inst3_3d_asm_Nv	Aura/GEOS5	Fall 2016
OMI-GEOS-5 5 and 10 m component winds	OMVFPI3NXASM	DFPIT3NXASM/inst3_2d_asm_Nx	Aura/GEOS5	Fall 2016
OMI-GEOS-5 Aerosol parameters	OMUVPT3NXAER	DFPIT3NXAER/tavg3_2d_aer_Nx	Aura/GEOS5	2017

Co-Location Methodology for A-Train Products

A typical OMI orbit (in red) and MODIS granule (in blue) are shown in FIG. 1a. The co-location methodology is illustrated in FIG 1b. The OMI/VIS pixel corner points from OMPICOR are used to define a sample space along constant latitudinal and longitudinal boundaries. The MODIS pixels inside of this sample space are then identified and tested to see if they fall inside of the OMI pixel shown in FIG 1b. The OMI pixel is defined by connecting the corner points by straight lines. An arbitrary test point X, shown in FIG 1b, is defined just outside of the sample space and a line segment is drawn between X and the MODIS pixel center (e.g., \overline{AX} , \overline{BX}). If the number of intersections, N , between this line segment and the 4 line segments defining the boundaries of the OMI pixel (i.e., s_1 , s_2 , s_3 , s_4) is odd, then the pixel is co-located inside the OMI pixel boundaries (red pixels), otherwise it is considered outside (blue pixels).

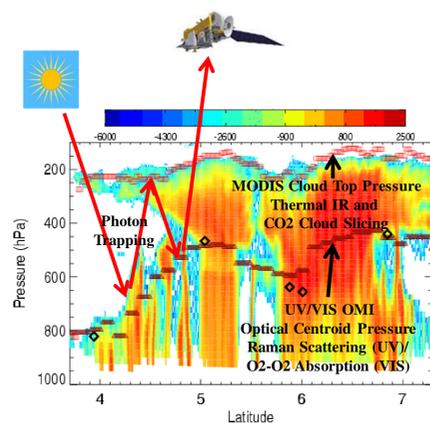
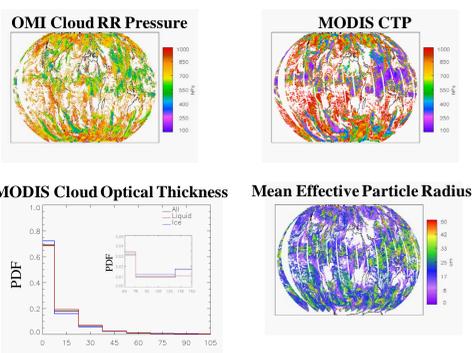


Uncertainties in Co-Location Methodology

- Scene changes due to temporal separation of Aura and Aqua satellites:
 - 15 minute separation before January 2008
 - 8 minute separation after March 2008
- OMI pixel boundaries are defined by straight lines with respect to the earth surface
- Co-location is determined by the pixel center coordinates and presently no statistical weighting is applied to cases where there is partial overlap between MODIS and OMI pixels
- Data range is limited to latitudes where data exists for both satellites. No data exists at the very high polar latitudes.

OMI MODIS Cloud Product (OMMYDCLD)

OMMYDCLD is a Level 2 orbital track data product that combines cloud data collected by the OMI-Aura with collocated statistical information from the MODIS-Aqua cloud product (MYD06_L2).



The above CloudSat image shows deep convection in association with a multilayer cloud. The CO2 slicing method used in the MODIS cloud pressure retrieval senses the tops of the clouds, while OMI Cloud RR and Cloud O2-O2 pressures represents the average pressure reached by backscattered photons. OMMYDCLD also provides histograms of the 1 km multilayer cloud flag from MODIS sampled at the OMI pixel scale.

Statistical Uncertainty

- Statistical sampling of MODIS pixels varies as a function of OMI swath position
- Statistical moments for each OMI pixel affected by number of missing MODIS pixels
- MODIS bow tie effect

Other Data Issues

- OMI Row anomaly
 - X-track quality flags provided with product
- No overlap in OMI rows 1-4, only partial overlap in row 60.

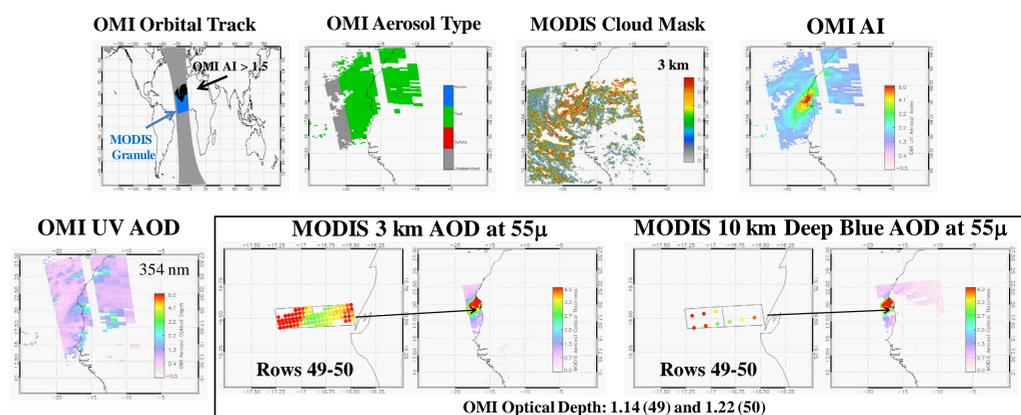
OMI MODIS Aerosol Co-Location Product (OMMYDAGEO)

OMMYDAGEO is a Level 2 product that co-locates pixel geo-locations from OMI-Aura onto the MODIS-Aqua pixels at 3 (MYD04_L2) and 10 (MYD04_3K) km resolution. This product allows users to more readily design studies for directly comparing aerosol measurements from MODIS and OMI.

Product Rationale

OMMYDAGEO was designed for users who want to directly compare co-located aerosol measurements from OMI and MODIS. In this product the exact pixel-to-pixel relations between OMI and MODIS geolocations are preserved. For logistical reasons, the co-location code was designed to map the OMI pixel indices onto the MODIS pixel/granule. The product is ideal for users that require a high level of precision in matching up the geolocations from the two satellites. In addition to providing the matching geolocations, the product also provides a 3 km Cloud Mask from the 500 m cloud mask provided with MYD04_L2 and the distance between the MODIS and OMI pixel centers.

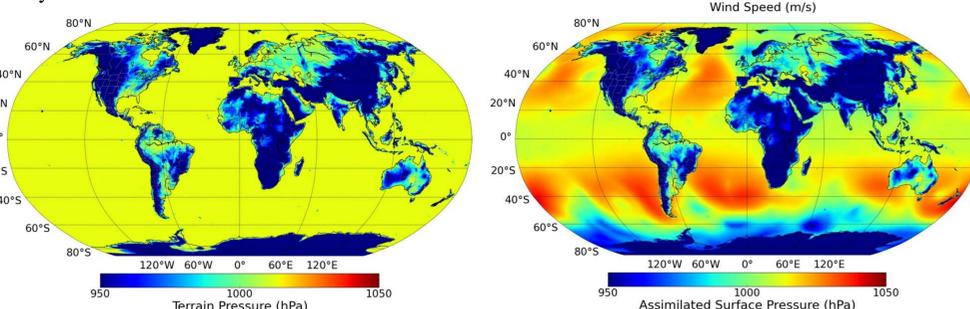
Sample Analysis for August 15, 2007



GEOS-5 Assimilated Data for OMI

Wind Speed, Surface Pressure, Temperature and O3 Profile, etc.

Many OMI algorithms use climatological or constant assumptions for fields such as surface pressure, wind speed, and temperature profile. Our new suite of data products provides daily linearly interpolated data fields from GEOS-5 Forward Processing for Instrument Teams (FP-IT) data products at the time and location of the OMI measurement. These products are designed for OMI Level 2 algorithm development and error analysis.



New Product Applications

Application	Product Shortname
Cloud Clearing	OMMYDCLD
Multi-layer cloud detection	OMMYDCLD
Radiative transfer studies involving the scattering and absorption properties of clouds	OMMYDCLD
Answer geophysical questions related to cloud structure, dynamics and climatology	OMMYDCLD
Investigation of OMI sub-pixel structure	OMMYDCLD OMMYDAGEO
Validation of OMI-MODIS aerosol retrievals	OMMYDAGEO
More accurate ancillary data set for aerosol and trace gas retrievals	OMUFPT3NVASM, OMUFPI3NXASM, OMUFPT3NXAER
Evaluation of geophysical uncertainties associated with trace gas retrievals	OMUFPT3NVASM, OMUFPI3NXASM, OMUFPT3NXAER
Synergistic applications to field campaigns such as DISCOVER-AQ and future missions such as TROPOMI and TEMPO	OMUFPT3NVASM, OMUFPI3NXASM, OMUFPT3NXAER