[Edited content from MODIS-Atmosphere master document Version 27]

Status Keyword List: [Not Started], [Investigating], [Coding], [Testing], [Dropped] or [Implemented].
Note: If no status keyword appears after an item, the status was not communicated to the author of this document.

Aerosol (04_L2)

Dark Target Aerosol (04) (Updated 4/8/2011) Lorraine Remer, Shana Mattoo, Rob Levy, Allen Chu

Over Land:

A) Modify maps for assigning aerosol models over land:

Due to a lack of sensitivity to aerosol absorption, the over-land retrieval must assume aerosol type. For C005, aerosol type was assigned, based on a global map of AERONET aerosol climatology. For C006, these map boundaries will be modified based on AERONET climatology collected since 2005.

B) Modify surface reflectance parameterization:

The aerosol retrieval must make assumptions as to surface reflectance boundary conditions. In C005, surface reflectance parameterization was based on small set of collocated MODIS and AERONET, and shown to have dependence on surface type, vegetation condition (NDVI), and scattering angle. For C006, the global parameterization will be modified to correct systematic biases in particular locations.

C) Changed Look up table

   a) modified Rayleigh calculation in the radiative transfer calculation by adjusting wavelengths and adding depolarization correction to the representation of the Rayleigh scattering matrix.
   b) increased number of zenith quadrature angles in the radiative transfer calculation

D) Deleted SDSs:

Based on validation studies of C005 products, the following derived aerosol size parameters have little or no quantitative scientific use, and will be deleted from L2 (and L3) processing:
   Angstrom_Exponent_Land

Optical_Depth_Small_Land
Mean_Reflectance_Land_All
Standard_Deviation_Reflectance_Land_All
Path_Radiance_Land
Error_Path_Radiance_Land
Critical_Reflectance_Land
Error_Critical_Reflectance_Land
QualityWeight_Path_Radiance_Land
QualityWeight_Critical_Reflectance_Land

E) Renamed SDSs:

"Cloud_Fraction_Land" becomes "Aerosol_Cloud_Fraction_Land"

F) New SDSs:
Topographic_Altitude_Land (Averaged topographic altitude (10 km resolution))

Over Ocean:

A) Renamed SDSs:

"Cloud_Fraction_Ocean"
becomes"Aerosol_Cloud_Fraction_Ocean"

B) New SDSs:

Glint_Angle (10 km resolution)
Wind_Speed_Ncep_Ocean(10 km resolution)

C) Implementation of wind speed dependence

 Algorithm has always ingested NCEP-derived wind speed as ancillary data, but now this information is used as an added index in the Look Up Table. Look Up Tables have been expanded to include choice of wind speed.

D) New Look Up Tables

   a) Corrected for Rayleigh Optical Depth (ROD). The C5 LUT assumed ROD values that were computed (offline) using outdated formula. For C6 LUT, the assumed ROD are consistent with Bodhaine et al., 1999, and that computed by 6S (Vermote) MODIS filter function. RODs changed by up to 0.003 depending on band.
   b) Tables have been extended to 4 Wind speeds (2, 6, 10, and 14 meters/second)

D) Sediment mask modified to avoid use of 1.61 μm inputs, because frequent lack of information at that channel.

E) CO2 correction in Ocean algorithm will be turned off because Ocean Lookup table reflectances already account for CO2 in channels 1.24 ,1.64 and 2.119. We had been inadvertently double correcting.

F) Quality flag will be changed to 3 when reflectance at 0.865 um is less than threshold (Aerosol content is too low) and optical depth is set to zero. Previously, low loading situations were assigned QA=0, which biased long-term statistics towards higher AOD.

Applies to Both Land and Ocean:

A) Expansion of retrieval over higher solar zenith angles. Based on sensitivity studies of radiative transfer, prior to MODIS launch on Terra (pre-1999), aerosol retrieval was limited to cases where solar zenith angle (solzen) was less than 72°. Relaxation of the threshold to solzen <84° greatly increases MODIS coverage in higher latitude/lower sun conditions. No large impact on data quality assurance (QA) is expected, but this is still being investigated.

B) Examine aerosols in the proximity of clouds

Cloud mask and distance to the nearest cloud is calculated and presented for every 500 m "cloud-free" pixel that allows better control of cloud contamination in the basic aerosol products. This information is also summarized statistically at the 10 km product resolution, and will be available for both land and ocean.
C) Introduce an integer QA flag

Users desire simple SDSs for QA that do not require bit decoding. We will introduce i) Flag determining whether a pixel is over land or ocean, and ii) Simple flag (0-3) that represents QA Confidence flags.

D) New SDSs:

These SDSs will be added to L2:
    Land_Sea_Flag (10 km resolution)
    Cloud_Distance_Land_Ocean (500 m resolution)
    Aerosol_Cldmsk_Land_Ocean (500 m resolution)
    Average_Cloud_Distance_Land_Ocean (10 km resolution)
    Land_Ocean_Quality_Flag (10 km resolution)

E) Renamed SDSs:

"Cloud_Mask_QA" becomes "Aerosol_Cloud_Mask_QA"

F) Deleted SDSs:

These SDSs will be taken out of Level 2 processing
Optical_Depth_Ratio_Small_Land_And_Ocean

Propagation to Level 3 (L3)

Aggregation Logic:

Remove pixel weighting in aggregating from daily to 8-day and to monthly, but retain minimum retrieval screen. Add information to attributes that gives threshold value of screen.

New SDSs

Average_Cloud_Distance_Land_Ocean

Deleted SDSs

Optical_Depth_Ratio_Small_Land_And_Ocean
Optical_Depth_Ratio_Small_Land
Optical_Depth_Small_Land
Angstrom_Exponent_Land
Mean_Reflectance_Land_All
Standard_Deviation_Reflectance_Land_All
Path_Radiance_Land
Error_Path_Radiance_Land
Critical_Reflectance_Land
Error_Critical_Reflectance_Land
QualityWeight_Path_Radiance_Land
QualityWeight_Critical_Reflectance_Land
Aerosol_Cloud_Mask_Cloud_Fraction_Land
Aerosol_Cloud_Mask_Cloud_Fraction_Ocean

Deep Blue Aerosol (04DB) (Updated 1/21/2010) Clare Salustro, Christina Hsu

Expand coverage to vegetated regions
- Whereas C005 and C051 Deep Blue retrievals were limited to bright surfaces, C006 will also include Deep Blue retrievals over vegetated regions.

Introduce an integer QA flag
- As with Dark Target above, we will introduce integer versions of the Deep Blue Usefulness Flag and Confidence Flag.

Dark Target/Deep Blue Merge (04DTDB) (Updated 4/8/2011) Lorraine Remer

A. New product that provides AOD at the L2 nominal 10 km spatial scale derived from both Dark Target over land and Deep Blue

algorithms. The following logic is used:

if DT QA=3 and DB QA < 2, then DT AOD is written and QA =3

if DT QA < 3 and DB QA > 1, then DB AOD is written and QA = DB QA

if DT QA = 3 and DB QA >1, then AOD = 0.5(DT AOD + DB AOD) and QA=3

if DT QA < 3 and DB QA < 2, then no AOD is written and fill value is given

B. New SDSs

Dark_Target_Deep_Blue_Combined_Aerosol_Optical_Depth(10 Km)
Dark_Target_Deep_Blue_Combined_Aerosol_Optical_Depth_QF(10Km)

Level-2 3KM Dark Target Aerosol (04_3K) (Updated 4/8/2011)

Lorraine Remer, Shana Mattoo, Robert Levy

New product at nominal 3 km resolution based on the same algorithm and using the same Look Up Tables as the standard Dark Target aerosol product (04). Because of finer resolution, subtle differences are made in selecting pixels for retrieval and in determining QA.

A. List of SDSs available at 3 km

      Longitude
      Latitude
       Scan_Start_Time
       Solar_Zenith
       Solar_Azimuth
       Sensor_Zenith
       Sensor_Azimuth
       Scattering_Angle
       Glint_Angle
       Land_Ocean_Quality_Flag
       Land_sea_Flag
       Wind_Speed_Ncep_Ocean
       Optical_Depth_Land_And_Ocean
       Image_Optical_Depth_Land_And_Ocean
       Aerosol_Type_Land
       Fitting_Error_Land
       Surface_Reflectance_Land
       Corrected_Optical_Depth_Land

Corrected_Optical_Depth_Land_wav2p1
Optical_Depth_Ratio_Small_Land
Number_Pixels_Used_Land
Mean_Reflectance_Land
STD_Reflectance_Land
float Mass_Concentration_Land
Aerosol_Cloud_Fraction_Land
byte Quality_Assurance_Land
Solution_Index_Ocean_Small
Solution_Index_Ocean_Large
Effective_Optical_Depth_Best_Ocean
Effective_Optical_Depth_Average_Ocean
Optical_Depth_Small_Best_Ocean
Optical_Depth_Small_Average_Ocean
Optical_Depth_Large_Best_Ocean
Optical_Depth_Large_Average_Ocean
float Mass_Concentration_Ocean
Aerosol_Cloud_Fraction_Ocean
Effective_Radius_Ocean
Cloud_Condensation_Nuclei_Ocean
Asymmetry_Factor_Best_Ocean
Asymmetry_Factor_Average_Ocean
Backscattering_Ratio_Best_Ocean
Backscattering_Ratio_Average_Ocean
Angstrom_Exponent_1_Ocean
Angstrom_Exponent_2_Ocean
Least_Squares_Error_Ocean
Optical_Depth_Ratio_Small_Ocean_0.55micron
Optical_Depth_by_models_ocean
Number_Pixels_Used_Ocean
Mean_Reflectance_Ocean
STD_Reflectance_Ocean
byte Quality_Assurance_Ocean
Topographic_Altitude_Land