MODIS-Atmosphere Collection 051 Changes

Version 01 (11/05/08)

Aerosol (04_L2) Christina Hsu, Lorraine Remer, Shana Mattoo, Allen Chu

Most of the Aerosol Collection 051 changes relate to Deep Blue Aerosol. The primary thrust of Aerosol Collection 051 is to extend the Deep Blue aerosol retrieval through the entire Terra archive. In Collection 005, Deep Blue Aerosol parameters were only available in the Aqua archive.

Current Collection 5 aerosol algorithm assumes Lambertian surfaces and thus is more problematic when sun is overhead. There are significant improvements in the science of the proposed new version (i.e., Collection 5.1) of Deep Blue algorithm, including new parameterization of the surface BRDF effect, cloud screening as well as QA/QC flag selection criteria.

The proposed change will update existing lookup tables, add eight new lookup tables, and add five new modules to the Deep Blue part of the PGE04. As a result, the size of the MYD04 will slightly increase compared to the current version of outputs.

Implementing the revised Deep Blue algorithm will improve the accuracy of the existing Collection 5.0 MODIS aerosol products over bright reflecting surfaces.

There are several other changes and improvements made in Collection 051.

A software change was implemented to avoid file space issue on IRIX machines. This change was achieved by splitting several tables and "include" files into smaller pieces. These changes neither alter the structure or the numerical output of Deep Blue Aerosol.

A new and improved procedure for determining QA flags was implemented.

Modified code to compute and output four new SDS's:

(1) Deep_Blue_Mean_Reflectance_Land
(2) Deep_Blue_Number_Pixels_Used_Land
(3) Deep_Blue_Aerosol_Optical_Depth_550_Land_STD
(4) Deep_Blue_Aerosol_Optical_Depth_Land_STD.

Several changes were made to better account for surface BRDF and terrain effects. In addition improved BRDF parameterization was implemented in the algorithm.

A bug in the computation of solar and satellite azimuth angles was identified and fixed. This software bug generated bad data points on and around the International Date Line when switching from -179 to +179 degrees and vice versa. A related problem in the Solar Azimuth computation was fixed. This solar azimuth computation problem occurred when the solar azimuth angle switched from -179 to +179 degrees.

A bug in the computation of solar azimuth angles was identified and fixed. This software bug generated bad data points wherever the solar azimuth angle crossed over from -179 to +179 degrees (unrelated to the International Date Line). This problem occurs for a small subset of data points in about ¼ of all global granules (the light colored pixels dotted along the boundary of the purple and red areas in Figure 1 are bad values).

This problem in the 04_L2 SDS Solar Azimuth causes problems in the computation of another SDS ("Relative_Azimuth_Angle") in the (downstream) Joint L2 product, which uses the 04_L2 Solar Azimuth SDS as input. These bad data points in the MYD04_L2 Solar Azimuth data (above) are causing the L2 Joint SDS Relative_Azimuth_Angle_10km to have a similar "arc" of bad data points.

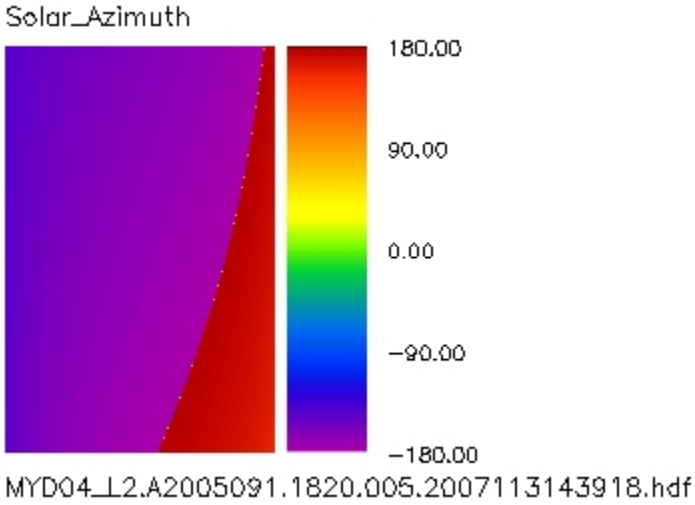

Figure 1. An image of Solar Azimuth Angle from 04_L2. The arc of light colored pixels between the purple and red areas (where the angle is switching from -179 to +179) depict bad data.

Cloud (06_L2)

These 06_L2 changes were implemented in Collection 005 Terra and Aqua, but in the forward stream only with a start date of September 2007. In Collection 051, these changes will be extended into the entire Terra and Aqua date set (from launch).

Cloud Optical Properties (06OD) Steve Platnick, Michael King, Gala Wind

"Striping Fix". The cloud optical properties retrieval software logic was modified in the handling of uncertainty indices for band 29 to compensate for the fact that in 2007 on Terra MODIS, detector 6 in band 29 went dead. This resulted in unwanted striping in the Level-2 product because band 29 was being used for phase determination for thin cirrus clouds. Every 6th line of every granule that contains any thin cirrus is affected by cloud phase being erroneously turned to water and the subsequent retrieval failing in most cases.

"Cloud Optical Thickness Retrieval over Land Dropout Fix". A fix to the Rayleigh correction code that was causing dropouts in the Cloud Optical Thickness retrieval (around 11.5 for liquid water clouds and 8.5 for ice clouds) was implemented. See Figure 2. Every retrieval over land was impacted (there was no dropout in ocean retrievals). There was a related (but smaller) impact on Cloud Effective Radius for both liquid water and ice clouds. This also impacts all L3 (downstream) related SDSs including Cloud Optical Thickness, Cloud Effective Radius, Cloud Water Path, Cloud Phase and Cloud Fraction for Optical Properties. In L3 this impact was primarily seen in the marginal histograms where the bins were small (fine) enough to detect the dropout. The affect on other L3 global statistics (means, etc.) was negligible.

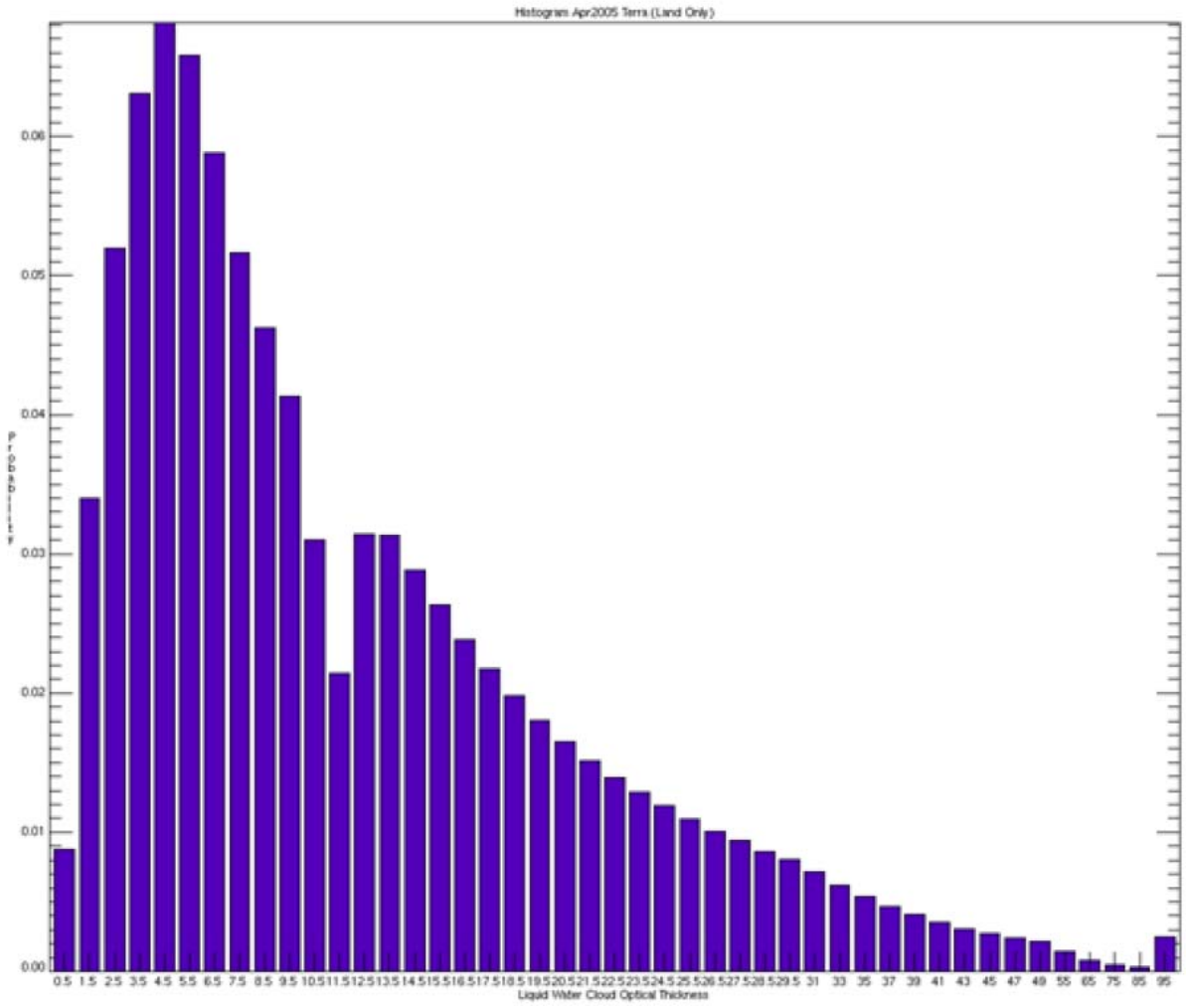

Figure 2. Monthly (April 2005 Terra) Histogram of Liquid Water Cloud Optical Thickness for Global: Land (snow/ice free & covered). The dip in counts around 11.5 is obvious.

Cloud Top Properties (06CT) Rich Frey, Kathy Strabala, Paul Menzel

Correct Negative Moisture Profiles. Changed the cloud top properties source code to properly handle moisture profiles that previously returned negative values. This had the consequence of not allowing cloud top pressure (and temperature) to be computed. This occurred primarily over high and dry regions (like Greenland).

Joint Atmosphere (ATML2) Steve Platnick, Michael King, Brad Wind, Paul Hubanks

A bug in the computation of Relative_Azimuth_10km that was introduced in the Collection 005 version of the Aqua algorithm (only) was identified and fixed. Terra data was not impacted.

In the old Collection 005 Joint L2 Aqua data, the formula that generated the Relative_Azimuth_10km SDS was incorrectly changed. This formula has now been fixed.

This error caused the Relative Azimuth Angle for approximately 25% of the globe to be computed in error (causing this angle to go negative). See Figure 3. Relative Azimuth Angle should always be ≥ 0 and should have a valid range of 0 to 180 degrees; where 0 to 90 is "forward (toward the sun) looking" and 90 to 180 is "backward (away from the sun) looking". See Figure 4.

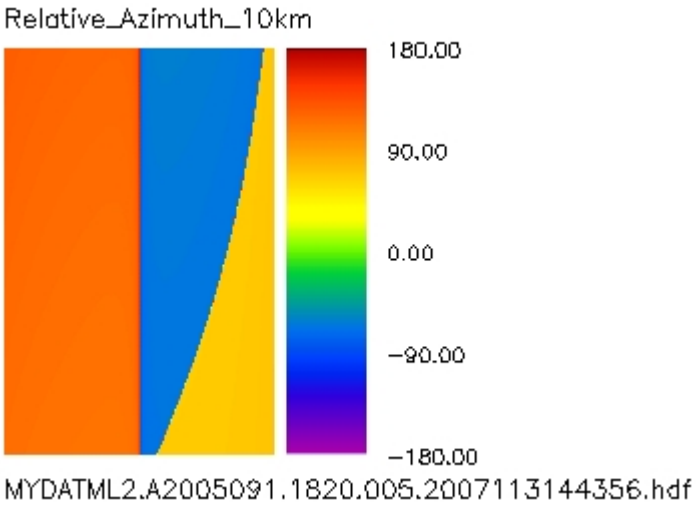

Figure 3. An image of Relative_Azimuth_10km from the Collection 005 Aqua ATML2. The blue colored pixels (showing negative relative azimuth angle) depict bad data.

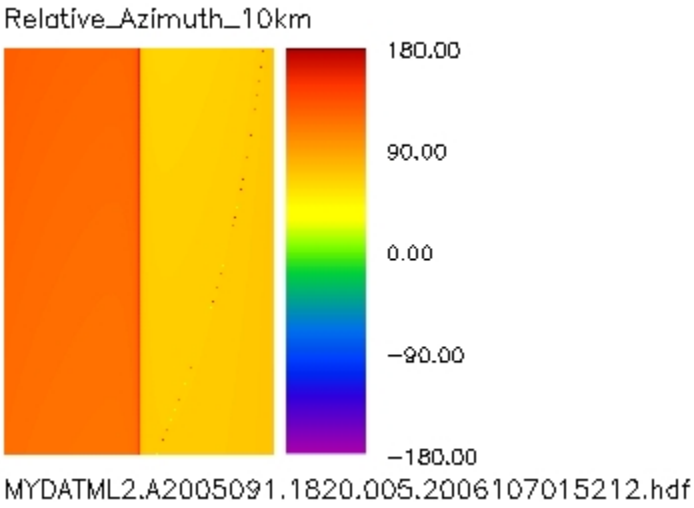

Figure 4. Same as Figure 3 except rerun with corrected Collection 051 code. Note there are still bad dots of data (an arc of dots in the yellow half of the image) which correspond to bad Solar Azimuth Angles from 04_L2 input. This bad arc of data is fixed in the Collection 051 Aerosol code.