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Release of MODIS/Aqua Collection 6 Level-2 Aerosol, Cloud, and other Products

The MODIS Atmosphere Team algorithm developers have released the Collection 6 (C6) reprocessing/forward processing stream of the Aqua Level-2 (L2) aerosol (**MYD04**, **MYD04_3K**), cloud (**MYD06**), column water vapor (**MYD05**), and joint team (**MYDATML2**) products. MODIS/Aqua C6 algorithms include numerous improvements and data set changes. A very brief discussion of the highest-level product dataset changes is given below. A description of algorithm changes and other dataset details can be found in documents available at http://modis-atmos.gsfc.nasa.gov/products_C006update.html. Global L2 browse imagery for many of the key Collection 5 (C5) and C6 atmospheric team datasets are available at <http://modis-atmos.gsfc.nasa.gov/IMAGES/index.html>.

Notes:

- The Atmosphere Team Aqua and Terra C6 L2 cloud mask (MOD35/MYD35) and atmospheric profile products (MOD07/MYD07) were previously released in July and November 2012, respectively.
- Atmosphere Team Level-3 (L3) product development is ongoing. A beta version will be released shortly. A final L3 product with updates to some cloud datasets and a revised “definition of day” for daily aggregations will follow.
- With regard to the nomenclature for the previous L2 collection, the cloud mask and profile products were produced using the original Collection 5 code while aerosol and cloud codes were updated and (re)processed under Collection 51. Here we generically refer both of these processing streams as C5.

Aerosol Product Updates

The MOD04 aerosol product continues to provide full global coverage of aerosol properties from the Dark Target (DT) and Deep Blue (DB) algorithms. The DT algorithm is applied over ocean and dark land (e.g., vegetation), while the DB algorithm now covers the entire land areas including both dark and bright surfaces. Both results are provided on a 10x10 pixel scale (10 km at nadir).

Based on C5 validation studies, a number of Science Data Sets (SDSs) have been deleted from the DT product (Angstrom_Exponent_Land, Optical_Depth_Small_Land, etc.) while a number of SDSs have been renamed or added. A number of algorithm changes have led to significant changes in regional aerosol product statistics (see link above). For C6, the DT algorithm team now provides a new 3 km spatial resolution product intended for the air quality community; this is provided in a separate file (MYD04_3K).

In C5, the DB algorithm was limited to only bright targets. With C6, the DB team has expanded coverage to include both bright targets and vegetated regions, using NDVI information in addition to a precalculated surface reflectance database. New DB products for C6 include an estimate on the aerosol retrieval uncertainty to assist with error analyses as well as a best estimate SDS containing the aerosol optical thickness data with quality assurance flags already applied (SDS names Deep_Blue_Aerosol_Optical_Depth_550_Land_Estimated_Uncertainty and Deep_Blue_Aerosol_Optical_Depth_550_Land_Best_Estimate respectively).

In addition to separate DT and DB retrievals, the C6 product now provides a merged (SDS) that combines both types of retrievals (SDS name AOD_550_Dark_Target_Deep_Blue_Combined). This SDS uses a combination of scene NDVI and retrieval Quality Assessment (QA) assignments to select one of the retrievals (if any) or an average of the two retrievals. Ocean retrievals from the DT algorithm are also provided if they have a sufficiently high retrieval QA value.

Cloud Product Updates

The cloud products include cloud-top and optical/microphysical properties. The cloud-top property product changes include new 1 km SDSs in addition to the legacy 5 km SDSs, and a new physical cloud height dataset. New 1 km products include cloud top pressure, IR cloud emissivity, cloud height, overshooting cloud top flag, and cloud phase. The 1 km IR phase product is generated using an updated algorithm while the other 1 km products were designed to be as similar as possible to the 5 km version.

Cloud optical/microphysical product changes include expanded/improved pixel-level retrieval uncertainty calculations that are intended to be used in lieu of retrieval QA assignments that are no longer assigned (legacy QA bits are now set to a value of 3 for all successful retrievals). Retrievals are now attempted on a pixel flagged as likely to have a partly cloudy field of view by the so-called clear sky restoral algorithm introduced in C5 processing. Successful retrievals from this pixel population have similar SDS names as the non-flagged pixel population but with “_PCL” (for Partly CLOUDy) appended to the end of the parameter name; an exception is the uncertainty SDSs where both PCL and non-PCL retrieval uncertainties are kept. Metrics for unsuccessful retrievals (those outside the look-up table solution space) are now provided as well (Retrieval_Failure_Metric_*). Finally, absolute retrievals are provided for the other visible and near-infrared (VNIR) and shortwave infrared band pairs (VNIR and 1.6 μm , VNIR and 3.7 μm) instead of as differences relative to the VNIR/2.1 μm retrieval. Other dataset changes are detailed in the document link given above.

It was found during C6 development that cloud optical property retrievals were sensitive to an improved 1 km L1B aggregation of the Aqua MODIS bands 1 (0.66 μm) and 2 (0.86 μm) native 250 m reflectances that partially accounts for misregistration of the VNIR focal plane with the other three focal planes. This intermediate L1B file (not archived but to be made available on demand) is used for all atmosphere team processing but was found to significantly affect only optical property L3 retrieval statistics.

Algorithm refinement for the Cirrus_Reflectance dataset is no longer being supported by NASA. Before support was terminated, updates to the C6 algorithm included use of the de-striped L1B reflectance data file that was developed for clear and cloudy-sky infrared algorithms but also includes band 26 (1.38 μm) used in the cirrus reflectance algorithm.

Column Water Vapor Product Updates

MODIS column water vapor (MOD05) datasets continue to be separately available from infrared and near-infrared methods.

The clear-sky IR precipitable water dataset is derived from the previously reprocessed Atmospheric Profile (MYD07) C6 product that included a new layer scheme for total precipitable water. The legacy near-infrared method uses reflectance information in and out of water vapor

absorption using MODIS bands in the 940 nm spectral region; algorithm refinement for this product is no longer being supported by NASA and as such there has been no update to this algorithm for C6.

Joint Atmosphere Team Product

The ATML2 product provides a subset of datasets from the suite of atmosphere team products on both a 10 km scale (aerosols) and 5km scale (native 5 km cloud properties and a 5x5 pixel sample of the 1km cloud datasets). The sampling of 1 km datasets is consistent with the team's L3 algorithm (using the pixel 4, 9 in the along-track direction for each 10 km scan in order to avoid contiguous dead 500 m band 6 (1.6 μm) pixels on the Aqua instrument).

C6 significantly increases the number of datasets included in the ATML2 product, including the full suite of QA datasets. Since the ATML2 data granule file size is significantly smaller than the combined size of the individual L2 products, and because the 1 km pixel sampling is consistent with the L3 algorithm, the ATML2 product is a more practical means for the user community to develop research L3 algorithms for their own specific purposes.

In addition, the atmosphere team has worked with the L1B algorithm team to modify the existing C6 version of the 5x5 pixel sampled 1 km L1B product (MOD02SSH) to be consistent with ATML2 sampling (see above); MOD02SSH is derived from MOD021KM.

Production Schedule

MODIS Aqua C6 L2 reprocessing for the described products began with calendar year 2008 to more quickly enable A-Train intercomparison and evaluation studies. After completion of 2008, reprocessing continued with the beginning of the MODIS data record (2002, day 185). The forward processing stream began with Jan 1, 2014. With current processing hardware, it is expected that Aqua reprocessing will be completed (i.e., through Jan 1, 2014) in May 2014.

MODIS Terra algorithms for the aerosol product are still in development. It is anticipated that Terra C6 (re)processing can begin for the cloud and aerosol products shortly after Aqua reprocessing is completed.

To allow the MODIS community to evaluate and gradually switch over to the C6 products, the C5 forward processing will continue at least one year after the reprocessing of the corresponding C6 products are completed. In addition, the C5 products will be kept in the on-line archive for another year after the C5 forward processing ends. At that time, a golden data set of the C5 data will be kept on-line as was done for prior collections.