

MODATML2

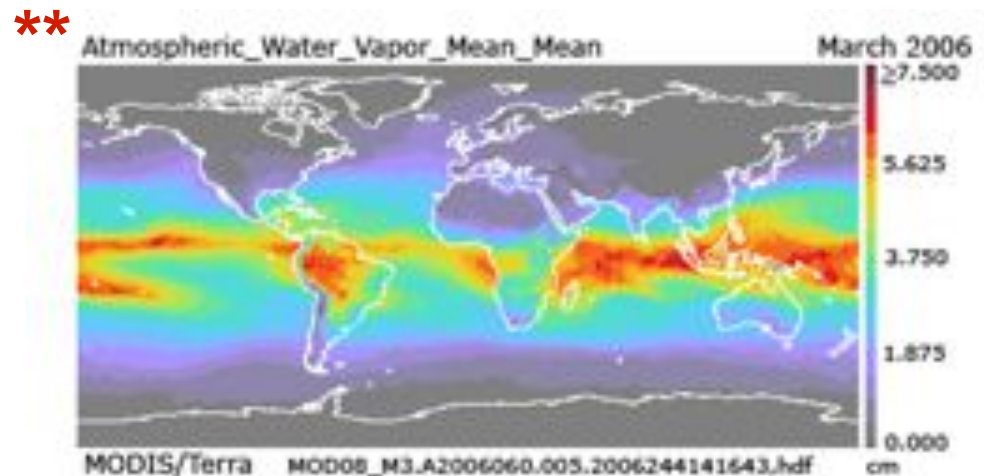
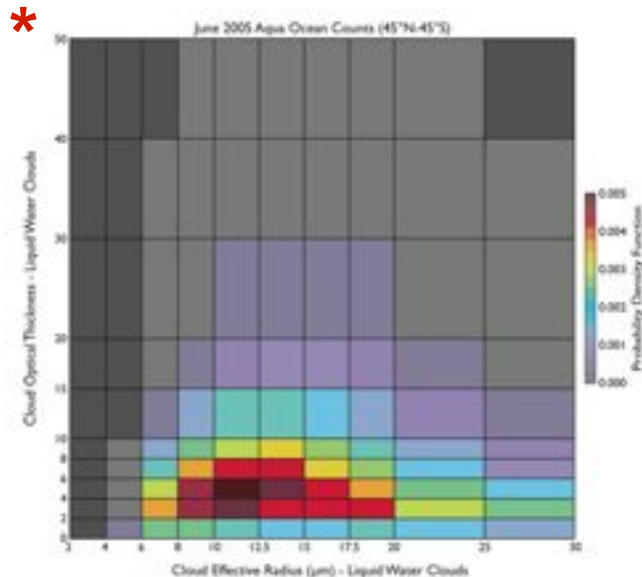
**in support of future infrastructure
for custom aggregations**



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Some Strengths of Standard Level-3:

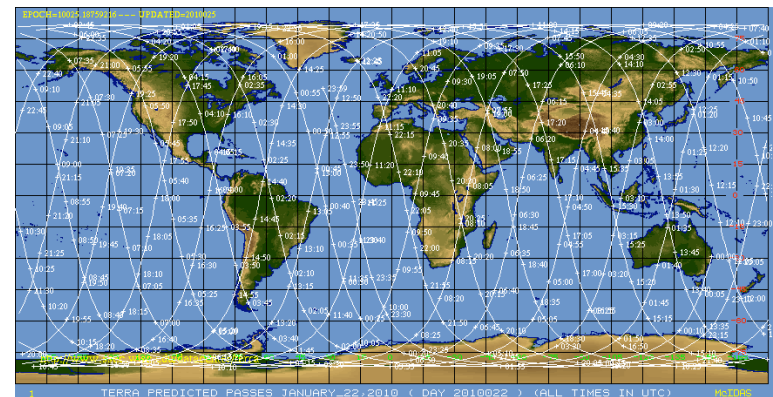
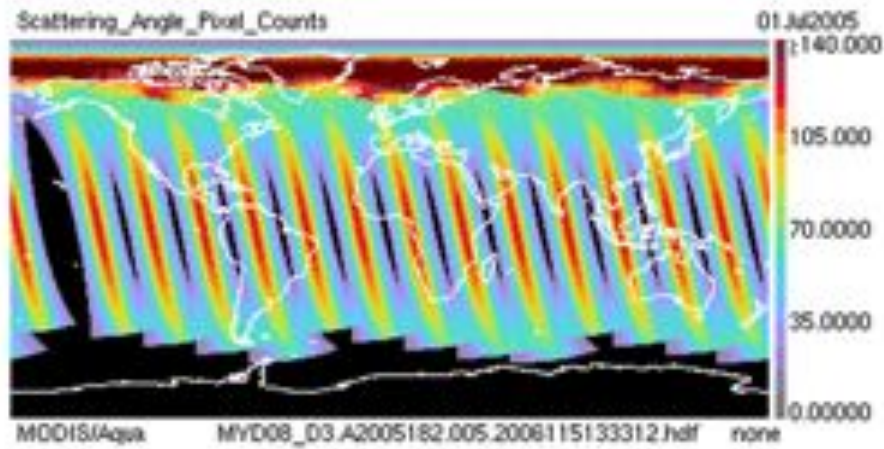
- Many different parameters (over 100)
- Many different statistics (over 20)
- Multiday files fill orbit gaps (full global coverage)
- Efficient study of global statistics & longer term trends
- Joint histograms show cross-parameter relationships *
- Useful in quality and debug efforts of L2 inputs ** (L3 browse)



Some Limitations of Standard Level-3:

- Fixed map projection (Lat-Lon)
- Fixed relatively coarse resolution (1°)
- Fixed parameter set (per Collection)
- Limited set of joint histograms (per Collection)
- Preset histogram bin boundaries (per Collection)
- Overlapping orbits are averaged * (Daily)

*



Need for a New Customized Level-3 (L3C):

- Flexible map projection**
- Flexible grid resolution**
- Flexible handling of overlapping orbits**
- Flexible parameter set**
- More complicated statistics**
- More detailed histograms and joint histograms**
- Run by users using provided software/tools**

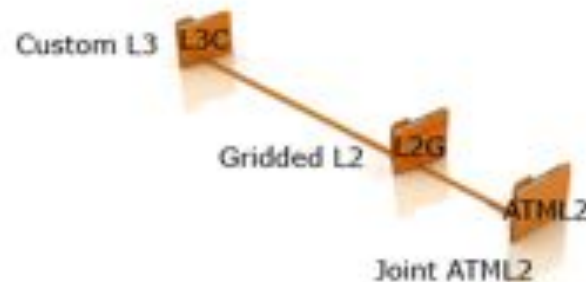
How can we build Customized L3 Products?



Need for Collection 006:

Optimize the Joint L2 (ATML2) Product
so it can be used as a
basis

for all possible permutations of future
L2G and L3C Products



What does the Joint L2 Atmosphere Product (ATML2) currently contain?

For C005 content see
modis-atmos.gsfc.nasa.gov/JOINT/format.html



The screenshot shows the MODIS Atmosphere website. The main heading is "MODIS Atmosphere". Below it, there is a navigation menu with links: HOME, PRODUCTS, USAGE, DATA, SUPPORT, NEWS, CONTACT, and HELP. The main content area is titled "Introduction" and contains the following text:

Product Description

The post-launch MODIS Atmosphere Level 2 Joint Product contains a spectrum of key parameters gleaned from the complete set of standard-or-derived Level 2 products: Aerosol, Water Vapor, Cloud, Profile, and Cloud Mask. The new Joint Atmosphere product was designed to be small enough to minimize data transfer and storage requirements, yet robust enough to be useful to a significant number of MODIS data users.

Scientific data sets (SDS) contained within the Joint Atmosphere product cover a full set of high-spatial-resolution parameters produced by the MODIS Atmosphere group, and are stored at 5-km and 10-km (at nadir) spatial resolutions. There are two MODIS L2 Joint Atmosphere data product files: MODATML2, containing data collected from the Terra platform, and MYDATML2, containing data collected from the Aqua platform. Both of these products began production on October 14th, 2002. The first available data files are data files 207 (20-12-2002) for Aqua and 208 (20-11-2002) for Terra.

Revisions and Applications

A few limitations were introduced into the Joint Product to reduce the file size. First, some parameters that were stored at 1-km resolution in their original (source) Level 2 product files were subsampled to 5-km in the Joint product. These include the cloud mask, cloud optical thickness, cloud effective radius, cloud quality assurance (includes cloud phase information), cloud reflectance, and the precipitable water (total H₂O) parameters. Second, production errors that were

On the right side of the page, there is an image of a CD-ROM and a small text box that reads: "The MODIS content is available in a full copy on the Terra CD-ROM."

SDS Parameter List

5-km Resolution Parameters

5-km Geolocation

o Latitude

Description: Latitude for 5-km parameters.

Source product: SDS: 06_L2, Latitude

Array type, dimension, size: Int*2, 406x270, 219k

Resolution, mode: 5-km, day & night

Notes: For reduced file size, Real*4 source data are repacked as Integer*2. A precision loss of 1/1000th of a degree results.



o Longitude

Description: Longitude for 5-km parameters.

Source product: SDS: 06_L2, Longitude

Array type, dimension, size: Int*2, 406x270, 219k

Resolution, mode: 5-km, day & night

Notes: For reduced file size, Real*4 source data are repacked as Integer*2. A precision loss of 1/1000th of a degree results.



Water Vapor (05_L2)

o Precipitable_Water_Near_Infrared_Clear

Description: Total column precipitable water vapor (cm) for clear sky (bright land and sunglint ocean only) using near infrared retrieval.

Source product: SDS: 05_L2, Water_Vapor_Near_Infrared

Array type, dimension, size: Int*2, 406x270, 219k

Resolution, mode: 5-km, daytime only

Notes: Source data at 1-km is subsampled at 5-km. Clear sky data are collected by using the Surface Type Flag in the 05_L2 SDS Quality_Assurance_Near_Infrared. Flag values of 0 (bright land) and 3 (ocean glint) only are used to pass data through to array. SDS name changed to clarify aggregation.



Cloud (06_L2)

Cloud Optical Parameters

o Cloud_Optical_Thickness

Description: Cloud optical thickness at 0.66 μm derived from a two-channel retrieval using MODIS band 7 and either band 1, 2, or 3.

Source product SDS: 06_L2_Cloud_Optical_Thickness

Array type, dimension, size: Int*2, 4096x270, 2196

Resolution, mode: 5-km, daytime only

Note: Source data at 1-km is subsampled at 5-km. Note that all cloud phases (liquid water, ice, and undetermined phase) are represented in the parameter; users must read the Cloud Phase (Retrieval Processing Path) Flag in the Cloud_Quality_Assurance SDS to determine the cloud phase represented by each pixel.



o Cloud_Optical_Thickness_Uncertainty

Description: Cloud Optical Thickness Relative Uncertainty (Percent).

Source product SDS: 06_L2_Cloud_Optical_Thickness_Uncertainty

Array type, dimension, size: Int*2, 4096x270, 2196

Resolution, mode: 5-km, daytime only

Note: Source data at 1-km is subsampled at 5-km. Note that all cloud phases (liquid water, ice, and undetermined phase) are represented in the parameter; users must read the Cloud Phase (Retrieval Processing Path) Flag in the Cloud_Quality_Assurance SDS to determine the cloud phase represented by each pixel.



Cirrus Parameters

o Cirrus_Reflectance

Description: Cirrus reflectance at 0.66 μm .
Source product SDS: 06_L2_Cirrus_Reflectance
Array type, dimension, size: Int*2, 406x270, 219k
Resolution, mode: 1-km, daytime only
Notes: Source data at 1-km is subsampled at 3-km.



Cloud Top Parameters

o Cloud_Top_Pressure

Description: Cloud top pressure (hPa) at 5x5 1-km pixel resolution using infrared retrieval methods. If less than 4 out of the 25 1-km pixels are cloudy (cloud fraction < 16%), then the 5x5 km area is processed using the "clear" retrieval path and cloud top pressure is set to missing (fill). This is done because CO₂-slicing is not sensitive enough to give an accurate cloud top pressure when the cloud fraction is less than around 15%.
Source product SDS: 06_L2_Cloud_Top_Pressure
Array type, dimension, size: Int*2, 406x270, 219k
Resolution, mode: 1-km, day & night
Notes: Data duplicated exactly from source file.



o Cloud_Top_Temperature

Description: Cloud top temperature (K) at 5x5 1-km pixel resolution using infrared retrieval methods. If less than 4 out of the 25 1-km pixels are cloudy (cloud fraction < 16%), then the 5x5 km area is processed using the "clear" retrieval path and cloud top temperature is set to missing (fill). This is done because CO₂-slicing is not sensitive enough to give an accurate cloud top pressure, from which temperature is derived, when the cloud fraction is less than around 15%.
Source product SDS: 06_L2_Cloud_Top_Temperature
Array type, dimension, size: Int*2, 406x270, 219k
Resolution, mode: 1-km, day & night
Notes: Data duplicated exactly from source file.



Profile (07_L2)

c. Precipitable_Water_Infrared_Clear

Description: Total column precipitable water vapor (cm) for clear sky using infrared retrieval.

Source product, SDS: 07_L2, Water_Vapor

Array type, dimension, size: Int*2, 406x270, 219k

Resolution, mode: 5-km, day & night

Note: Data duplicated exactly from source file. SDS name changed to clarify application.



Cloud Mask (35_L2)

c. Cloud_Mask

Description: Cloud mask information.

Source product, SDS: 35_L2, Cloud_Mask (1st byte only)

Array type, dimension, size: Int*1, 406x270, 109k

Resolution, mode: 5-km, day & night

Note: Source data at 1-km is subsampled at 5-km. Only the first byte is copied from the source (input) SDS. The first byte contains six QA flags.

Key: For help reading QA (bit) flag arrays, review the [Bit Interpretation](#) page.



QA (Bit) Flag Description Key		
All bit and byte numbering starts at 0.		
Right (least significant bit) to Left (most significant bit)		
Byte #0		
Bits	Flag Description	Flag Interpretation
0	Cloud Mask Status Flag	0 = Not Determined 1 = Determined
1-2	Unobstructed FOV Cloudiness Flag	0 = Cloudy 1 = Probably Cloudy 2 = Probably Clear 3 = Confident Clear
3	Day/Night Flag	0 = Night 1 = Day
4	Sunglint Flag	0 = Yes 1 = No
5	Snow/Ice Background Flag	0 = Yes 1 = No
6-7	Land/Water Flag	0 = Water 1 = Coastal 2 = Desert 3 = Land

10-km Resolution Parameters

10-km Geolocation and Viewing Geometry

o Latitude_10km

Description: Latitude for 10-km parameters.

Source product, SDS: 04_L2, Latitude

Array type, dimension, size: Int*2, 200x135, 54k

Resolution, mode: 10-km, daytime only

Note: For reduced file size, Real*4 source data are repacked as Integer*2. A precision loss of 1/1000th of a degree results. SDS name changed to clarify application.



o Longitude_10km

Description: Longitude for 10-km parameters.

Source product, SDS: 04_L2, Longitude

Array type, dimension, size: Int*2, 200x135, 54k

Resolution, mode: 10-km, daytime only

Note: For reduced file size, Real*4 source data are repacked as Integer*2. A precision loss of 1/1000th of a degree results. SDS name changed to clarify application.



o Solar_Zenith_10km

Description: Solar zenith angle (cell to sun) for 10-km parameters.

Source product, SDS: 04_L2, Solar_Zenith

Array type, dimension, size: Int*2, 200x135, 54k

Resolution, mode: 10-km, daytime only

Note: Data duplicated exactly from source file. SDS name changed to clarify application.



Aerosol (04_L2)

o Aerosol_Optical_Depth

Description: Aerosol optical depth at 0.55 μm over land (corrected solution) and ocean (best solution).

Source product: SDS: 04_L2_Optical_Depth_Land_And_Ocean

Array type, dimension, size: lrt*2, 203x135, 54k

Resolution, mode: 10-km, daytime only

Notes: Data duplicated exactly from source file. SDS name changed to clarify application.



o Aerosol_Optical_Depth_Ratio_Small

Description: Ratio of small mode optical depth to all modes at 0.55 μm over land and ocean.

Source product: SDS: 04_L2

Optical_Depth_Ratio_Small_Land_And_Ocean

Array type, dimension, size: lrt*2, 203x135, 54k

Resolution, mode: 10-km, daytime only

Notes: Data duplicated exactly from source file. SDS name changed to clarify application.



o Aerosol_Solution_Index_Ocean_Small_Average

Description: Solution number index (1 through 4) for small aerosol particles (average solution only) over ocean. Indices of ocean models 1 through 4 correspond to accumulation (small) mode models with effective radii 0.10, 0.15, 0.20, 0.25 μm , respectively.

Source product: SDS: 04_L2_Solution_Index_Ocean_Small

Array type, dimension, size: lrt*1, 203x135, 27k

Resolution, mode: 10-km, daytime only

Notes: Data packed from lrt*2 in source file to lrt*1 to save space (causes no data accuracy loss). Only the 2nd (average) solution is kept. SDS name changed to clarify application.



Last Item on ATML2 Optimization ... Don't Forget!

L2 Science Teams: Review L2 QA Flags for Possible Inclusion

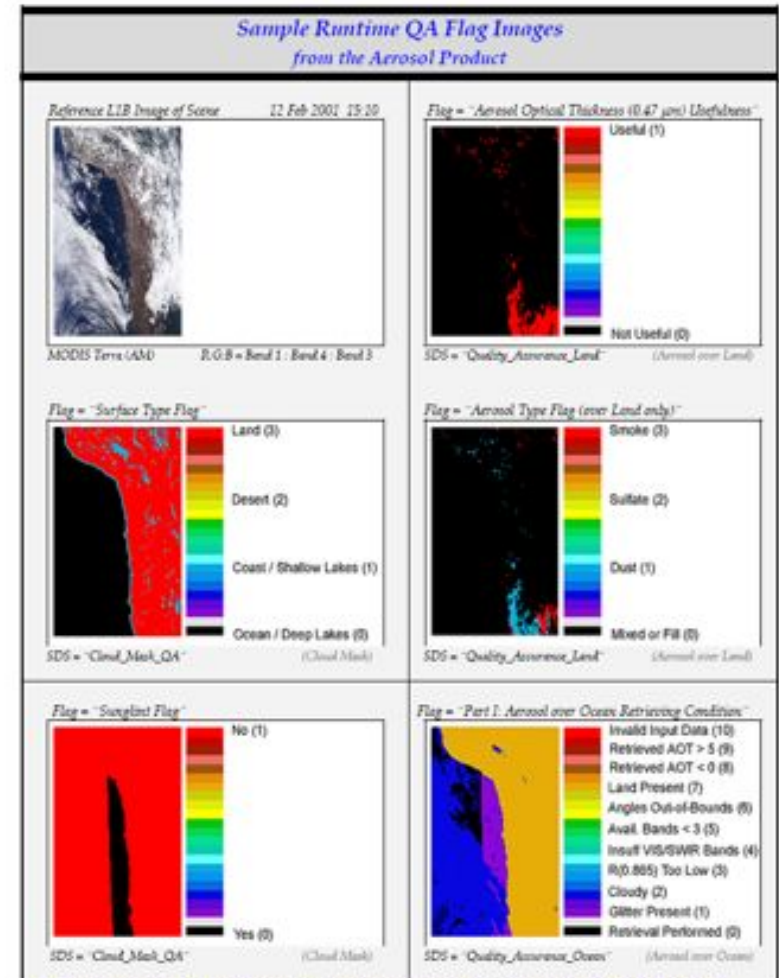
Aerosol Product: MOD04_L2 (Terra) & MYD04_L2 (Aqua)

For the Aerosol product, the Runtime QA flags are stored in three Scientific Data Sets (SDSs): *Cloud_Mask_QA*, *Quality_Assurance_Land*, and *Quality_Assurance_Ocean*. *Cloud_Mask_QA* is a single byte SDS that contains several cloud mask QA flags recomputed on a 10x10 km grid. This recomputation is performed using specific numerical thresholds of percentages of 1 km Cloud Mask pixels that meet certain criteria within the Aerosol 10x10 km retrieval area (see "Bit Value Definitions" column in the table below). So for each 10x10 km pixel, up to one hundred 1 km Cloud Mask pixels are queried. It should be noted that in the previous version of the QA Plan, the 2nd flag in sequence below was incorrectly documented, it is now correctly specified as being "Spares." All other flags provide information on the processing (logic) path taken in the aerosol retrieval algorithm.

Quality_Assurance_Land and *Quality_Assurance_Ocean* are five byte SDSs that contain product quality flags, retrieval processing flags, and input data resource flags designed separately for land and ocean because of differences in the retrieval algorithms. All Aerosol QA Flag arrays have the following characteristics:

- Spatial resolution: 10x10 km
- Processing mode: Daytime only

Scientific Data Set (SDS) Name: "Cloud_Mask_QA"			
Description: Cloud mask QA flags recomputed at 10x10 km resolution			
Length: 1 byte (8 bits)			
Flag Name	Number of Bits	Bit Values	Bit Value Definitions
Cloud Mask Status Flag	1	0 1	Undetermined (< 100% cloud mask determined pixels) Determined (100% cloud mask determined pixels)
Spares	2		TBD
Day / Night Flag	1	0 1	Night (< 100% daytime pixels) Day (100% daytime pixels)
Sunglint Flag	1	0 1	Yes (100% cloud mask sunglint pixels) No (< 100% cloud mask sunglint pixels)
Snow / Ice Flag	1	0 1	Yes (≥ 90% snow / ice pixels) No (< 90% snow / ice pixels)
Surface Type Flag	2	0 1 2 3	Ocean (≥ 90% ocean or deep lakes and rivers) Coast (other criteria not met) Desert (100% desert) Land (100% land and < 100% desert)



Note: Images were created by "l1flag_visualizer", available at http://modis-atmos.gsfc.nasa.gov/tools_l1flag_visualizer.html.

Science Team Action Item

Review:

Content of ATML2 (for missing SDSs and QA Flags)

C005 ATML2 Content: modis-atmos.gsfc.nasa.gov/JOINT/format.html

C005 QA Plan: modis-atmos.gsfc.nasa.gov/reference_atbd.html

I will be in contact with L2 Teams over the next few months



The screenshot displays the MODIS Atmosphere website interface. The main content area is titled 'Format & Content' and 'SDS Parameter List'. It features a section for '5-km Resolution Parameters' with a sub-section for '5-km Geolocation'. Under '5-km Geolocation', there are three entries: 'Latitude', 'Longitude', and 'Precipitable_Water_Near_Infrared_Clear'. Each entry includes a description, source product, array type, resolution, and notes. The 'Latitude' and 'Longitude' entries note that Real*4 source data are repacked as Integer*2 for reduced file size. The 'Precipitable_Water_Near_Infrared_Clear' entry notes that source data at 1-km is subsampled at 5-km and that Quality_Assurance_Near_Infrared flag values of 0 (bright land) and 3 (ocean glint) are used to pass data through to array. The website also includes a navigation menu at the top and a sidebar on the left with various links like 'HOME', 'PRODUCTS', 'MAGIS', 'DATA ISSUES', 'NEWS', 'STAFF', 'FORUM', 'REFERENCE', 'TOOLS', 'HELP', and 'SUPPORT TEAM'.

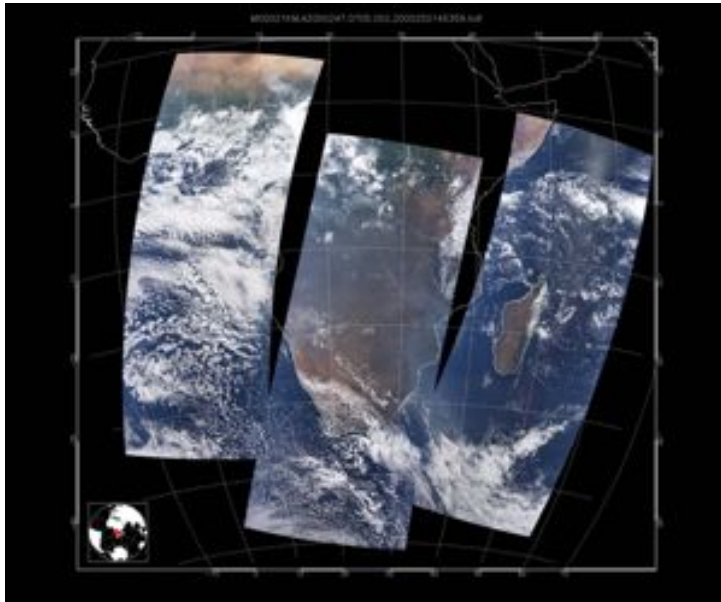
A final issue on Customized L3: MOD02SSH and sampling

MODIS/Terra Level 1B Subsampled Calibrated Radiance at 5km (MOD02SSH)

For Collection 005

- A 5km subsample from the MODIS Level 1B 1km data (MOD021KM)
- Every fifth frame or pixel (along-scan) and fifth line (across-scan) is sampled
- **The subsampling starts at the third frame, and at the third line.**
- There is a one-to-one correspondence between the data and geolocation with no offset

- Contains calibrated and geolocated at-aperture radiances for 36 bands
- Visible, shortwave infrared (SWIR) and Near Infrared (NIR) measurements are made during daytime only
- Radiances for Thermal Infrared (TIR) are measured continuously
- The spatial coverage is similar to that of MOD021KM (nominally it is 2330 by 2030 km, cross-track by along-track).



Action Item:

Ensure that MOD02SSH uses the same sampling pixels and has the same size as 5km products in MODATML2 to facilitate their joint use for climate data generation.



Topic 2.

A Summary of Collection 006 Changes to the Standard MODIS-Atmosphere Level 3

Summary of C6 Changes to L3

1. Cloud Optical Properties (06_OD) derived

- a. New Parameters: Permutations of Tau and Re
- b. Possible new QA weighting scheme (using Uncertainty)
- c. Possible new statistics (Median?, Mode?)
- d. Define some new joint histograms
- e. Histogram and joint histogram bin optimization

2. Cloud Top Properties (06_CT) derived

- a. New Parameters: CTH, TStorm Overshooting Top Statistics
- b. New Aggregations
 1. low/middle/high clouds (440, 680 hPa boundaries)
 2. near nadir view ($\text{SensorZenithAngle} < 32^\circ$)
- c. Define some new joint histograms
- d. Histogram and joint histogram bin optimization

Summary of C6 Changes to L3 (con't)

3. Aerosol (04) derived
 - a. New multiday weighting scheme: Daily to Multiday
 - b. Parameter list changes (1 added & 14 dropped)
 - c. Other changes for Deep Blue Aerosol? (pending)

4. Water Vapor (05), Cirrus Detection (06_CD), Atmospheric Profile (07) derived
 - a. No L3 changes requested thus far; however improvements at L2 will propagate to L3

More Details can be found
in the C006 Change Summary Document

modis-atmos.gsfc.nasa.gov/products_c006update.html



The screenshot shows the MODIS Atmosphere website interface. At the top, there is a navigation bar with links for HOME, PRODUCTS, IMAGES, DATA ISSUES, NEWS, STAFF, FORUM, REFERENCE, TOOLS, and HELP. Below this is a secondary navigation bar with categories: AEROSOL, H₂O VAPOR, CLOUD, PROFILE, CLO. MASK, JOINT (Level-2 Products), DAILY, EIGHT DAY, MONTHLY (Level-3 Products), ALBEDO, NDI, ECOSYSTEM (Level-3 Ancillary). The main content area is titled 'Collection 006 Update' and contains the following text: 'The document below describes proposed Collection 006 changes to all L2 and L3 MODIS data. The next generation of MODIS data products, tagged Collection 006, is expected to begin production late in 2009 or early 2010.' To the right of this text is a logo for 'Collection 006' featuring a globe. Below the main text is a section titled 'Collection 006 Change Summary Document' with a bullet point: 'Collection 006 Change Document v22' followed by a 'View' button, '(PDF)', and the date '1/21/2010'. At the bottom, there is a note: 'All Collection 001 Change Summary documents are stored in Portable Document Format (PDF). Adobe Acrobat must be used to view these files. If you do not have this program, click on the download Adobe Acrobat icon to connect to the Adobe Web site and obtain a free copy of Acrobat Reader.' To the right of this note is a 'download' button with an Adobe Acrobat icon.



Questions?

Contact Paul.A.Hubanks@nasa.gov