CloudSat Project

A NASA Earth System Science Pathfinder Mission

Cloudsat MODIS-AUX Auxiliary Data Process Description and Interface Control Document

Algorithm Version: 5.1
Date: July 18, 2007

Questions concerning the document and proposed changes shall be addressed to

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Contents

1. Introduction

1.1. Overview

The MODIS-AUX data set is an intermediate product that contains a subset of ancillary MODIS radiance and cloud mask data that overlaps and surrounds each CloudSat cloud profiling radar (CPR) footprint. Input data are obtained from the 1B-CPR and AN-MODIS products, and the MODIS-AUX data are used as input to the 2B-GEOPROF, 2B-CLDCLASS, 2B-TAU, and 2B-FLXHR algorithms in the CloudSat data processing system. The MODIS-AUX product is created by the Generic-AUX Subset-to-Reference algorithm. This document describes the interfaces between the input data sets and the Generic-AUX algorithm, the format of the MODIS-AUX product, and quality assessment instructions for the Data Processing Center (DPC) operator. Details of the operation of the data sub-setting performed by the Generic-AUX algorithm can be found in the CORE Data Manipulation Routines document (see below).

1.2. Applicable Documents

- Level 1B CPR Process Description and Interface Control Document (v5.3), 27JUN07.
- Cloudsat AN-MODIS Ancillary Data Interface Control Document (draft), 15APR02.
- atbd_mod01.pdf: Draft of the MODIS Level 1B Algorithm Theoretical Basis Document Version 2.0 (ATBMOD-01).
- atbd_mod35.pdf: Discriminating Clear-Sky From Cloud With MODIS Algorithm Theoretical Basis Document (MOD35).
- Cloudsat Data Processing Center System Description and Data Processing Plan, 29MAY01.
- The CORE Data Manipulation Routines – Process Description, 1JUN04.
- Cloudsat L3 Ground System-Science Data Processing, 22APR01.
- End-to-End Information System (EEIS), 19APR01.

2. Brief Description of the Generic-AUX Process

The Generic-AUX subset-to-reference algorithm uses two datasets: an independent dataset and a reference dataset. To produce the MODIS-AUX product, AN-MODIS is the independent dataset containing the radiances, cloud mask, geolocation, etc. data that will be sub-set around each CloudSat ray. The geolocation data from the 1B-CPR product comprise the reference dataset. Operating one CloudSat ray at a time, the subset-to-reference algorithm uses the reference and independent geolocation data to find the closest AN-MODIS pixel to the CloudSat ray, then stores a 3-pixel across-track by 5-pixel along-track grid of each AN-MODIS parameter of interest in a 15-element vector associated with that ray. If the CloudSat geolocation for a particular ray is missing or the

closest valid AN-MODIS pixel is more than 0.71 km from the CloudSat ray, the resulting MODIS geolocation data and the associated data vectors are filled with a missing value flag.

3. Generic-AUX Algorithm Inputs

Input data for the Generic-AUX algorithm includes CloudSat 1B-CPR and AN-MODIS data sets. Each 1B-CPR data file contains data for one orbit of the CloudSat spacecraft, whereas each AN-MODIS file contains 5 minutes of MODIS data.

3.1 1B-CPR

Fields available in the 1B-CPR data set used to create the MODIS-AUX product include:

1. Spacecraft Latitude (4-byte float, array size: nray, units: degrees, source product: 1B-CPR)
HDF-EOS field: Latitude

Spacecraft Geodetic Latitude.

2. Spacecraft Longitude (4-byte float, array size: nray, units: degrees, source product: 1B-CPR)
HDF-EOS field: Longitude

Spacecraft geodetic longitude

The 1B-CPR data are stored in an HDF-EOS format and are made available to the MODIS-AUX algorithm from the data processing system (CORE) internal memory structure. Further documentation for these fields can be found in

• Level 1B CPR Process Description and Interface Control Document (v5.3), 27JUN07.

3.2 AN-MODIS

The AN-MODIS data set is provided by the Goddard Earth Sciences (GES) DAAC. The swath is 11 km wide, centered on the CloudSat ground track. The data are provided in HDF 4 format and include the following fields:

- Geodetic Latitude and Longitude (MOD03).
- Radiances and associated scale factors and offsets, radiance uncertainty indexes and associated specified uncertainty and scaling factors: bands 1-7, 17-20, and 26-36, 1 km resolution (MOD02_1KM_L1B).
- Cloud mask and spectral test results,1 km resolution (MOD35_L2).

The radiance channels for each band are:

Band	WaveLength	IFOV	Bandwidth	Example Usage
1	645nm	250m	50nm	Veg. Chlorophyll Absorp.
2	858nm	250m	35nm	Cloud/Veg. Land Cover
3	469nm	500m	20nm	Soil & Veg. Differences
4	555nm	500m	20nm	Green Vegetation
5	1240nm	500m	20nm	Leaf/Canopy Differences
6*	1640nm	500m	24.6nm	Snow/Cloud Differences
7	2130nm	500m	50nm	Land/Cloud Properties
17	905nm	1000m	30nm	Cloud/Atmos Properties
18	936nm	1000m	10nm	Cloud/Atmos Properties
19	940nm	1000m	50nm	Cloud/Atmos Properties
20	3.75µm	1000m	0.18µm	Sea Surface Temp Fraction
26	1375nm	1000m	30nm	Cinfraredrus Cloud Detect
27	6.72µm	1000m	0.36µm	Mid-Tropospheric Humidity
28	7.33µm	1000m	0.30µm	Upper-Tropospheric Humidity
29	8.55µm	1000m	0.30µm	Surface Temperature
30	9.73µm	1000m	0.30µm	Total Ozone
31	11.03µm	1000m	0.50µm	Cloud/Surface Temp
32	12.02µm	1000m	0.50µm	Cloud Height & Surface Temp
33	13.34µm	1000m	0.30µm	Cloud Height & Fraction
34	13.64µm	1000m	0.30µm	Cloud Height & Fraction
35	13.94µm	1000m	0.30µm	Cloud Height & Fraction
36	14.24µm	1000m	0.30µm	Cloud Height & Fraction

*Aqua/MODIS Band 6 failed before launch.

More information about the radiance and cloud mask fields can be found their respective product ATBDs and in

- Cloudsat AN-MODIS Ancillary Data Interface Control Document (draft), 15 APR 02.

Note: as mentioned in the above document, MODIS band 6 radiance may be omitted or synthesized from other bands due to a mechanical problem

4. Data Product Output Specifications

The only AN-MODIS data required by the CloudSat standard data products are the radiances (MOD02_1KM), geolocation (MOD03), and cloud mask (MOD35). The AN-MODIS data are sub-set into one 3 pixel across-track by 5 pixel along-track grid for each CPR ray and data dimension (for example, radiance channel). The grids are stored as a 15-element vector for each CPR ray in the HDF-EOS 4 MODIS-AUX product file. The dimension name of the vector in the product is "mod_1km". The first element in the vector corresponds to the lower right corner of the 3x5 pixel grid (assuming the along-track dimension points up). The element count increases across the MODIS track to the left. Element 4 in the vector is the first pixel of the second along-track row in the 3x5 grid. The pixel in the middle of the 3x5 grid (vector element 8) is the closest pixel to the CPR footprint for that grid (Fig. 1).

data vector in product:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
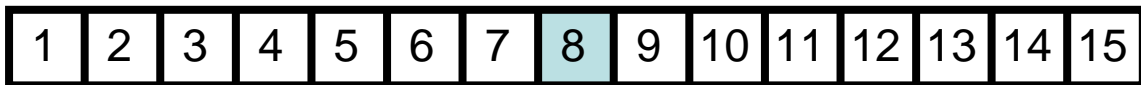
physical representation:

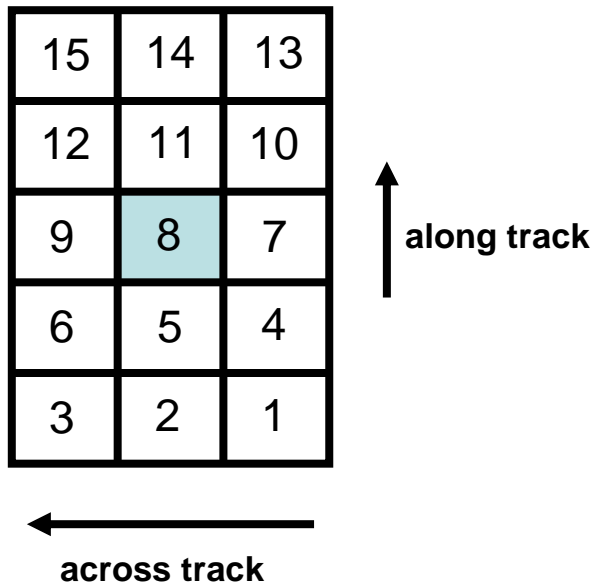| 15	14	13
12	11	10
9	8	7
6	5	4
3	2	1

along track →

← across track

Figure 1. Visualization of data storage in the MODIS-AUX product and how it is to be physically interpreted. Pixel 8 (blue) is the closest pixel to the CPR footprint.

Each HDF-EOS 4 product file is built for the orbit specified by the input 1B-CPR data. The HDF-EOS format for the MODIS-AUX file is as follows:

MODIS-AUX HDF-EOS Data Contents

Dimensions Used

1. **mod_1km** (typical value: 15)
   3 (across) x 5 (along) MODIS grid around CPR footprint.

2. **nray** (typical value: ~38000)
   Number of CPR rays in one orbit.

3. **Byte_Segment** (typical value: 6)
   MODIS cloud mask byte segment.

4. **mod_granules** (typical value: 21 or 22)
   Number of MODIS granules per CloudSat orbit

5. **Band_1KM_RefSB** (typical value: 4)
   MODIS shortwave radiance channels

6. **Band_1KM_Emissive** (typical value: 11)
   MODIS longwave radiance channels

7. **Band_250M** (typical value: 2)
   MODIS 250M shortwave radiance channels.

8. **Band_500M** (typical value: 5)
   MODIS 500M shortwave radiance channels.

Geolocation Fields

1. **Geodetic latitude of MODIS pixels**

HDF-EOS field:	MODIS_latitude
Type:	4-byte float
Dimensions:	(nray, mod_1km)
Units:	degrees
Factor:	1
Offset:	0
Missing value:	-999

This array contains the vector of latitudes for the closest 15 pixels to the CloudSat CPR footprint in a 3x5 (across track x along track) grid.

2. Geodetic longitude of MODIS pixels

HDF-EOS field: MODIS_longitude
Type: 4-byte float
Dimensions: (nray, mod_1km)
Units: degrees
Factor: 1
Offset: 0
Missing value: -999

This array contains the vector of longitudes for the closest 15 pixels to the CloudSat CPR footprint in a 3x5 (across track x along track) grid.

3. Seconds since the start of the granule.

HDF-EOS field: Profile_time
Type: 4-byte float
Dimensions: (nray)
Units: seconds
Factor: 1
Offset: 0
Missing value: none

Seconds since the start of the granule for each profile. The first profile is 0.

4. UTC seconds since 00:00 Z of the first profile.

HDF-EOS field: UTC_start
Type: 4-byte float
Dimensions: scalar
Units: seconds
Factor: 1
Offset: 0
Missing value: none

The UTC seconds since 00:00 Z of the first profile in the data file.

5. TAI time for the first profile.

HDF-EOS field: TAI_start
Type: 8-byte float
Dimensions: scalar
Units: seconds
Factor: 1
Offset: 0
Missing value: none

The TAI timestamp for the first profile in the data file. TAI is International Atomic Time: seconds since 00:00:00 Jan 1 1993.

Data Fields

1. MODIS granule index of each pixel.

HDF-EOS field:	MODIS_granule_index
Type:	1-byte signed integer
Dimensions:	(nray, mod_1km)
Units:	none
Factor:	1
Offset:	0
Missing value:	--99

Key to the granule index dimension in data fields associating each field with a MODIS granule and corresponding scales and offsets.

2. MODIS Across-Track Pixel Index

HDF-EOS field:	MODIS_pixel_index_across_track
Type:	2-byte signed integer
Dimensions:	(nray, mod_1km)
Units:	none
Factor:	1
Offset:	0
Missing value:	-999

Across-track pixel index of the data point in the original AN-MODIS file. This is primarily used for consistency checks between AN-MODIS and MODIS-AUX.

3. MODIS Along-Track Pixel Index

HDF-EOS field:	MODIS_pixel_index_along_track
Type:	2-byte signed integer
Dimensions:	(nray, mod_1km)
Units:	none
Factor:	1
Offset:	0
Missing value:	-999

Along-track pixel index of the data points in the original AN-MODIS file. This is primarily used for consistency checks between AN-MODIS and MODIS-AUX.

4. Solar zenith angle at the MODIS pixel

HDF-EOS field: Solar_zenith
Type: 2-byte signed integer
Dimensions: (nray, mod_1km)
Units: degrees
Factor: 1
Offset: 0
Missing value: -32767

This is the solar zenith angle as measured at the location of the MODIS pixel. It is stored in a 2-byte signed integer and must be divided by 100 before use.

5. Solar azimuth angle at the MODIS pixel

HDF-EOS field: Solar_azimuth
Type: 2-byte signed integer
Dimensions: (nray, mod_1km)
Units: degrees
Factor: 1
Offset: 0
Missing value: -32767

This is the solar azimuth angle as measured at the location of the MODIS pixel. It is stored in a 2-byte signed integer and must be divided by 100 before use.

6. Sensor zenith angle at the MODIS pixel

HDF-EOS field: Sensor_zenith
Type: 2-byte signed integer
Dimensions: (nray, mod_1km)
Units: degrees
Factor: 1
Offset: 0
Missing value: -32767

This is the zenith angle as measured from the MODIS pixel in the direction of the MODIS instrument. It is stored in a 2-byte signed integer and must be divided by 100 before use.

7. Sensor azimuth angle at the MODIS pixel

HDF-EOS field: Sensor_azimuth
Type: 2-byte signed integer
Dimensions: (nray, mod_1km)
Units: degrees
Factor: 1

| **Offset:** | 0 |
| **Missing value:** | -32767 |

This is the zenith angle as measured from the MODIS pixel in the direction of the MODIS instrument. It is stored in a 2-byte signed integer and must be divided by 100 before use.

8. MODIS Cloud Mask Subset

HDF-EOS field:	Cloud_Mask
Type:	1-byte signed integer
Dimensions:	(Byte_Segment, nray, mod_1km)
Units:	none
Factor:	1
Offset:	0
Missing value:	0

The MODIS cloud mask is a bit field that contains information about clouds observed in each pixel including type and height. A full description of the cloud mask can be found in atbd_mod06.pdf (see http://daac.gsfc.nasa.gov/MODIS/Aqua/atmosphere/MYD35_L2.shtml). The full MODIS data has been subset to the closest 3x5 pixel grid around the CloudSat CPR footprint. The missing value of 0 is specified by the Generic-AUX algorithm when geolocation data are missing. Other missing parameters for this field are passed through from the original AN-MODIS file and instructions for use should be obtained from the ATBD.

9. MODIS Earth View 1KM Reflective Solar Bands Scaled Integers Subset

HDF-EOS field:	EV_1KM_RefSB
Type:	2-byte unsigned integer
Dimensions:	(Band_1KM_RefSB, nray, mod_1km)
Units:	W/(m2 str um)
Factor:	1
Offset:	0
Missing value:	65535

This data array contains radiances for MODIS band numbers 17-19 and 26. The full MODIS data has been subset to the closest 3x5 pixel grid around the CloudSat CPR footprint. More information can be found in the AN-MODIS ICD or in atbd_mod01.pdf (see http://daac.gsfc.nasa.gov/MODIS/Aqua/rad_geo/MYD021KM.shtml). The missing value of 65535 is specified by the Generic-AUX algorithm when geolocation data are missing. Other missing parameters for this field are passed through from the original AN-MODIS file and instructions for use should be obtained from the ATBD.

10. Radiance scales for EV_1KM_RefSB

HDF-EOS field: EV_1KM_RefSB_rad_scales
Type: 4-byte float
Dimensions: (Band_1KM_RefSB, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Radiance scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

11. Radiance offsets for EV_1KM_RefSB

HDF-EOS field: EV_1KM_RefSB_rad_offsets
Type: 4-byte float
Dimensions: (Band_1KM_RefSB, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Radiance offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

12. Reflectance scales for EV_1KM_RefSB

HDF-EOS field: EV_1KM_RefSB_ref_scales
Type: 4-byte float
Dimensions: (Band_1KM_RefSB, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Reflectivity scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

13. Reflectance offsets for EV_1KM_RefSB

HDF-EOS field: EV_1KM_RefSB_ref_offsets
Type: 4-byte float
Dimensions: (Band_1KM_RefSB, mod_granules)
Units: none

Factor:	1
Offset:	0
Missing value:	-999

Reflectivity offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

14. MODIS Earth View 1KM Reflective Solar Bands Uncertainty Indexes Subset

HDF-EOS field:	EV_1KM_RefSB_Uncert_Indexes
Type:	1-byte unsigned integer
Dimensions:	(Band_1KM_RefSB, nray, mod_1km)
Units:	%
Factor:	1
Offset:	0
Missing value:	255

Uncertainty indexes corresponding to the EV_1KM_RefSB radiances. The radiance uncertainty is calculated with: uncertainty(%) = specified_uncertainty*exp(uncertainty_index/scaling_factor). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

15. MODIS Earth View 1KM Reflective Solar Bands Specified Uncertainty

HDF-EOS field:	EV_1KM_RefSB_spec_uncert
Type:	4-byte float
Dimensions:	(Band_1KM_RefSB, mod_granules)
Units:	none
Factor:	1
Offset:	0
Missing value:	-999

The specified uncertainty is used along with the uncertainty indexes and scale factors to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

16. MODIS Earth View 1KM Reflective Solar Bands Uncertainty Scaling Factor

HDF-EOS field:	EV_1KM_RefSB_scaling_factor
Type:	4-byte float
Dimensions:	(Band_1KM_RefSB, mod_granules)
Units:	none
Factor:	1
Offset:	0

Missing value: -999

The scaling factor is used along with the uncertainty indexes and specified uncertainty to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

17. MODIS Earth View 1KM Emissive Bands Scaled Integers Subset

HDF-EOS field: EV_1KM_Emissive
Type: 2-byte unsigned integer
Dimensions: (Band_1KM_Emissive, nray, mod_1km)
Units: W/(m2 str um)
Factor: 1
Offset: 0
Missing value: 65535

This data array contains radiances for MODIS band numbers 20 and 27-36. The full MODIS data has been subset to the closest 3x5 pixel grid around the CloudSat CPR footprint. More information can be found in the AN-MODIS ICD or in atbd_mod01.pdf (see http://daac.gsfc.nasa.gov/MODIS/Aqua/rad_geo/MYD021KM.shtml). The missing value of 65535 is specified by the Generic-AUX algorithm when geolocation data are missing. Other missing parameters for this field are passed through from the original AN-MODIS file and instructions for use should be obtained from the ATBD.

18. Radiance scales for EV_1KM_Emissive

HDF-EOS field: EV_1KM_Emissive_rad_scales
Type: 4-byte float
Dimensions: (Band_1KM_Emissive, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Radiance scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

19. Radiance offsets for EV_1KM_Emissive

HDF-EOS field: EV_1KM_Emissive_rad_offsets
Type: 4-byte float
Dimensions: (Band_1KM_Emissive, mod_granules)
Units: none
Factor: 1

Offset: 0
Missing value: -999

Radiance offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

20. MODIS Earth View 1KM Emissive Bands Uncertainty Indexes Subset

HDF-EOS field: EV_1KM_Emissive_Uncert_Indexes
Type: 1-byte unsigned integer
Dimensions: (Band_1KM_Emissive, nray, mod_1km)
Units: %
Factor: 1
Offset: 0
Missing value: 255

Uncertainty indexes corresponding to the EV_1KM_Emissive radiances. The radiance uncertainty is calculated with: uncertainty(%) = specified_uncertainty*exp(uncertainty_index/scaling_factor). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

21. MODIS Earth View 1KM Emissive Bands Specified Uncertainty

HDF-EOS field: EV_1KM_Emissive_spec_uncert
Type: 4-byte float
Dimensions: (Band_1KM_Emissive, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

The specified uncertainty is used along with the uncertainty indexes and scale factors to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

22. MODIS Earth View 1KM Emissive Solar Bands Scaling Factor

HDF-EOS field: EV_1KM_Emissive_scaling_factor
Type: 4-byte float
Dimensions: (Band_1KM_Emissive, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

The scaling factor is used along with the uncertainty indexes and specified uncertainty to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

23. MODIS Earth View 250M Aggregated 1km Reflective Solar Bands Scaled Integers Subset

HDF-EOS field:	EV_250_RefSB
Type:	2-byte unsigned integer
Dimensions:	(Band_250M, nray, mod_1km)
Units:	W/(m2 str um)
Factor:	1
Offset:	0
Missing value:	65535

This data array contains radiances for MODIS band numbers 1 and 2 aggregated to 1 km. The full MODIS data has been subset to the closest 3x5 pixel grid around the CloudSat CPR footprint. More information can be obtained from the AN-MODIS ICD or from atbd_mod01.pdf (see http://daac.gsfc.nasa.gov/MODIS/Aqua/rad_geo/MYD021KM.shtml). The missing value of 65535 is specified by the Generic-AUX algorithm when geolocation data are missing. Other missing parameters for this field are passed through from the original AN-MODIS file and instructions for use should be obtained from the ATBD.

24. Radiance scales for EV_250_RefSB

HDF-EOS field:	EV_250_RefSB_rad_scales
Type:	4-byte float
Dimensions:	(Band_250M, mod_granules)
Units:	none
Factor:	1
Offset:	0
Missing value:	-999

Radiance scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

25. Radiance offsets for EV_250_RefSB

HDF-EOS field:	EV_250_RefSB_rad_offsets
Type:	4-byte float
Dimensions:	(Band_250M, mod_granules)
Units:	none

Factor:　　　　1
Offset:　　　　0
Missing value:　-999

Radiance offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

26. Reflectance scales for EV_250_RefSB

HDF-EOS field: EV_250_RefSB_ref_scales
Type:　　　　4-byte float
Dimensions:　　(Band_250M, mod_granules)
Units:　　　　none
Factor:　　　　1
Offset:　　　　0
Missing value:　-999

Reflectivity scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

27. Reflectance offsets for EV_250_RefSB

HDF-EOS field: EV_250_RefSB_ref_offsets
Type:　　　　4-byte float
Dimensions:　　(Band_250M, mod_granules)
Units:　　　　none
Factor:　　　　1
Offset:　　　　0
Missing value:　-999

Reflectivity offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

28. MODIS Earth View 250M Aggregated 1KM Reflective Solar Bands Uncertainty Indexes Subset

HDF-EOS field: EV_250_RefSB_Uncert_Indexes
Type:　　　　1-byte unsigned integer
Dimensions:　　(Band_250M, nray, mod_1km)
Units:　　　　%
Factor:　　　　1
Offset:　　　　0
Missing value:　255

Uncertainty indexes corresponding to the EV_250_Aggr1km_RefSB radiances. The radiance uncertainty is calculated with: uncertainty(%) = specified_uncertainty*exp(uncertainty_index/scaling_factor). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

29. MODIS Earth View 250M Aggregated 1KM Reflective Solar Bands Specified Uncertainty

HDF-EOS field: EV_250_RefSB_spec_uncert
Type: 4-byte float
Dimensions: (Band_250M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

The specified uncertainty is used along with the uncertainty indexes and scale factors to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

30. MODIS Earth View 250M Aggregated 1KM Reflective Solar Bands Scaling Factor

HDF-EOS field: EV_250_RefSB_scaling_factor
Type: 4-byte float
Dimensions: (Band_250M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

The scaling factor is used along with the uncertainty indexes and specified uncertainty to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

31. MODIS Earth View 500M Aggregated 1km Reflective Solar Bands Scaled Integers Subset

HDF-EOS field: EV_500_RefSB
Type: 2-byte unsigned integer
Dimensions: (Band_500M, nray, mod_1km)
Units: W/(m2 str um)
Factor: 1

Offset: 0
Missing value: 65535

This data array contains radiances for MODIS band numbers 3-7 aggregated to 1 km. The full MODIS data has been subset to the closest 15 pixels around the CloudSat CPR footprint. More information can be obtained from the AN-MODIS ICD or from atbd_mod01.pdf (see http://daac.gsfc.nasa.gov/MODIS/Aqua/rad_geo/MYD021KM.shtml). The missing value of 65535 is specified by the Generic-AUX algorithm when geolocation data are missing. Other missing parameters for this field are passed through from the original AN-MODIS file and instructions for use should be obtained from the ATBD.

32. Radiance scales for EV_500_RefSB

HDF-EOS field: EV_500_RefSB_rad_scales
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Radiance scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

33. Radiance offsets for EV_500_RefSB

HDF-EOS field: EV_500_RefSB_rad_offsets
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Radiance offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

34. Reflectance scales for EV_500_RefSB

HDF-EOS field: EV_500_RefSB_ref_scales
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none

Factor: 1
Offset: 0
Missing value: -999

Reflectivity scales needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

35. Reflectance offsets for EV_500_RefSB

HDF-EOS field: EV_500_RefSB_ref_offsets
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

Reflectivity offsets needed to convert unscaled radiance data to scientific values. Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

36. MODIS Earth View 500M Aggregated 1KM Reflective Solar Bands Uncertainty Indexes Subset

HDF-EOS field: EV_500_RefSB_Uncert_Indexes
Type: 1-byte unsigned integer
Dimensions: (Band_500M, nray, mod_1km)
Units: %
Factor: 1
Offset: 0
Missing value: 255

Uncertainty indexes corresponding to the EV_500_Aggr1km_RefSB radiances. The radiance uncertainty is calculated with: uncertainty(%) = specified_uncertainty*exp(uncertainty_index/scaling_factor). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

37. MODIS Earth View 500M Aggregated 1KM Reflective Solar Bands Specified Uncertainty

HDF-EOS field: EV_500_RefSB_spec_uncert
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none
Factor: 1

Offset: 0
Missing value: -999

The specified uncertainty is used along with the uncertainty indexes and scale factors to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

38. MODIS Earth View 500M Aggregated 1KM Reflective Solar Bands Specified Uncertainty

HDF-EOS field: EV_500_RefSB_scaling_factor
Type: 4-byte float
Dimensions: (Band_500M, mod_granules)
Units: none
Factor: 1
Offset: 0
Missing value: -999

The scaling factor is used along with the uncertainty indexes and specified uncertainty to calculate the radiance uncertainty in % (see uncertainty indexes description). Note: this data is missing only when the geolocation data, and therefore the radiance data are missing.

5. Operator Instructions

The DPC operator will perform quality assessment functions by running an IDL routine that will post-process the MODIS-AUX HDF-EOS file and input 1B-CPR file and summarize the data. The information reported will include:

- An image of the CloudSat orbit derived from 1B-CPR data and MODIS-AUX geolocation.
- The number of CloudSat rays in this orbit.
- The number of CloudSat rays from 1B-CPR data.
- Per MODIS-AUX field:
    - Number of missing data points.
    - A histogram of data values.

The operator will first make sure the CloudSat and MODIS-AUX derived orbits match by looking at the above image and possibly zooming in on several sections. Second, MODIS-AUX data field histograms may be checked for consistency between orbits. Error investigation may include visualization of the input AN-MODIS data.

6. Acronym List

ATBD   Algorithm Theoretical Basis Document
CORE   CloudSat Operational and Research Environment
CPR   Cloud Profiling Radar
DAAC   Distributive Active Archive Center
DPC   Data Processing Center
EOS   Earth Observing System
GES   Goddard Earth Sciences (DAAC)
HDF   Hierarchical Data Format
MODIS   MOderate-Resolution Imaging Spectrometer

7. Changes Since Version 5.0

The primary change is the input of the latest 1B-CPR product (generated by 1B-CPR algorithm version 5.3). That product eliminates the granule overlap seen at the beginning and end of each file. Granules now start with the first profile on or after the equator on the descending pass and end with the last profile before the equator on the following descending pass.

Changes to this document include:
- Removal of the Time field from the list of inputs.
- Corrected the mistaken references to atbd_mod06.pdf in section 1.2. Should be atbd_mod35.pdf.
- Added Profile_time, UTC_start, and TAI_start to the list of MODIS-AUX geolocation fields.