

A Programming (Specification) Guide for 06CT Collection 006 Update for Level 2 Cloud Top Properties needed for L3 changes (Version 6.0, 1/3/2013)

NOTE TO PAUL from RICH FREY 4/1/13: The usefulness flag is always set to 1 if we were able to begin the cloud retrieval processing. There is no need to screen data by a "not useful" usefulness flag.

Note: Version 6 had a change to the Cloud_Mask_5km duplicating the Day/Night flag in byte #2. Version 6 changes are highlighted in green on the FINAL PAGE

Note: Version 5 had changes to the Cirrus Flag and High Cloud Flag -- adding a category for Clear Sky. Version 5 changes are highlighted in blue

Note: Version 4 made a modification to the new Cloud_Mask_5km flags on page 6. Version 4 changes are highlighted in red.

Note the changes listed in this document are driven by needs in L3. This change list may not be complete; that is, there may be other changes needed in the CT part of 06_L2 file that are driven by requests from other sources (from internal UW discussions or from user requests that were adopted)

New L2 SDSs:

Three (or four or five) new sets of SDS's need to be added to the 06_L2 file that contain L2 data screened for Sensor Zenith (View) Angles less than or equal to 32 degrees.

Note on list of parameters (in red) below: Bryan did not mention the parameters in red (listed in 4 and 5 below), but these were discussed previously. If you want CF and CTH using the nadir aggregation in L3, then these need to be added to L2. If you don't want them, they can be dropped.

Note on the "Nadir" naming convention: I think using the "Nadir" string in the L2 SDS name is preferred -- it's very short (5 chars) and conveys the meaning to the user effectively. I am quickly running out of characters for the L3 SDS names (there is a 64 character limit in SDS names in the version of HDF being run by MODAPS) -- so even the thought of changing this to "NearNadir" won't work since I need to reserve as many as 22 characters for the statistic suffix. I did consider making this string SZA32 but that doesn't save any characters and some in our group thought that could easily be confused with solar zenith angle and the 32 doesn't tell anyone which side the aggregation was on. If you have any thoughts on this or can think of a string 5 characters or less that better conveys the thrust of the aggregation, let me know! Also keep the _Day and _Night keywords at the very end of the SDS name string as shown below.

- 1a. Cloud_Top_Pressure_Nadir
- 1b. Cloud_Top_Pressure_Nadir_Day
- 1c. Cloud_Top_Pressure_Nadir_Night

- 2a. Cloud_Top_Temperature_Nadir
- 2b. Cloud_Top_Temperature_Nadir_Day
- 2c. Cloud_Top_Temperarure_Nadir_Night

- 3a. Cloud_Effective_Emissivity_Nadir
- 3b. Cloud_Effective_Emissivity_Nadir_Day
- 3c. Cloud_Effective_Emissivity_Nadir_Night

- 4a. Cloud_Top_Height_Nadir (see note in red above!)
- 4b. Cloud_Top_Height_Nadir_Day
- 4c. Cloud_Top_Height_Nadir_Night

- 5a. Cloud_Fraction_Nadir (see note in red above!)
- 5b. Cloud_Fraction_Nadir_Day
- 5c. Cloud_Fraction_Nadir_Night

Programming Notes to Rich Frey:

Make sure you describe all of these in the "long_name" local attribute ... e.g. "Cloud Top Temperature for Sensor Zenith (View) Angles less than or equal to 32 degrees ... "

Note that each set of 3 new SDSs are in addition to the existing set. For example we are keeping the existing SDSs Cloud_Top_Temperature, Cloud_Top_Temperature_Day, Cloud_Top_Temperature_Night that already exist in C005 and adding three new SDS's that contain some duplicated data.

Programming Note to Paul Hubanks:

Must watch the 64 character SDS name limit previous to HDF 4.2 r2. Note that MODAPS is running HDF 4.1 r5. This string is 64 characters ... Cloud_Effective_Emissivity_Nadir_Night_Low_QA_Standard_Deviation
 Two of the longer suffix's are: QA_Standard_Deviation (21) Joint_Histogram_vs_xxx (22+)
 Might have to use L,M,H notation in L3 SDS name to fit to 64 chars (not sure yet): Low to Lo or L, Mid to Md or M, High to Hi or H. This will depend on which statistics are computed for the longer prefix name parameters.

Additional New L2 SDS's (needed for L3 Aggregation):

- 1a. Solar_Zenith_Day
- 1b. Solar_Zenith_Night

- 2a. Solar_Azimuth_Day
- 2b. Solar_Azimuth_Night

- 3a. Sensor_Zenith_Day
- 3b. Sensor_Zenith_Night

- 4a. Sensor_Azimuth_Day
- 4b. Sensor_Azimuth_Night

(Note currently there are 06_L2 SDS's called Solar_Zenith, Solar_Azimuth, etc ... however all L2 teams named these Angle array SDSs the same in their L2 files ... This causes the L3 code to get confused on which L2 SDS to read – it ends up using the first set of arrays it finds which turns out to be those from 04_L2 (which are computed for daytime only). L3 needs a uniquely named SDS so it can compute angle data for both daytime and nighttime scenes.)

Changes to the L2 QA SDS Quality_Assurance_5km:

Note to Rich: Be sure you set the "Usefulness Flag" to 0 for those non-fill L2 pixels you want completely screened from L3. Also you need to tell me which of the parameters will have Usefulness flags set to 0 so I can turn on the L3 local attribute "Screen using Usefulness Flag = True" option for that parameter. In these cases, you must explicitly set the Usefulness Flag to 1 for those pixels you want included in L3 statistics.

Color Code Key:

	Existing flags that will be set starting in C006
	Newly defined flags for C006
	Change specification of flag for C006

Yellow highlight means make a note!

Scientific Data Set (SDS): "Quality_Assurance_5km"

Description: Cloud Top Property product quality and retrieval processing QA flags at 5x5 km

Length: 10 bytes (80 bits)

Flag Name	Number of Bits	Bit Values	Bit Value Definitions
Cloud Top Pressure Usefulness Flag	1	0 1	Not useful (can be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Top Pressure Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>not currently used</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence
Cloud Top Temperature Usefulness Flag	1	0 1	Not useful (can be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Top Temperature Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>not currently used</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence
Cloud Fraction Usefulness Flag	1	0 1	Not useful (can be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Fraction Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>not currently used</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence
Cloud Effective Emissivity Usefulness Flag	1	0 1	Not useful (can be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Effective Emissivity Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>not currently used</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence
Cloud Phase Infrared Usefulness Flag	1	0 1	Not useful (will be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Phase Infrared Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>mixed or undetermined phase</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence (<i>ice or liquid water phase</i>)
<i>processing path flags</i>			
"Cirrus" Flag (CTP ≤ <i>x</i> hPa & CEE ≤ <i>y</i>) <i>Change x from 700 to 680 for C6?</i> <i>Change y from 0.95 to 0.75 for C6?</i> (Check with Maddox or Menzel!)	2	0 1 2 3	Missing Cloudy, No cirrus found Cloudy, Cirrus found Clear Sky
"High Cloud" Flag (CTP < <i>z</i> hPa) <i>Change z from 400 to 440 for C6?</i> (Check with Maddox or Menzel!)	2	0 1 2 3	Missing Cloudy, No high cloud found Cloudy, High cloud found Clear Sky

Number of Cloudy Pixels	Int 8	0-25	Number of 1 km cloudy pixels in 5x5 km retrieval area
Number of Clear Pixels	Int 8	0-25	Number of 1 km clear pixels in 5x5 km retrieval area
Number of Missing Pixels	Int 8	0-25	Number of 1 km missing pixels in 5x5 km retrieval area
<i>Additional QA and input data resource flags</i>			
Cloud Top Height Usefulness Flag	1	0 1	Not useful (will be screened from L3) Useful (if flag is used, must set all valid pixel flags to 1)
Cloud Top Height Confidence Flag	3	0 1 2 3	Fill Marginal Confidence (<i>not currently used</i>) Good Confidence (<i>not currently used</i>) Very Good Confidence
Overshooting Thunderstorm Top Flag	2	0 1 2	Fill No Overshooting Thunderstorm Top Found Overshooting Thunderstorm Top Found
Clear Radiance Origin	2	0 1 2	MOD35* (MODIS Cloud Mask) Forward calculation from model (NCEP GDAS) Other
Moisture Profile	2	0 1 2 3	NCEP GDAS GMAO AIRS / AMSU Other
Temperature Profile	2	0 1 2 3	NCEP GDAS GMAO AIRS / AMSU Other
Dir Surface Temperature Over Land	2	0 1 2 3	NCEP GDAS GMAO MOD11* (MODIS Land Surface Temperature) Other
Surface Temperature Over Ocean	2	0 1 2 3	Reynolds blended GMAO MOD28* (MODIS Sea Surface Temperature) Other
Surface Pressure	2	0 1 2	NCEP GDAS GMAO Other
Topography	2	0 1	EOS DEM Other
Surface Emissivity	2	0 1	CERES MOD11* (MODIS Land Surface Temperature)
Surface Type	2	0 1 2 3	Loveland 1 km NA Olson Ecosystem MOD12* (MODIS Land Cover) Other
<i>additional QA flags</i>			

Cloud Height Category	3	0 1 2 3 4 5	Fill (Missing data) Clear Sky ¹ Cloudy, but not retrieved (retrieval failed) ² Low Clouds (CTP ≥ 680 hPa) Middle Clouds (680 hPa > CTP ≥ 440 hPa) High Clouds (CTP < 440 hPa)
Nadir View Angle Flag	2	0 1 2	Fill (Missing data) Near Nadir View Angle (View Angle ≤ 32°) Oblique View Angle (View Angle > 32°)
Cloud Height Method <small>(Note: Index's 0-4 and 6 were set to match the Cloud_Height_Method SDS. Index 5 is not used in the Cloud_Height_Method SDS, a new category 5 was added here)</small>	3	0 1 2 3 4 5 6 7	Fill (Missing data) CO ₂ Slicing (band 36/35) CO ₂ Slicing (band 35/34) CO ₂ Slicing (band 35/33) CO ₂ Slicing (band 34/33) Cloudy, but not retrieved (retrieval failed) ² IR Window Clear Sky ¹

* MOD prefix denotes MODIS/Terra (AM overpass) data -- MYD prefix should be substituted for MODIS/Aqua (PM overpass) data.

- 1 Note to Rich Frey: By setting "explicit clear sky" scenes in the Cloud Height Category Flag above, it would allow a true L,M,H cloud fraction to be computed in L3 (and it would not be skewed by fills (missing data)). Note this flag can be set at the same time in both the Cloud Height Category and Cloud Height Method flags above.
- 2 Note to Rich Frey: Cloudy, but not retrieved (retrieval failed) information was requested by Brent Maddox. Note this flag can be set at the same time in both the Cloud Height Category and Cloud Height Method flags above.

Changes to the L2 QA SDS Cloud_Mask_5km:

Note to Rich: Be sure you set the "Usefulness Flag" to 0 for those non-fill L2 pixels you want completely screened from L3. Also you need to tell me which of the parameters will have Usefulness flags set to 0 so I can turn on the L3 local attribute "Screen using Usefulness Flag = True" option for that parameter. In these cases, you must explicitly set the Usefulness Flag to 1 for those pixels you want included in L3 statistics.

The Cloud_Mask_5km SDS needs to be expanded from 1 byte to 2 bytes. The first byte remains as is. The second byte is a reworked combination of particular flags in byte 1.

Scientific Data Set (SDS): "Cloud_Mask_5km"			
Description: Cloud mask 1 km QA flags subsampled at 5 km (every 5 th line, every 5 th pixel)			
Length: 2 bytes (16 bits)			
Flag Name	Number of Bits	Bit Values	Bit Value Definitions
Cloud Mask Status Flag	1	0	Undetermined
		1	Determined
Cloud Mask Cloudiness Flag	2	0	Confident Cloudy (or Fill, if Status Flag = 0)
		1	Probably Cloudy
		2	Probably Clear
		3	Confident Clear
Day / Night Flag	1	0	Night (or Fill, if Status Flag = 0)
		1	Day

Sunglint Flag	1	0 1	Yes (or Fill, if Status Flag = 0) No
Snow / Ice Flag	1	0 1	Yes (or Fill, if Status Flag = 0) No
Surface Type Flag	2	0 1 2 3	Ocean or Deep Lakes and Rivers (or Fill) Coast or Shallow Lakes and Rivers Desert Land
C6 Sunglint Flag (<i>Retooled</i>) (Note: "Sunglint = Yes" goes from 0 above to 2 here)	2	0 1 2	Fill or CTP retrieval fail No Sunglint & CTP retrieval success Sunglint & CTP retrieval success
C6 Snow / Ice Flag (<i>Retooled</i>) (Note: "Snow/Ice = Yes" goes from 0 above to 2 here)	2	0 1 2	Fill or CTP retrieval fail No Snow/Ice & CTP retrieval success Snow/Ice & CTP retrieval success
C6 Surface Type Flag (<i>Retooled</i>) (Note 1: Surface Type Flags are re-indexed here, as compared to the above (original) S.T.Flag) (Note 2: Cloud Mask Status Flag must be 1 for cats 1-5 because Maddux wants the surface type the cloud top properties were retrieved over)	3	0 1 2 3 4 5	Fill or CTP retrieval fail Ocean, Deep Lakes and Rivers & CTP retr. success Coast, Shallow Lakes and Rivers & CTP retr. success Desert & CTP retrieval success Land & CTP retrieval success All other valid (non-fill) surface types & CTP retr. success
Spare (Note this spare bit was changed to the Day/Night Flag in Jan 2013) See final page of doc.	1		TBD (NOTE THIS WAS CHANGED TO THE DAY/NIGHT FLAG IN A REQUEST MADE IN JAN 2013) ... See Final page of document for details

Note to Paul Hubanks:

The new L3 Surface Type SDS's will be

Sunglint_Fraction_Day (& _Pixel_Counts) [Sunglint makes no sense at night]

Snow_Fraction_Day (& _Pixel_Counts)
Snow_Fraction_Night (& _Pixel_Counts)

Ocean_Fraction_Day (& _Pixel_Counts)
Ocean_Fraction_Night (& _Pixel_Counts)

Coast_Fraction_Day (& _Pixel_Counts)
Coast_Fraction_Night (& _Pixel_Counts)

Desert_Fraction_Day (& _Pixel_Counts)
Desert_Fraction_Night (& _Pixel_Counts)

Land_Fraction_Day (& _Pixel_Counts)
Land_Fraction_Night (& _Pixel_Counts)

Note to Paul Hubanks:

The C6 Surface Type is initially being set in the Cloud_Mask_5km array because Brent wanted the surface type under the Cloud Top Property retrieval. Brent also mentioned he was interested in the surface type under the Cloud Optical Property retrieval – however this would involve similar changes to the Cloud_Mask_1km array – I need to discuss this with Platnick and Gala Wind.

January 2013 Change Request : (Noted in GREEN shade)

Scientific Data Set (SDS): "Cloud_Mask_5km"			
Description: Cloud mask 1 km QA flags subsampled at 5 km (every 5 th line, every 5 th pixel)			
Length: 2 bytes (16 bits)			
Flag Name	Number of Bits	Bit Values	Bit Value Definitions
Cloud Mask Status Flag	1	0 1	Undetermined Determined
Cloud Mask Cloudiness Flag	2	0 1 2 3	Confident Cloudy (or Fill, if Status Flag = 0) Probably Cloudy Probably Clear Confident Clear
Day / Night Flag	1	0 1	Night (or Fill, if Status Flag = 0) Day
Sunglint Flag	1	0 1	Yes (or Fill, if Status Flag = 0) No
Snow / Ice Flag	1	0 1	Yes (or Fill, if Status Flag = 0) No
Surface Type Flag	2	0 1 2 3	Ocean or Deep Lakes and Rivers (or Fill) Coast or Shallow Lakes and Rivers Desert Land
C6 Sunglint Flag (Retooled) <small>(Note: "Sunglint = Yes" goes from 0 above to 2 here)</small>	2	0 1 2	Fill or CTP retrieval fail No Sunglint & CTP retrieval success Sunglint & CTP retrieval success
C6 Snow / Ice Flag (Retooled) <small>(Note: "Snow/Ice = Yes" goes from 0 above to 2 here)</small>	2	0 1 2	Fill or CTP retrieval fail No Snow/Ice & CTP retrieval success Snow/Ice & CTP retrieval success
C6 Surface Type Flag (Retooled) <small>Note 1: Surface Type Flags are re-indexed here, as compared to the above (original) S.T.Flag</small> <small>Note 2: Cloud Mask Status Flag must be 1 for cats 1-5 because Maddux wants the surface type the cloud top properties were retrieved over</small>	3	0 1 2 3 4 5	Fill or CTP retrieval fail Ocean, Deep Lakes and Rivers & CTP retr. success Coast, Shallow Lakes and Rivers & CTP retr. success Desert & CTP retrieval success Land & CTP retrieval success All other valid (non-fill) surface types & CTP retr success
Day / Night Flag	1	0 1	Night (or Fill, if Status Flag = 0) Day