MODIS Collection 006 Cloud Optical Properties (06OD) Change Status
COMPLETED TASKS ONLY

Version 2.10c (4/21/2011)

	Cloud Optical Properties (06OD) Changes: Steve Platnick, Michael King, Gala Wind AIR, MOD, SIM are CHIMAERA section definitions: AIR = Airborne Sensors (MAS and MASTER) MOD = MODIS SIM = Retrieval Code that runs on DISORT simulated radiances/reflectances	Investigation Begun	Programming Begun	Investigation Completed	Programming Completed	Chimaera Implemented (I) or Dropped (D) ?			Operational Implemented (I) or Dropped (D) ?
						AIR	MOD	SIM	
2.	Update current MOD06OD multilayer flag to include other techniques and approaches (e.g., Pavolonis and Heidinger). (11/06) **Comments & Results:** GW-3.3.09: standalone code for the PH (Pavolonis-Heidinger) algorithm is fully tested and operational. The difference-of-tau method has been looked into, there is information, hadn't quantified just how much. GW – 3.17.09: the delta-tau method has been tested on DISORT simulations. The delta-tau has better detection rate for thicker clouds, but not as sensitive to thin ice clouds as the standard method. Images are available for DISORT simulations. The delta-tau method in combination with the standard operational should achieve detection rates somewhat similar to the PH algorithm. However the PH algorithm overkills like no tomorrow and additional 1.38 µm reflectance threshold will be added to it to prevent it from over-detecting. I discussed this with Mike Pavolonis. GW – 3.24.09: note that there is still no decoding necessary for the casual user. Any value of the multilayer flag that is not 1 or 0 indicates that there is a multilayer cloud in the scene. Now if the user is actually interested in the settings of the individual tests, that's another story. GW – 4.1.09 : the multilayer answer is now given as a confidence level. It's a weighted sum of the test values. The results of individual tests will be stored in the QA when we have a new CR. The weights are as follows: Phase test : 1 Delta-tau : 1 PW test : 2 PW_900 test : 2 Pavolonis-Heidinger : 3 There is a new 'don't bother' threshold based on MODIS band 34 radiance, needed to control the PH algorithm in particular, as it tends to over-detect. Not going to go into huge amount of details, but it's based on the DISORT simulations that I did for the multilayer paper. I was looking for something that would be a function of the upper layer thickness only and of not anything else. Atmosphere is not much of an issue for cirrus, as there's no water vapor above it. 1.38 µm was totally out as it had a signal from all geometry, ice re and upper layer tau. Band 35 wasn't sensitive enough and band 33 was starting to show the lower layer signature in addition to increased view angle sensitivity. Plots and further discussion is available upon request. Integration completed, checked into CVS. GW: 1.7.10 --- in light of global test results the PH algorithm will have very limited use. It over-detects like crazy and we are not comfortable aggregating its result to L3. The test result will still be available in L2, but will not make it to the QA used by L3.	X	X	X	X	I	I	I	I
2b	Drop the use of band 50 from the MAS CO_2 slicing algorithm for C6. **Comments & Results:** GW-4.30.09: MAS band 50 is really not a useful band because its weighting function really peaks above the altitude of the ER-2. It should be dropped from the CT code because it does nothing but add more noise. GW – 05.20.09 change completed, checked into CVS	X	X	X	X	I	–	–	–
3.	Improve cirrus cloud retrievals of τ_c, r_e								
3a.	Improve thin cirrus detection using a combination of IR and 1.38 µm bands. **Comments & Results:** Comments and Results here.	D	D	D	D	D	D	D	D

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3b.	Perform additional retrieval of τ_c using IR and/or 1.38 μm bands as an augmentation of the current solar reflectance approach Pavolonis/Heidinger beta 1DVAR. (05/08) **Comments & Results:** Comments and Results here.	D	D	D	D	D	D	D	D
4.	Modify table look-up libraries and solution algorithm:								
4a.	Add more small τ_c in libraries to reduce interpolation errors for thin clouds. **Comments & Results:** GW-3.3.09: Tested this over two years ago, default behavior for all CHIMAERA codes: tau extended to scaled 0.1. This will be incorporated into the new forward libraries. GW – 6.2.09: New libraries have been delivered to me. Integration has started. GW – 7.8.09 : received the MAS<TER> libraries, the last part of this task.	X	X	X	X	I	I	I	I
4b.	Remove asymptotic algorithm for thick clouds, replacing it with more τ_c libraries; no impact on solutions but simplifying algorithm maintenance. **Comments & Results:** GW-3.3.09: I already tested this and generated difference images for sample granules. The results are a wash as expected. There will be no visible impact when new asymptotic-free libraries are delivered. GW – 6.2.09: New libraries have been delivered to me. Integration has started. GW – 7.8.09 : received the MAS<TER> libraries, the last part of this task.	X	X	X	X	I	I	I	I
4c.	Include ocean BRDF to accommodate, especially, thin cloud retrievals over ocean. (POC: Nandana Amarasinghe) **Comments & Results:** GW – 11.26.10: received new forward libraries, integrated new forward libraries the results ran as science test 5 in MODAPS. Test successful. Waiting for new libraries for airborne sensors, so this task can be struck off this list. GW: 12.30.10: this item is completed. That's it.	X	X	X	X	I	I	I	I
5.	Partly cloudy pixels:								
5a.	Better use of 250 m cloud mask (at least over ocean) for QA of MOD06OD and CT retrievals. (11/06) **Comments & Results:** According to Gala Wind, the default for 250 m CSR test is to set all of the 250 m pixels to clear, and then change to cloudy upon reading such a result from cloud mask. But the logic should be reversed, i.e., all 250 m pixels are set to cloudy and then changed to clear upon reading such a result from the cloud mask. The approach becomes key when there are missing 250 m L1B pixels. This is the reason why CSR was showing thick ice cloud striping due to the faulty QA in the Jan. 2007 L1B LUT delivery. The old/original LUT was then used to reprocess data so isn't a cause of immediate concern but this is an error in the logic. GW-4.28.09: logic changed. There isn't any visible impact on the data I ran. We don't really have any missing 250m data in the test set. Checked into CVS	X	X	X	X	-	I	-	I
6.	Either provide scaled optical thickness in the data set and/or include a vector of ice cloud g and ω_0 in the data set, so: (1) users could scale optical thickness from our retrievals to their own library of g values in non-absorbing bands, and g & ω_0 for absorbing bands (e.g., a broadband code in a climate model) and (2) users could scale our effective radius to their own library of r_e by scaling ω_0. (03/08) **Comments & Results:** GW – 6.2.09: New libraries have been delivered to me. Integration has started. GW – 7.8.09 : received the MAS<TER> libraries, the last part of this task.	X	X	X	X	I	I	I	I
7.	Despite tradition, we don't believe that delta transmittance should be included in ice cloud radiative transfer calculations. For MODIS C5, eliminating delta transmittance reduces g for r_e > 10 μm and reduces the slope of g vs. r_e. This mitigates some of the need for roughened particles. (05/08) **Comments & Results:** GW – 6.2.09: New libraries have been delivered to me. Integration has started. GW – 7.8.09 : received the MAS<TER> libraries, the last part of this task.	X	X	X	X	I	I	I	I
8.	Pursue Aqua cold focal plane adjustment in L1B production. Jack Xiong says Vermote has done something along these lines. (05/08) **Comments & Results:** SEP – 6.1.09: This addressed the issue that we tried to quantify with the Terra deregistration test. How/if we can better register Aqua is still TBD. If anything is to be done, than yes it's likely/hopefully a L1B action item ... but as the only apparent group interest-	T	T	T	T	–	T	–	T

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	ed in an Aqua registration improvement, it is nevertheless an issue we should track.								
9.	Change the multilayer cloud code so that above-cloud precipitable water is interpolated instead of being estimated by the nearest table index. (01/09) **Comments & Results:** GW – 5.31.09: Implemented and committed to CVS. This change doesn't have a huge impact because the differences in PW tend to be much more than 0.2cm when a multilayer cloud is in the scene. This is just more to be correct and also to give a better cloud top properties retrieval for MASTER, which uses the 0.94um method as it has no other choice.	X	X	X	X	I	I	I	I
10.	Examine correcting the 0.86 µm ozone in the multilayer cloud detection algorithm. (01/09) **Comments & Results:** GW – 3.18.09: The extinction cross-section of ozone at 0.86µm is about a factor of 10 less than for 0.65µm (1.4e-22 cm2, source WMO). Ozone absorption in 0.86µm band is about 0.003, which I really think is quite negligible. This change is being dropped due to lack of scientific value, but now when Bryan Baum starts bugging me again about that, I have an answer for him once and for all.	X	--	X	--	D	D	D	D
11.	Use ecosystem-dependent vegetation and snow/ice thresholds in the multilayer cloud detection algorithm. (01/09) **Comments & Results:** GW – 12.28.09 : this item may just get dropped if I don't get to it before everyone else gets their stuff together. It's not a super-essential change really. I'll look through simulations and see what if anything I can see with this, but besides that, the amount of simulations necessary to determine this may just be prohibitive.	D	D	D	D	D	D	D	D
12.	Reduce the size of multilayer and cloud phase SDSs from 16 bit to 8 bit to save space. (01/09) **Comments & Results:** GW-3.3.09: There isn't much to investigate. This will be done once we have a C6 CR process from UW GW-4.30.09 : the CR process is now working and filespec has been altered to resize the SDSs. This change has been completed and checked into CVS. This was an issue for MODIS only.	X	X	X	X	-	I	-	I
13.	Store the 1.6 and 3.7 µm retrievals as actual values instead of differences from 2.1 µm. (01/09) **Comments & Results:** GW-3.3.09: Ran a day science test locally. Aggregation to L3 will not be possible locally. The impact is dramatic on successful retrieval numbers for the 1.6 and 3.7 µm retrievals. They have completely different failure patterns and their histograms are affected a lot from screening by the 2.1 µm retrieval. I want to send this to Wisconsin so they can run a month for me. GW. 3.17.09 : change completed, checked into CVS.	X	X	X	X	I	I	I	I
14.	Examine the effect of interpolated (advected where needed) ancillary data on the retrievals. (01/09) **Comments & Results:** GW-3.3.09. Ran a day science test locally. Aggregation to L3 requested for the day test. The month will be sent to UW for processing. Good impact on the 3.7 µm retrievals, more successful retrievals, better numbers for what was already there. Want to investigate further difference between using the GDAS SST vs Reynolds. Reynolds is a weekly product and I want to know what the behavior is like for the 3.7 µm retrieval. GW-12.28.09: The data will be interpolated, not advected. Little benefit, greater uncertainty from full advection. Interpolation provides good results. GW: 1.7.10 – will also use spatially and temporally interpolated surface temperature provided by Wisconsin. GW: 12.10.10 – after a conversation with NOAA folks I've reached a decision to drop the use of Reynolds weekly SST product, because the GDAS SST is the same exact algorithm only updated every 6 hours instead of once a week. GW: 1.6.11 – Implemented across CHIMAERA. This will be science test 7.	X	X	X	X	I	I	–	I

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15.	Examine the effect of 1 km cloud top properties on cloud retrievals. (01/09) **Comments & Results:** GW-3.3.09 This is fully implemented on CHIMAERA platform. Tested extensively with daily and monthly tests completed. Good news for all retrievals: more success, particularly in broken cloud situations. GW: 5.12.09 – Collection 6 MOD06 files can now be filled-in with the 1 km cloud top properties, currently coming from the CHIMAERA 1 km CT due to lack of any delivery from Madison. Once Madison really delivers, the numbers may change a bit, but the actual infrastructure from the standpoint of MOD_PR06OD will not change. Eventual Madison inclusion will be transparent. GW: 5.13.09 – this change is now integrated into CHIMAERA through the C6 filespec that allows for relevant SDSs to be 1 km. CHIMAERA MOD_PR06CT writes to those SDS and the OD code picks that up transparently. Whenever Madison delivers their code, nothing structurally will change for us. So this change is deemed to be complete from our standpoint. Checked into CVS. Of course this change is not applicable to either DISORT or MAS for obvious reasons.	X	X	X	X	–	I	–	I
16.	Document the meaning of the settings (0 to 4) in the CDL file spec and HDF file for the "Cloud_Phase_Optical_Properties" SDS. Add a new local attributed called "description". (01/09) **Comments & Results:** GW-4.30.09 : this change is completed and checked into CVS. This was applicable to MODIS only.	X	X	X	X	–	I	–	I
17.	Examine the possibility of augmenting the Surface Albedo dataset to include colored water albedo: sedimented / blooming / shallow. (Wind, 02/09) **Comments & Results:** Comments and Results here.	D	D	D	D	D	D	D	D
19.	Clean up junk arrays from the code (Wind, 03/09) **Comments & Results:** GW-3.10.09 There are a number of junk arrays in the OD code. By junk I mean allocated, read and trashed as soon as the subroutine completes, or made way larger than really necessary. Model pressure is a perfect example: a 360x181x16 array that has P(I,j,k) set to constant for every I,j. i.e. P(I,j,0) = 1000 for every I,j. Waste if I've even seen it. Tested on individual granules, as expected, no impact on retrievals of any kind. GW – 3.17.09 : change completed, checked into CVS	X	X	X	X	I	I	I	I
20.	Add the ECS attributes writing to the CHIMAERA OD code **Comments & Results:** GW - 5.20.09 : added the attribute writing to the end of the .par.work files that would be then picked up by the eventual CHIMAERA-MODAPS wrapper. The CHIMAERA-MODAPS wrapper is a separate project outside the scope of this code.	X	X	X	X	–	I	–	I
22.	Deal with bad pixels that pop up in both channel 8 and channel 19. **Comments & Results:** GW – 5.20.09: This is important for the multilayer algorithm. The numbers that come out are nonsense. These bands CAN saturate, go figure and the uncertainty index for them is set to 15. In cases when 0.94um saturates the PW tests should not be applied and in cases when the 0.41um saturates the desert test for Pavolonis-Heidinger should not be applied. GW – 5.31.09 : Implemented and committed to CVS. Very minimal impact. Maybe a few pixels in a granule here and there.	X	X	X	X	–	I	–	I
23.	Implement a test for detecting fresh snow/ice under thin cloud. A problem I've seen in the data before. By fresh I mean that it hasn't made it into the NISE or ICE products yet, but is sure there on the ground as the passing storm just dumped a foot of it. **Comments & Results:** GW – 6.19.09: This is something that got me thinking after talking with Joanna yesterday. I explained to Joanna and Vasiliy how we swap out tau bands in the retrieval and something got me thinking about how I could fix the abnormally large optical thicknesses that occur when we retrieve thin cirrus over freshly-fallen snow/ice. An examination of 1.2, 0.65 and 0.86 bands should yield a decision to use the 1.2 band as tau band as the cloud in such conditions will look significantly darker in 1.2 than in the others. GW-12.28.09 – there will be no additional test. We will simply use the later NISE that had a chance to detect the snow. This is a production rule change.	X	X	X	X	I	I	I	I
24.	Can somebody tell me why the heck are we reading only 16 levels of NCEP when it got 26?!!! If you are going to downsample a profile, you can't just say 'oh, I'll just read fewer levels' you actually have to downgrade the profile using interpolation like the ECMWF reader I have does: downgrade from 60 levels to 36. We are incorrectly using the NCEP profiles!!!!! **Comments & Results:** GW – 6.19.09: Umm, fix it.	X	X	X	X	I	I	–	I

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						AIR	MOD	SIM	
25.	Perform a dual-phase retrieval before phase is determined so that more information is available for cloud phase. **Comments & Results:** GW-12.28.09 – Added as per discussion with Steve on 12.24.09 GW-4.15.10: implemented in MODIS. Starting science test 5A GW–11.26.10: tested, this works just fine. Science test successful. When this method is implemented for airborne sensors, this item will be struck off this list.	X	X	X	X	I	I	I	I
26.	Change the code so the lines are counted along-track instead of current cross-track alignment. This would really cut down on interpolations done. **Comments & Results:** GW – 7.8.09: do I need to really say anything?	X	X	X	X	I	I	I	I
27.	Change the interpolation angle limits to be a function of scattering angle instead of theta, theta0 and phi in order to speed up the code. Now this would need to have different thresholds for ice and water and may end up more trouble than it's worth, but it is worth a look. **Comments & Results:** GW – 7.8.09: After looking at a bunch of different phase functions, I came up with a scheme that is different for ice and water, but that's just fine because by the time we think about interpolating, we already know what the phase is.	X	X	X	X	I	I	–	I
28.	Change the code so that 99 lines are processed at a time instead of 10 as it currently is (that's so we can have the 3x3 CSR boxes instead of the current 3x2. **Comments & Results:** GW – 7.8.09: GW: 12.30.10: we are actually retrieving 100 lines to make sure that the CT 5km pixels can be used nicely when needed. Overscan has been implemented, so the issue of not having enough 3x3 boxes is now moot.	X	X	X	X	I	I	–	I
33.	Use L1B uncertainty index as measurement uncertainty instead of hardcoded 5% **Comments & Results:** GW-12.22.10 – Implemented. Sent to science test 6.	X	X	X	X	–	I	–	I
32.	Retrieve pixels that are normally clear-sky-restored and set the appropriate QA for them, like not useful or something, but report the numbers nonetheless **Comments & Results:** GW-12.28.09 – Added as per discussion with Steve on 12.24.09 GW-6.23.10: implemented, in science test at this moment. Will propagate to MAS and sims code based on the results of science test 5A.2. GW–11,26.10: science test successful. This will be propagated to airborne sensors and struck off this list. GW: 12.02.10 – Will not allow retrievals of dust/smoke/aerosol, but only retrievals of broken/edge clouds.	X	X	X	X	I	I	–	I

PGE (06OD) General Status as of 1/19/2011

1. CHIMAERA 6.0.0-M2.1 is now available from CVS. Due to filespec changes for all processing paths to reflect C6 improvements the CHIMAERA code will no longer execute over C5 data. CR must be run anew for any and all processing paths that are present or you will be risking some seriously nasty segfaults.
2. CHIMAERA 6.1.0-M2.2 is now available from CVS.
3. All MODAPS-CHIMAERA wrappers are now in place thanks to George Britzolakis from MODAPS. CHIMAERA plays nice with MODAPS system. No problems.
4. CHIMAERA 6.0.13-M2.3 is now available from CVS. We are now keeping the main version number in line with what MODAPS is using as science tests for the operational code are now well underway. You MUST do a clean checkout. You can not do an 'update' because the code structure has been significantly altered.
5. CHIMAERA 6.0.15-M2.3 is now available from CVS. If you already have 6.0.13-M2.3, do a CVS update. If you don't then follow instructions in item 4.

PGE (06OD) Schedule

Item	Projected Date	Actual Date
PGE Initial Investigation and Programming Begun		February of 2007
PGE Initial Investigation and Programming Completed		
PGE Version 1 Delivered for Testing		
PGE Version 1 Testing Completed		
PGE Version 1 Analysis of Results		
PGE Version 2 Investigation and Programming Begun		
PGE Version 2 Investigation and Programming Completed		
PGE Version 2 Delivered for Testing		
PGE Version 2 Testing Completed		
PGE Version 2 Analysis of Results		
PGE Version 3 Investigation and Programming Begun		
PGE Version 3 Investigation and Programming Completed		
PGE Version 3 Delivered for Testing		
PGE Version 3 Testing Completed		
PGE Version 3 Analysis of Results		
PGE Final Version Delivered to Operations		
PGE Final Test Confirmation and Sign Off		

Gala's Notes on Library Integration

6.2.09

I will do integration with the DISORT simulations (_DIS) path of CHIMAERA in order to be able to better track and quantify the impacts of the new libraries. Once I'm happy with how the _DIS path is behaving, propagating the changes to the rest of the processing paths is a matter of cut-n-paste for the most part.

The potentially useful subroutine optimumvector() is not used the way it really should be. The original desire was to read in only the part of the libraries that covers a particular granule's angle span in solar and sensor angles in order to cut down on memory usage. However that was never actually implemented, even though a cursory examination would suggest otherwise. The full library space is being read in no matter what kind of granule we are dealing with. No query of granule is being done. This should be redesigned to figure out the total angle span of the granule by reading MOD03 before library arrays are allocated and read. This is a note for the future once the integration is completed and verified. There shall be no freeloading subroutines.

End-of-day status: I have the new arrays defined and I am able to read all the relevant 1D arrays and allocate all the necessary nD arrays, phase function library included. All the names and variables are propagating correctly. The code compiles and runs. The code returns proper values when asked to print the arrays that have been read in at this point.

6.3.09

Files modified so far:

Driver_MOD_PR06OD.f90 ← read in the name of the phase function library
Mod_pr06od.f90 ← pass in the phase function library to reader and allocator
Libraryarrays.f90 ← define the new arrays needed by new libraries
Libraryinterpolates.f90 ← reorganize the array definitions
Modis_frontend_module.f90 ← big changes to the reader and allocator
Modis_science_module.f90 ← all the library interpolation routines are here

I will keep for now the 3-degree interpolation threshold. We may decide to do something different considering the fact that the libraries are now in μ-space. Or maybe not, but this is just a note to keep in mind.

End-of-day status: The library reader is fully functional. The interpolation routines have been integrated fully. The code compiles and runs. It is difficult to verify the array contents due to the size of the arrays, but they look reasonable so far. The true test will be when the full retrieval is done. The next step is to change the routines in corescience and in get_retrieval_uncertainty to not use the asymptotic theory, but use these interpolated libraries instead. Corescience will be relatively easy, as I've gone through that exercise before. Uncertainty is a different story. It has a lot of places where the tau space is queried and so a lot to keep track of.

6.4.09

Files modified:

Corescience_module.f90 ← big changes to the main retrieval code
MOD_PR06CR_DIS/MOD_PR06CR_DIS.f90 ← create the G and W0 SDSs

6.5.09 – 6.8.09

Base retrievals (non-NIR) are fully operational. The retrieval values are almost identical to the original C5, which I guess is a good thing, but also not so good because the 'spike' at small tau <2 is still there. We now think that it might have something to do with inherent difficulties retrieving thin clouds.

Found bug in the 3.7um retrieval that's been there for who knows how long. The bug is in the arguments passed to toa_radiance37(). The optical thickness vector passed in is not scaled by the Qext ratio as it should be. The impact is mainly for liquid water clouds with smaller re.

6.9.09

Files modified:

Get_retrieval_uncertainty.f90 ← all asymptotic calculations removed
Modis_io_module.f90 ← write the ice g and w0 SDSs.

If you fix the aforementioned bug in granule test many more 3.7um retrievals come in that failed before, otherwise the overall impact is a wash, which I guess is a good thing. Of course none of this ever makes it to Level-3.

End-of-day status: The new libraries are now fully integrated into the DISORT(SIM) path of CHIMAERA. The next step is to integrate to MODIS. The MAS<TER> part will come later pending MAS<TER> libraries. It would be nice to process Bob Holz's data using the new non-asymptotic libraries.

6.19.09

The new forward libraries are now fully integrated into the MODIS path of CHIMAERA. Difference images of granule tests are available. The comparison against asymptotic libraries is favorable overall. We obtain a number of additional good successful retrievals, which is always a good thing. A global daily test is currently executing and is expected to complete sometime Saturday.

7.8.09

Global test is all done. All images are available. Ice r_e increased, water re kind of a wash: some up, some down, some who cares. Optical thickness impact is minimal. I've already found room for improvement, particularly the evil backscatter. Our 3° interpolation thresholds really kill us in the backscatter creating nasty angular features that pop like crazy when clouds are uniform. Interestingly they don't really show up in 2.1 μm, but 1.6 and 3.7 they are clear as daylight, shining away. A sample granule is available if you are interested in seeing the mess. I'm looking at a number of improvements to implement in order to refine the interpolation together with reducing the amount of interpolation done. The timing hit of the new libraries was quite minimal because I was able to ditch all the spline interpolations in the code. I think I can speed up the code even more while improving the results.

7.9.09

The new libraries are fully integrated into CHIMAERA. End of this story.