Validation of MODIS Derived Cloud Properties and Modeled Irradiances using C3M Processes

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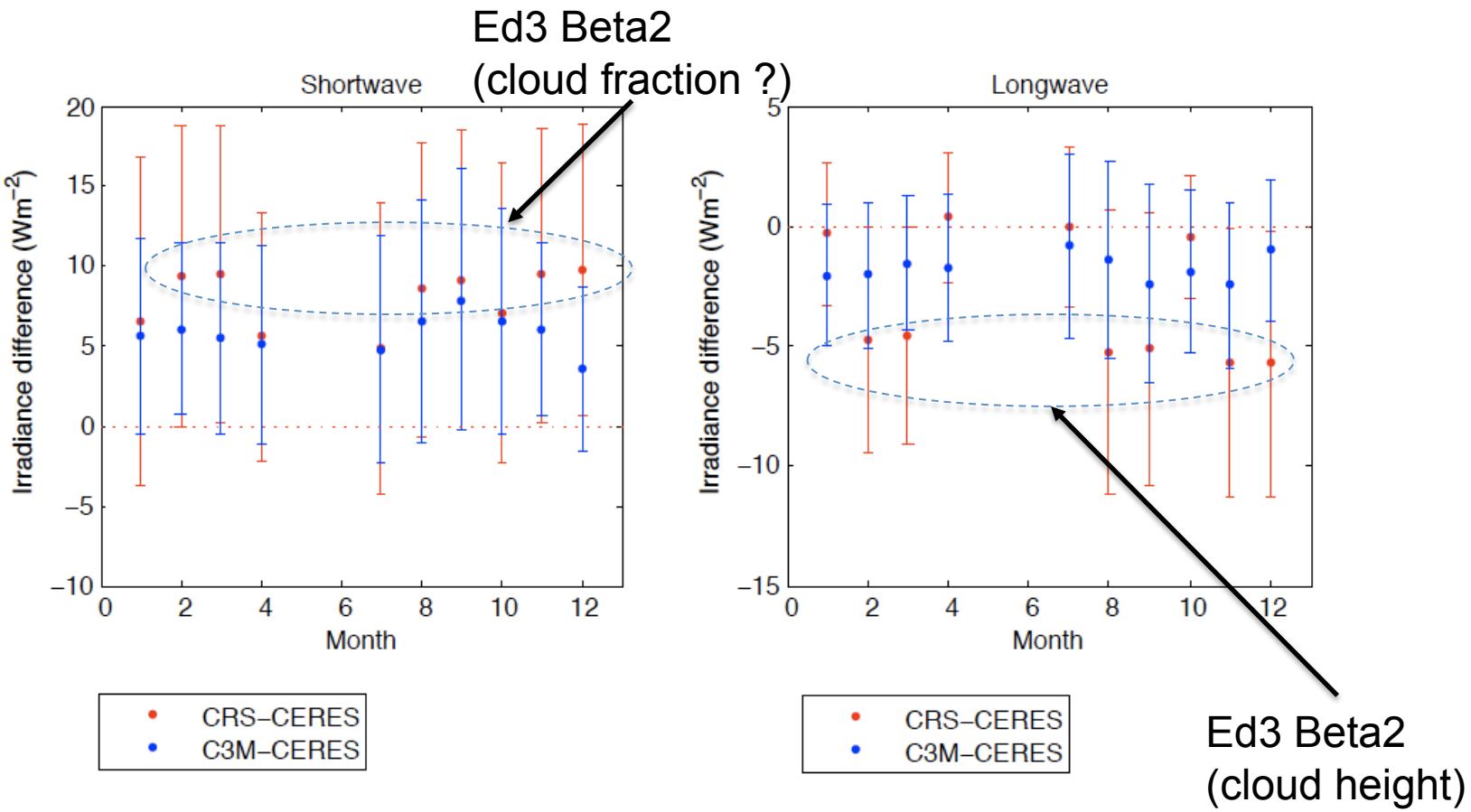
C3M product update

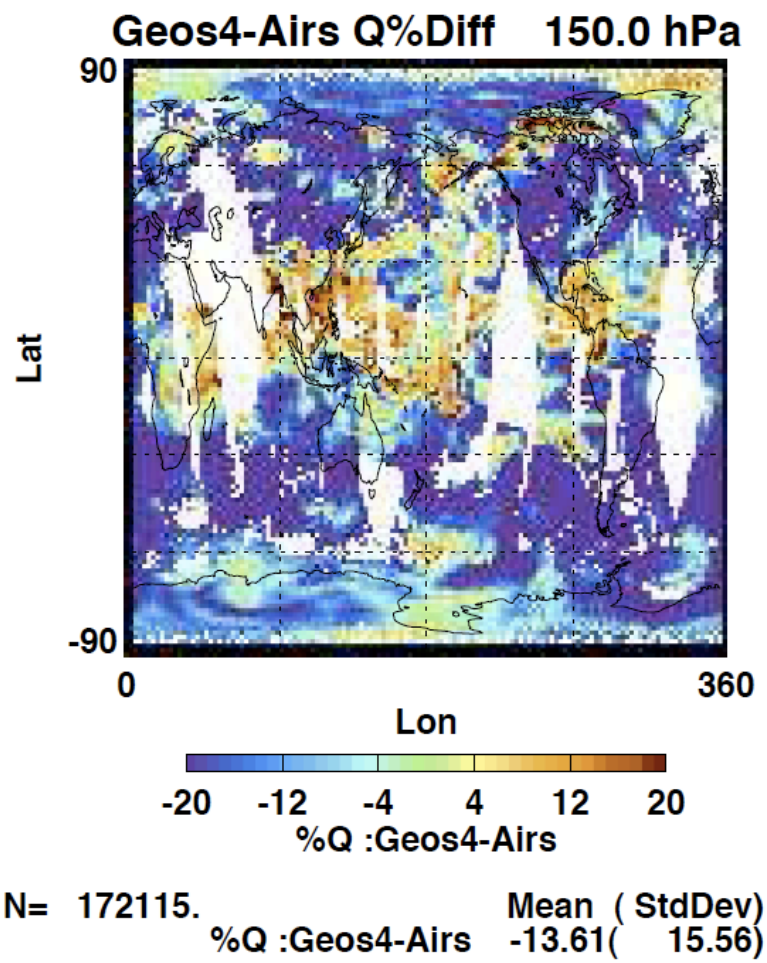
- 4 months (200607, 200610, 200701, and 200704) were processed with the Ed3 beta 1 cloud algorithm
- 8 more months (200608, 200609, 200611, 200612, 200702, 200703, 200705, and 200706) were processed with the Ed3 beta 2 cloud algorithm
- 10 months of data were released
- Developed an algorithm to screen clouds below 4 km introduced by a CALIPSO algorithm problem
- Plan to process 2008 4 seasonal months before start processing with CALIPSO version 3 data

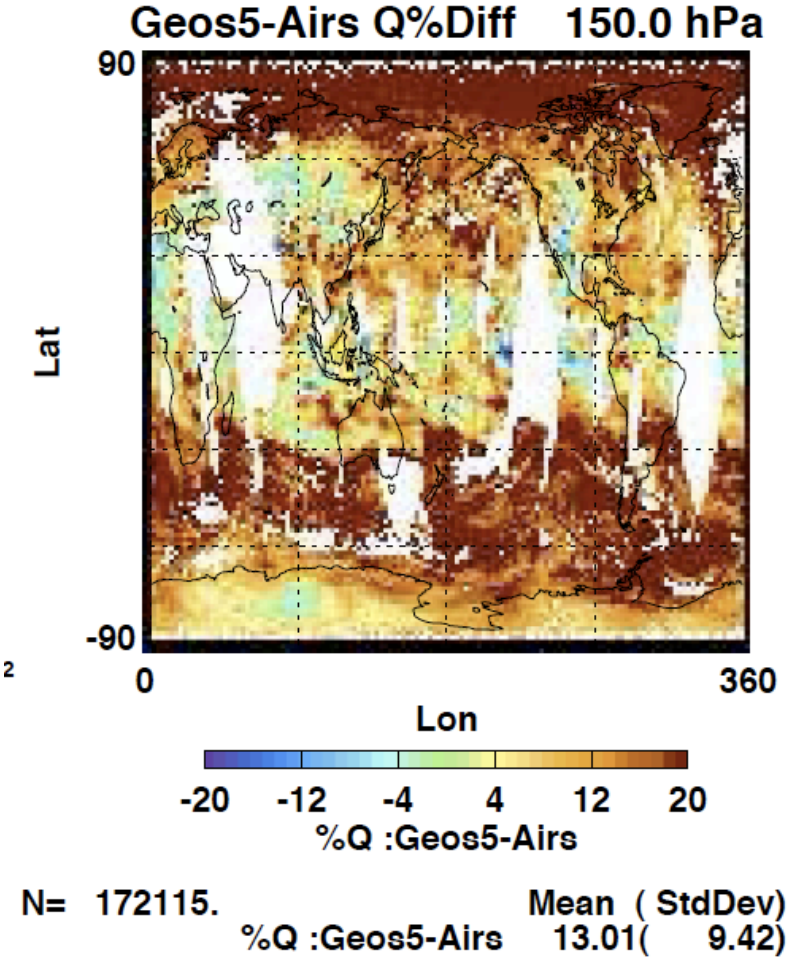
TOA flux comparison with CERES



All irradiances are computed with GEOS-4
Error bars are RMS computed from hourly means

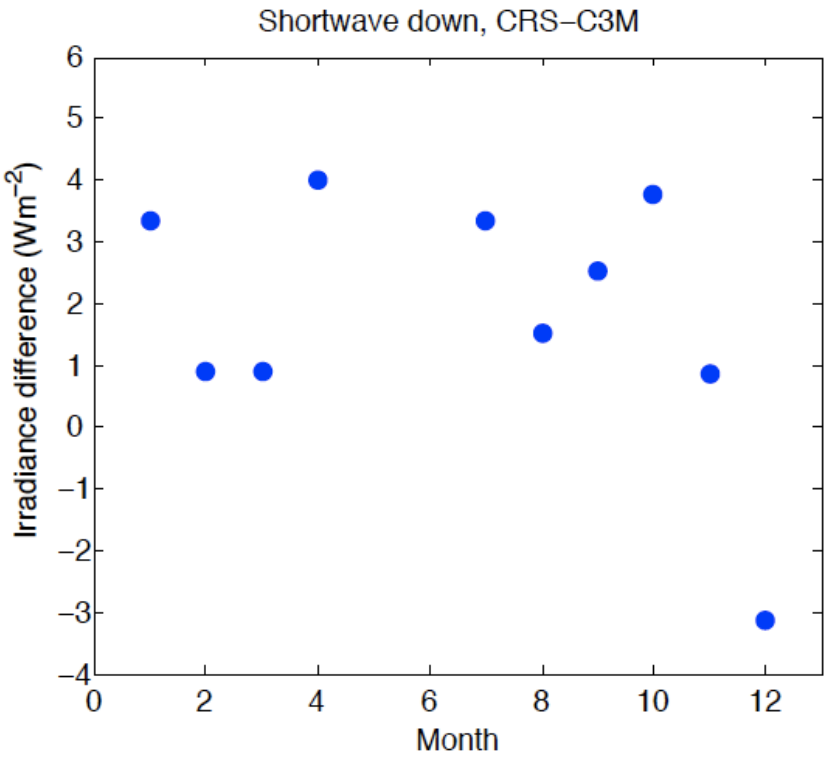
GEOS-4, GEOS-5, vs. AIRS water vapor

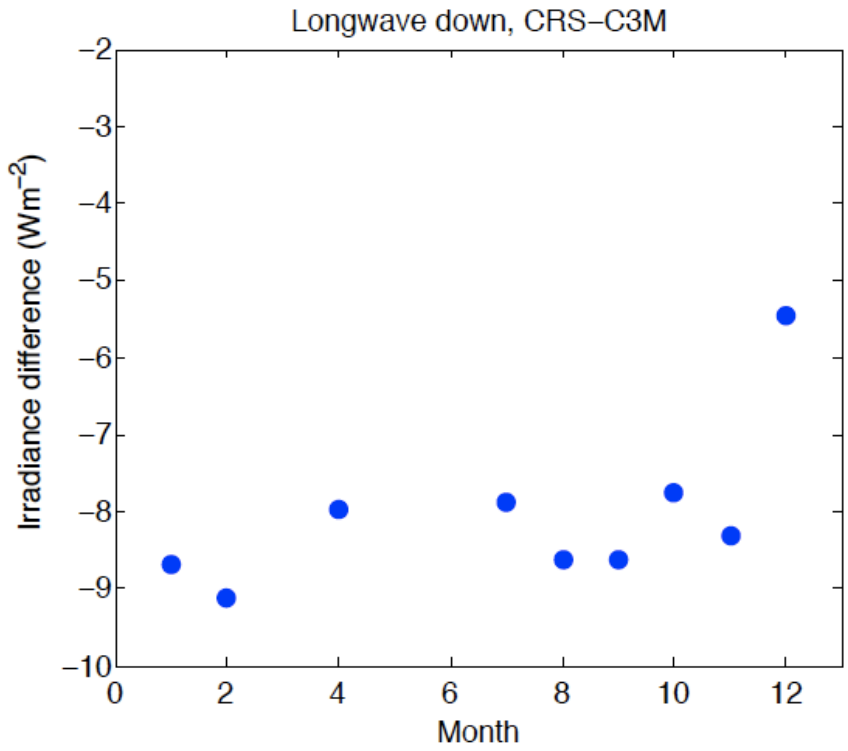




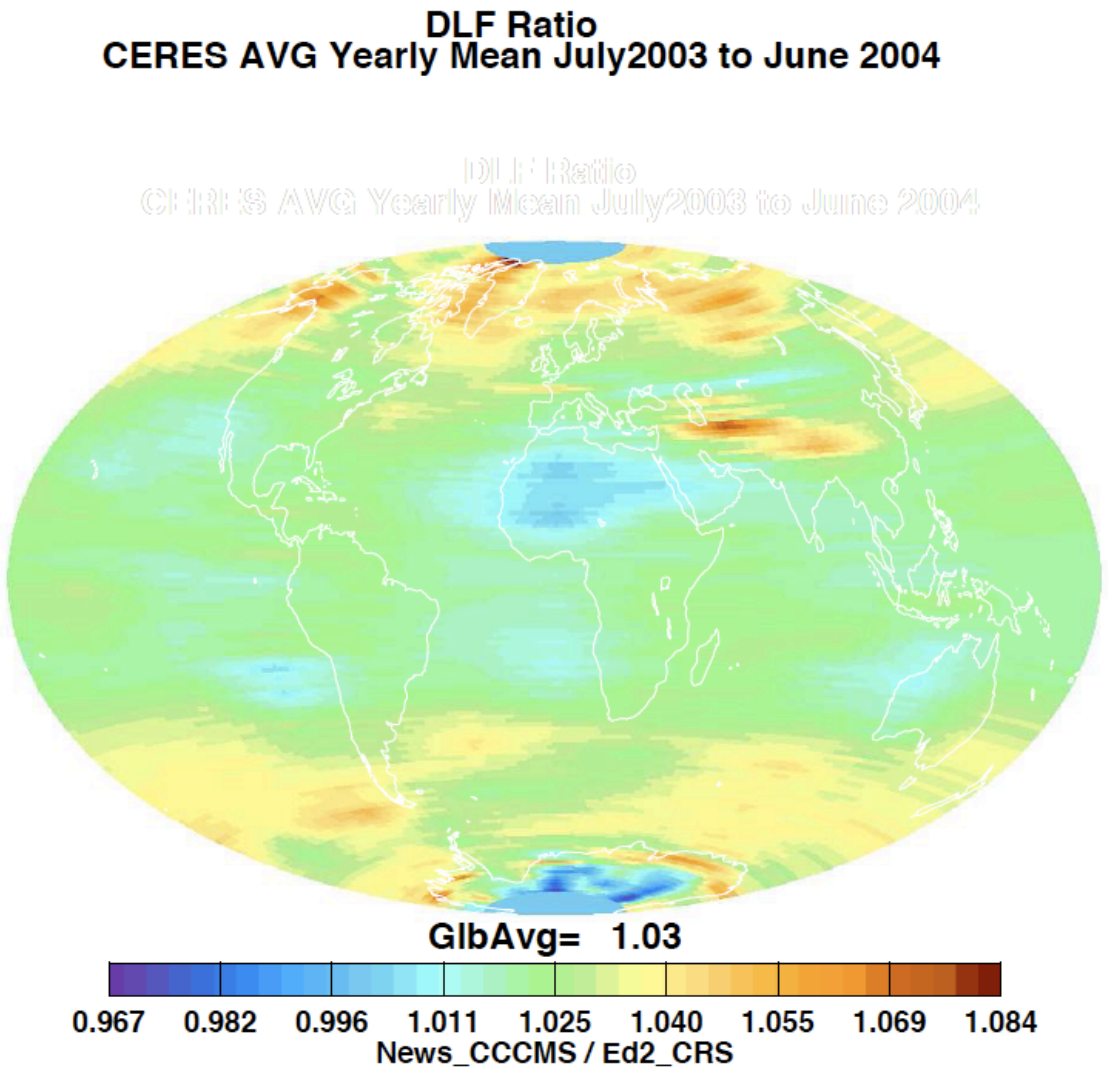
AIRS retrieval accuracy of water vapor in 2 km layers is better than 15%

Surface flux comparison



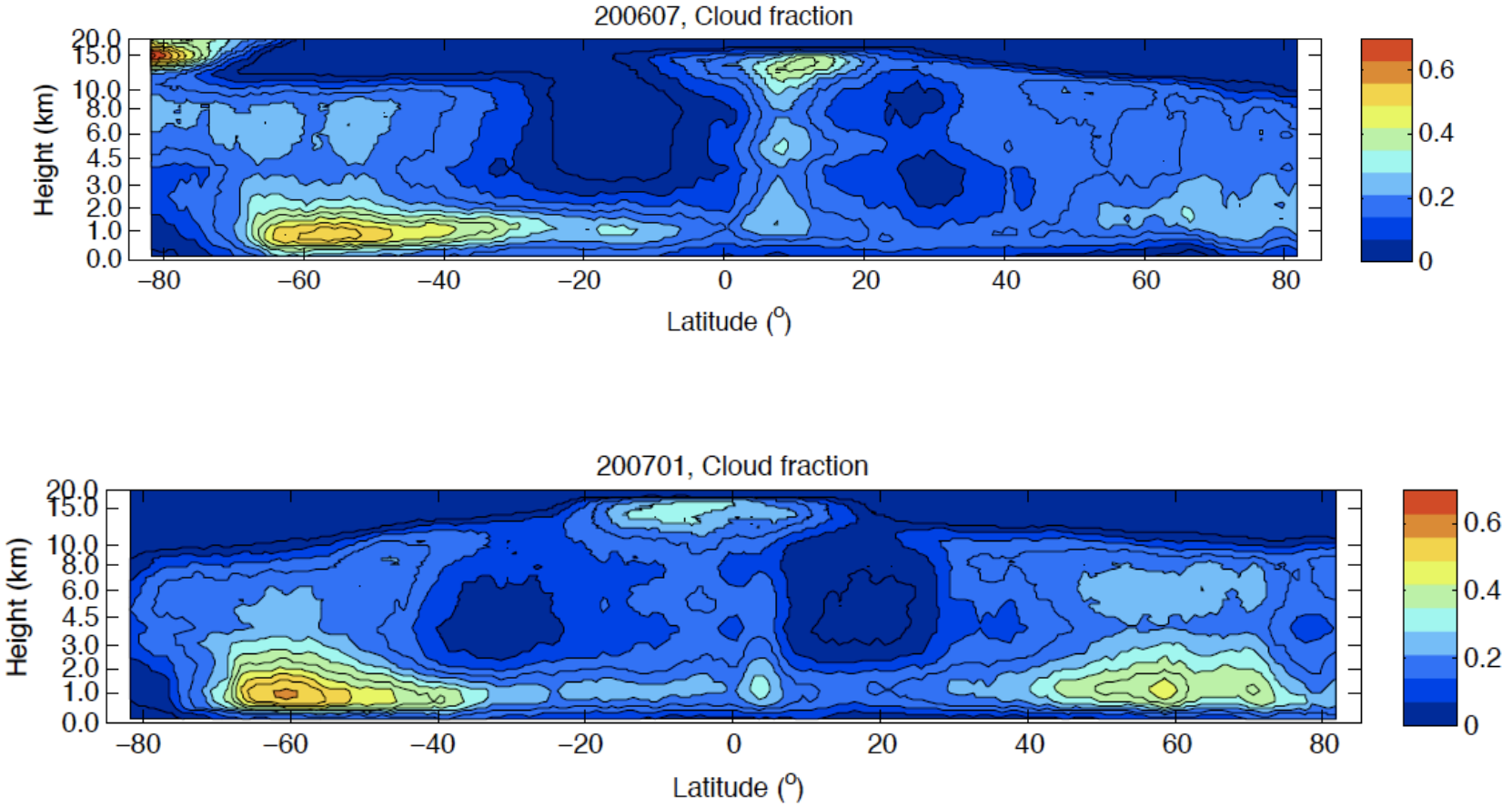


Surface LW Irradiance ratio C3M/Ed2 CRS



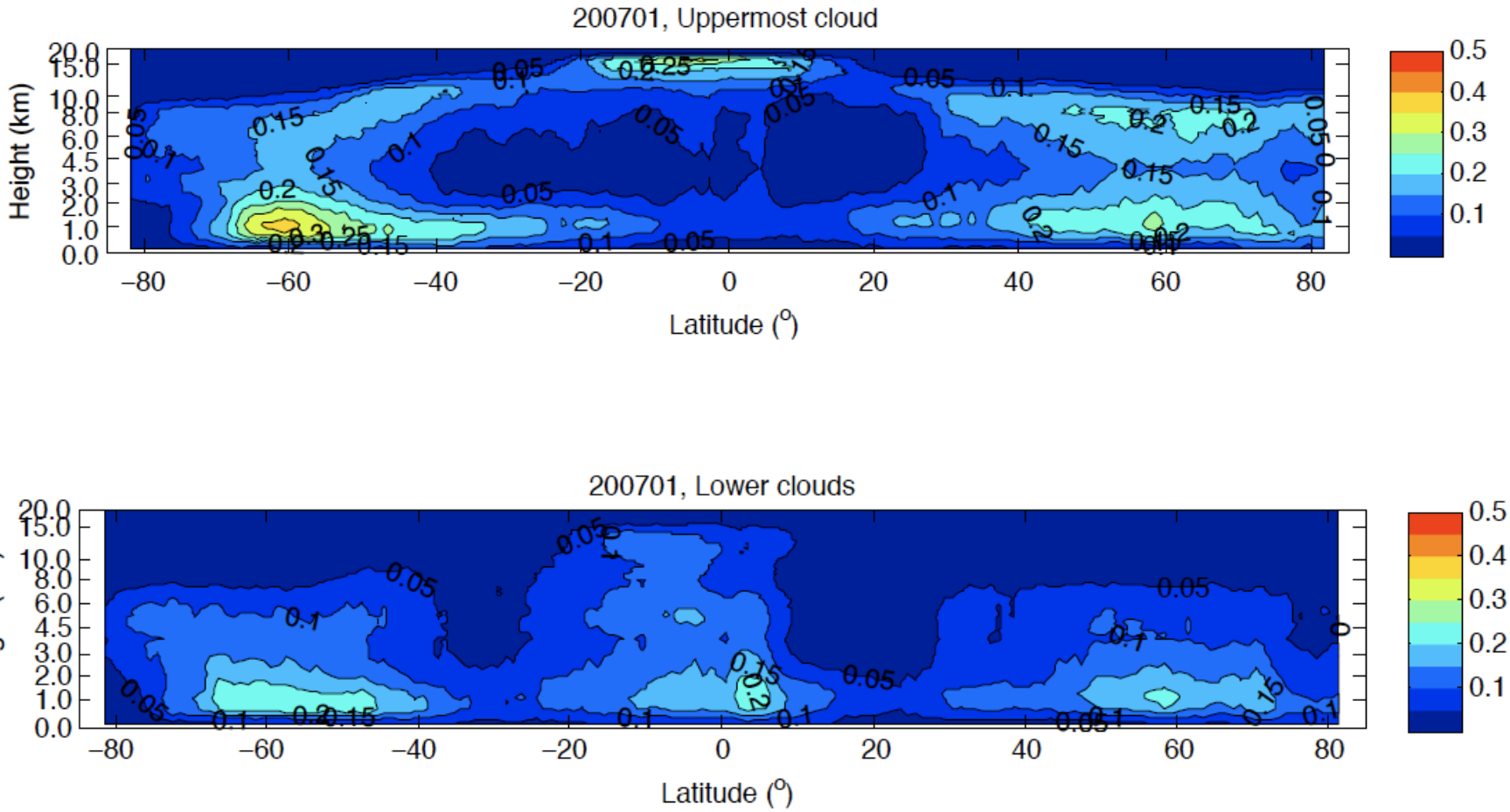
Cloud thickness?

Cloud profile from CALIPSO and CloudSat

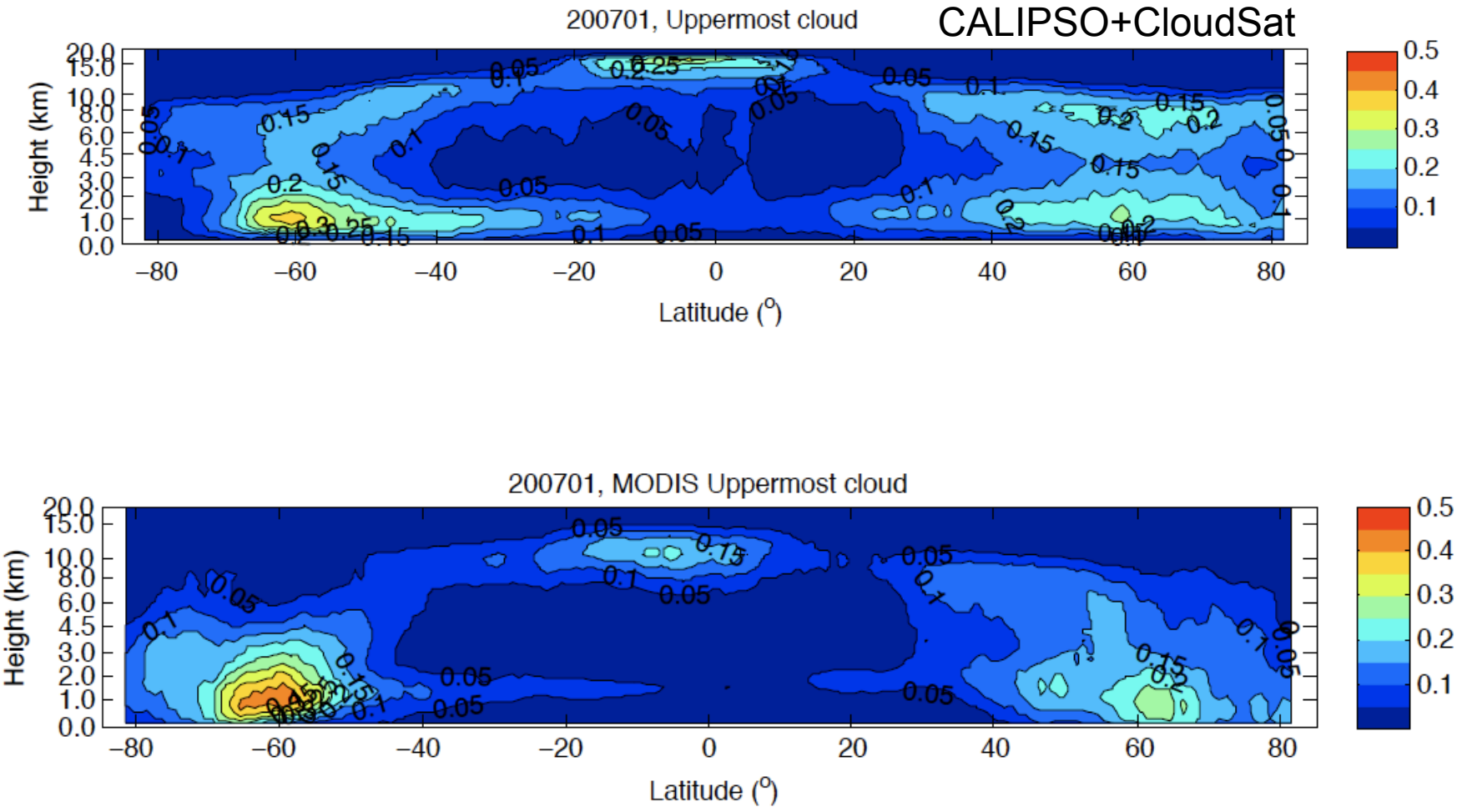


Cloud fraction in a 200 m by 1 degree volume

Uppermost cloud layer and lower level clouds

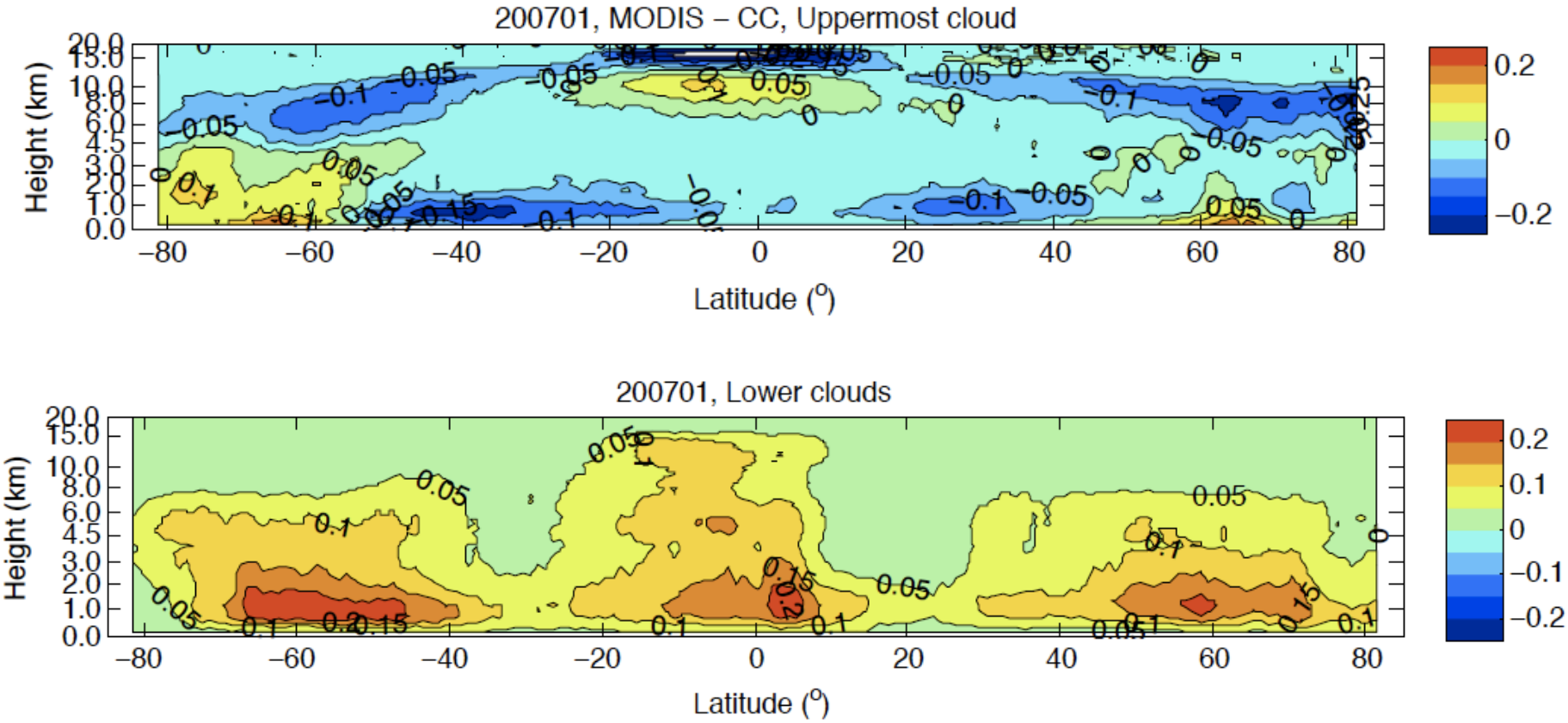


Uppermost cloud profile comparison



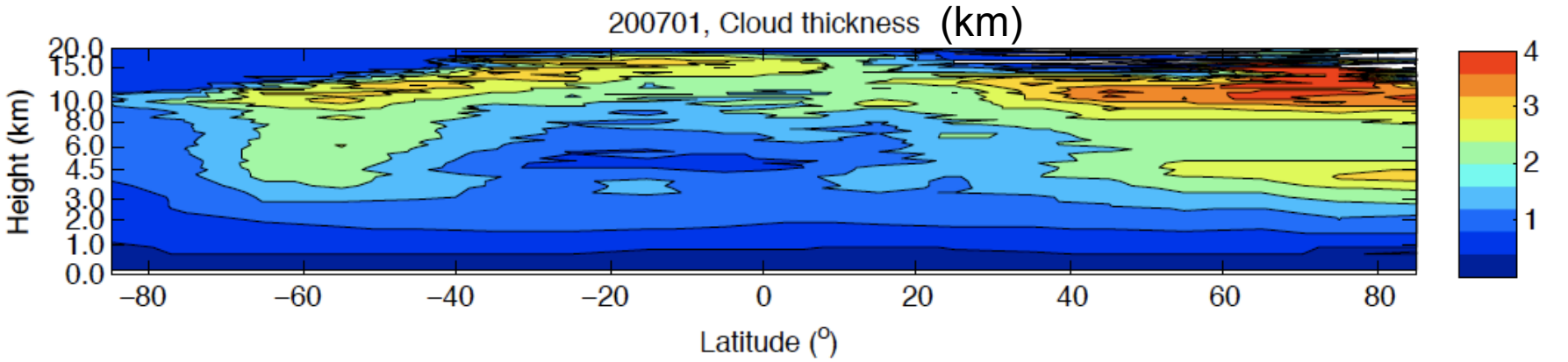
MODIS: Ed3 beta1 + Ed2 cloud thickness algorithm, nadir view only

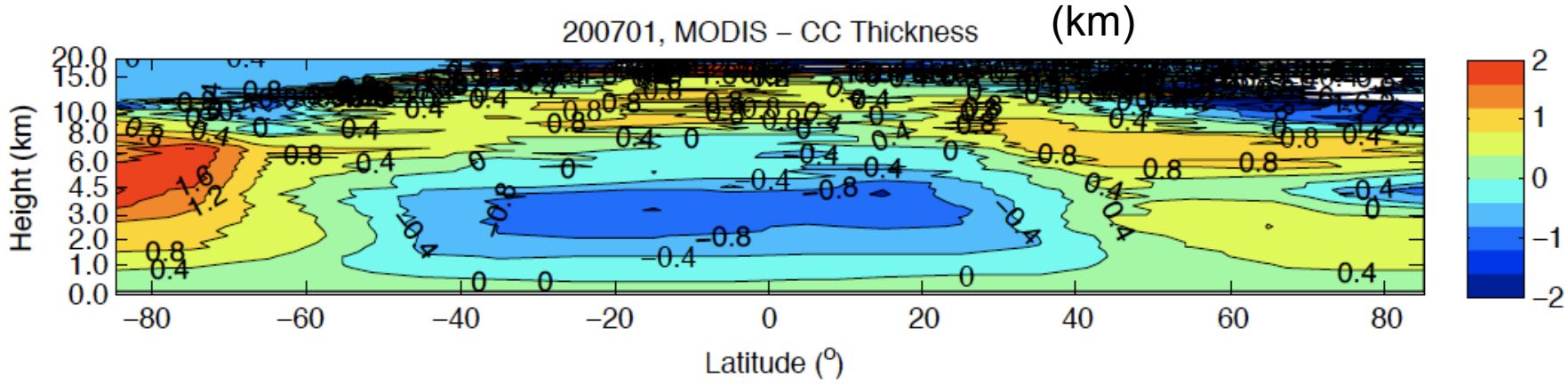
Cloud profile difference



Missing low-level clouds is due to cloud overlap

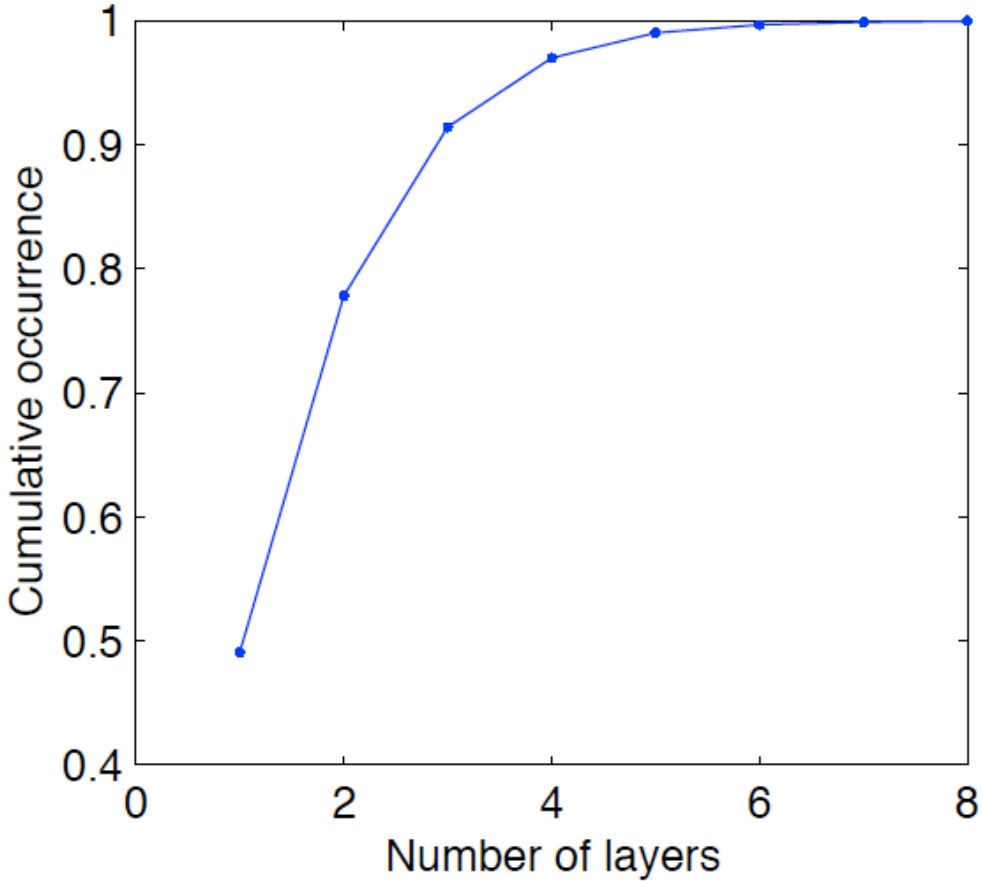
Cloud thickness difference





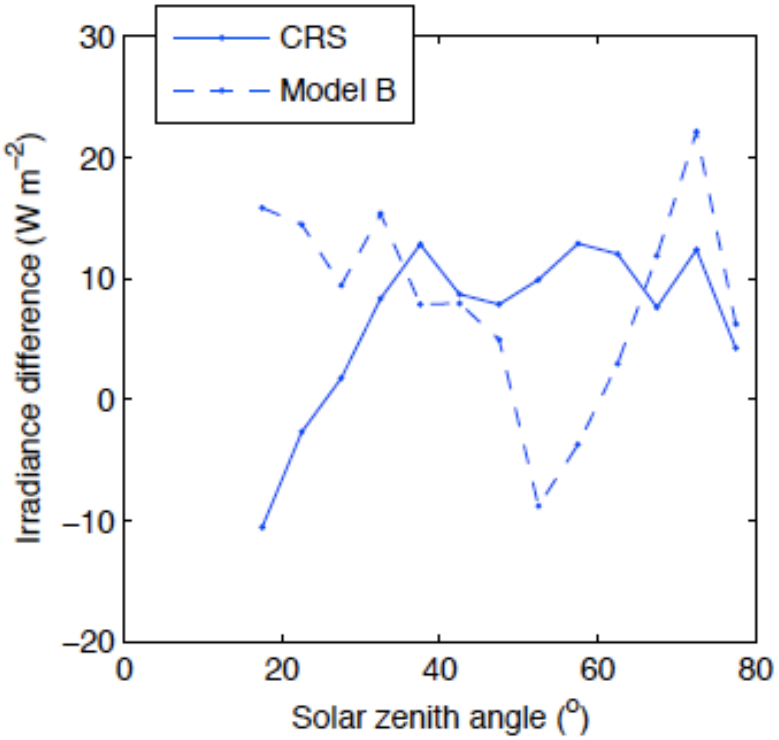
Ed 2 cloud thickness algorithm is used

Number of overlapping layers

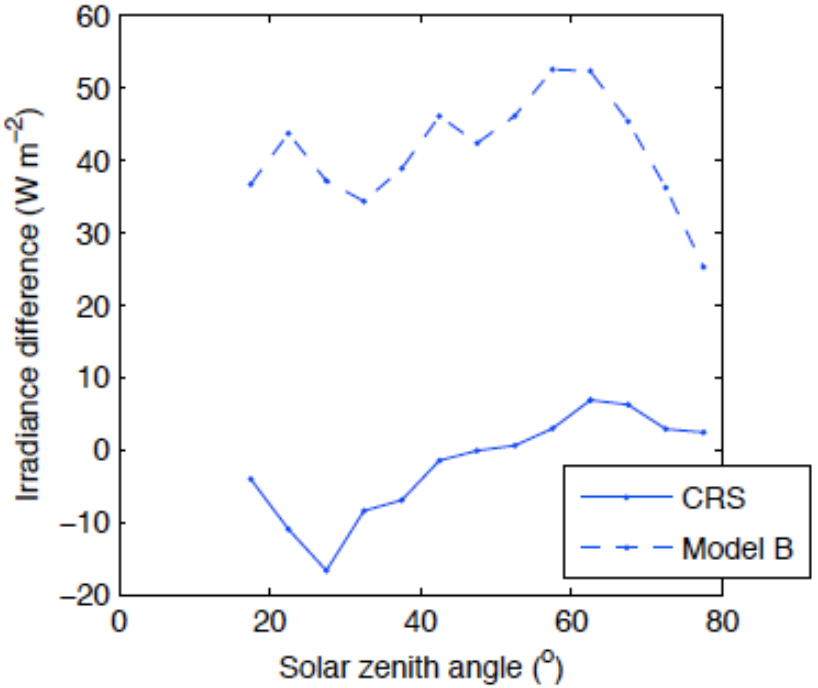


Comparison of C3M and Model B (Mean)

Land



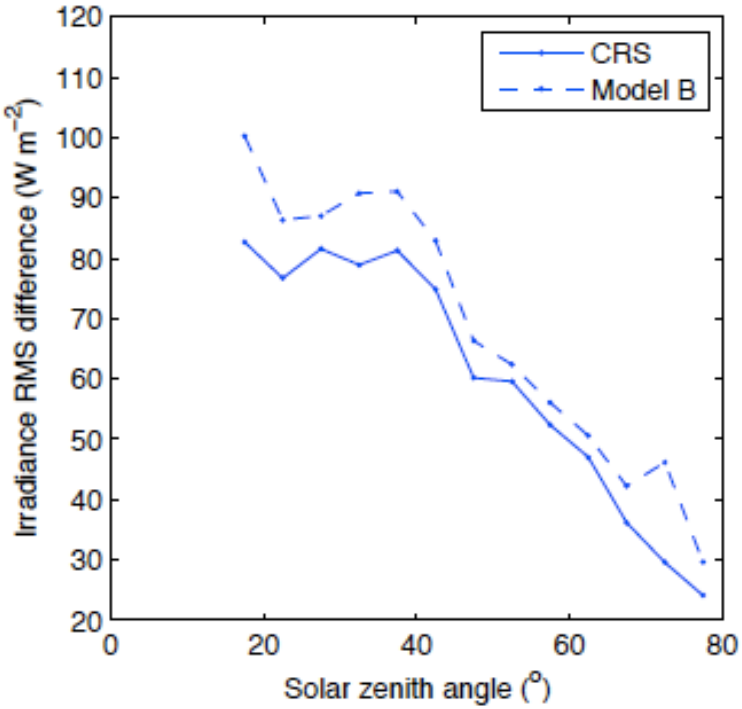
Ocean



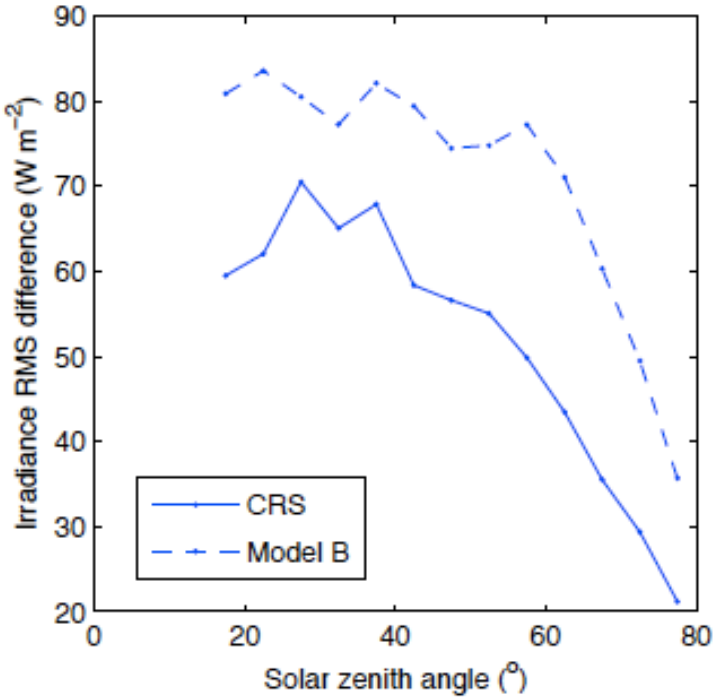
200607, nadir view only

Comparison with CRS and Model B (RMS)

Land



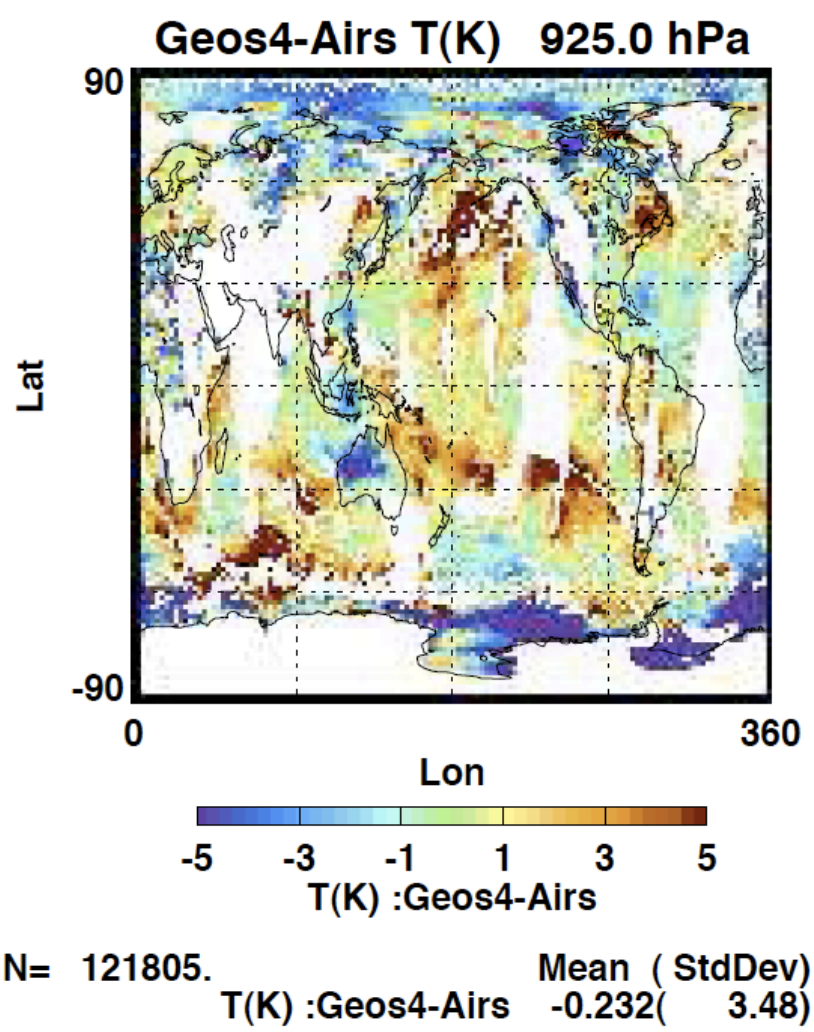
Ocean

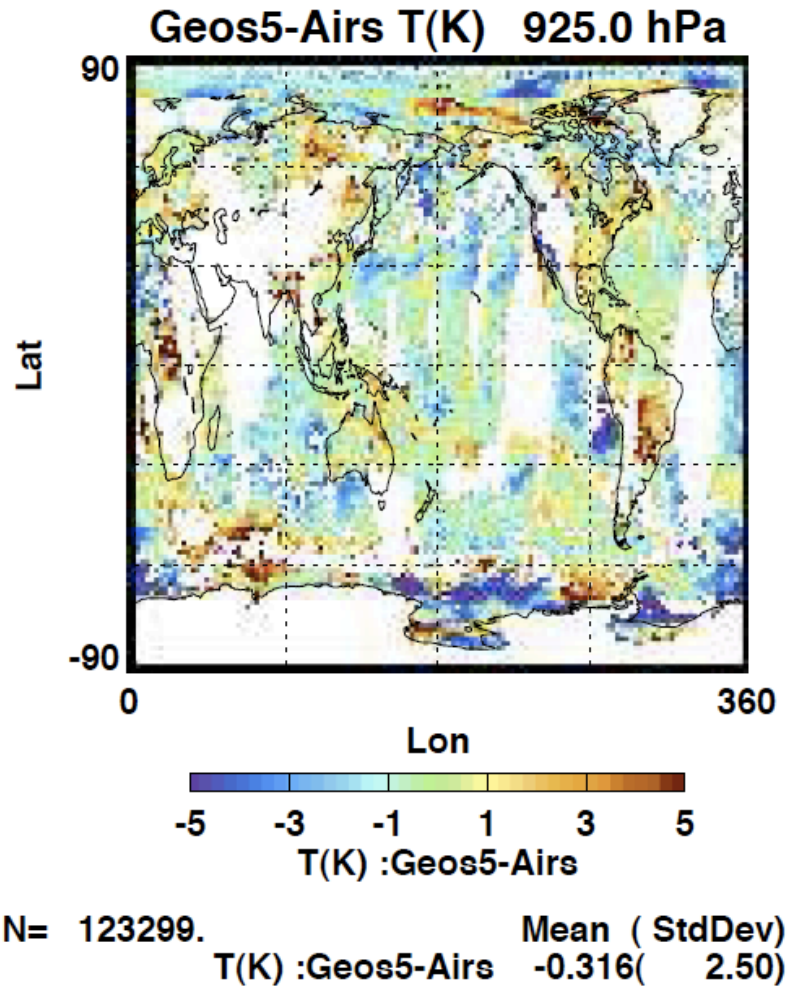


Summary and conclusions

- C3M data product can be used to validate retrieved cloud properties and surface fluxes that are included in CERES data products.
- Cloud height in derived from the Ed 3 beta 2 appears to be too high.
- Need to account for cloud overlap to improve the surface downward longwave irradiance.
- Surface downward shortwave irradiance derived by Model B over ocean needs further investigation.

GEOS-4, GEOS-5, vs AIRS temperature





Effect of the CALIPSO low-level clouds problem on flux computations

1. (23.3%) Clouds with cloud top less than 4 km are detected by CALIPSO and CloudSat and MODIS derived cloud fraction is greater than 0 for this cloud group and no cloud extinction is given by CALIPSO
2. (3.7%) same as 1 but MODIS did not see clouds
3. (39.6%) clouds with cloud top less than 4 km are detected by CALIPSO and CloudSat and tau integrated from CALIPSO extinction is between 0 and 1
4. (33.5%) clouds with cloud top less than 4 km are detected by CALIPSO and CloudSat and tau integrated from CALIPSO extinction is greater than 1

Percentage is based on one day of data (20060701).

Among those case

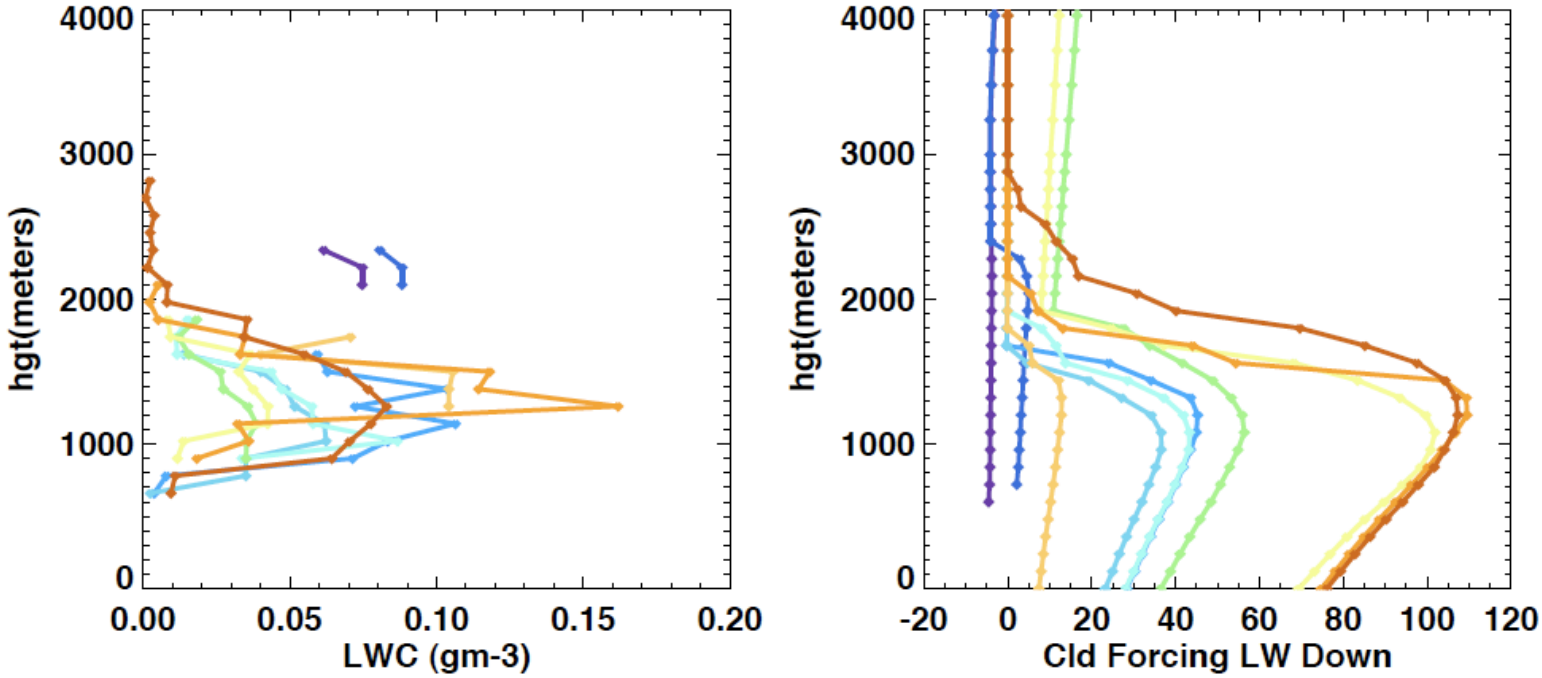
1 is the bad case.

2 No clouds are included

3 Thin clouds are included

4 is real clouds.

Bad clouds


4000
3000
2000
1000
0
hgt(meters)
0.00
0.05
0.10
0.15
0.20
LWC (gm-3)
4000
3000
2000
1000
0
hgt(meters)
-20
0
20
40
60
80
100
120
Cld Forcing LW Down

Cloud fraction comparison

Cloud fraction used in model – CALIPSO CloudSat cloud fraction[1]

Month	Ed3 Beta 1	Ed3 Beta 2
200607	0.024	0.034
200610	0.037	
200701	0.046	
200702		0.076
200704	0.040	
200706		0.068