CALIPSO, CloudSat, CERES and MODIS merged data product (CCCM): Improvements of satellite-derived cloud, aerosol and radiative flux profiles

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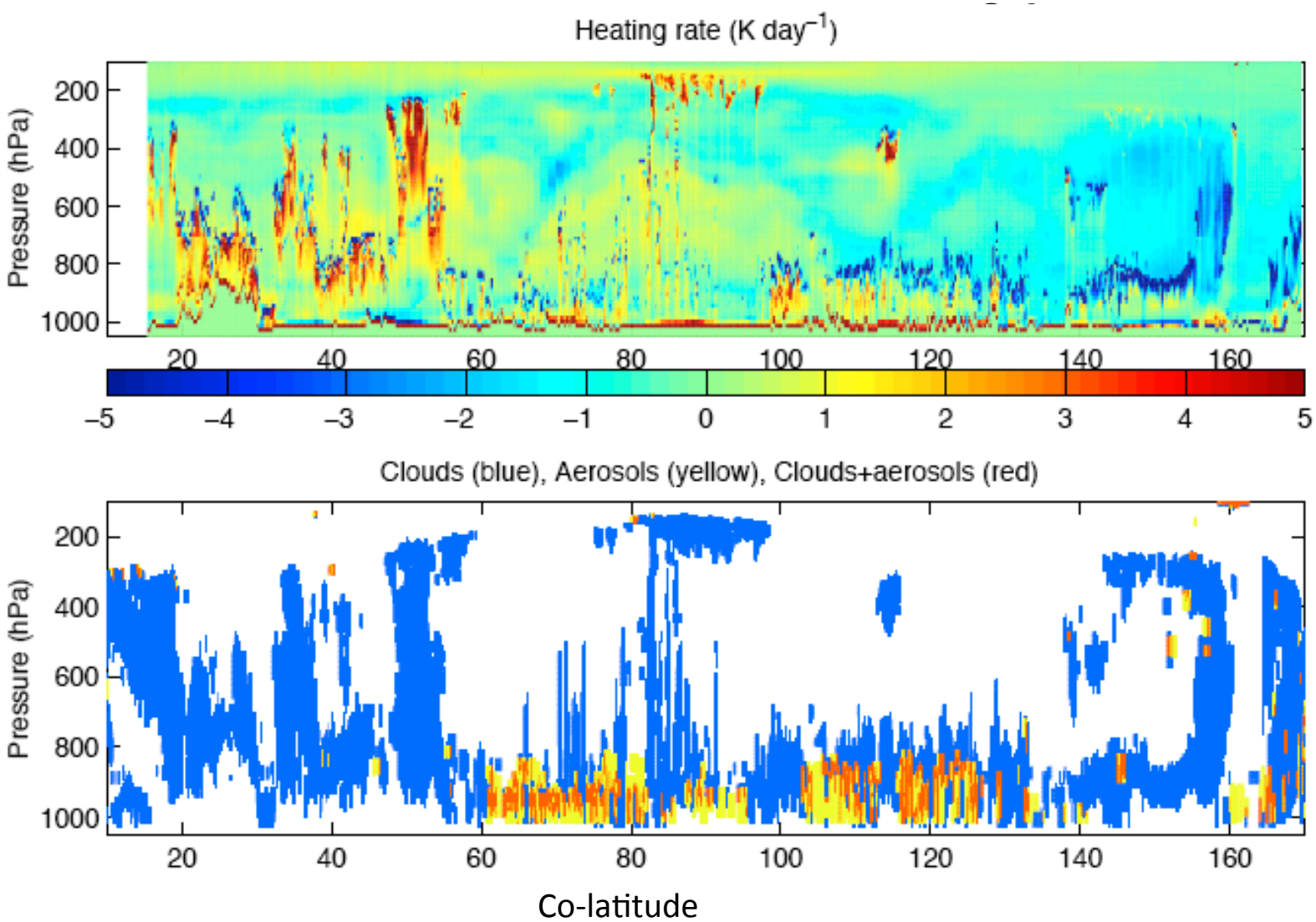
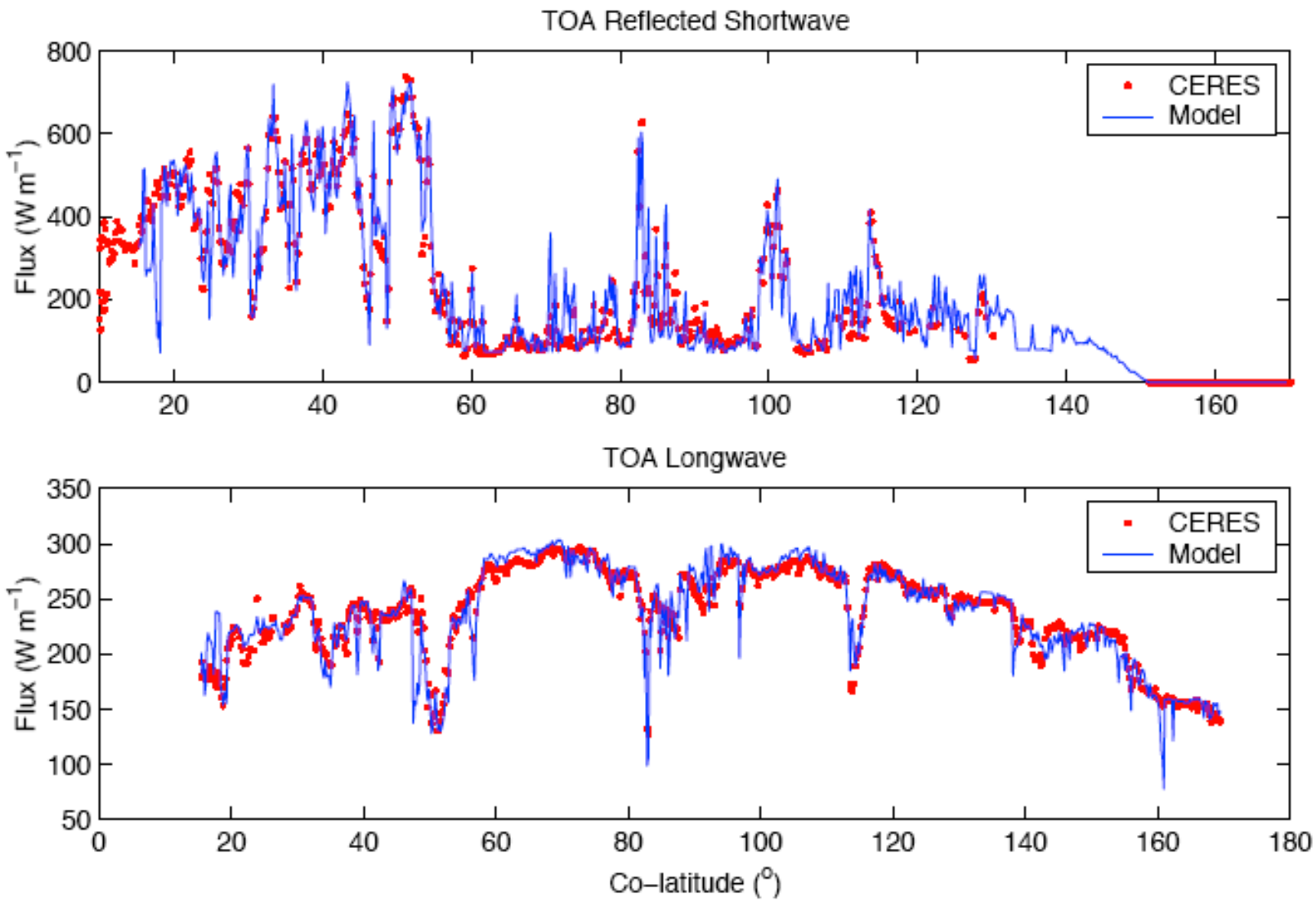
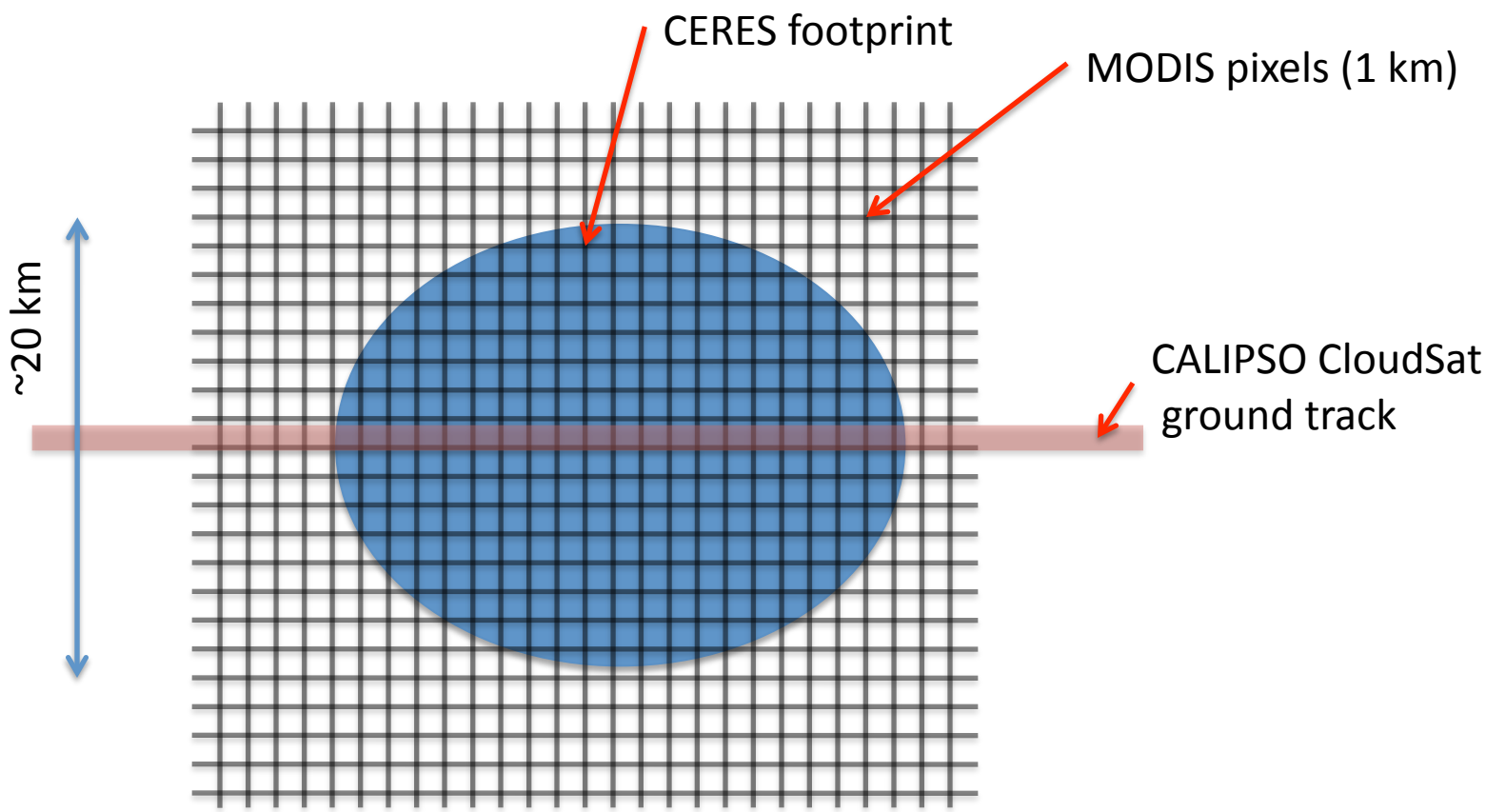
Nov. 4, 2009 CERES science team meeting



Radiative effect of Cirrus, cloud overlap, cloud-aerosol overlap

Comparison with CERES fluxes



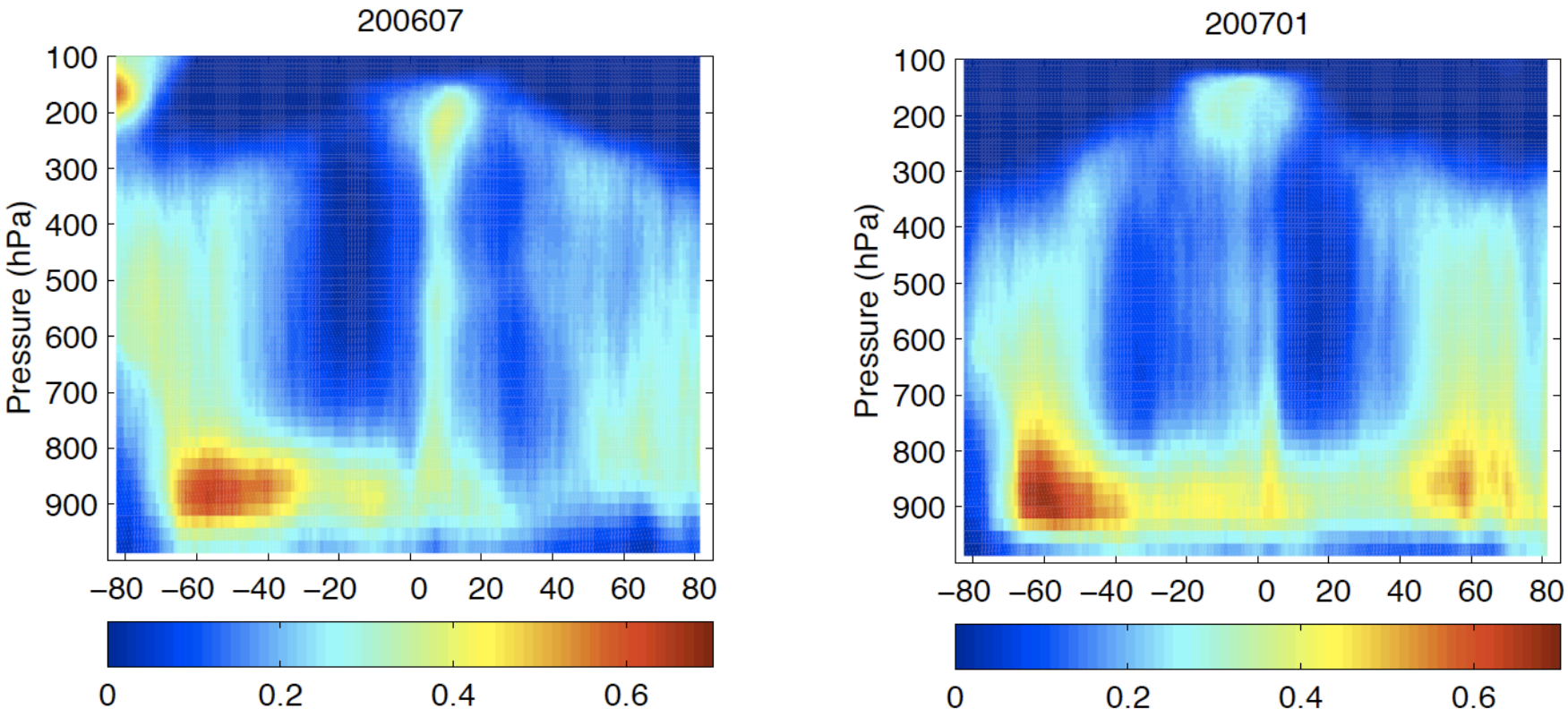


CERES point spread function is used to reduce FOV size difference

CALIPSO CloudSat clod mask integration

Cloud boundary	CALIPSO	CloudSat	Merged Cloud boundary
Top	Detected	Detected	Higher cloud top
Top	Detected	Undetected	CALIPSO cloud top
Top	Undetected	Detected	CloudSat cloud top
Base	Not completely attenuated	Undetected	CALIPSO cloud base
Base	Not completely attenuated	Detected	CALIPSO cloud base
Base	Totally attenuated	Detected	CloudSat cloud base
Base	Totally attenuated	Undetected	CALIPSO lowest unattenuated base

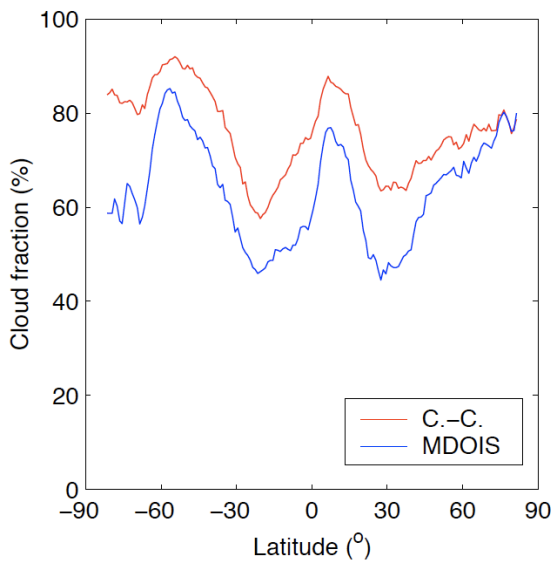
Zonal cloud fraction profile

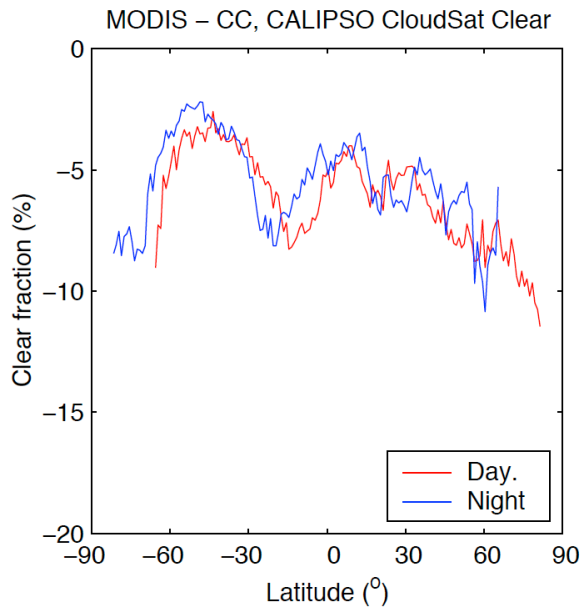


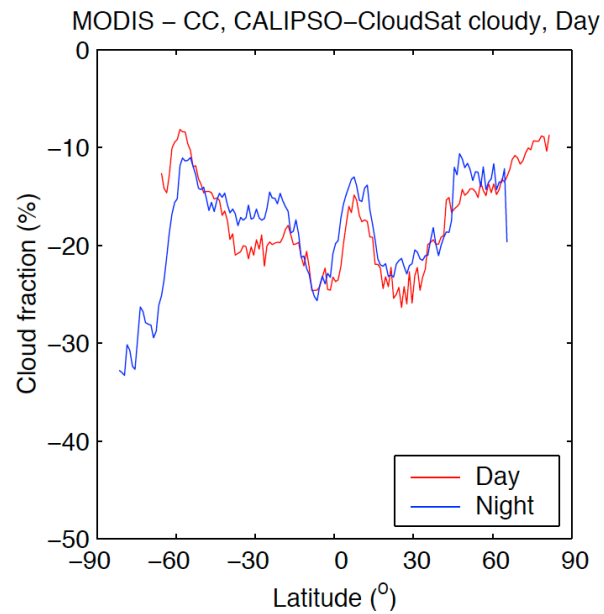
Cloud fraction in 200 m vertical layers

Cloud mask (July 2006)

Zonal mean cloud fraction







MODIS cloud fraction is derived from CERES cloud algorithm. Clear and overcast are defined over a 1 km to 20 km piece of CALIPSO and CloudSat ground track.

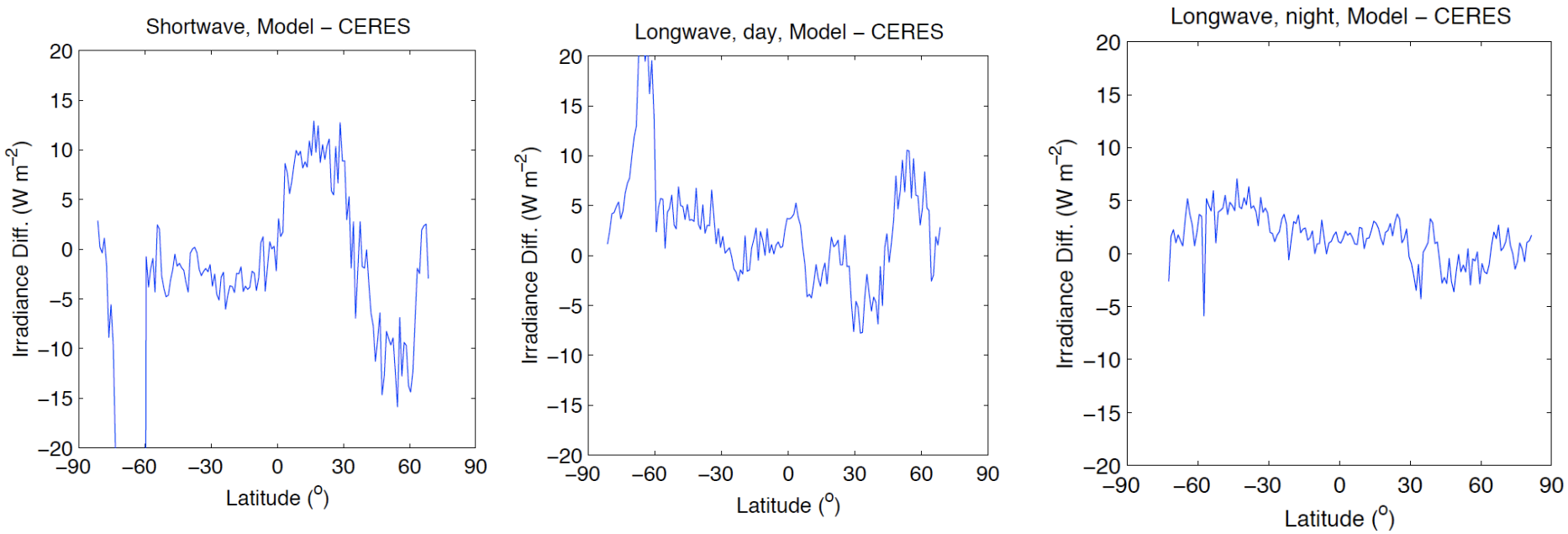
TOA irradiance comparison with CERES

	SW (W m^{-2})		LW (W m^{-2})	
	CCCM-CERES	CRS-CERES	CCCM-CERES	CRS-CERES
200607	4.71	4.84	-0.84	-0.02
200610	6.55	7.05	-1.91	-0.43
200701	5.56	6.53	-2.11	-0.32
200704	5.08	5.57	-1.78	0.37

CRS: MODIS only
CCCM: MODIS + CALIPSO + CloudSat
Based on all matched footprints
Need to be investigated some miss matched footprints (CCCM vs CRS) <~5%, when MODIS derived cloud properties are missing.

Footprints with missing cloud properties

are treated as clear ….



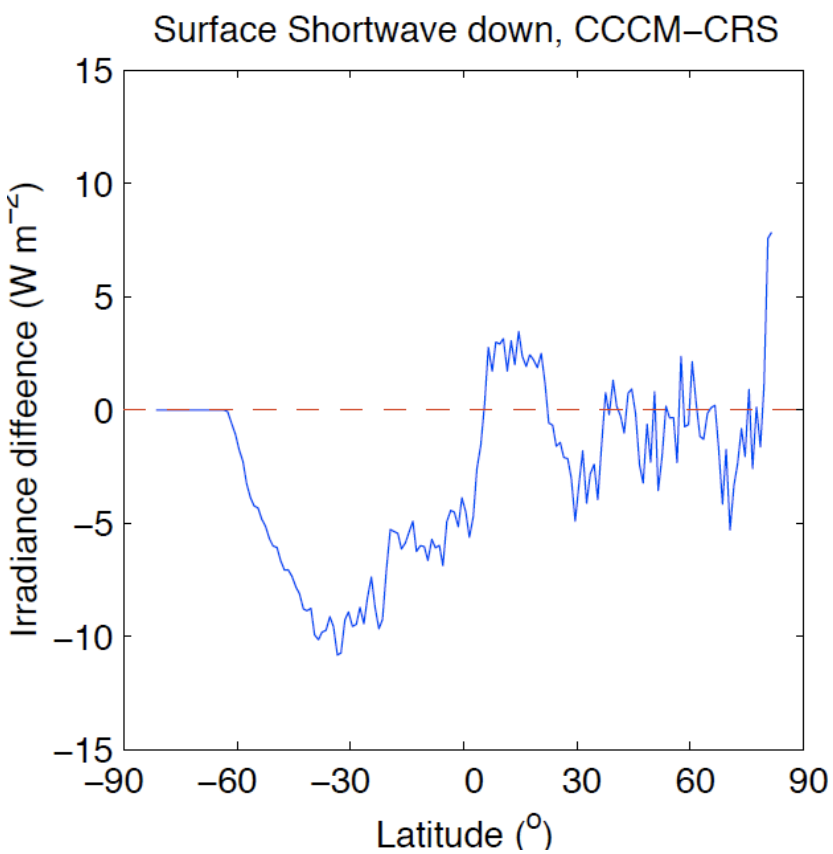
Computed irradiance comparison

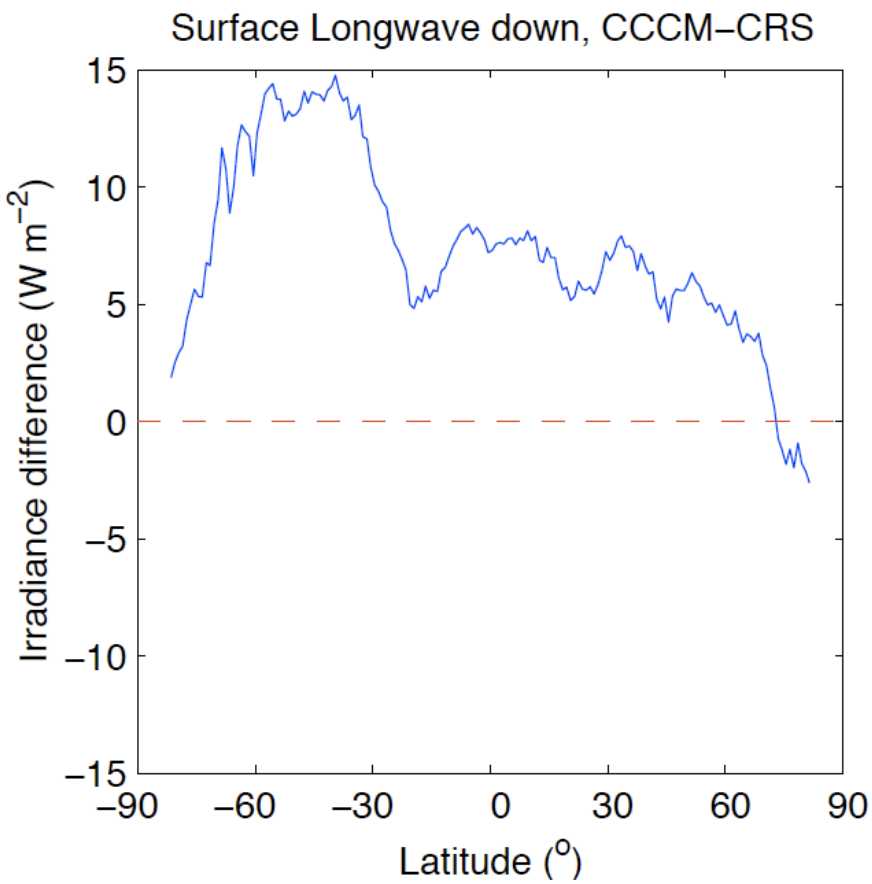
	CCCM	CRS	Difference (CCCM- CRS)
TOA SW down (W m^{-2})	488.3	488.3	
TOA SW up (W m^{-2})	127.4	127.9	-0.42
TOA LW up (W m^{-2})	236.9	238.5	-1.56
500 hPa SW down (W m^{-2})	412.6	405.7	6.92
500 hPa SW up (W m^{-2})	103.8	89.4	14.40
500 hPa LW down (W m^{-2})	147.9	144.3	3.60
500 hPa LW up (W m^{-2})	307.7	309.7	-2.00
Sfc SW down (W m^{-2})	279.2	282.9	-3.63
Sfc SW up (W m^{-2})	27.9	29.3	-1.40
Sfc LW down (W m^{-2})	353.0	344.9	8.07
Sfc LW up (W m^{-2})	404.3	403.1	1.15

Mean of instantaneous values from July 2006, Oct. 2006, Jan. 2007, and April 2007
Day + night for longwave

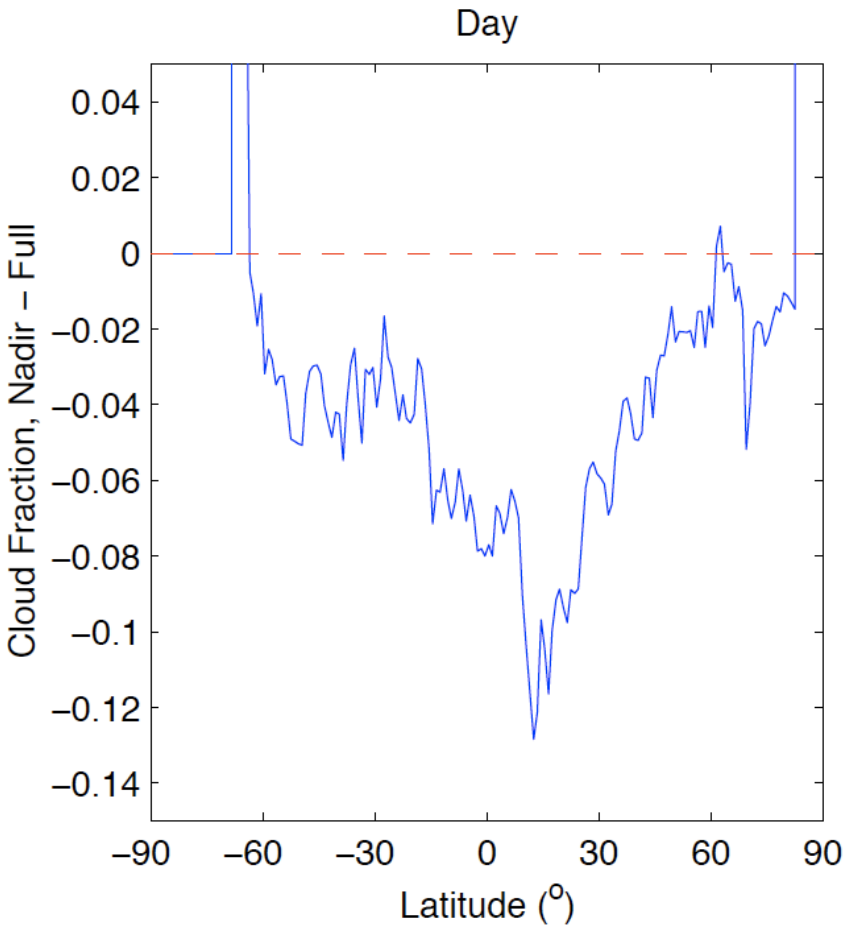
Values are area weighted global means

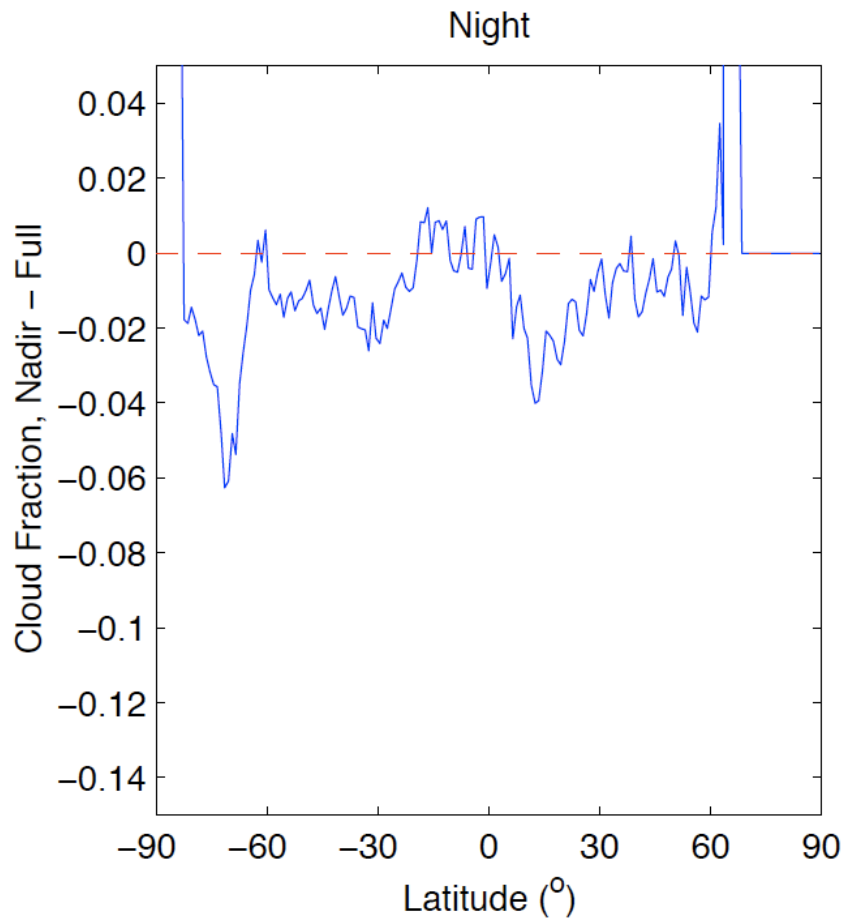
Zonal surface flux difference (July 2006)





Nadir vs. Full swath cloud fraction difference (June 2002)

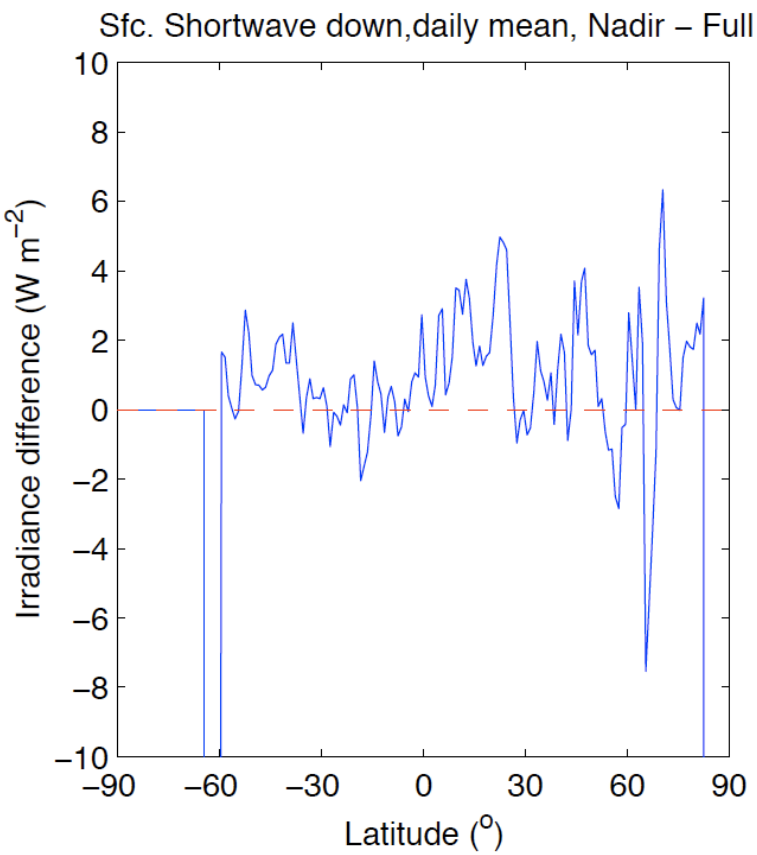


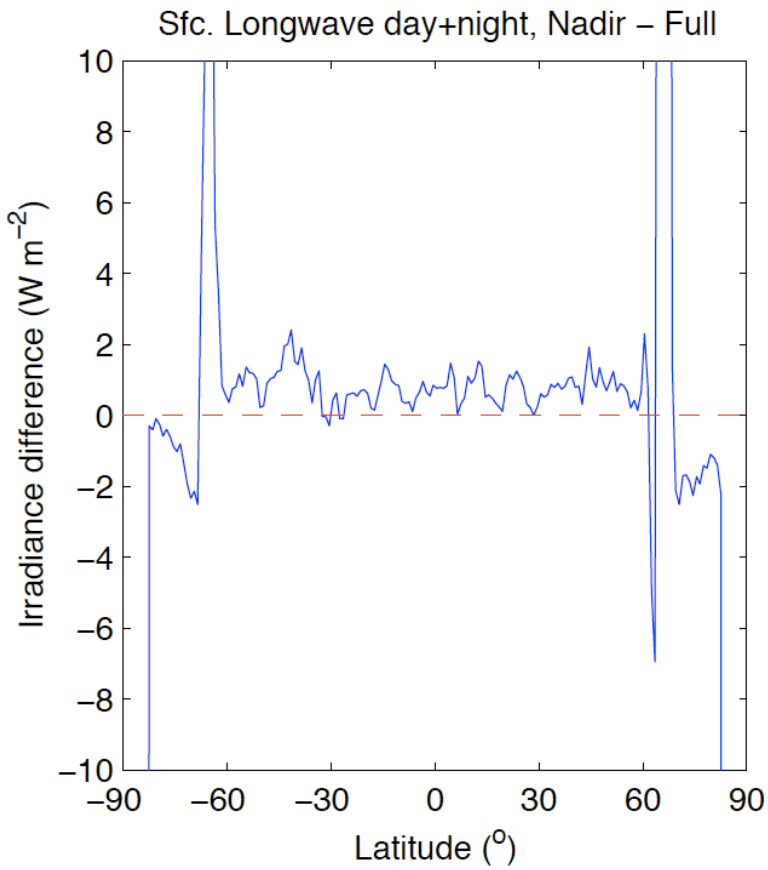


Global mean

	Day	Night	Day + Night
Nadir - Full	0.05	0.01	0.03

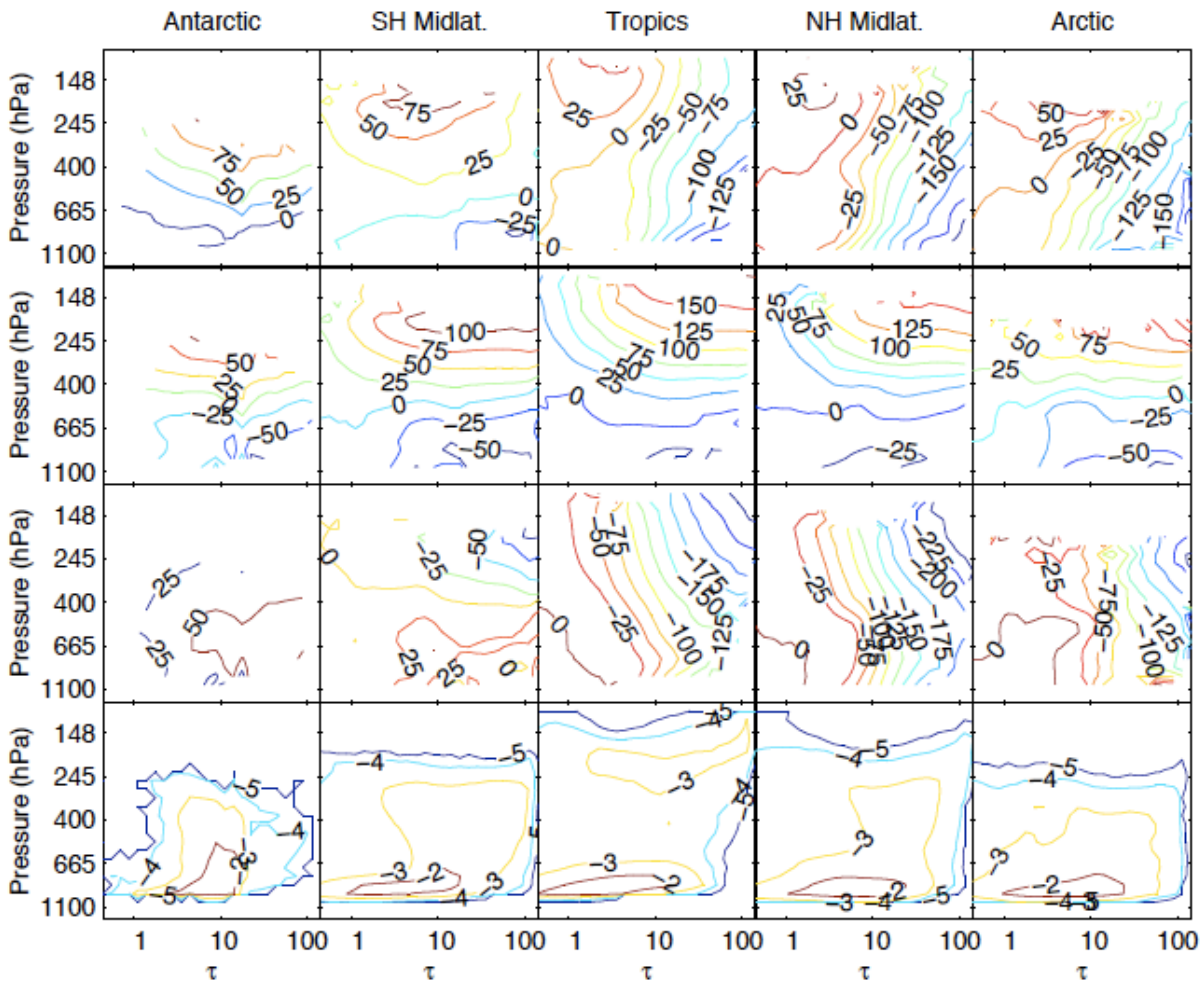
Nadir vs. Full swath surface Irradiance difference (June 2002)





	Daily SW (W m^{-2})	LW day + night (W m^{-2})
Nadir – Full (global)	0.95	-0.13

Cloud radiative effects

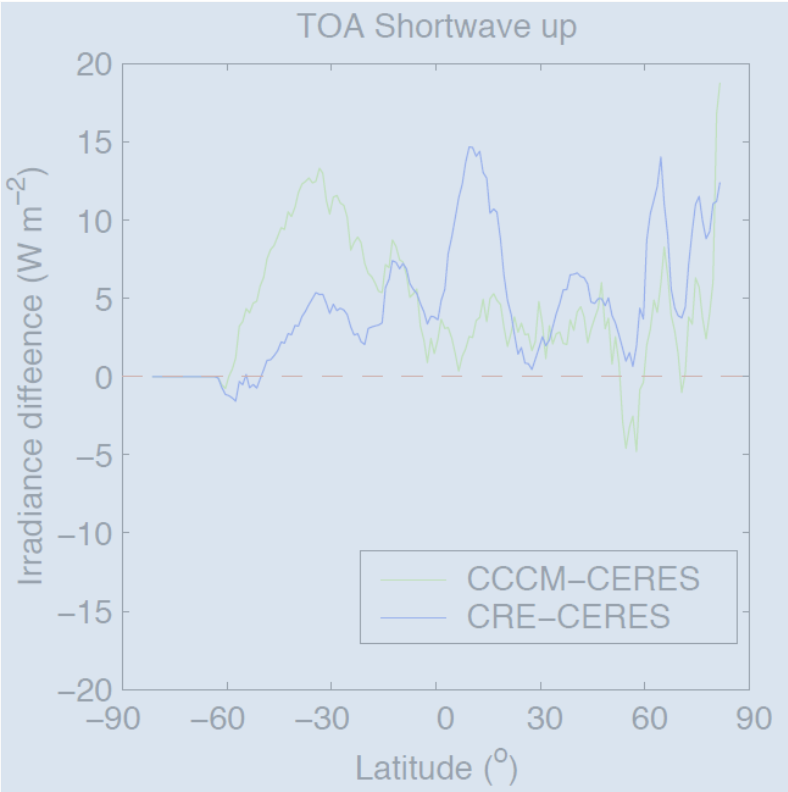


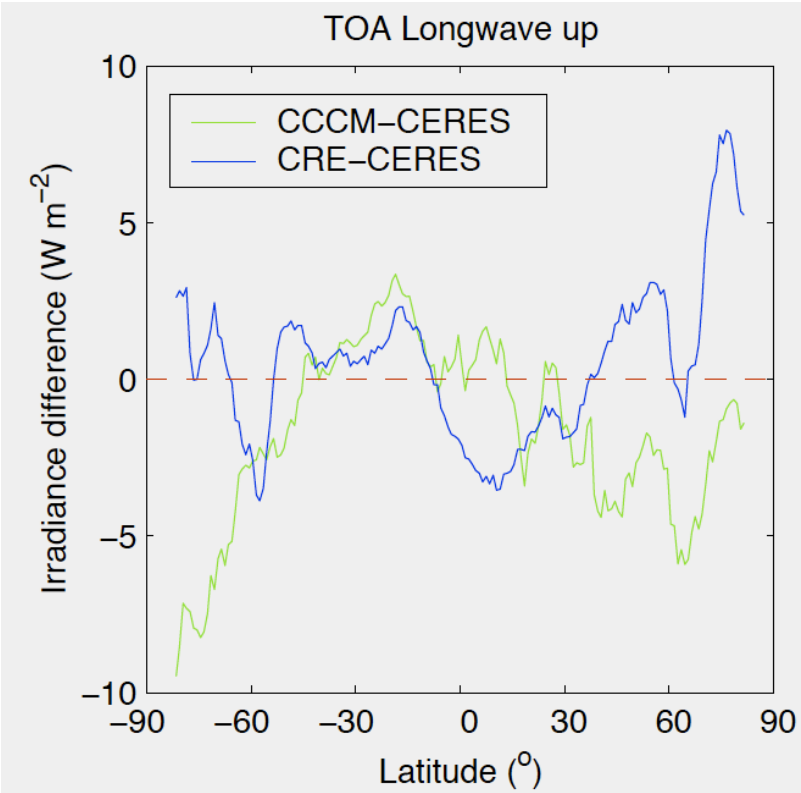
Top) at TOA, 2nd) to the atmosphere, 3rd) at the surface, and bottom) log of frequency of occurrence

Summary and conclusions

- 4 months of CCCM data are now available from the Langley ASDC through http://eosweb.larc.nasa.gov/PRODOCS/ceres-news/table_ceres-news.html
- CCCM TOA shortwave flux improves slightly compared with CRS untune but the difference from CERES LW flux is larger compared with CRS untune. The vertical extinction coefficient profile is needed to improve further.
- CCCM downward surface longwave flux is significantly larger (~8.1 Wm^{-2}) compared with CRS because of lower cloud base height. Incomplete screening of precipitations might be a part of he reason. But to see whether or not this is actually an improvement, we need to look ground-based observations.
- The effect of nadir view versus full swath on surface flux computations is probably negligible for longwave and about +1 W m^{-2} for shortwave when the flux is averaged over the globe. The regional effect cloud be larger (~5 W m^{-2} <= shortwave, ~2 W m^{-2} <= longwave).

TOA radiative flux comparison (200607)





Separating clouds into multiple layers appears to lower TOA shortwave over tropics

LW problem over polar region is due to uncertainty in cloud optical thickness and the vertical extinction profile