

# CRS Issues and Plans

(but fasten seat belts for Fred's talk on SYNI)

## Surface and Atmosphere Radiation Budget (SARB)

Clouds and the Earth's Radiant Energy System (CERES)

Science Team Meeting at Williamsburg, Virginia (2-4 May 2006)

**T. P. Charlock** (NASA LaRC)

**Fred G. Rose** (AS&M) algorithm development

**David A. Rutan** (AS&M) CAVE validation

**Zhonghai Jin** (AS&M) coupled ocean atmosphere radiative transfer

. **Seiji Kato** (H.U.) - modification of LaRC Fu-Liou code

**Wenying Su** (H.U.) - surface UV and PAR algorithms

**Lisa H. Coleman, Thomas E. Caldwell, Scott Zentz** (SAIC) - Data Management

**David Fillmore and Bill Collins** (NCAR) aerosol assimilation

SARB/SOFA Working Group Wed. AM:

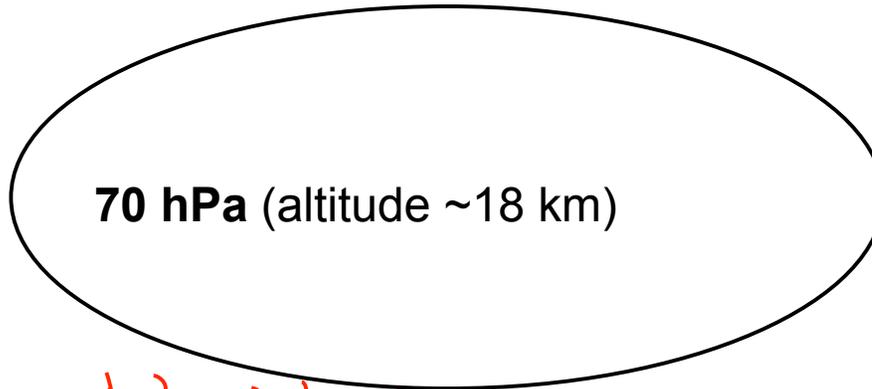
SOFA Issues (Kratz), ARM Collaboration (Rutan), Ocean albedo update (Jin)

**[www-cave.larc.nasa.gov/cave/](http://www-cave.larc.nasa.gov/cave/) or goggle "CERES CAVE"**

# SARB vertical profile at ~2,000,000 CRS footprints/day

*Gridded SYNI, which has surface UV, etc., coming soon (90 min.)*

NCEP O3(z)  
Mostly from SBUV/2



*Handwritten red scribbles*

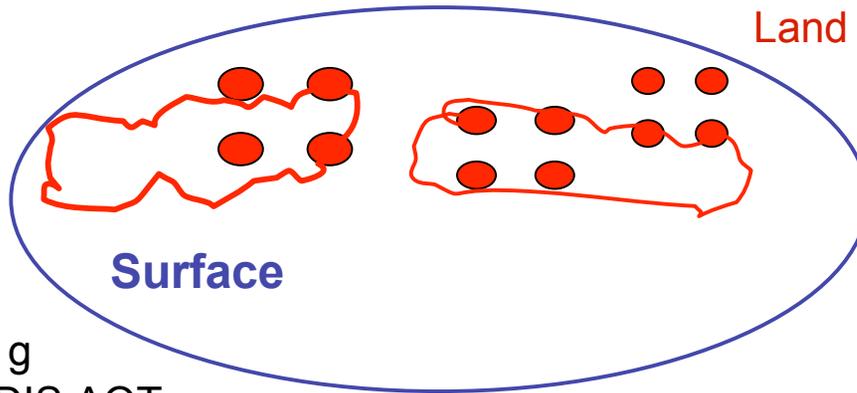
MODIS ~1km pixels provide

GEOS4 T(z), q(z), surface wind  
Wind speed affects ocean surface albedo

Cloud properties (almost always)

Aerosol AOT (sometimes)

Land skin temperature (if clear)



MATCH aerosols  
Always used for SSA & g  
Used for AOT if no MODIS AOT

← ~20-50 km →

**Large CERES footprint  
for TOA flux**

[www-cave.larc.nasa.gov/cave/](http://www-cave.larc.nasa.gov/cave/) or goggle "CERES CAVE"

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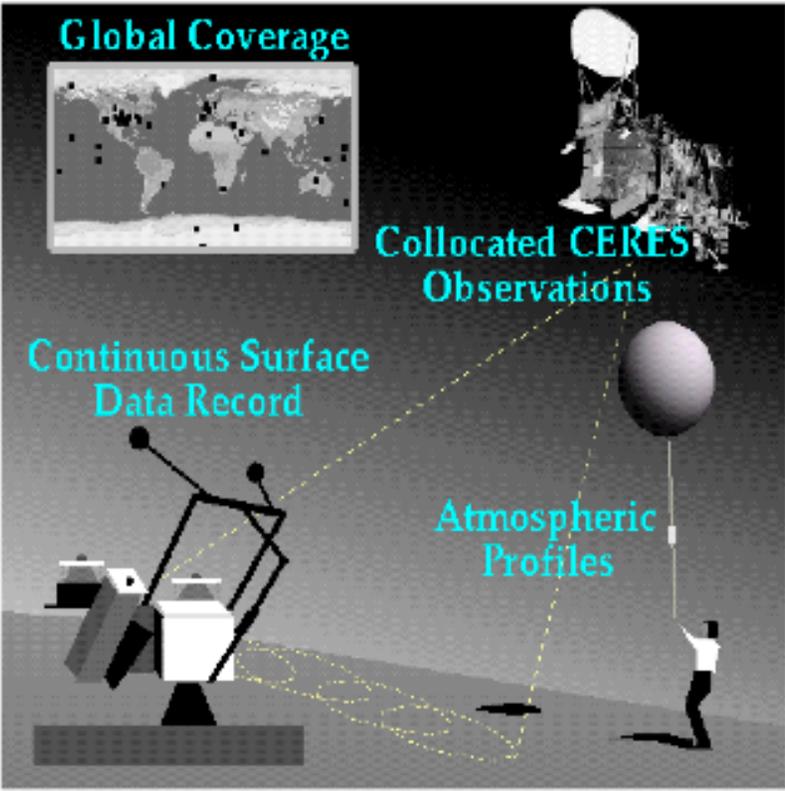
## NASA Langley CERES ARM Validation Experiment CAVE



[Home](#) [Surface Observations](#) [CERES CRS Data](#) [CERES ESS Data](#) [Atmospheric Profiles](#) [Useful Links](#)

Welcome to the CAVE web site. Data collected in this effort are meant for use in validation studies of Clouds & The Earth's Radiant Energy System ([CERES](#)) instruments operating on the Tropical Rainfall Measurement Mission ([TRMM](#)) and Earth Observing Systems(EOS) [Terra](#) (soon [Aqua](#)) satellites.

**Important Change to CAVE Surface flux, Aerosol, Meteorology (SAM) Files**  
[Please Read for Details](#)

<p><b>CAVE Data Info &amp; Validation Results</b></p> <p>Overview and Site Map</p> <p>Plot CAVE Data On Line</p> <p>Validation Plots &amp; Statistics</p> <p>Publications</p> <p>Cloud Fraction In CAVE</p> <p>Aerosols In CAVE</p> <p>Updates Mar 23, 2005</p> <p>The Group</p>	 <p><b>Global Coverage</b></p> <p><b>Collocated CERES Observations</b></p> <p><b>Continuous Surface Data Record</b></p> <p><b>Atmospheric Profiles</b></p> <p>Referencing CAVE data</p>	<p><b>Radiation Transfer &amp; Related Links</b></p> <p>COART Coupled Ocean-Atmos RT Model</p> <p>Ocean Albedo Look-up Table</p> <p>Point &amp; Click Fu &amp; Liou</p> <p>CRS Advice</p> <p>CLAMS</p> <p>ULDB Balloon Observations</p> <p>Site Map</p>
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# TOA Flux Validation

## Instantaneous Footprint Results

### Terra, 70 Months of CRS Ed2B, “clear” - imager

Upward Untuned TOA Flux Biases (Model-Obs)(W/m2)					TOA Aerosol Forcing		
	All Sky		Clear Sky		Clear-Pristine		SW
	LW	SW	LW	SW	LW	SW	CNA*
ARM/SGP	+2	+2	+0	-1	-0	+5	+5
Island Sites	-2	+17	-4	+7	-1	+10	+4
Polar Sites	+3	+16	-2	+6	-0	+1	+1
SURFRAD	-1	-1	-1	+0	-0	+6	+5
European	+2	+8	-0	-2	-0	+9	+4
Validation Sites	+1(8)	+11 (27)	-1(5)	-0(6)	-1	+6	+4

\*Difference model run with clouds and aerosols and model run with clouds, no aerosols.  
 (SW is daytime only, LW is day and night. )

# Surface Flux Validation

## Instantaneous Footprint Results

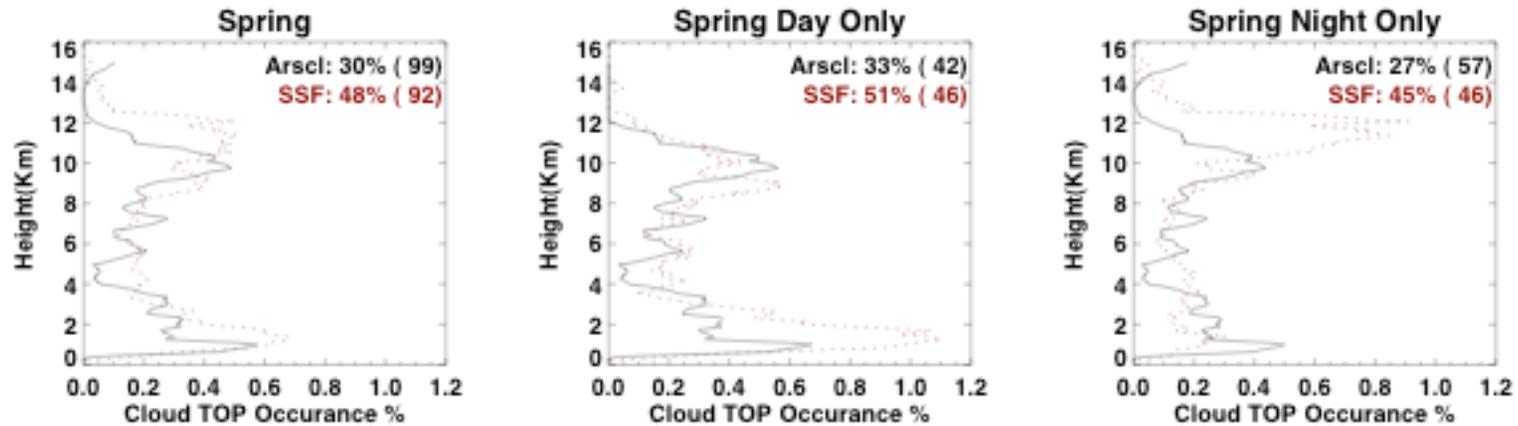
Terra, 70 Months of CRS Ed2B, (“clear” – imager)

Downward Untuned Surface Flux Biases (Model-Obs)(W/m2)					SFC Aerosol Forcing		
	All Sky		Clear Sky		Clear-Pristine		SW
	LW	SW	LW	SW	LW	SW	CNA*
ARM/SGP	-7	+8	-8	+3	+1	-16	-16
Island Sites	-3	+25	0	+14	+1	-9	-7
Polar Sites	-4	+11	-7	-3	+0	-4	-3
SURFRAD	-8	+11	-9	-0	+1	-17	-16
European	-6	+21	-3	+0	+2	-27	-19
Validation Sites	-6 (23)	+13 (94)	-9 (15)	+2 (29)	+3	-16	-10

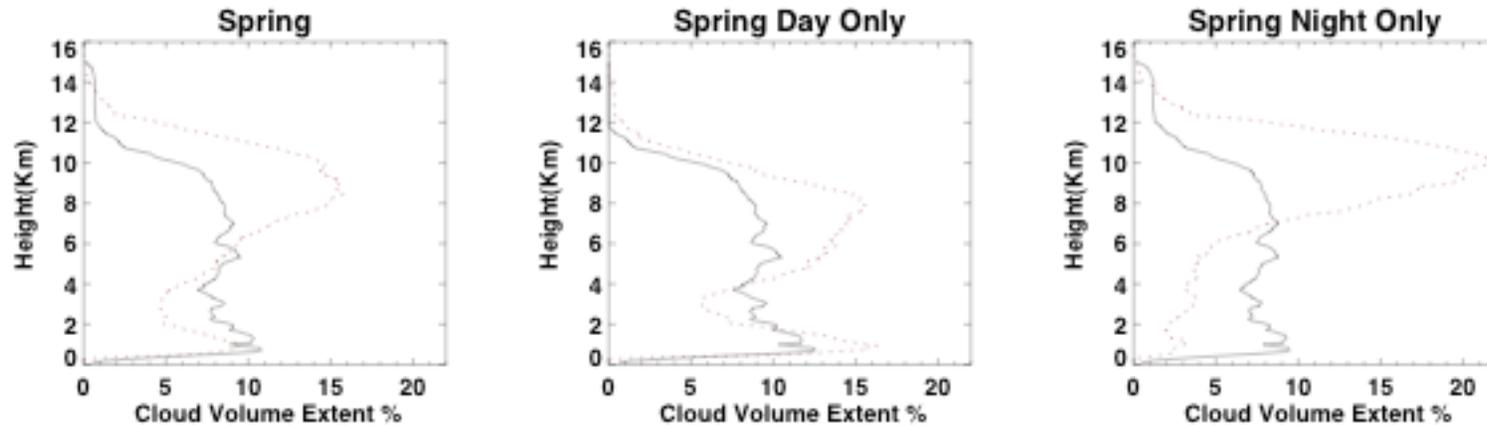
\*Difference model run with clouds and aerosols and model run with clouds, no aerosols.  
(SW is daytime only, LW is day and night. )

Rutan's presentation in SARB/SOFA WG tomorrow uses  
Kato-Rose analysis of ARM radar and SSF clouds

### Cloud TOP Occurance % ARSL(Black Solid) SSF(Red Dotted) SGP E13 Mar2000-Feb2003



### Cloud Volume Extent % ARSL(Black Solid) SSF(Red Dotted) SGP E13 Mar2000-Feb2003



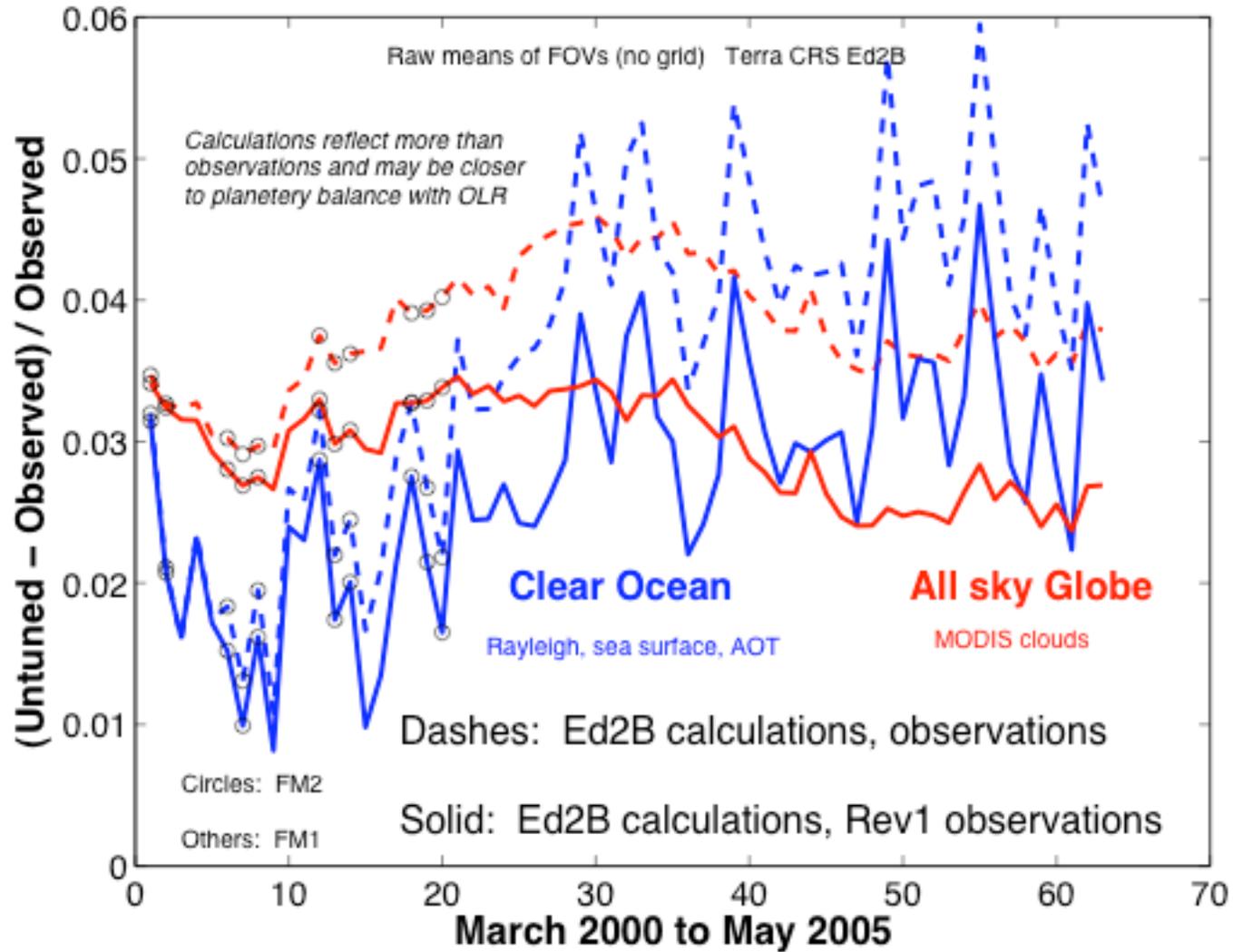
One month comparison of BBHRP with CRS Terra Ed2B  
 Full report by Rutan in tomorrow's WG session

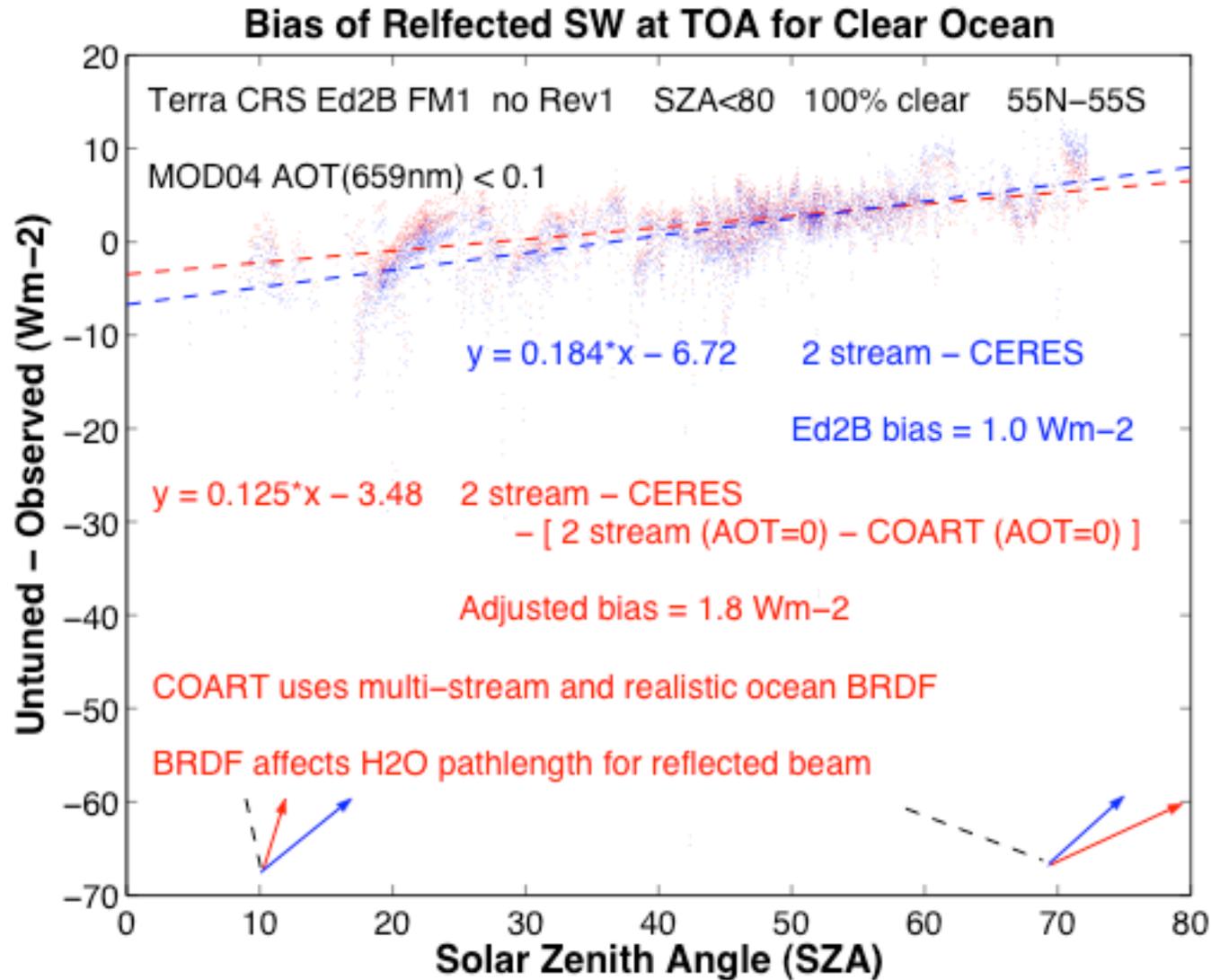
ARM Broadband Heating Rate Profile BBHRP (Mlawer et al.)  
 RRTM radiative transfer code  
 Uplooking active and passive sensors in narrow FOV  
 Aerosol SSA by tuning diffuse MFRSR  
 Surface albedo from downlooking MFRSR tower

	Longwave Bias (RMS) ( $W/m^2$ )				Shortwave Bias (RMS) ( $W/m^2$ )			
	All Sky		Clear Sky		All Sky		Clear Sky	
	BBHRP	CRS	BBHRP	CRS	BBHRP	CRS	BBHRP	CRS
<b>TOA</b>	+10(21)	+3(9)	+1(4)	+1(5)	+14(70)	-7(23)	+5(17)	-5(7)
<b>Surface</b>	-5(15)	-7(18)	-3(7)	-7(11)	-24(86)	-12(79)	+3(11)	-10(27)
<b>N samples</b>	72	72	24	24	25	29	6	8

Table 1. Model biases with respect to observations for LW & SW flux up at the top of atmosphere and LW & SW flux down at the surface.

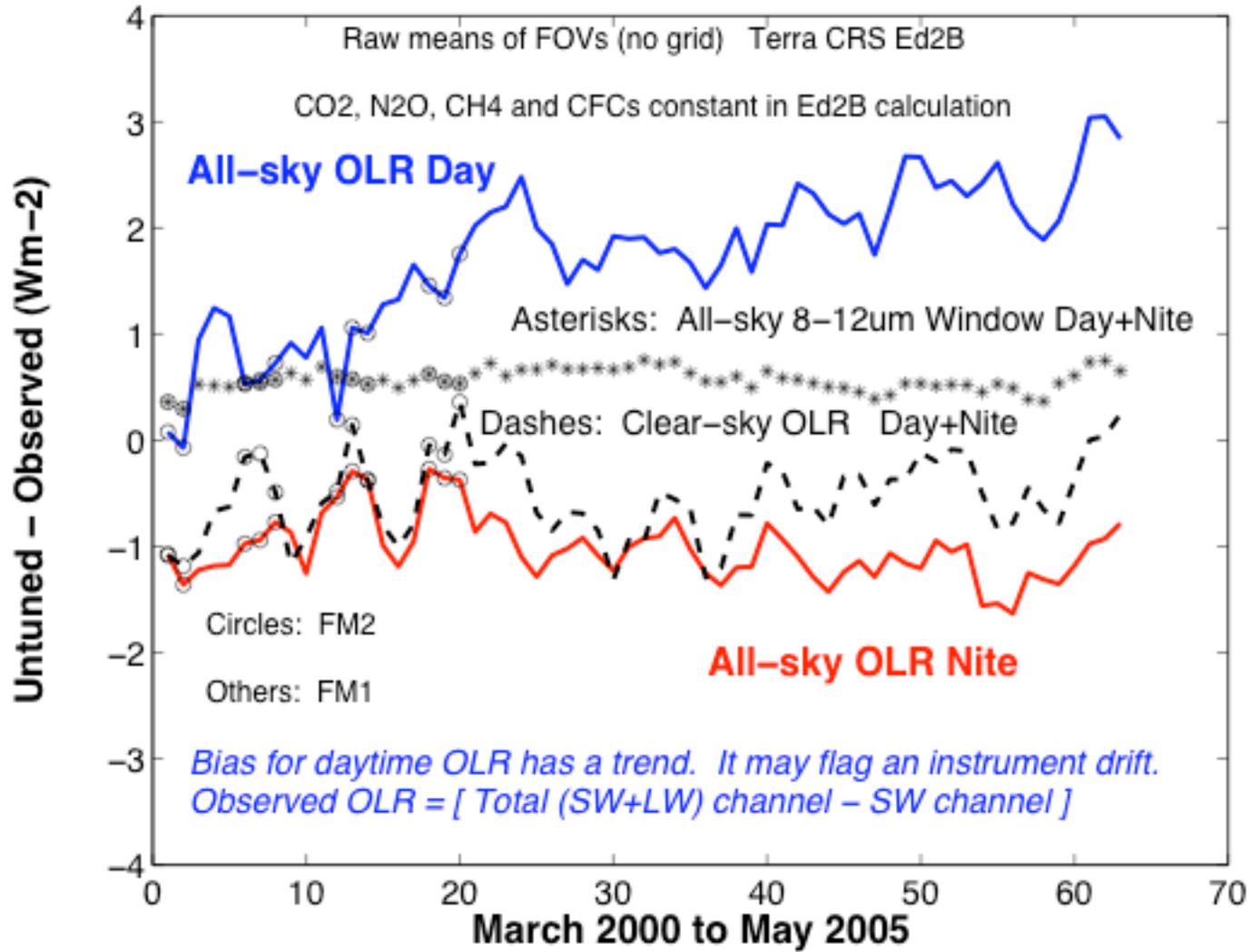
### Relative Bias of SW at TOA --- Deseasonalized





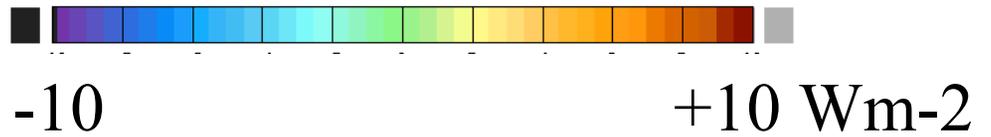
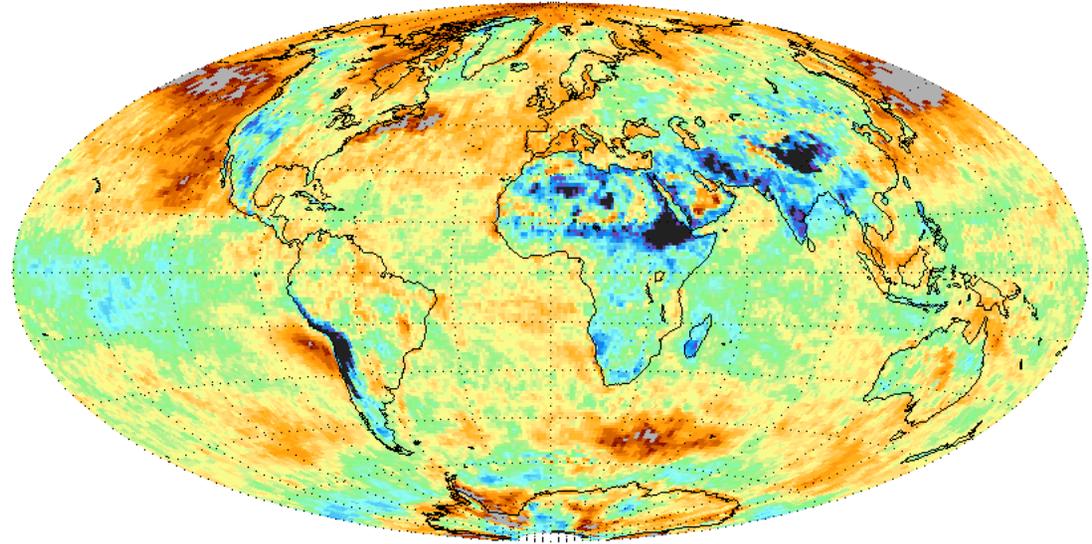
Clear ocean SW at TOA: Multi-stream COART would reduce SZA-dependent bias now seen in 2-stream CRS Ed2B, but slightly increase the domain mean bias.

### Bias of LW at TOA --- Deseasonalized

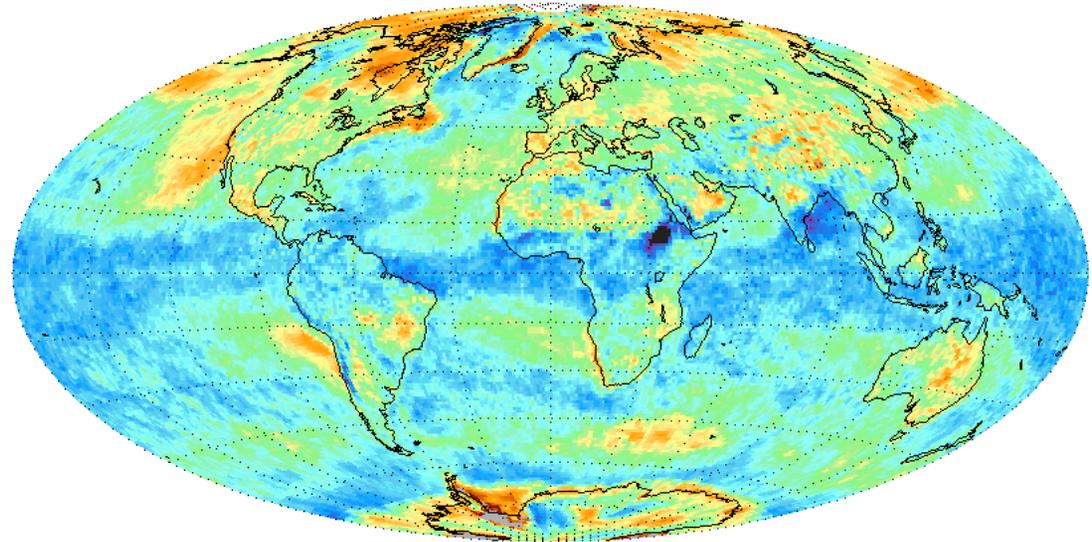


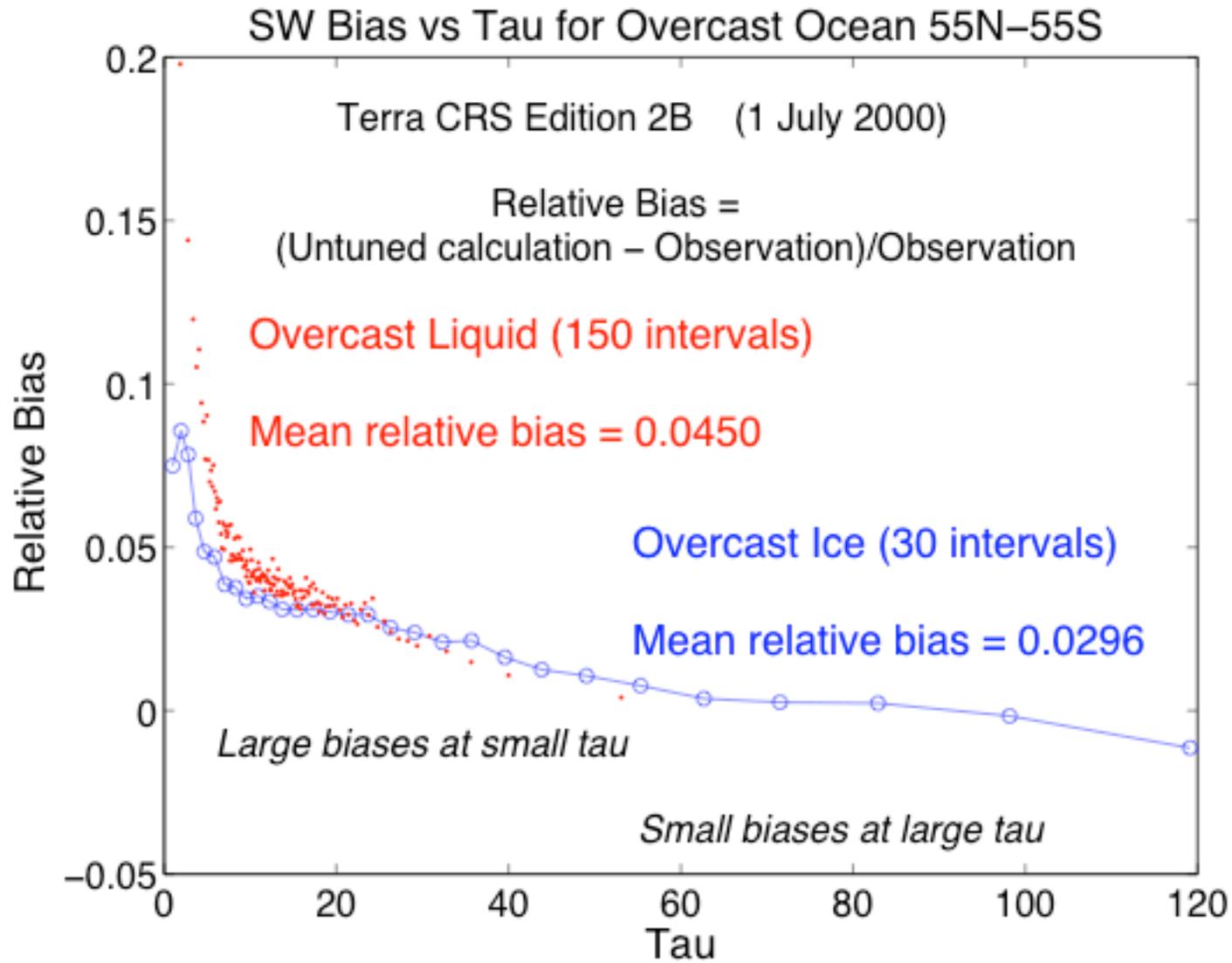
OLR bias =  
Untuned-Observed  
Day (April 2002)

(UT-OBS) LW TOA  
CER\_FSWB\_Terra-FM1-MODIS\_Edition2C\_018020.200204  
200204.day



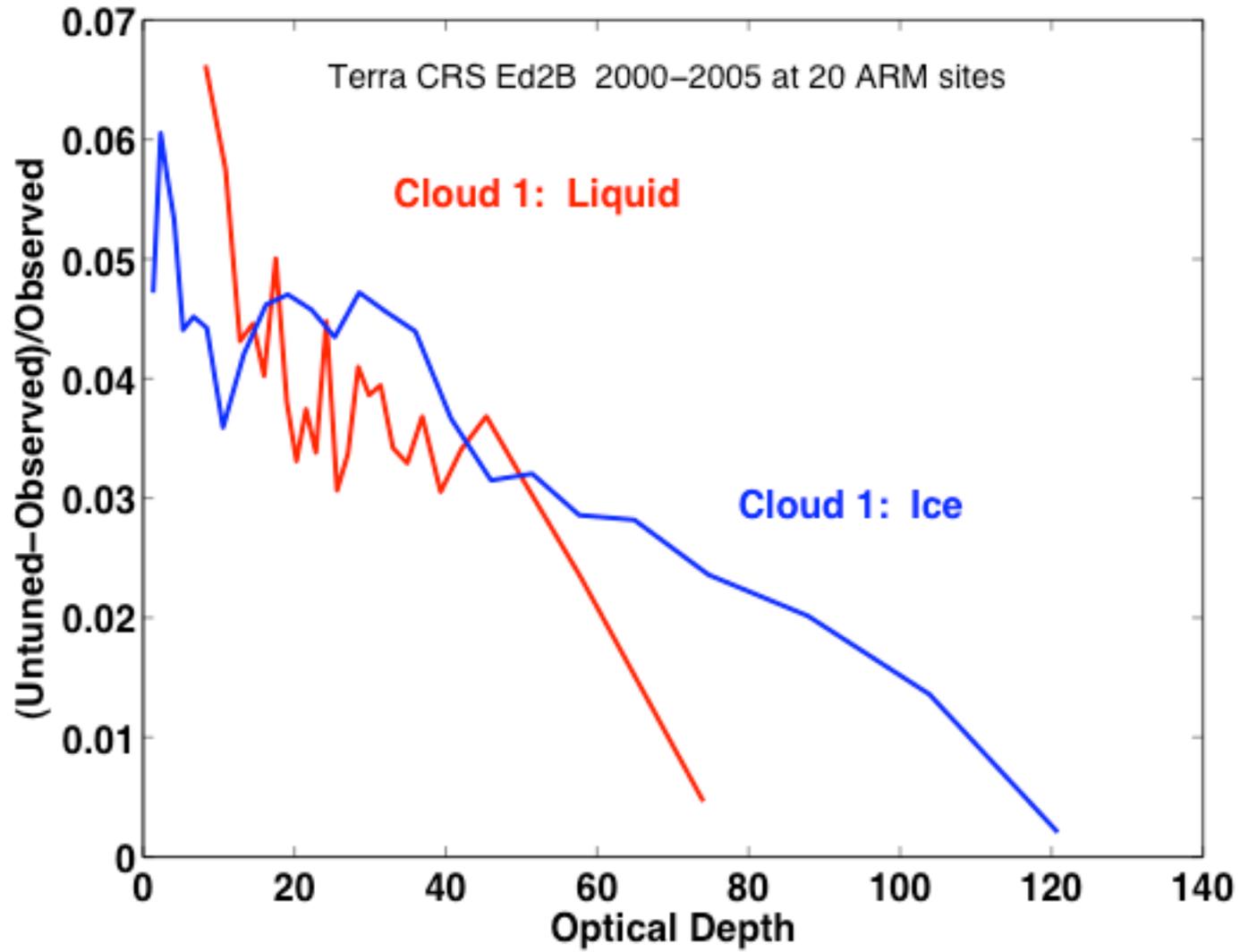
Nite (April 2002)

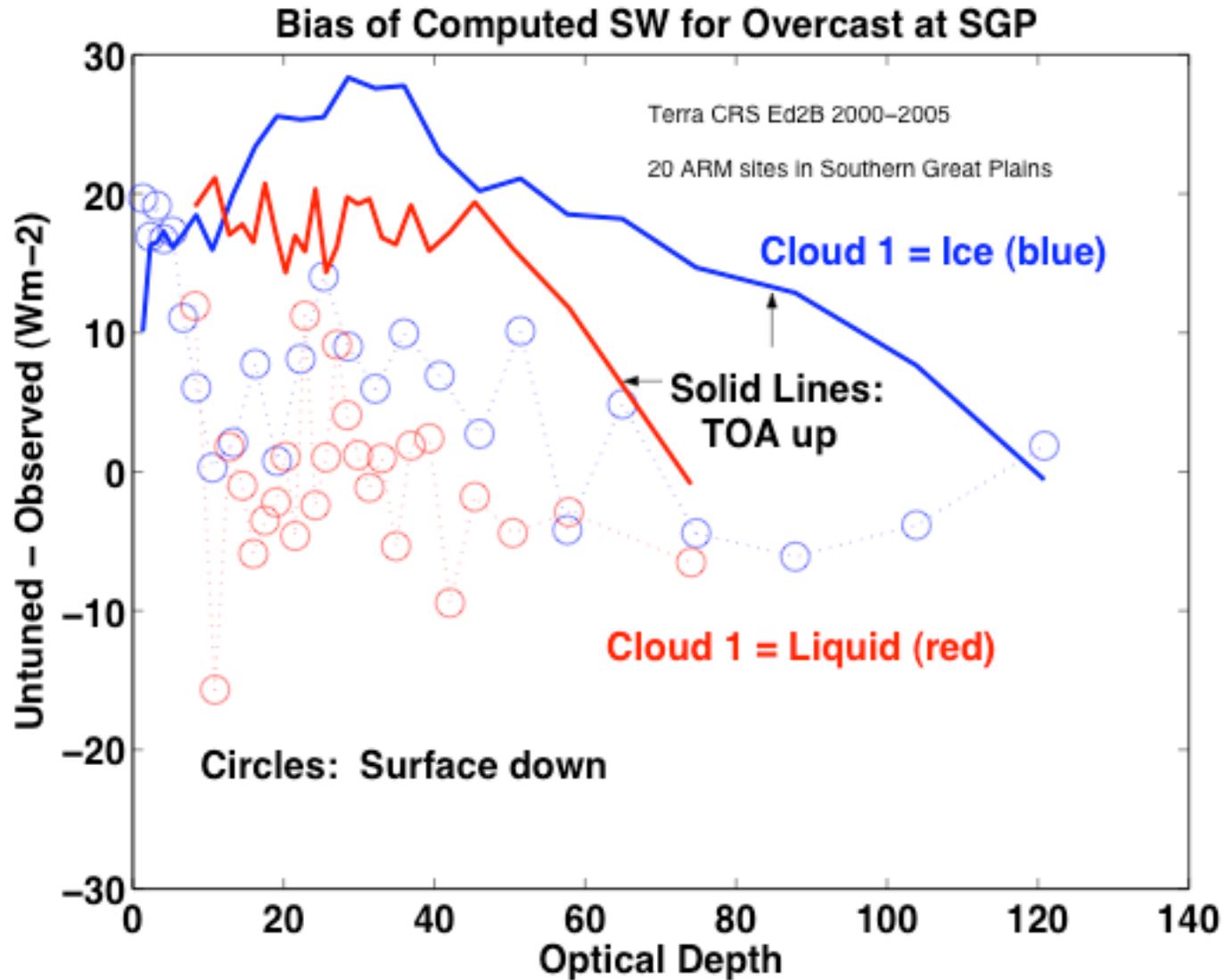




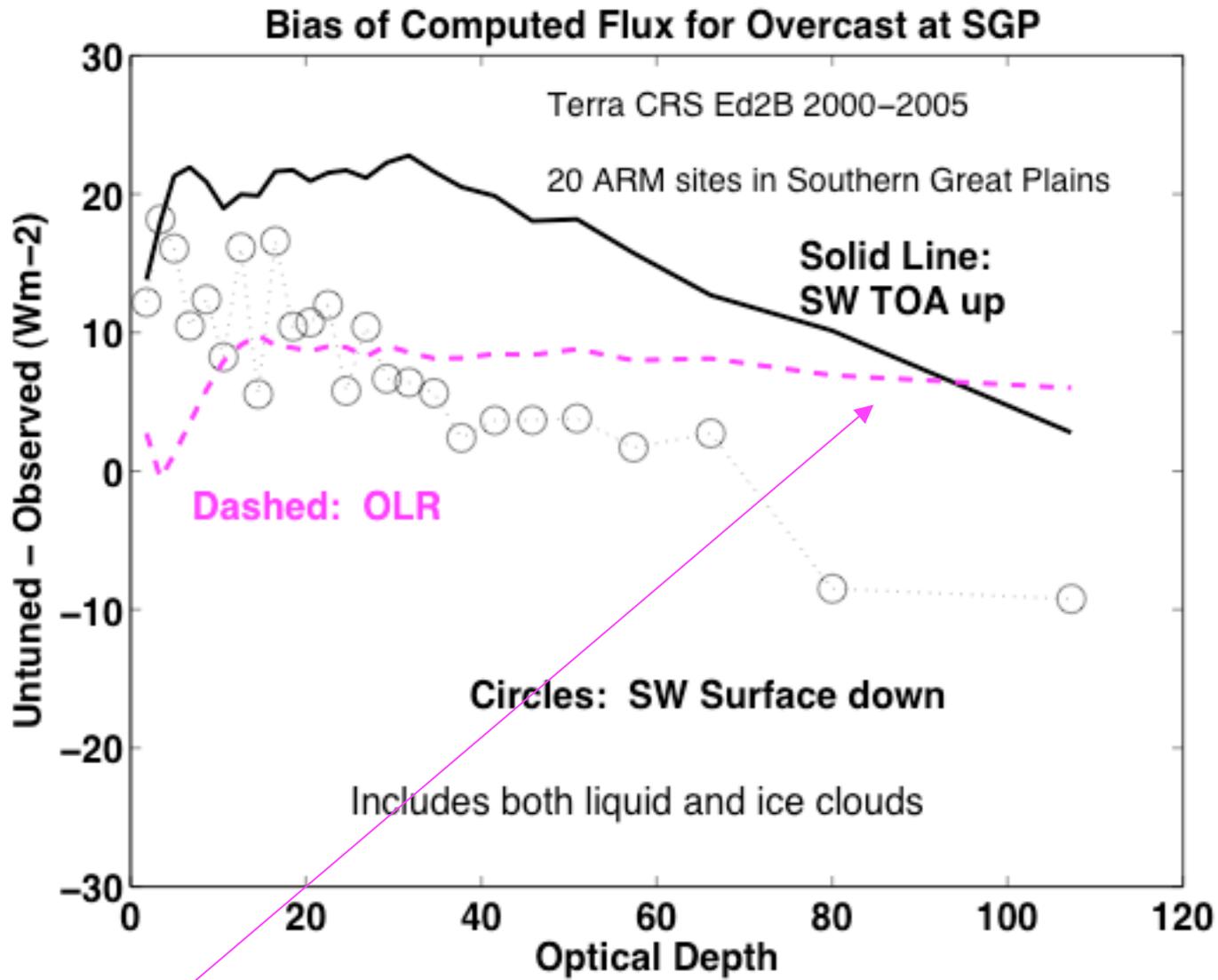
Calculations show possible effect of effect of aerosols on relative bias. Say cloud  $\tau=20$ , where relative bias above is 0.03 or about 20  $\text{Wm}^{-2}$  for  $\cos\text{SZA}=0.8$ . Aerosol ( $\text{AOT}=0.2$ ) would then increase TOA by only 1.3  $\text{Wm}^{-2}$ . But “double counting” of aerosols at small cloud  $\tau$  could be important. AOT effect on cloud retrieval needed.

### Relative SW Bias at TOA for Overcast at SGP

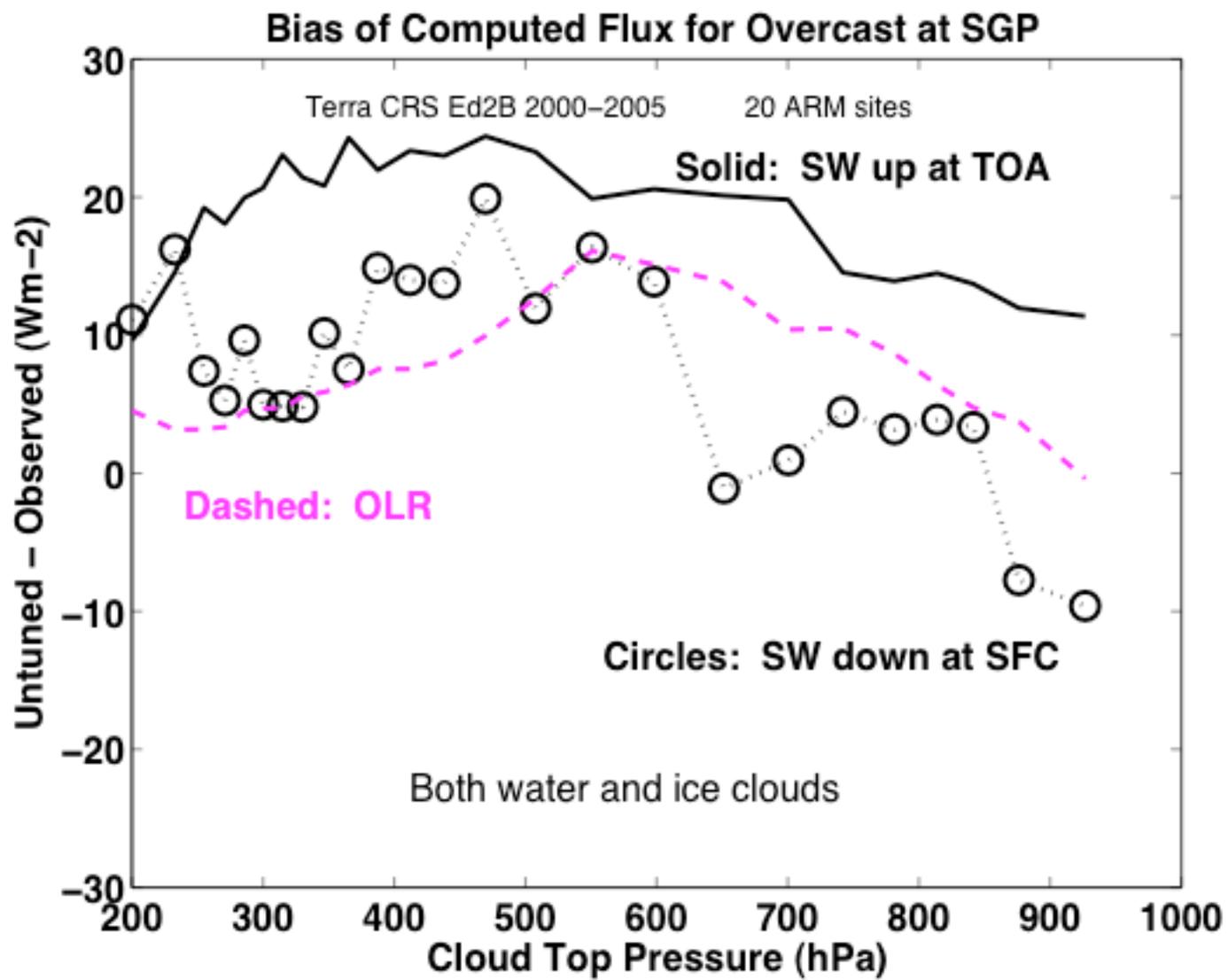


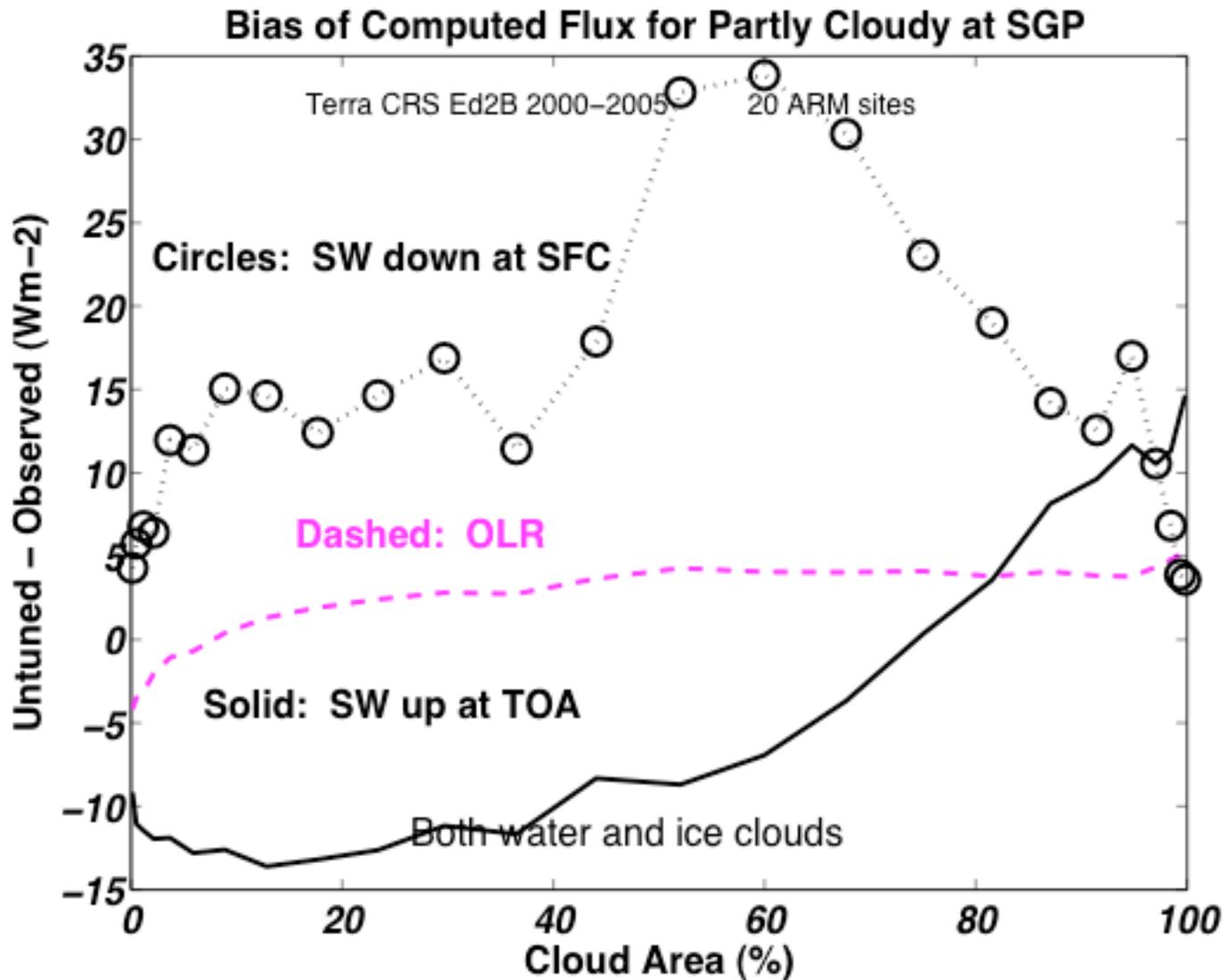


Low and moderate optical depth clouds are  
a problem over land, too.



These clouds are essentially black. The OLR bias for clouds is too large in this daytime-only plot.



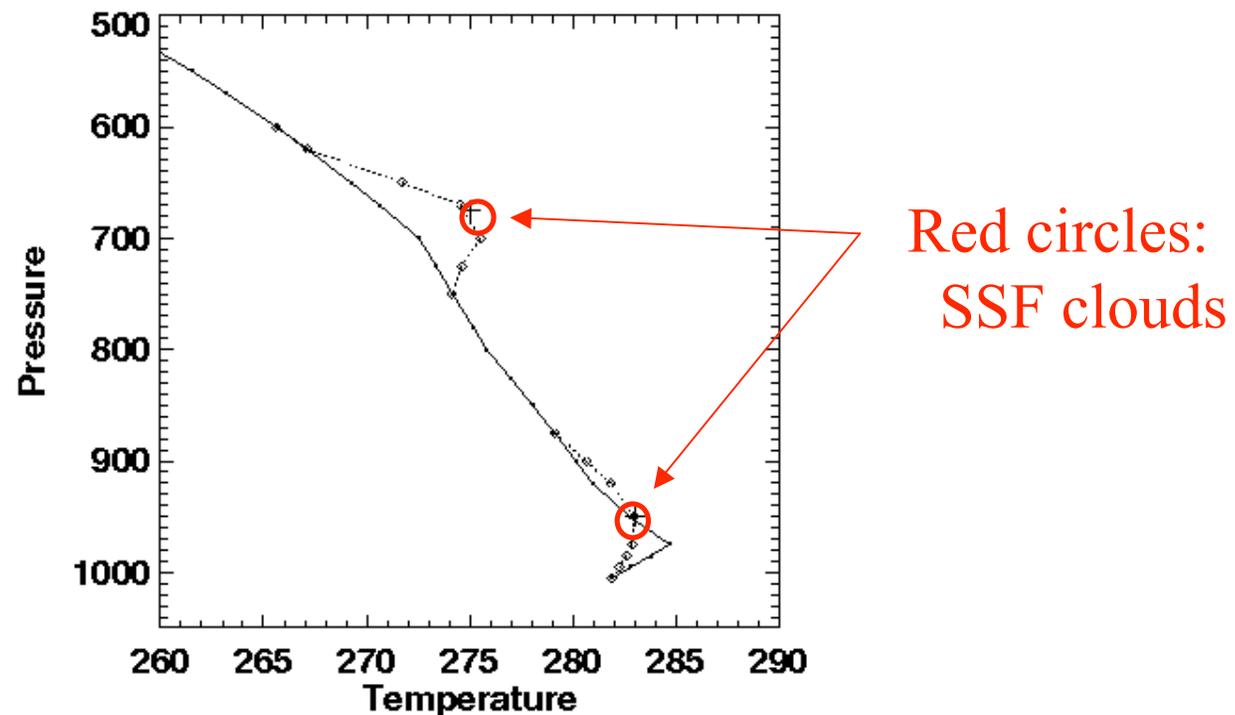


BIAS (RMS)	CLEAR	PARTLY CLOUDY	OVERCAST	
SW up TOA	-1 (4)	-3 (25)	19 (29)	<i>Day only</i>
SW down SFC	3 (22)	14 (117)	8 (95)	<i>~1030 LST</i>
OLR	1 (4)	2 (10)	7 (12)	<i>No nite</i>
LW down SFC	-13 (21)	-8 (21)	-4 (17)	<i>samples</i>

Minnis SSF cloud retrieval uses lapse rate adjustment to GEOS4 to improve characterization of marine boundary layer. The retrieved cloud temperature is fairly independent of GEOS4. Cloud top pressure is also retrieved.

Terra CRS Edition 2B SARB uses GEOS4 for  $T(z)$  and  $q(z)$ , assigning the SSF cloud to the GEOS4 profile using cloud top pressure.

Here test new method. Use SSF cloud temperature explicitly and adjust the GEOS4 lapse rate using Cloud WG concepts.



**Standard Ed2B method:**

Bias / Std (Wm-2)

1.04 / 8.58 Edition 2B

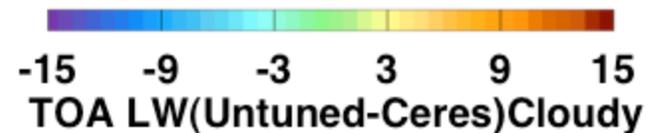
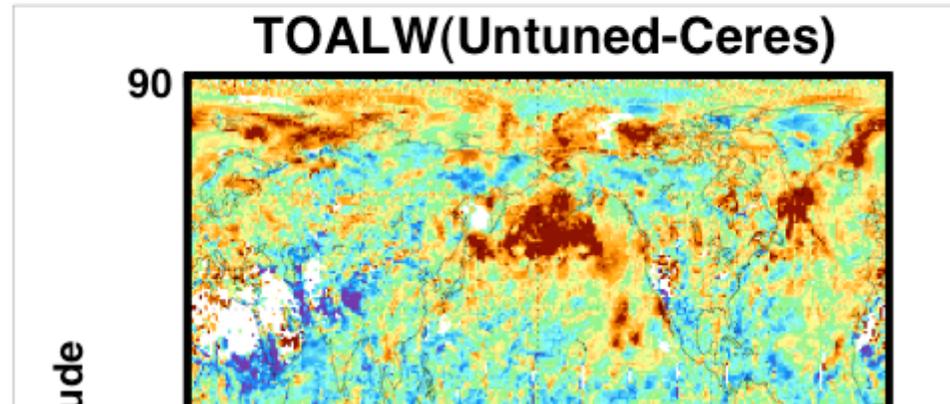
*Bias/Std values for globe  
Plots show only NH*

**Test with new SARB  
placement of SSF cloud  
and sounding adjustment:**

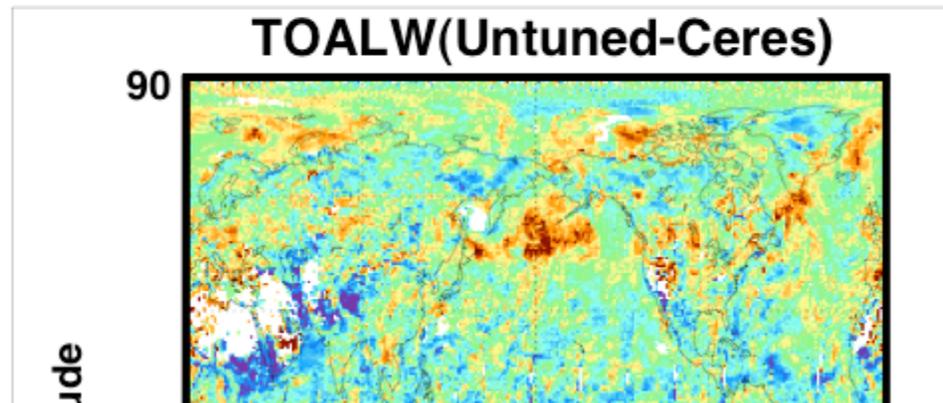
Bias / Std (Wm-2)

-0.65 / 7.42 Test version

**ED2b Cloudy 20030629**



**Test Ed3 CRS Tadj(Peff,Teff) Cloudy 20030629**



# *COVE Beach Cleanup of SSF and CRS for Aqua*

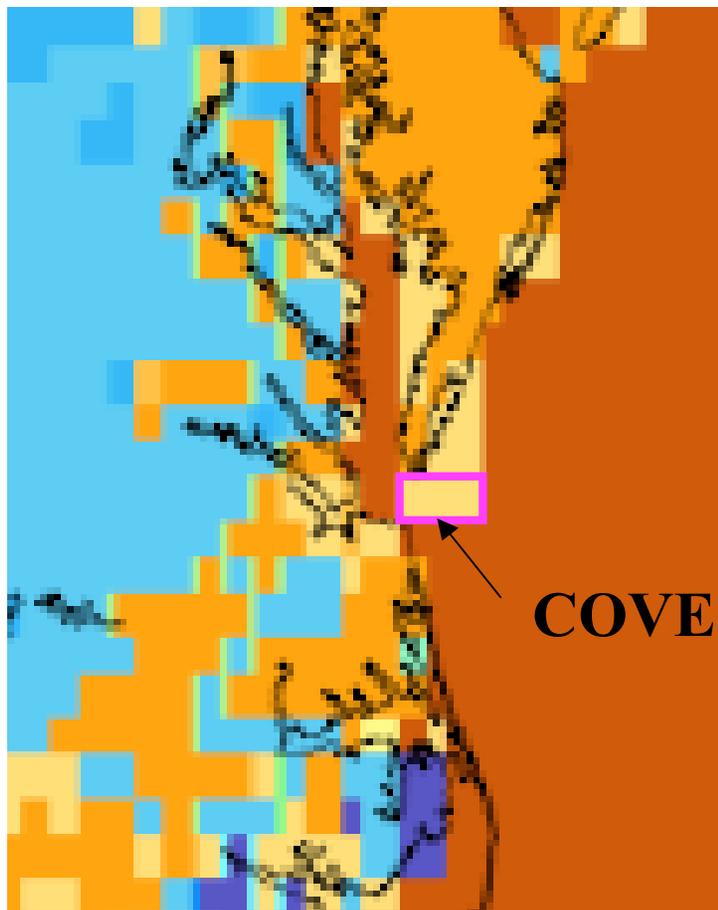
Bias    RMS    Std    (Wm-2)    for Reflected SW TOA <25km of COVE

34       42       25

Decembers of 00-04    (Terra Ed2B)

14       18       11

*December 02    (SCF run of Aqua)*

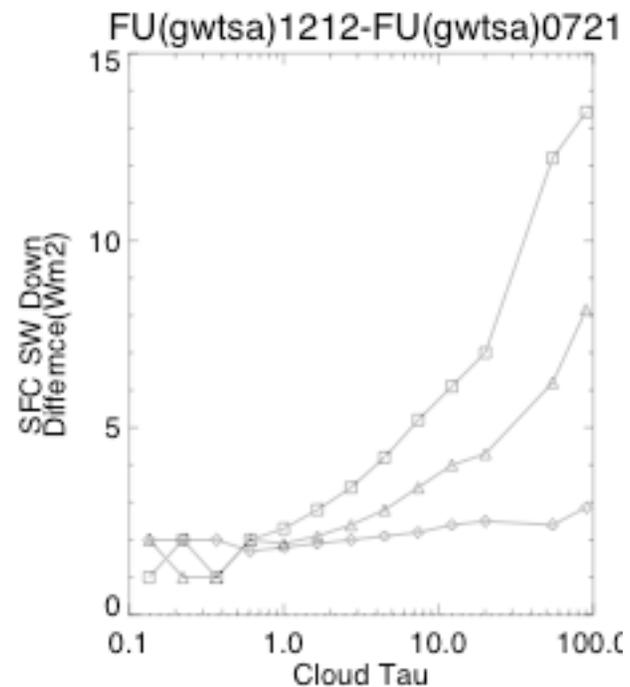
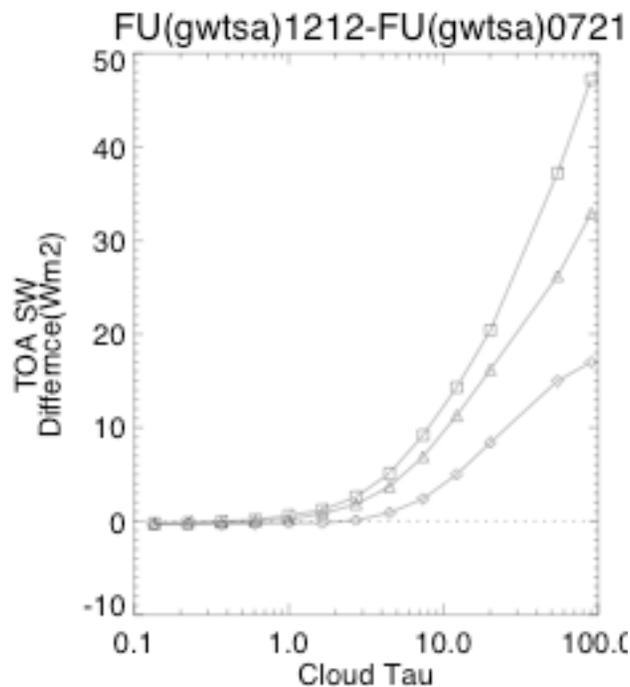


This is a CERES map of IGBP types near Tidewater, Virginia. The area within the **magenta rectangle** appears to contain 3 tiles (with each tile 10 minutes by 10 minute) of IGBP type 12 (cropland). This wrecks Terra CRS Edition 2B validation at COVE, which is the sole site with surface radiometers deployed over water that subscribe to BSRN protocols. For Aqua CRS Val processing, this has “COVE Beach Problem” been cleaned up.

Kato and Rose revise LaRC Fu-Liou code again for Edition 3. A band that spanned 0.7-1.3 micron is now split into 3 parts for more rigorous treatment of the overlapping absorption by water vapor and cloud particles.

The new way reduces absorption by the atmosphere for ice clouds; a large effect at high optical depths.

Will be tested with CAVE “Grand Time Series” (GTS).



This summary from last meeting still holds for Terra CRS Edition 2B:

SARB calculations are noisy (compared with data) and they:

- *reflect more SW at TOA than observed by CERES (~3-5%) --- ocean*
- *transmit more SW to surface for all-sky (~2%) & clear-sky (0-1%) --- land*

*Aerosol forcing has some credibility*

- *less surface LW down than PIR (~10 Wm<sup>-2</sup>)*
- *more daytime OLR than CERES (0-2 Wm<sup>-2</sup>)*

Summary for this meeting:

Parallel assessment of Edition 2B CRS bias w.r.t. CERES TOA calibration continues.

Changes to Aqua maps will allow better use of COVE for validation.

New Grand Time Series (GTS) resource allows multi-year re-runs with new data sources and code for CAVE sites.

Revised radiative transfer for Edition 3. Expect more bias for a domain where Ed2B calculations and observations agree.

Cloud tests also underway for Edition 3.