Surface and Atmosphere Radiation Budget (SARB)

Clouds and the Earth's Radiant Energy System (CERES)
Science Team Meeting (Victoria, B.C. 14-16 Nov. 2007)

T. P. Charlock (NASA LaRC)
Fred G. Rose (AS&M) *speaks later on "Synoptic" SARB*
David A. Rutan (AS&M) ***Part II of THIS PRESENTATION***
Zhonghai Jin (AS&M) *speaks later on snow grain retrieval, computed & measured MODIS/CERES radiances*
. **Seiji Kato** (H.U.) - modification of LaRC Fu-Liou code
Wenying Su (H.U.) - UV, PAR algorithms
Lisa H. Coleman, Thomas E. Caldwell (SAIC) - Data Management

D. Fillmore, W. Collins provide MATCH assimilation

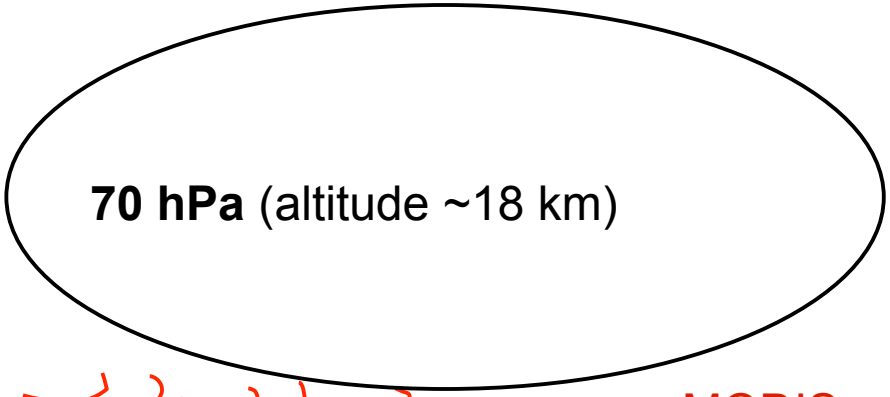
SARB/SOFA Working Group Thurs. AM:
First: Steve Warren of the Ice Second: Discussion, questions

www-cave.larc.nasa.gov/cave/ or goggle "CERES CAVE"
Easy to use subsets of data, on line radiative transfer, ocean albedo tables…

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

Langley Fu-Liou radiative transfer: Kato 2005 SW upgrade, retains Kratz-Rose window

NCEP O3(z)
Mostly from SBUV/2



MINNIS modis

GSFC NWP

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

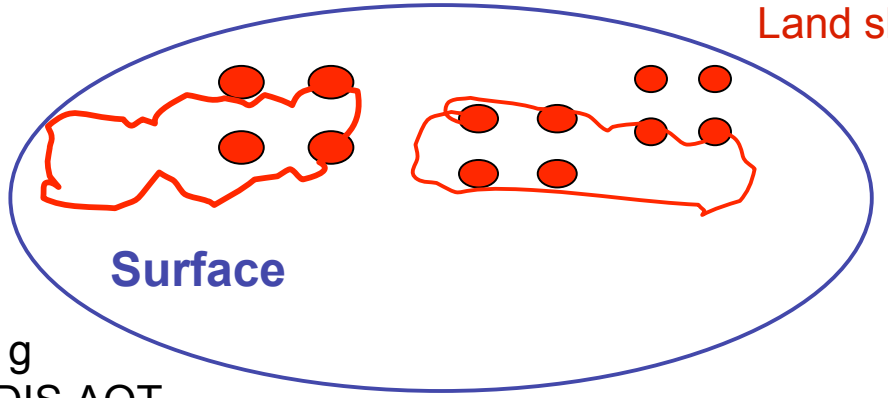
Modis Atmosphere Team

MODIS ~1km pixels provide

Cloud properties (almost always)

Aerosol AOT (sometimes)

Land skin temperature (if clear)



Collins NCAR

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

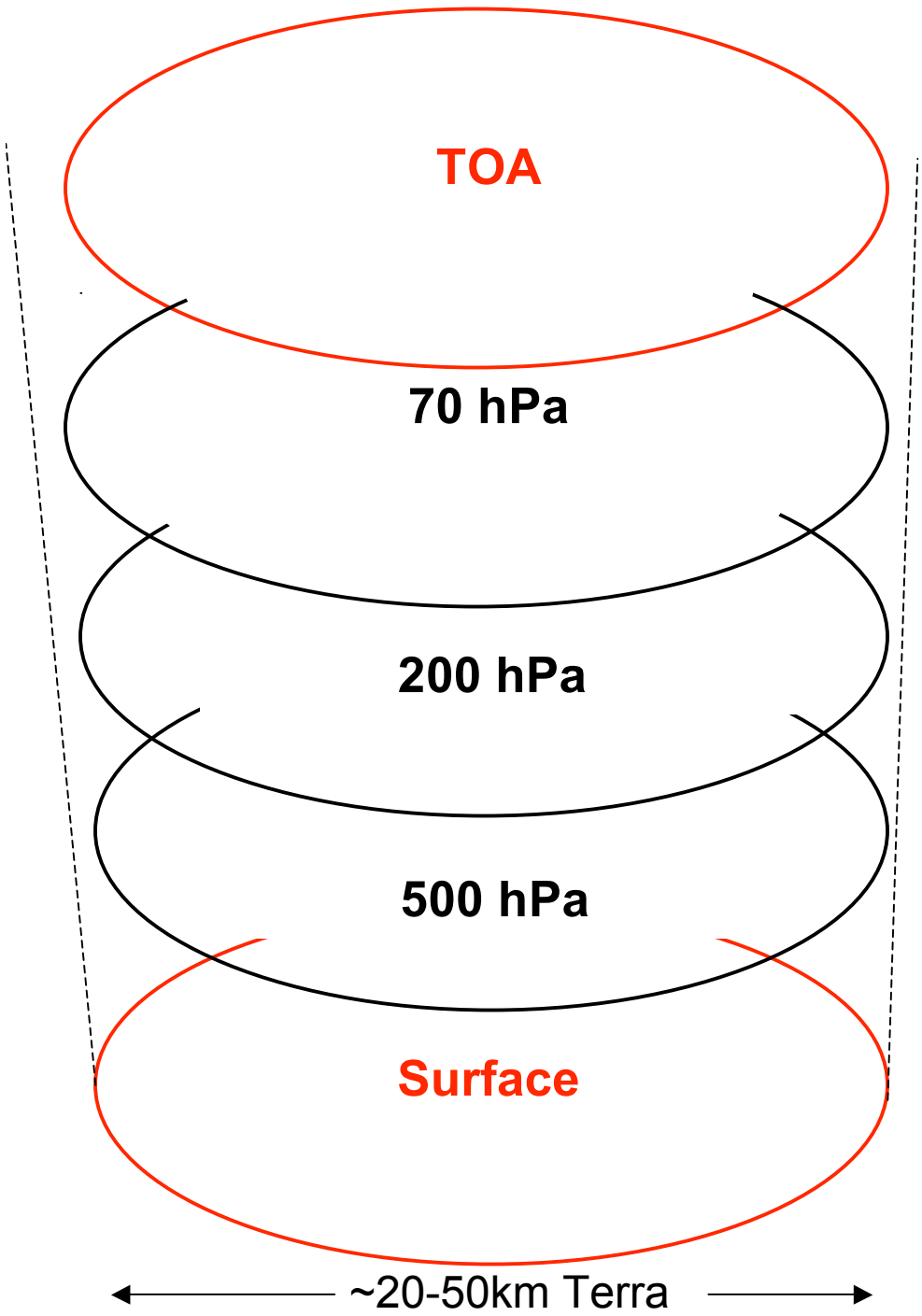
Wielicki

Loeb

Priestley

~20-50 km

Large CERES footprint for TOA flux



CERES CRS: Surface and Atmosphere Radiation Budget (SARB) Product

Tuned fluxes at all 5 levels
All-sky & Clear-sky, Up & Down,
SW and LW

Surface & TOA also have Untuned fluxes
Fluxes with aerosols
Pristine fluxes (no aerosols)

Aerosol forcing for all-sky & clear-sky

Tuning does NOT yield a perfect match to TOA observations.

Parameters adjusted when clear:
Skin temperature, aerosol AOT, precipitable water (PW)

Parameters adjusted when cloudy:
LWP/IWP, cloud top temperature, cloud fractional area within footprint

Clear Ocean During Day:
Bias of Calculated SW up at TOA and AOT Source

Aqua CRS Edition 2A (here all FM4)

Bias = (Untuned SW at TOA) - (Observed SW at TOA)

Conclusion: Aqua CRS Ed2A interpolation for MODIS Daily Average AOT has defects.

Source of AOT	**Bias**	**RMS**	**AOT**	**FOV**
	Wm-2	Wm-2	vis	(N)
13 July 2002				
MOD04 Instantaneous	2.7	5.4	0.08	13872
Interp MODIS Daily Avg	17.2	28.5	0.32	9549

***Problem** from last CERES meeting: Bias of 17.2 Wm-2*

(Clear ocean reflects ~80 W/m**2 to TOA)

Solution:

Aqua CRS Ed 2B	Bias	RMS	AOT	FOV
MOD04 Instantaneous	2.7	5.4	0.08	13872
MATCH assimilation	6.5	14.7	0.18	14800
Stowe-Ignatov	4.2	5.9	0.05	690

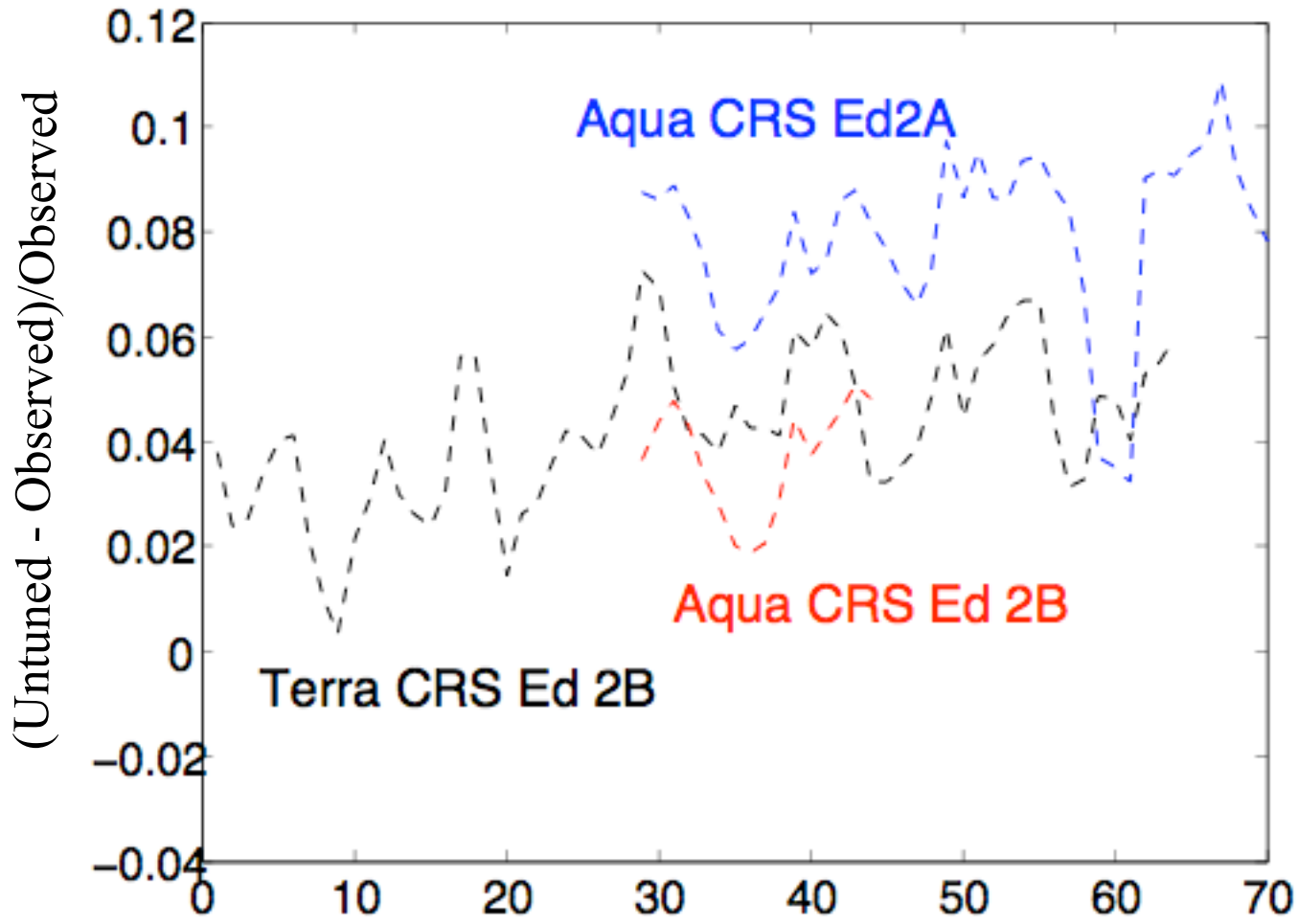
SW Table Aug02 - Jul03 CAVE (with all SGP) Untuned

	Observation (Wm-2)	N	Bias (Wm-2)	RMS (Wm-2)	
SFC ↓	555	13287	8	116	Aqua
SFC ↑	117	10009	-25	65	CRS
TOA ↑	274	13282	7	28	Ed 2A
SFC ↓	550	13894	9	115	**Aqua**
SFC ↑	117	10511	-25	65	**CRS**
TOA ↑	273	13891	6	28	**Ed 2B**
SFC ↓	566	13932	11	101	Terra
SFC ↑	120	10388	-20	58	CRS
TOA ↑	270	13923	8	26	Ed 2B

LW Table Aug02 - Jul03 CAVE (with all SGP) Untuned

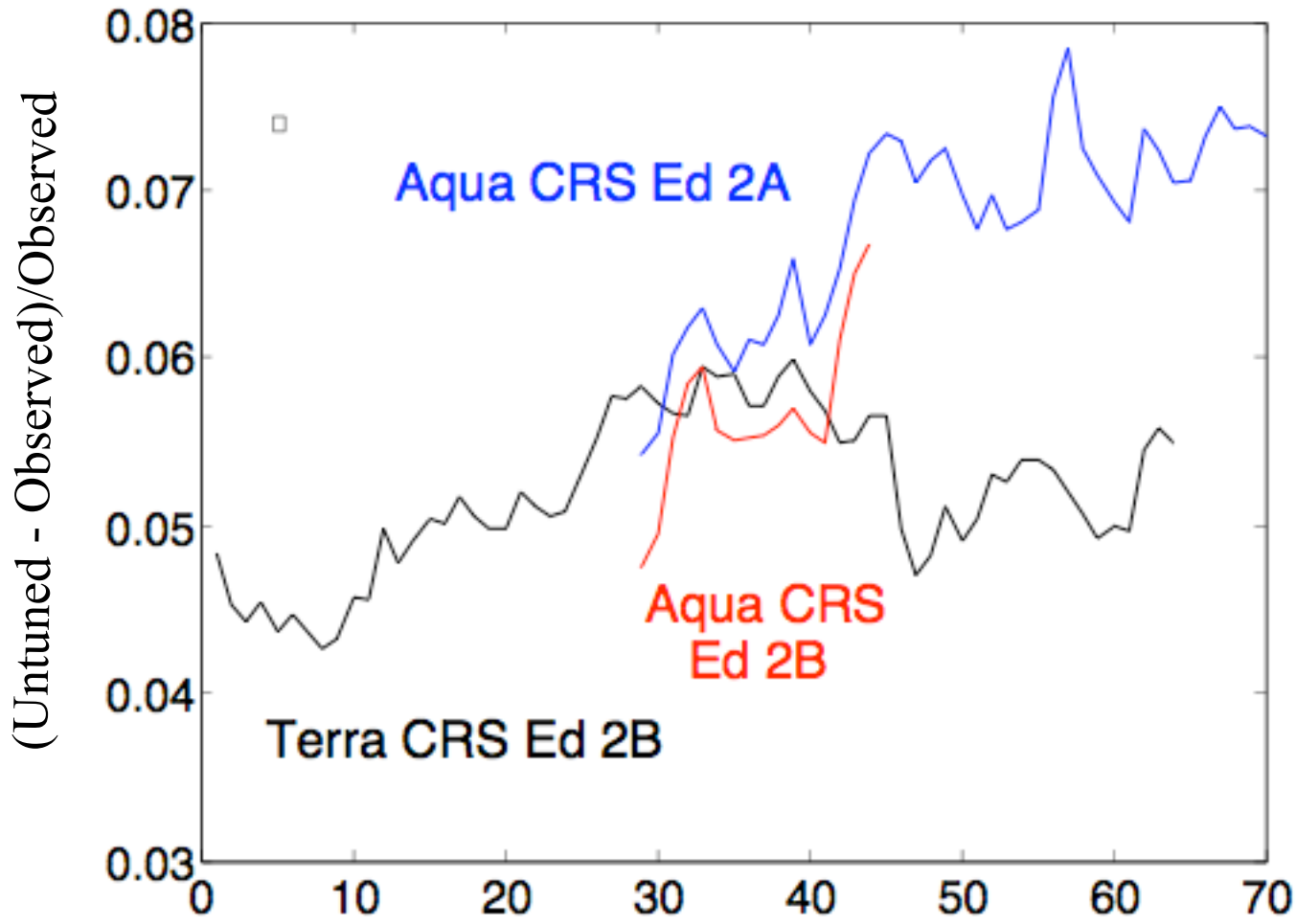
	Observation (Wm-2)	N	Bias (Wm-2)	RMS (Wm-2)	
SFC ↓	324	25928	-9	21	Aqua
SFC ↑	392	19473	-6	27	CRS
TOA↑	237	26390	-1	9	Ed 2A
SFC ↓	324	27643	-9	21	**Aqua**
SFC ↑	392	20954	-6	27	**CRS**
TOA↑	236	27823	-1	9	**Ed 2B**
SFC ↓	323	26950	-8	20	Terra
SFC ↑	391	20183	-3	24	CRS
TOA↑	237	27426	1	8	Ed 2B

SW Bias at TOA for Clear-sky Ocean FOVs



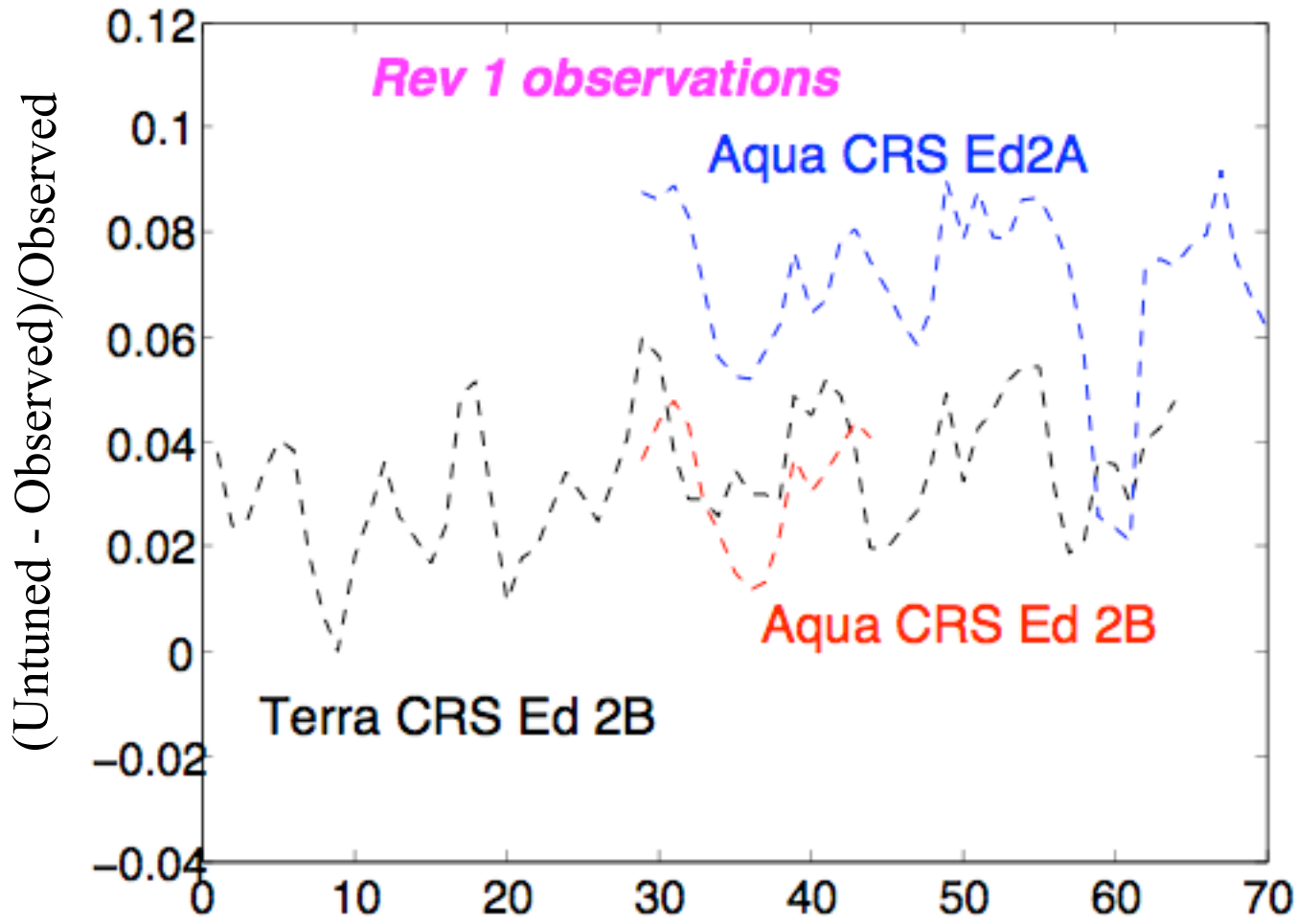
March 2000 to December 2005

SW Bias at TOA for All-sky Ocean FOVs



March 2000 to December 2005

SW Bias at TOA for Clear-sky Ocean FOVs



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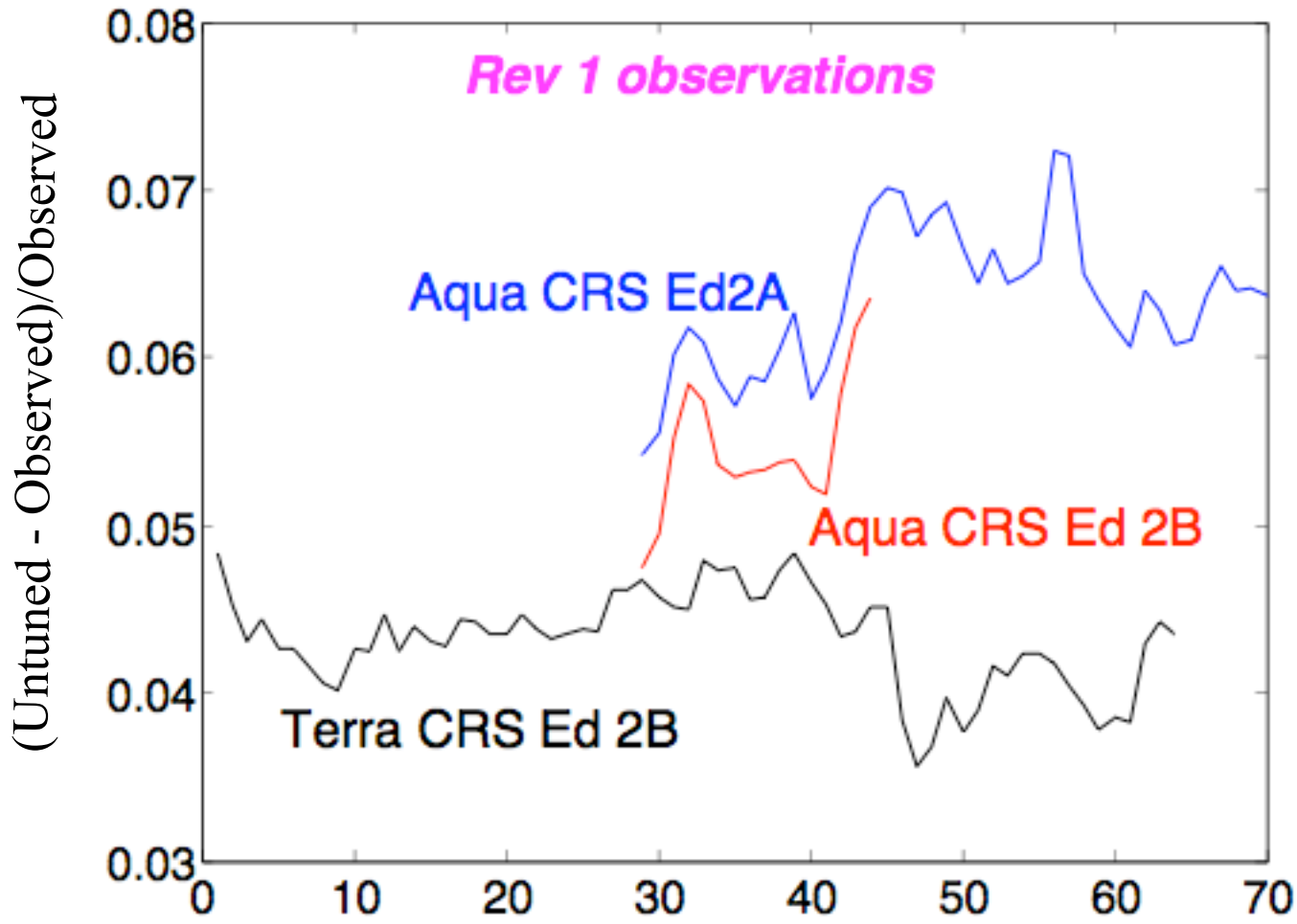
SW Bias at TOA for All-sky Ocean FOVs



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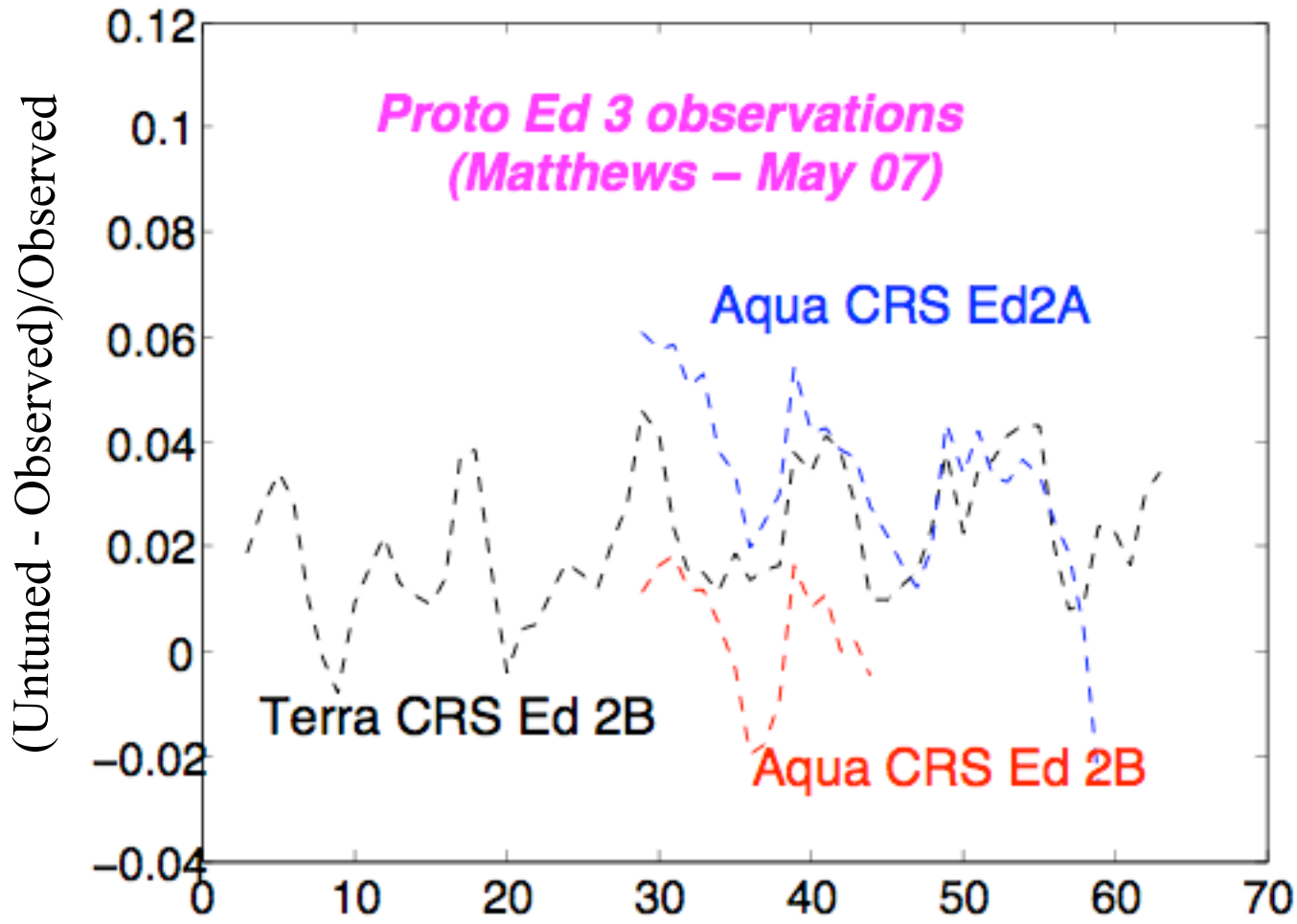
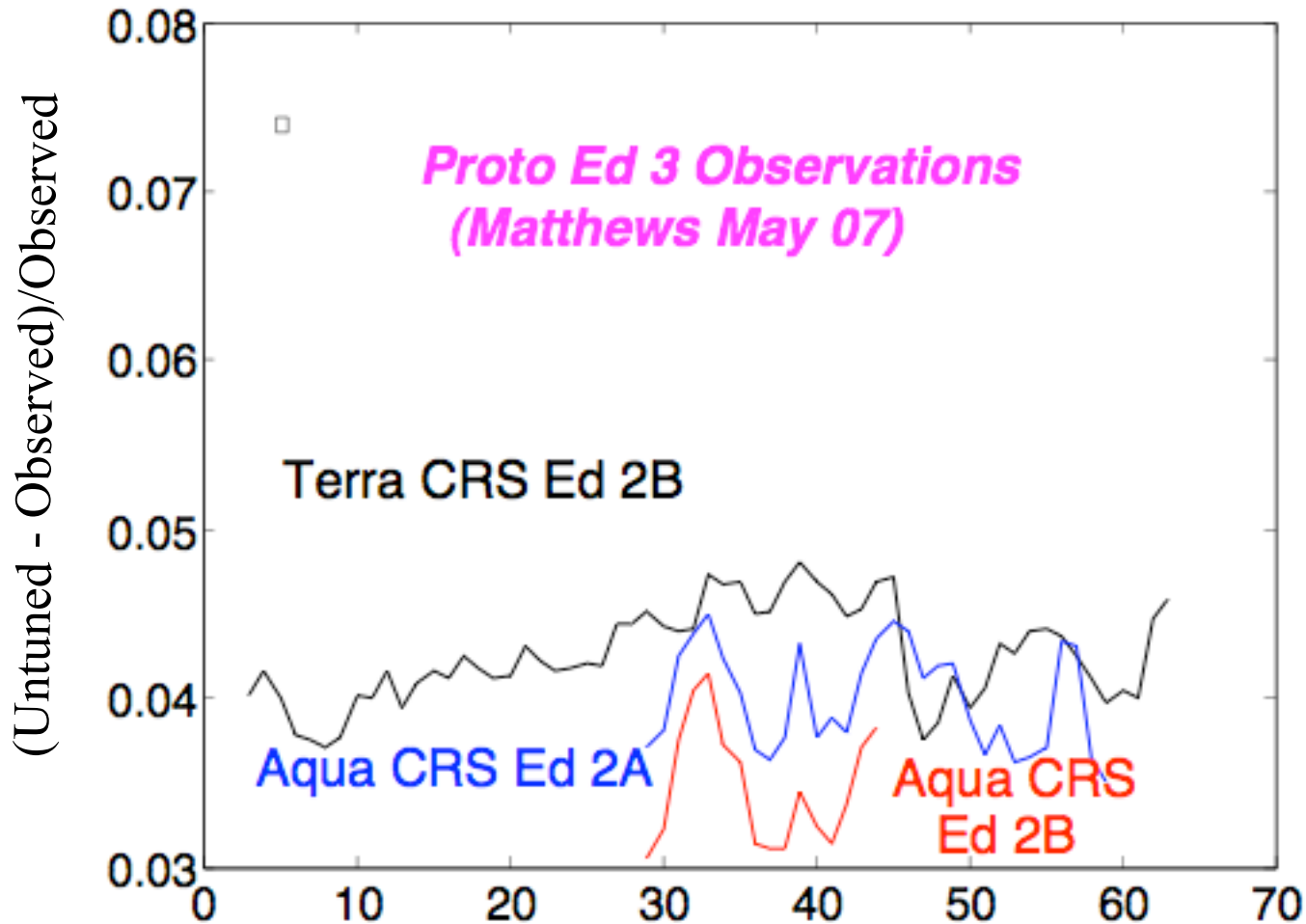


March 2000 to December 2005

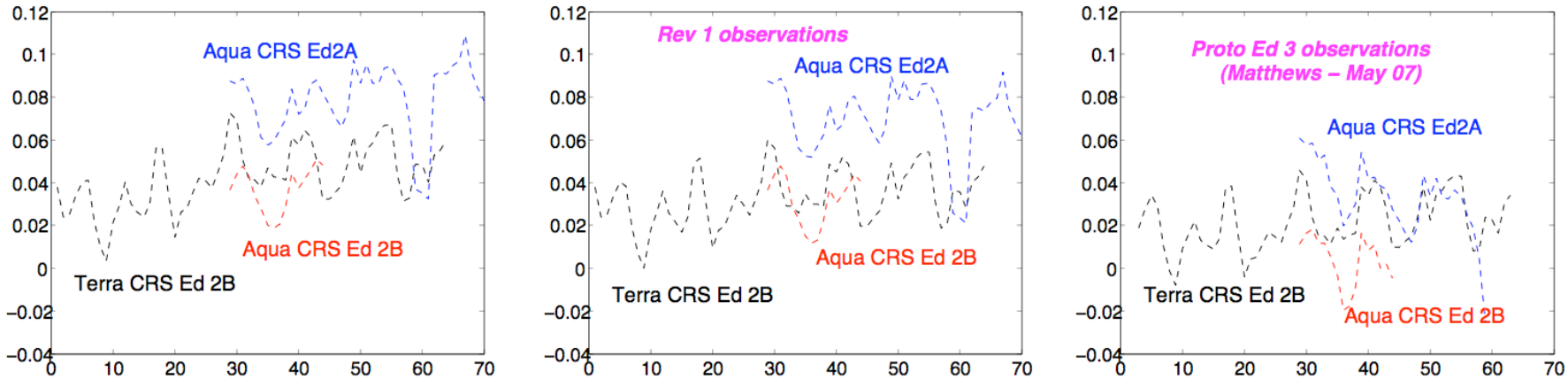
SW Bias at TOA for All-sky Ocean FOVs



March 2000 to December 2005

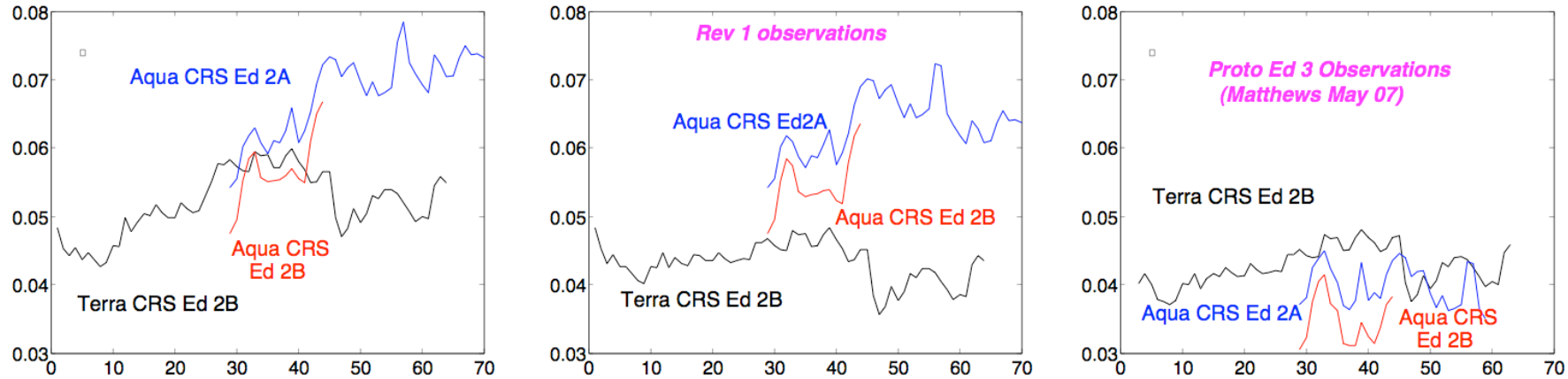
SW Bias at TOA for **Clear-sky Ocean** FOVs

(Untuned - Observed)/Observed



Edition 2 ***Rev 1*** ***Proto-Ed 3***

SW Bias at TOA for **All-sky Ocean** FOVs



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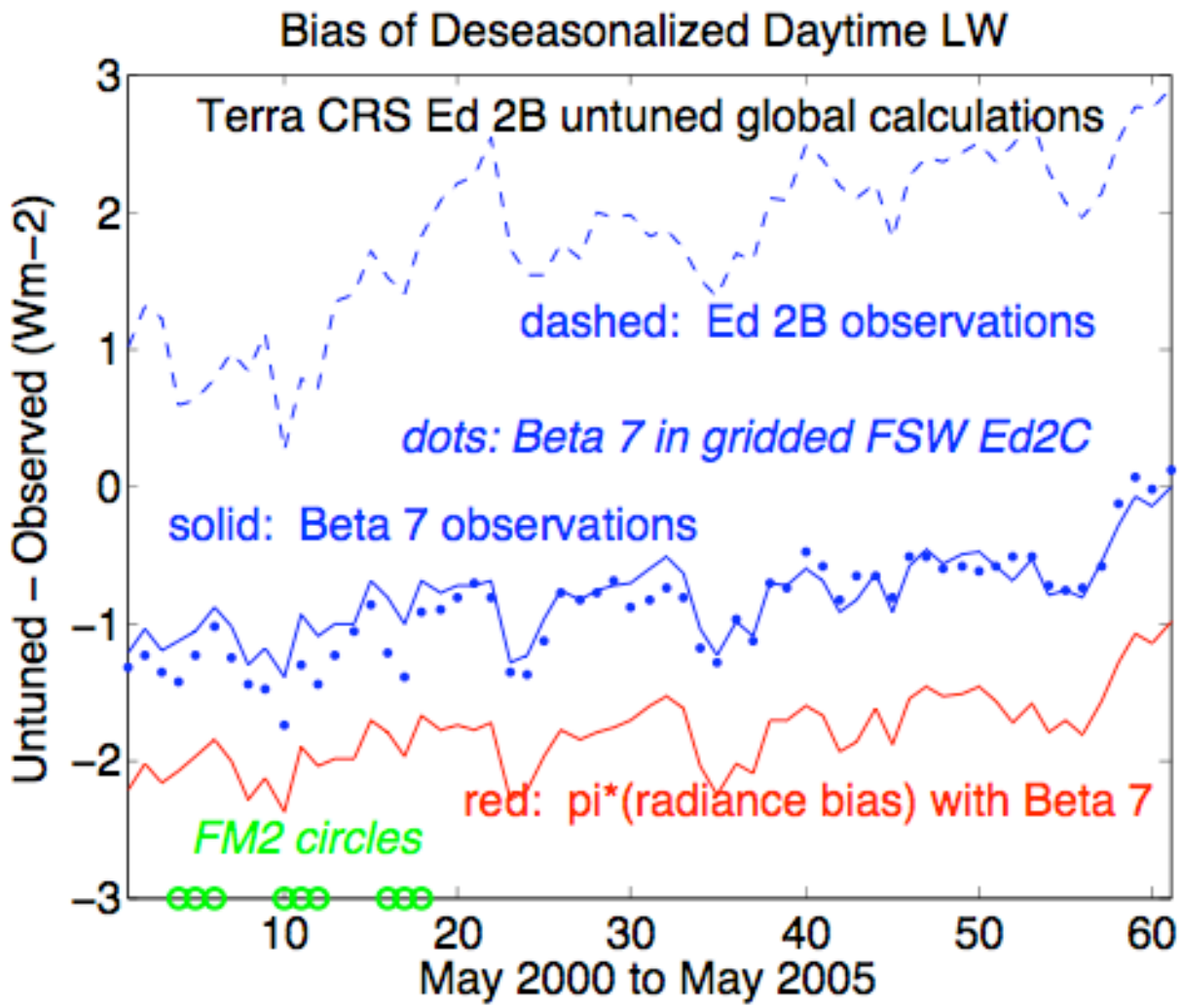
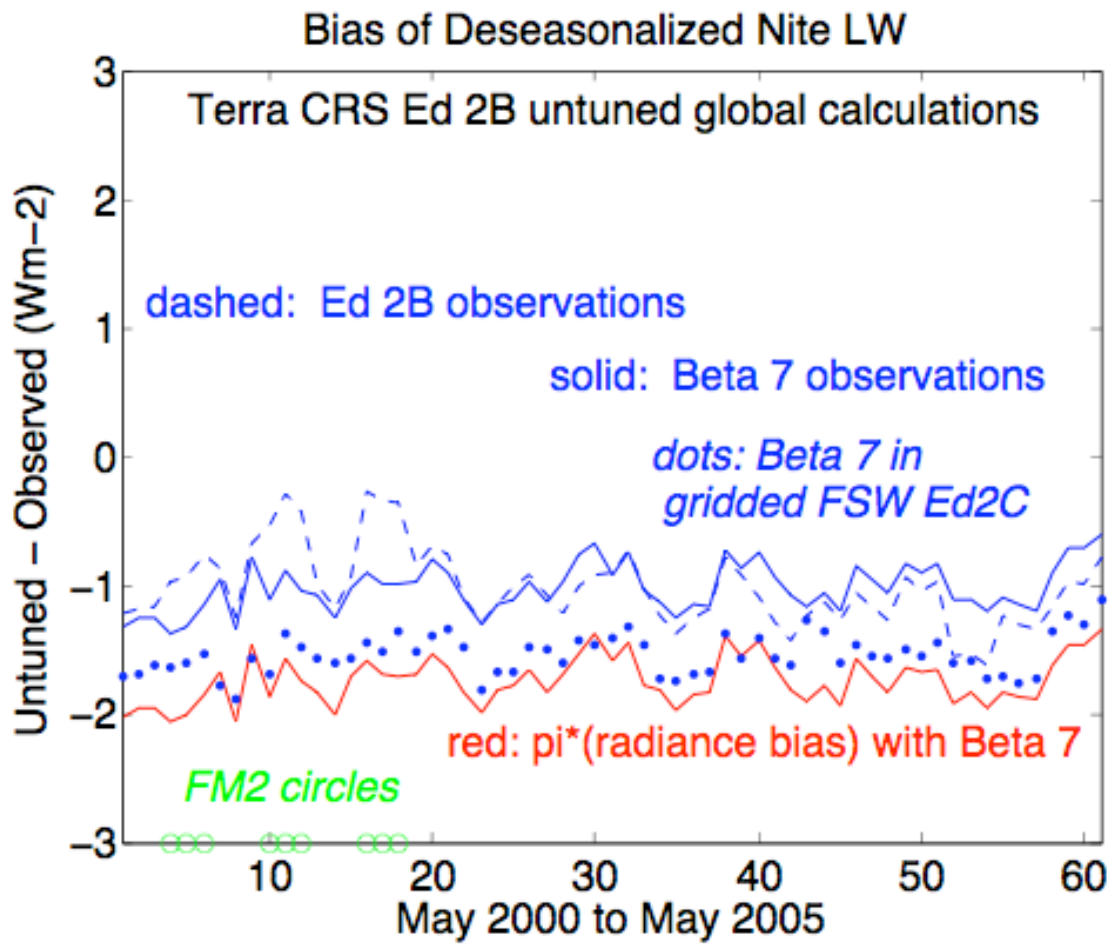
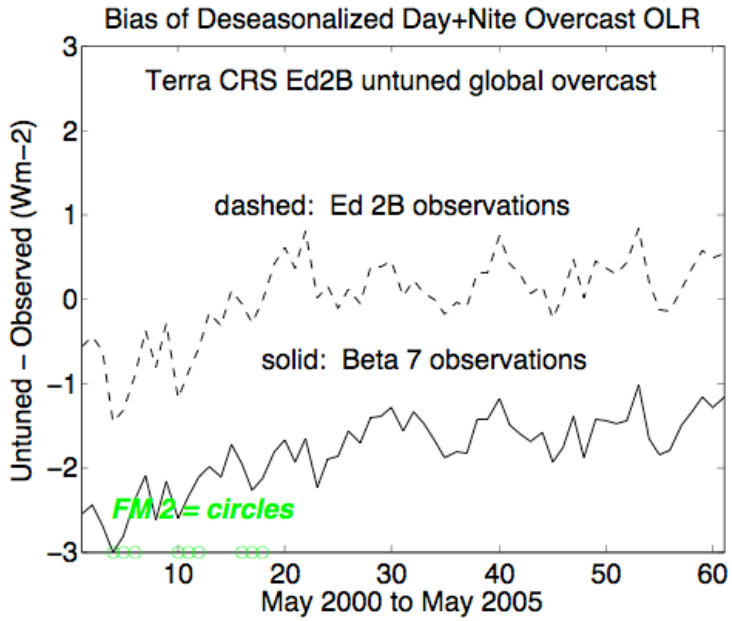


SARB's interpretation of Instrument WG numbers

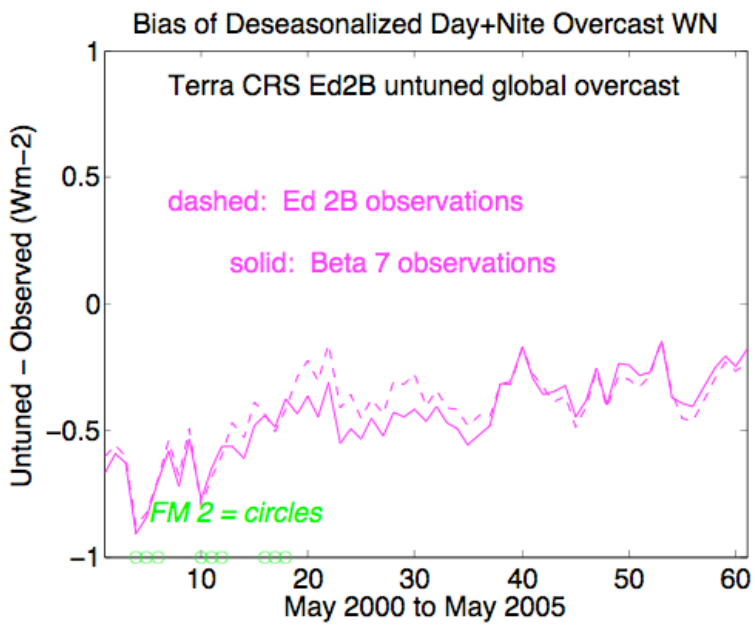
for Beta 7 is not rigorous for ***day time*** *LW observations.*



Nite radiance bias for all-sky OLR is significant; larger than could be accounted from use of dated LW parameters for gases (Kratz, 2007).

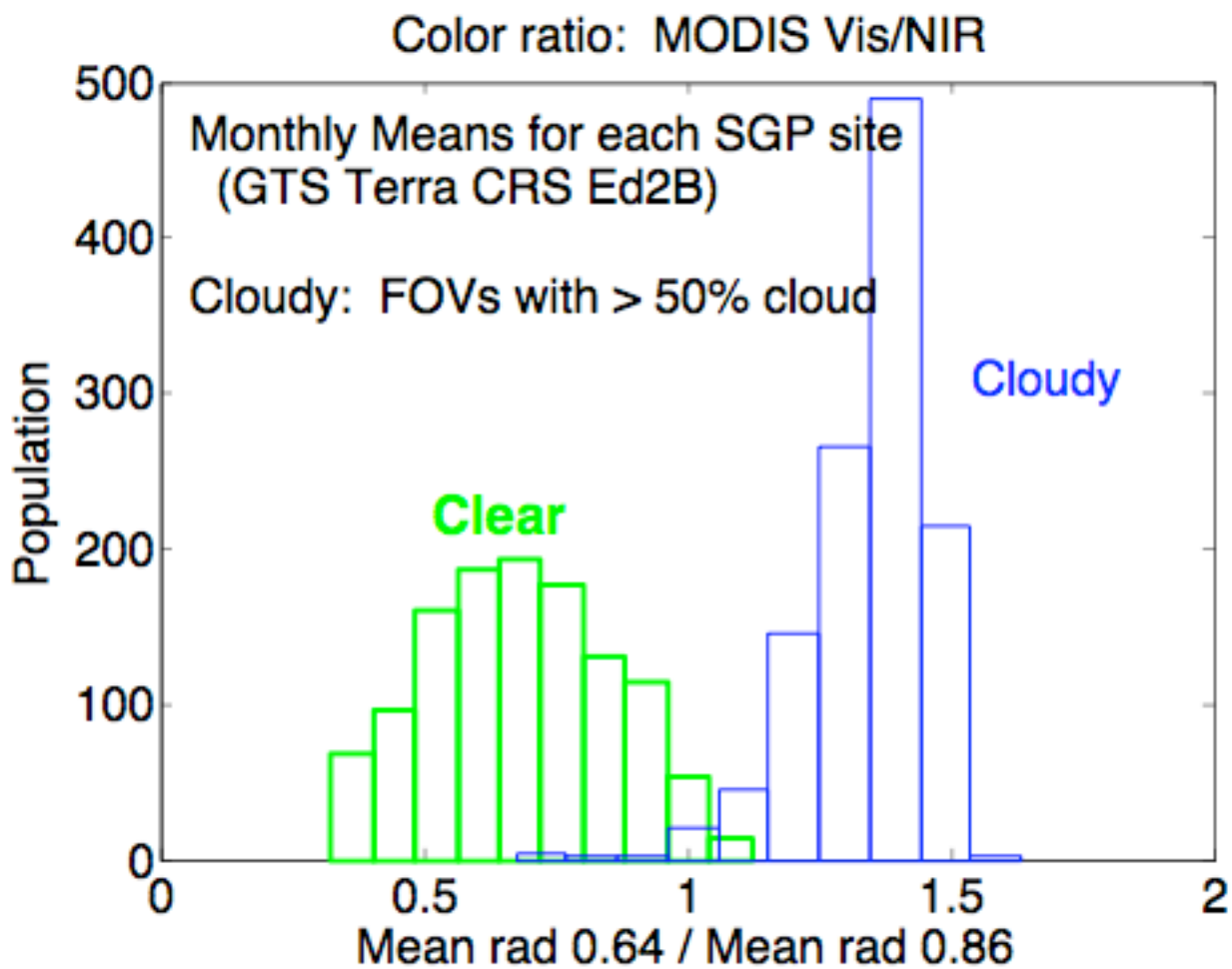


SARB's interpretation of Instrument WG numbers for Beta 7 (proto Edition 3) ***daytime OLR*** *is here crude.*

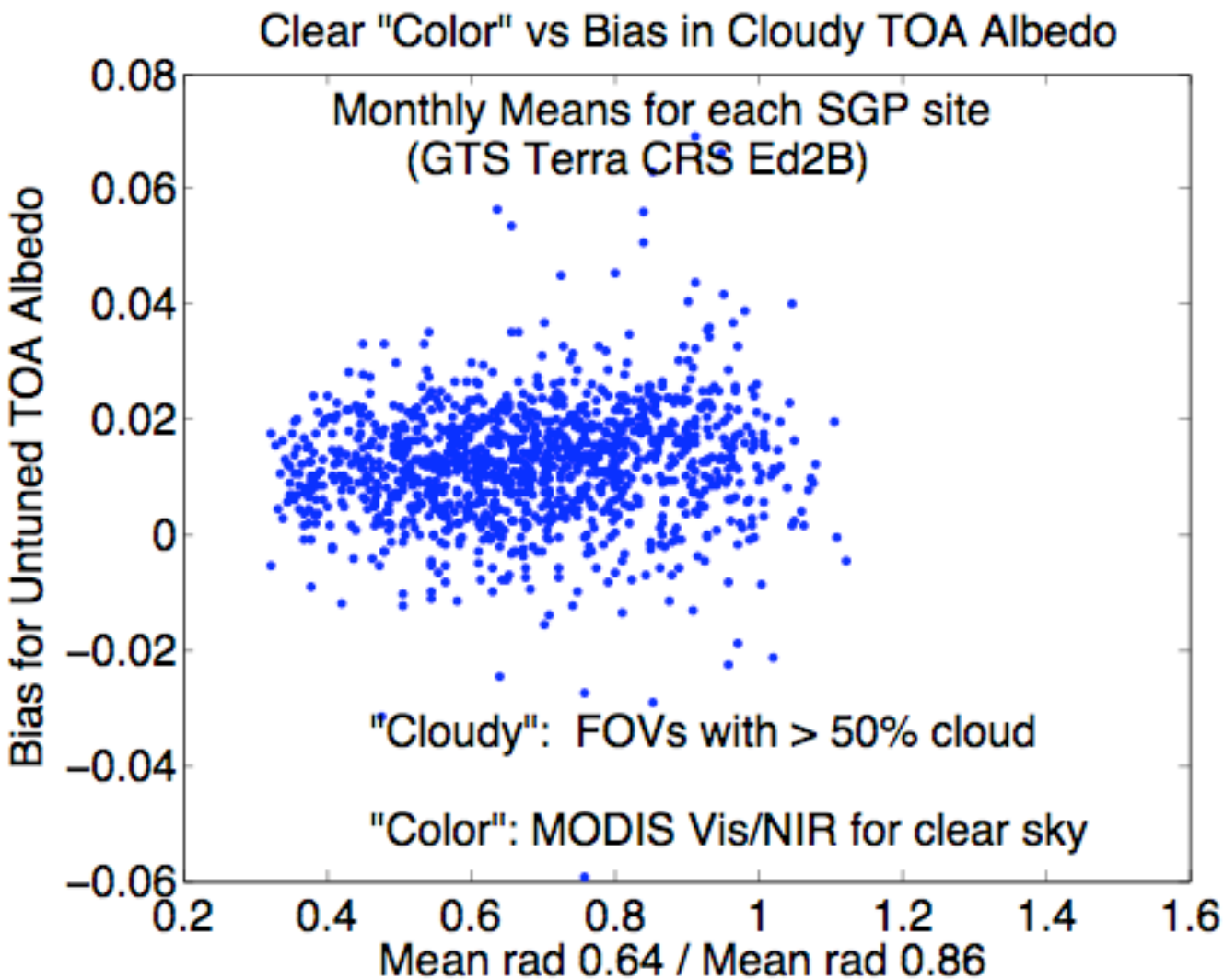


But the drift in ***overcast*** *bias for the CERES* ***window*** *(WN) is disturbing.*

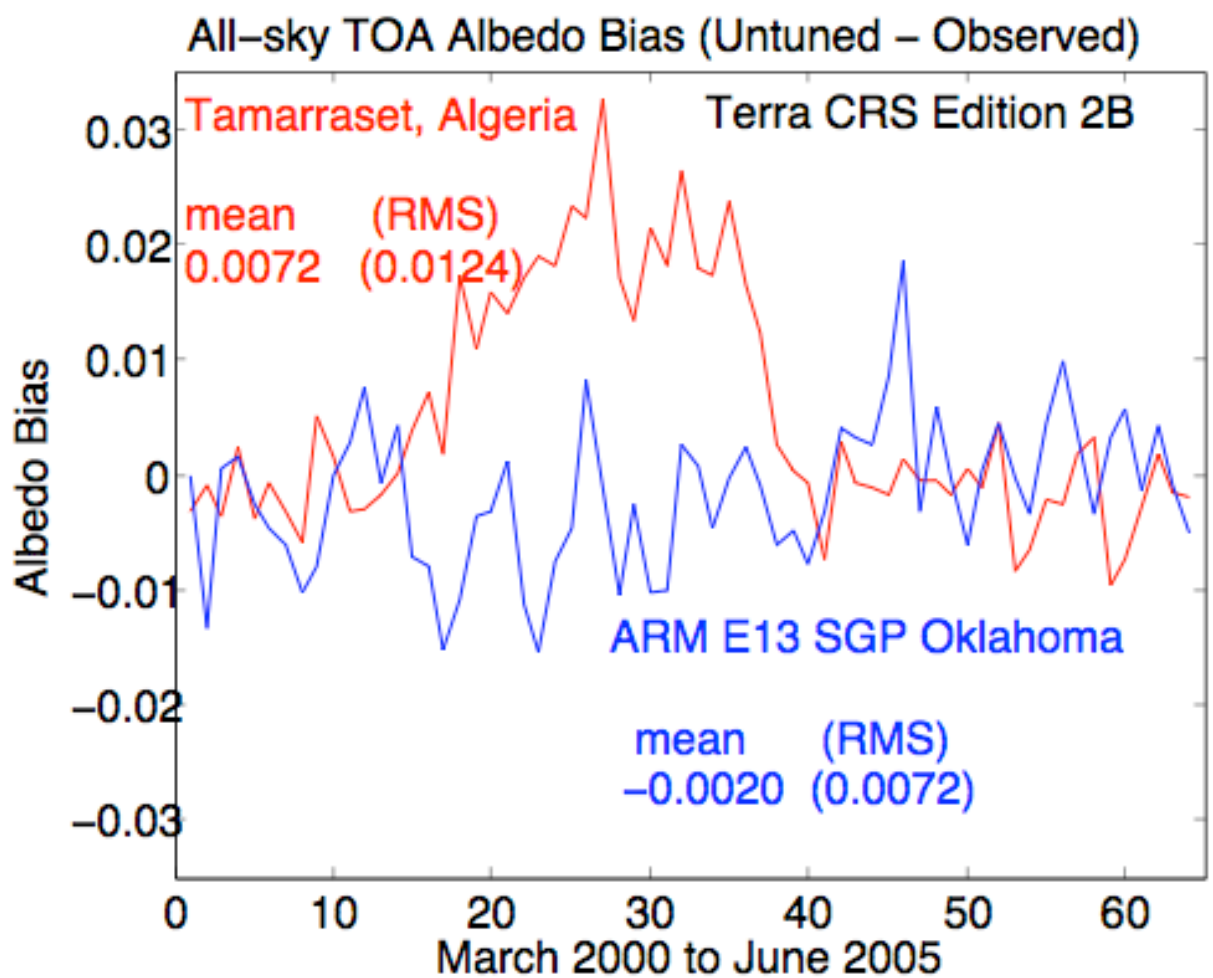
Exercise touching on on color, spectral response, calibration…

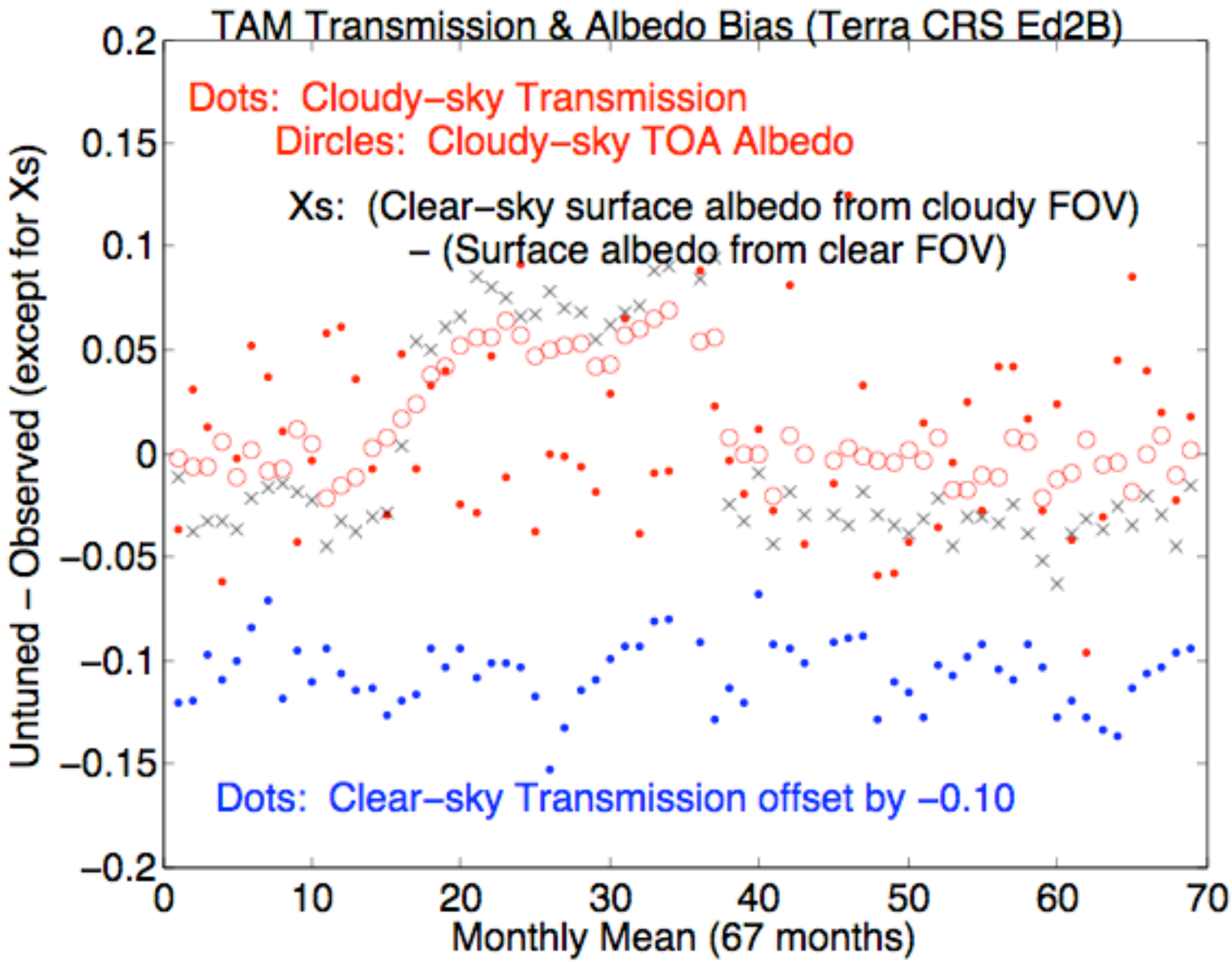


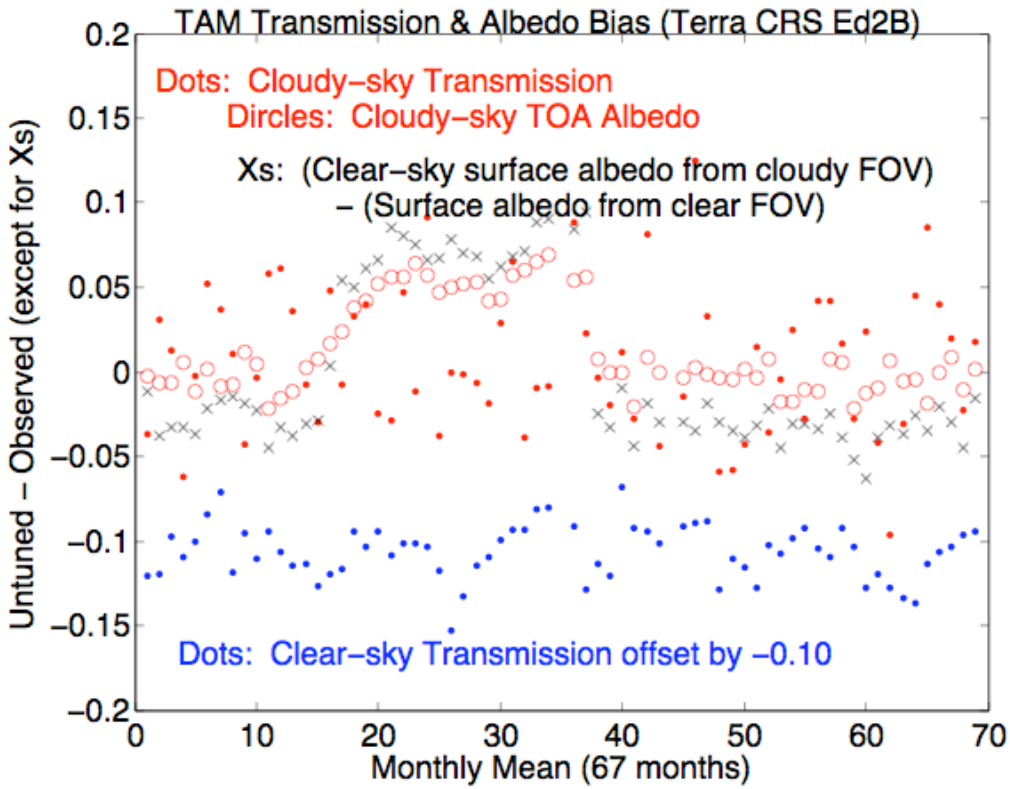
SAH provides surface albedo for cloudy FOVs using clear FOV history.


Clear "Color" vs Bias in Cloudy TOA Albedo
Monthly Means for each SGP site
(GTS Terra CRS Ed2B)
"Cloudy": FOVs with > 50% cloud
"Color": MODIS Vis/NIR for clear sky
Bias for Untuned TOA Albedo
Mean rad 0.64 / Mean rad 0.86
0.08
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6

Another SARB Problem from previous CERES Science Team Meetings:



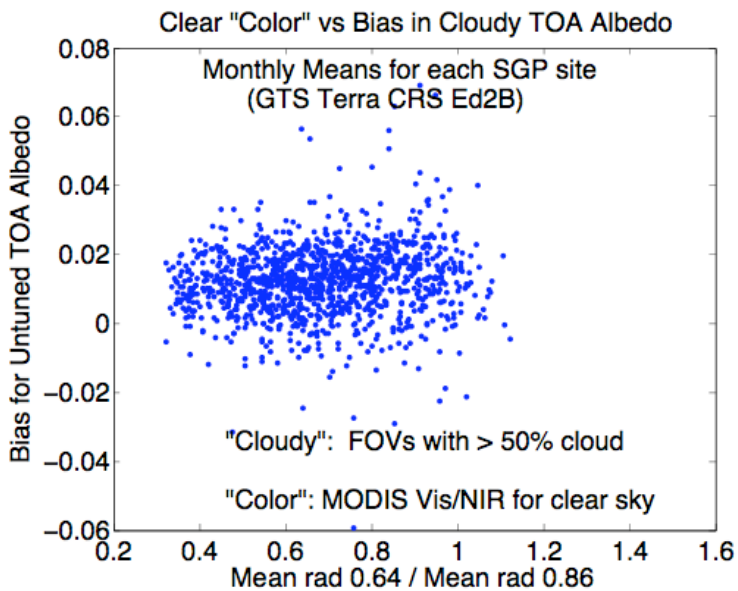

TAM Transmission & Albedo Bias (Terra CRS Ed2B)
Dots: Cloudy−sky Transmission
Dircles: Cloudy−sky TOA Albedo
Xs: (Clear−sky surface albedo from cloudy FOV)
− (Surface albedo from clear FOV)
Dots: Clear−sky Transmission offset by −0.10
Untuned − Observed (except for Xs)
Monthly Mean (67 months)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
0
10
20
30
40
50
60
70



Months with reported ***operator error*** for Surface Albedo History (SAH):

July 01 (17) to December 03 (46)

SAH provides surface albedo for cloudy FOVs using clear FOV history.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Mean rad 0.64 / Mean rad 0.86
0.08
0.06
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0
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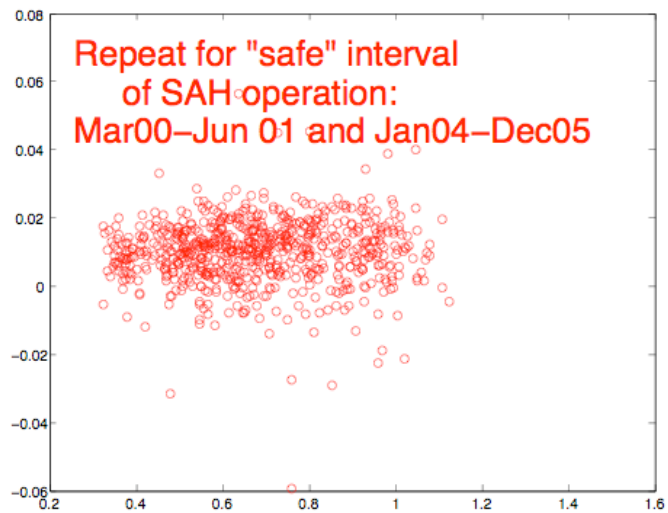
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6


Repeat for "safe" interval
of SAH operation:
Mar00–Jun 01 and Jan04–Dec05
0.08
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6

1. Aqua CRS Ed 2B has improved (debugged) input for ocean AOT.

2. Terra CRS Ed 2B operator error: duration of impact in question.
Desert dust was not the problem.

3. Successive improvements in Terra SW, LW observations
but questions about calculations/retrievals/observations
for window (WN) for overcast.