TRMM CRS Edition 2b Validation and Readi

CERES Science Team Meeting

Williamsburg, Virginia (14 May 2002)

. Charlock (NASA LaRC)

l G. Rose (AS&M)

d A. Rutan (AS&M)

nghai Jin (AS&M) - coupled radiative transfer

H. Coleman (SAIC) - Data Management Team

mas E. Caldwell (SAIC) - Data Management Team

hie Manalo Smith (AS&M)

access to CAVE on line surface and CERES valida

www-cave.larc.nasa.gov/cave/

CRS Beta 3 TRMM Jan-Aug 1998 ... soon CRS

CRS (cloud radiation swath) is the instantan

footprint scale SARB product

“Beta” : for release “Edition”: publicatio

Surface and Atmospheric Radiation Budget (SA

SW/LW/WN (surface, 500-200-70 hPa, TO

Cloud forcing, aerosol forcing, PAR

Adjustments to PW, UTH, AOT, skin T

cloud tau, cloud fraction, cloud heig

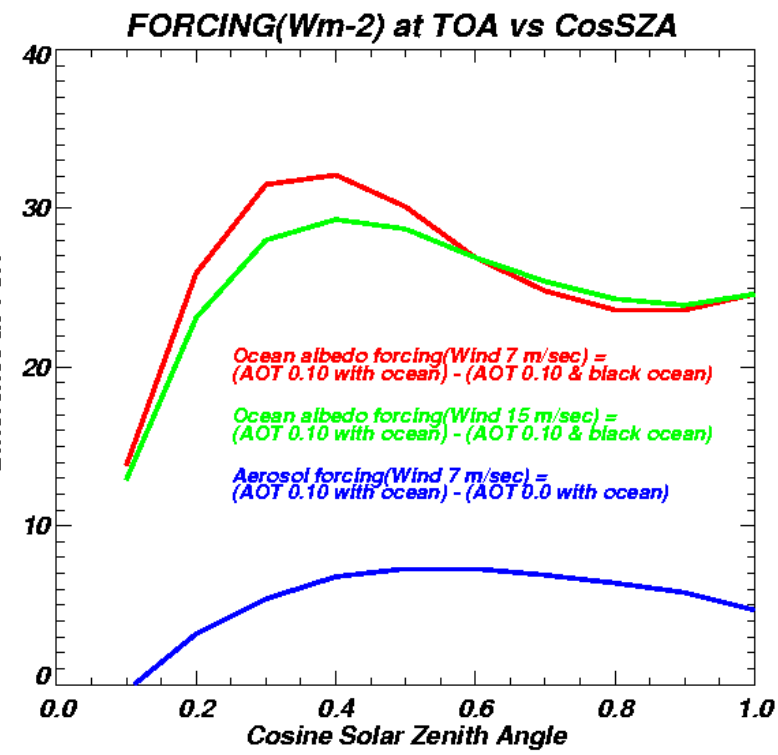
Inputs include SSF, ECMWF, MATCH, SM

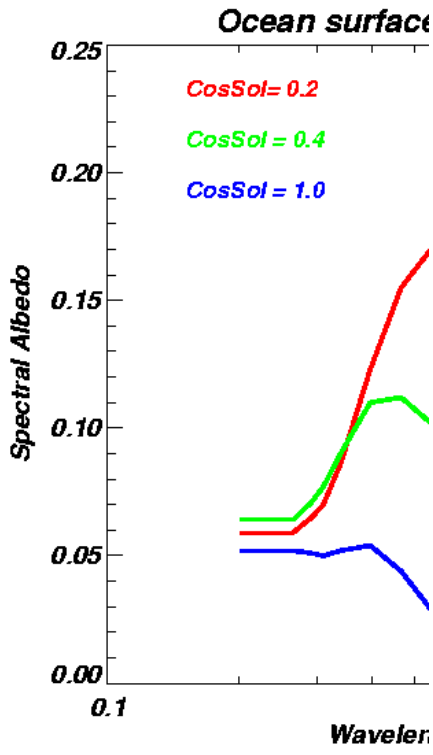
Modified Fu-Liou 2 stream SW (2/4 LW)

LUT to Jin coupled ocean-atmosphere mode

http://snowdog.larc.nasa.gov/jin/rtset.html

Jin's on line Coupled Ocean Atmosphere Radiative Transfer (C





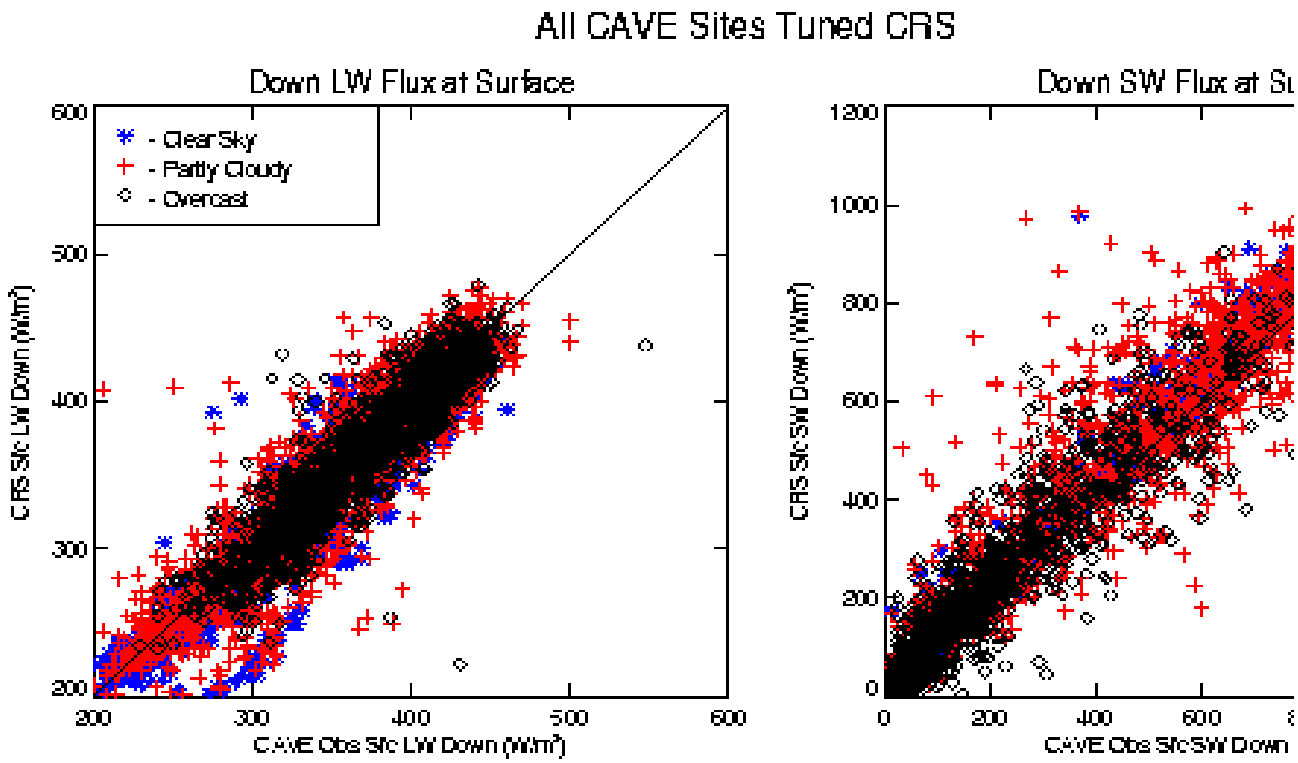
How does CRS Beta3 differ from CRS Edition 2b?

. When cloud fraction < 0.05, cloud properties in E
b are NOT tuned (but “clear sky” parameters like P
urface albedo are tuned).

. CRS Beta3 did not run in sunglint. Inspired by
CLAMS, fearless CRS Edition 2b runs, glint or no gl

. Here compare CRS Beta3 with 8 months of CAVE
urface observations and show a simply gridded FSW
product for 1 month (May 1998). We show only a da
CRS Edition 2b.

CRS Beta3 and Ed2b have errors for footprints conta
both snow AND clouds; not a major issue in tropics



www-cave.larc.nasa.gov/cave/ select "Site Statistics"

	Obs Mean	N	Bias Obs-CRS	RMS	Cld F All-C
ALL SKY					
LW Dn Sfc	358	8405	3	20	16
LW Up Sfc	429	7031	3	20	
SW Dn Sfc	439	4725	-31	82	-10
SW Up Sfc	89	4308	11	25	
LW Up TOA	253	9071	1	5	-24
SW Up TOA	221	4962	1	19	89

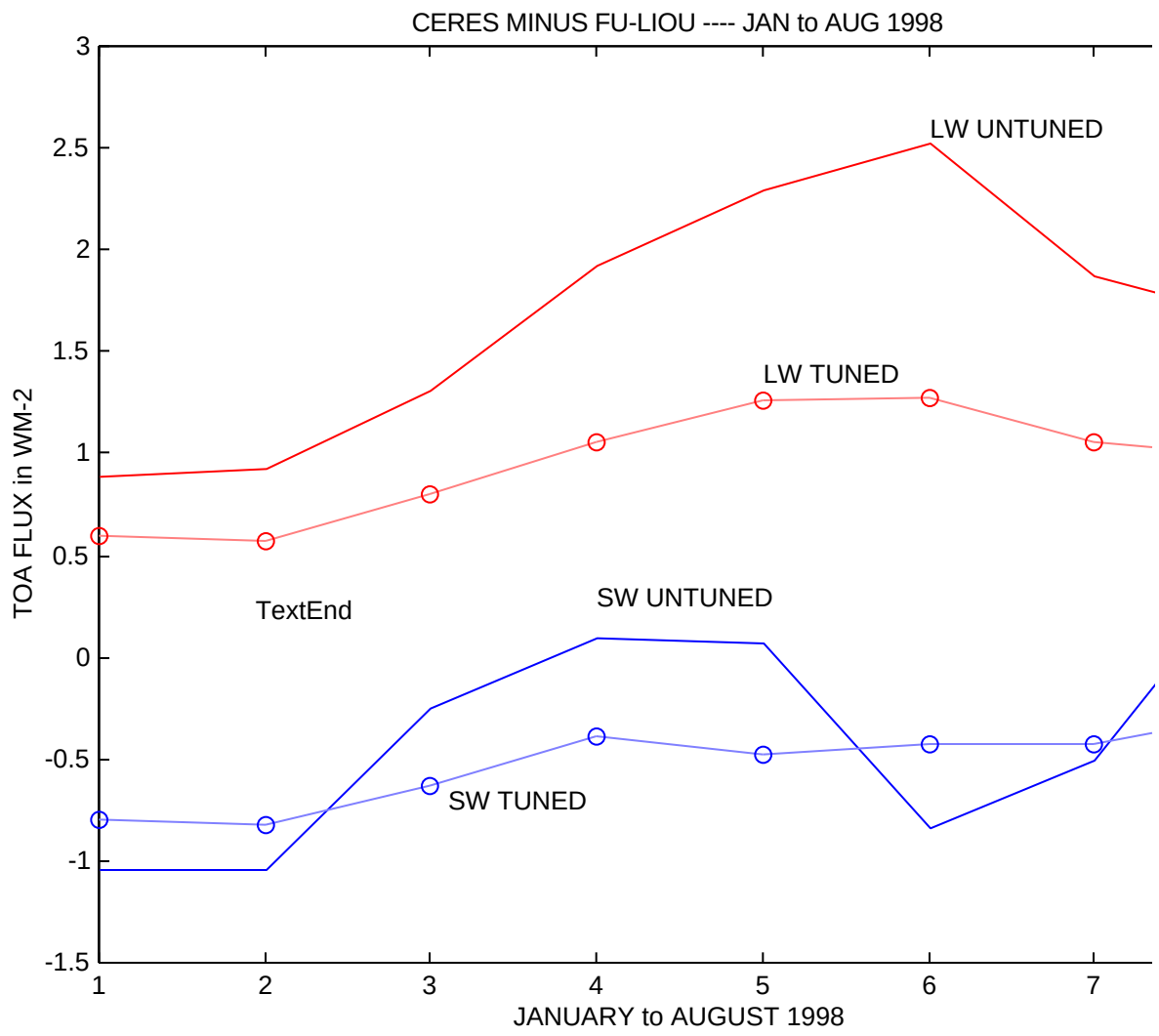
Comparison of tuned CRS (SARB) with CERES and "CAVE"

www-cave.larc.nasa.gov/cave/ select "Site Statistics"

	Obs Mean	N	Bias Obs-CRS	RMS	Cld All
ALL SKY					
LW Dn Sfc	358	8405	3	20	
LW Up Sfc	429	7031	3	20	
SW Dn Sfc	439	4725	-31	82	-1
SW Up Sfc	89	4308	11	25	
LW Up TOA	253	9071	1	5	-
SW Up TOA	221	4962	1	19	
OVERCAST					
SW Dn Sfc	241	1176	-25	81	-3
CLEAR VIRS					Aer
SW Dn Sfc	519	1534	-32	49	-15
CLEAR VIRS + pyranometer					
SW Dn Sfc	486	202	-22	27	-12

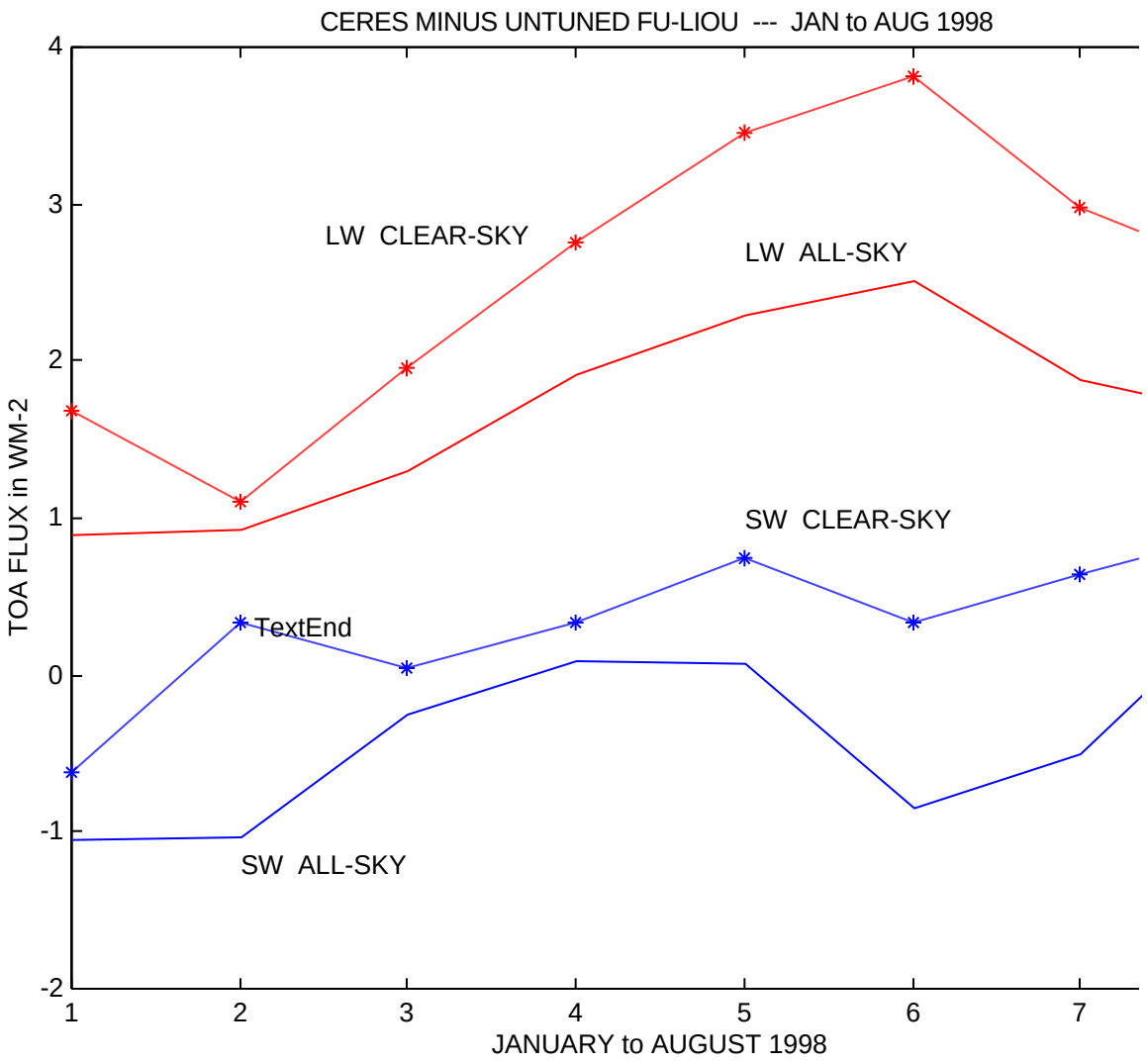
Coarse means (Jan-Aug98) of CERES minus Fu-

Tuned (dash-dot) Untuned (solid) LW(red) S



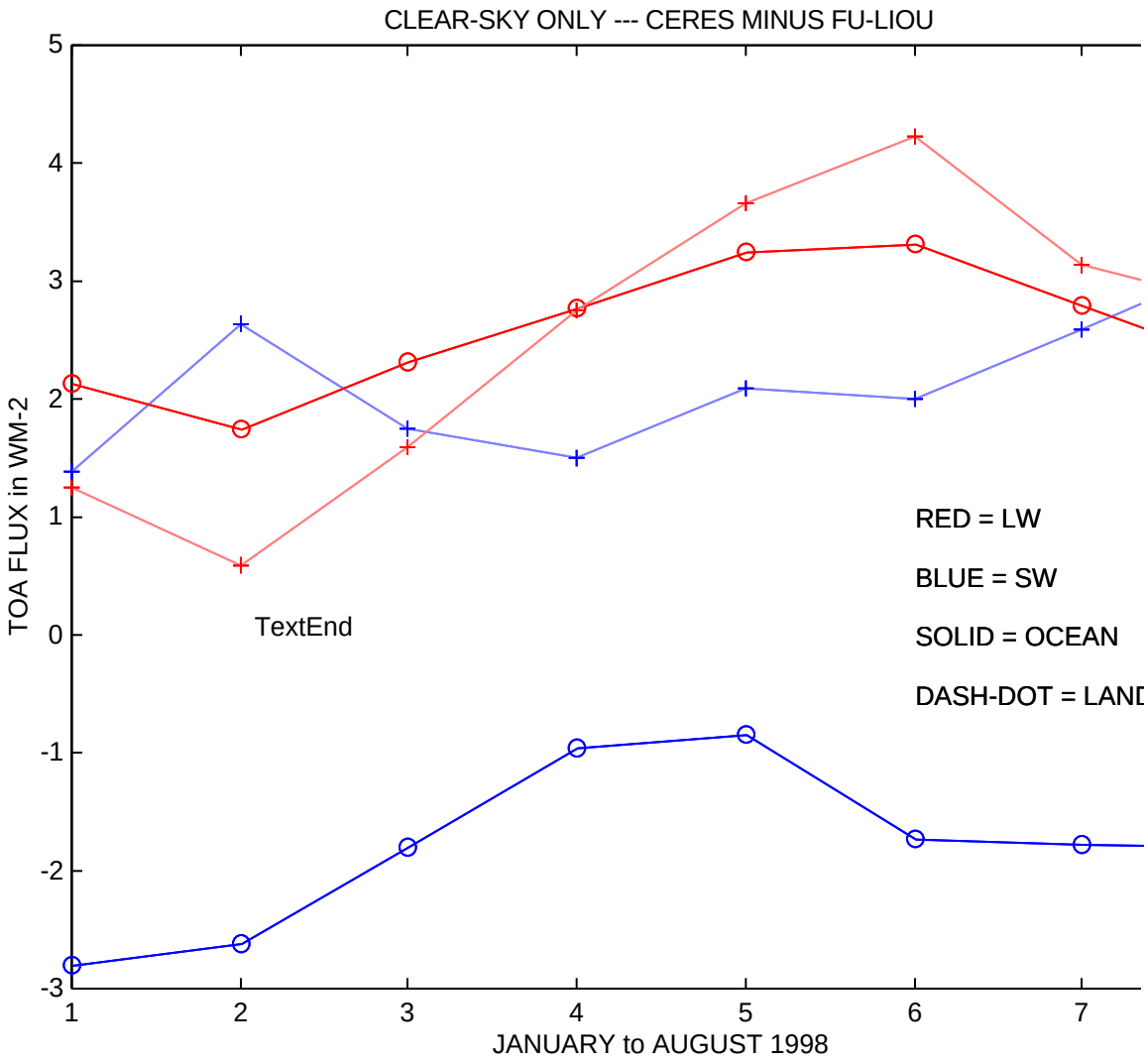
rse means (Jan-Aug98) CERES minus Untuned F

ar-sky (dash-dot) All-sky (solid) LW(red) SW



Clear-sky only: CERES minus Untuned Fu-Liou

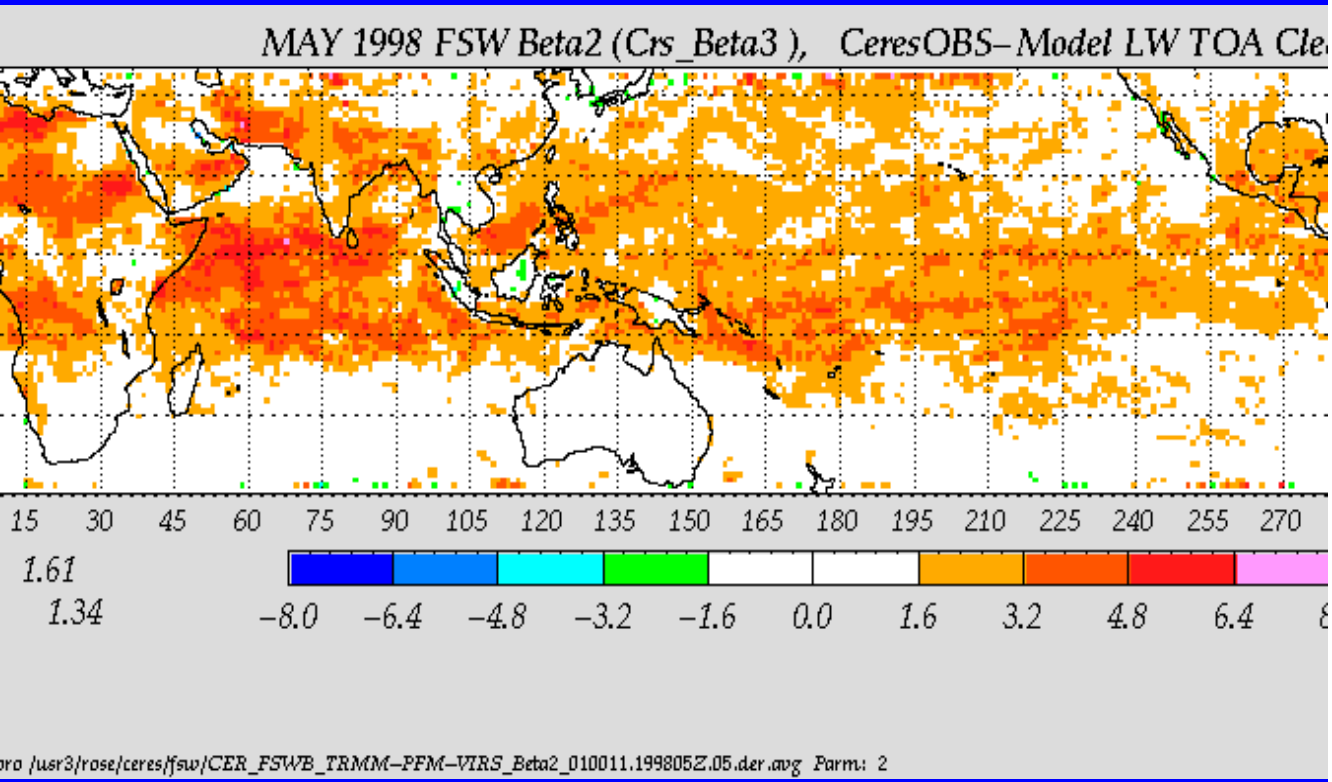
Ocean (solid) Land (dash-dot) LW (red) SW

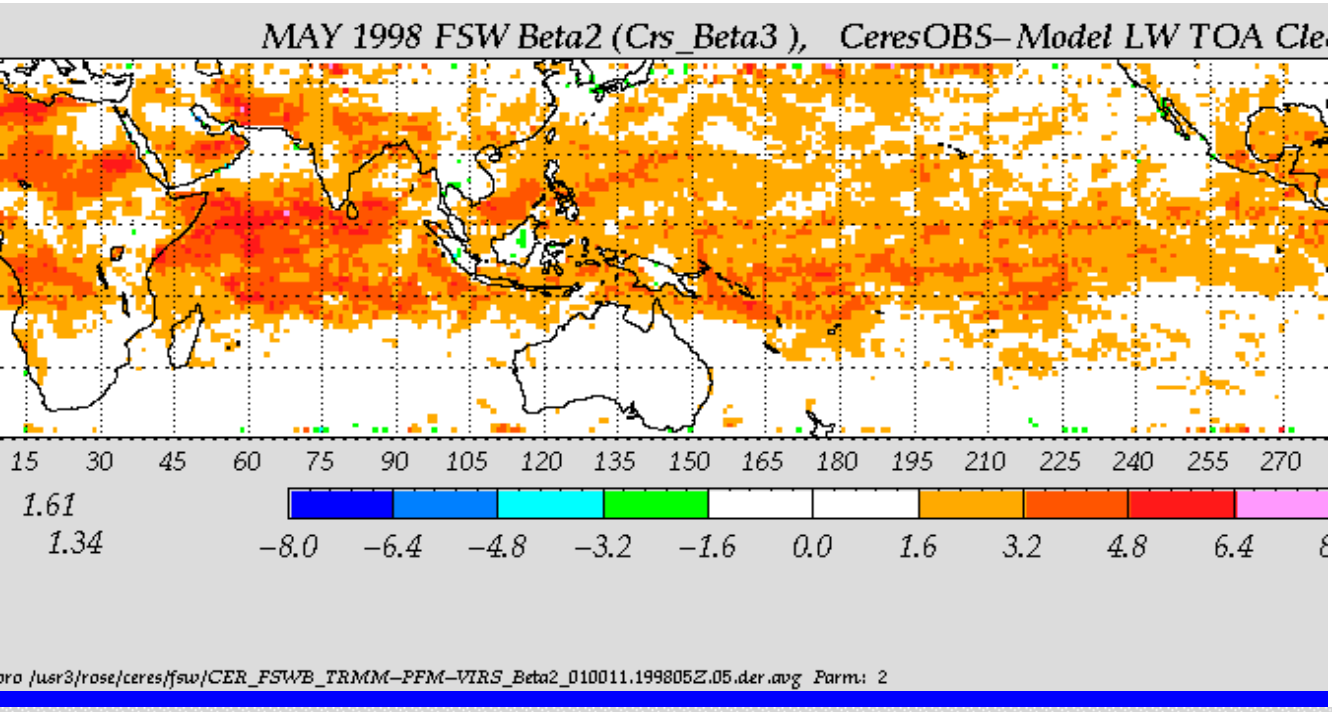


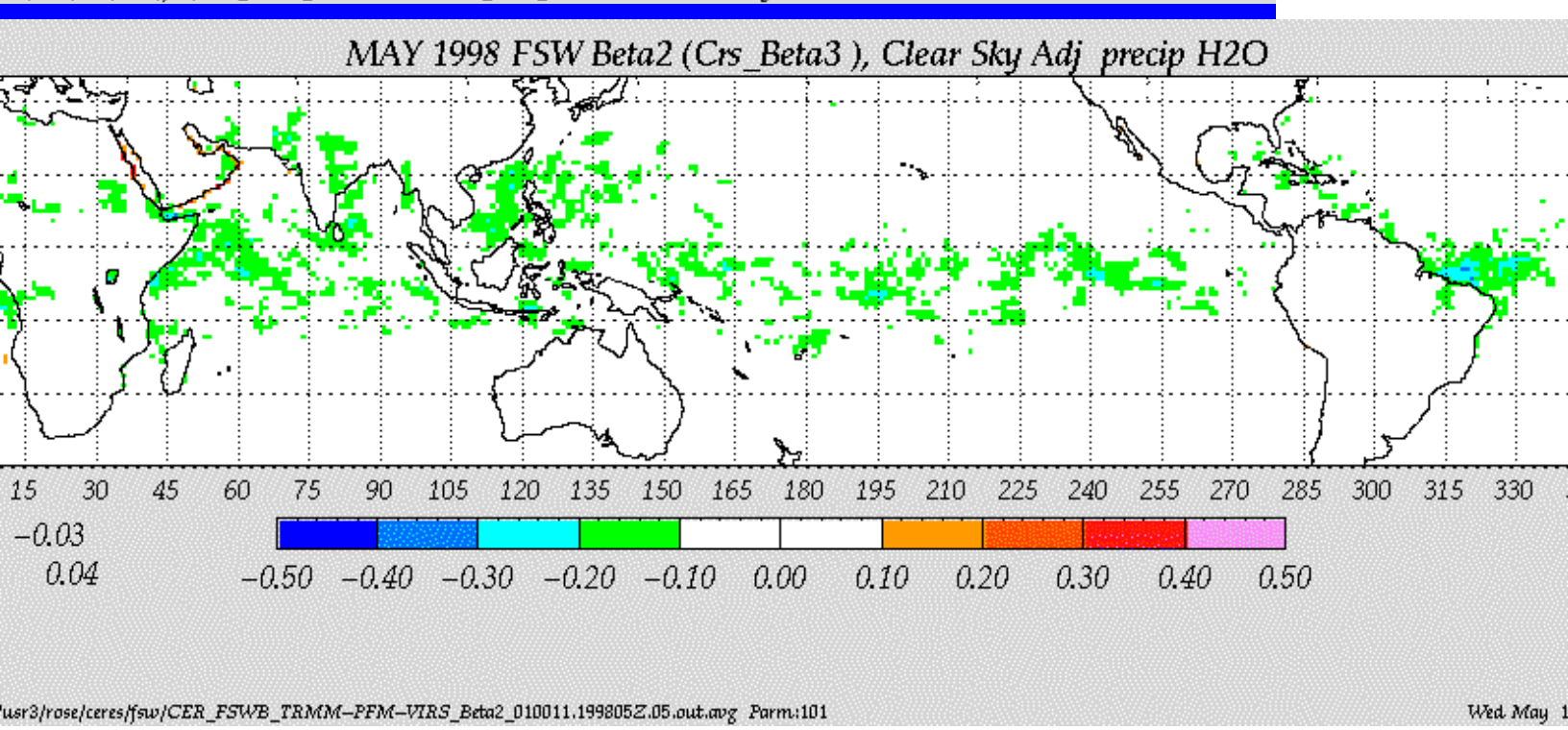
“FSW”: hourly **gridded** CERES (here averaged fo

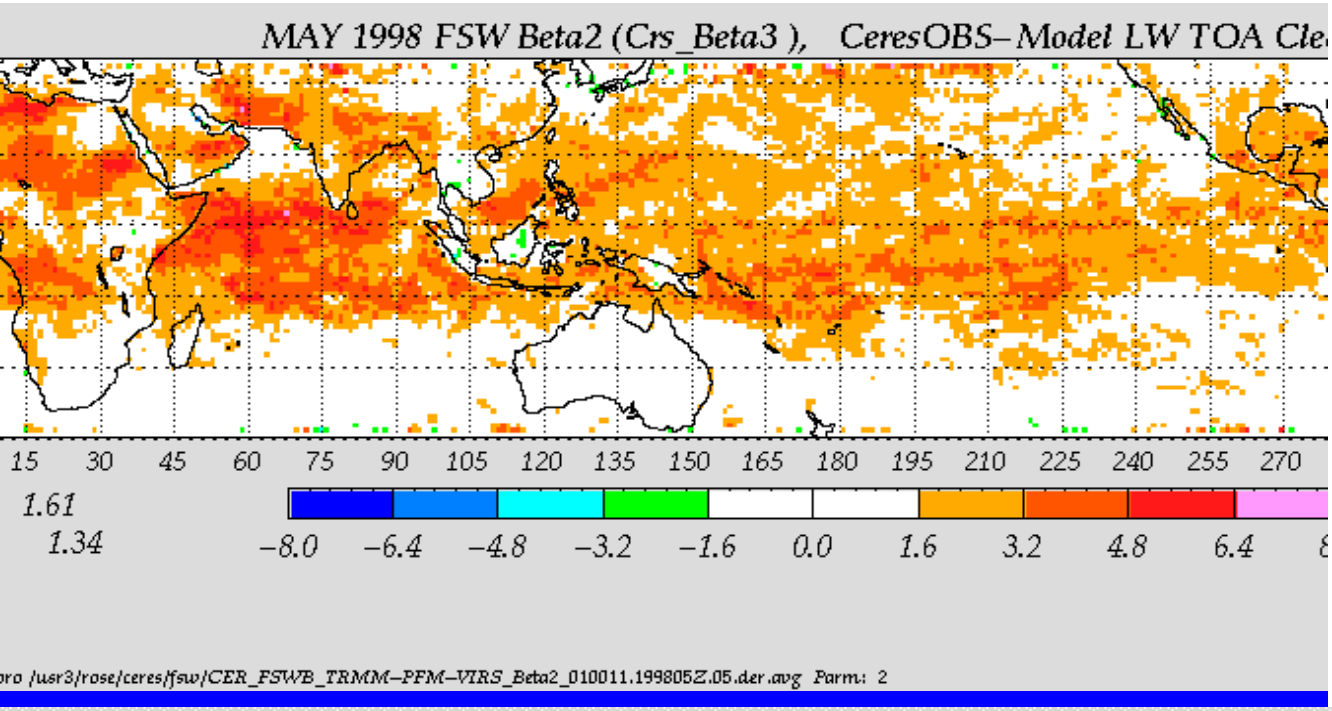
“CeresOBS-Model LW TOA Clear Sky”

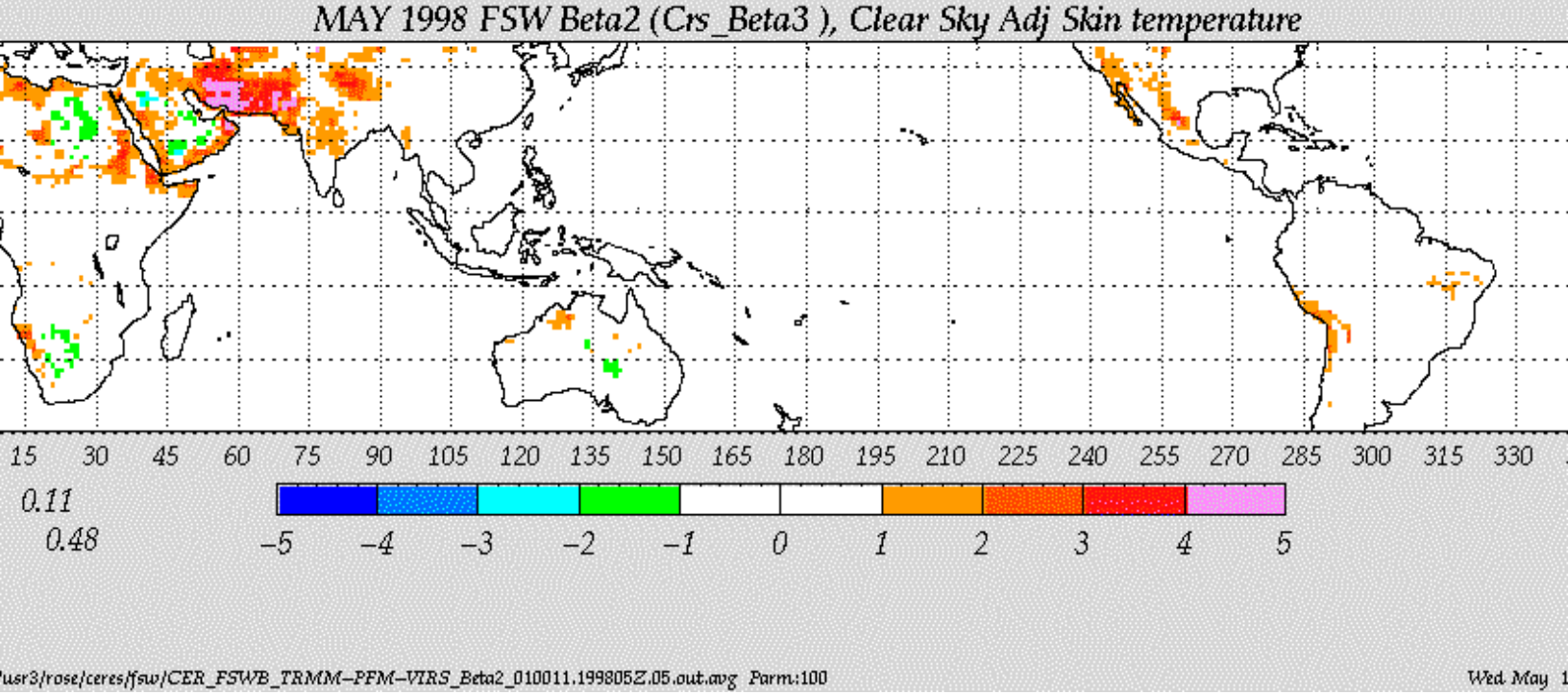
(SSF OLR)-(CRS Tuned Fu-Liou) for Clear

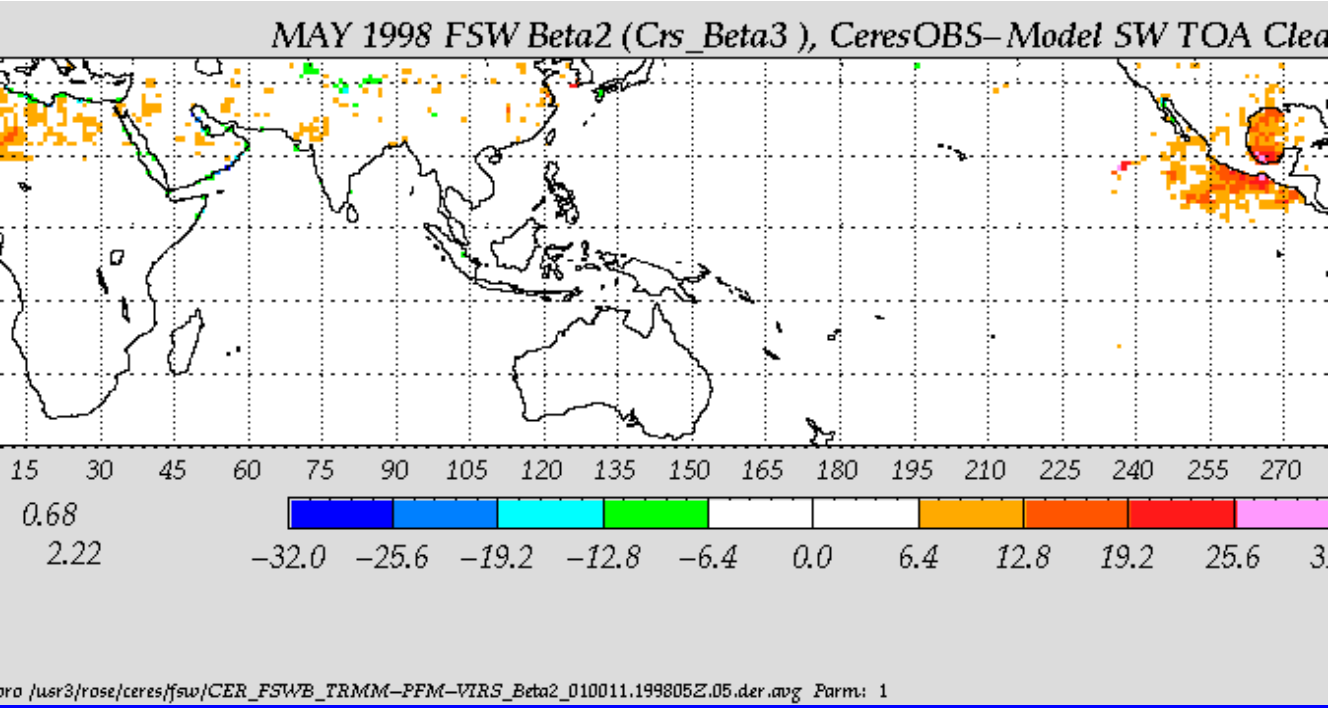


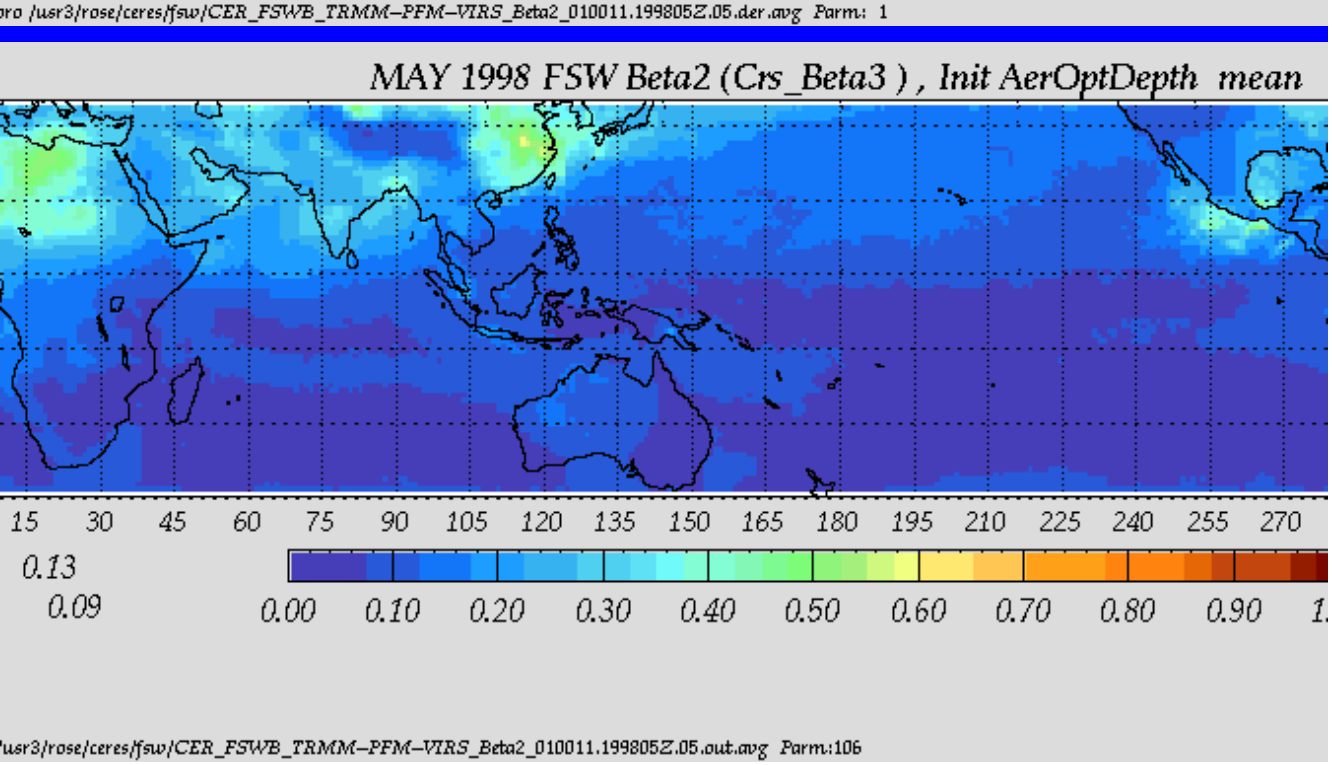

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS– Model LW TOA Cle
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
1.61
1.34
−8.0 −6.4 −4.8 −3.2 −1.6 0.0 1.6 3.2 4.8 6.4
pro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 2

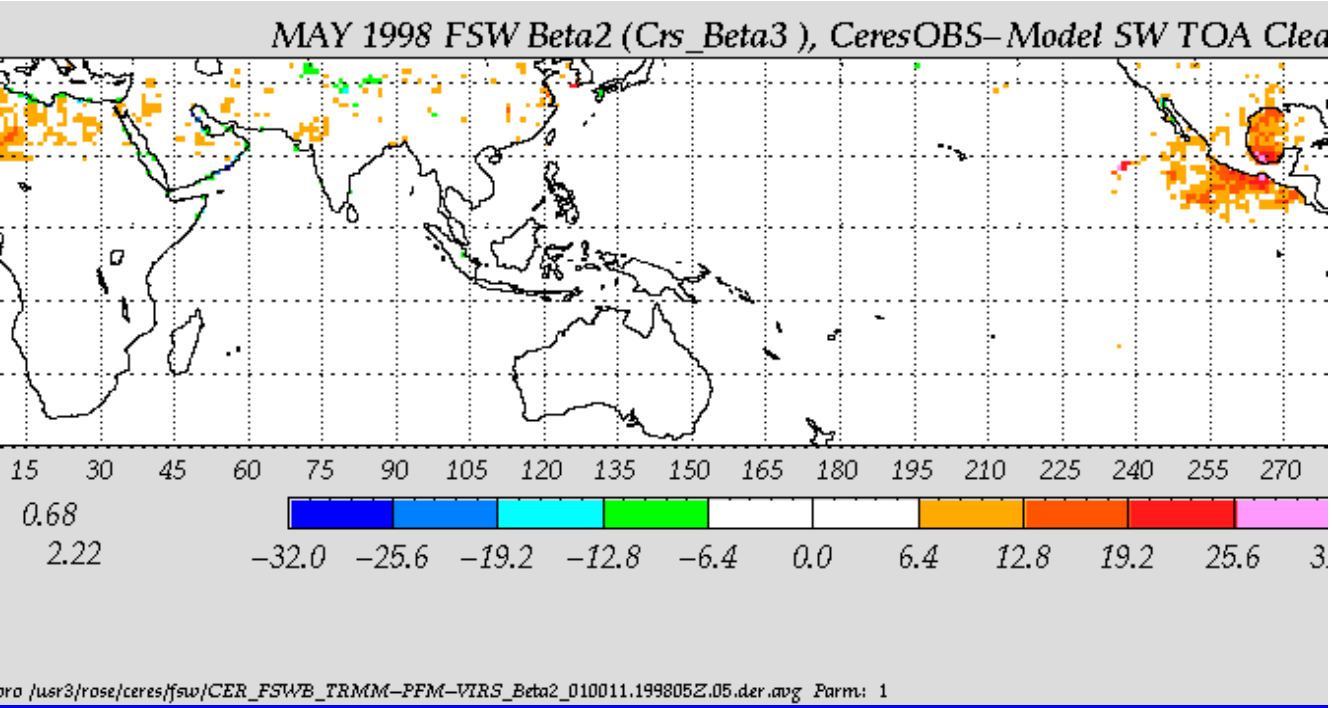

MAY 1998 FSW Beta2 (Crs_Beta3), Clear Sky Adj precip H2O
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330
−0.03
0.04
−0.50 −0.40 −0.30 −0.20 −0.10 0.00 0.10 0.20 0.30 0.40 0.50
usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.out.avg Parm:101
Wed May 1

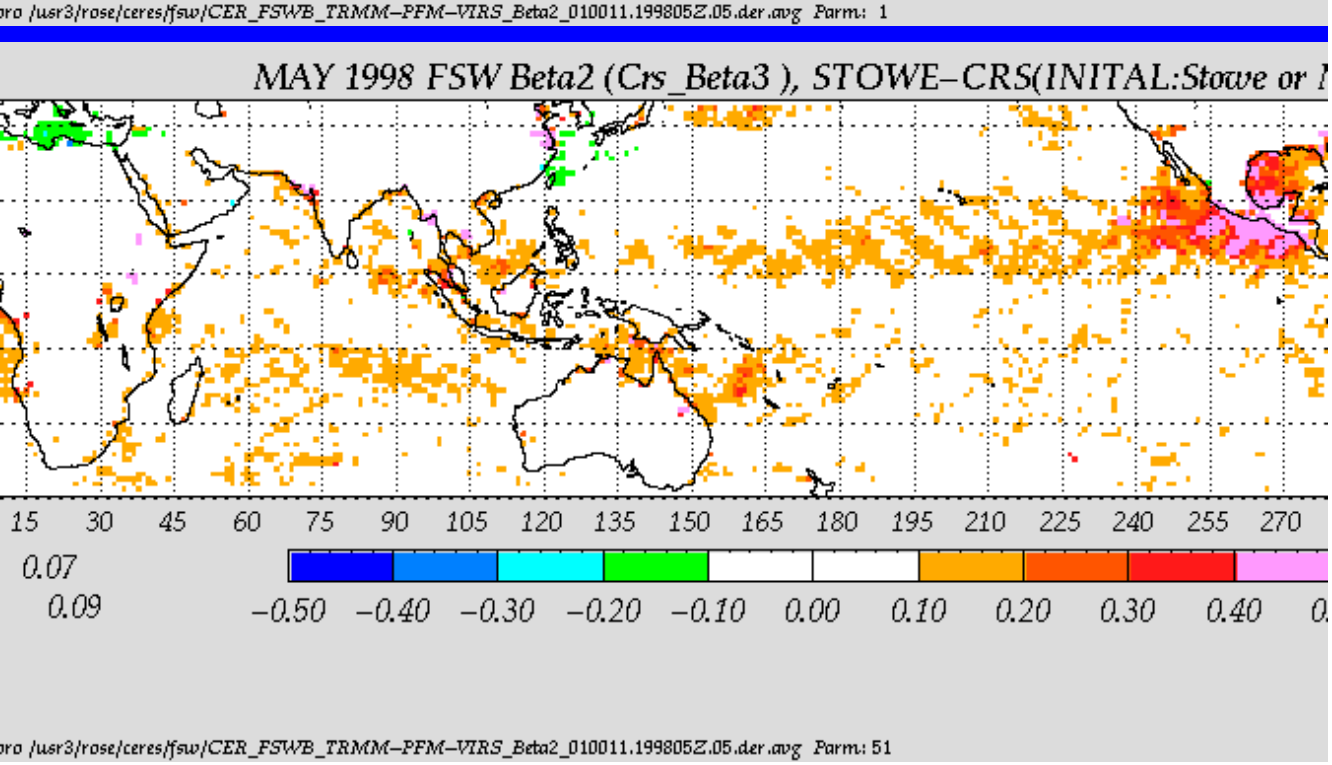

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS– Model LW TOA Cle
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
1.61
1.34
−8.0 −6.4 −4.8 −3.2 −1.6 0.0 1.6 3.2 4.8 6.4
pro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 2

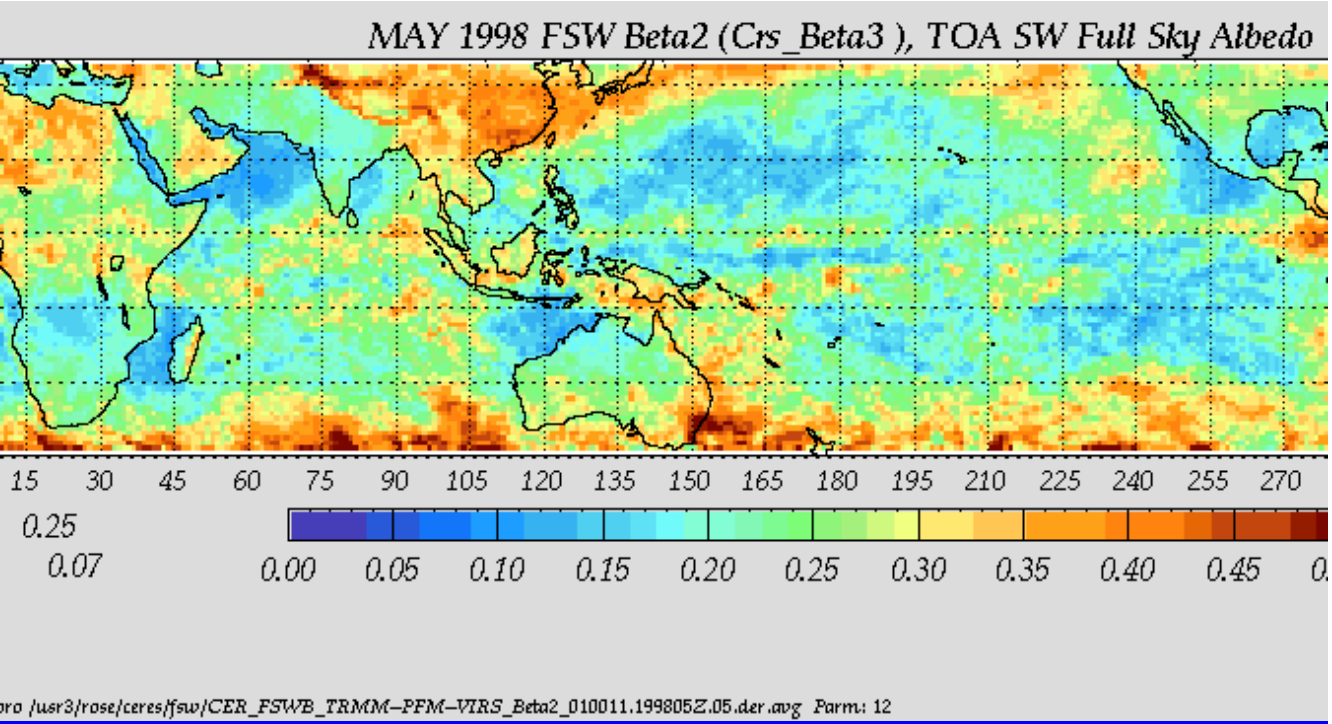

MAY 1998 FSW Beta2 (Crs_Beta3), Clear Sky Adj Skin temperature
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330
0.11
0.48
−5 −4 −3 −2 −1 0 1 2 3 4 5
usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.out.avg Parm:100
Wed May

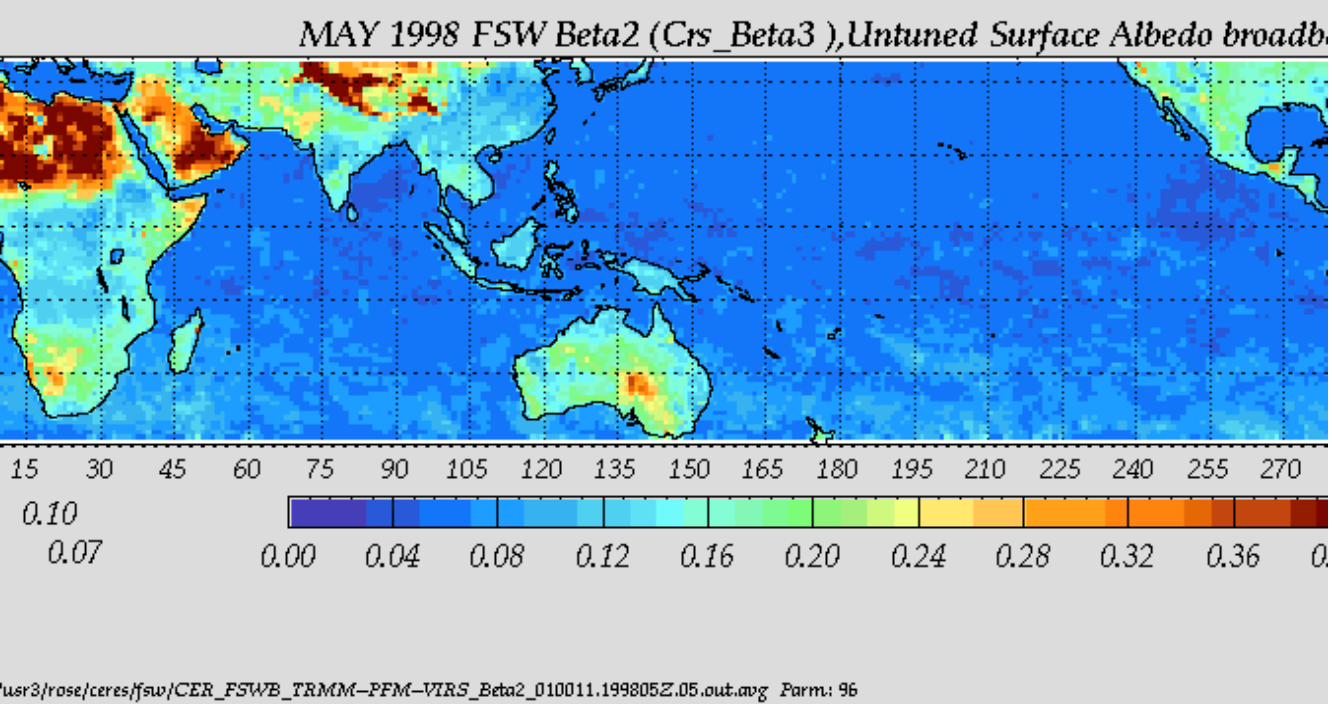

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS–Model SW TOA Clea
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.68
2.22
−32.0 −25.6 −19.2 −12.8 −6.4 0.0 6.4 12.8 19.2 25.6 3
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 1

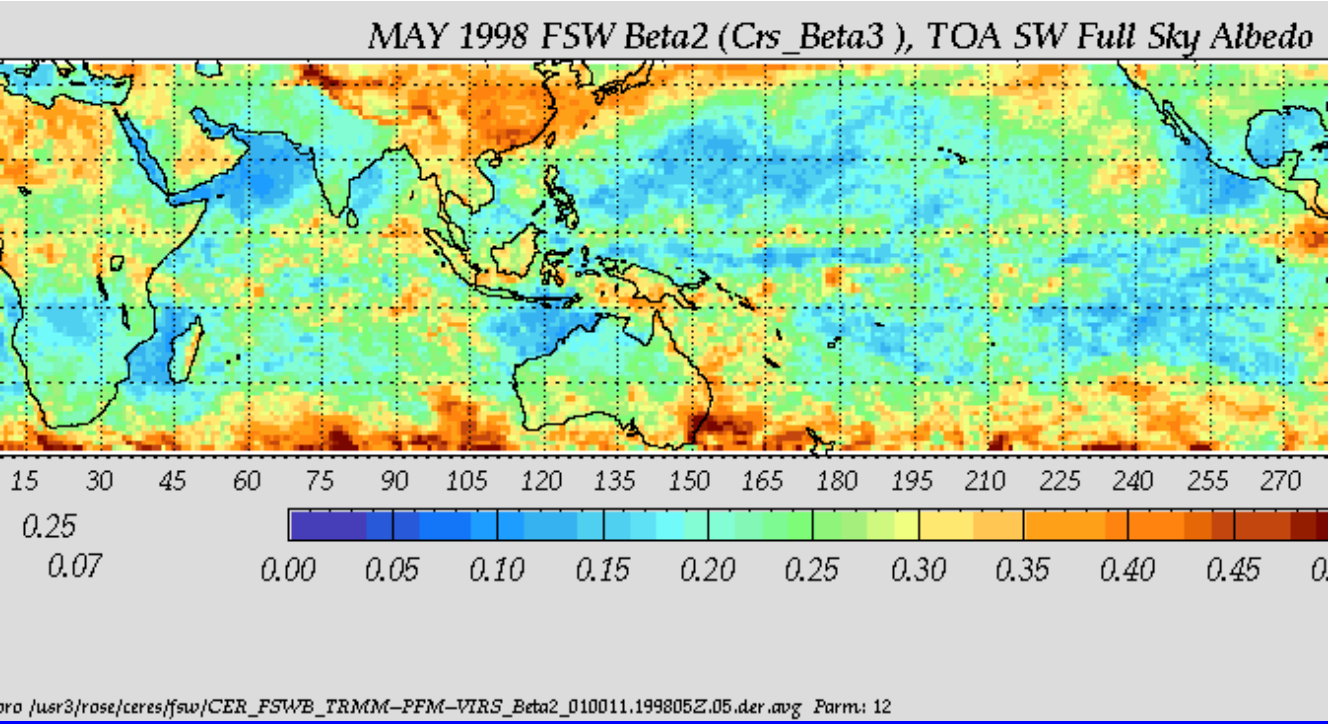

MAY 1998 FSW Beta2 (Crs_Beta3) , Init AerOptDepth mean
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.13
0.09
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.
usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.out.avg Parm:106

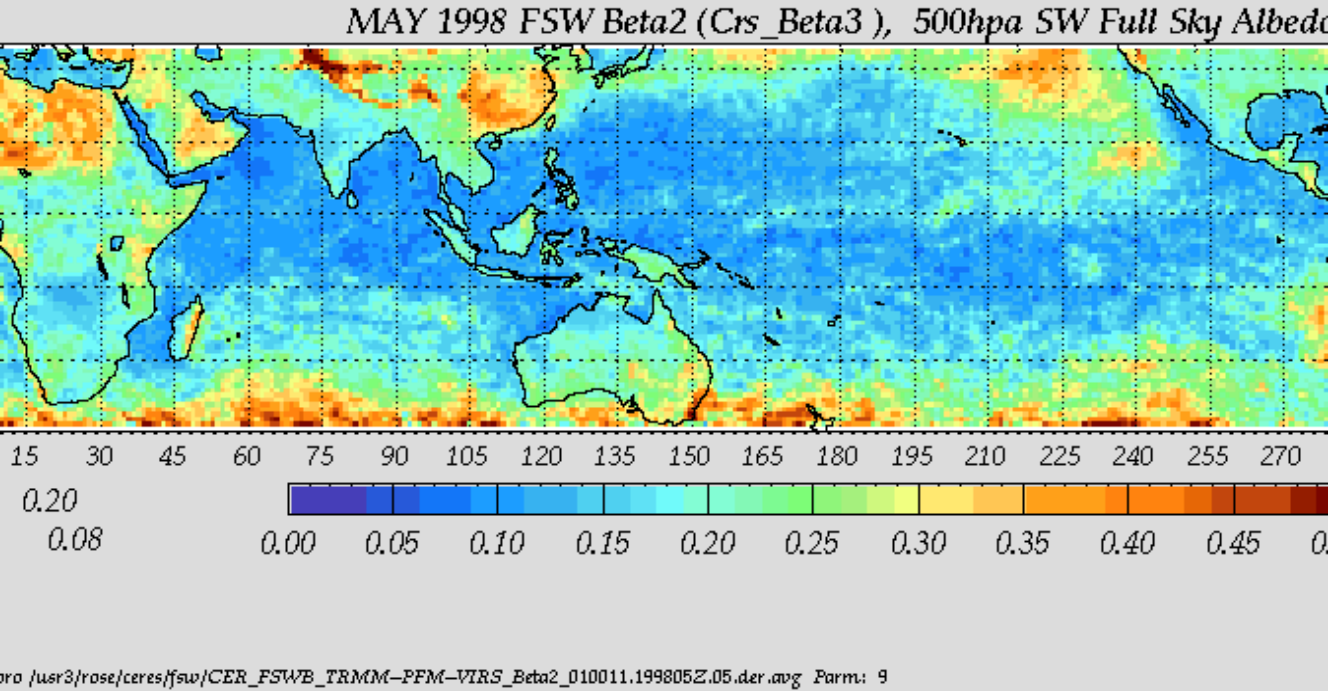

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS–Model SW TOA Clea
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.68
2.22
–32.0 –25.6 –19.2 –12.8 –6.4 0.0 6.4 12.8 19.2 25.6 3
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 1

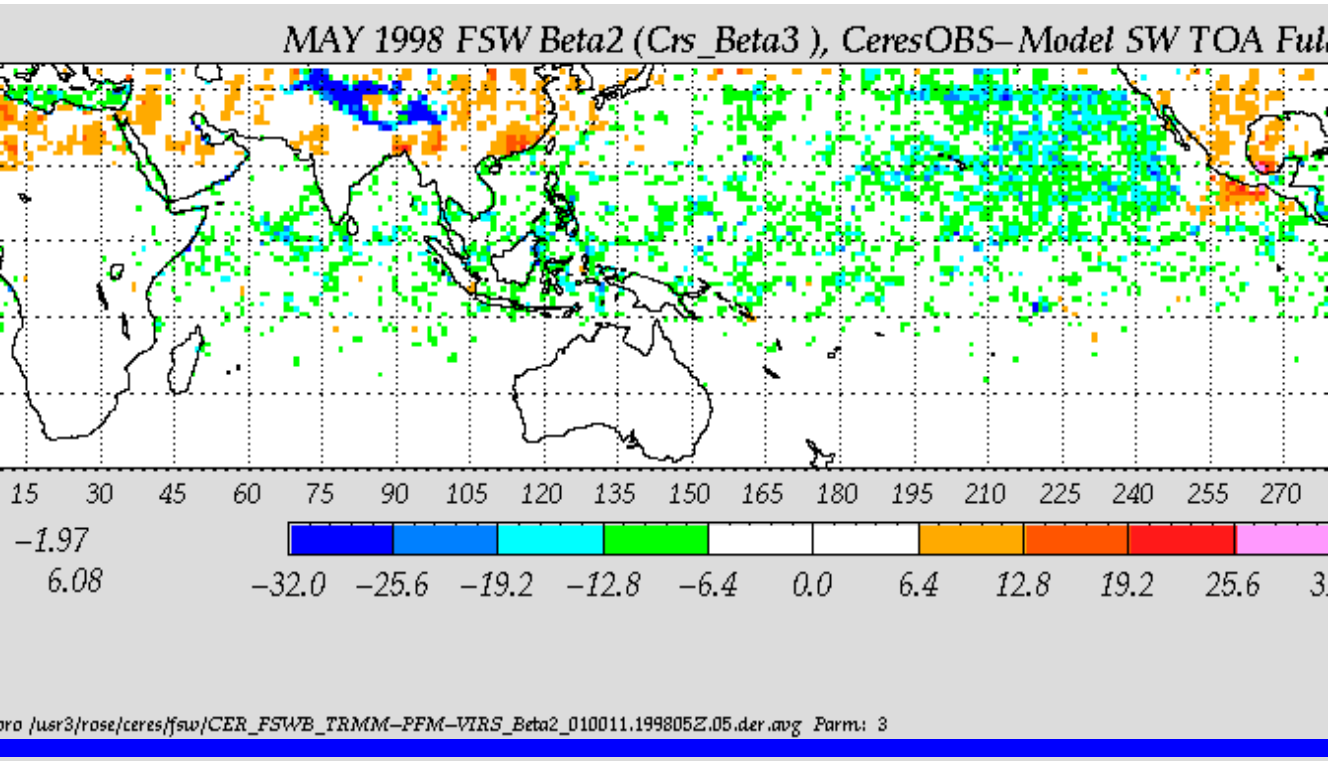

MAY 1998 FSW Beta2 (Crs_Beta3), STOWE–CRS(INITAL:Stowe or
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.07
0.09
–0.50 –0.40 –0.30 –0.20 –0.10 0.00 0.10 0.20 0.30 0.40 0.
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 51

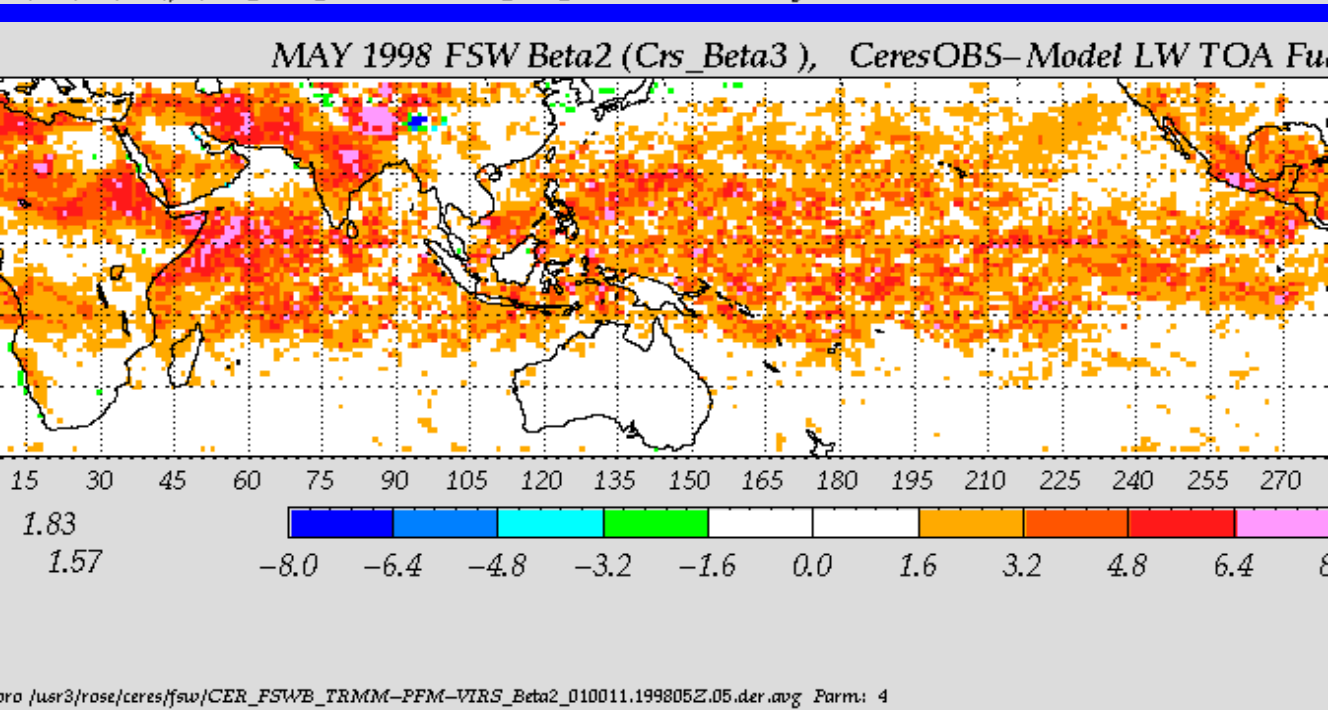

MAY 1998 FSW Beta2 (Crs_Beta3), TOA SW Full Sky Albedo
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.25
0.07
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.der.avg Parm: 12

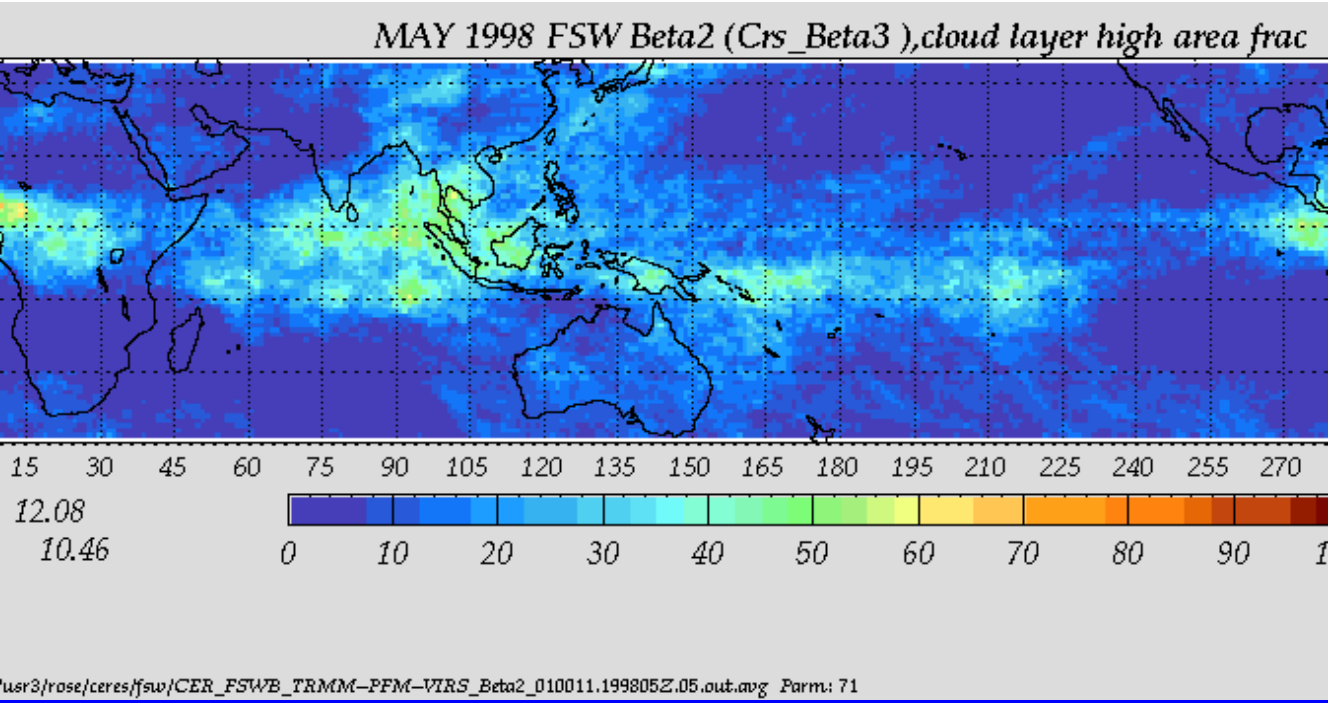

MAY 1998 FSW Beta2 (Crs_Beta3),Untuned Surface Albedo broadb
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.10
0.07
0.00 0.04 0.08 0.12 0.16 0.20 0.24 0.28 0.32 0.36
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 96

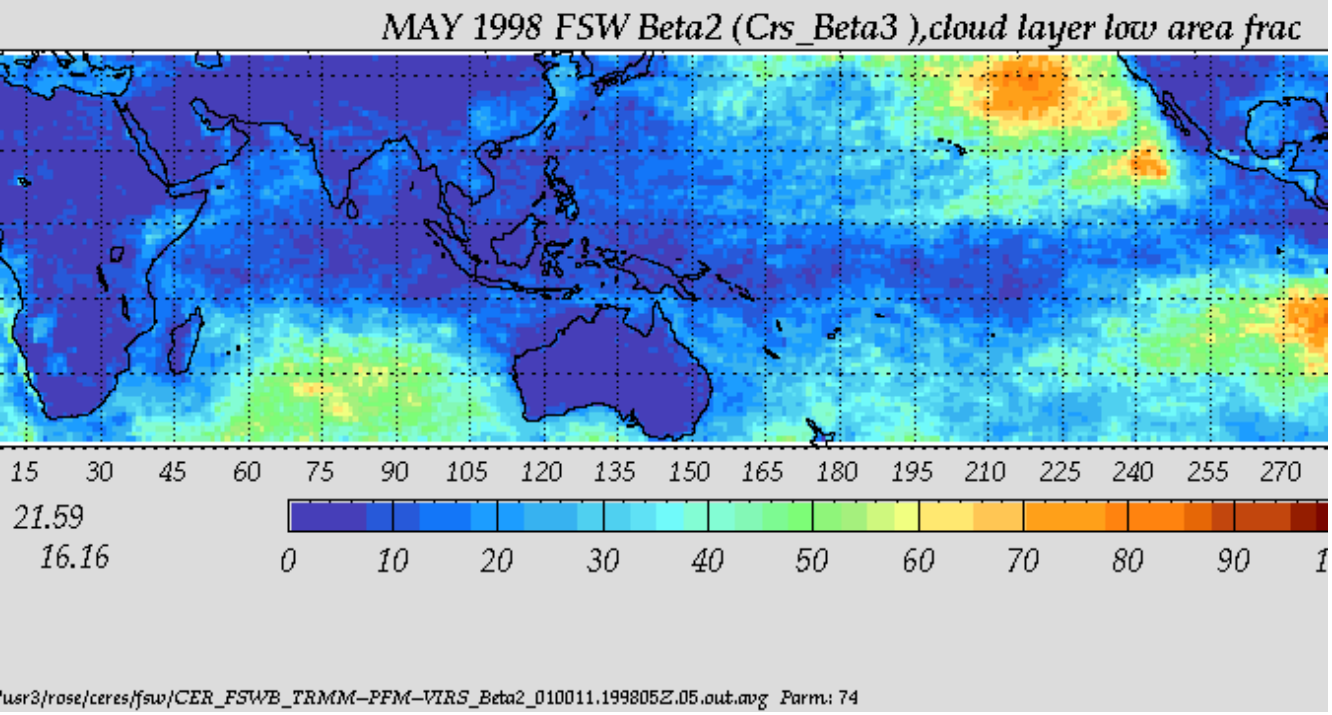

MAY 1998 FSW Beta2 (Crs_Beta3), TOA SW Full Sky Albedo
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.25
0.07
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.der.avg Parm: 12

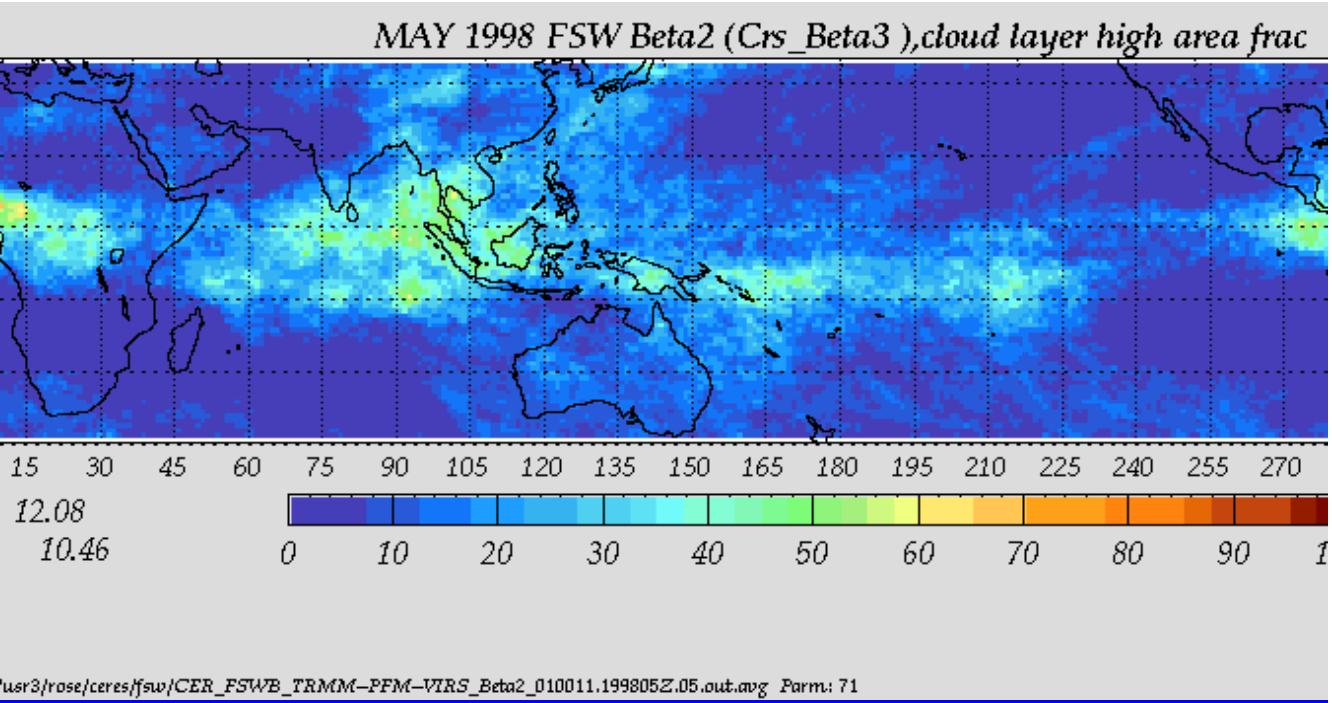

MAY 1998 FSW Beta2 (Crs_Beta3), 500hpa SW Full Sky Albedo
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.20
0.08
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.der.avg Parm: 9

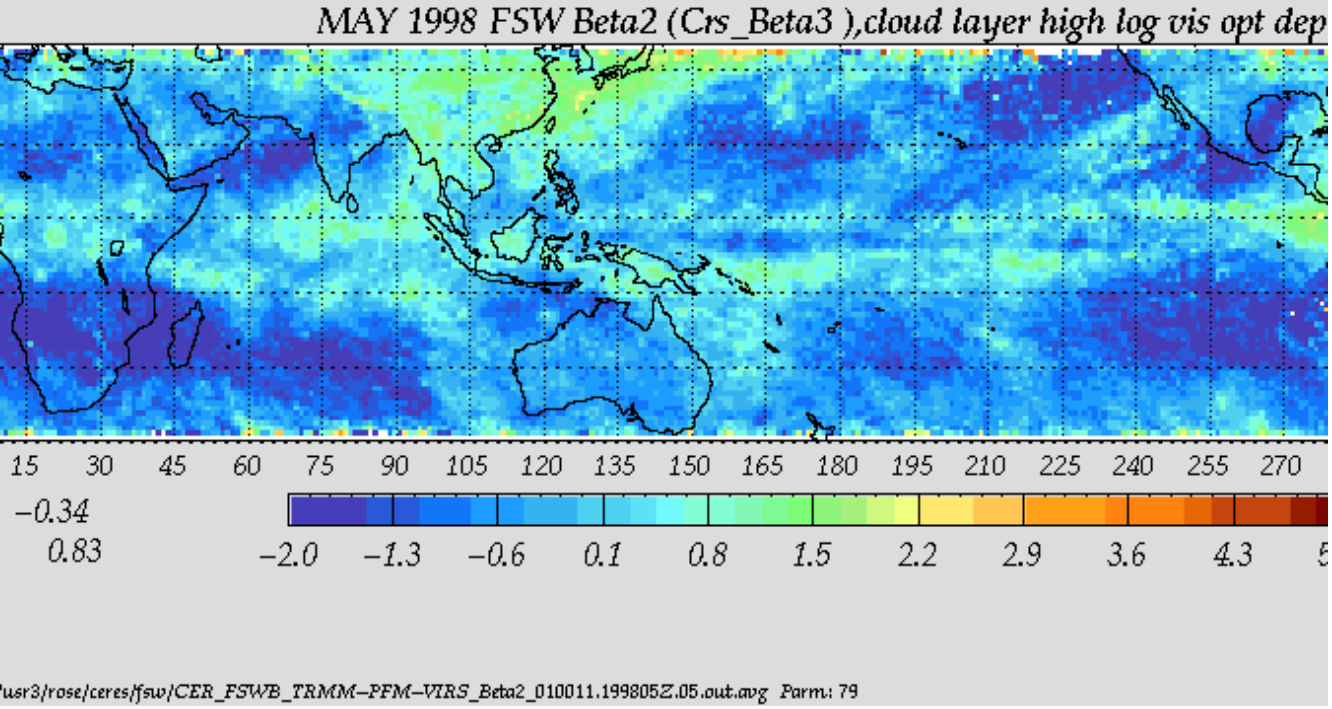

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS–Model SW TOA Ful
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−1.97
6.08
−32.0 −25.6 −19.2 −12.8 −6.4 0.0 6.4 12.8 19.2 25.6
pro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 3

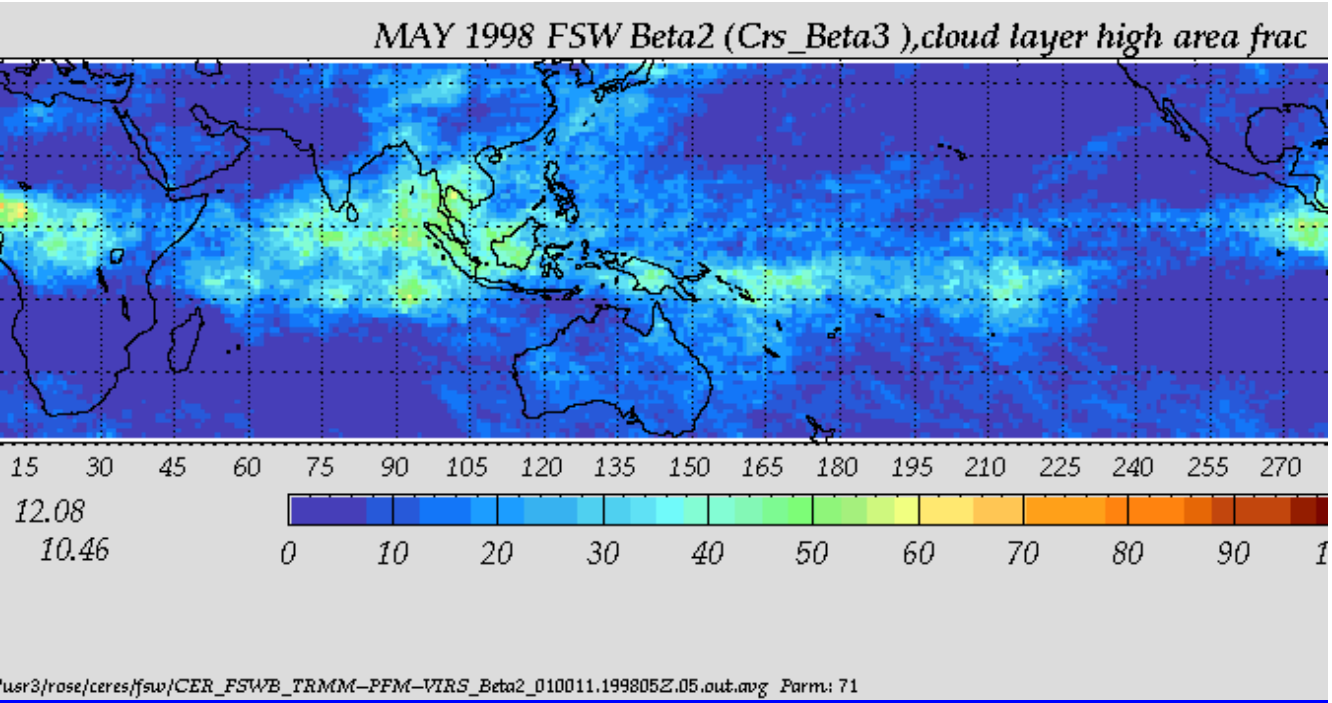

MAY 1998 FSW Beta2 (Crs_Beta3), CeresOBS–Model LW TOA Fu
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
1.83
1.57
−8.0 −6.4 −4.8 −3.2 −1.6 0.0 1.6 3.2 4.8 6.4
pro /usr3/rose/ceres/fsw/CER_FSWB_TRMM–PFM–VIRS_Beta2_010011.199805Z.05.der.avg Parm: 4

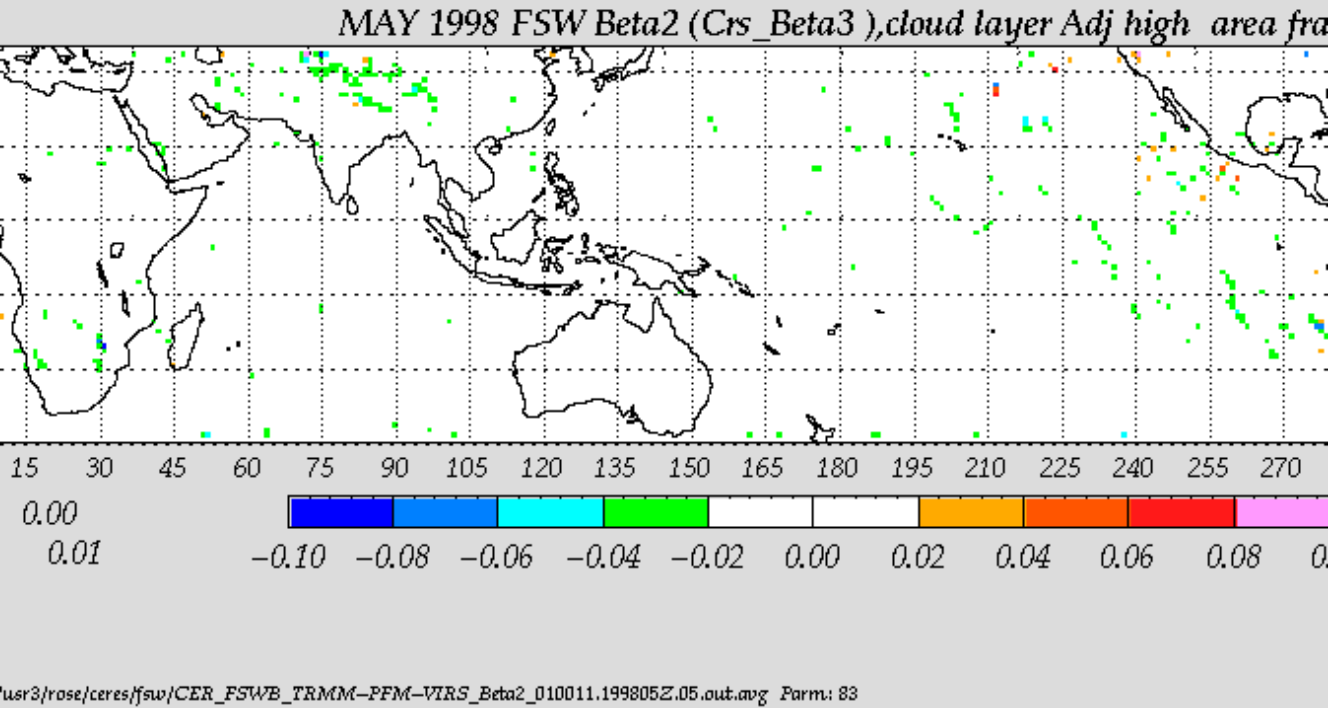

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer high area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
12.08
10.46
0 10 20 30 40 50 60 70 80 90 1
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 71

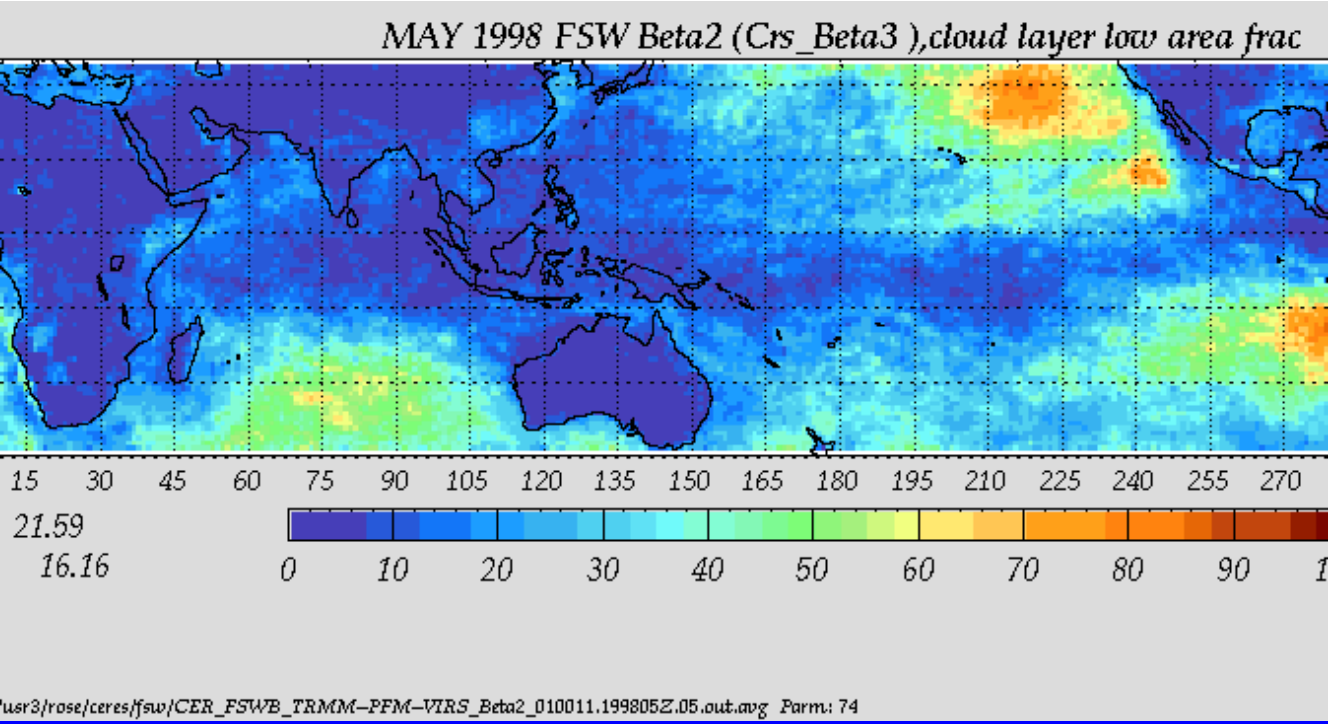

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
21.59
16.16
0 10 20 30 40 50 60 70 80 90 1
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 74

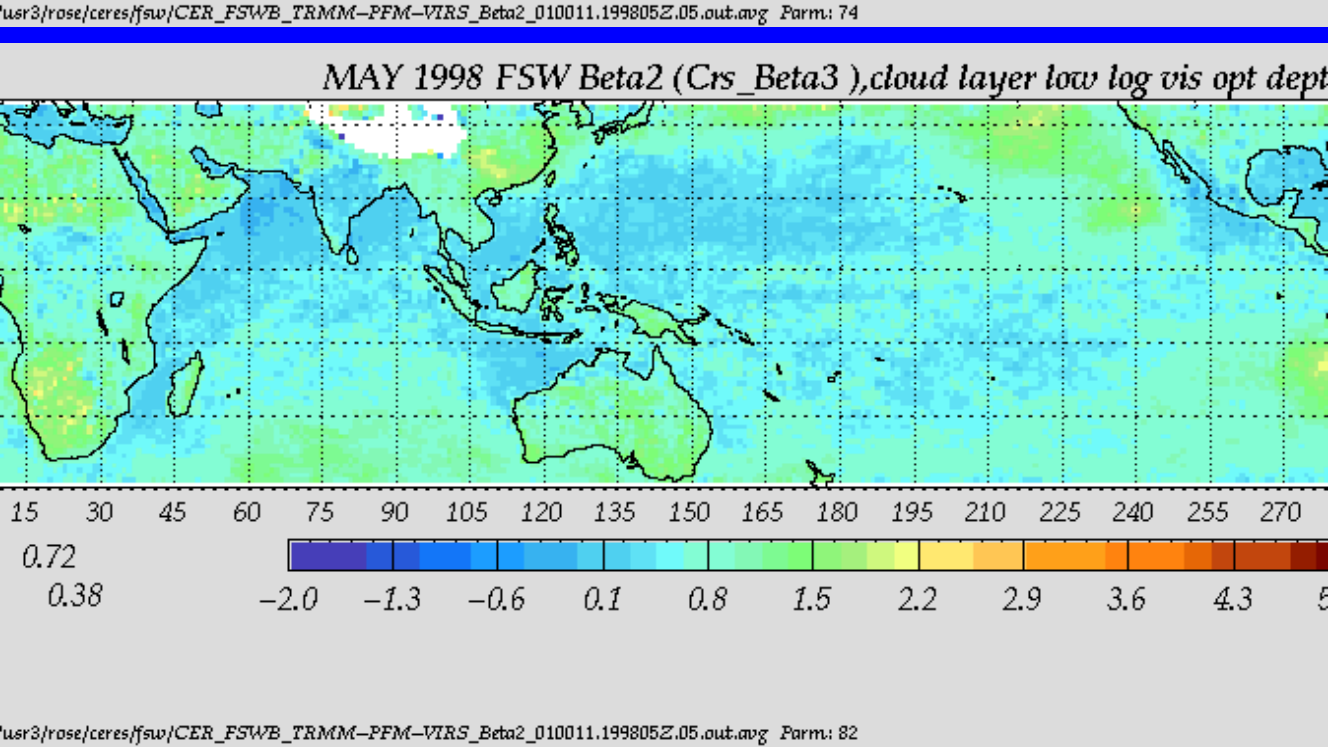

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer high area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
12.08
10.46
0 10 20 30 40 50 60 70 80 90
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 71

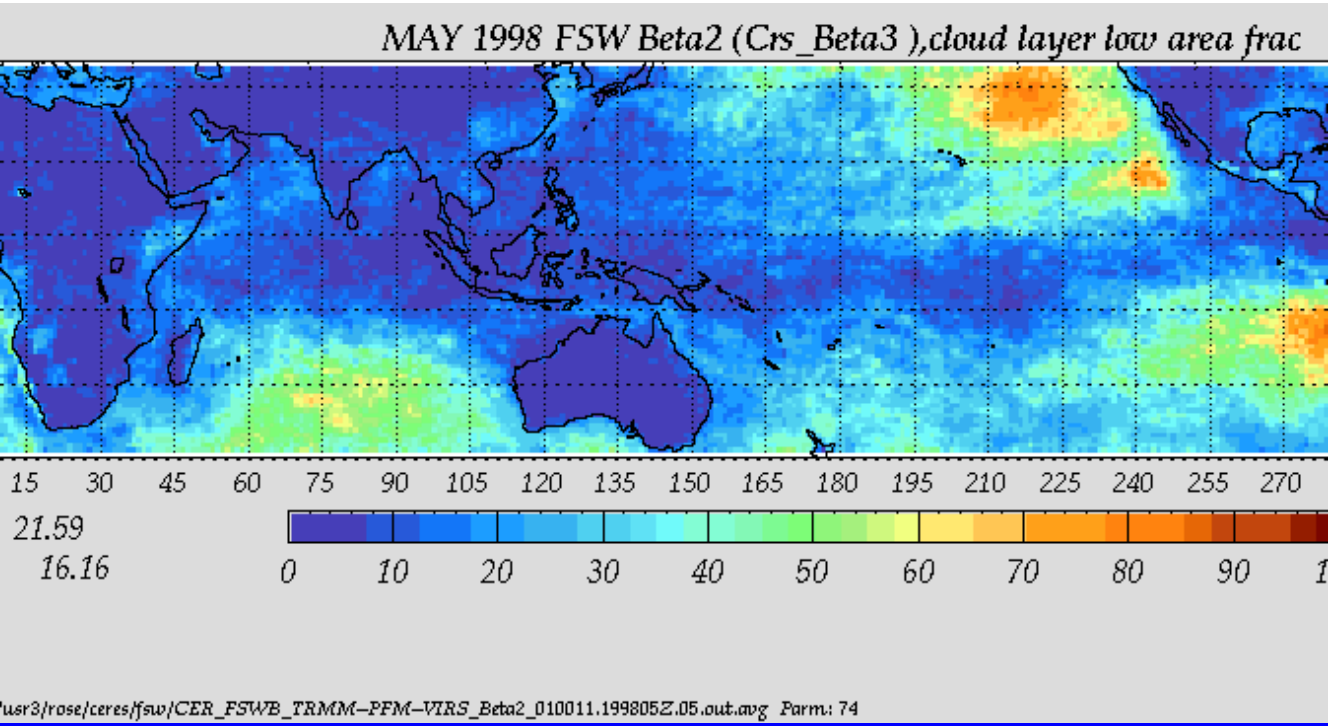

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer high log vis opt dep
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
-0.34
0.83
-2.0 -1.3 -0.6 0.1 0.8 1.5 2.2 2.9 3.6 4.3
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 79

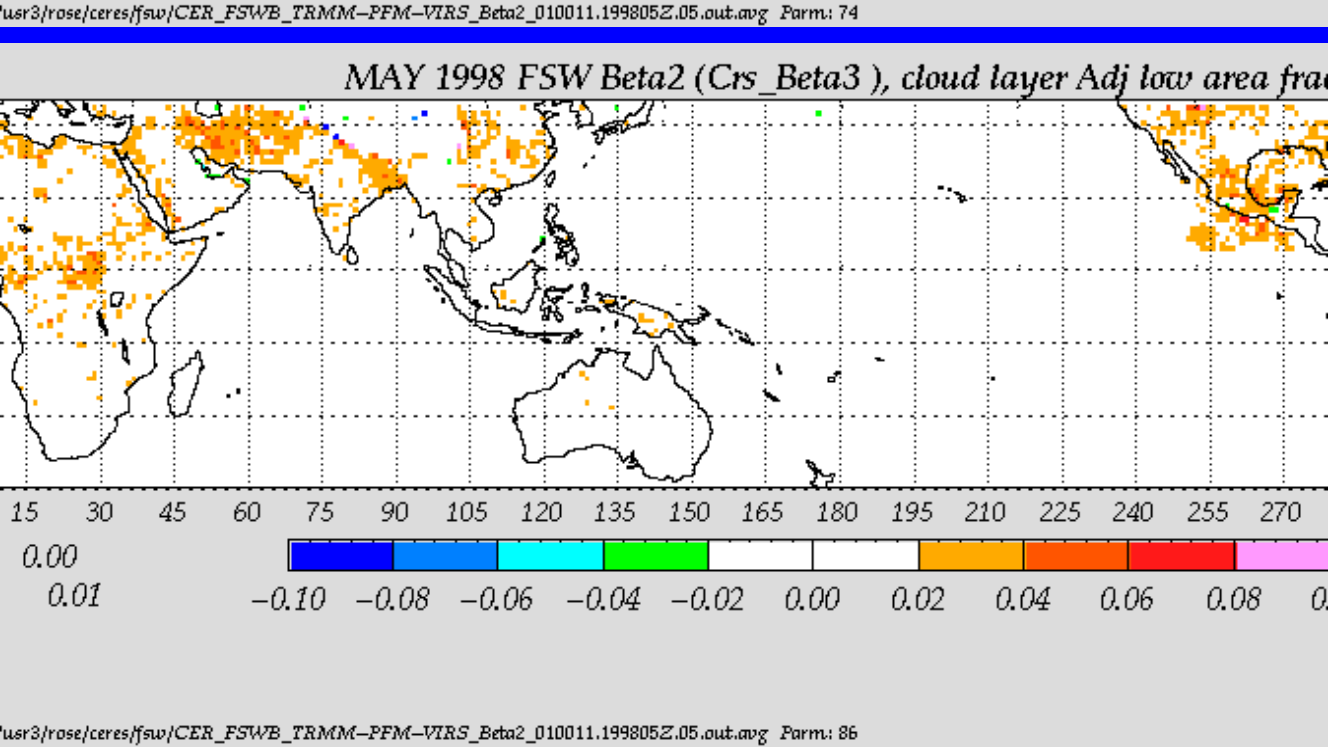

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer high area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
12.08
10.46
0 10 20 30 40 50 60 70 80 90 1
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 71

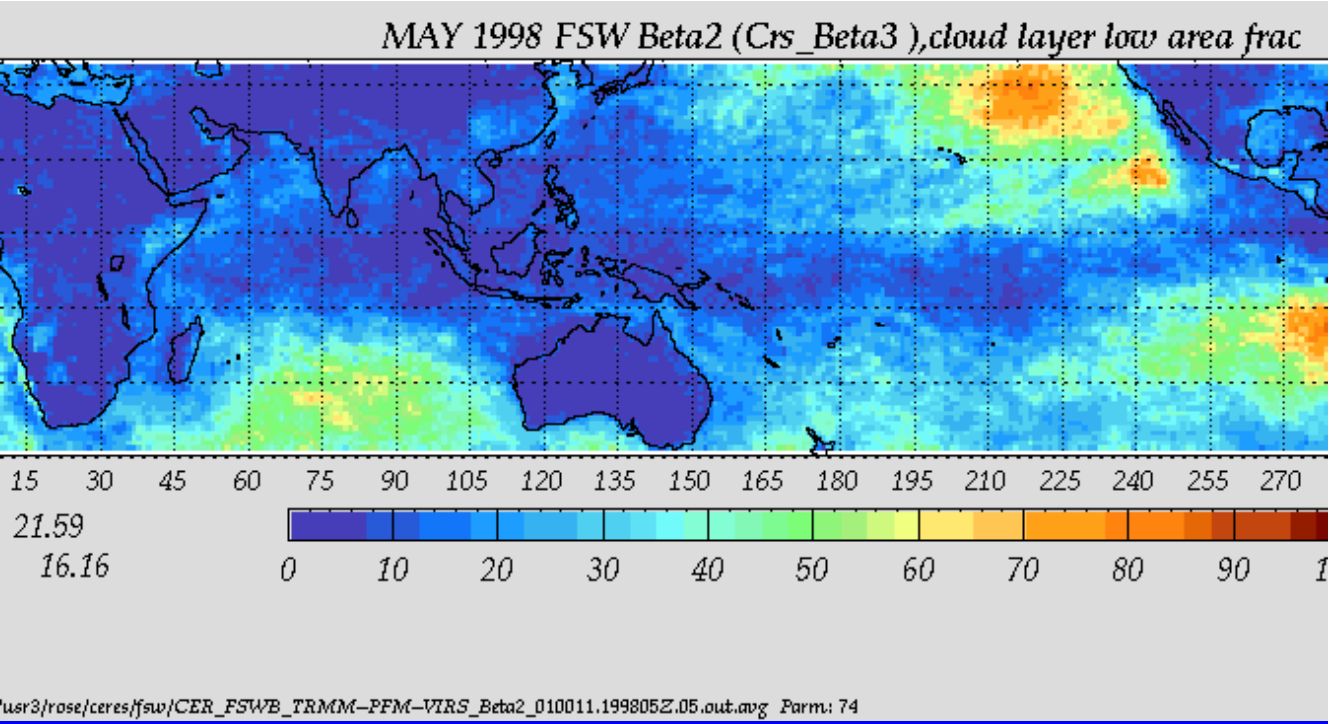

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer Adj high area fra
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.00
0.01
−0.10 −0.08 −0.06 −0.04 −0.02 0.00 0.02 0.04 0.06 0.08 0.
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 83

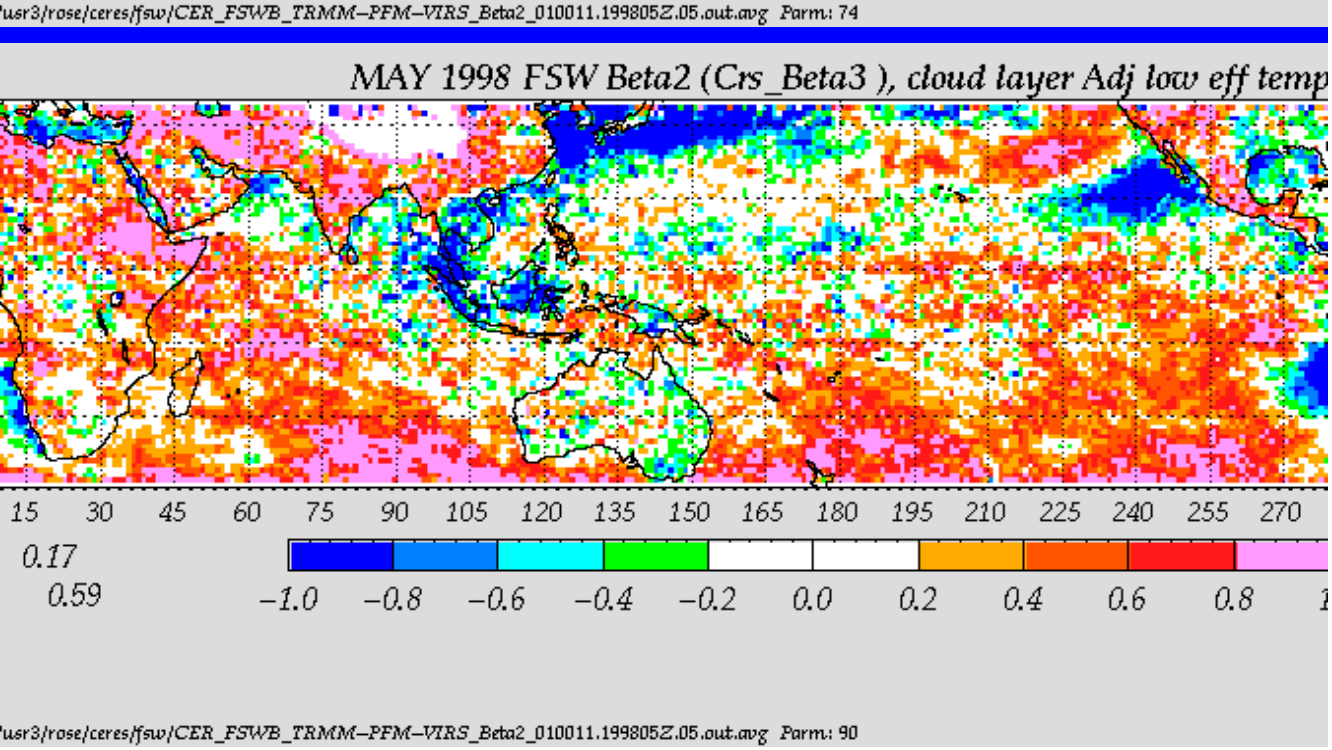

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
21.59
16.16
0 10 20 30 40 50 60 70 80 90
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 74

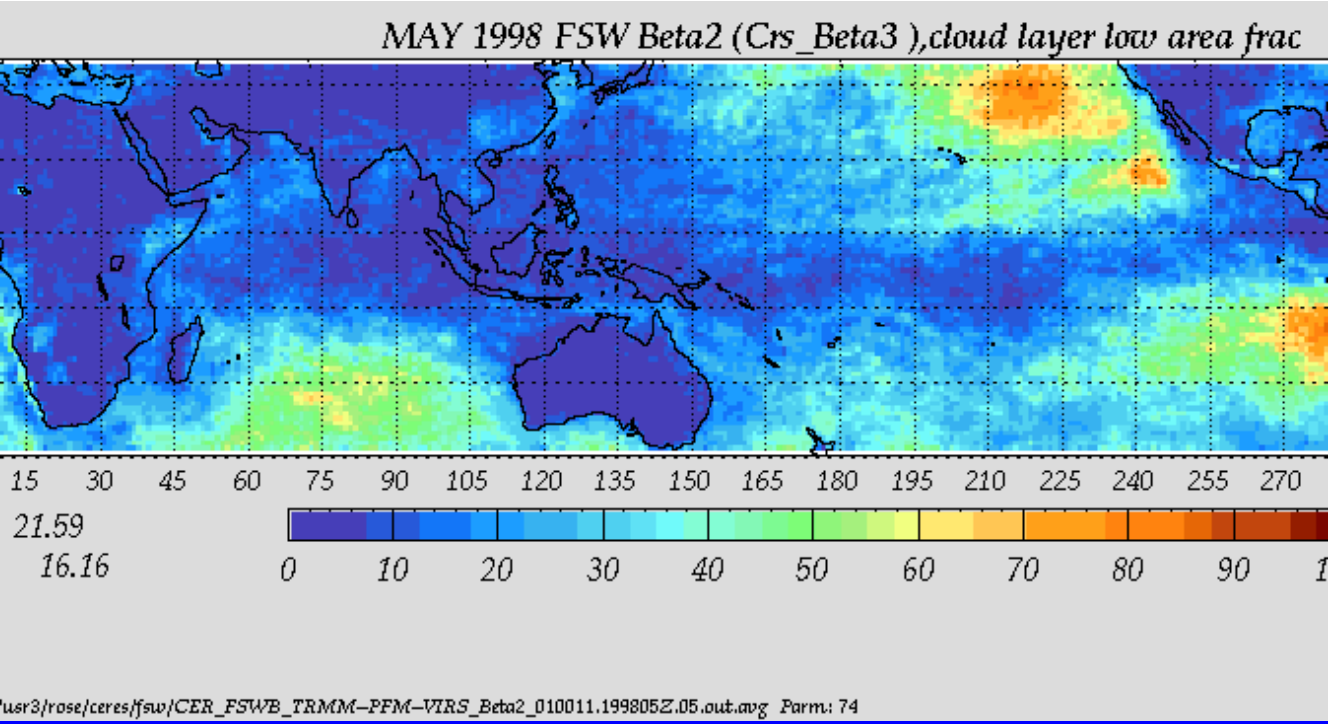

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low log vis opt dept
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.72
0.38
−2.0 −1.3 −0.6 0.1 0.8 1.5 2.2 2.9 3.6 4.3
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 82

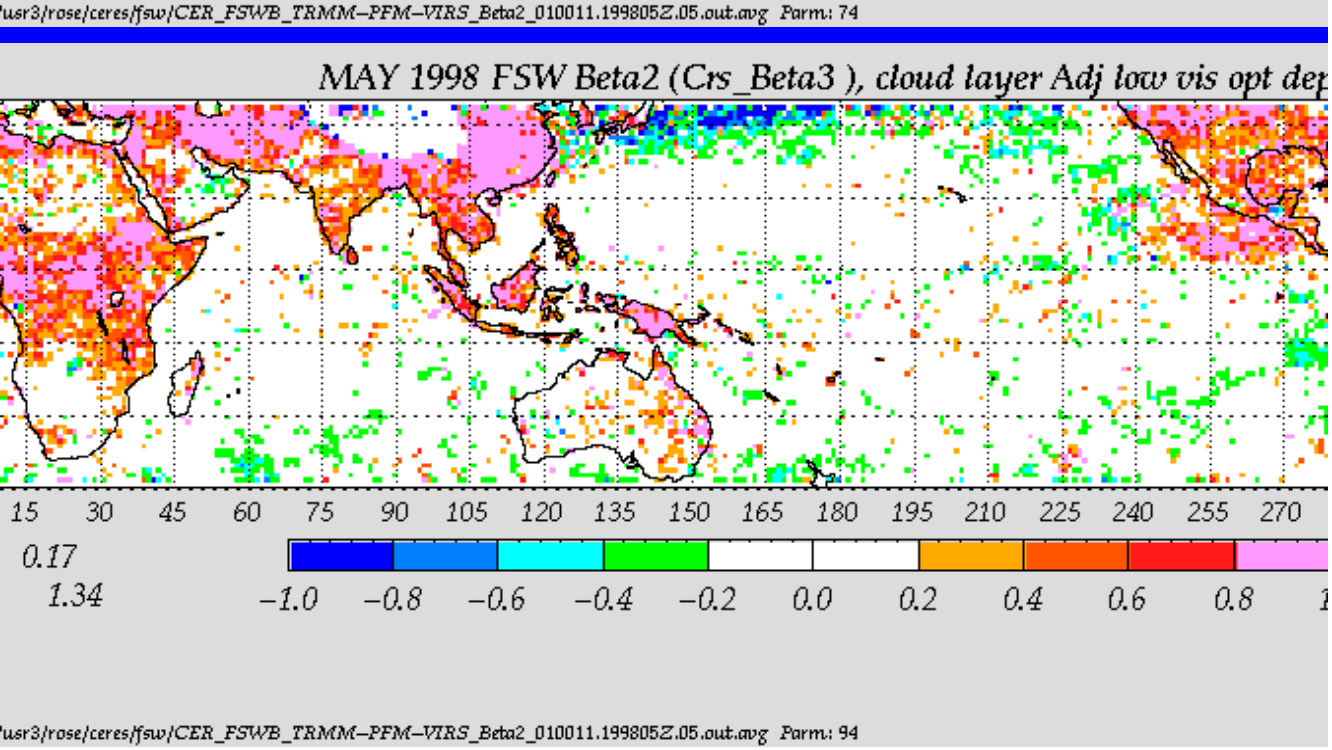

MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
21.59
16.16
0 10 20 30 40 50 60 70 80 90
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 74


MAY 1998 FSW Beta2 (Crs_Beta3), cloud layer Adj low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.00
0.01
−0.10 −0.08 −0.06 −0.04 −0.02 0.00 0.02 0.04 0.06 0.08
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 86


MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
21.59
16.16
0 10 20 30 40 50 60 70 80 90
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 74


MAY 1998 FSW Beta2 (Crs_Beta3), cloud layer Adj low eff temp
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.17
0.59
−1.0 −0.8 −0.6 −0.4 −0.2 0.0 0.2 0.4 0.6 0.8
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 90


MAY 1998 FSW Beta2 (Crs_Beta3),cloud layer low area frac
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
21.59
16.16
0 10 20 30 40 50 60 70 80 90
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 74


MAY 1998 FSW Beta2 (Crs_Beta3), cloud layer Adj low vis opt dep
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
0.17
1.34
−1.0 −0.8 −0.6 −0.4 −0.2 0.0 0.2 0.4 0.6 0.8
usr3/rose/ceres/fsw/CER_FSWB_TRMM-PFM-VIRS_Beta2_010011.199805Z.05.out.avg Parm: 94

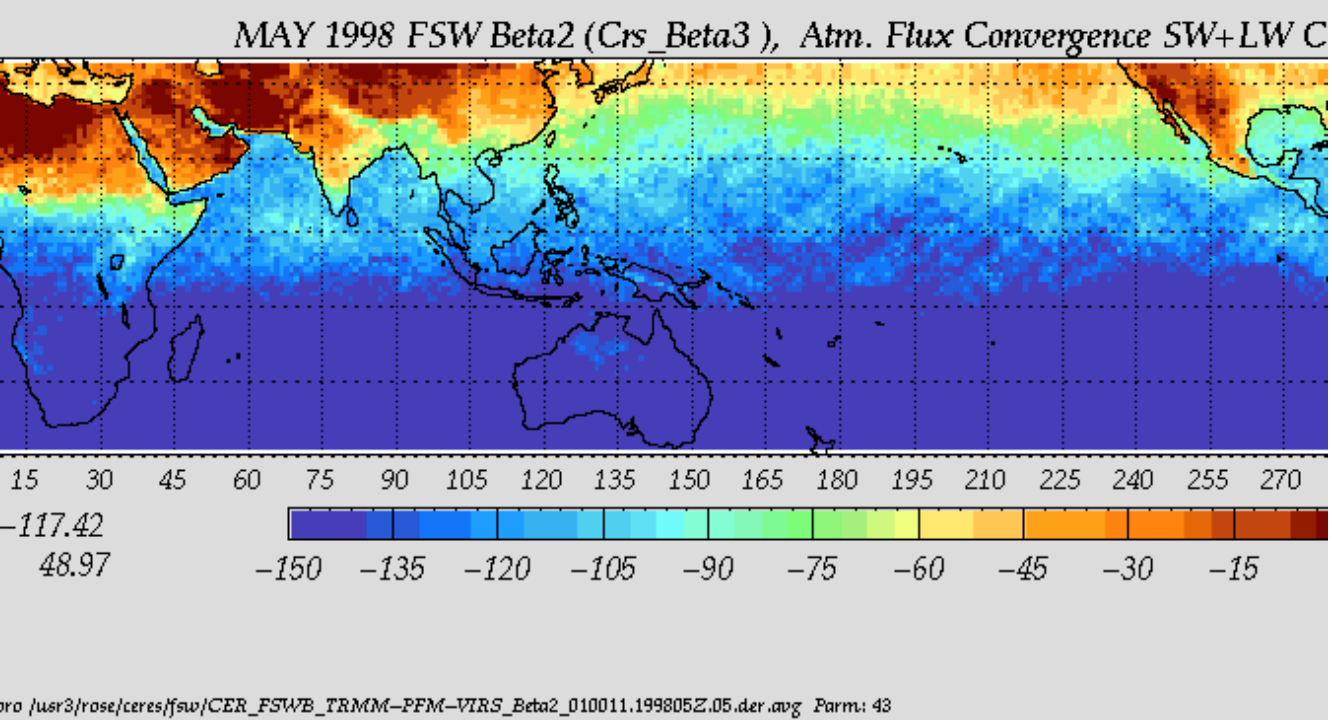
FSW “Convergence” in Atmosphere

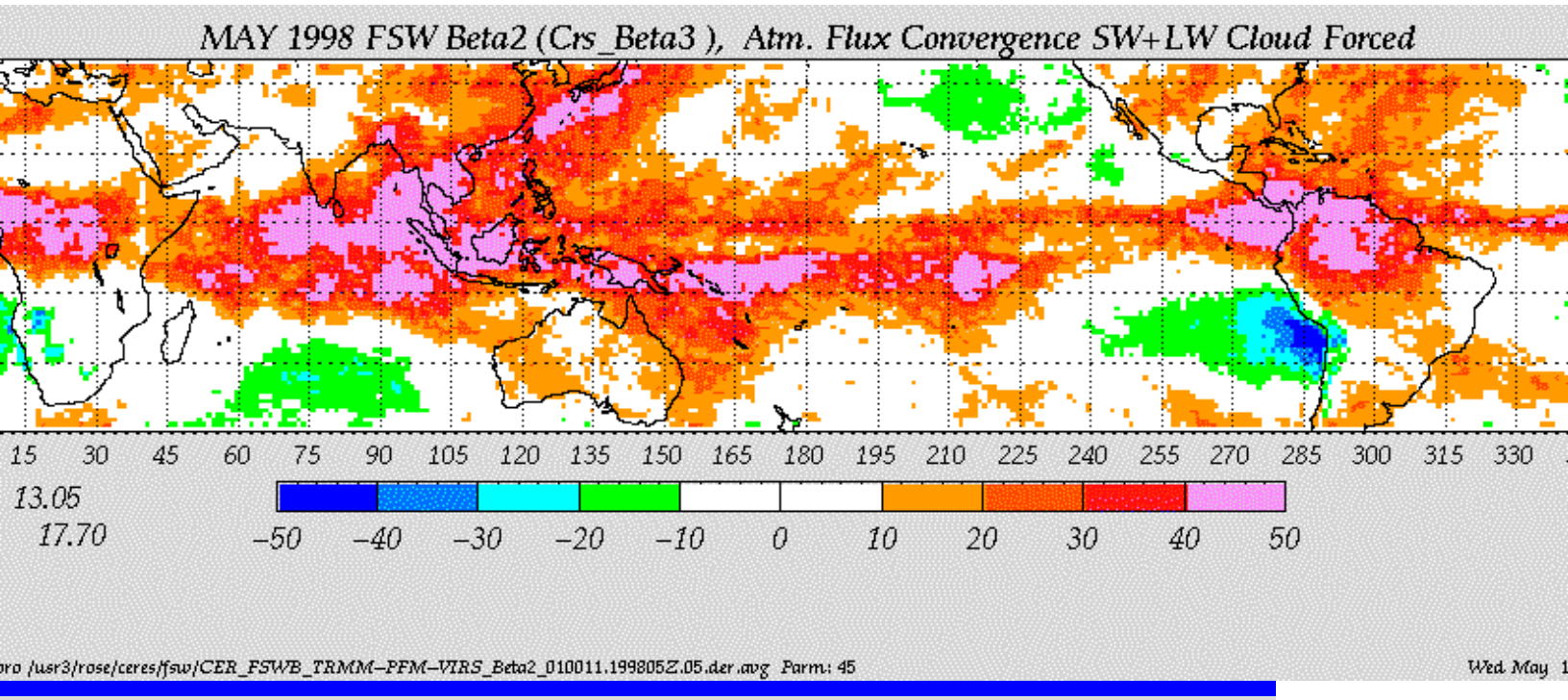
SW (crude 24 hour mean) is positive

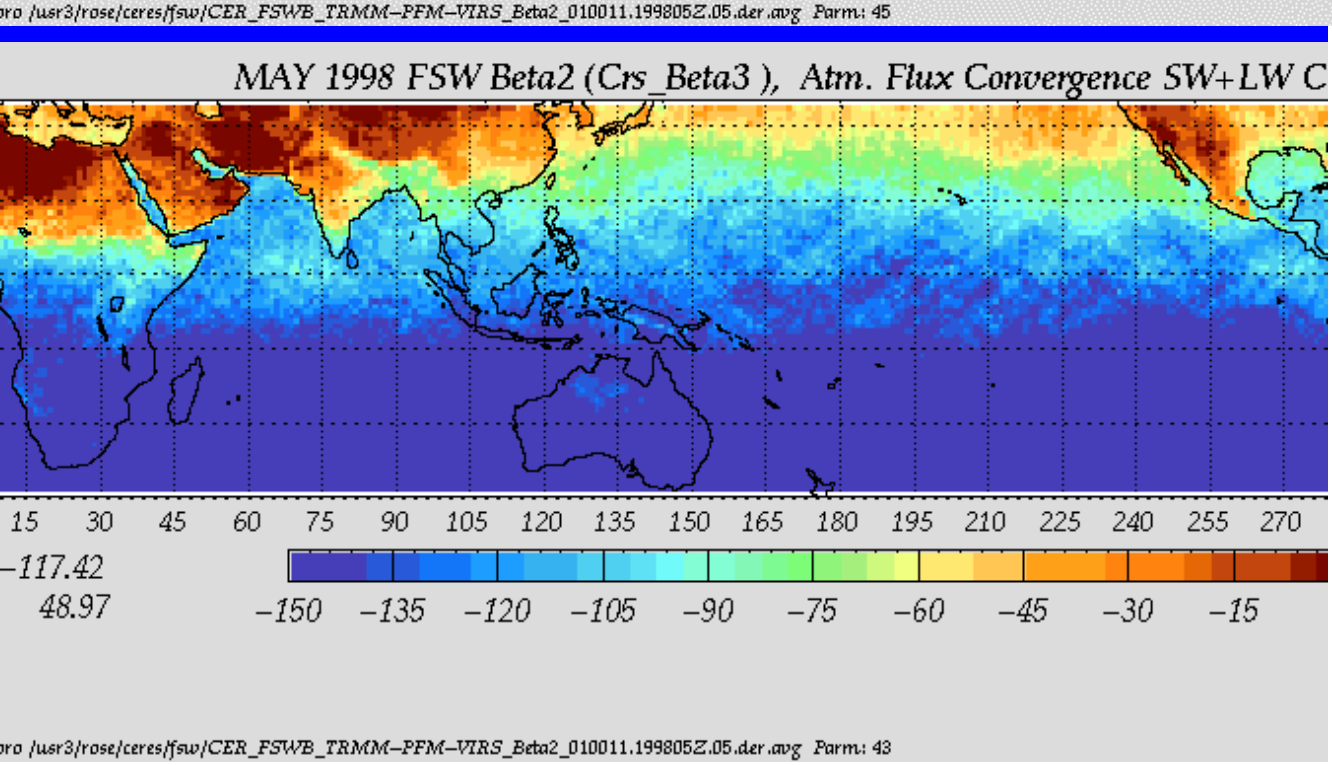
LW is generally negative

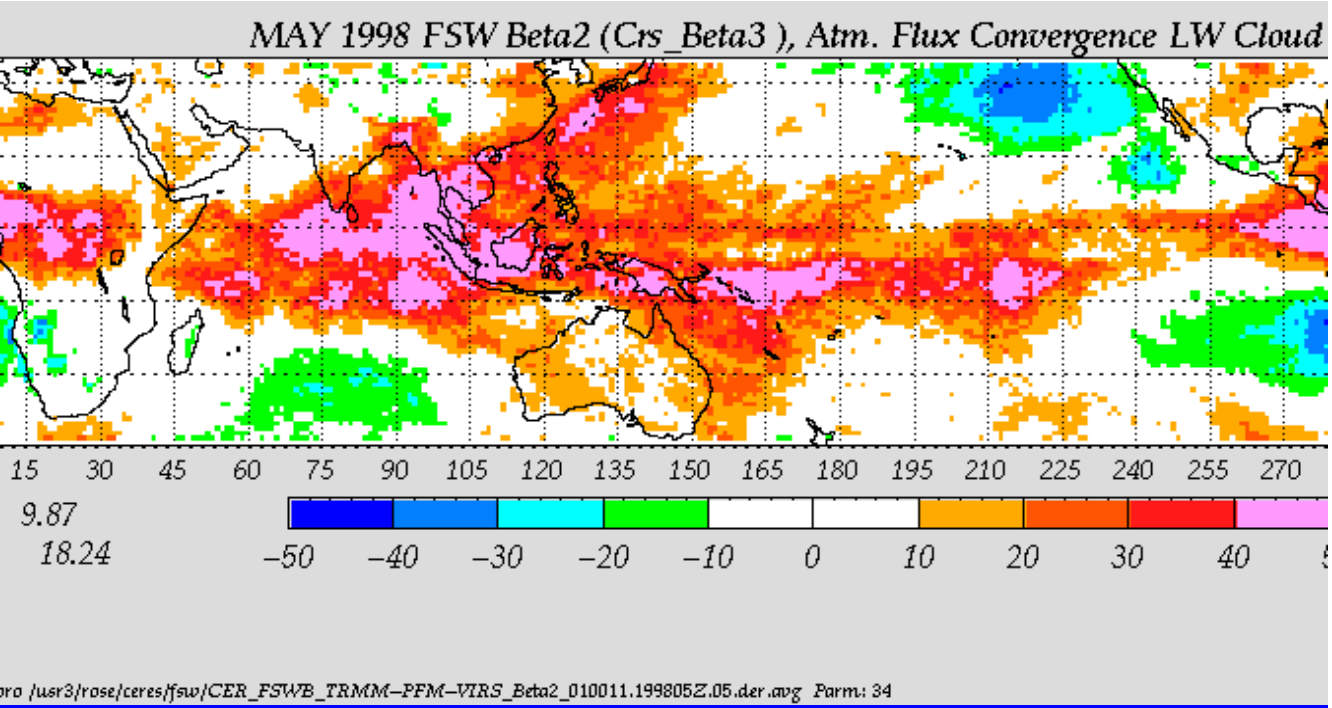
Sum of SW+LW is generally negative

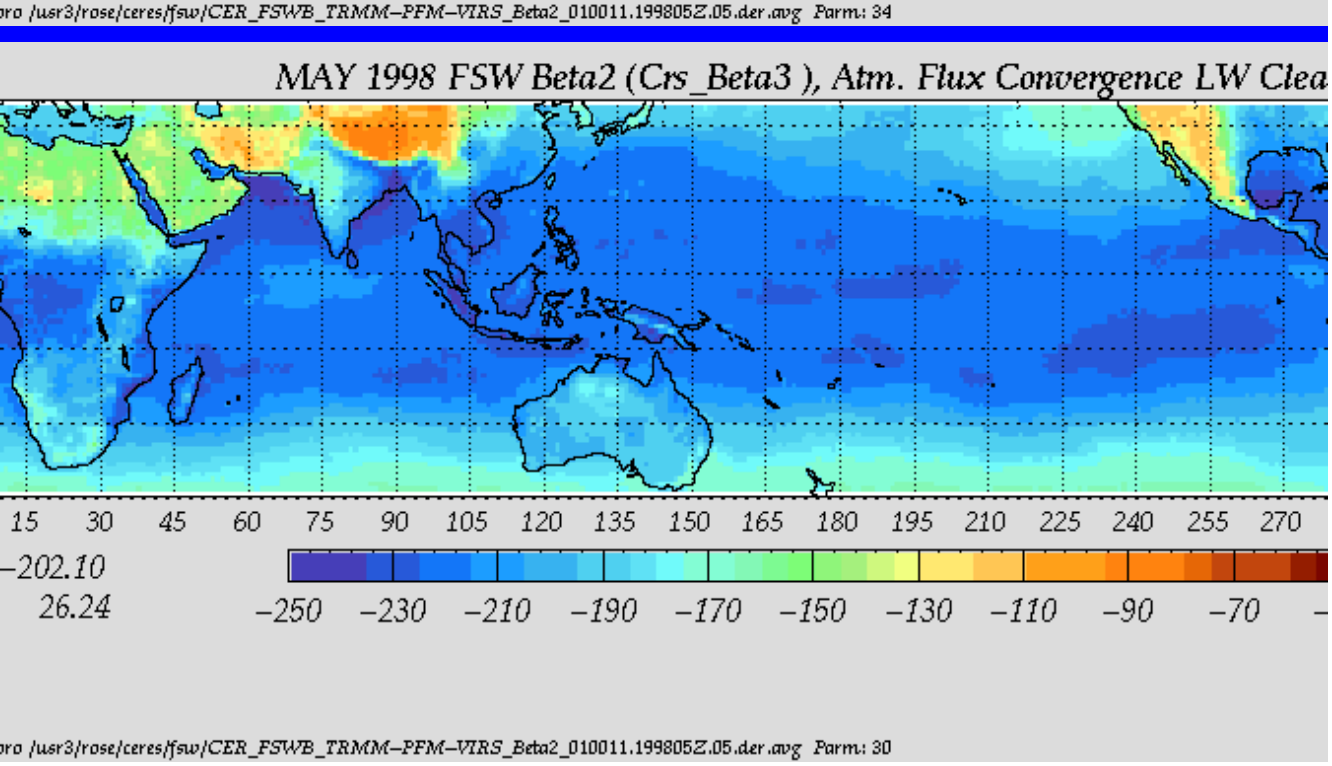
lear-sky Convergence SW+LW from surface to T

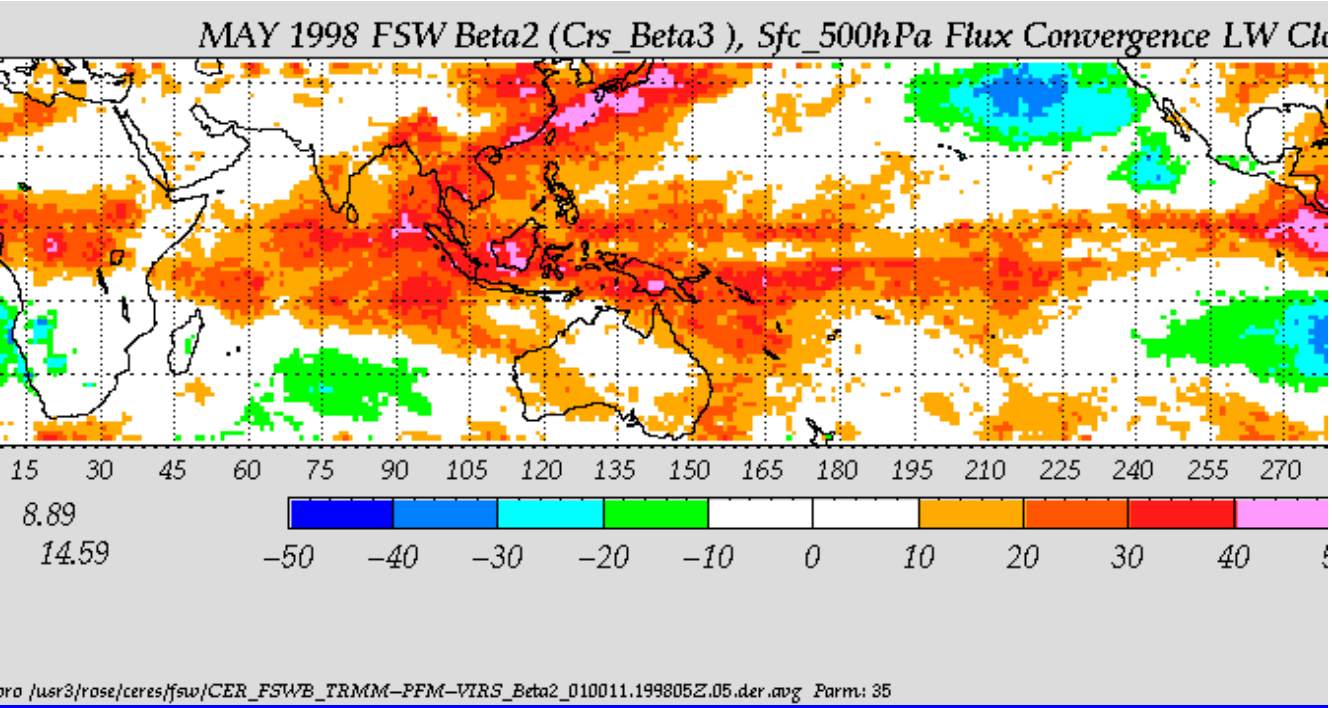


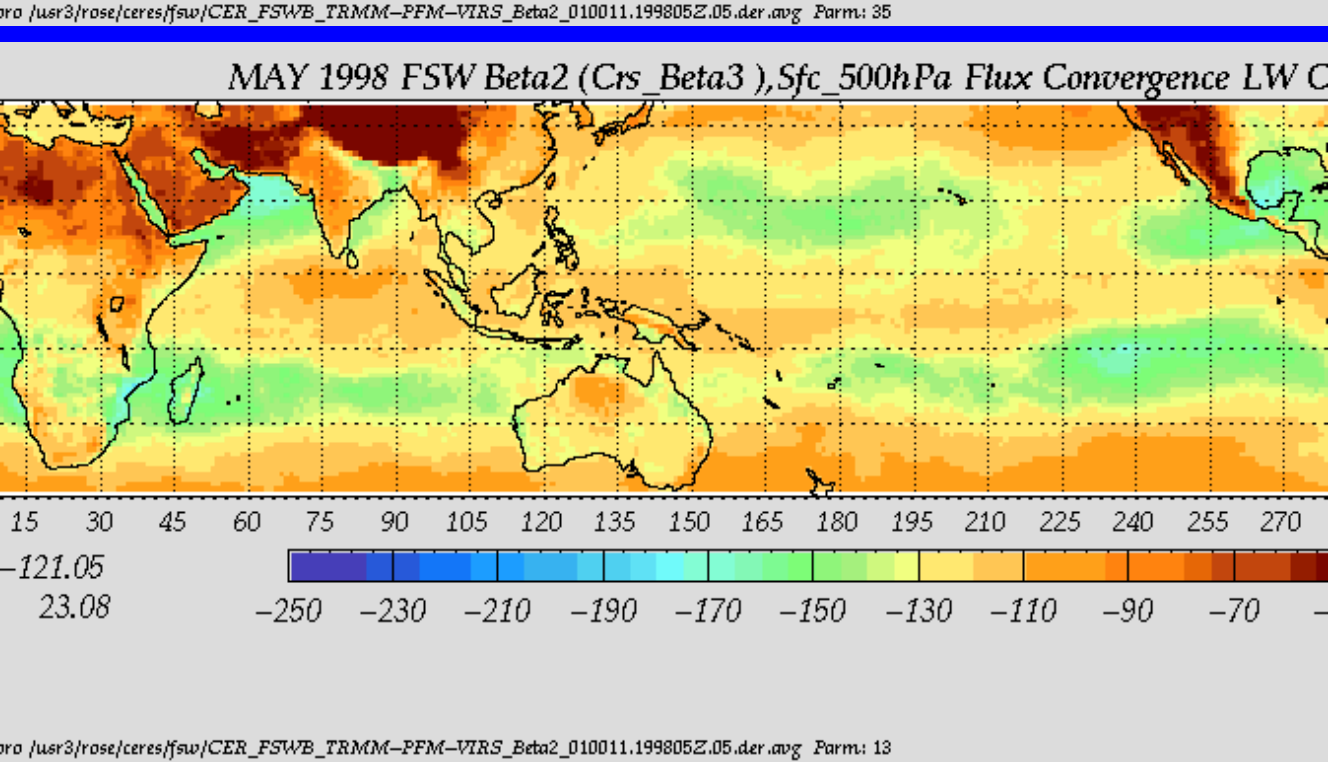

MAY 1998 FSW Beta2 (Crs_Beta3), Atm. Flux Convergence SW+LW Cloud Forced
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330
13.05
17.70
−50 −40 −30 −20 −10 0 10 20 30 40 50
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 45
Wed May 1

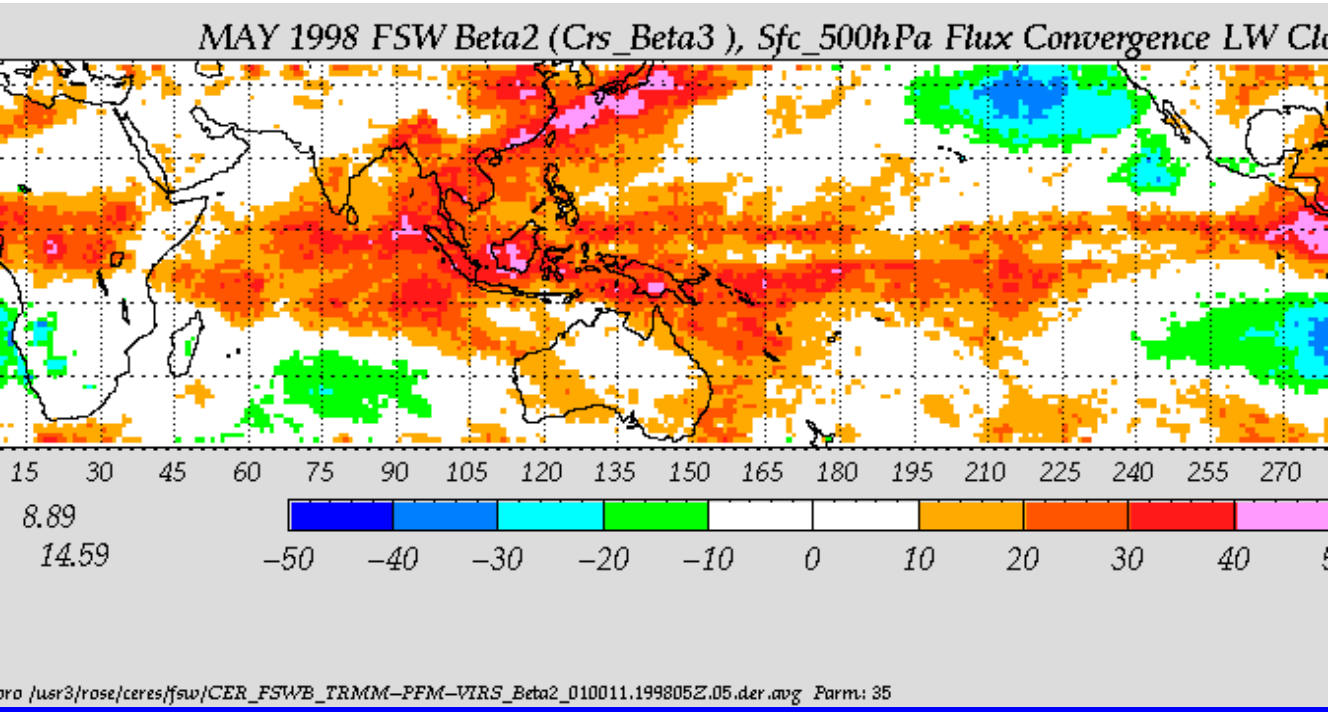

MAY 1998 FSW Beta2 (Crs_Beta3), Atm. Flux Convergence SW+LW C
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−117.42
48.97
−150 −135 −120 −105 −90 −75 −60 −45 −30 −15
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 43

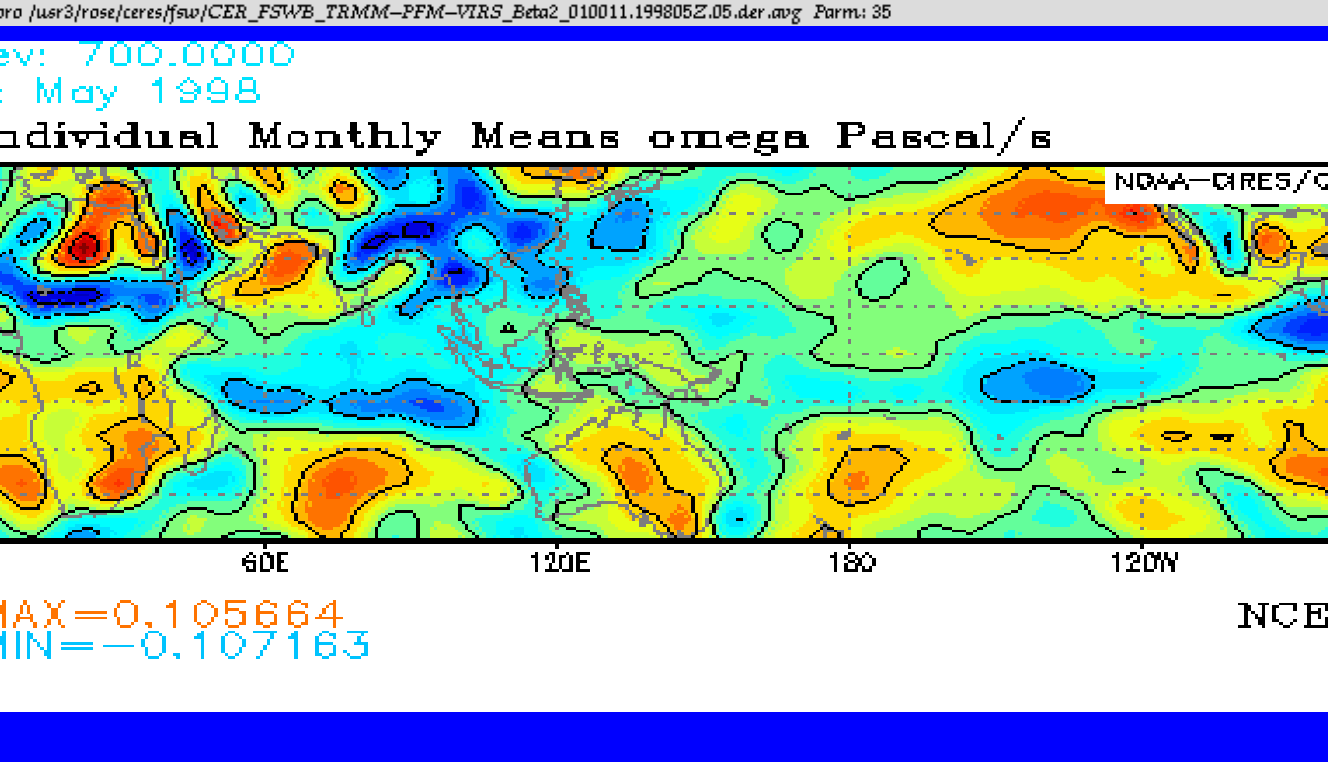

MAY 1998 FSW Beta2 (Crs_Beta3), Atm. Flux Convergence LW Cloud
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
9.87
18.24
−50 −40 −30 −20 −10 0 10 20 30 40
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 34

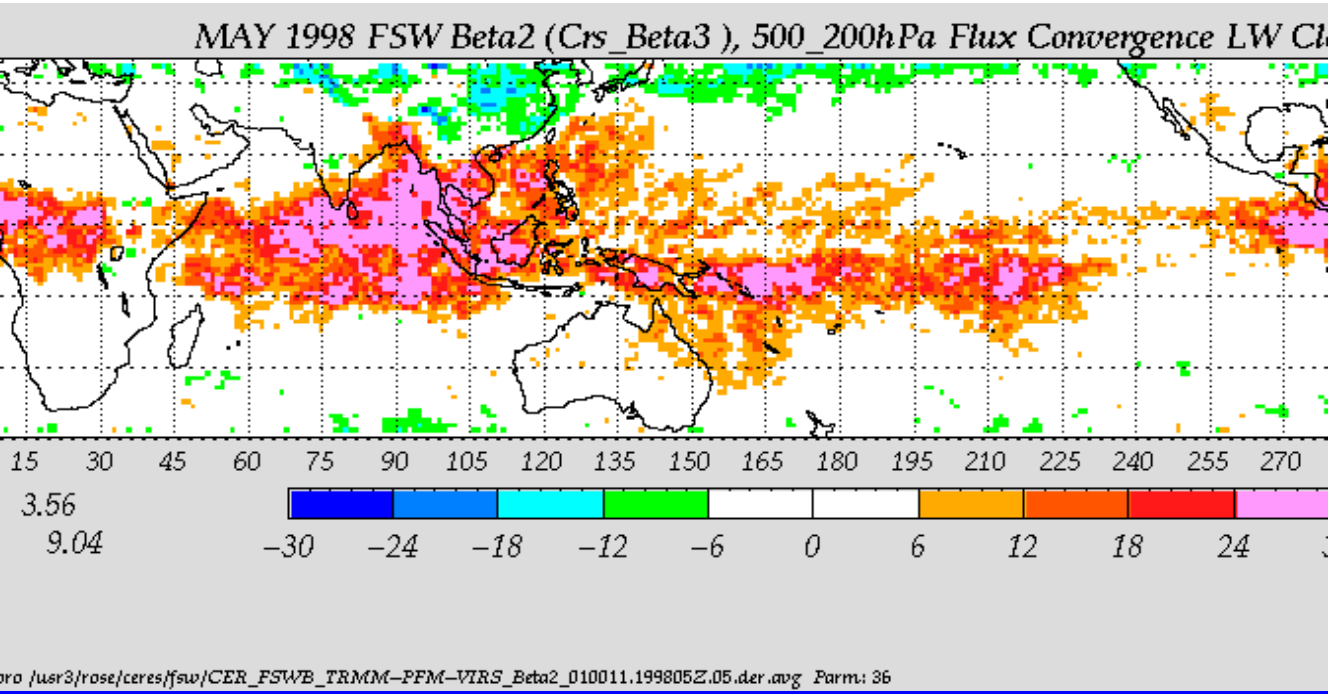

MAY 1998 FSW Beta2 (Crs_Beta3), Atm. Flux Convergence LW Clea
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−202.10
26.24
−250 −230 −210 −190 −170 −150 −130 −110 −90 −70
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 30

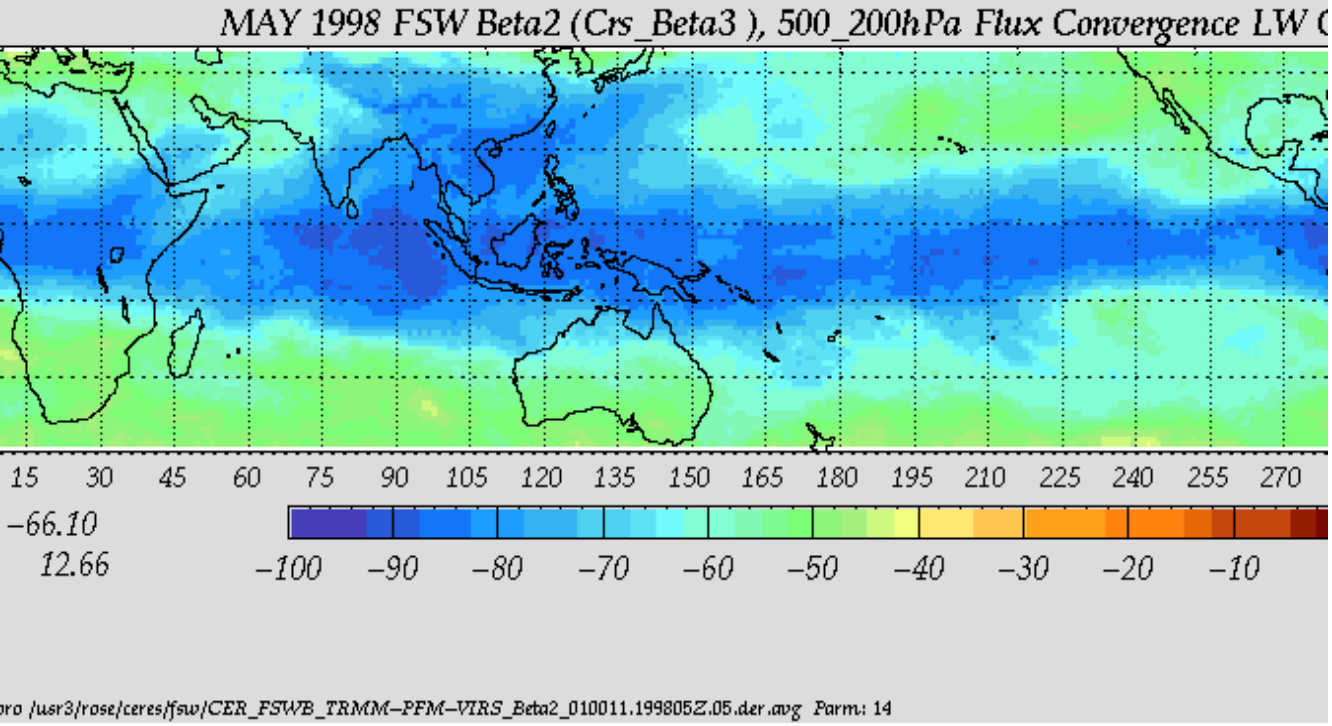

MAY 1998 FSW Beta2 (Crs_Beta3), Sfc_500hPa Flux Convergence LW Cl
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
8.89
14.59
−50 −40 −30 −20 −10 0 10 20 30 40
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 35

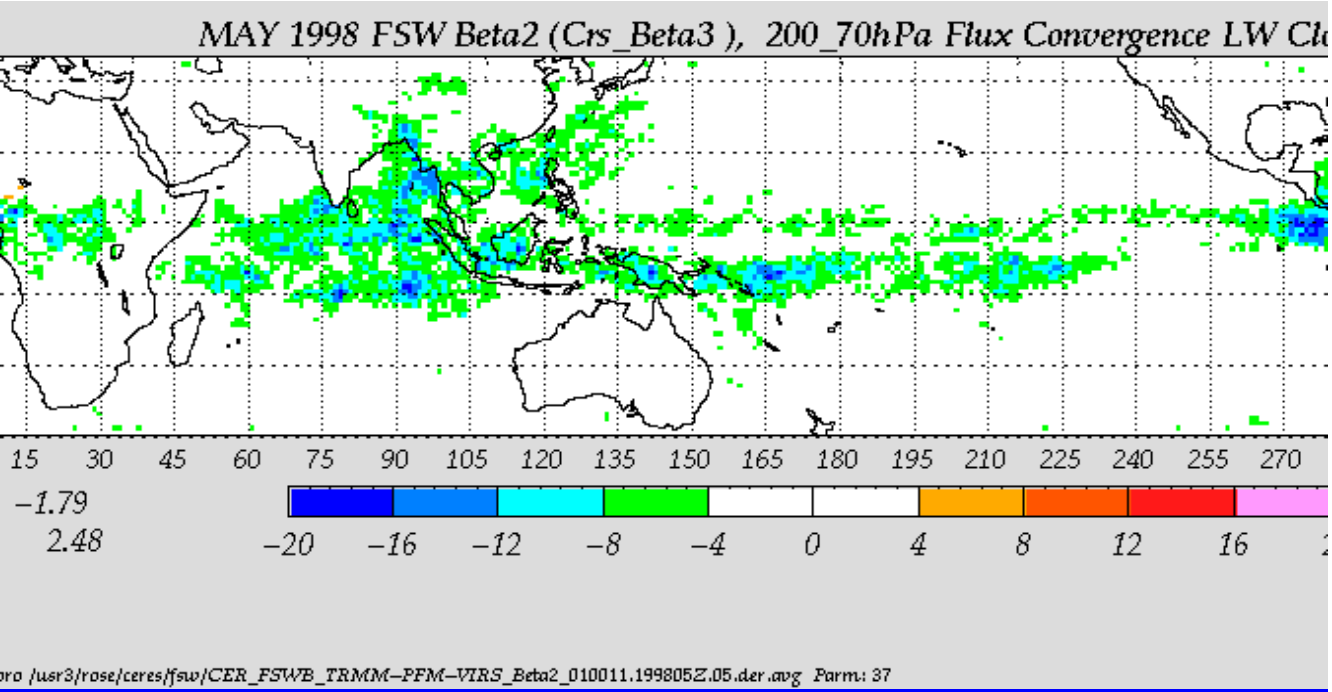

MAY 1998 FSW Beta2 (Crs_Beta3),Sfc_500hPa Flux Convergence LW C
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−121.05
23.08
−250 −230 −210 −190 −170 −150 −130 −110 −90 −70
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 13

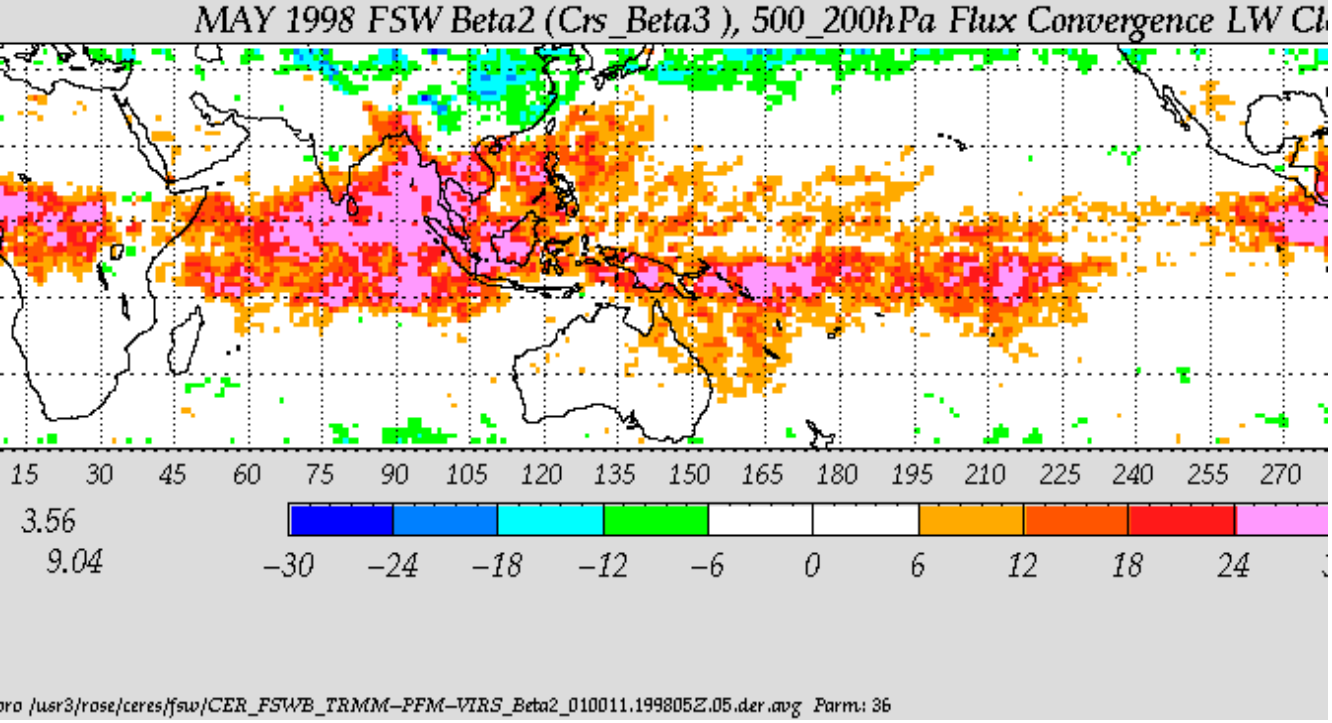

MAY 1998 FSW Beta2 (Crs_Beta3), Sfc_500hPa Flux Convergence LW Cl
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
8.89
14.59
−50 −40 −30 −20 −10 0 10 20 30 40
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 35


ev: 700.0000
: May 1998
ndividual Monthly Means omega Pascal/s
NOAA−CIRES/C
60E
120E
180
120W
AX=0.105664
IN=−0.107163
NCE

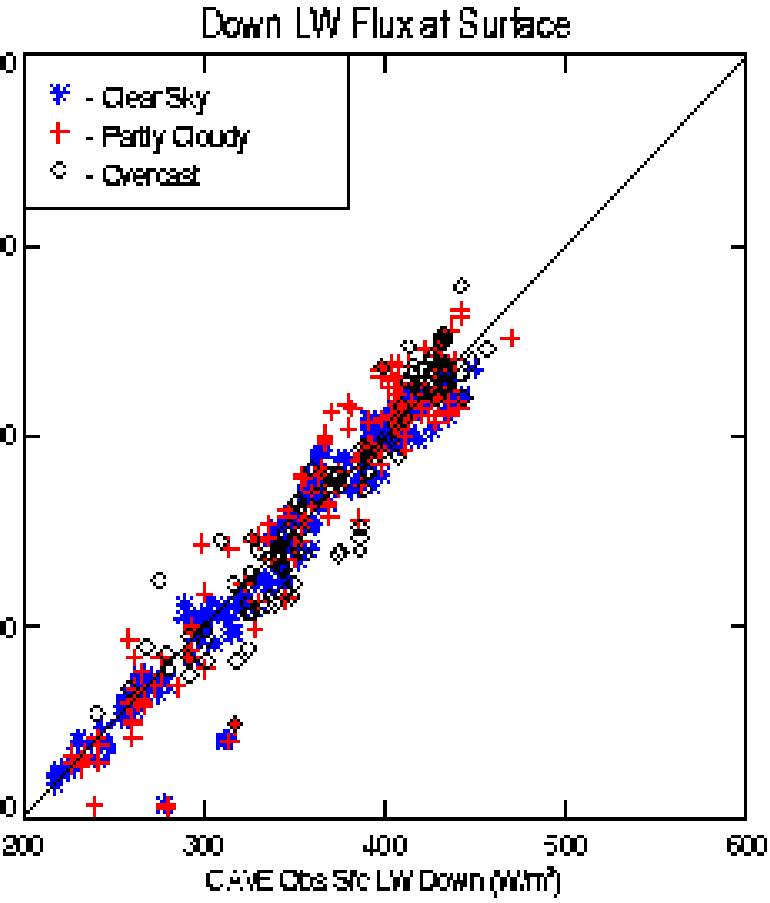

MAY 1998 FSW Beta2 (Crs_Beta3), 500_200hPa Flux Convergence LW Cl
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
3.56
9.04
−30 −24 −18 −12 −6 0 6 12 18 24
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 36

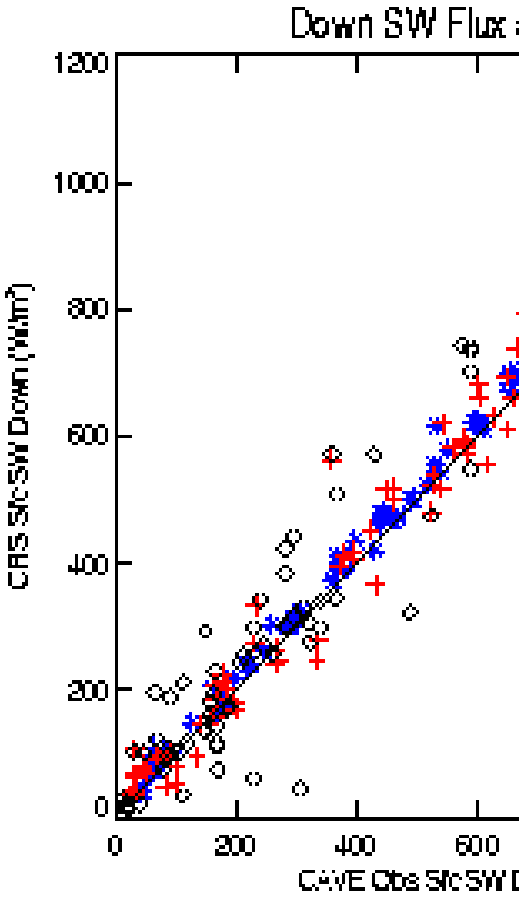

MAY 1998 FSW Beta2 (Crs_Beta3), 500_200hPa Flux Convergence LW C
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−66.10
12.66
−100 −90 −80 −70 −60 −50 −40 −30 −20 −10
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 14


MAY 1998 FSW Beta2 (Crs_Beta3), 200_70hPa Flux Convergence LW Cl
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
−1.79
2.48
−20 −16 −12 −8 −4 0 4 8 12 16
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 37


MAY 1998 FSW Beta2 (Crs_Beta3), 500_200hPa Flux Convergence LW Cl
15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270
3.56
9.04
−30 −24 −18 −12 −6 0 6 12 18 24
ro /usr3/rose/ceres/fsw/CER_FSWB_TRMM−PFM−VIRS_Beta2_010011.199805Z.05.der.avg Parm: 36

E13-Cent Facil (ARM) Tuned CRS

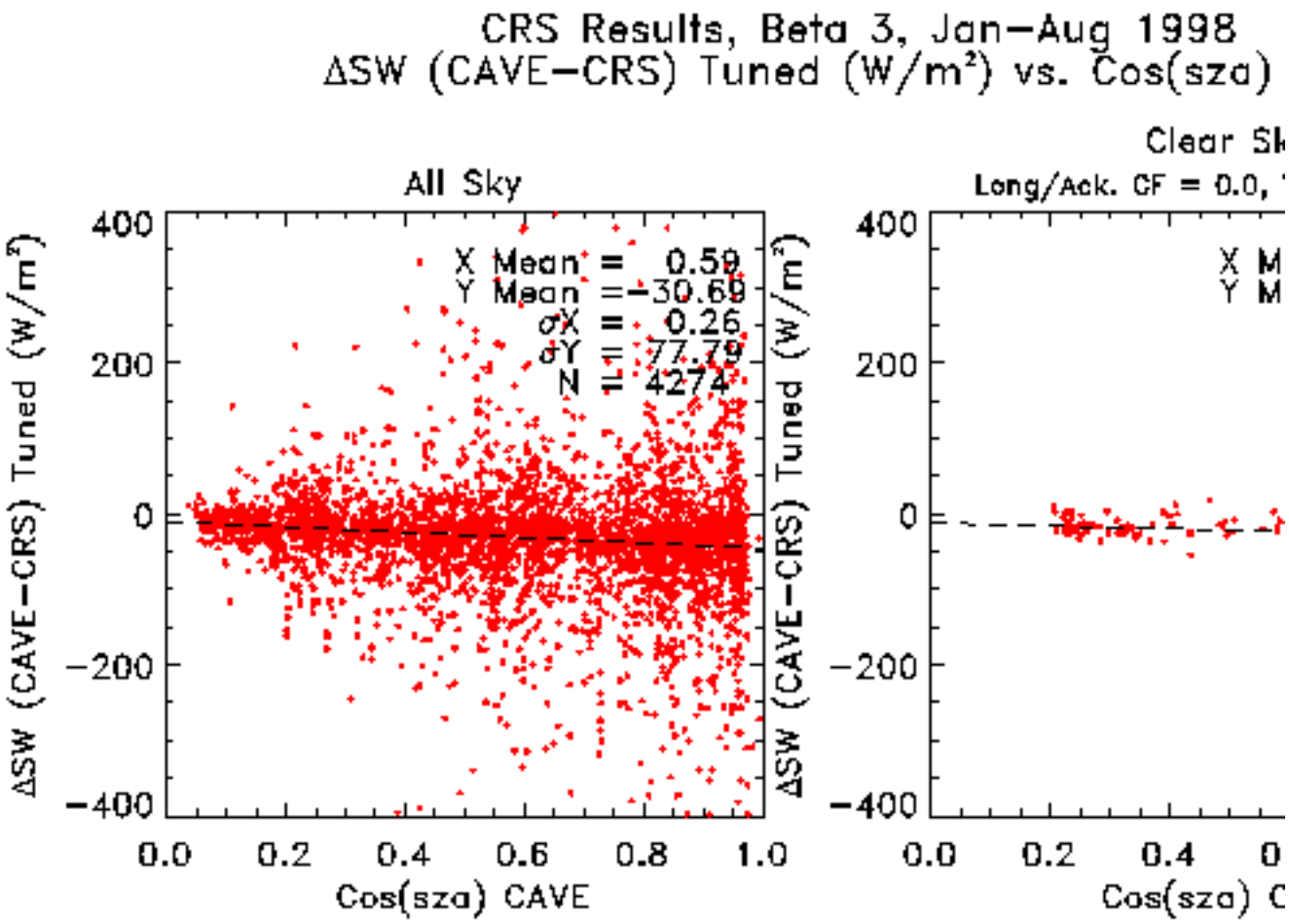


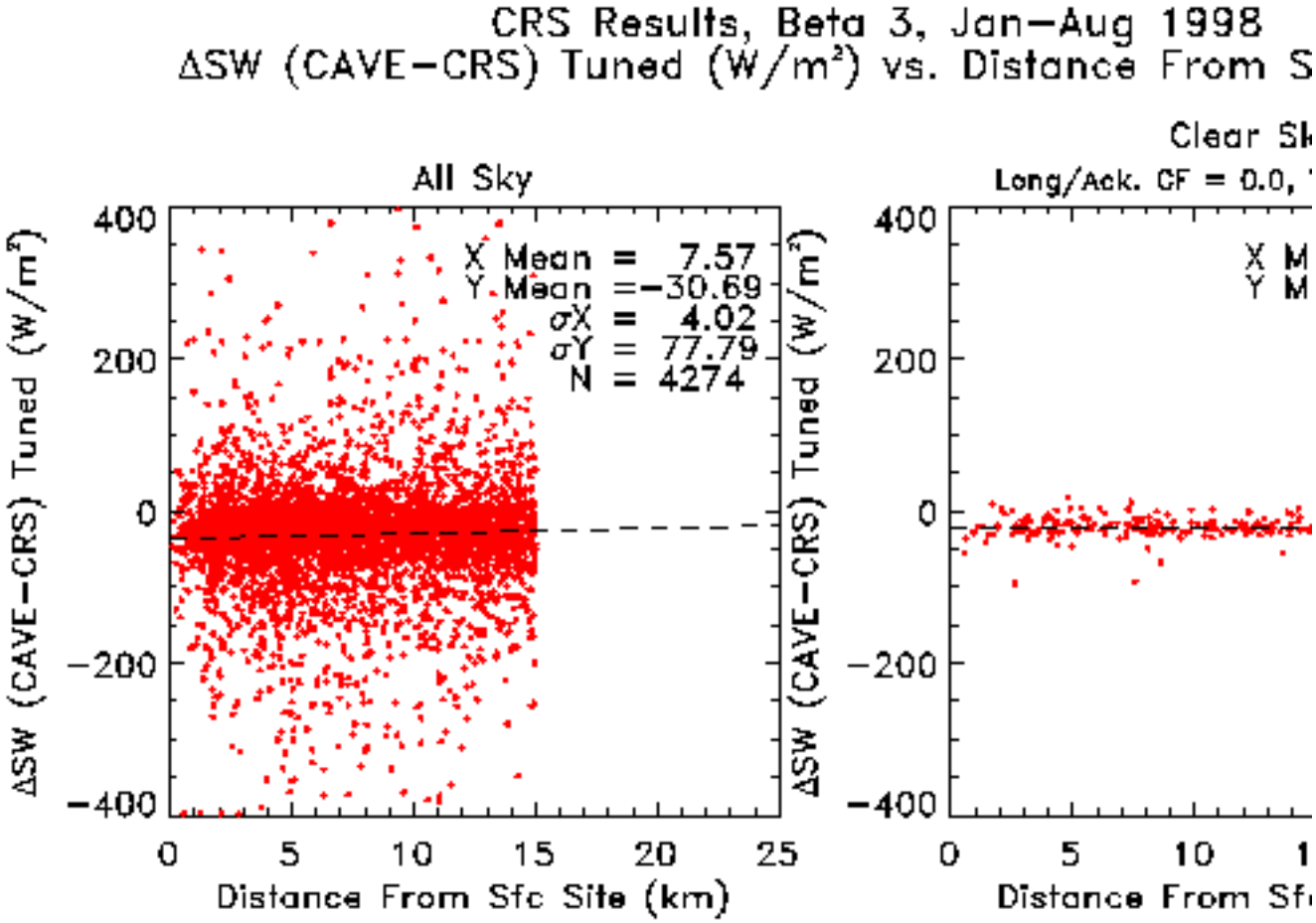


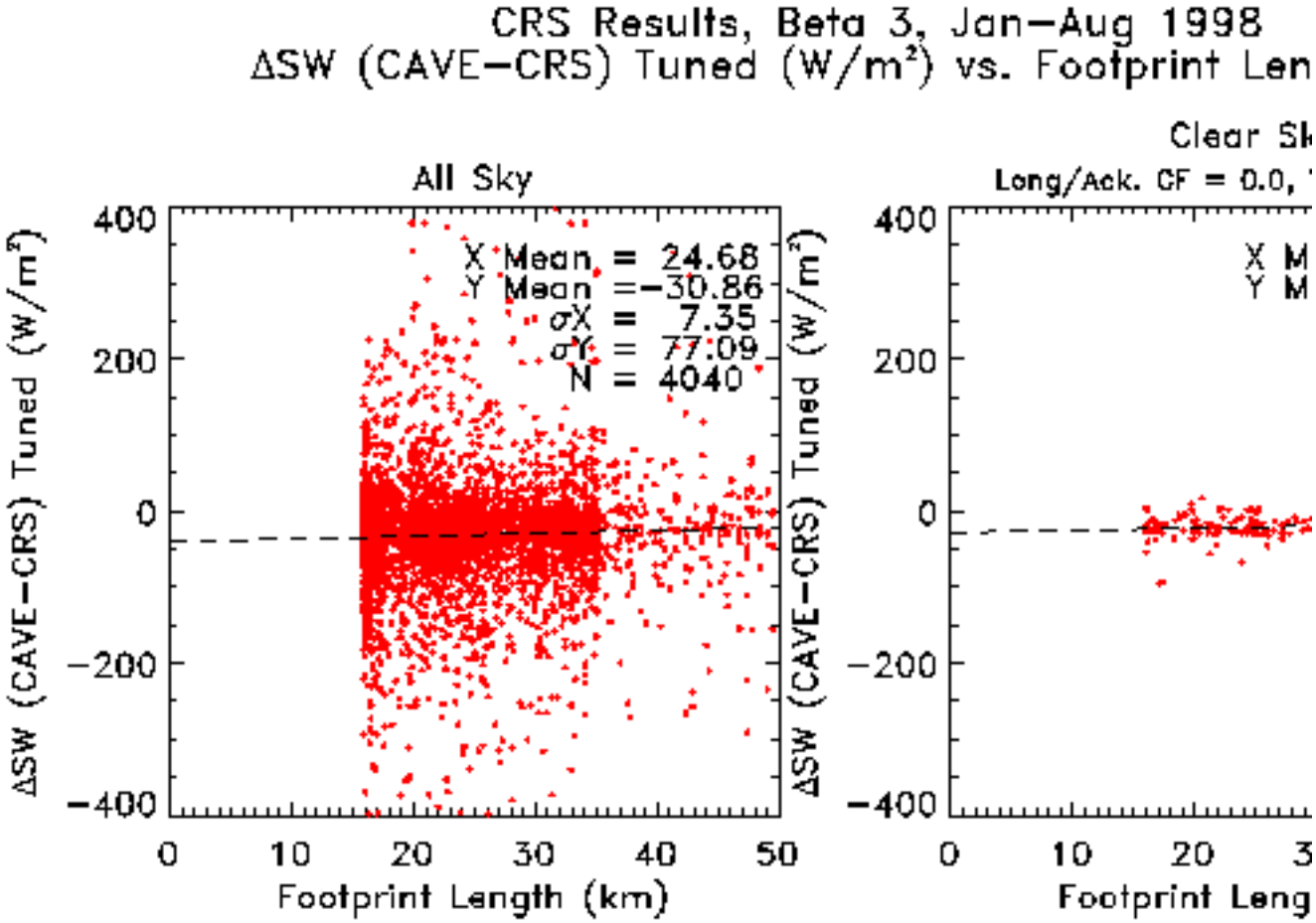
ARM SGP E13 (collocated with Central Facility)

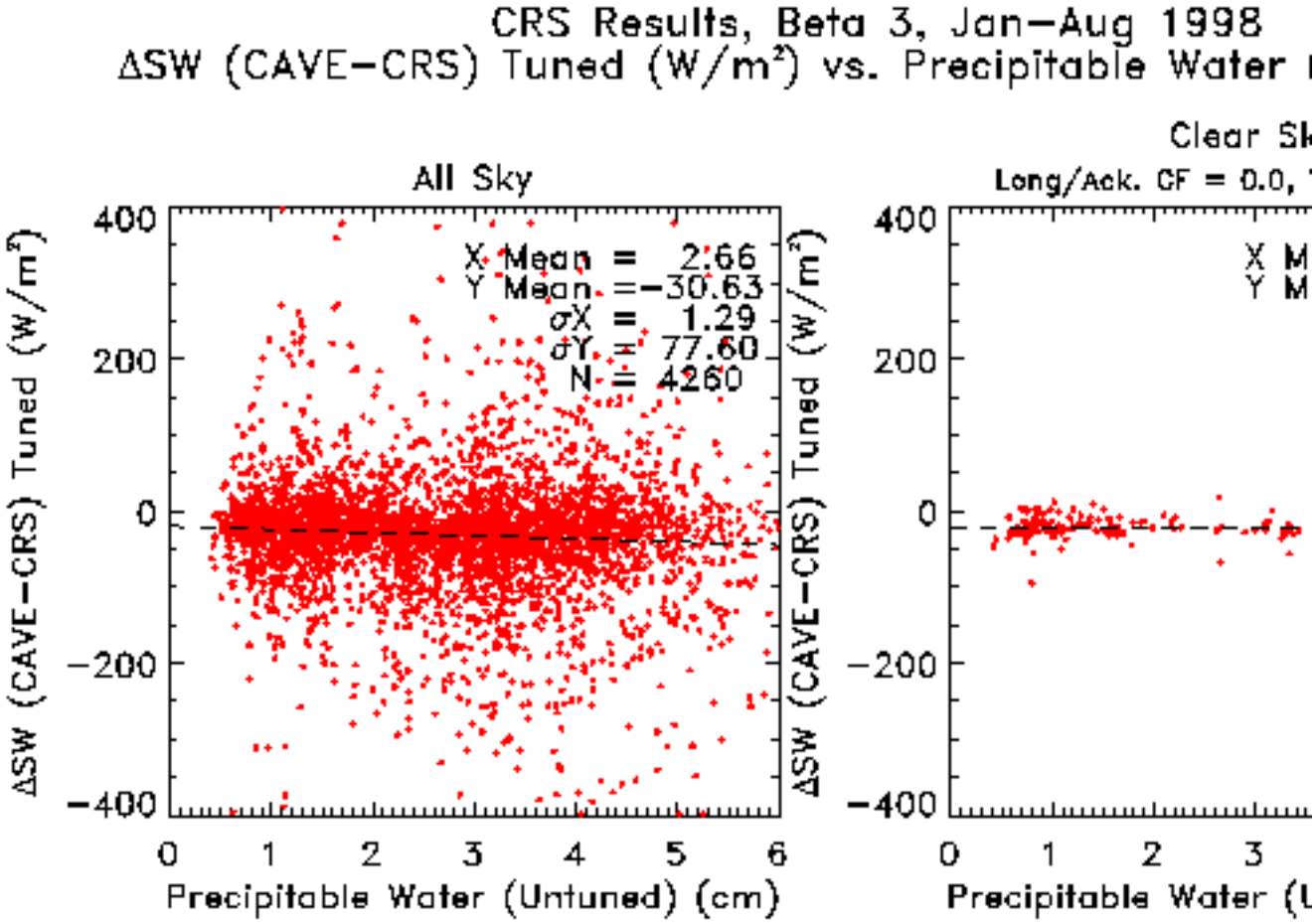
	Obs Mean	N	Bias Obs-CRS	RMS	Cld All-
ALL SKY					
LW Dn Sfc	352	448	1	18	1
LW Up Sfc	421	423	2	16	
SW Dn Sfc	431	258	-18	58	-1
SW Up Sfc	85	258	9	18	
LW Up TOA	248	454	0	4	-2
SW Up TOA	224	258	2	10	8
OVERCAST					
SW Dn Sfc	242	66	-23	86	-3
CLEAR VIRS					Aer
SW Dn Sfc	516	94	-19	26	-16
					SW
CLEAR VIRS + pyranometer					
SW Dn Sfc	400	18	-10	14	-12/
SW direct			-2		
SW diffuse			-8		

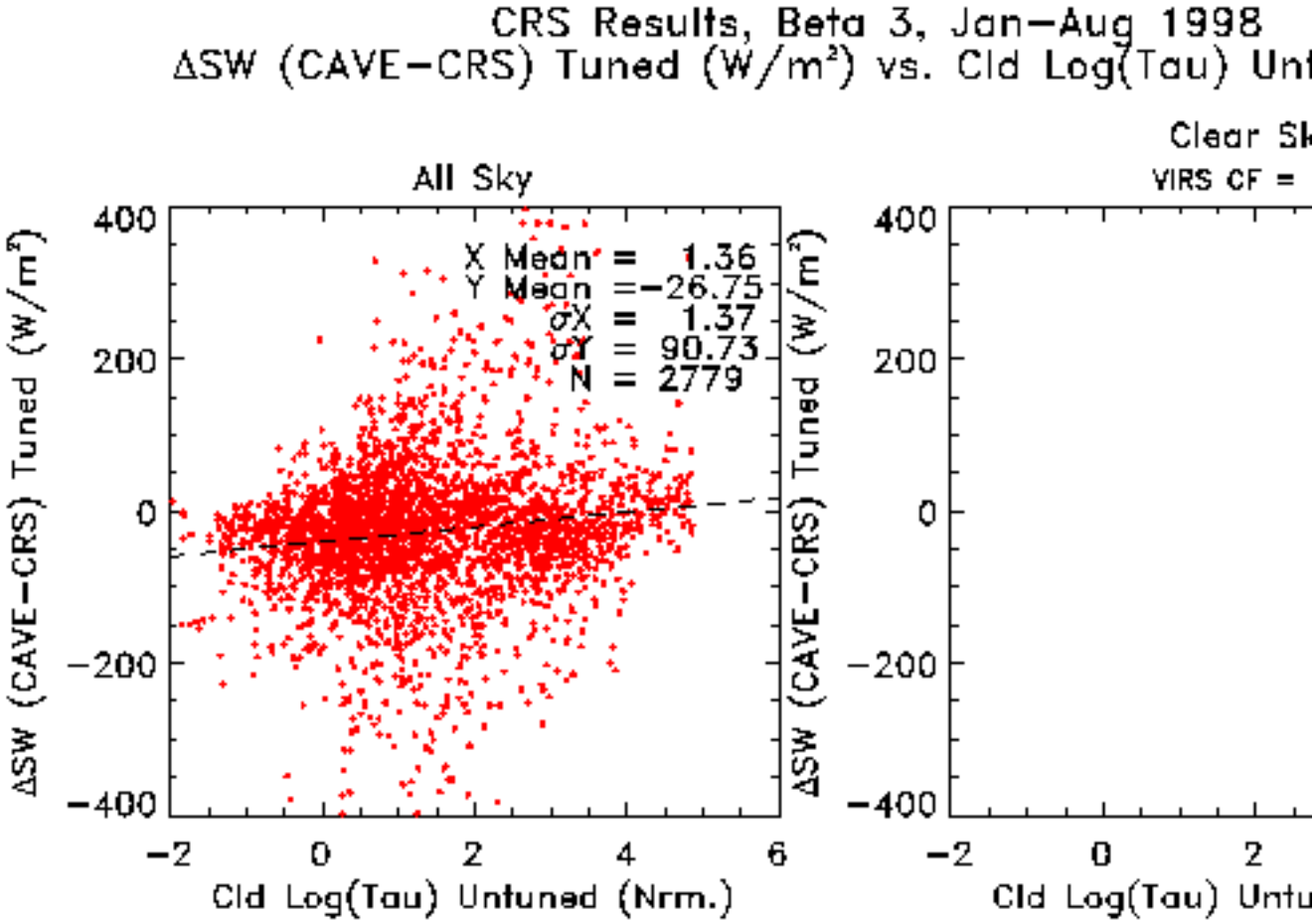
All CAVE sites

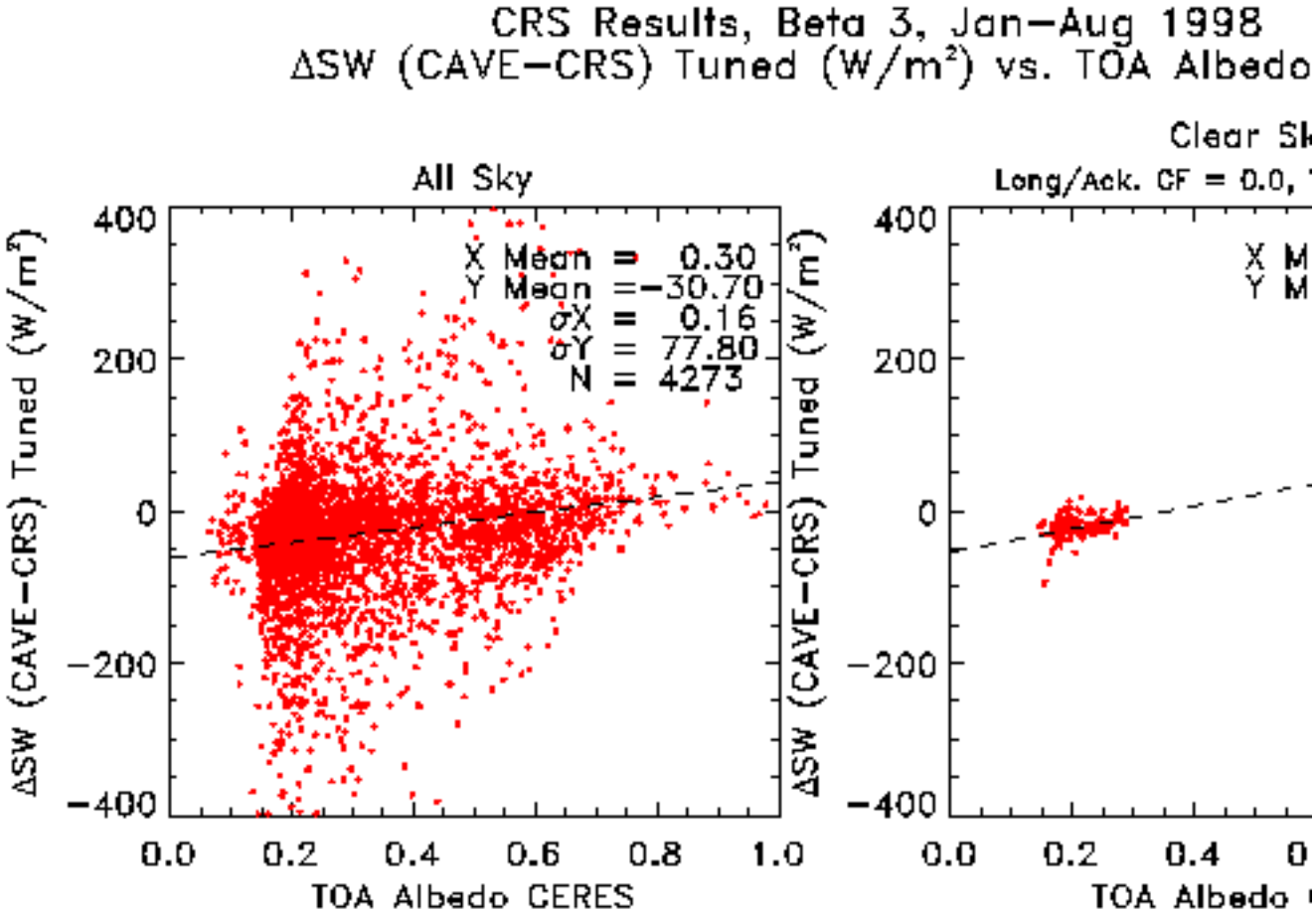


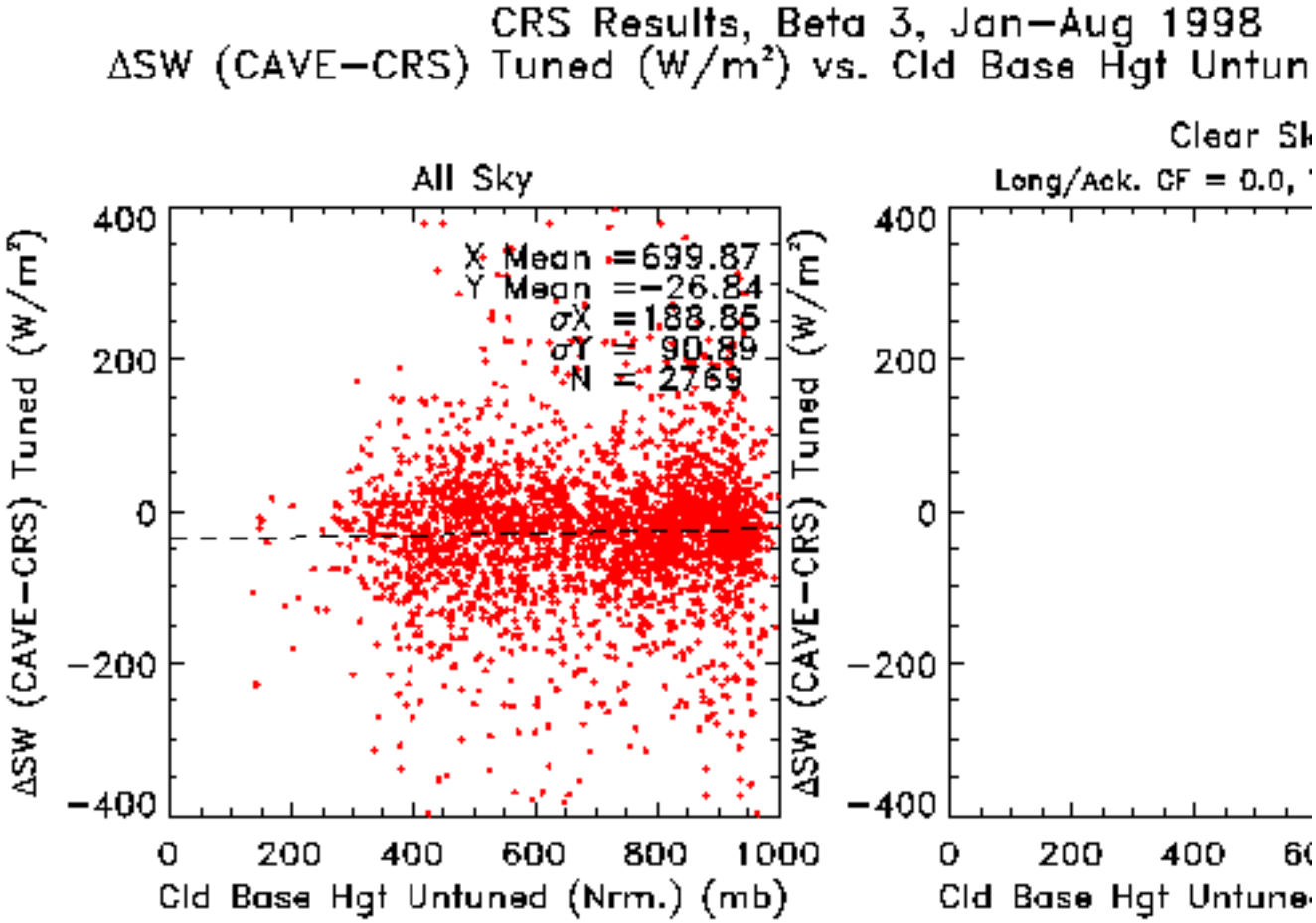

CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Distance From S
All Sky
X Mean = 7.57
Y Mean = −30.69
σX = 4.02
σY = 77.79
N = 4274
ΔSW (CAVE–CRS) Tuned (W/m²)
Distance From Sfc Site (km)
Clear Sk
Long/Ack. CF = 0.0,
X M
Y M
Distance From Sf

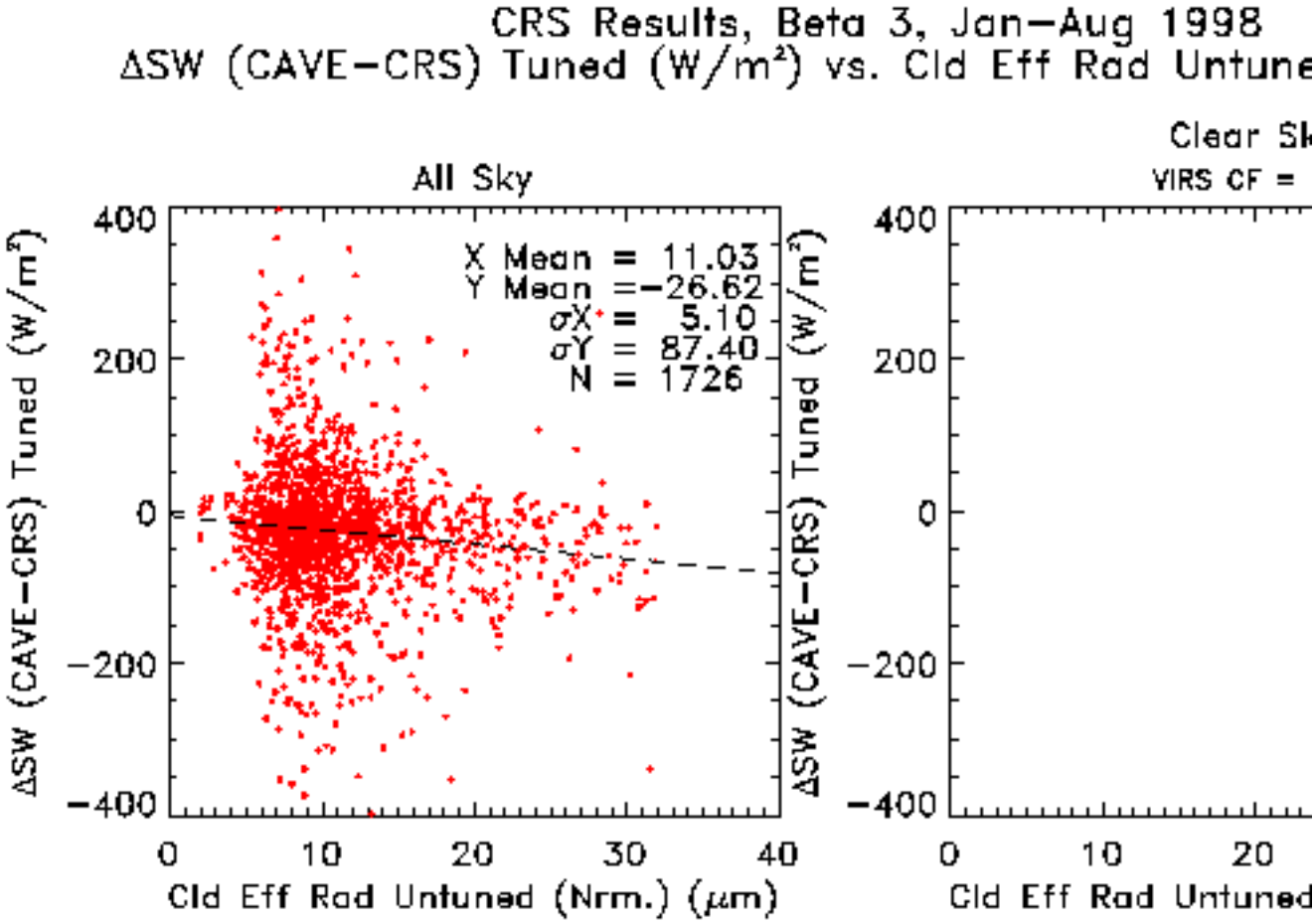

CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Footprint Len
All Sky
X Mean = 24.68
Y Mean = −30.86
σX = 7.35
σY = 77.09
N = 4040
ΔSW (CAVE–CRS) Tuned (W/m²)
Footprint Length (km)
Clear Sk
Long/Ack. CF = 0.0,
X M
Y M
Footprint Leng

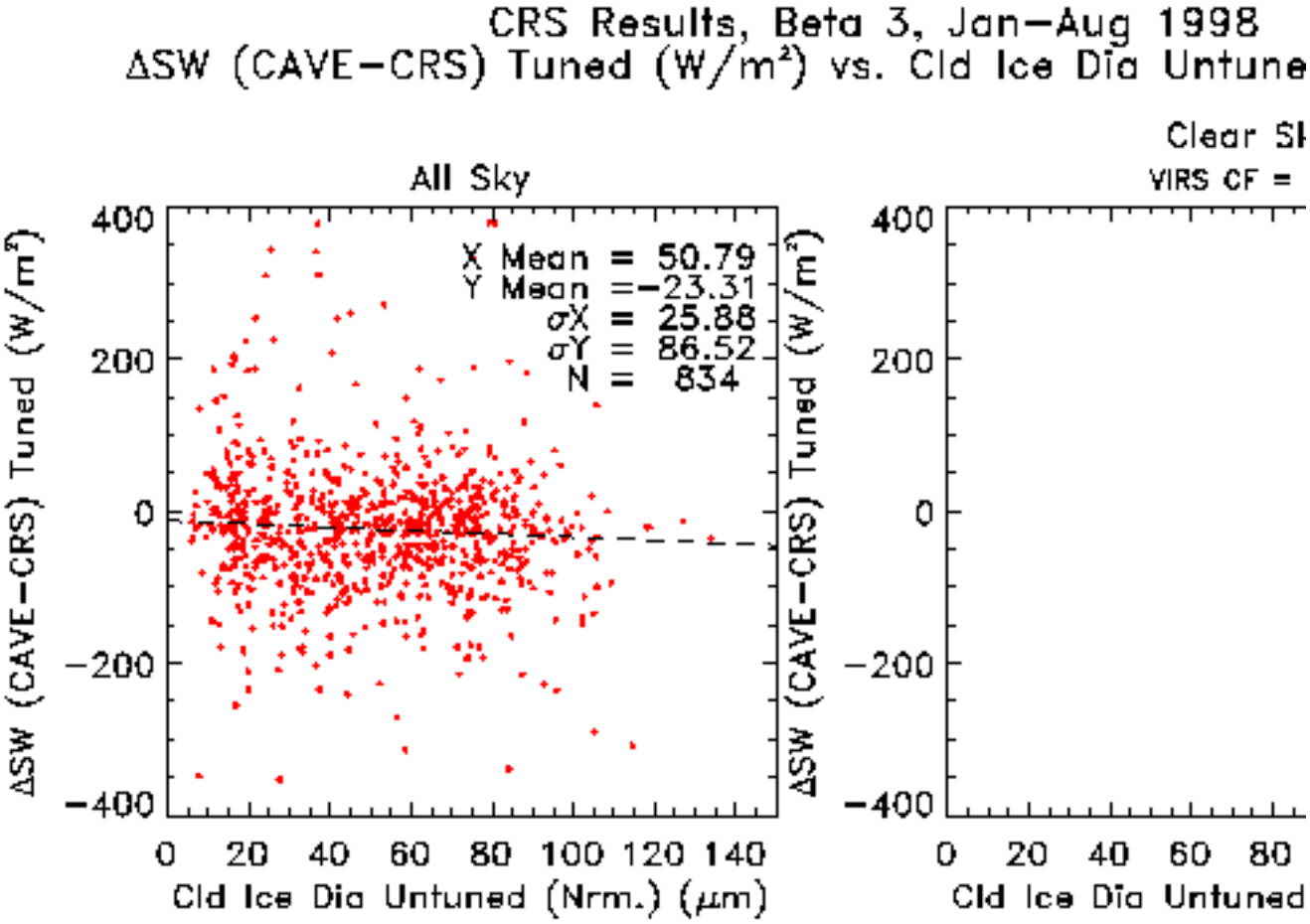

CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Precipitable Water
All Sky
X Mean = 2.66
Y Mean = −30.63
σX = 1.29
σY = 77.60
N = 4260
ΔSW (CAVE–CRS) Tuned (W/m²)
Precipitable Water (Untuned) (cm)
Clear Sk
Long/Ack. CF = 0.0,
X M
Y M
Precipitable Water (U

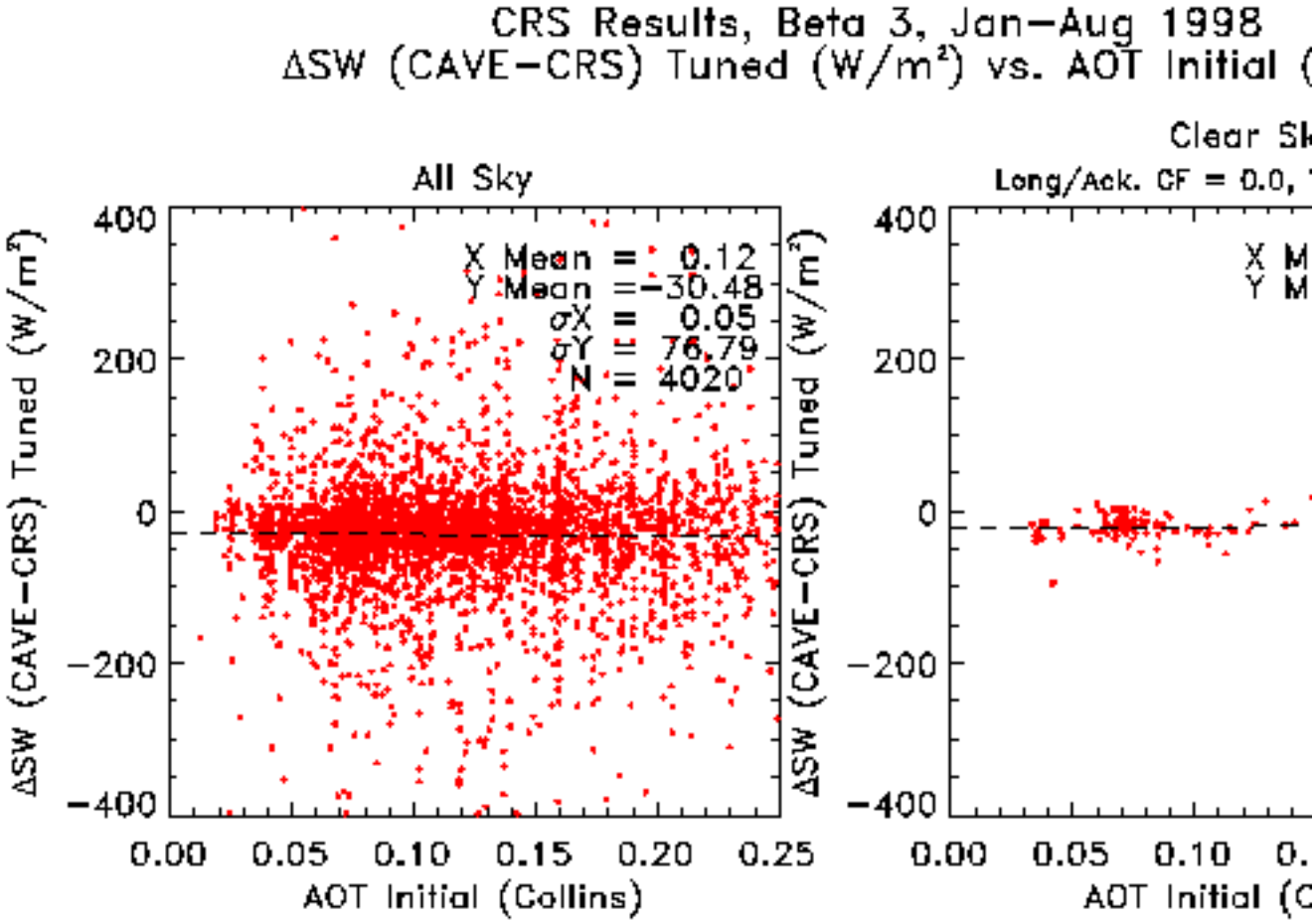

CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Cld Log(Tau) Unt
Clear Sk
VIRS CF =
All Sky
X Mean = 1.36
Y Mean =−26.75
σX = 1.37
σY = 90.73
N = 2779
ΔSW (CAVE–CRS) Tuned (W/m²)
400
200
0
−200
−400
−2
0
2
4
6
Cld Log(Tau) Untuned (Nrm.)
Cld Log(Tau) Untu


CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. TOA Albedo
All Sky
X Mean = 0.30
Y Mean =−30.70
σX = 0.16
σY = 77.80
N = 4273
ΔSW (CAVE–CRS) Tuned (W/m²)
TOA Albedo CERES
Clear Sk
Long/Ack. CF = 0.0,
X M
Y M
ΔSW (CAVE–CRS) Tuned (W/m²)
TOA Albedo


CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Cld Base Hgt Untun
Clear Sk
All Sky
Long/Ack. CF = 0.0,
X Mean =699.87
Y Mean =−26.84
σX =188.85
σY = 90.89
N = 2769
ΔSW (CAVE–CRS) Tuned (W/m²)
400
200
0
−200
−400
0
200
400
600
800
1000
Cld Base Hgt Untuned (Nrm.) (mb)
Cld Base Hgt Untune


CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Cld Eff Rad Untune
Clear Sk
VIRS CF =
All Sky
X Mean = 11.03
Y Mean =−26.62
σX = 5.10
σY = 87.40
N = 1726
ΔSW (CAVE–CRS) Tuned (W/m²)
400
200
0
−200
−400
0
10
20
30
40
Cld Eff Rad Untuned (Nrm.) (μm)
Cld Eff Rad Untuned


CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. Cld Ice Dia Untune
All Sky
X Mean = 50.79
Y Mean =−23.31
σX = 25.88
σY = 86.52
N = 834
ΔSW (CAVE–CRS) Tuned (W/m²)
Cld Ice Dia Untuned (Nrm.) (μm)
Clear Sk
VIRS CF =
Cld Ice Dia Untuned


CRS Results, Beta 3, Jan–Aug 1998
ΔSW (CAVE–CRS) Tuned (W/m²) vs. AOT Initial (
All Sky
X Mean = 0.12
Y Mean = −30.48
σX = 0.05
σY = 76.79
N = 4020
ΔSW (CAVE–CRS) Tuned (W/m²)
AOT Initial (Collins)
Clear Sk
Long/Ack. CF = 0.0,
X M
Y M
AOT Initial (C

S Edition 2B -

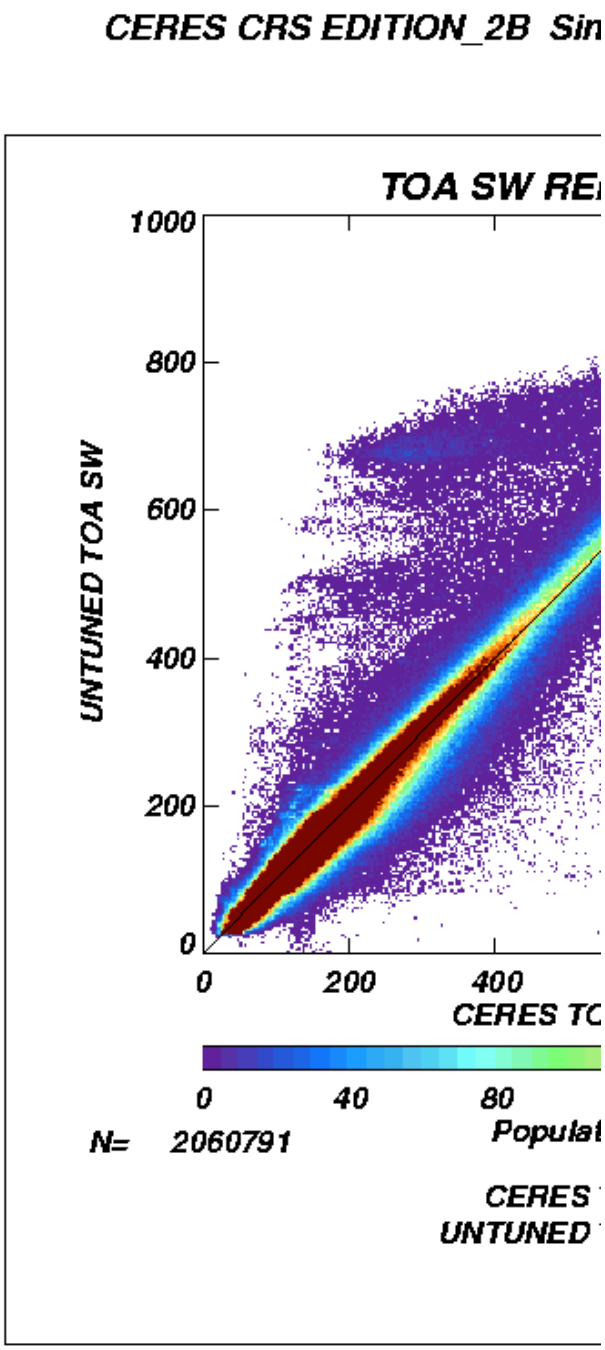
day caught snow over
alayas during high sun.

or error in snow albedo with
ds: fixed from table and
wmap coverage.

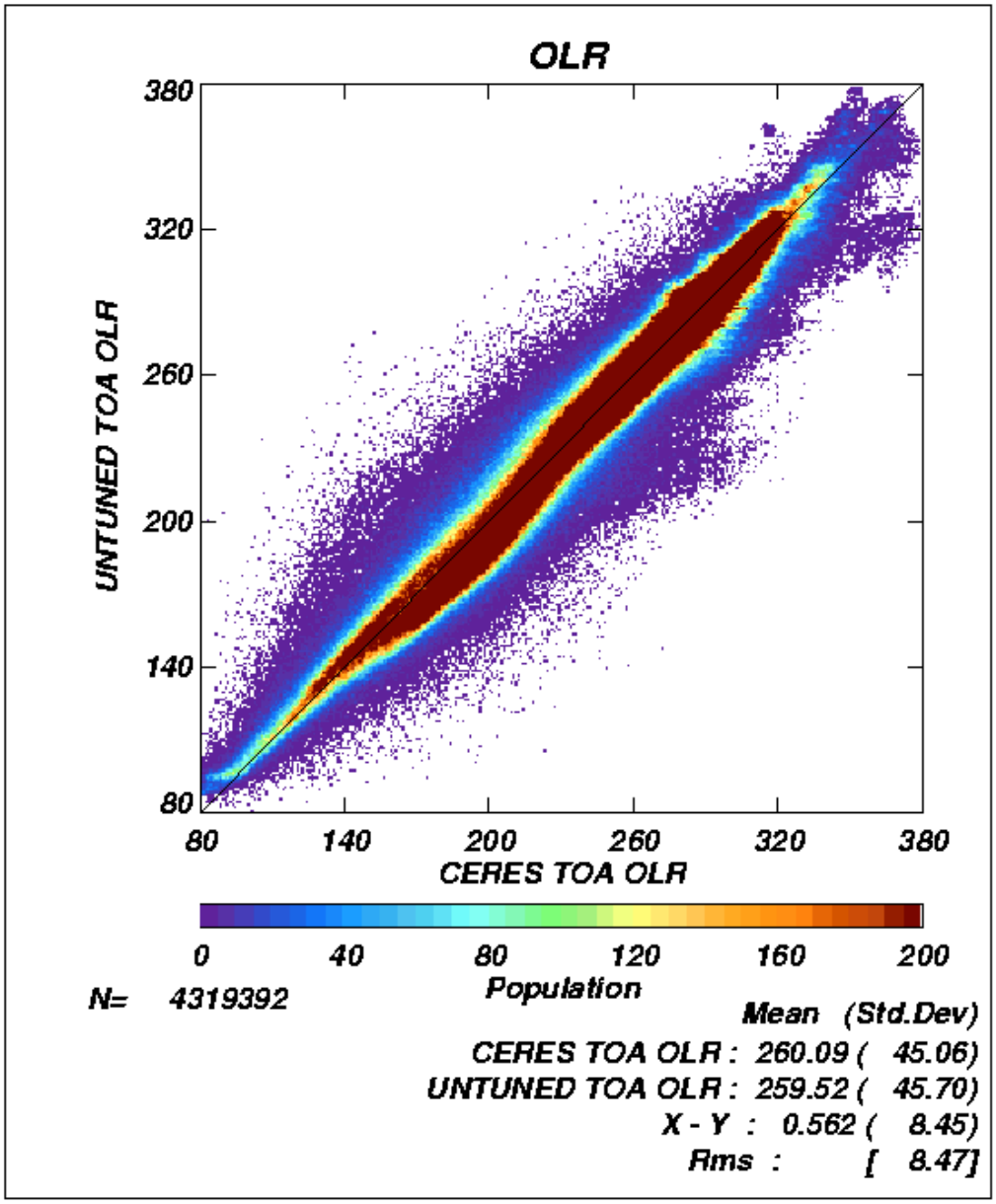
ing responded by screwing
loud field, greatly increasing
S.

r has limited effect on
MM spatial domain.

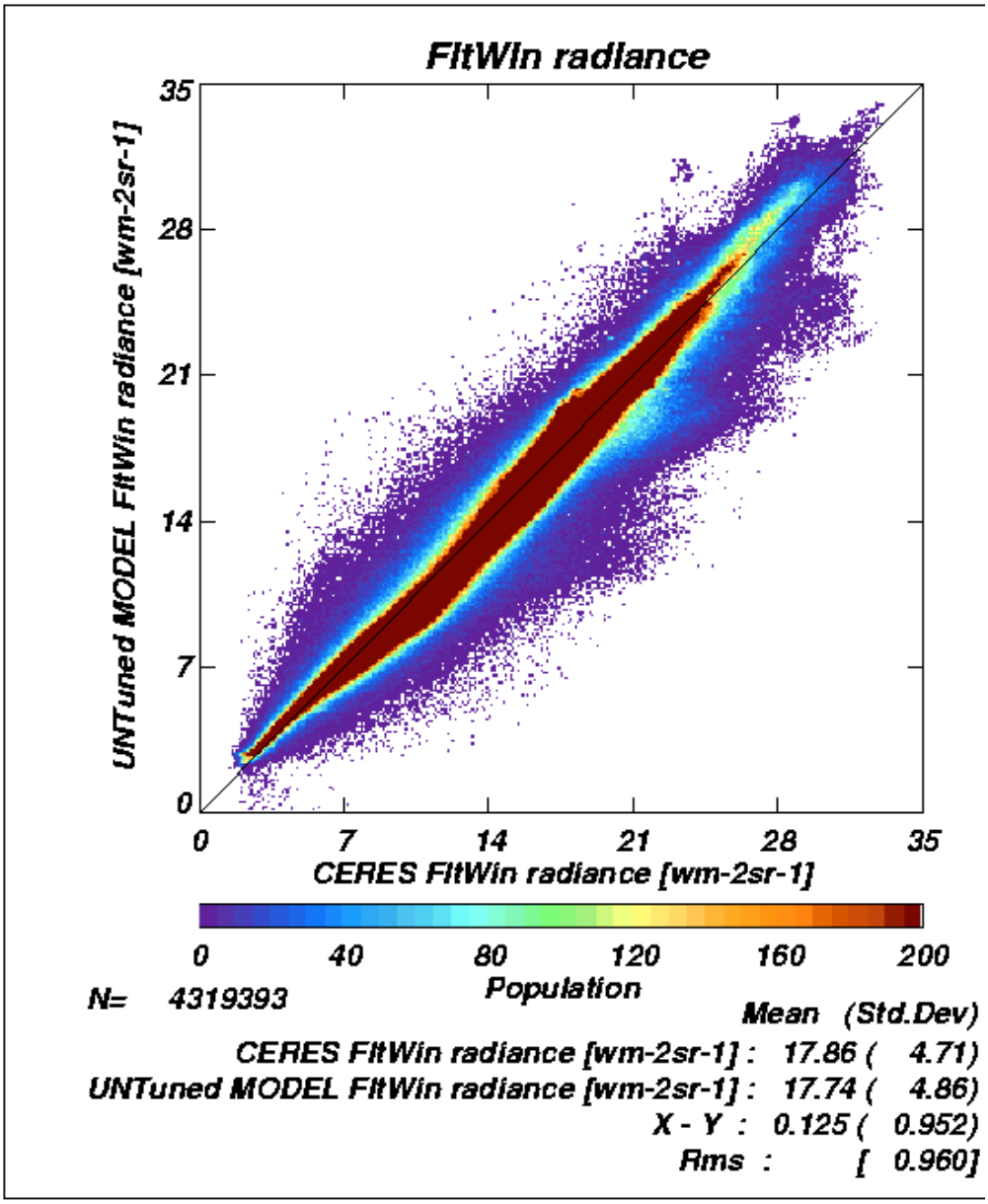
y to remedy for Terra (just
surface albedo when
dy+snowy).



CERES CRS EDITION_2B Single Day APR 2 1998



CERES CRS EDITION_2B Single Day APR 2 1998

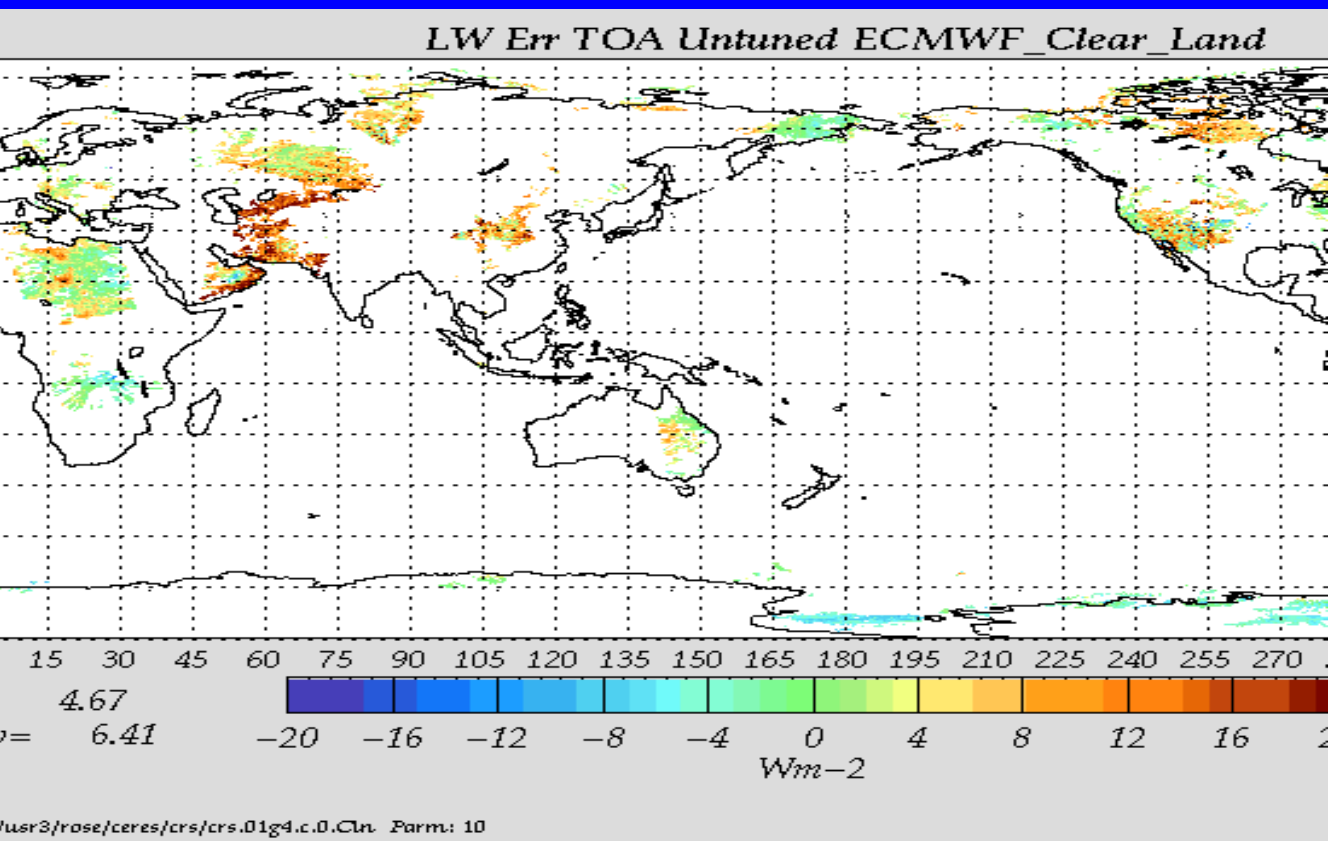


Further CERES processing: ECMWF or GEOS4?

8 hours of Clear-sky Terra SSF on 1 May 2001

(Observed OLR) – (Untuned Fu-Liou)
as mean/std dev in Wm-2

	OCEAN	LAND
ECMWF	2.69/5.82	4.67/6.41
GEOS4	4.71/6.26	5.72/7.17



Comparison of tuned CRS (SARB) with CERES and "CAVE"

www-cave.larc.nasa.gov/cave/ select "Site Statistics"

	Obs Mean	N	Bias Obs-CRS	RMS	Cld All
ALL SKY					
LW Dn Sfc	358	8405	3	20	
LW Up Sfc	429	7031	3	20	
SW Dn Sfc	439	4725	-31	82	-1
SW Up Sfc	89	4308	11	25	
LW Up TOA	253	9071	1	5	-
SW Up TOA	221	4962	1	19	
OVERCAST					
SW Dn Sfc	241	1176	-25	81	-3
CLEAR VIRS					Aer
SW Dn Sfc	519	1534	-32	49	-15
CLEAR VIRS + pyranometer					
SW Dn Sfc	486	202	-22	27	-12