CERES ERBE-like Product Validation: First Comparison of TRMM and Terra Data

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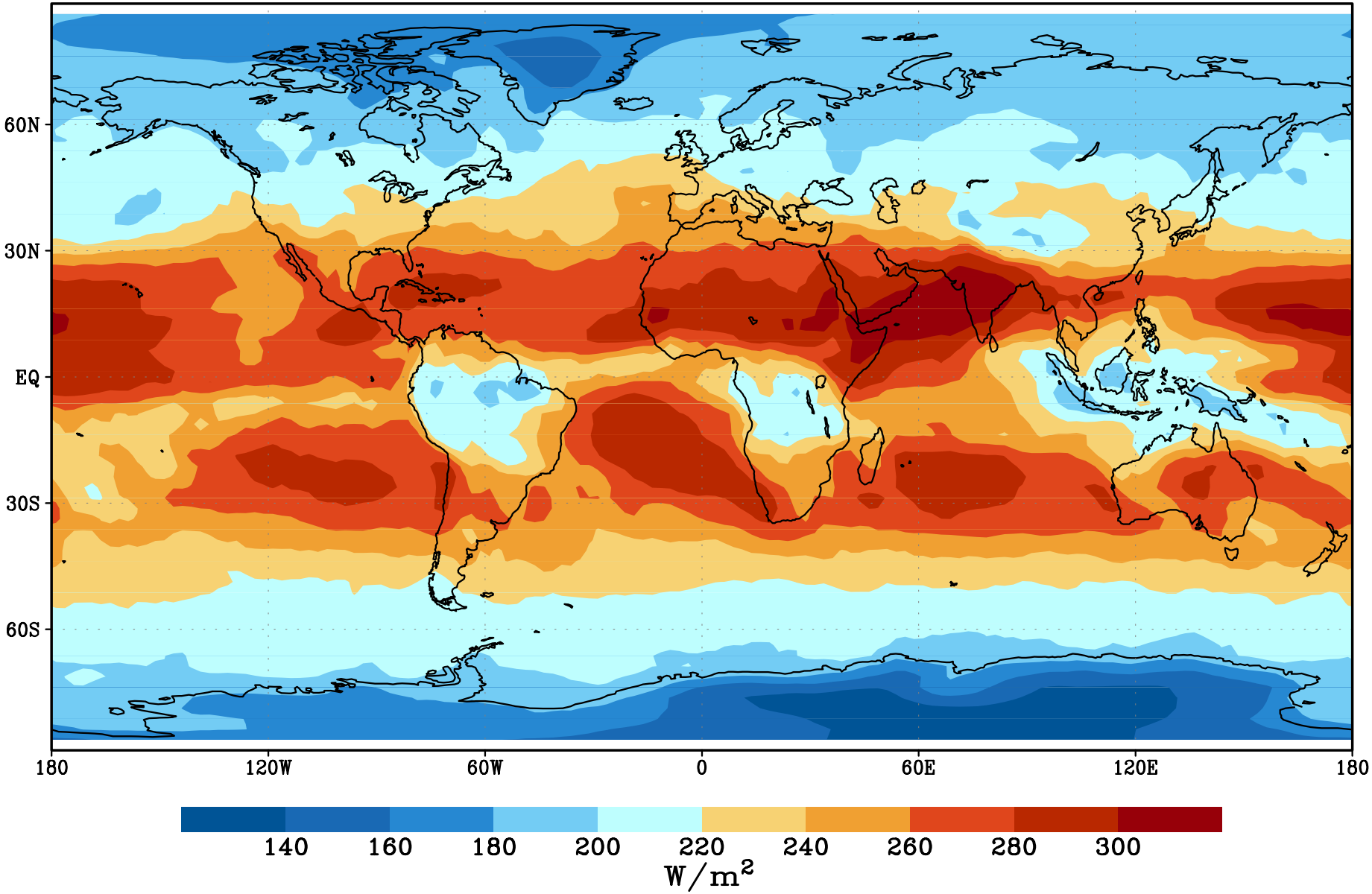
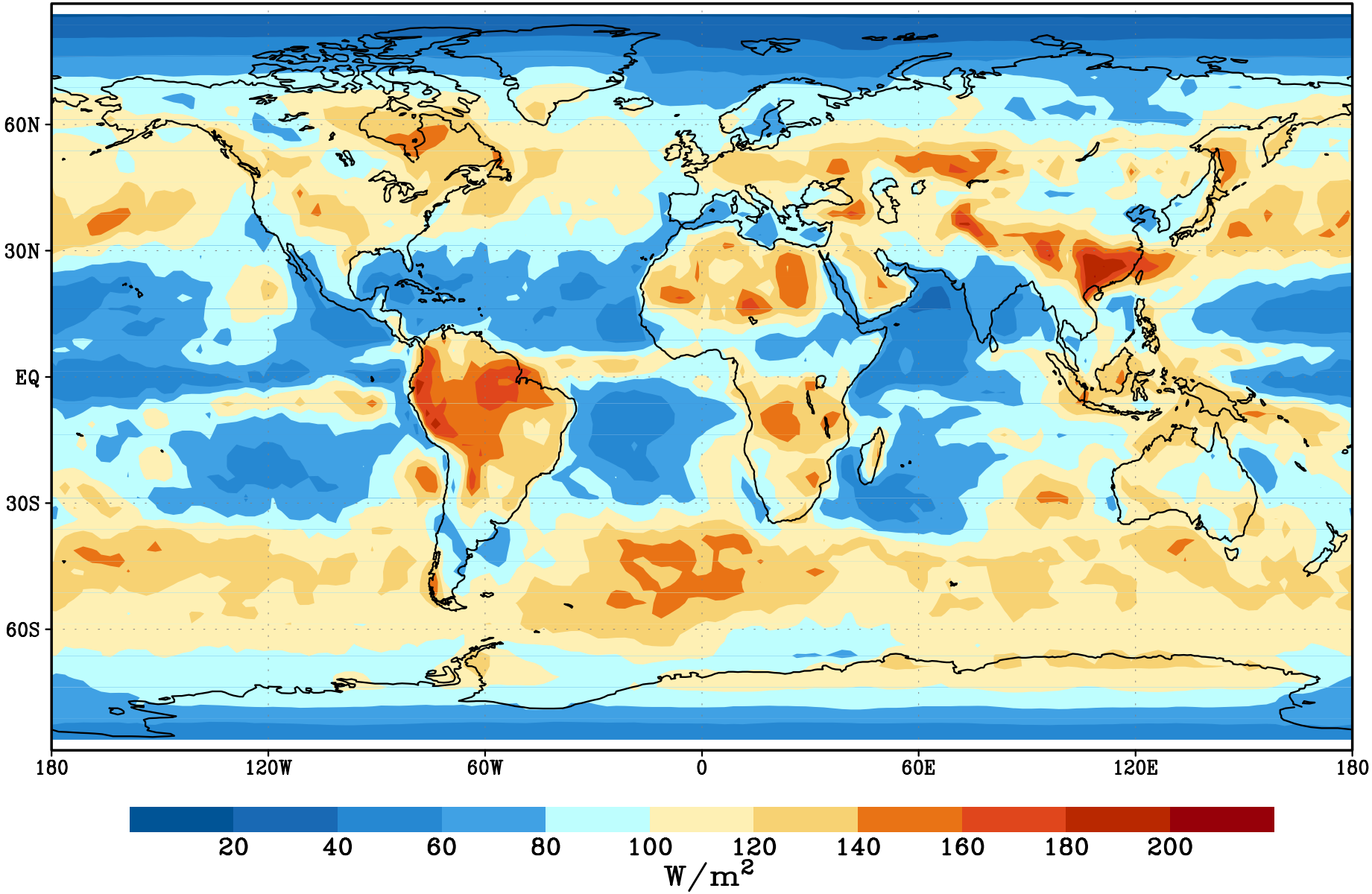
Total–Sky Longwave Flux

CERES/Terra FM1 March 2000



Total-Sky Shortwave Flux

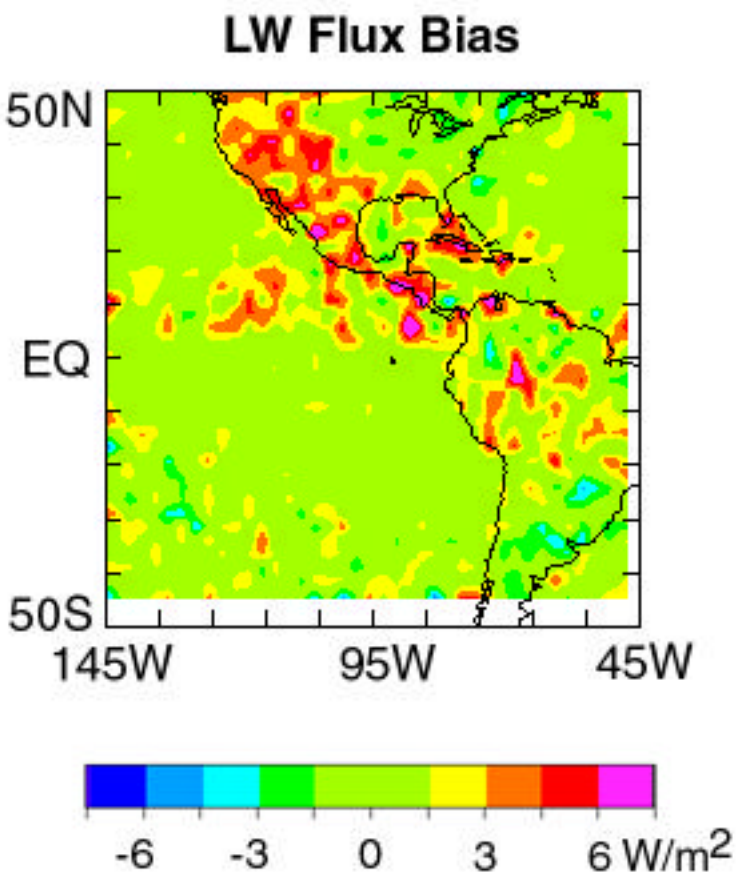
CERES/Terra FM1 March 2000

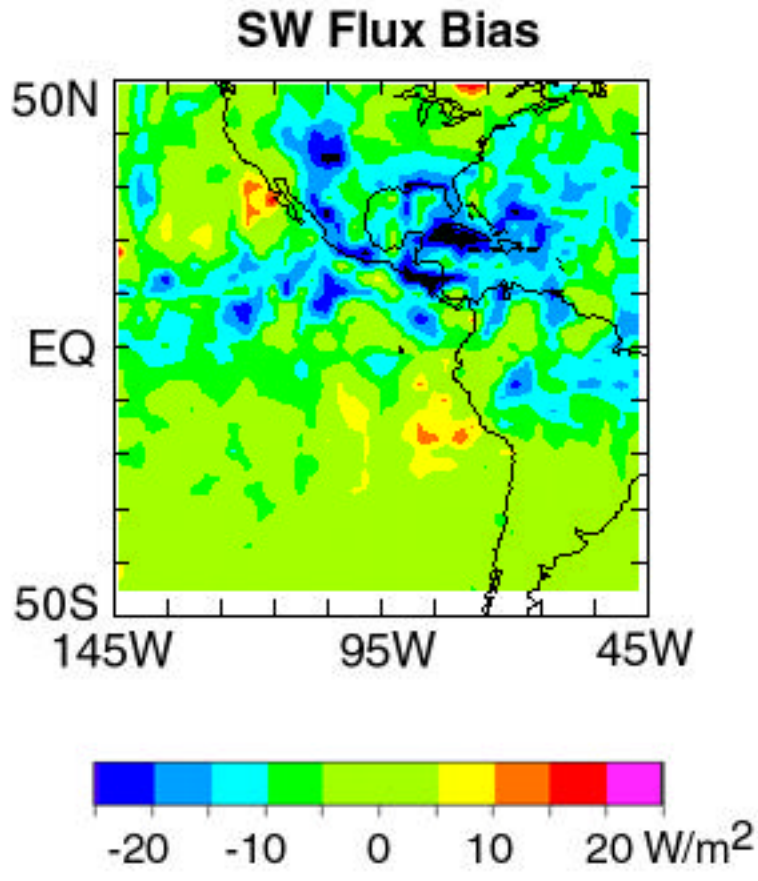


Summary of Global Mean Radiation (W/m^2)

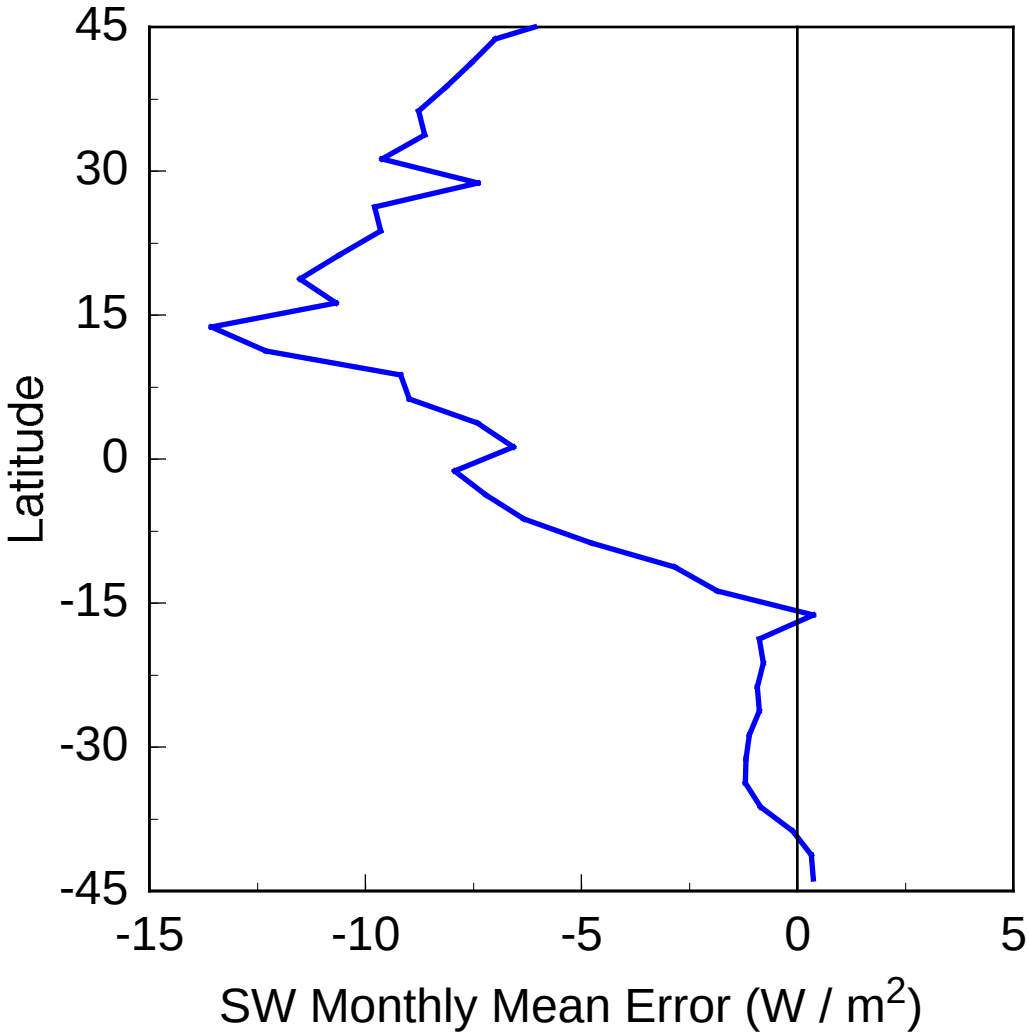
	CERES March 2000		ERBE March 1985		ERBE March 1986	
	TERRA/ FM1	TERRA/ FM2	ERBS + NOAA 9	NOAA 9	ERBS + NOAA 9	NOAA 9
Net	8.47	8.86	11.8	14.1	11.1	12.1
Longwave	238.3	237.7	230.4	228.7	232.4	231.9
Shortwave	97.9	98.1	102.7	102.1	101.4	100.9
Albedo	28.4%	28.5%	29.8%	29.6%	29.4%	29.2%
CS-Net	27.4	27.8	28.4	29.4	27.1	26.8
CS-Longwave	266.2	265.5	263.7	263.0	263.4	263.8
CS-Shortwave	51.2	51.5	53.2	52.8	54.7	54.7
CS-Albedo	14.8%	14.9%	15.4%	15.3%	15.8%	15.8%

Terra Time Sampling Errors
Terra - Truth Bias
Based on July 1985 GOES Data





Zonal Time Sampling Bias in Monthly Mean Shorrtwave Flux from Terra (Based on July 1985 GOES Data)



45°N - 45°S

Mean = -5.6 W/m^2

rms = 9.3 W/m^2

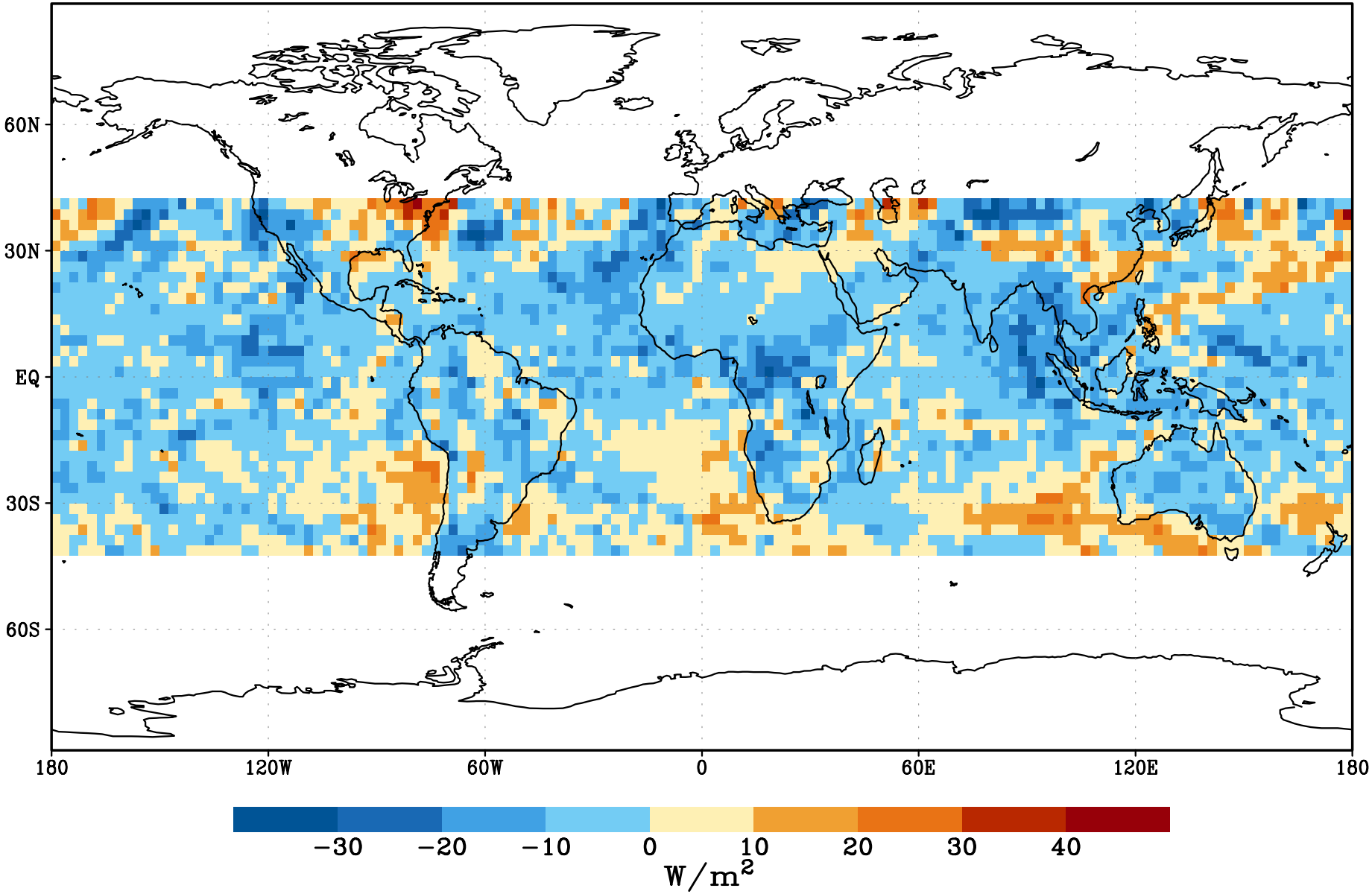
20°N - 20°S

Mean = -7.0 W/m^2

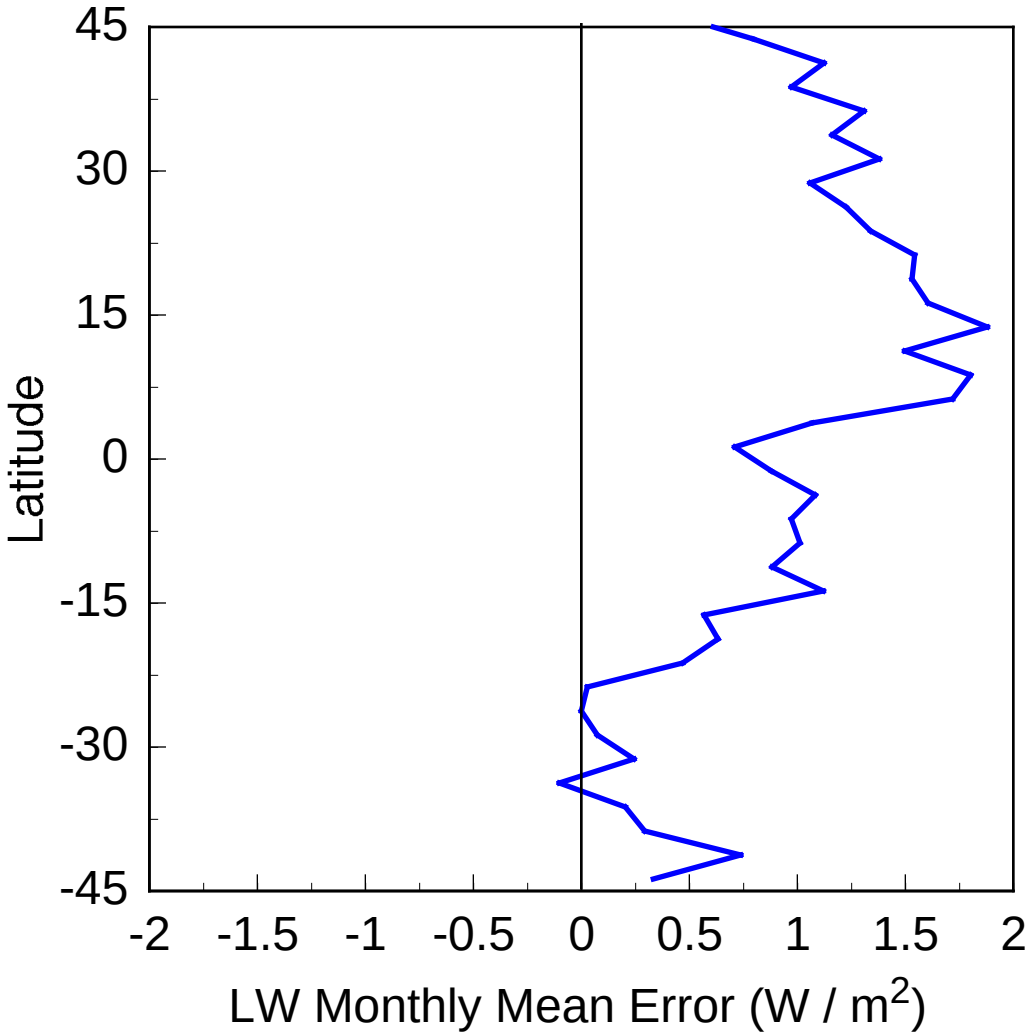
rms = 10.4 W/m^2

Total–Sky Shortwave Flux

CERES/Terra FM1 – CERES/TRMM March 2000



Zonal Time Sampling Bias in Monthly Mean Longwave Flux from Terra (Based on July 1985 GOES Data)



45°N - 45°S

Mean = +0.9 W/m^2

rms = 2.2 W/m^2

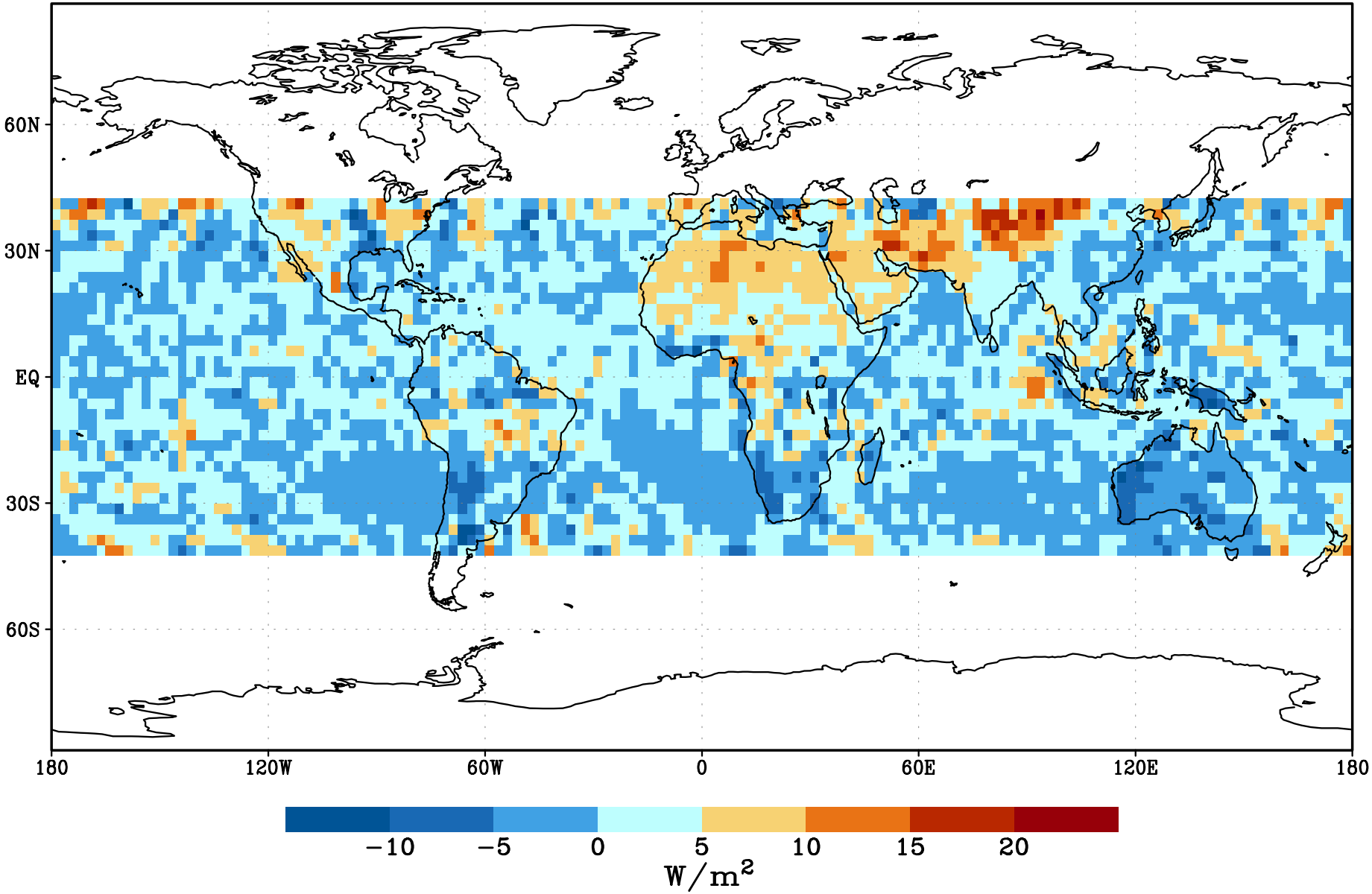
20°N - 20°S

Mean = +1.2 W/m^2

rms = 2.3 W/m^2

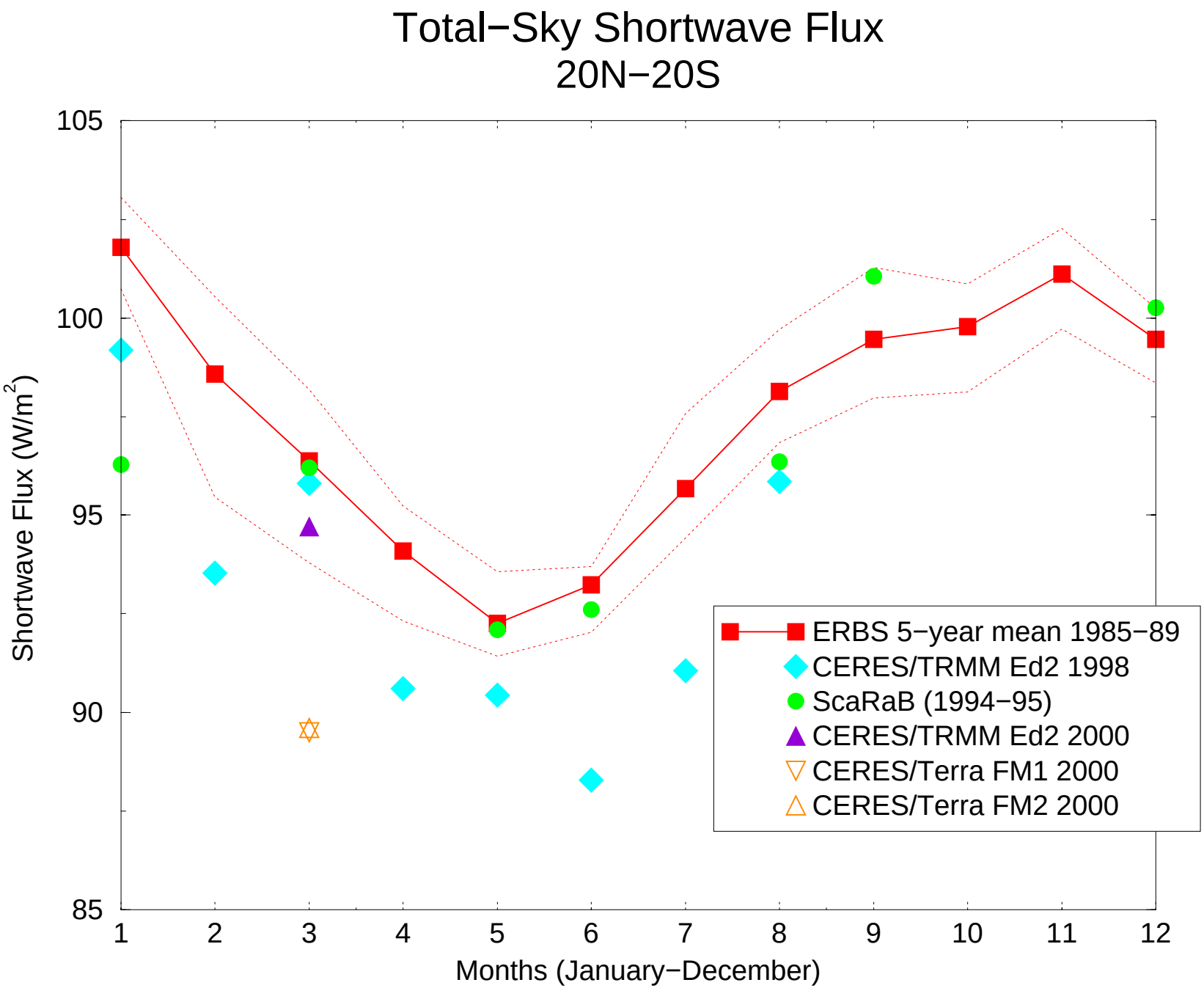
Total–Sky Longwave Flux

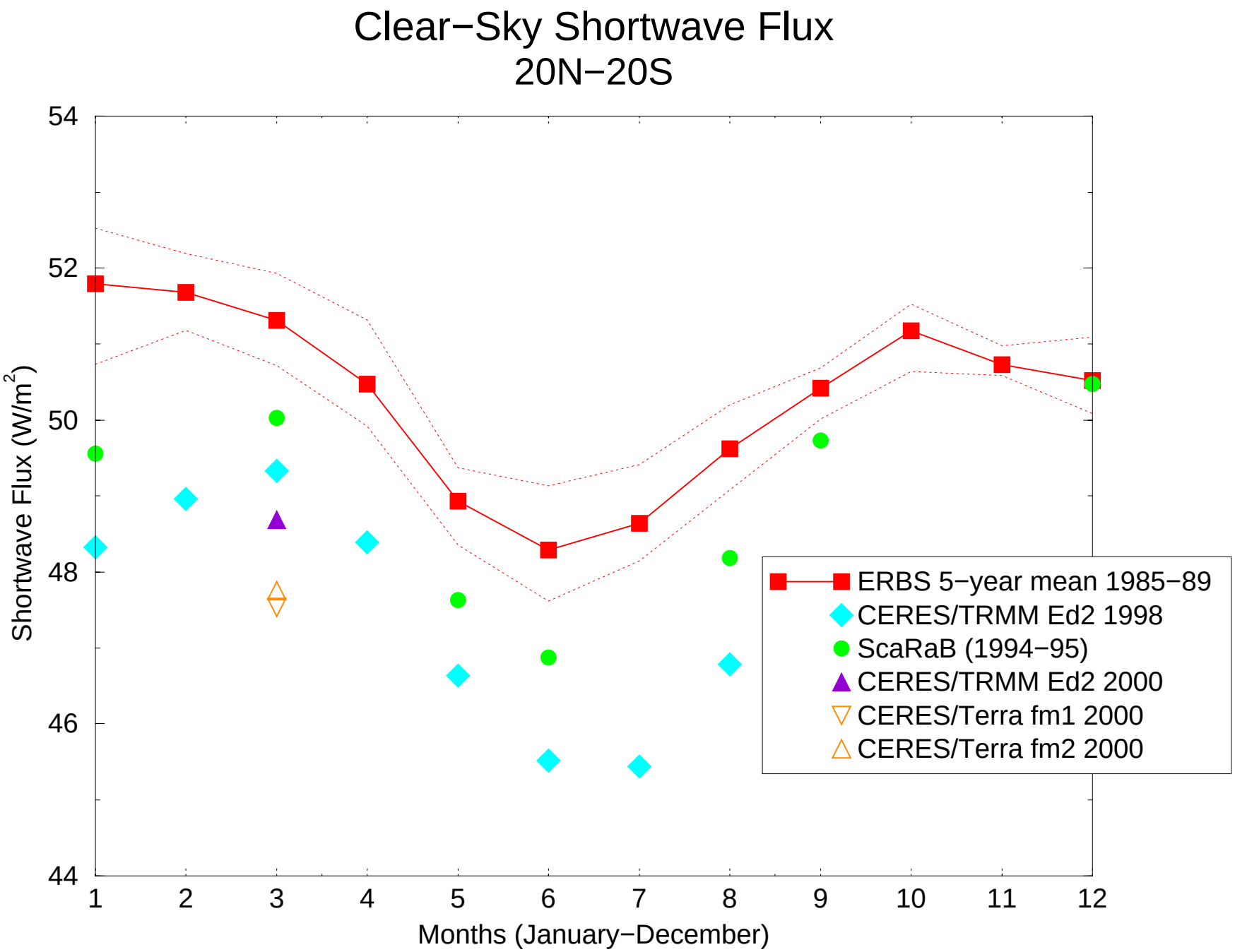
CERES/Terra FM1 – CERES/TRMM March 2000



Tropical Means

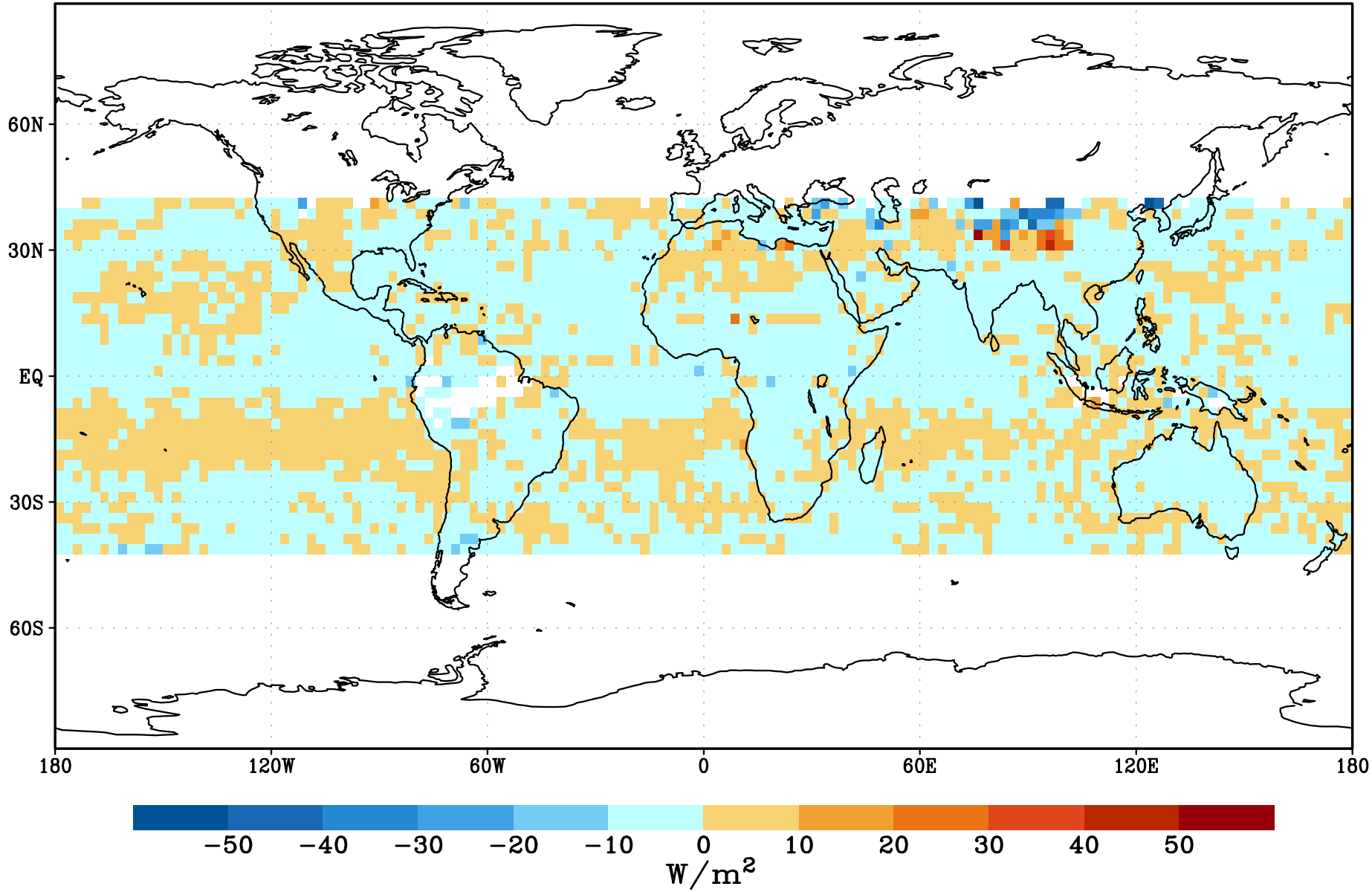
- Tropical Means Used to Minimize Temporal Sampling Errors
- Define Tropics as 20°N - 20°S
- Compare Tropical Means From CERES 1998 With ERBS Scanner 5-Year Averages (1985 - 1989)
- From Footprint Data
  - Ocean Only
  - Nighttime
  - Nadir Only
- From Regional Monthly Means
  - All Regions
  - Day and Night
  - All Viewing Angles


Total−Sky Shortwave Flux
20N−20S
Shortwave Flux (W/m2)
105
100
95
90
85
1
2
3
4
5
6
7
8
9
10
11
12
Months (January−December)
ERBS 5−year mean 1985−89
CERES/TRMM Ed2 1998
ScaRaB (1994−95)
CERES/TRMM Ed2 2000
CERES/Terra FM1 2000
CERES/Terra FM2 2000


Clear−Sky Shortwave Flux
20N−20S
Shortwave Flux (W/m^2)
54
52
50
48
46
44
1
2
3
4
5
6
7
8
9
10
11
12
Months (January−December)
ERBS 5−year mean 1985−89
CERES/TRMM Ed2 1998
ScaRaB (1994−95)
CERES/TRMM Ed2 2000
CERES/Terra fm1 2000
CERES/Terra fm2 2000

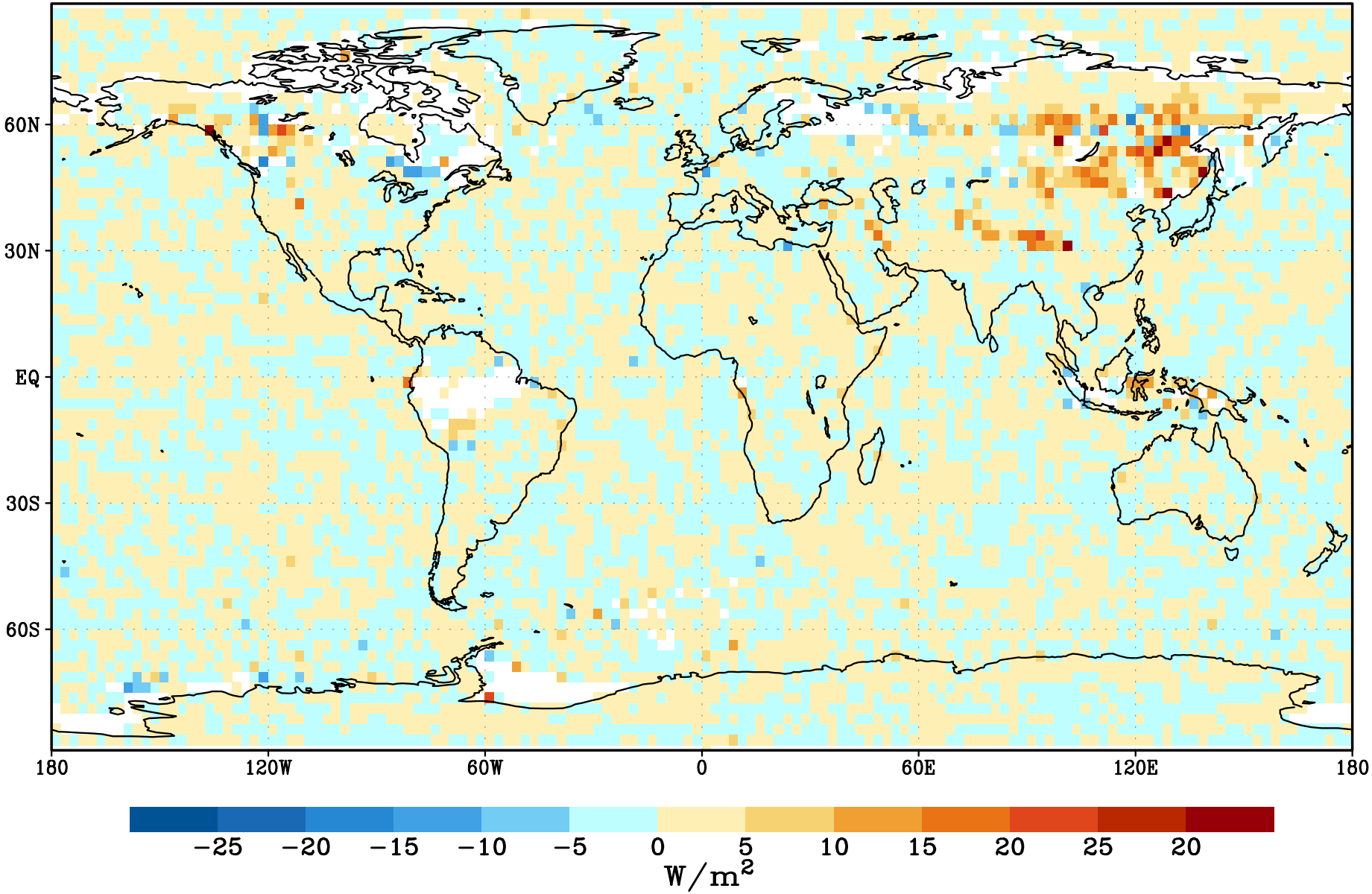
Clear-Sky Shortwave Flux

CERES/Terra FM1 - CERES/TRMM March 2000



Clear-Sky Shortwave Flux

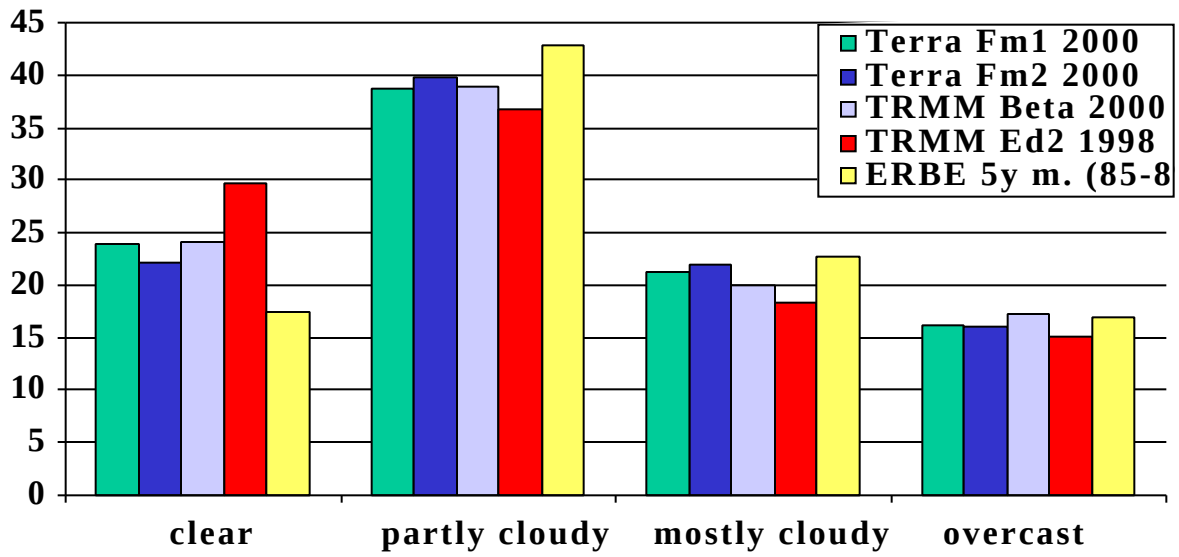
FM2-FM1 CERES/Terra March 2000

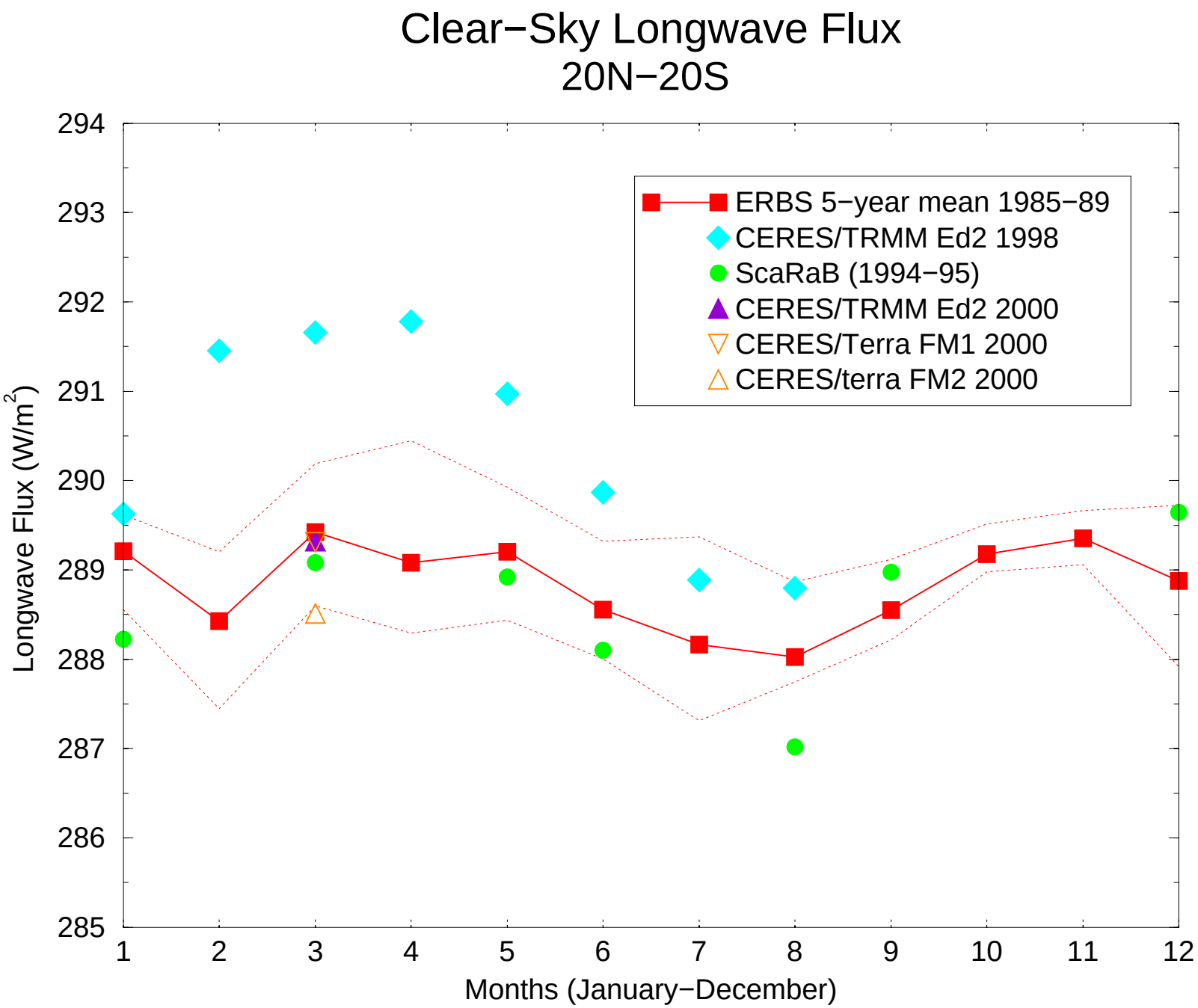


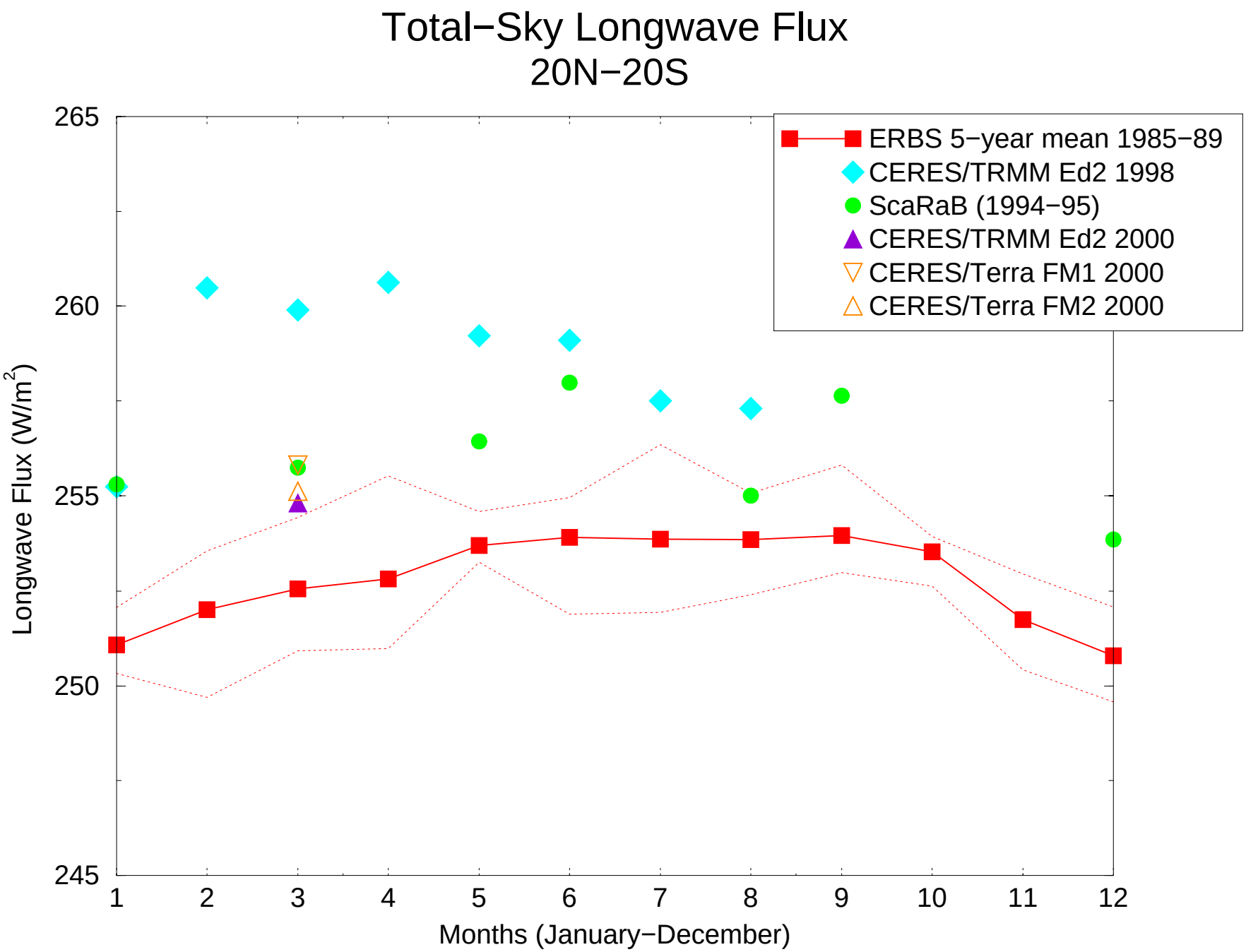
Comparison of Mean Clear-sky Albedo by Scene Type March 2000

	Ocean 20°N - 20° S	Land 20°N - 20° S	Desert 40°N - 40° S
ERBS (March Mean)	10.2	16.5	25.5
FM1	9.5	15.4	24.3
FM2	9.6	15.5	24.4
TRMM	9.7	15.7	24.5

March Scene ID Frequency (%)
ALL Scenes (20N-20S)




Clear−Sky Longwave Flux
20N−20S
ERBS 5−year mean 1985−89
CERES/TRMM Ed2 1998
ScaRaB (1994−95)
CERES/TRMM Ed2 2000
CERES/Terra FM1 2000
CERES/terra FM2 2000
Longwave Flux (W/m2)
Months (January−December)
294
293
292
291
290
289
288
287
286
285
1
2
3
4
5
6
7
8
9
10
11
12


Total−Sky Longwave Flux
20N−20S
ERBS 5−year mean 1985−89
CERES/TRMM Ed2 1998
ScaRaB (1994−95)
CERES/TRMM Ed2 2000
CERES/Terra FM1 2000
CERES/Terra FM2 2000
Longwave Flux (W/m2)
265
260
255
250
245
1
2
3
4
5
6
7
8
9
10
11
12
Months (January−December)

Comparison of Tropical (20°N - 20°S) Means From CERES and ERBS Scanner March Means

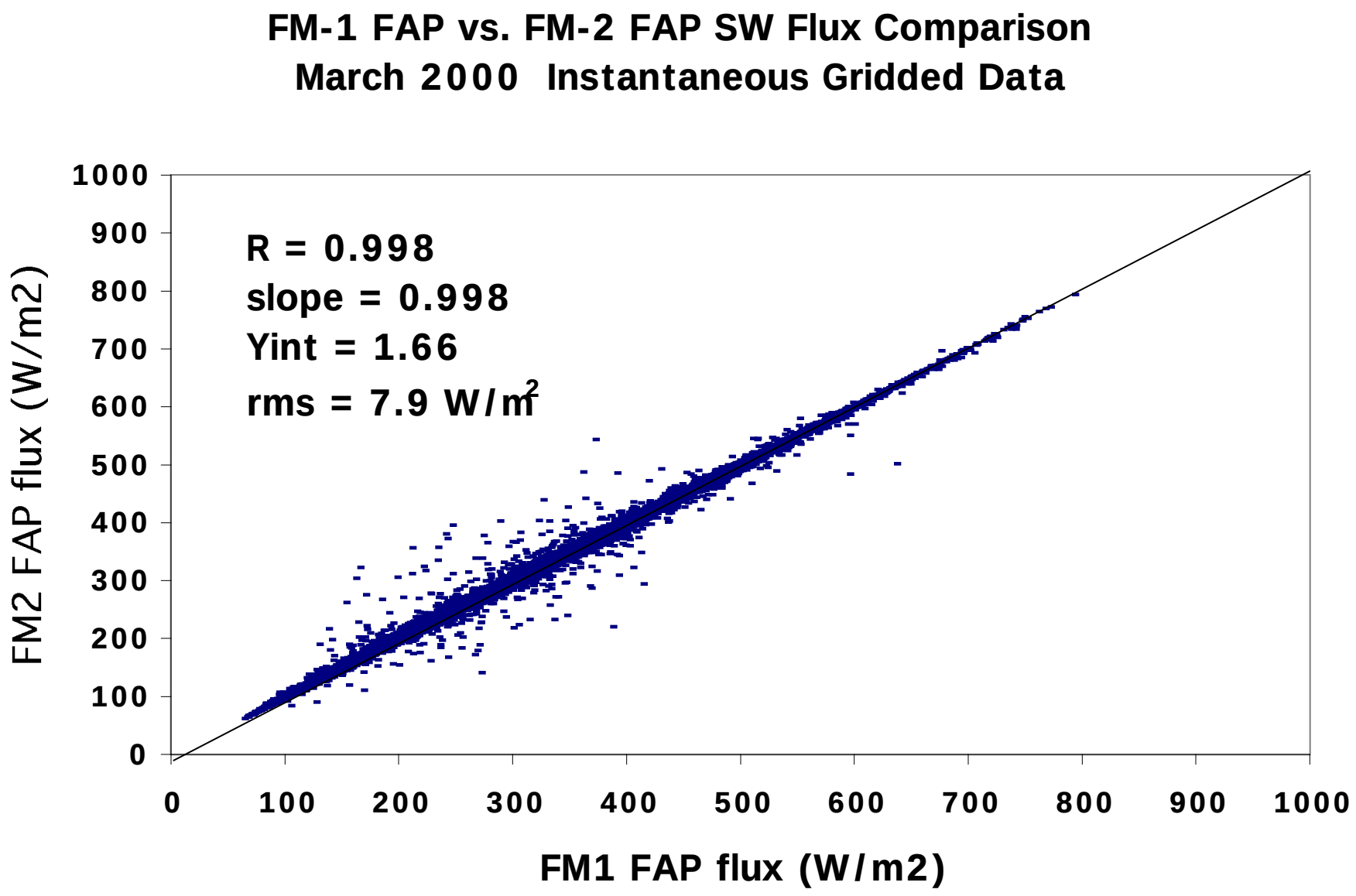
Parameter	FM1	FM2	TRMM	ERBS March 1985-1989
Total-Sky LW (W/m^2)	255.8	255.1	254.8	252.6
Clear-Sky LW (W/m^2)	289.3	288.5	289.3	289.3
Total-Sky SW (W/m^2)	89.5	89.6	94.7	96.4
Clear-Sky SW (W/m^2)	47.5	47.8	48.7	51.4
Total-Sky Albedo (%)	20.9	20.9	22.1	22.5
Clear-Sky Albedo (%)	11.1	11.1	11.4	12.0
LW Cloud Forcing (W/m^2)	32.2	32.2	33.9	36.3
SW Cloud Forcing (W/m^2)	-40.7	-40.5	-46.0	-45.0
Net Cloud Forcing (W/m^2)	-8.5	-8.3	-12.1	-8.7

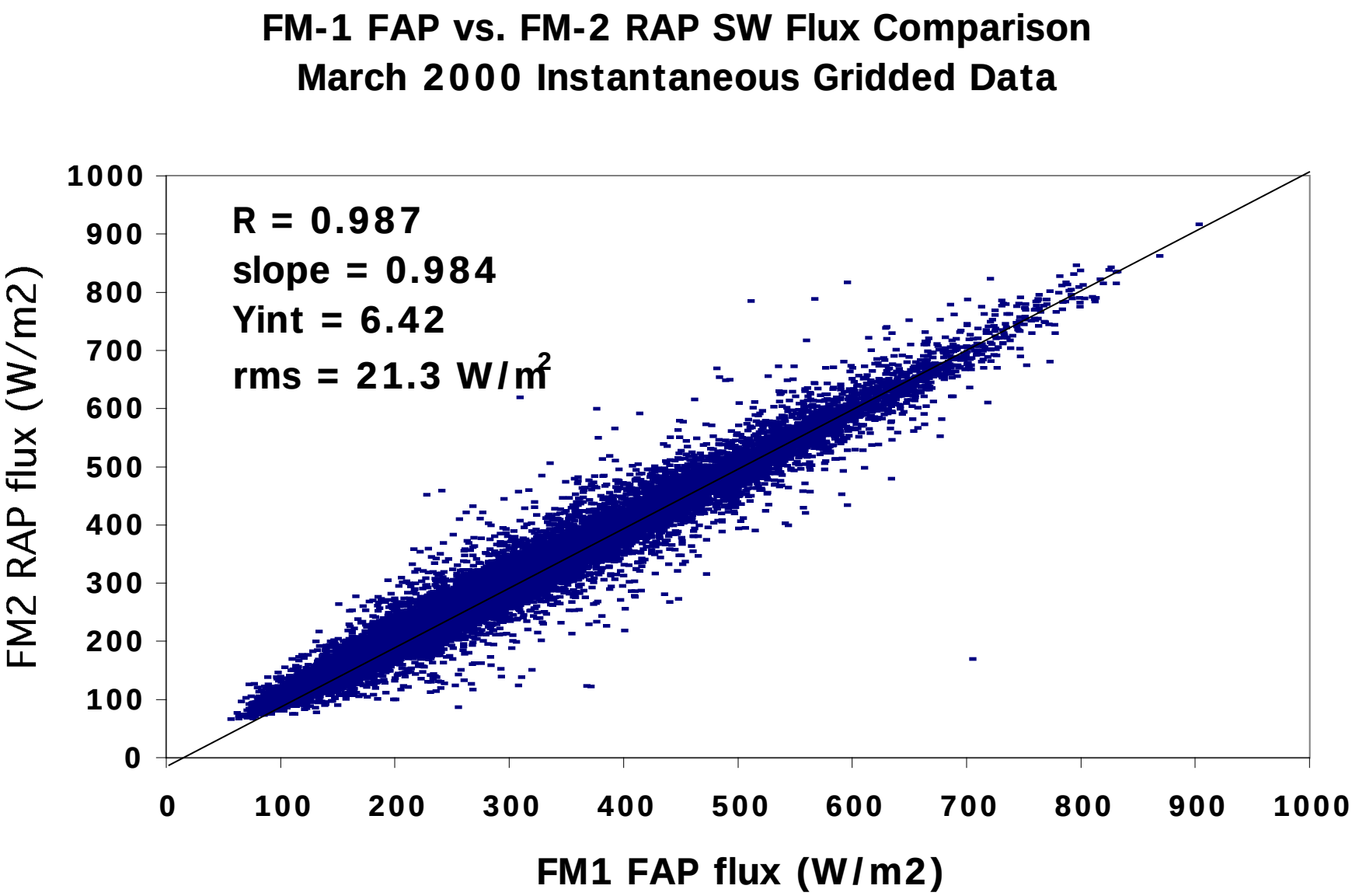
Comparison of CERES and ERBS Scanner Day and Night Total-Sky LW Fluxes (W/m^2) Tropical Ocean (20°N - 20°S)

Parameter	Night	Day	Day - Night
ERBS March 1985	256.7	256.0	-0.7
ERBS March 1986	255.7	254.5	-1.2
ERBS March 1987	260.1	258.3	-1.8
ERBS March 1988	258.6	257.1	-1.5
ERBS 4-Year Mean	257.8	256.5	-1.3
FM1 March 2000	258.6	259.6	1.0
FM2 March 2000	257.5	259.6	2.1
TRMM March 2000	259.0	258.0	-1.0

FM1 - FM2 Crosstrack / RAP Comparison

- Objective
  - Compare Instantaneous, Coincident Gridded Fluxes from FM-1 and FM-2 on Terra
  - Derive Combined Gridding, ADM, and Scene ID Errrors
- Method
  - Match 2.5° Gridded Data from FM-1 and FM-2
  - Compare Gridded Fluxes for 3 Cases
    - FM-1 FAP vs. FM-2 FAP
    - FM-1 RAP vs. FM-2 FAP
    - FM-1 FAP vs. FM-2 RAP


FM-1 FAP vs. FM-2 FAP SW Flux Comparison
March 2000 Instantaneous Gridded Data
R = 0.998
slope = 0.998
Yint = 1.66
rms = 7.9 W/m2
FM2 FAP flux (W/m2)
FM1 FAP flux (W/m2)
0
100
200
300
400
500
600
700
800
900
1000


FM-1 FAP vs. FM-2 RAP SW Flux Comparison
March 2000 Instantaneous Gridded Data
R = 0.987
slope = 0.984
Yint = 6.42
rms = 21.3 W/m2
FM2 RAP flux (W/m2)
FM1 FAP flux (W/m2)
0
100
200
300
400
500
600
700
800
900
1000

FM-1 / FM-2 Instantaneous SW Flux Comparison

All Data

	R	Slope	Y intercept	RMS (W/m^2)
FM-1 FAP FM-2 FAP	0.998	0.998	1.66	7.9
FM-1 RAP FM-2 FAP	0.986	0.990	2.26	22.6
FM-1 FAP FM-2 RAP	0.987	0.984	6.42	21.3

VZ < 45°

	R	Slope	Y intercept	RMS (W/m^2)
FM-1 FAP FM-2 FAP	0.998	1.001	0.32	9.2
FM-1 RAP FM-2 FAP	0.994	0.989	5.70	15.1
FM-1 FAP FM-2 RAP	0.993	1.003	-2.42	15.4

FM-1 / FM-2 Instantaneous LW Flux Comparison

All Data

	R	Slope	Y intercept	RMS (W/m^2)
FM-1 FAP FM-2 FAP	0.998	0.985	2.85	2.26
FM-1 RAP FM-2 FAP	0.993	0.974	6.74	4.88
FM-1 FAP FM-2 RAP	0.993	0.987	2.03	4.80

VZ < 45°

	R	Slope	Y intercept	RMS (W/m^2)
FM-1 FAP FM-2 FAP	0.999	0.987	2.68	1.77
FM-1 RAP FM-2 FAP	0.998	0.982	4.88	2.87
FM-1 FAP FM-2 RAP	0.997	0.988	1.70	2.97

RAPS and FAPS Relative Difference as a Function of the Cosinus of the Solar Zenith Angle ((FM2-FM1)*100/FM2) All Scenes March 2000

%	COS(SZN)									
	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.15	0.05
Raps-Faps	-0.67	-1.93	-0.91	-0.86	-0.15	0.01	0.56	1.24	0.92	0.42
Faps-Raps	1.13	1.37	0.82	1.61	1.19	0.38	-0.31	-0.82	-0.55	-0.33
Faps-Faps	0.69	-0.52	-0.53	-1.10	-0.23	-0.04	-0.09	0.16	0.11	-0.06