

Simpler Surface Radiative Fluxes

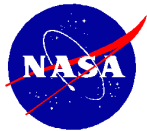
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CERES Data Products Workshop
Norfolk, Virginia

29-30 January 2003

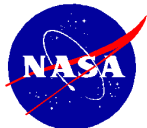


Simpler Surface Radiative Fluxes

- Downwelling clear-sky and all-sky, SW and LW surface fluxes derived from TOA-to-Surface transfer algorithms and radiation parameterizations
- Each component currently computed with two models

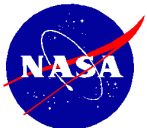
		Model A	Model B
SW	Clear	Li et al.	LPSA
	All-sky	-	LPSA
LW	Clear	Inamdar and Ramanathan	LPLA
	All-sky	-	LPLA

- LPSA/LPLA = Langley Parameterized SW/LW Algorithm



Simpler Surface Radiative Fluxes

- CERES Science Team strongly recommended that several model-based methods be used concurrently for ensuring high accuracy in surface fluxes.
- Surface-only algorithms should also try to make as much use of TOA measurements as possible.
- Surface-only algorithms are simple, computationally fast and allow quick testing of time averaged and interpolated data products such as SRBAVG.
- Surface-only algorithms establish links with other project: NASA/GEWEX SRB Project (SW and LW Models B).



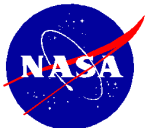
Simpler Surface Radiative Fluxes

- SW Model A:
Li *et al.* (1993): *J. Climate*, **6**, 1764-1772.
- SW Model B (LPSA/Staylor Algorithm):
Darnell *et al.* (1988): *J. Climate*, **1**, 820-835.
Darnell *et al.* (1992): *J. Geophys. Res.*, **97**, 15741-15760.
Gupta *et al.* (2001): *NASA/TP-2001-211272*, 31 pp.
- LW Model A:
Inamdar and Ramanathan (1997): *Tellus*, **49B**, 216-230.
- LW Model B:
Gupta (1989): *J. Climate*, **2**, 305-320.
Gupta *et al.* (1992): *J. Appl. Meteor.*, **31**, 1361-1367.



Simpler Surface Fluxes: Validation

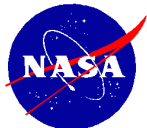
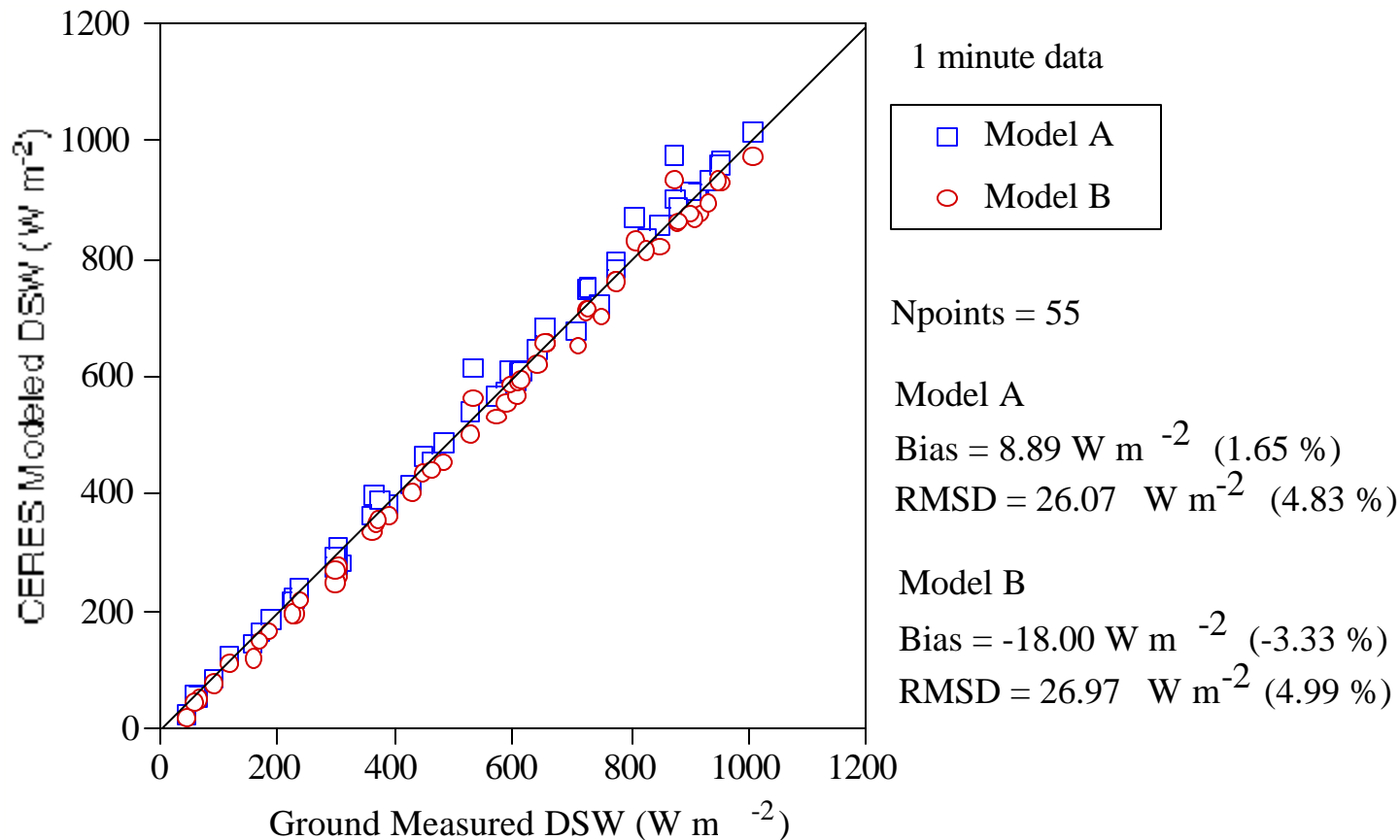
- Validation on instantaneous/footprint level using ground-measured fluxes from different climate regimes
- Validation criteria:
 - $\pm 20 \text{ Wm}^{-2}$ for instantaneous/footprint level fluxes
- Validation data sources:
 - ARM/SGP Central and Extended Facilities
 - BSRN Sites: Alice Springs (Australia), Tateno (Japan), and Florianopolis (Brazil)
 - CMDL Sites: Bermuda and Kwajalein (U. S. Marshall Is.)
- Gridded monthly average results: Part of SRBAVG



Shortwave Clear-sky Comparison

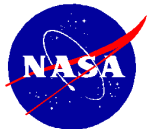
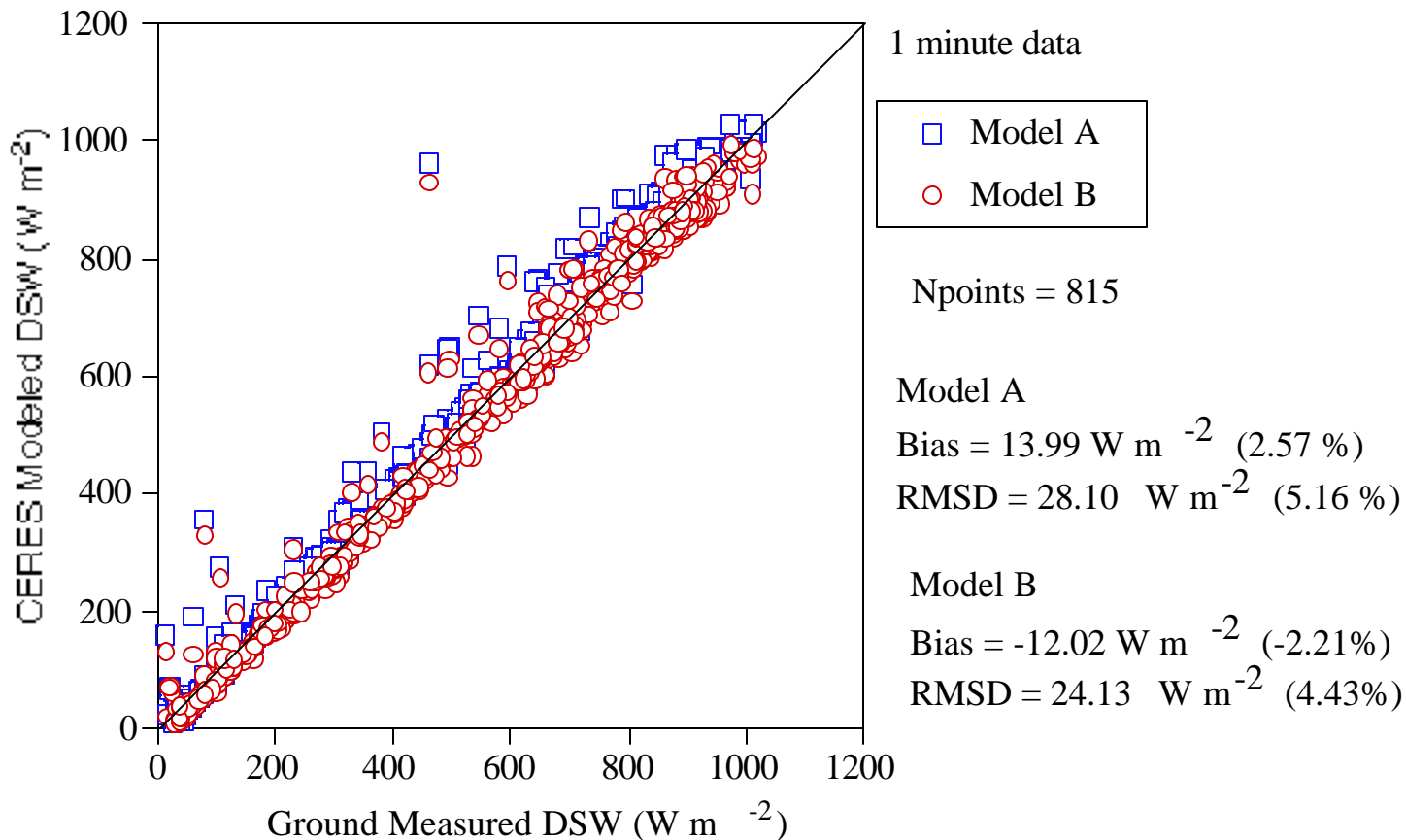
Central Facility

TRMM2B



Shortwave Clear-sky Comparison

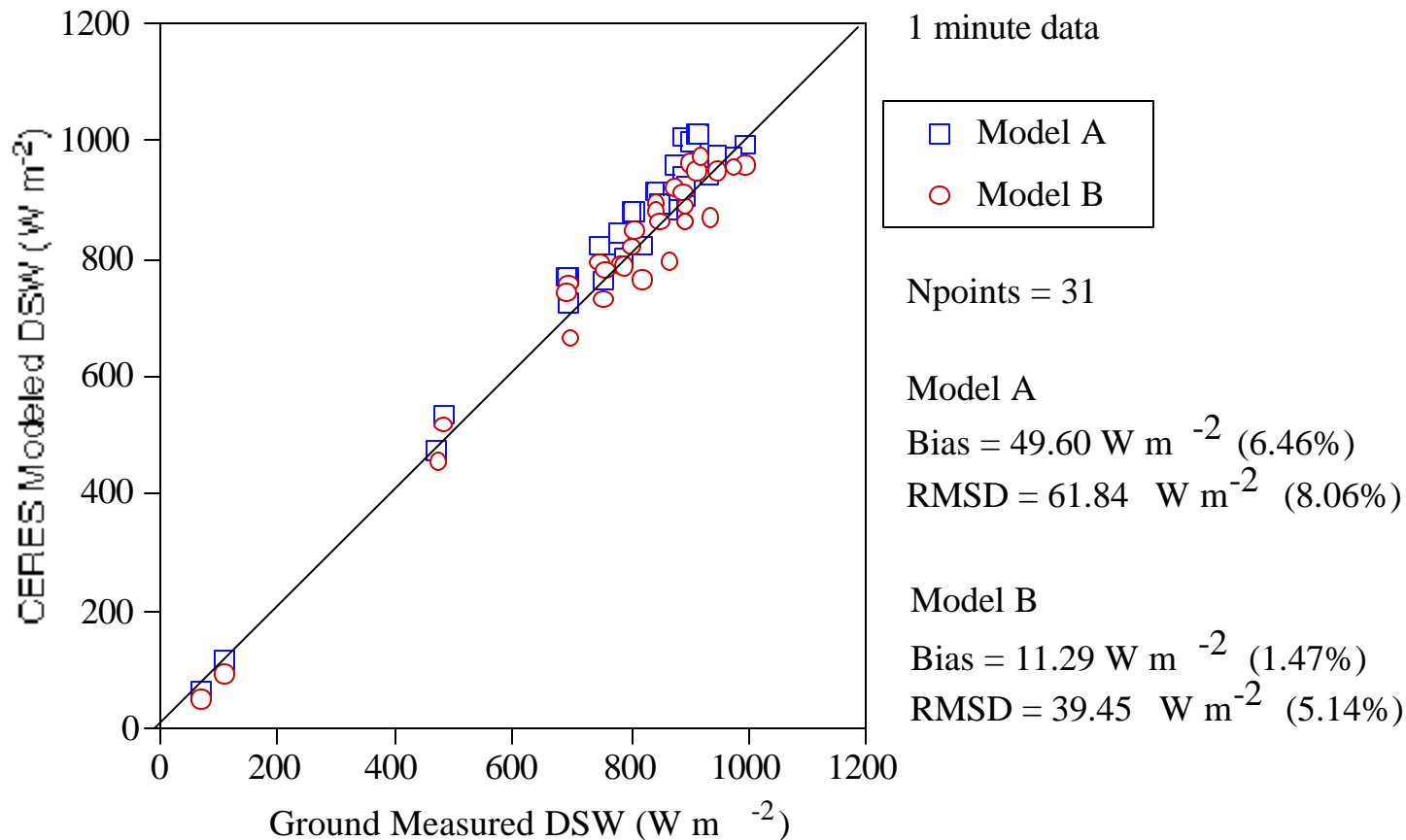
Extended Facilities TRMM2B



Surface
-only
Fluxes

Shortwave Clear-sky Comparison

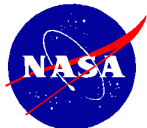
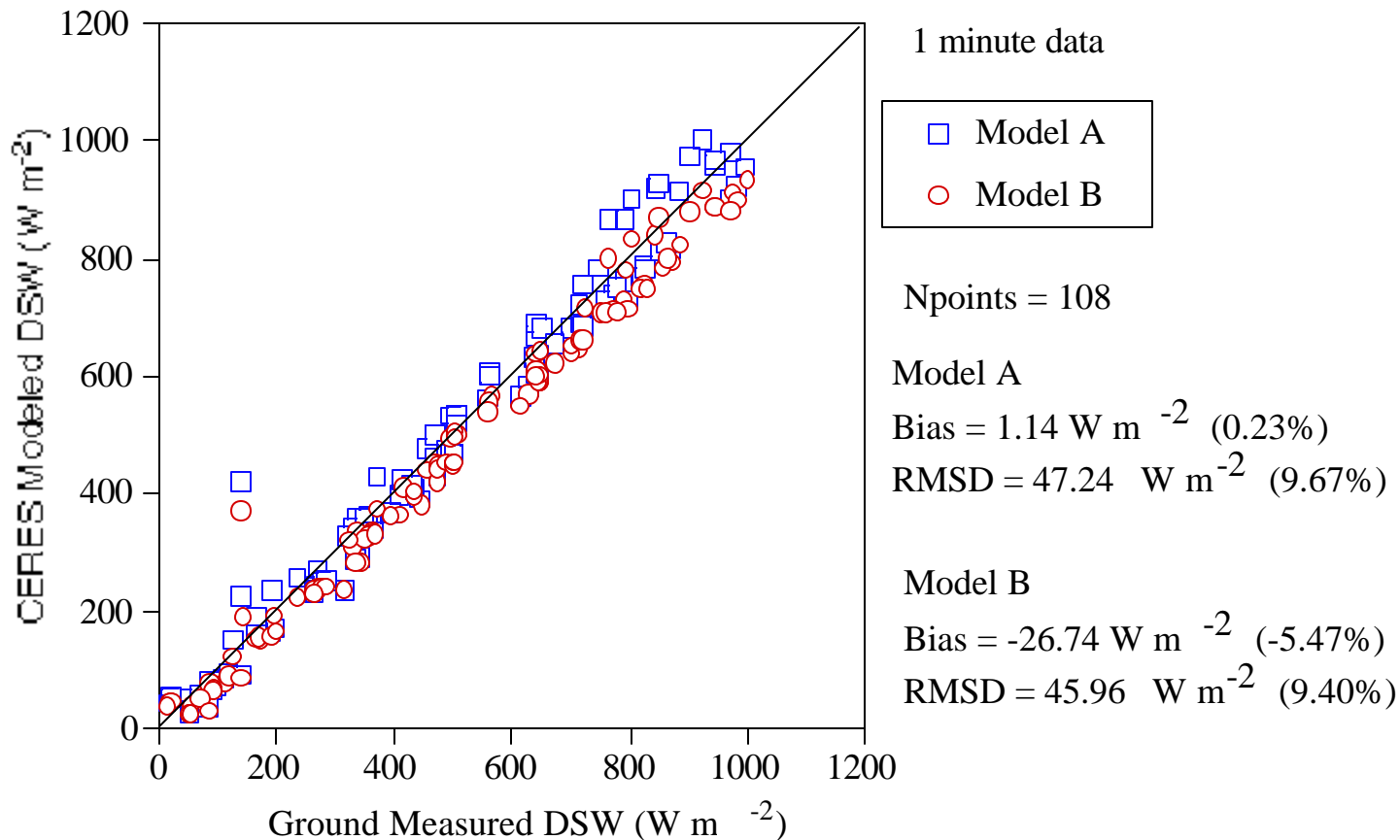
CMDL TRMM2B



Surface
-only
Fluxes

Shortwave Clear-sky Comparison

BSRN TRMM2B



SW Clear-Sky Comparisons (Summary Statistics)

SW Model A - TRMM Edition2B

Sites	# Points	Mean Bias, $W m^{-2}$ (%)	RMS Diff., $W m^{-2}$ (%)
ARM/CF	55	8.9 (1.7)	26.1 (4.8)
ARM/EF	815	14.0 (2.6)	28.1 (5.2)
CMDL	31	49.6 (6.5)	61.8 (8.1)
BSRN	108	1.1 (0.2)	47.2 (9.7)

SW Model B - TRMM Edition 2B

Sites	# Points	Mean Bias, $W m^{-2}$ (%)	RMS Diff., $W m^{-2}$ (%)
ARM/CF	55	-18.0 (-3.3)	27.0 (5.0)
ARM/EF	815	-12.0 (-2.2)	24.1 (4.4)
CMDL	31	11.3 (1.5)	39.5 (5.1)
BSRN	108	-26.7 (-5.5)	46.0 (9.4)



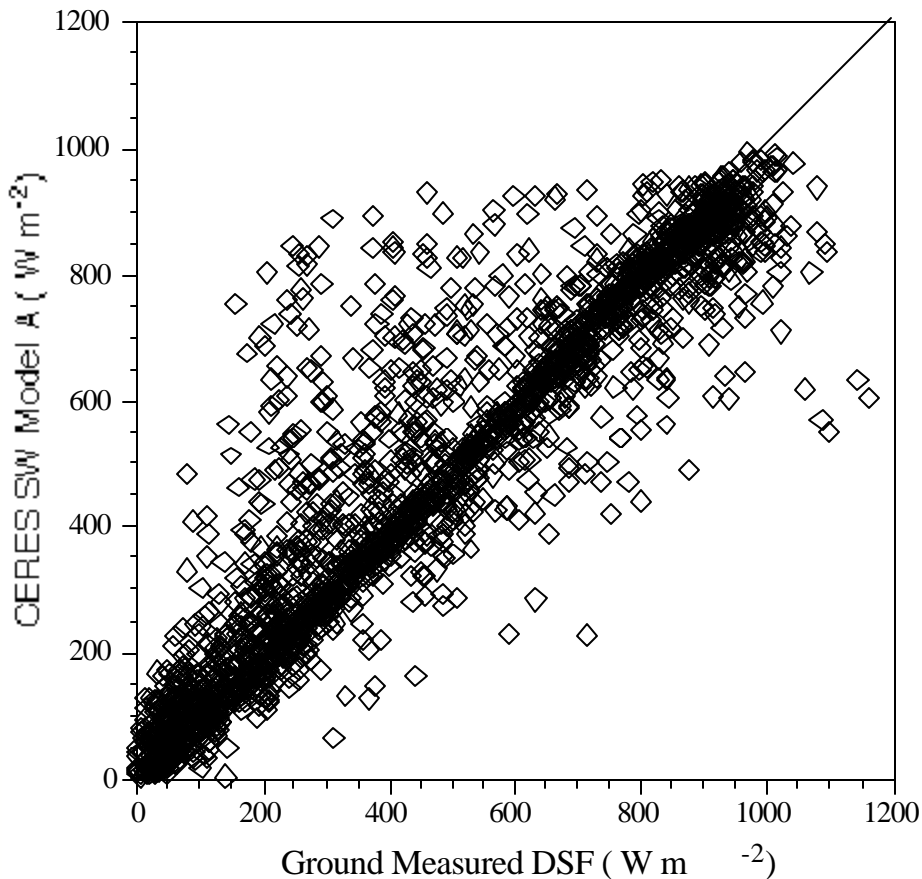
Surface
-only
Fluxes

Shortwave All-sky Comparison

Model B Extended Facilities TRMM Edition 2A

(LPSA)

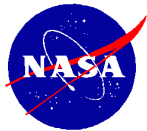
1 minute data



Npoints = 2226

Bias = 12 W m^{-2}

RMS = 109 W m^{-2}

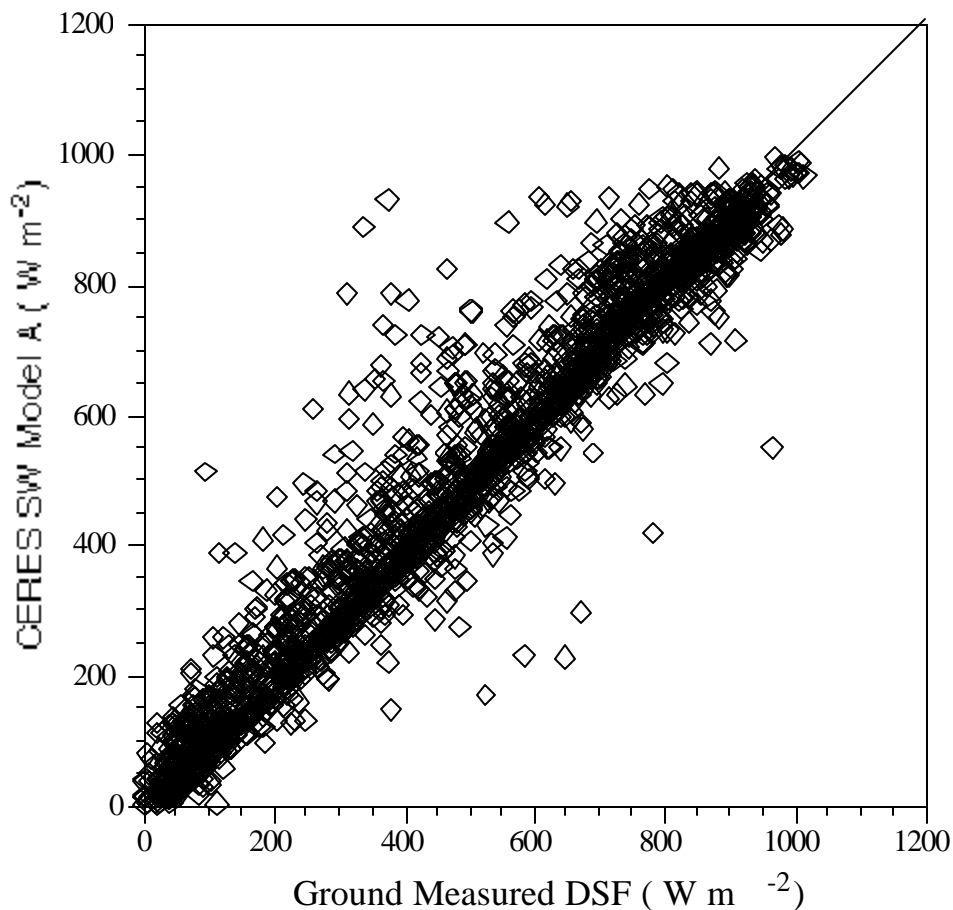


Surface
-only
Fluxes

Shortwave All-sky Comparison

Model B Extended Facilities

TRMM Edition 2A



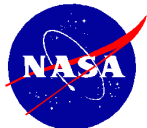
(LPSA)

60 minute data

Npoints = 2138

Bias = $13 W m^{-2}$

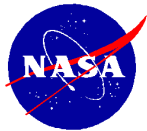
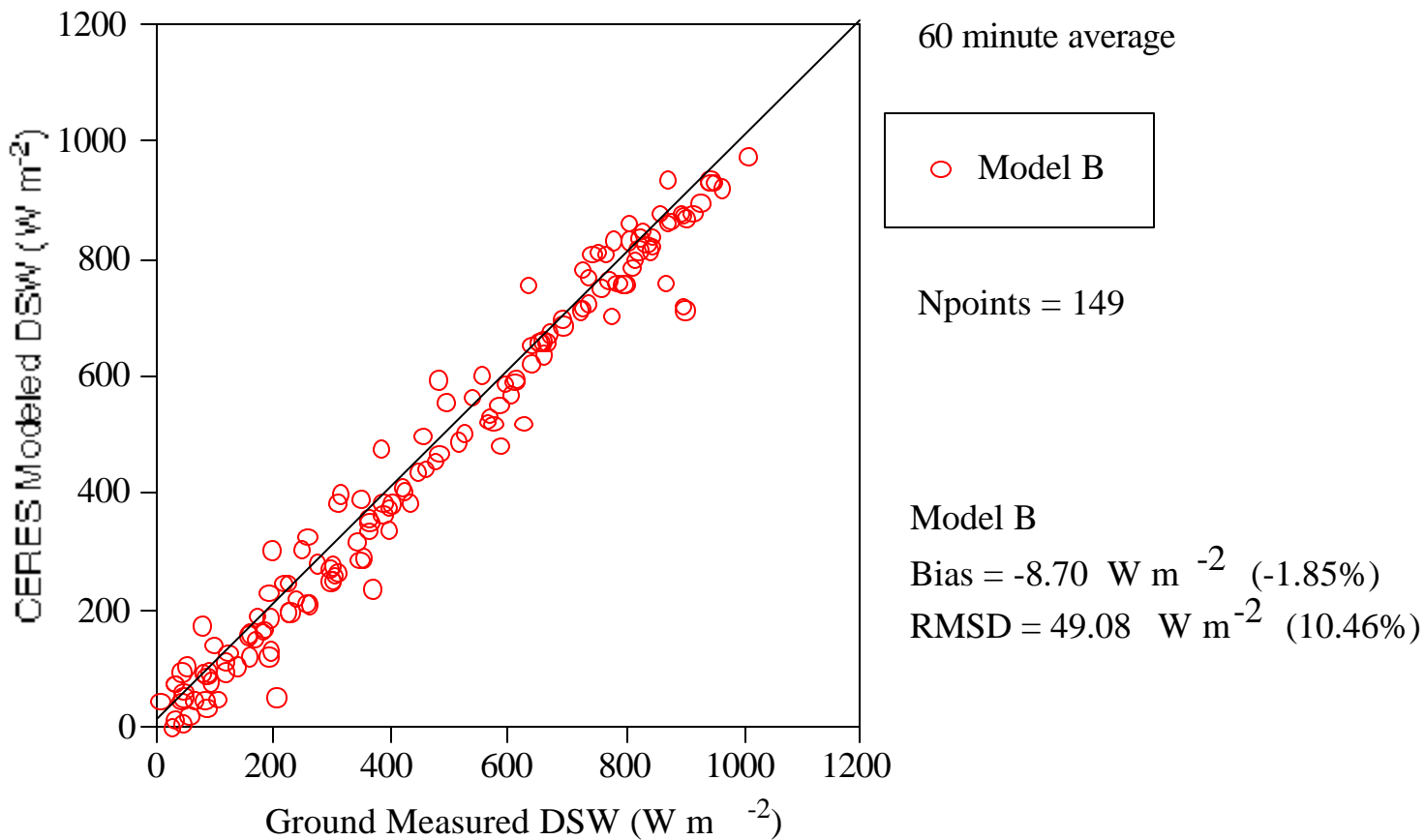
RMS = $72 W m^{-2}$



Surface
-only
Fluxes

Shortwave All-sky Comparison

Central Facility TRMM2B

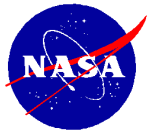
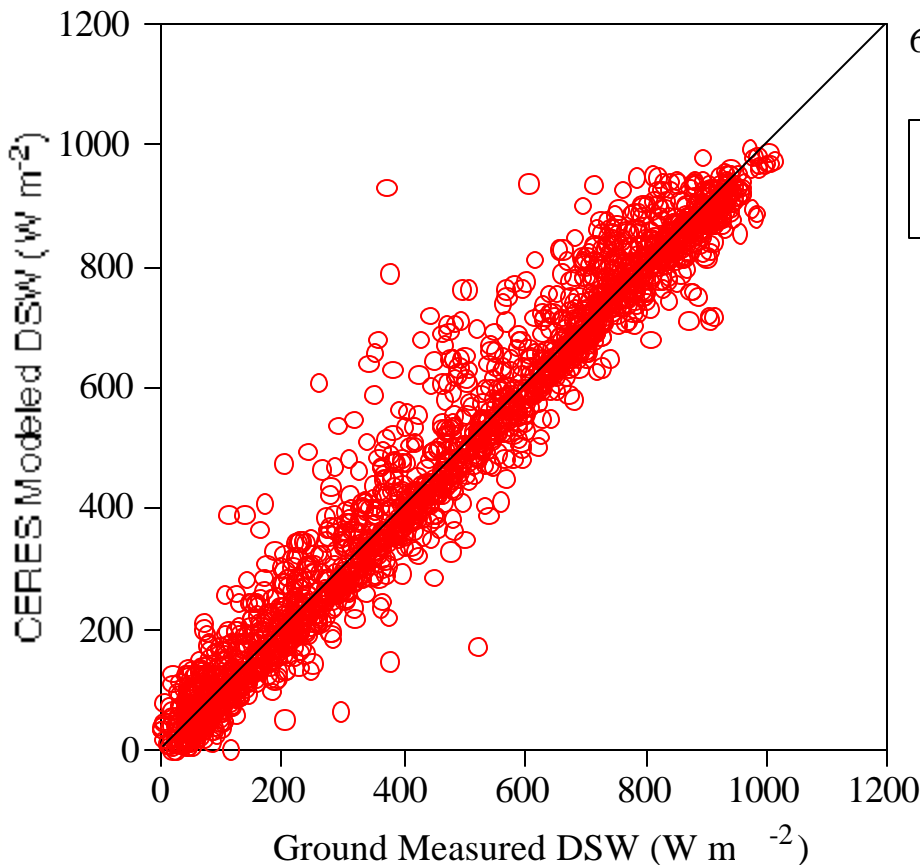


Surface
-only
Fluxes

Shortwave All-sky Comparison

Extended Facilities

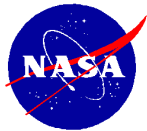
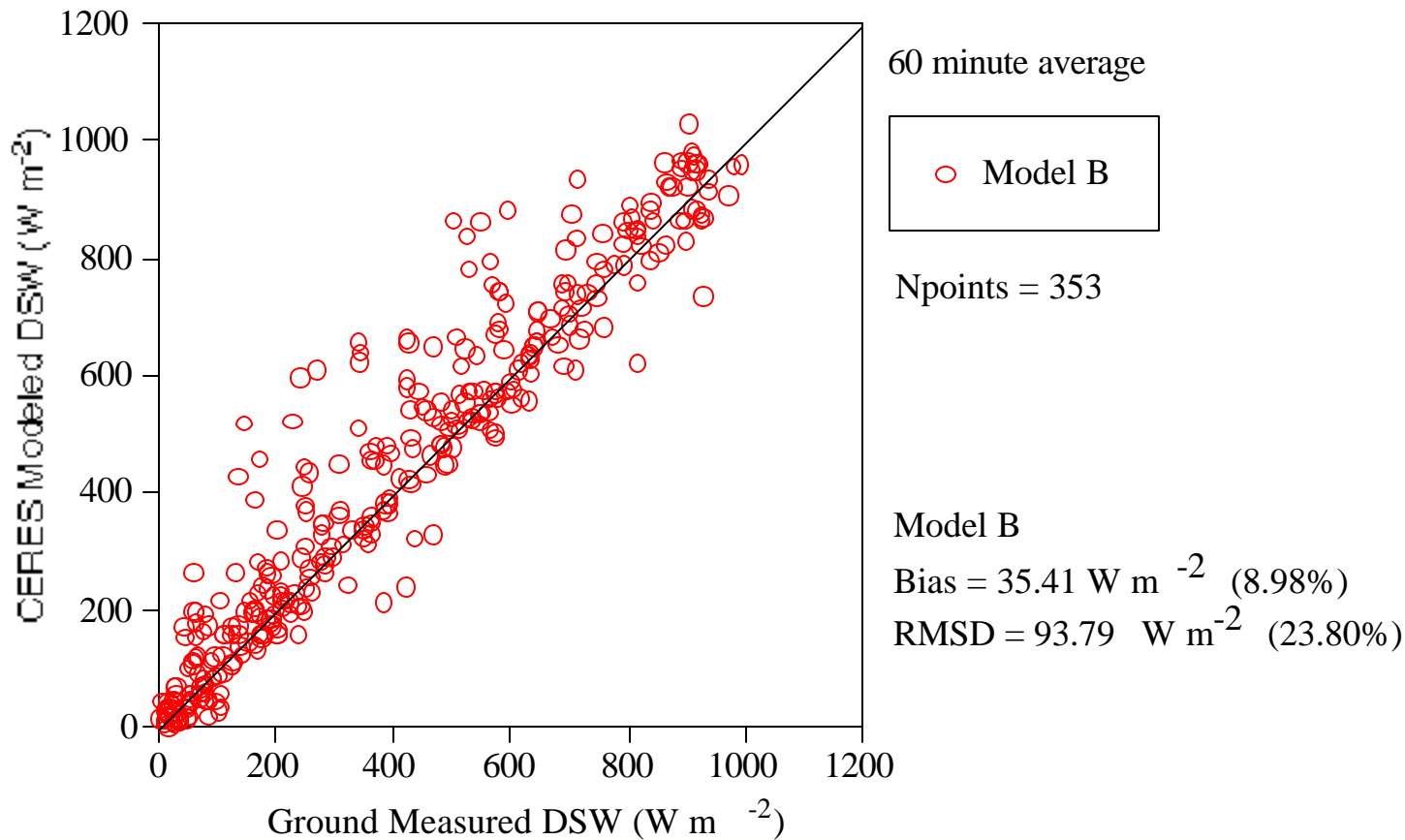
TRMM2B



Surface
-only
Fluxes

Shortwave All-sky Comparison

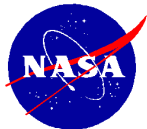
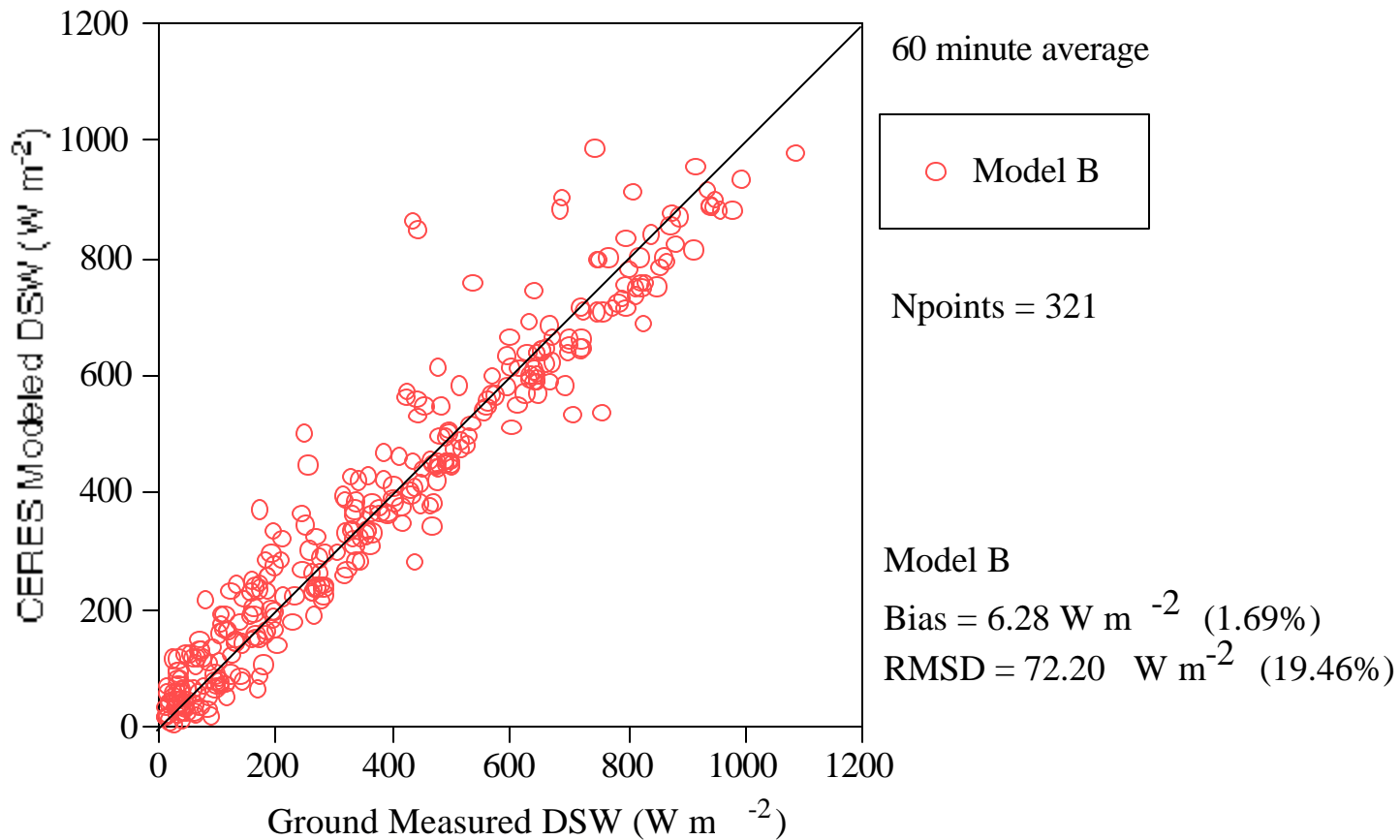
CMDL TRMM2B



Surface
-only
Fluxes

Shortwave All-sky Comparison

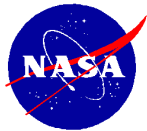
BSRN TRMM2B



SW All-Sky Comparisons (Summary Statistics)

SW Model B - TRMM Edition 2B

Sites	# Points	Mean Bias, Wm^{-2} (%)	RMS Diff., Wm^{-2} (%)
ARM/CF	149	-8.7 (-1.9)	49.1 (10.5)
ARM/EF	2087	9.6 (2.0)	61.9 (13.1)
CMDL	353	35.4 (9.0)	93.8 (23.8)
BSRN	321	6.3 (1.7)	72.2 (19.5)

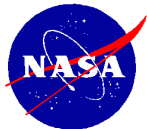
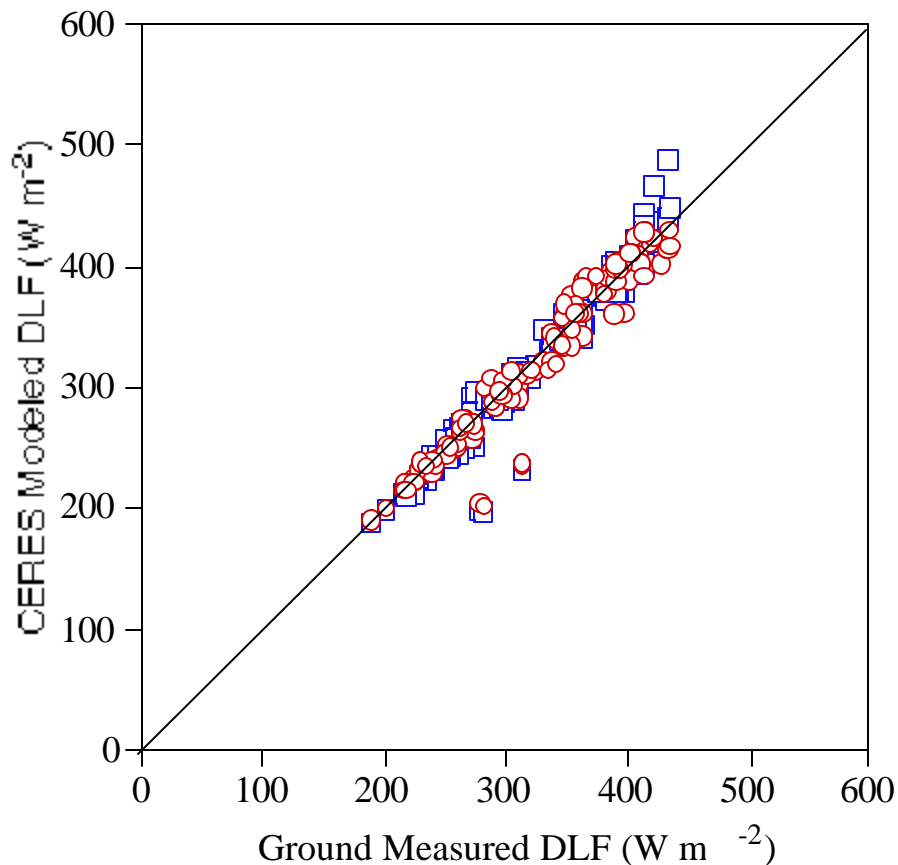


Surface
-only
Fluxes

Longwave Clear-sky Comparison

Central Facility

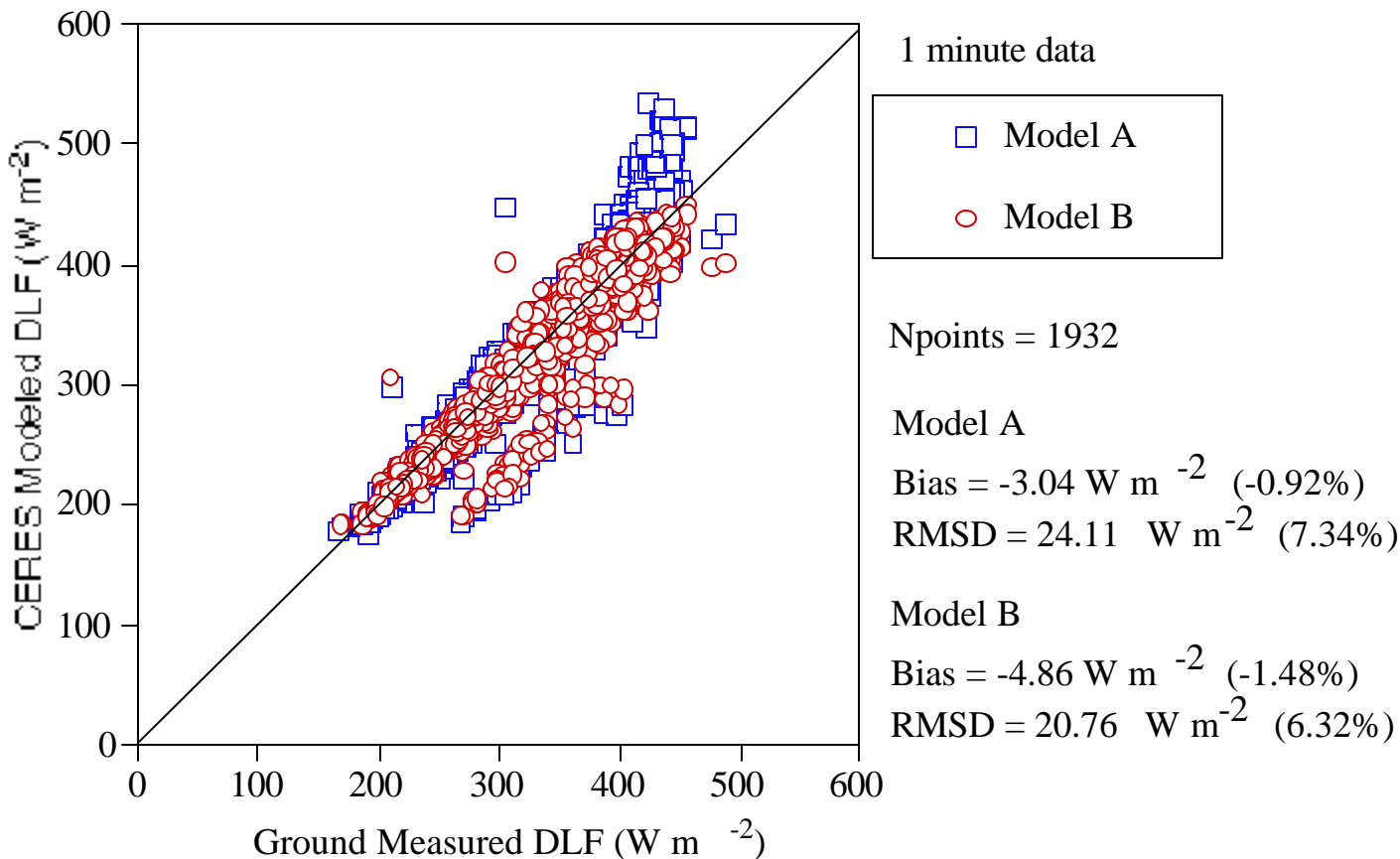
TRMM2B



Surface
-only
Fluxes

Longwave Clear-sky Comparison

Extended Facilities TRMM2B

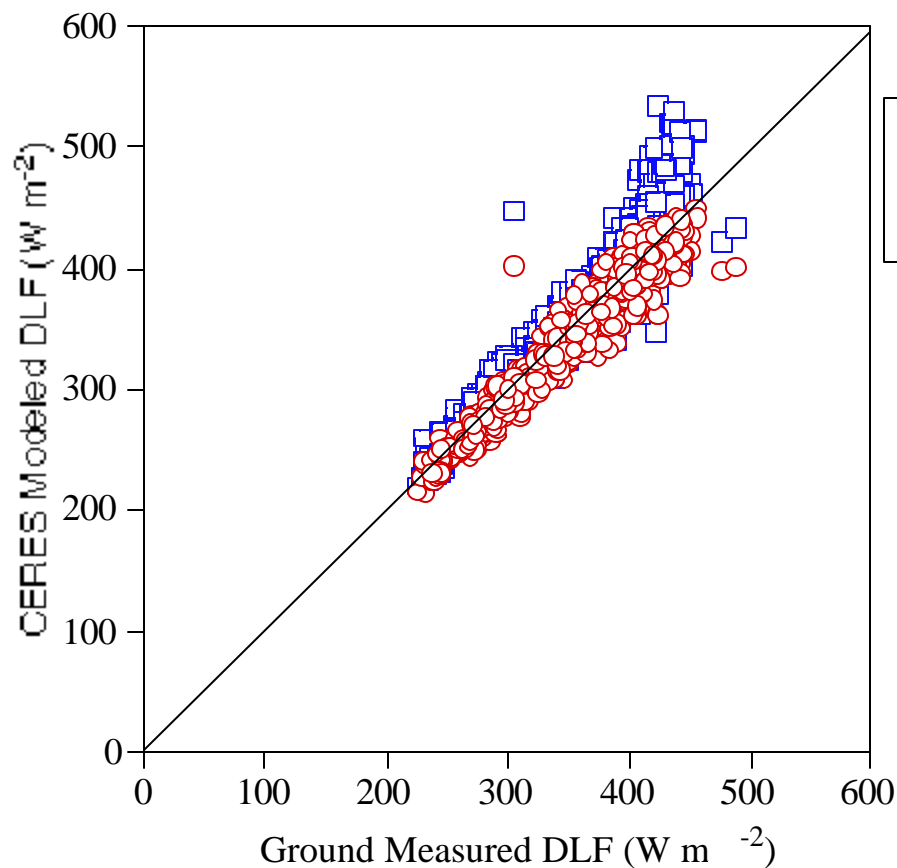


Surface
-only
Fluxes

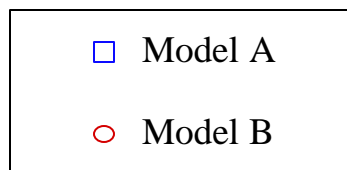
Longwave Clear-sky Comparison

Extended Facilities

TRMM2B Daytime



1 minute data



Npoints = 854

Model A

Bias = 9.11 W m^{-2} (2.54 %)

RMSD = 22.98 W m^{-2} (6.41%)

Model B

Bias = -9.53 W m^{-2} (-2.66%)

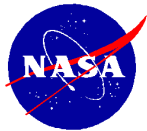
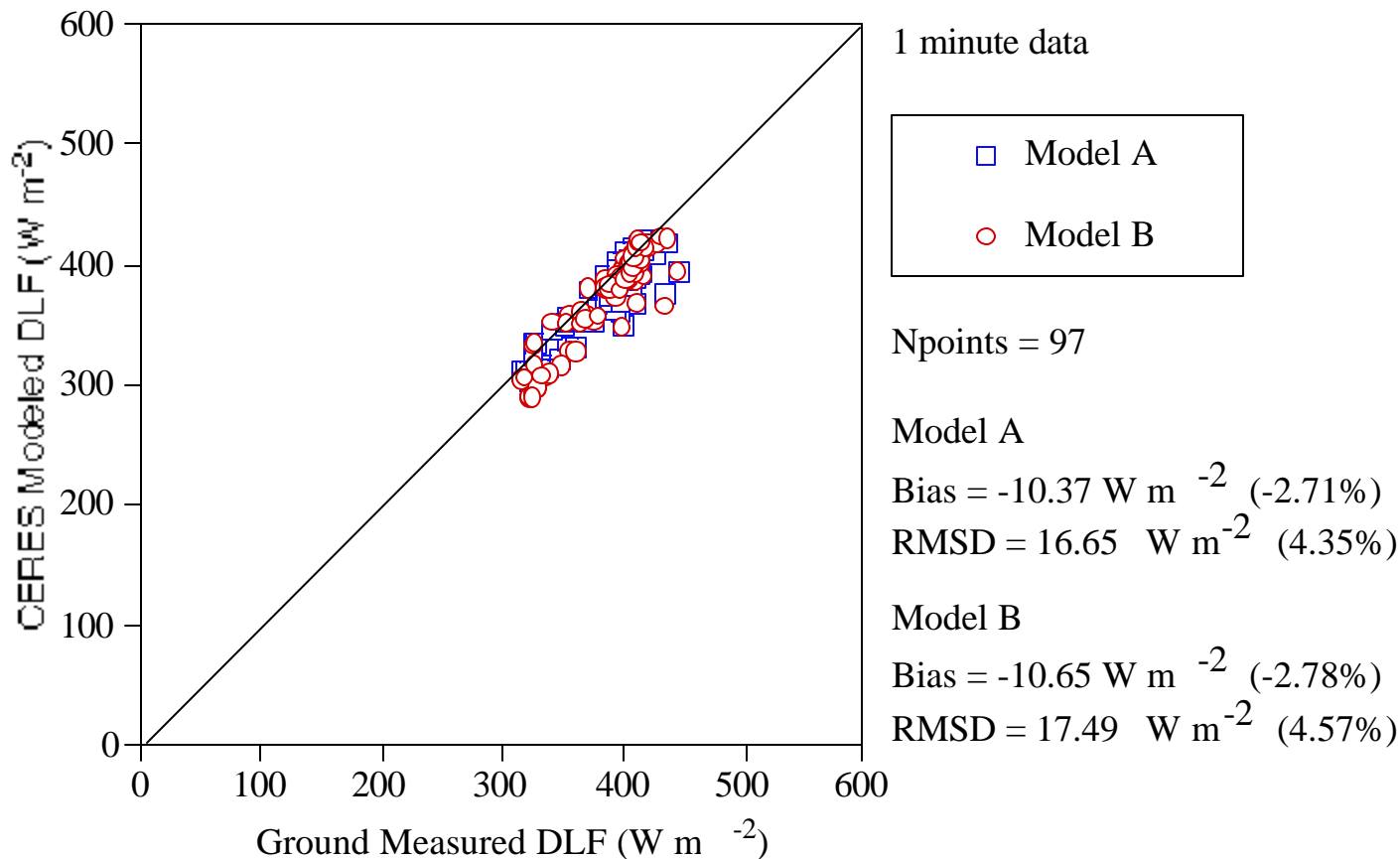
RMSD = 17.64 W m^{-2} (4.92%)



Surface
-only
Fluxes

Longwave Clear-sky Comparison

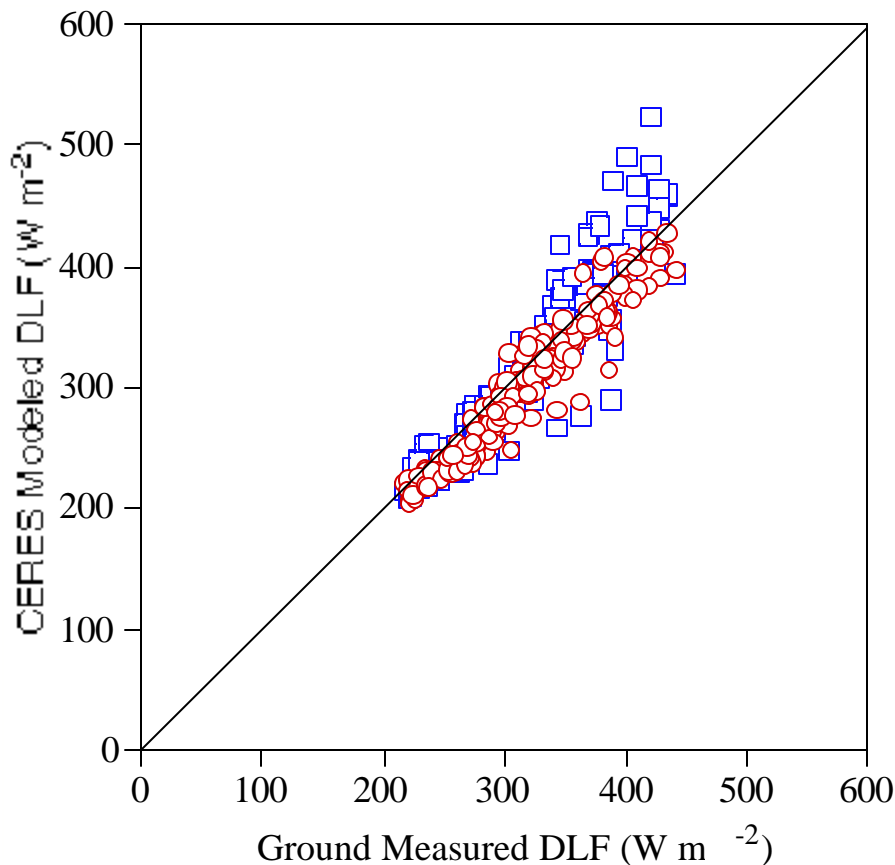
CMDL TRMM2B



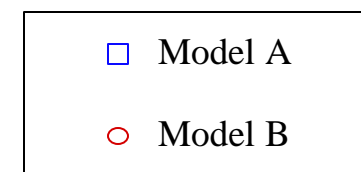
Surface
-only
Fluxes

Longwave Clear-sky Comparison

BSRN TRMM2B



1 minute data



Npoints = 209

Model A

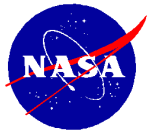
Bias = -0.55 W m^{-2} (-0.18%)

RMSD = 25.57 W m^{-2} (8.22%)

Model B

Bias = -12.46 W m^{-2} (-4.01%)

RMSD = 19.47 W m^{-2} (6.26%)



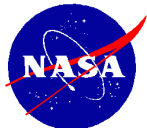
LW Clear-Sky Comparisons (Summary Statistics)

LW Model A - TRMM Edition 2B

Sites	# Points	Mean Bias, Wm^{-2} (%)	RMS Diff., Wm^{-2} (%)
ARM/CF	129	-2.0 (-0.6)	18.6 (5.9)
ARM/EF	1932	-3.0 (-0.9)	24.1 (7.3)
CMDL	97	-10.4 (-2.7)	16.7 (4.4)
BSRN	209	-0.6 (-0.2)	25.6 (8.2)

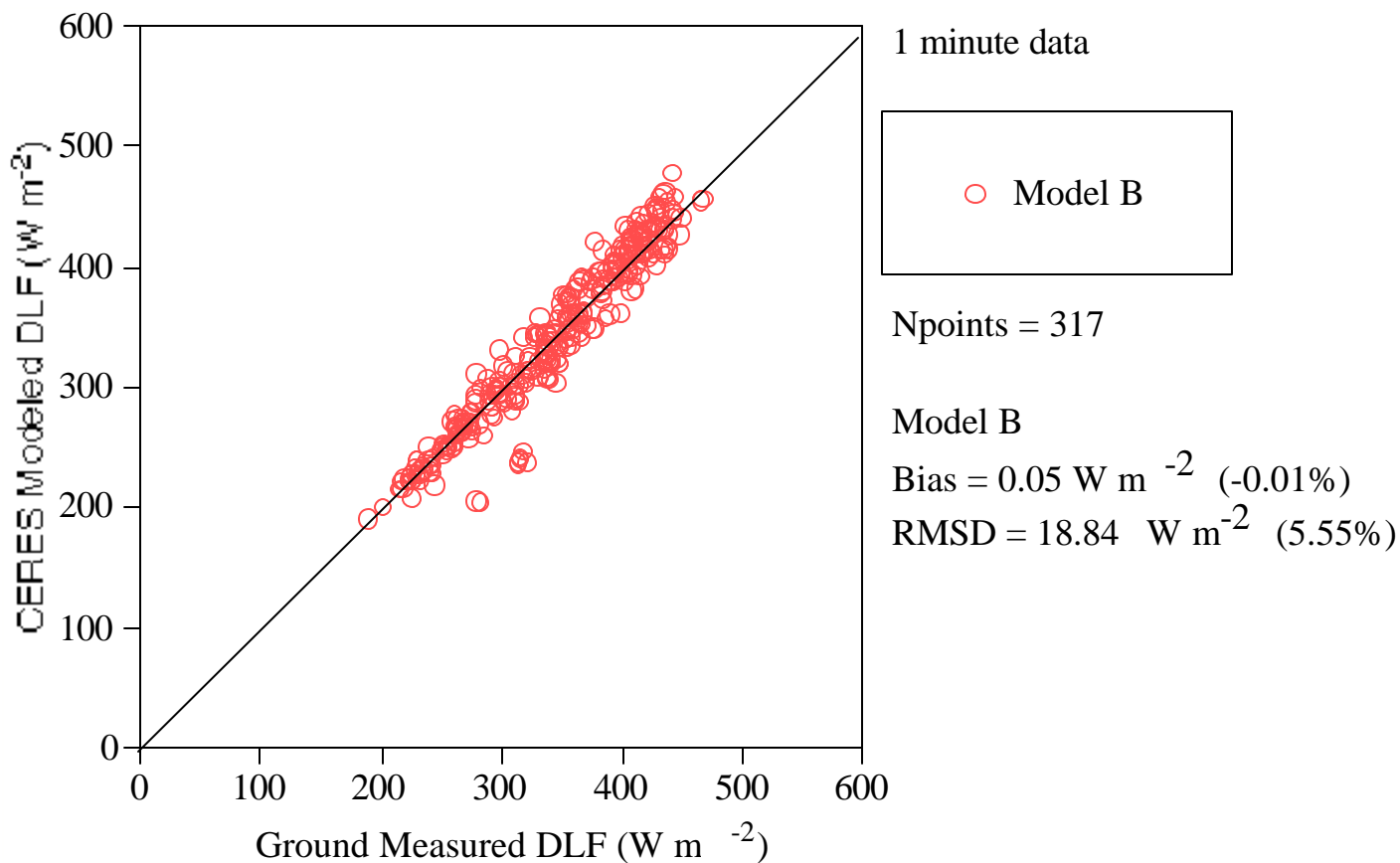
LW Model B - TRMM Edition 2B

Sites	# Points	Mean Bias, Wm^{-2} (%)	RMS Diff., Wm^{-2} (%)
ARM/CF	129	-1.7 (-0.5)	17.4 (5.5)
ARM/EF	1932	-4.9 (-1.5)	20.8 (6.3)
CMDL	97	-10.7 (-2.8)	17.5 (4.6)
BSRN	209	-12.5 (-4.0)	19.5 (6.3)



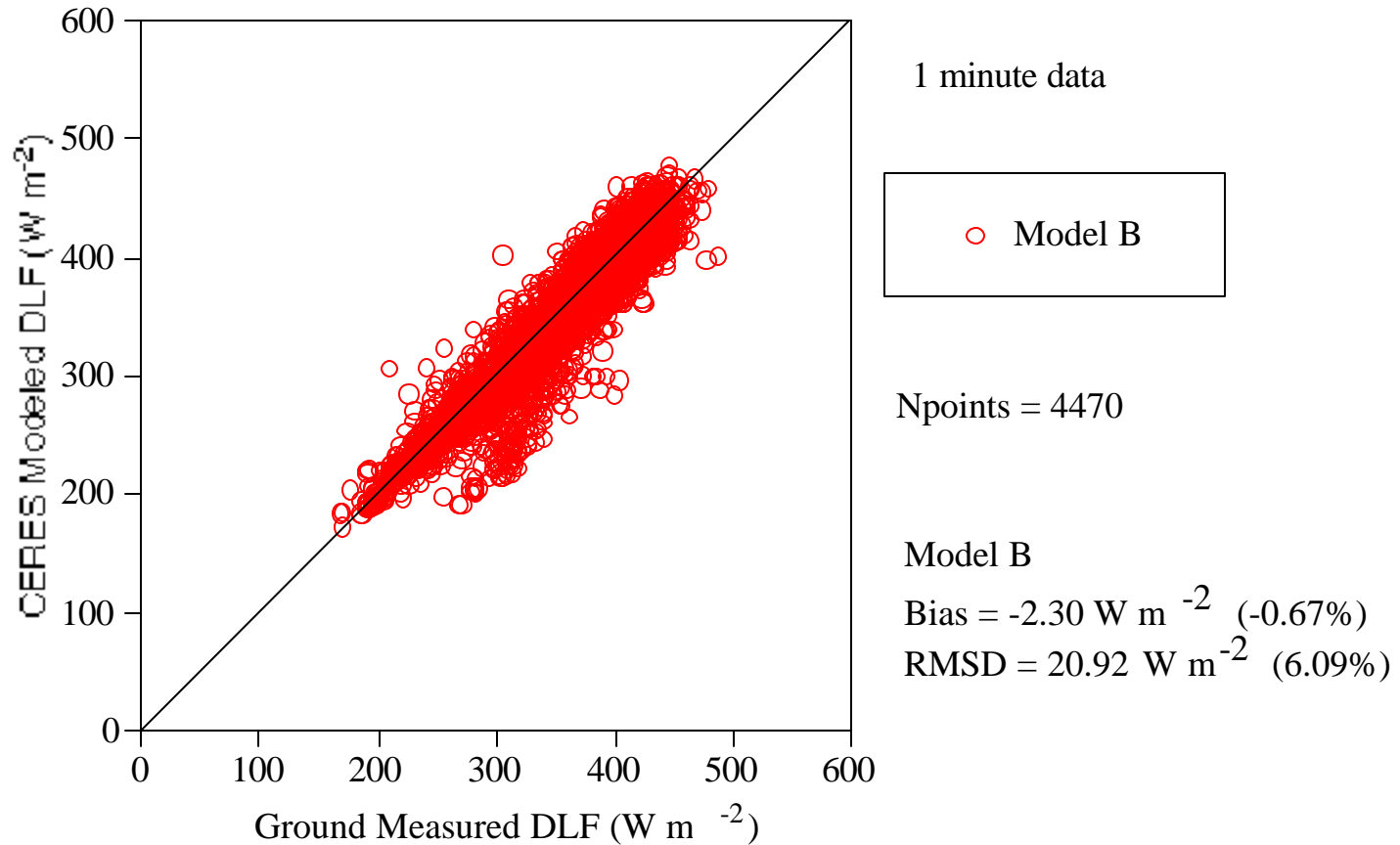
Longwave All-sky Comparison

Central Facility TRMM2B



Longwave All-sky Comparison

Extended Facilities TRMM2B

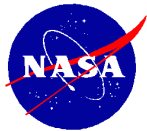
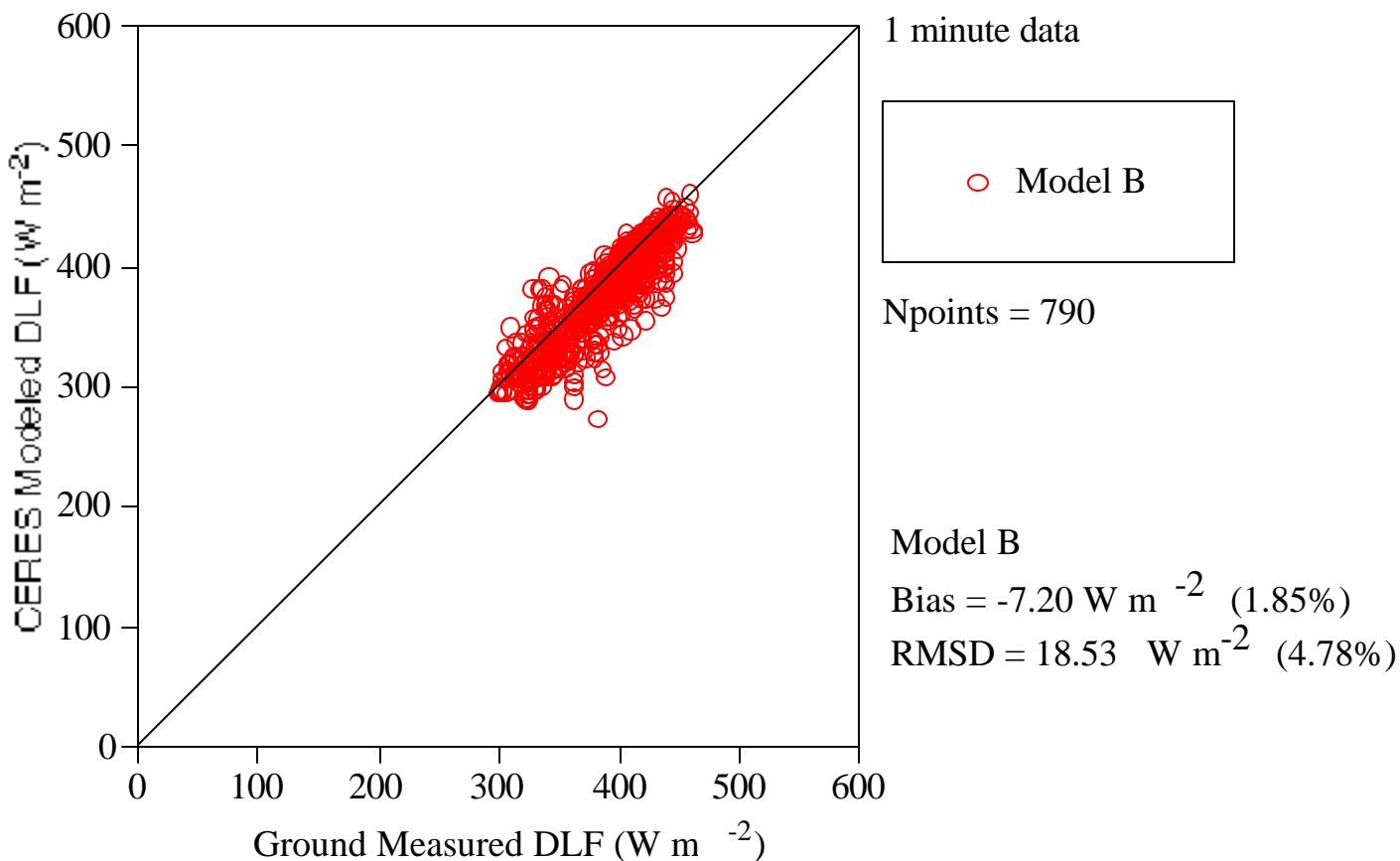


Surface
-only
Fluxes

Longwave All-sky Comparison

CMDL

TRMM2B

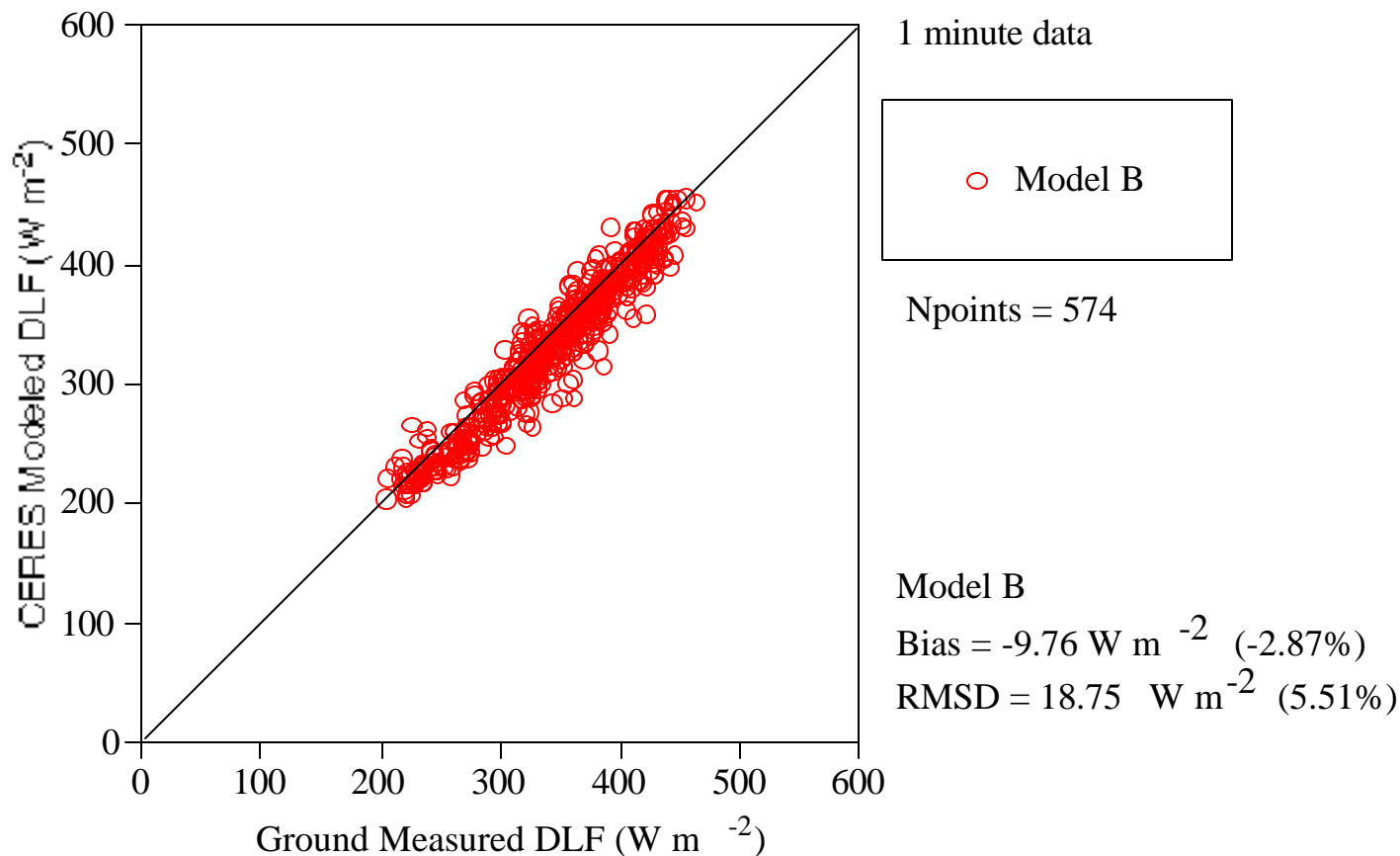


Surface
-only
Fluxes

Longwave All-sky Comparison

BSRN

TRMM2B



LW All-Sky Comparisons (Summary Statistics)

LW Model B - TRMM Edition 2B

Sites	# Points	Mean Bias, Wm^{-2} (%)	RMS Diff., Wm^{-2} (%)
ARM/CF	317	-0.1 (-0.0)	18.8 (5.6)
ARM/EF	4470	-2.3 (-0.7)	20.9 (6.1)
CMDL	790	-7.2 (-1.9)	18.5 (4.8)
BSRN	574	-9.8 (-2.9)	18.8 (5.5)



Summary

- Simple and efficient algorithms used to derive surface SW and LW fluxes for CERES/SSF.
- SSF fluxes complement CRS results; Provide redundancy, intercomparison, and quick results.
- Models A provide clear-sky fluxes only; Models B provide all-sky fluxes.
- SSF fluxes validated against ground-based measurements from many different climate regimes.
- LW fluxes close to meeting accuracy criteria for climate research.

