Surface Irradiance Network for EOS/CERES Applications

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and
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(funded under NRA-03-OES-02)

CERES-II ST-01 Meeting
29-31 March 2004
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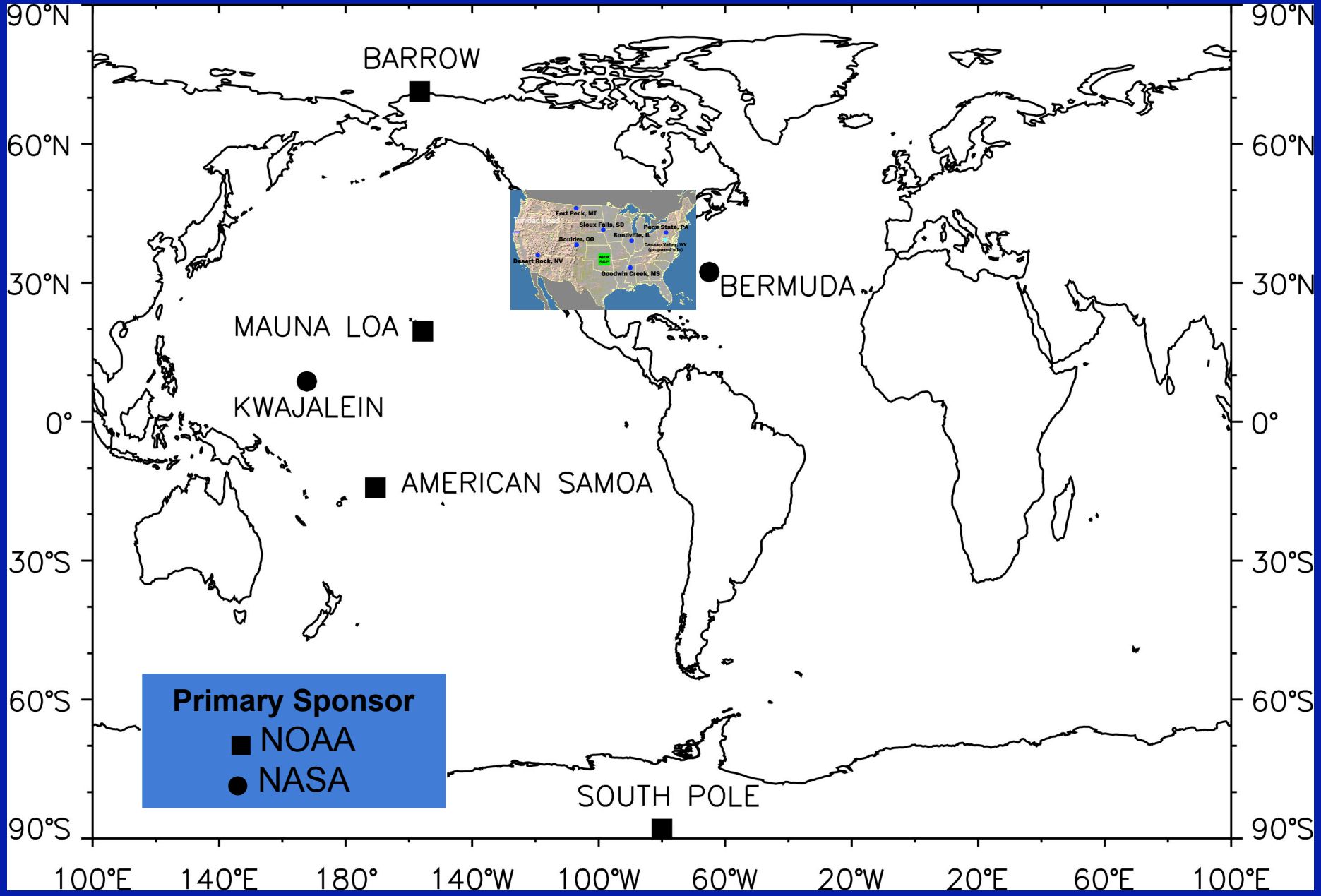
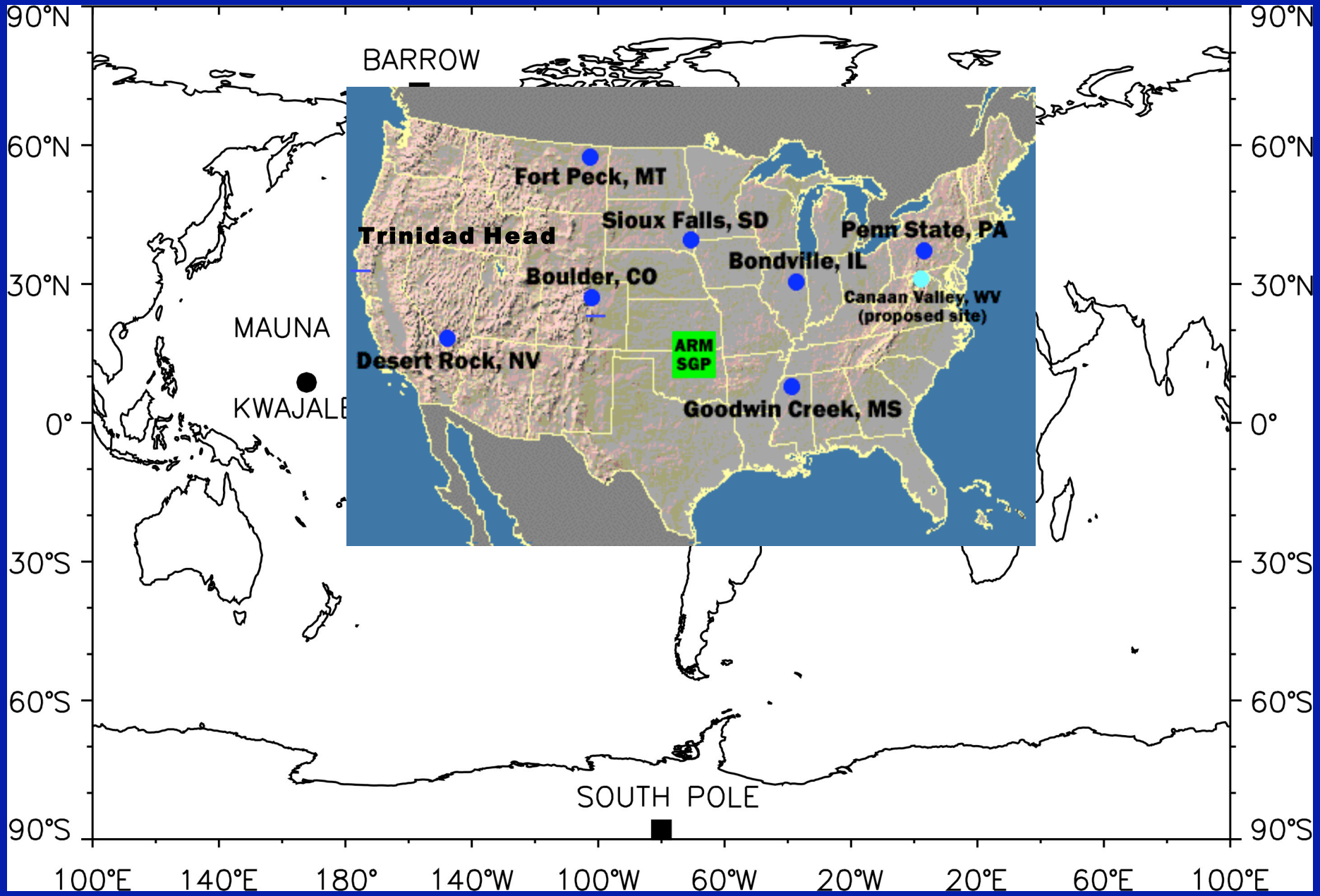
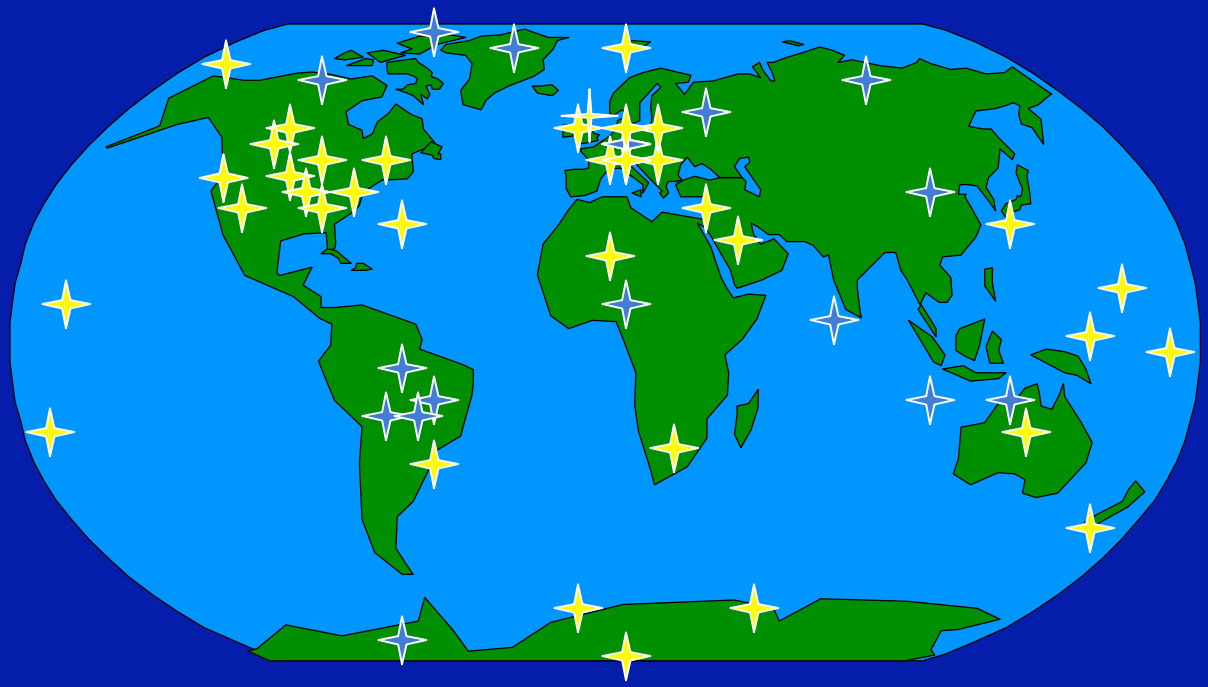
Combined CMDL and SURFRAD Networks



Combined CMDL and SURFRAD Networks



Baseline Surface Radiation Network



Archiving Provisional

With NASA Support

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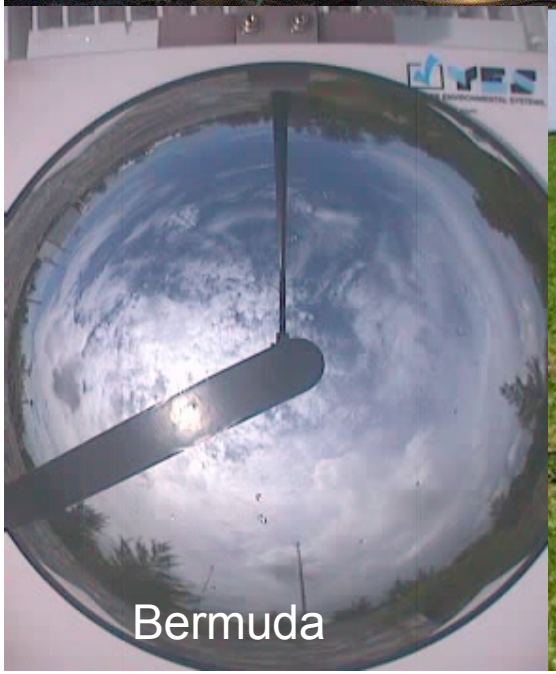
- Diffuse & direct solar
- Global solar
- Downwelling IR
- Upwelling IR & solar
- Stand. Met.
- Spectral AOD
- All-sky imagery
- Upper-air soundings
- UV & PAR



So, What's New!

- Spectral aerosol optical depth processing and cloud screening
- Site aerosol climatologies
- Refined and expanded cloudiness ID, including O.D. and nighttime sky cover
- Cloud and aerosol effects investigations
- Instrument & operational improvements
- But:

  Only partially funded

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Advances in Sunphotometry

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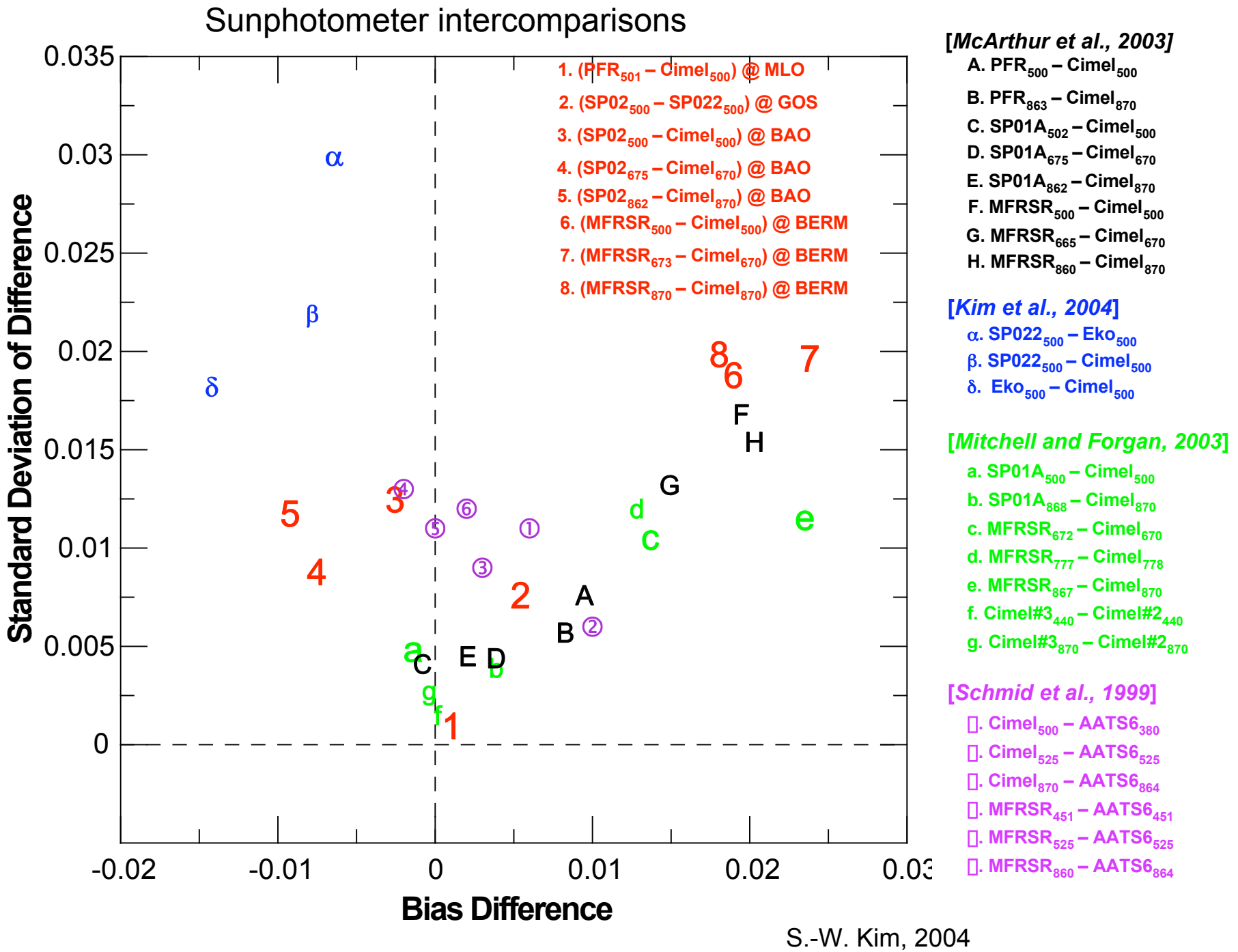


[McArthur et al., 2003]

A. PFR_{500} – $Cimel_{500}$
B. PFR_{863} – $Cimel_{870}$
C. $SP01A_{502}$ – $Cimel_{500}$
D. $SP01A_{675}$ – $Cimel_{670}$
E. $SP01A_{862}$ – $Cimel_{870}$
F. $MFRSR_{500}$ – $Cimel_{500}$
G. $MFRSR_{665}$ – $Cimel_{670}$
H. $MFRSR_{860}$ – $Cimel_{870}$

[Kim et al., 2004]

α. $SP022_{500}$ – Eko_{500}
β. $SP022_{500}$ – $Cimel_{500}$
δ. Eko_{500} – $Cimel_{500}$

[Mitchell and Forgan, 2003]

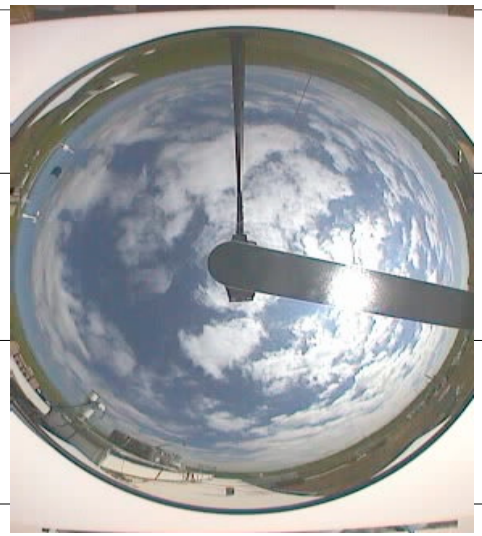
a. $SP01A_{500}$ – $Cimel_{500}$
b. $SP01A_{868}$ – $Cimel_{870}$
c. $MFRSR_{672}$ – $Cimel_{670}$
d. $MFRSR_{777}$ – $Cimel_{778}$
e. $MFRSR_{867}$ – $Cimel_{870}$
f. $Cimel\#3_{440}$ – $Cimel\#2_{440}$
g. $Cimel\#3_{870}$ – $Cimel\#2_{870}$

[Schmid et al., 1999]

□. $Cimel_{500}$ – $AATS6_{380}$
□. $Cimel_{525}$ – $AATS6_{525}$
□. $Cimel_{870}$ – $AATS6_{864}$
□. $MFRSR_{451}$ – $AATS6_{451}$
□. $MFRSR_{525}$ – $AATS6_{525}$
□. $MFRSR_{860}$ – $AATS6_{864}$

S.-W. Kim, 2004

Example of Automated Cloud Screening



unscreened
screened

Total Optical Depth

3.00
2.50
2.00
1.50
1.00
0.50
0.00

2.5 2.6 2.7 2.8 2.9 3.0 3.1

Time (Day of Month)

NOAA/CMDL

Cloudiness objectively deduced from surface-based irradiance obs.

- Pyranometer only
- Long & Ackerman Solar Flux Analysis
- Durr and Philipona IR Nighttime Analysis
- (All-sky imagery)

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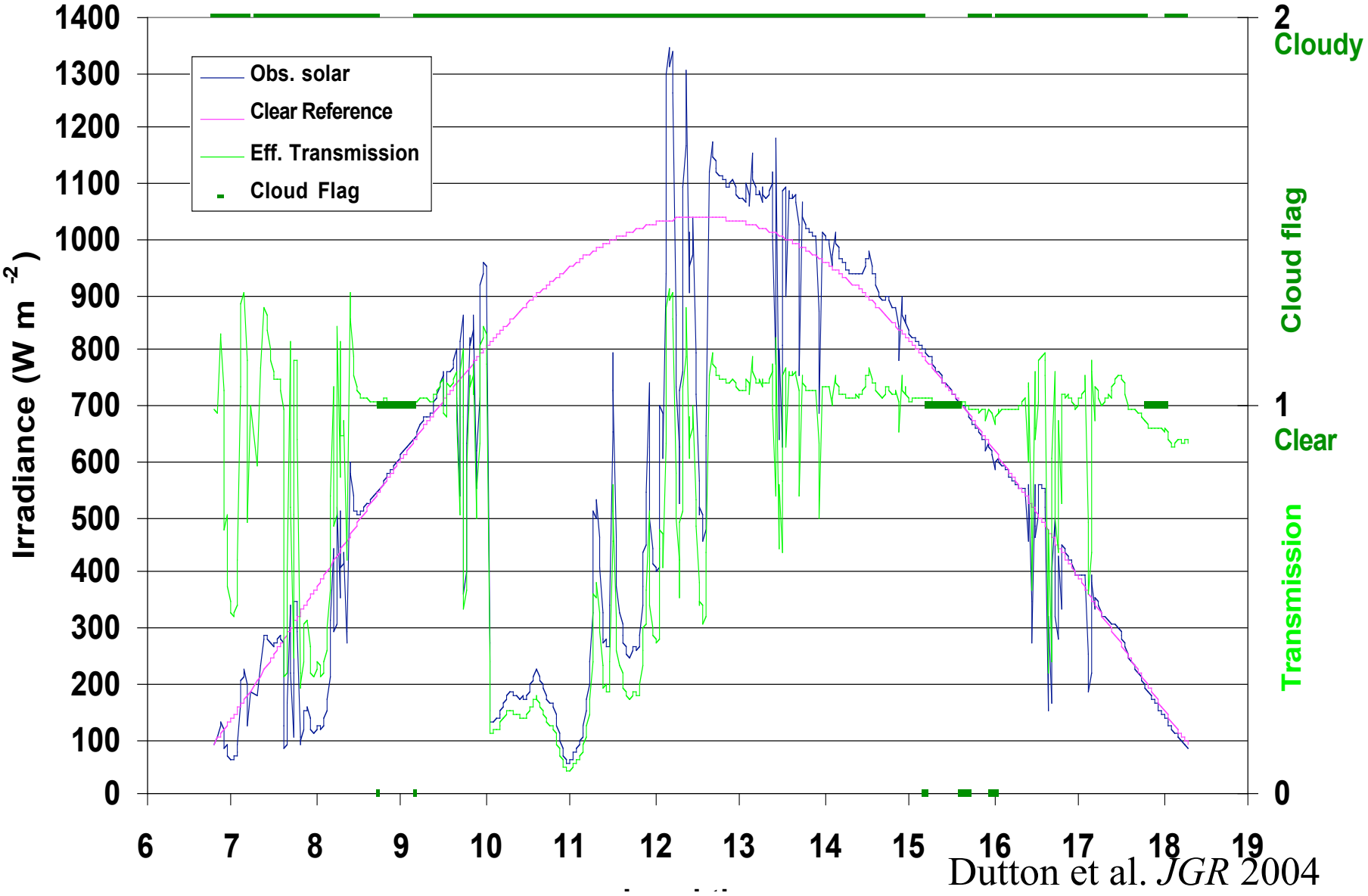
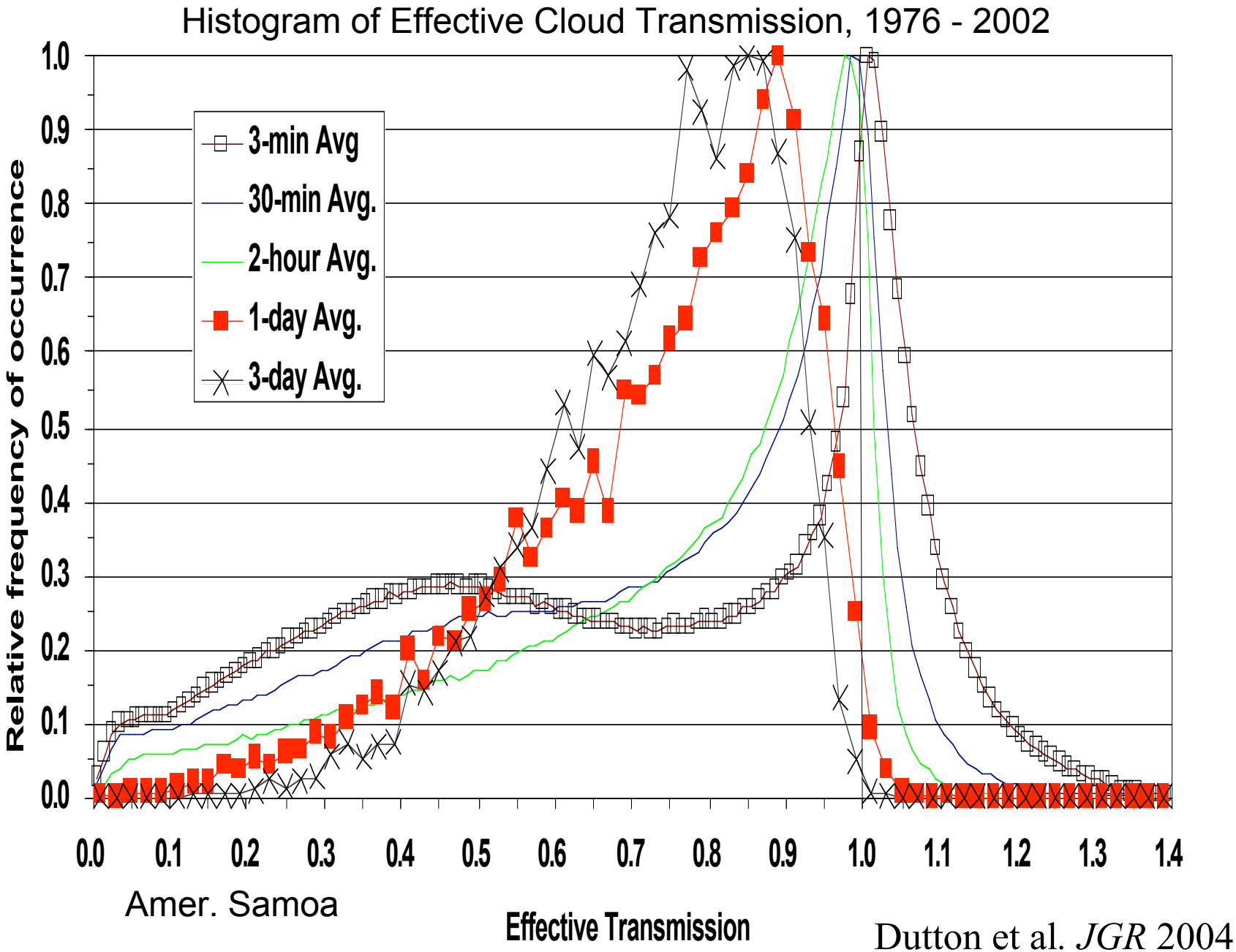
Detection of cloud occurrence and determination of effective cloud transmission and from surface pyranometer observations

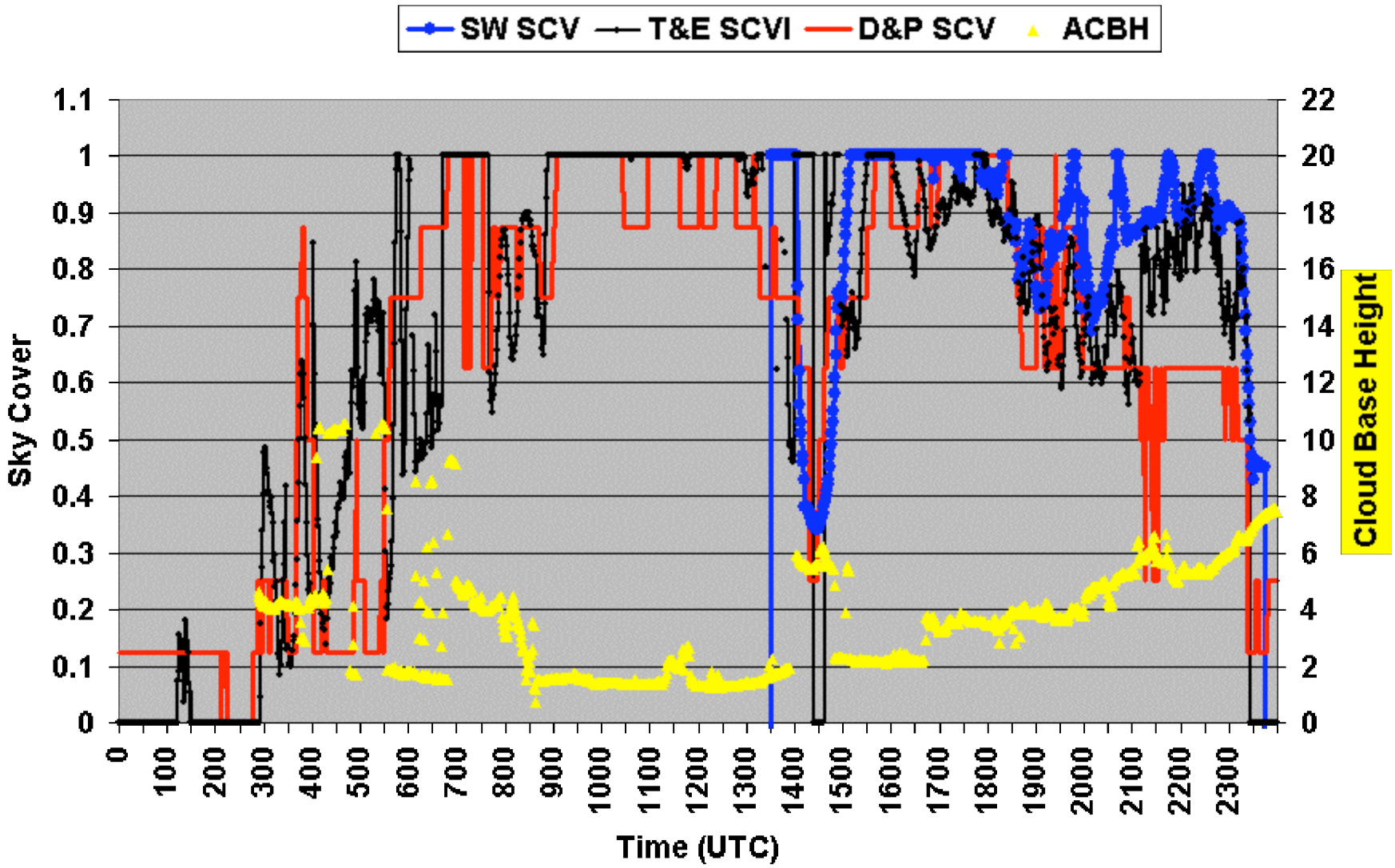


Dutton et al. *JGR* 2004



Dutton et al. *JGR* 2004

Cloudiness estimates from surface radiation measurements



C. Long, 2004

Advances in accuracy of surface irradiance observations since last report to CERES ST

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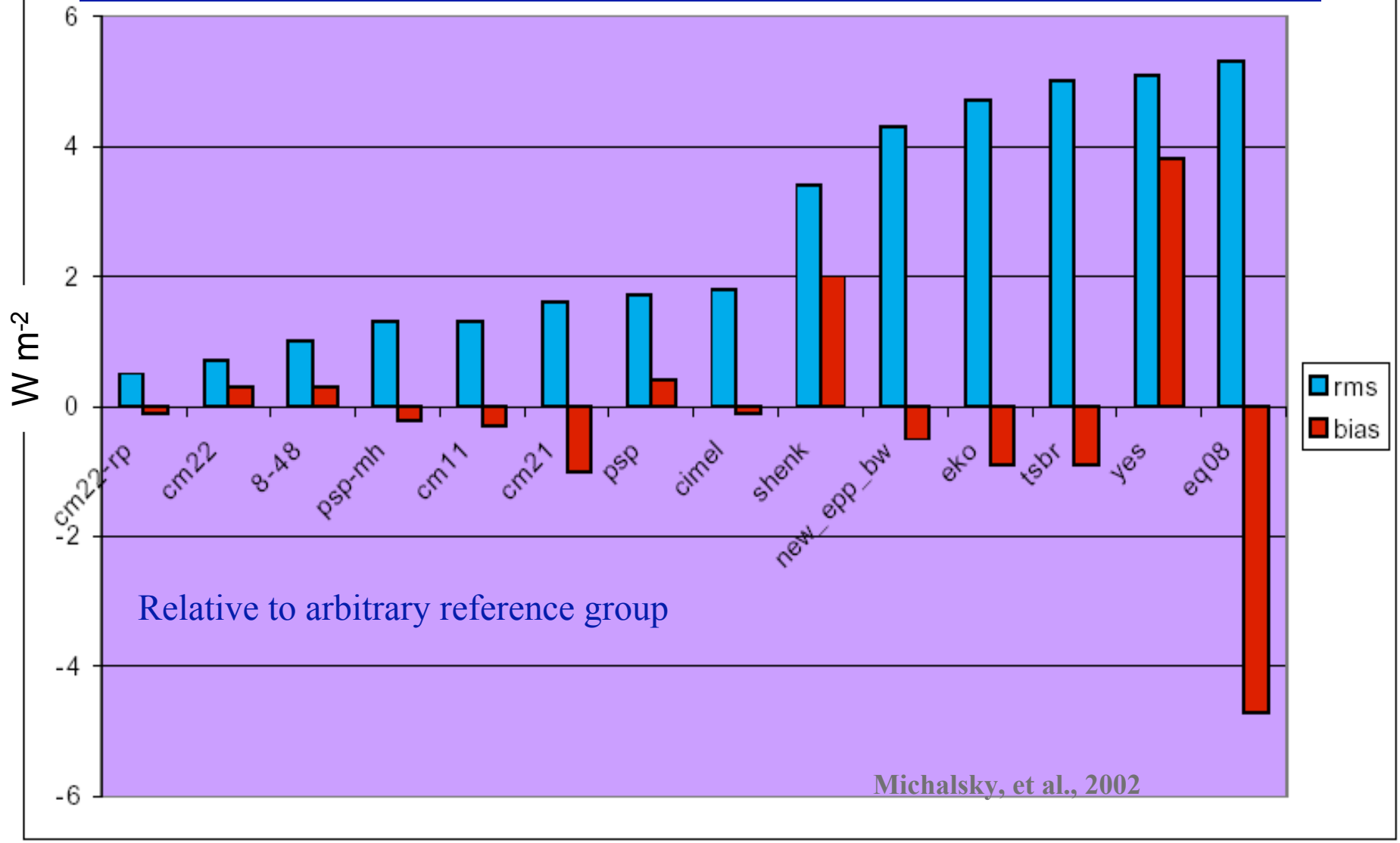
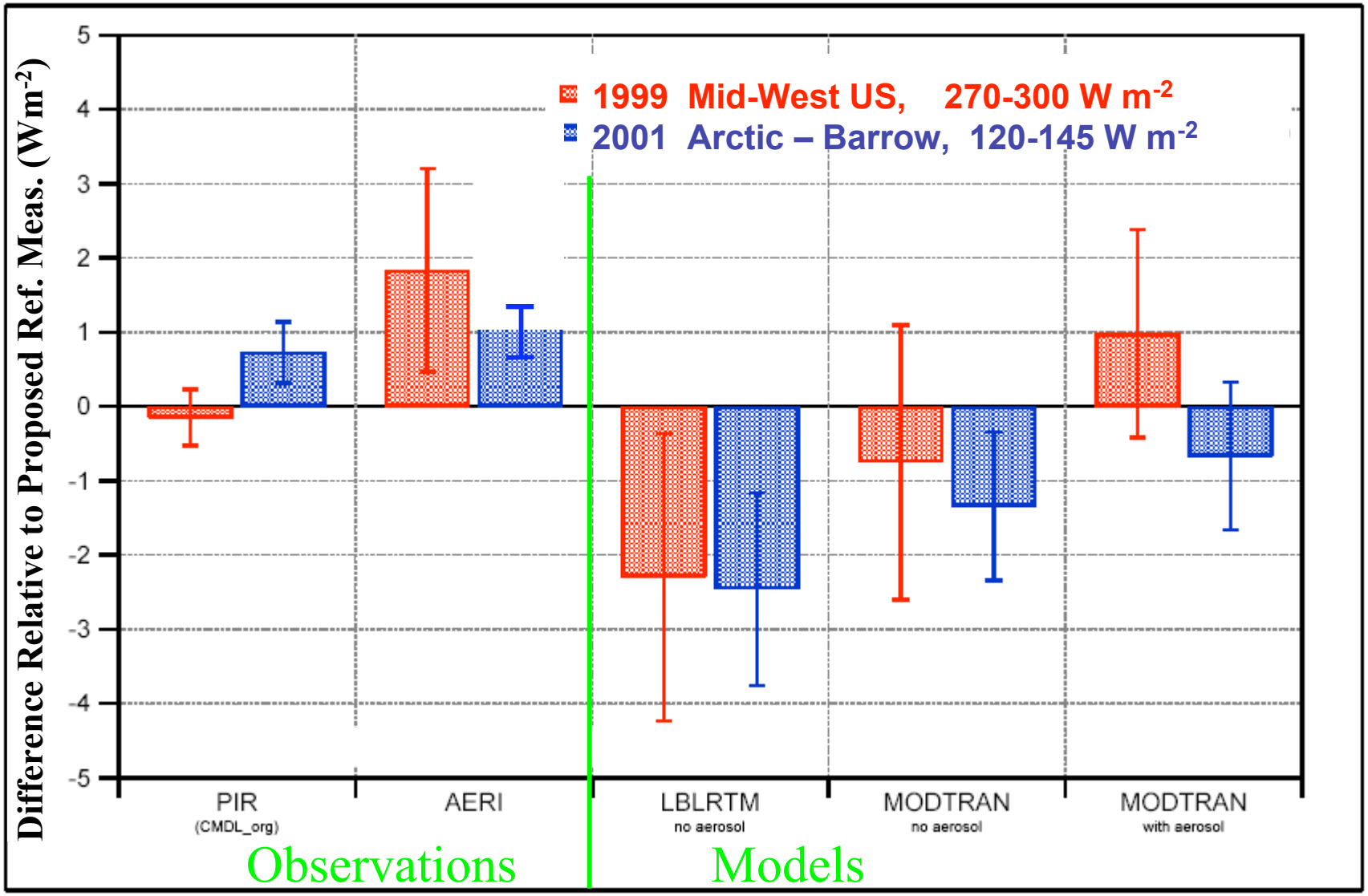
Solar-Diffuse Radiometer Intercomparison - I

BSRN-ARM/SUNY-A/CMDL + SGP 2001



IR Radiometer Intercomparisons



BSRN-ARM/CMDL

Philipona et al., 2001/Marty et al., 2003

Current Needs and Activities in Surface Radiometry

- More complete climatic/geographic coverage
- Better understanding of site representativeness
- Improved operational observations, e.g., tracking, cleaning, QC
- Diffuse solar irradiance reference standard
- Thermal irradiance reference standard
- Strengthened recognition as a long-term requirement (GCOS)
- Trends investigation

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Potential End

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Applications of Ground-based Surface Irradiance Obs Outside CERES

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Y. Zhang, W. B. Rossow, A. A. Lacis, V. Oinas, M M. Mishchenko, submitted JGR

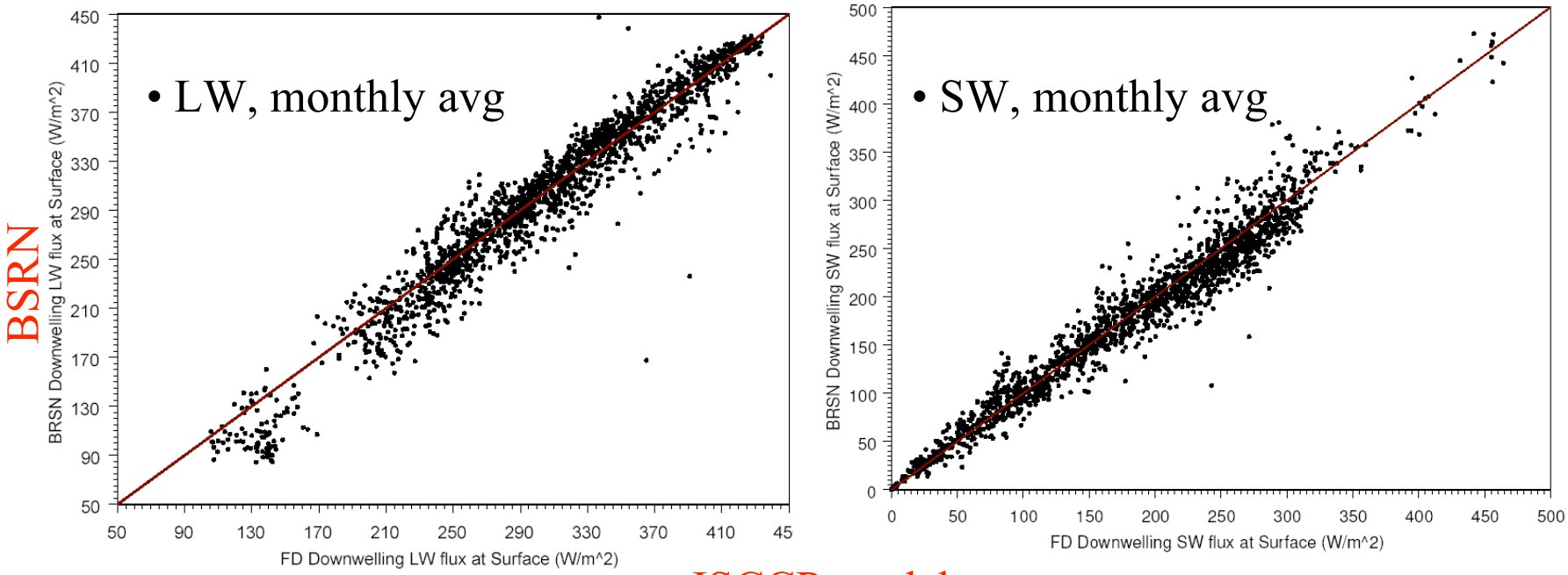
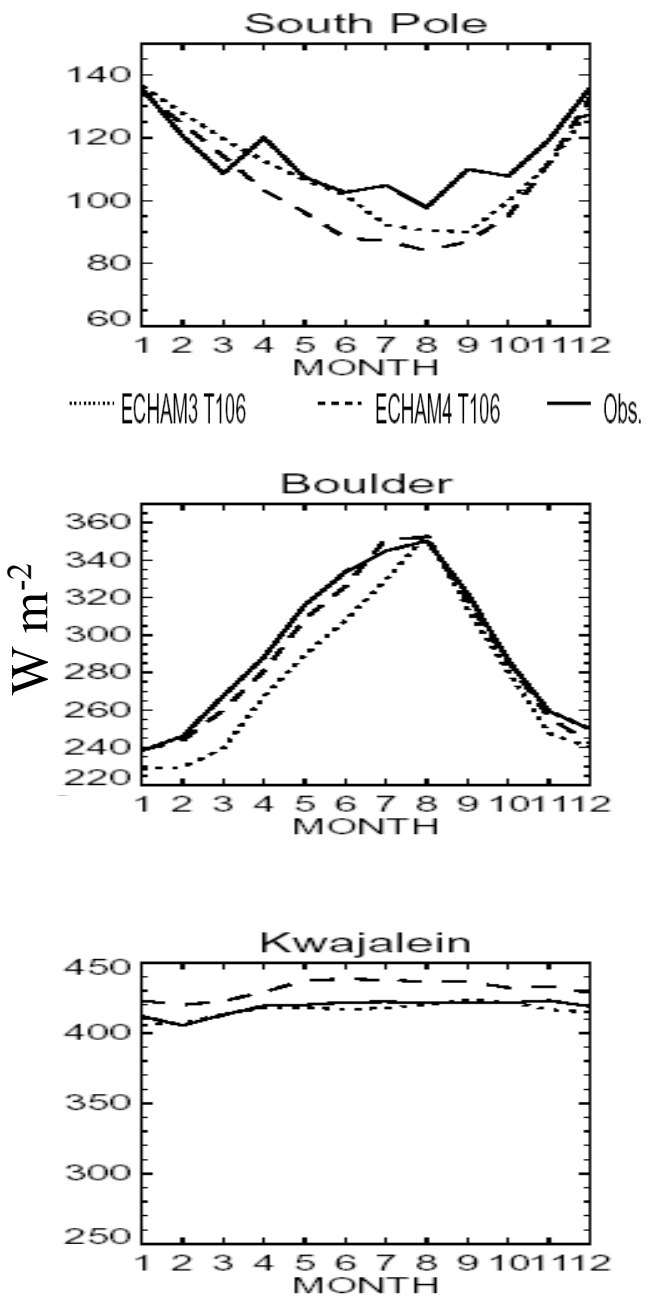


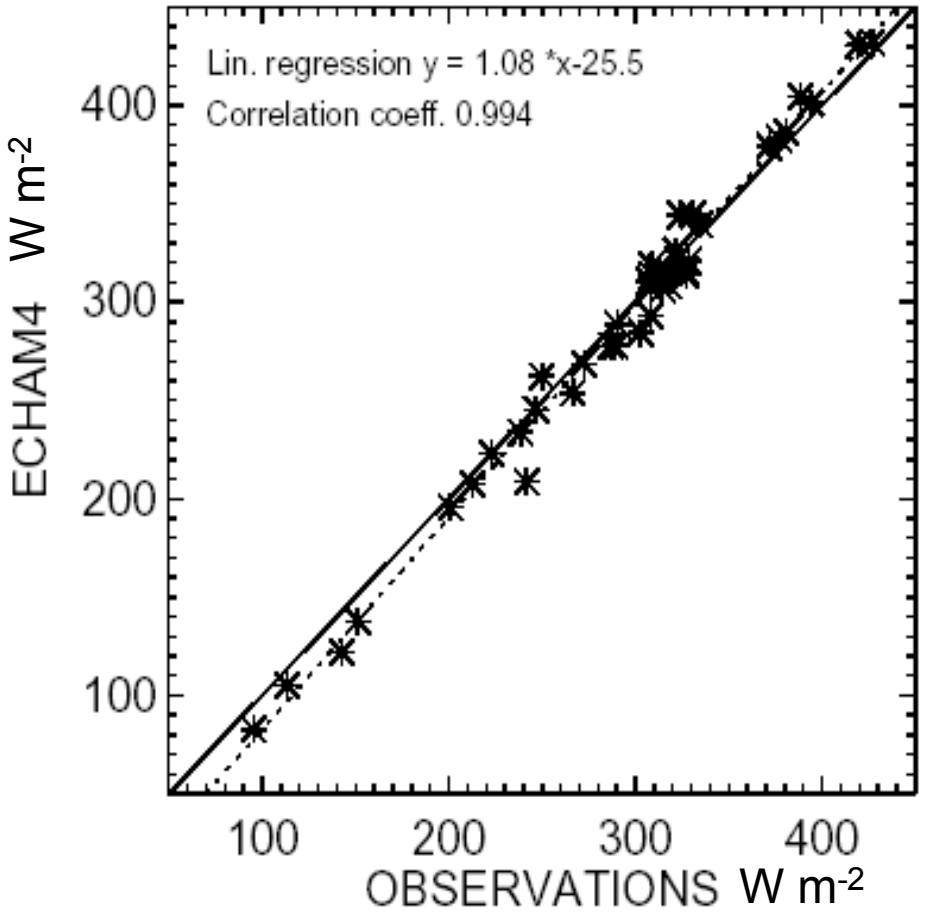
Figure 13. Scatter plots for all the available monthly mean surface fluxes from BSRN and corresponding values from ISCCP-FD: (a) S9s and (b) L9s in Wm!2. Statistics from the plot are given in Table 7a.

7a. Surface downwelling SW and LW fluxes for **all** ISCCP-FD and BSRN data.

Quantity	FD	BRSN	mean difference	Stdv	corr coefficient	Slope	intercept	Norm dev	sample #
$S\downarrow_s$	168.20	166.19	2.017	18.491	0.9825	0.96	3.90	13.07	1970
$L\downarrow_s$	302.23	300.01	2.219	19.042	0.9706	1.05	-17.40	12.89	1831

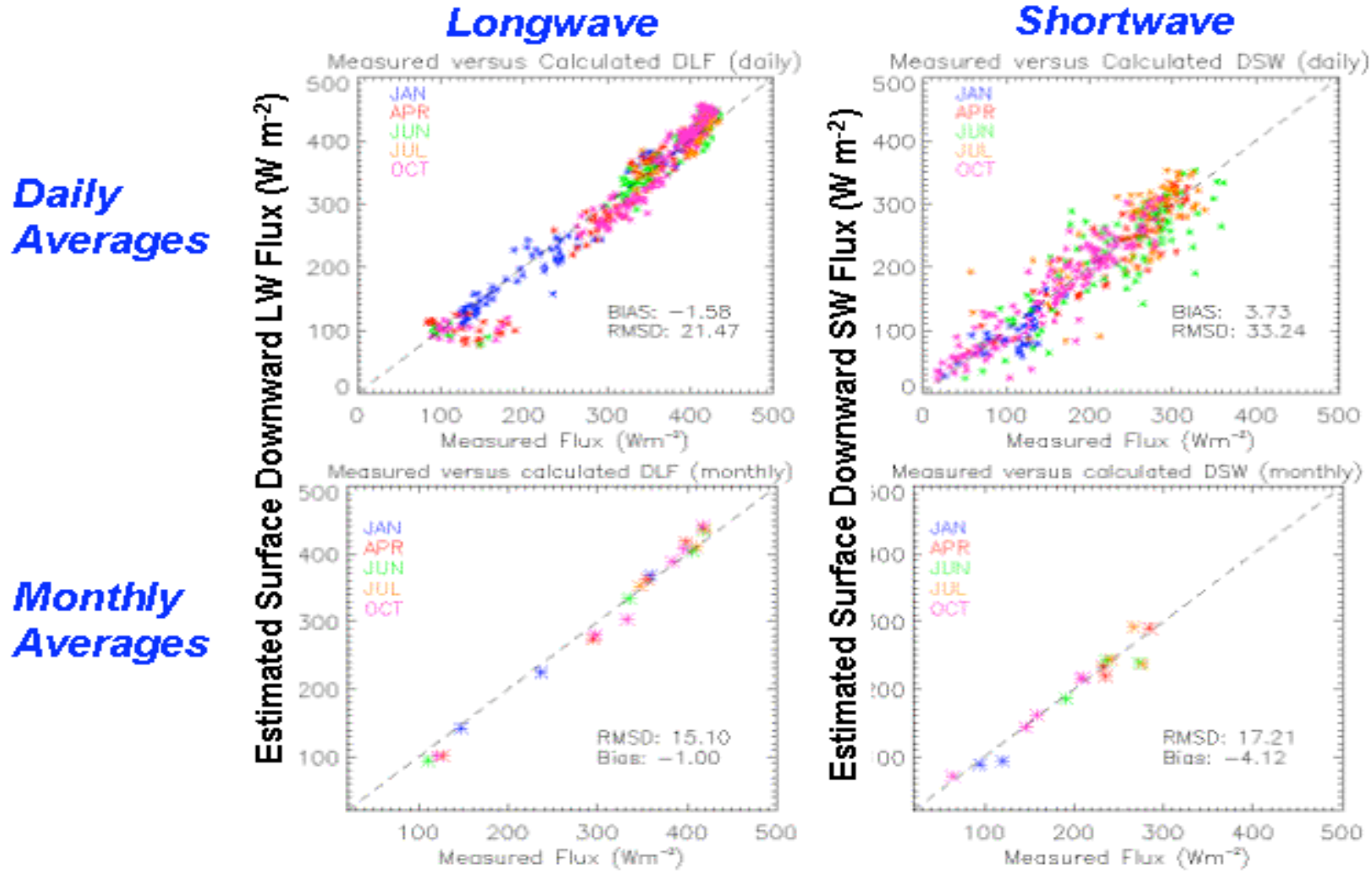
GCM and Surface Observations Comparisons – Longwave



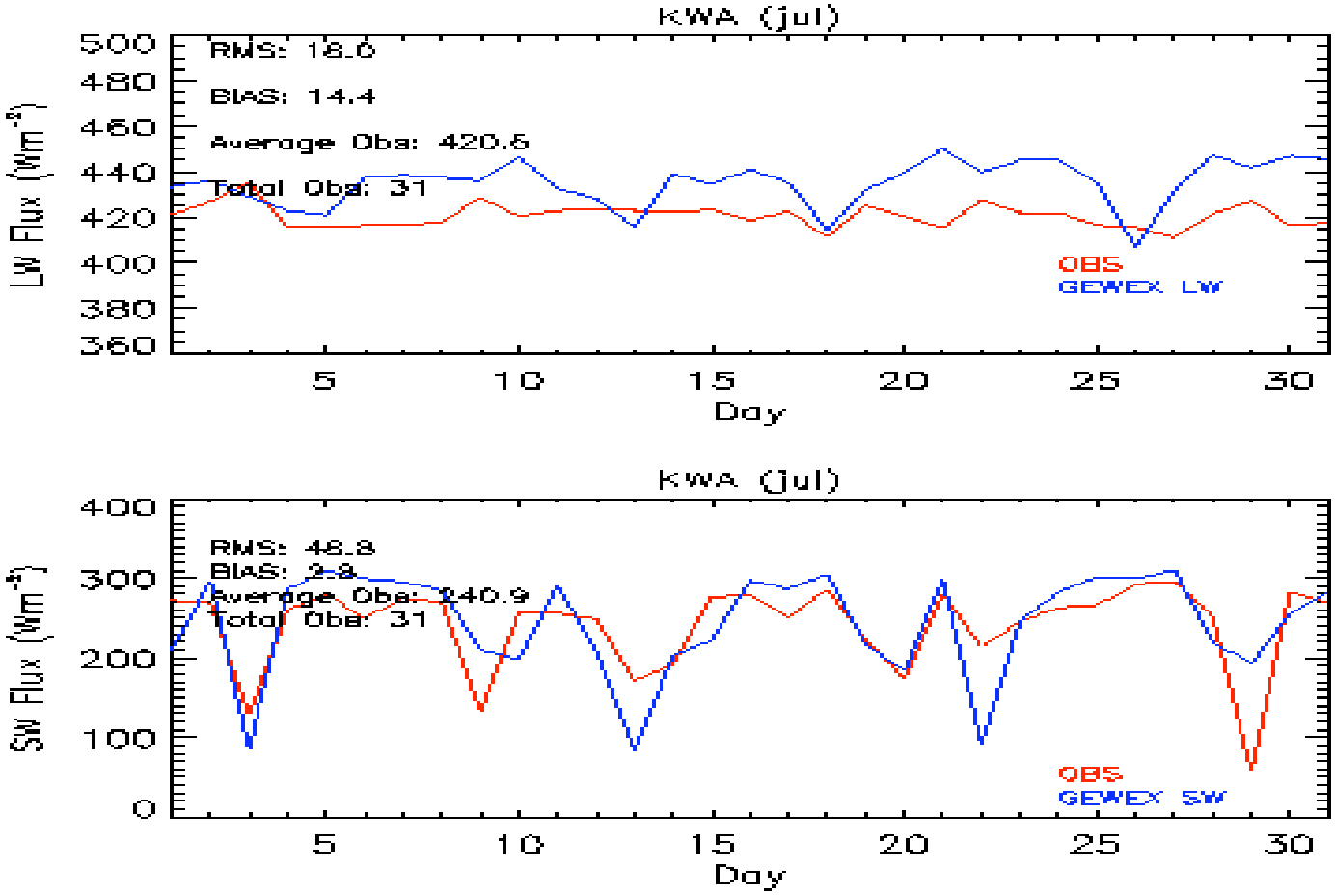


Wild et al., 2001

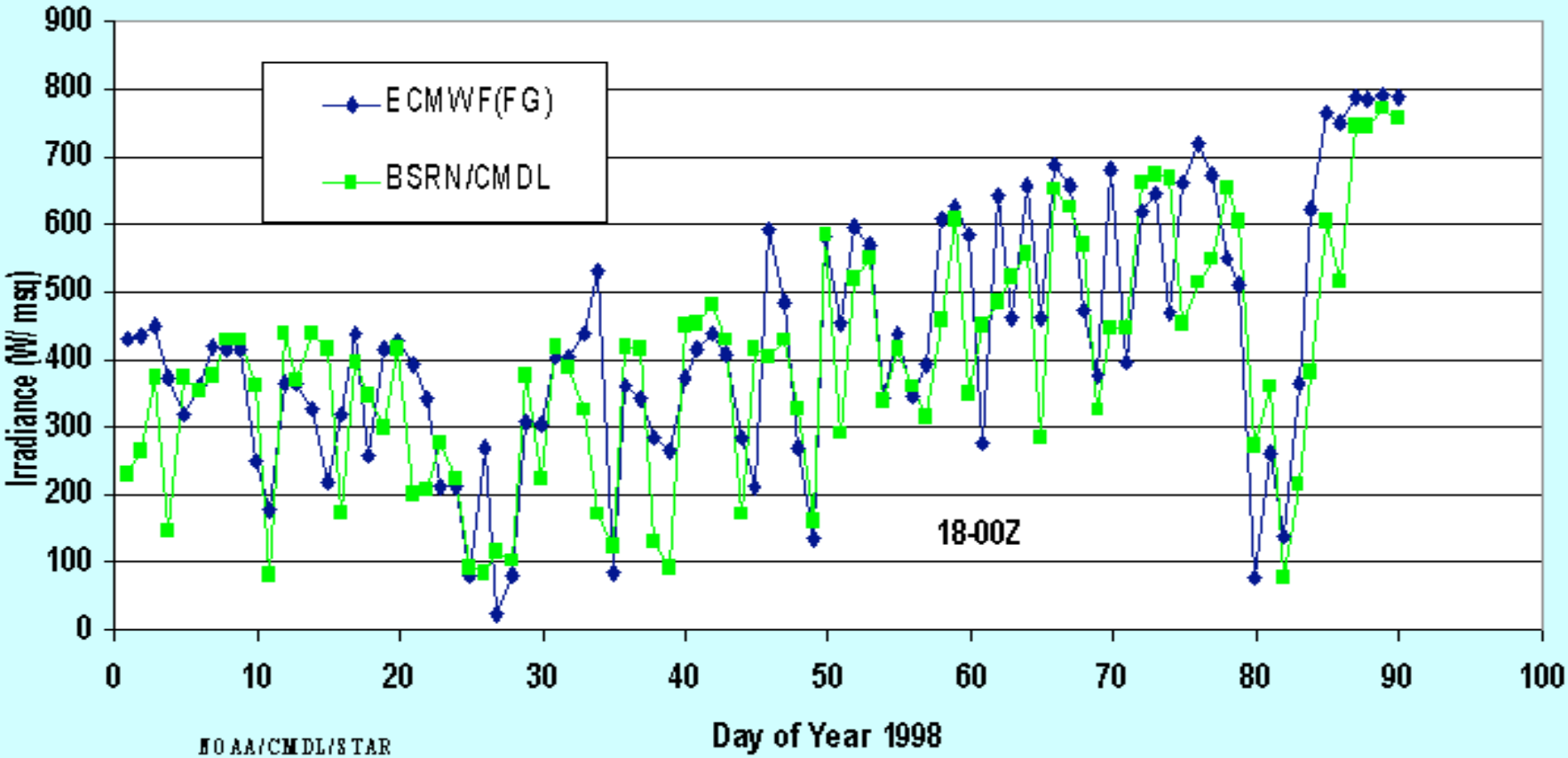
GEWEX Satellite Surface Radiation Budget Project: Comparisons to BSRN



Paul Stackhouse, 2001



Paul Stackhouse, 2002


Comparison of GCM (ECMWF) and CMDL Radiation Obs.
Bermuda Daily Solar Radiation
ECMWF(FG)
BSRN/CMDL
18-00Z
Irradiance (W/ msq)
Day of Year 1998
NOAA/CMDL/STAR
0
100
200
300
400
500
600
700
800
900
0
10
20
30
40
50
60
70
80
90
100

Almost Certain End

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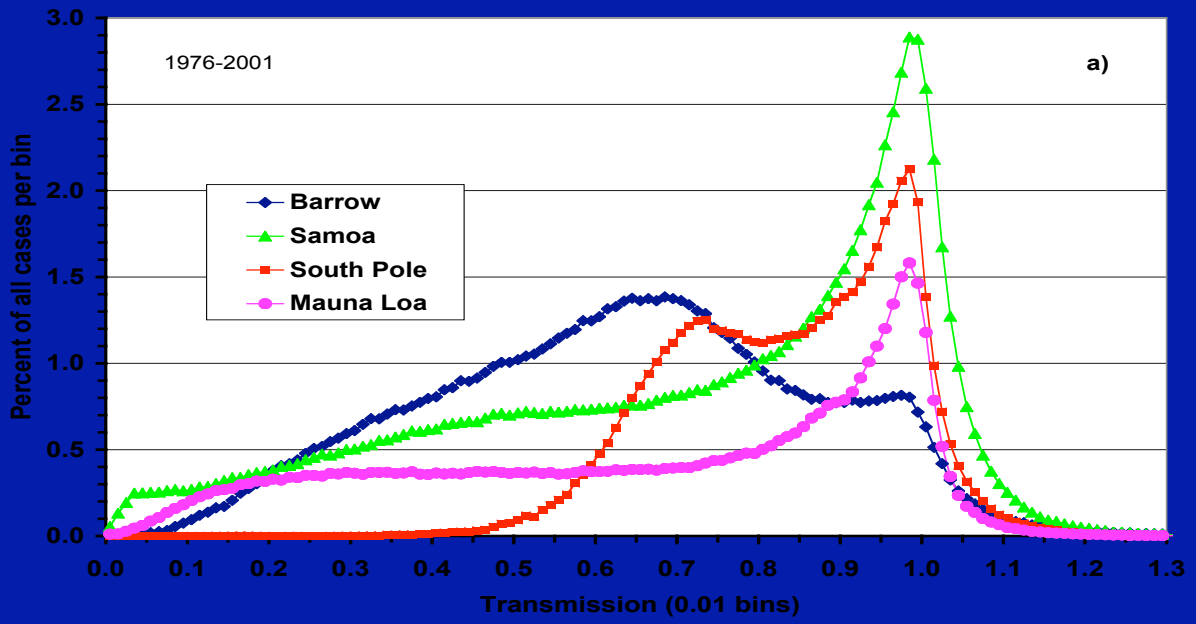
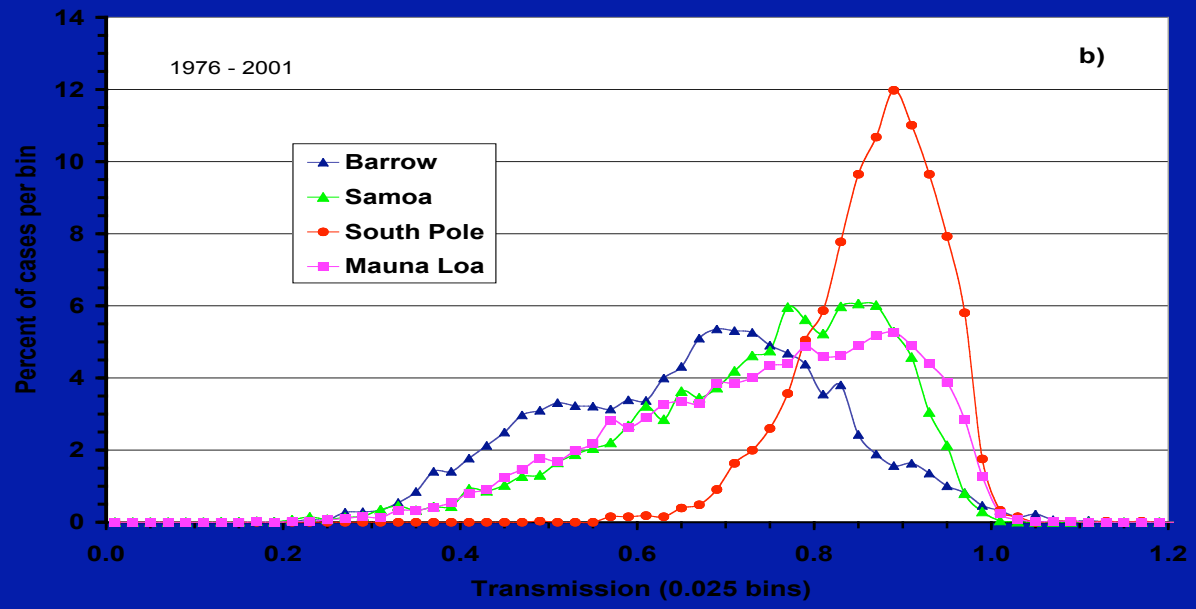
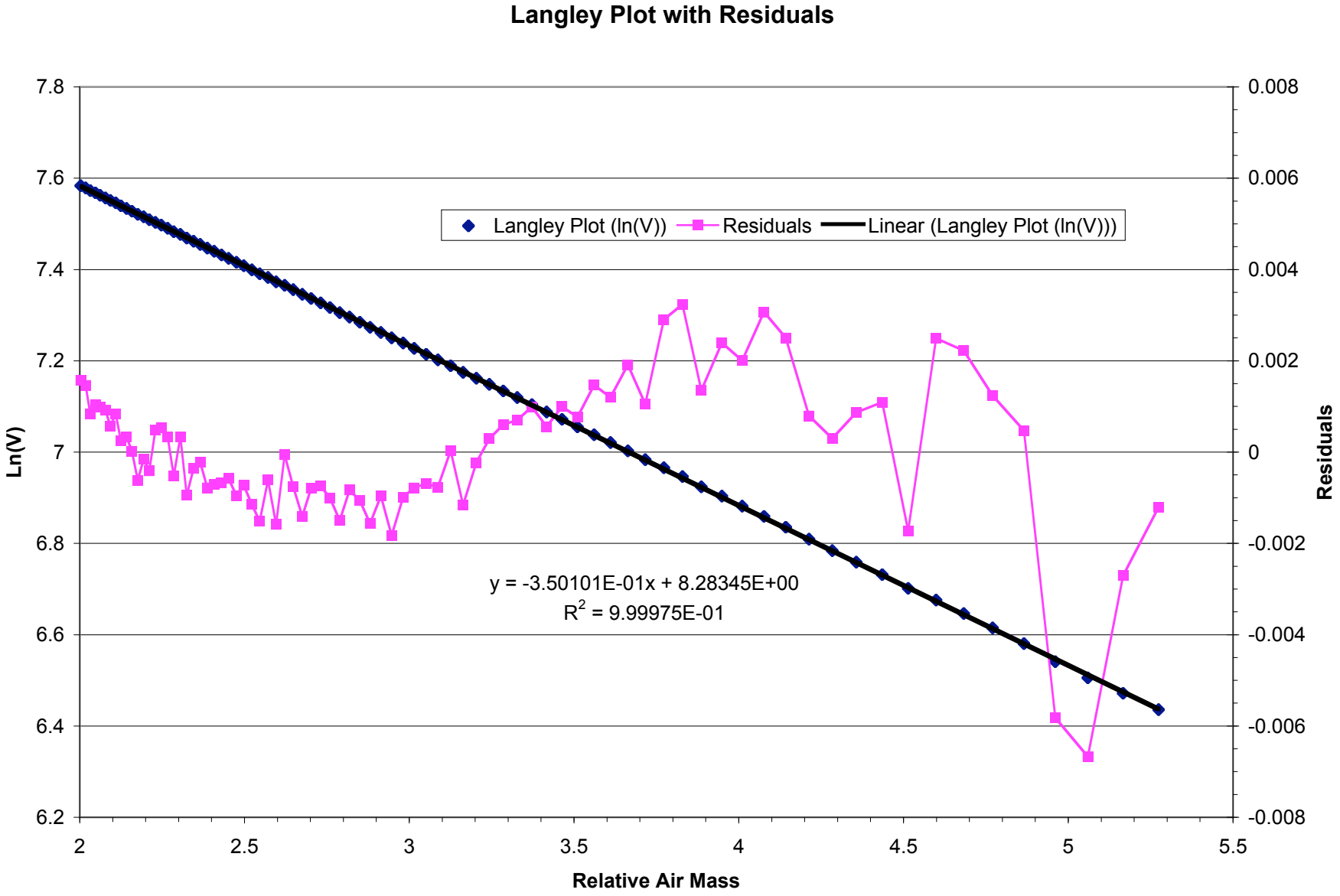
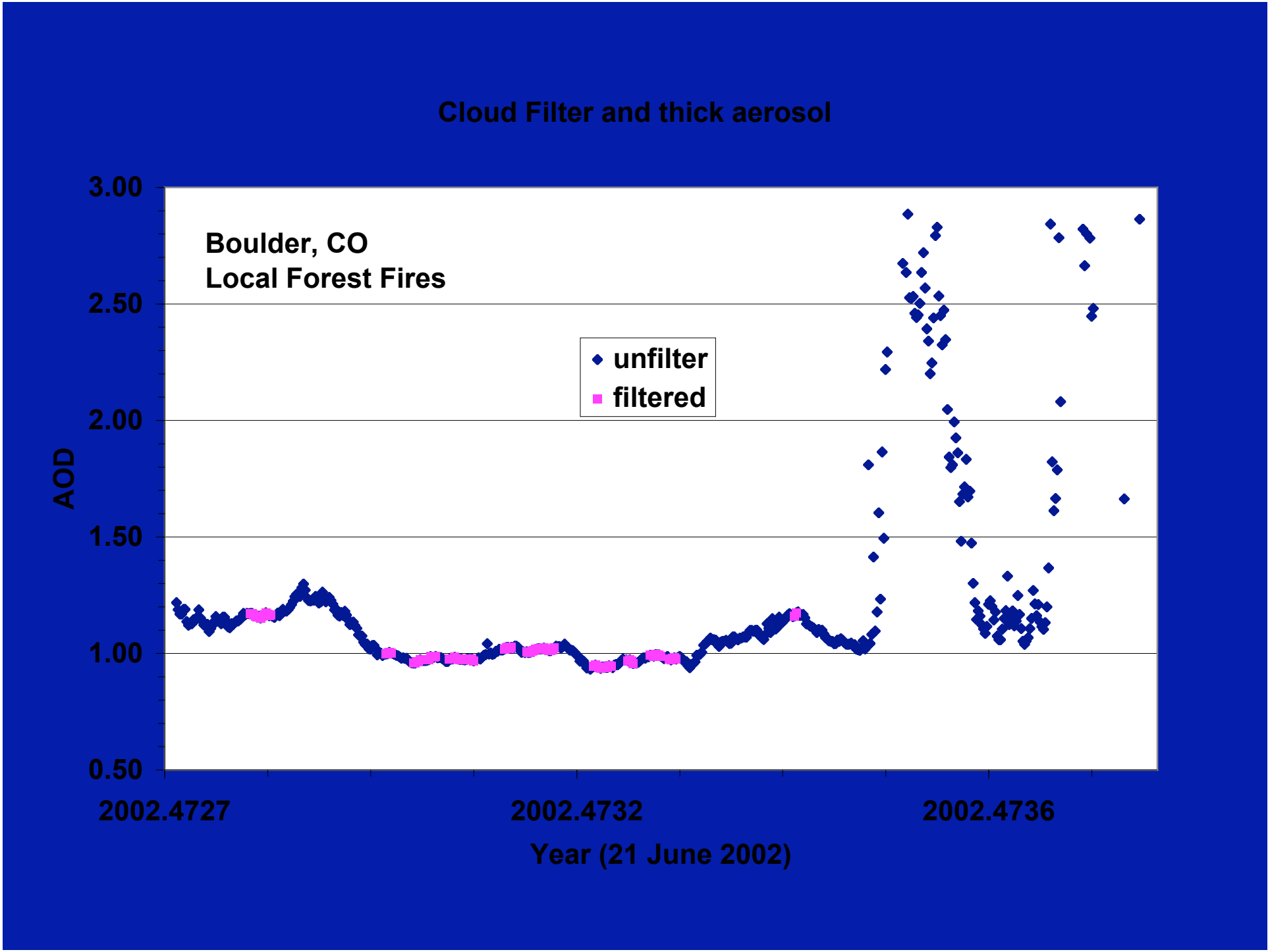
Spares


1976-2001
a)
Barrow
Samoa
South Pole
Mauna Loa
Percent of all cases per bin
Transmission (0.01 bins)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3


1976 - 2001
b)
Barrow
Samoa
South Pole
Mauna Loa
Percent of cases per bin
Transmission (0.025 bins)
0
2
4
6
8
10
12
14
0.0
0.2
0.4
0.6
0.8
1.0
1.2


Langley Plot with Residuals
Langley Plot (ln(V))
Residuals
Linear (Langley Plot (ln(V)))
y = -3.50101E-01x + 8.28345E+00
R2 = 9.99975E-01
Ln(V)
Residuals
Relative Air Mass
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
2
2.5
3
3.5
4
4.5
5
5.5


Cloud Filter and thick aerosol
Boulder, CO
Local Forest Fires
unfilter
filtered
AOD
3.00
2.50
2.00
1.50
1.00
0.50
2002.4727
2002.4732
2002.4736
Year (21 June 2002)