Validation of the Clouds and the Earth's Radiant Energy System (CERES) Surface Radiation Budget Algorithms

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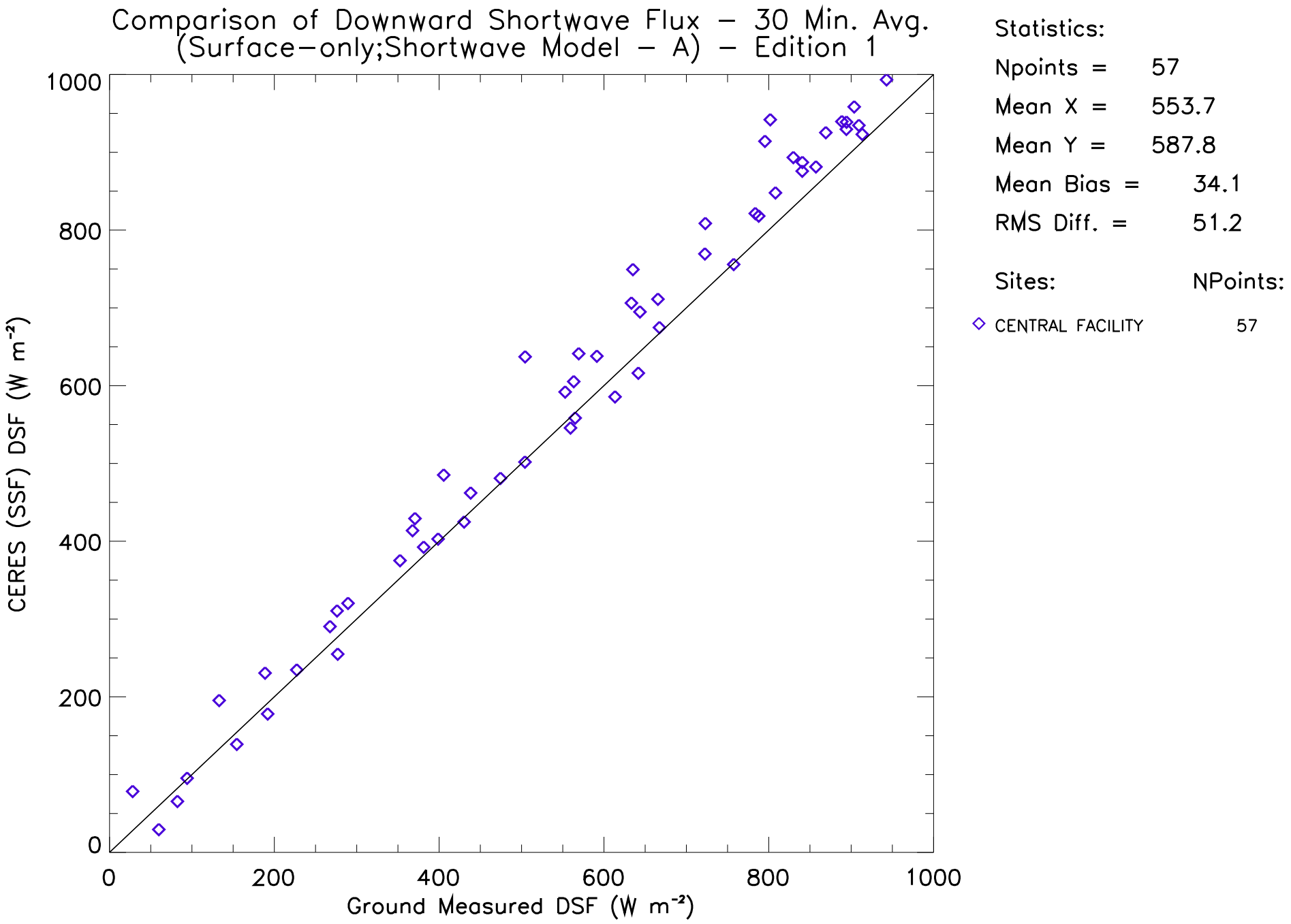
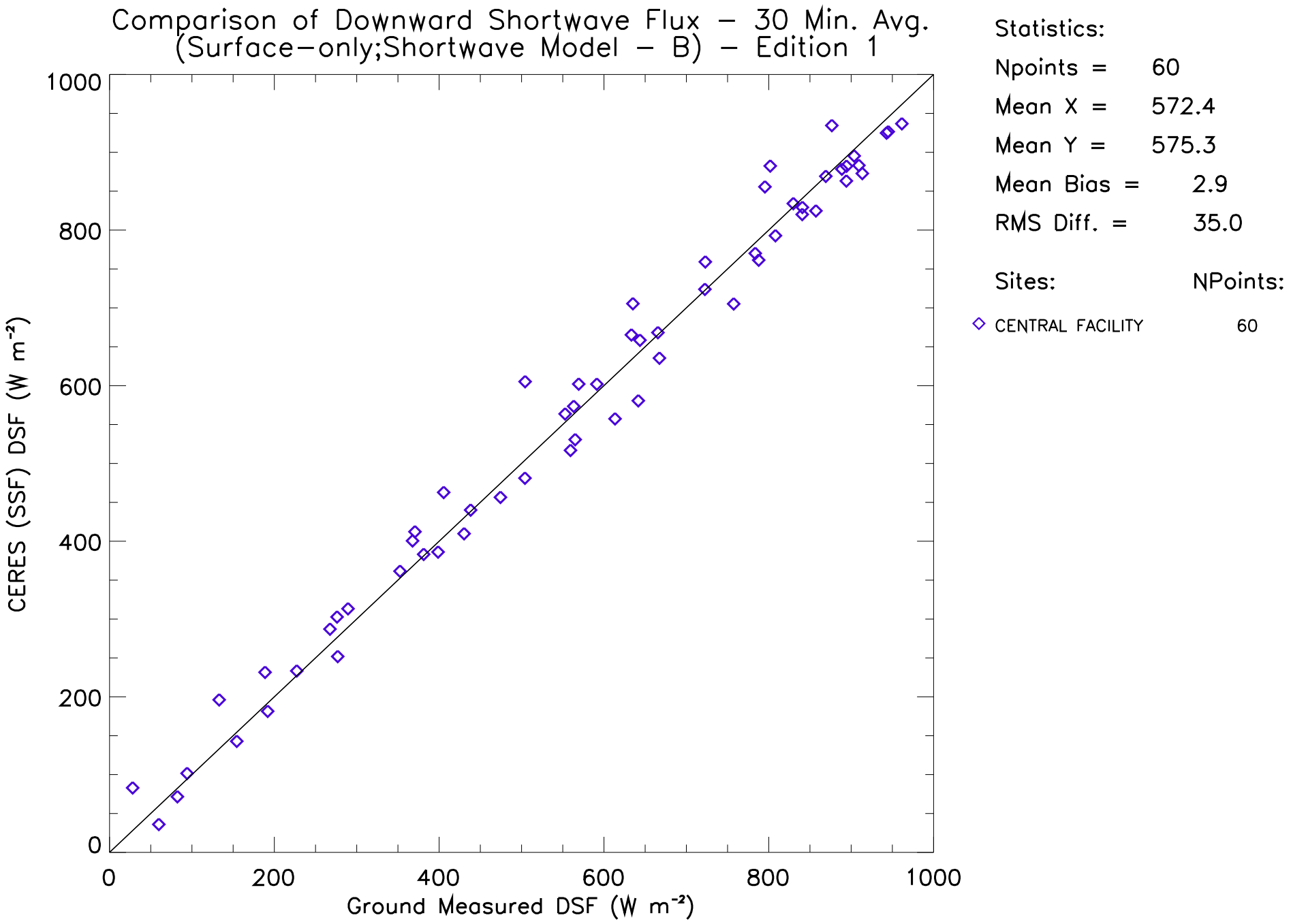
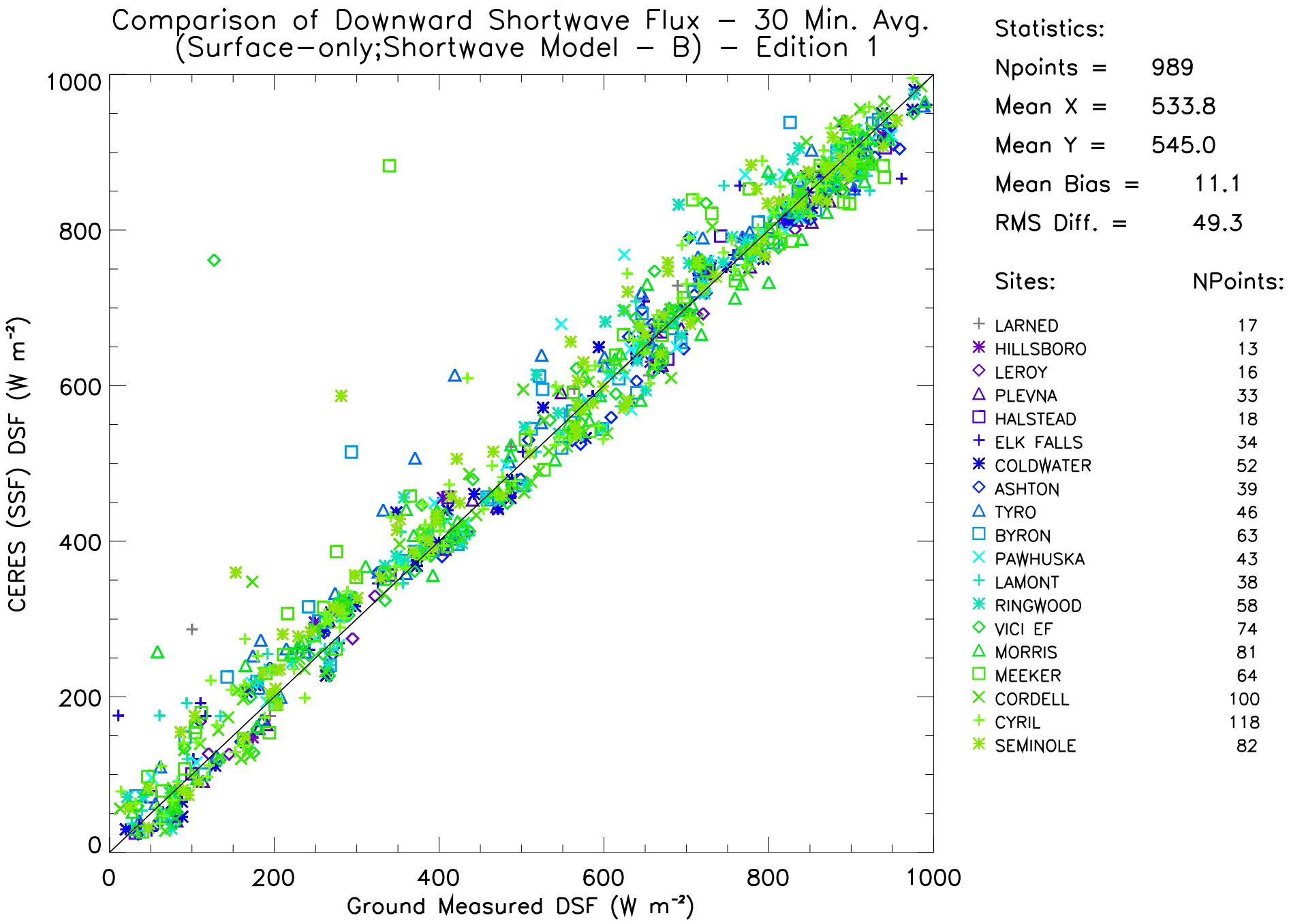
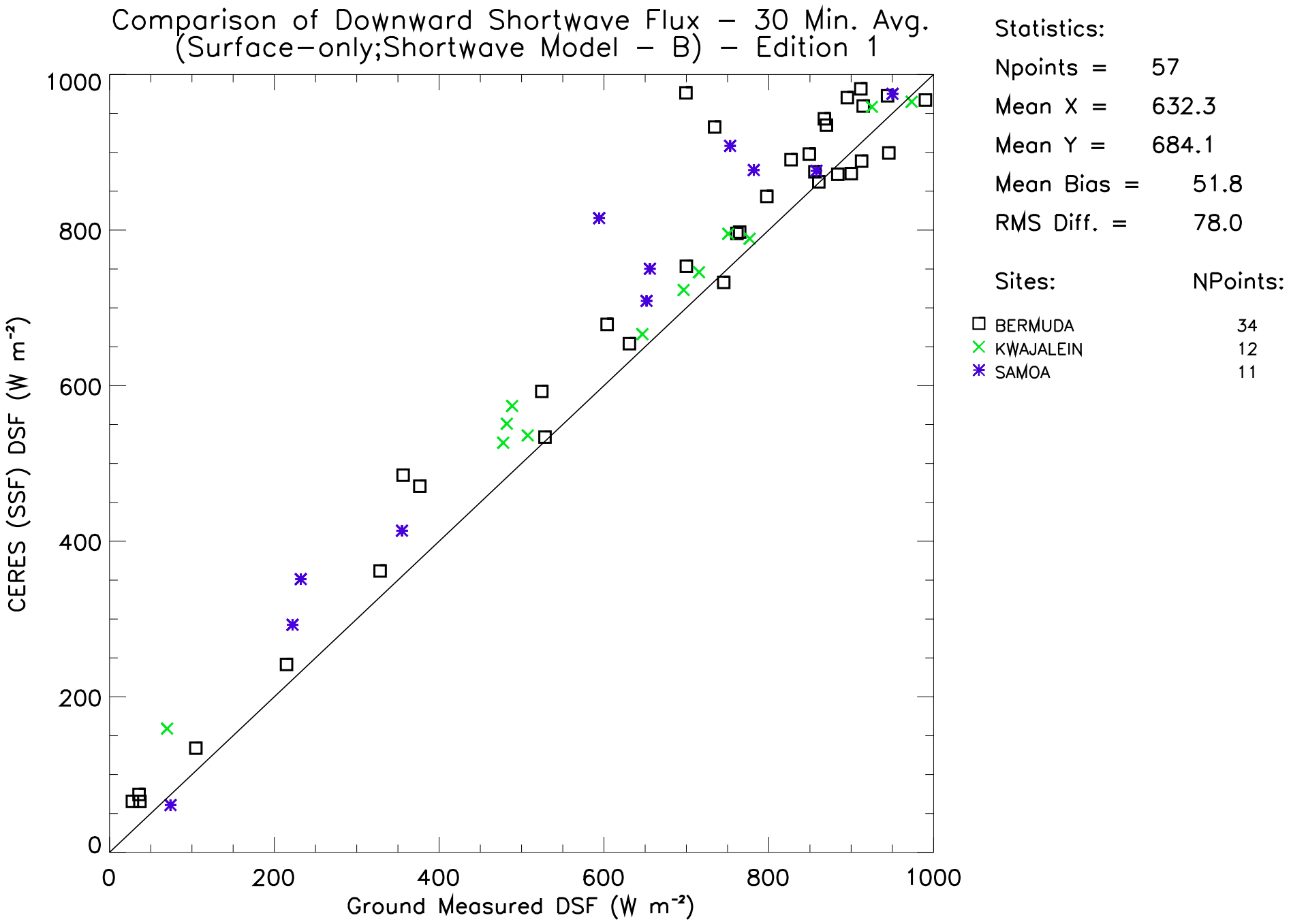
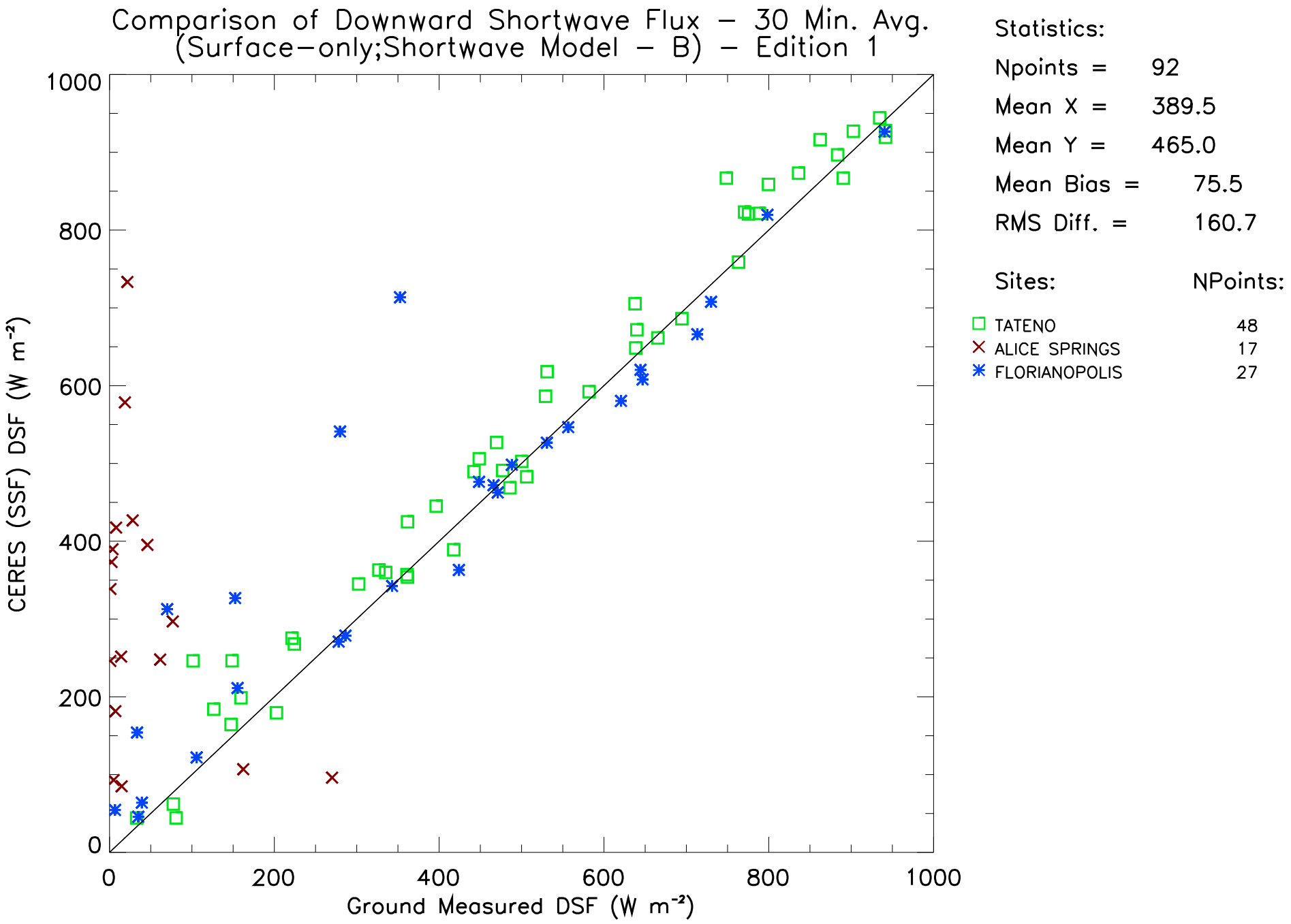
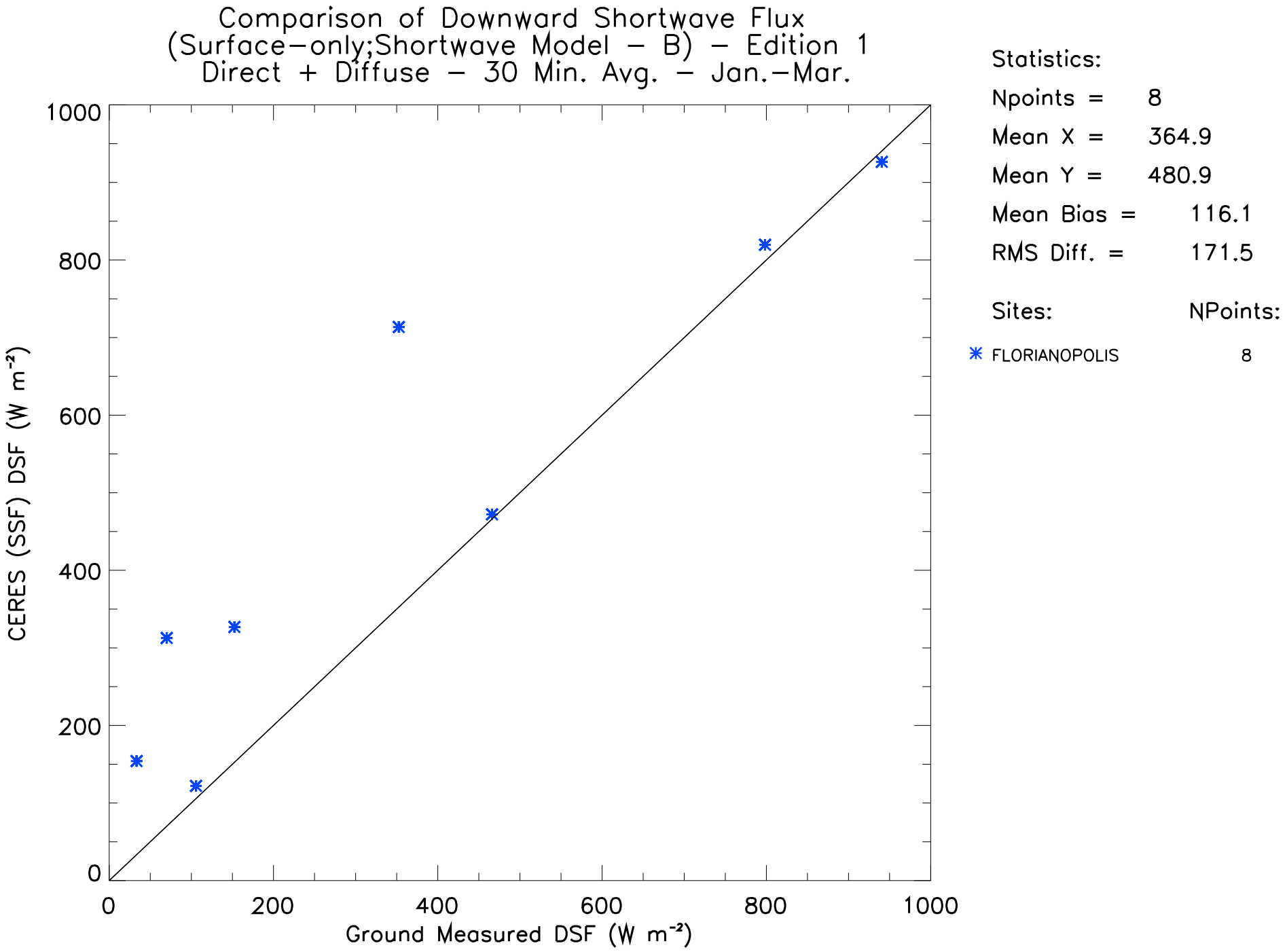

Comparison of Downward Shortwave Flux – 30 Min. Avg.
(Surface–only;Shortwave Model – A) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 57
Mean X = 553.7
Mean Y = 587.8
Mean Bias = 34.1
RMS Diff. = 51.2
Sites: NPoints:
CENTRAL FACILITY 57

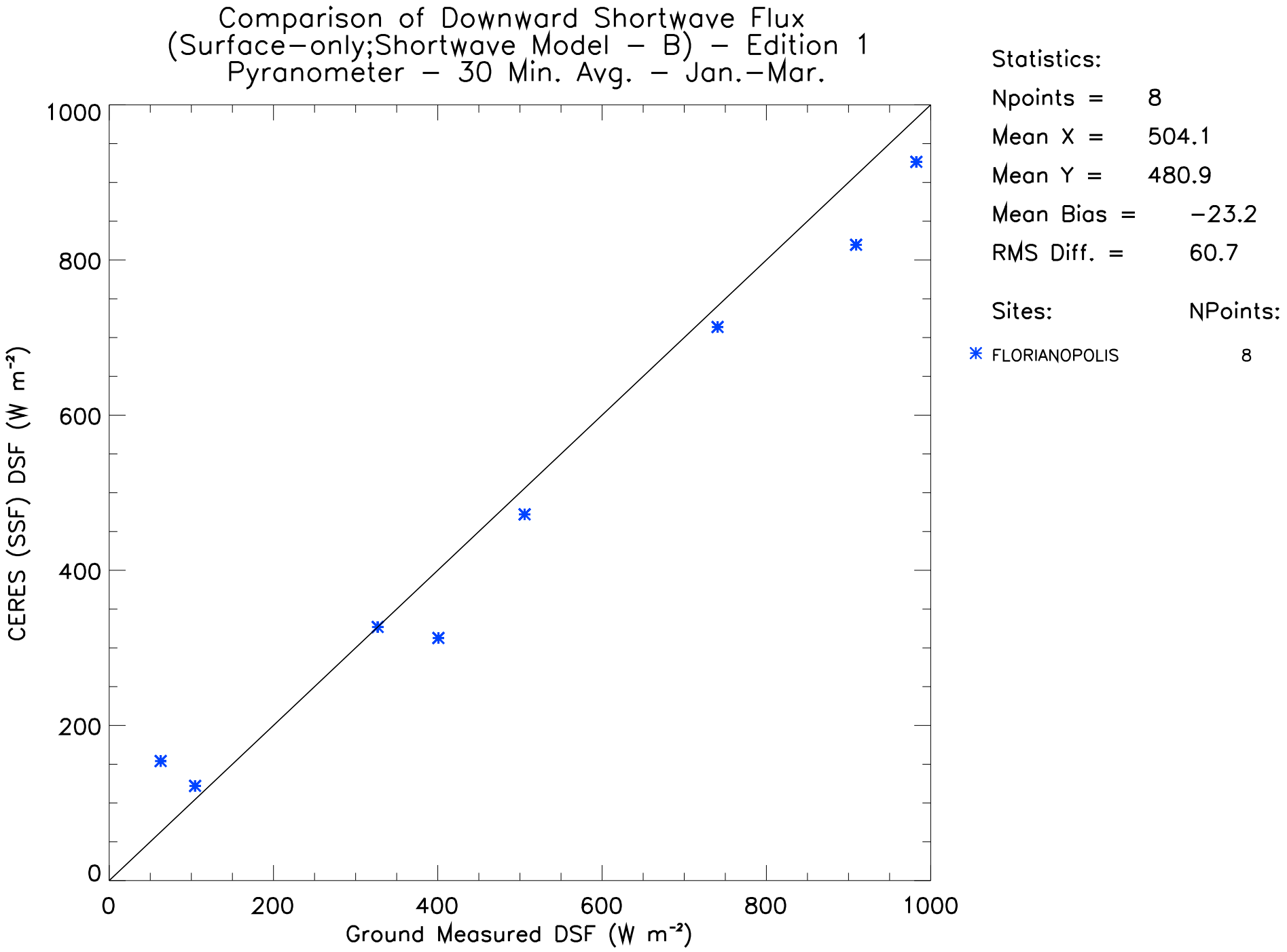

Comparison of Downward Shortwave Flux – 30 Min. Avg.
(Surface–only;Shortwave Model – B) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 60
Mean X = 572.4
Mean Y = 575.3
Mean Bias = 2.9
RMS Diff. = 35.0
Sites:
NPoints:
CENTRAL FACILITY 60

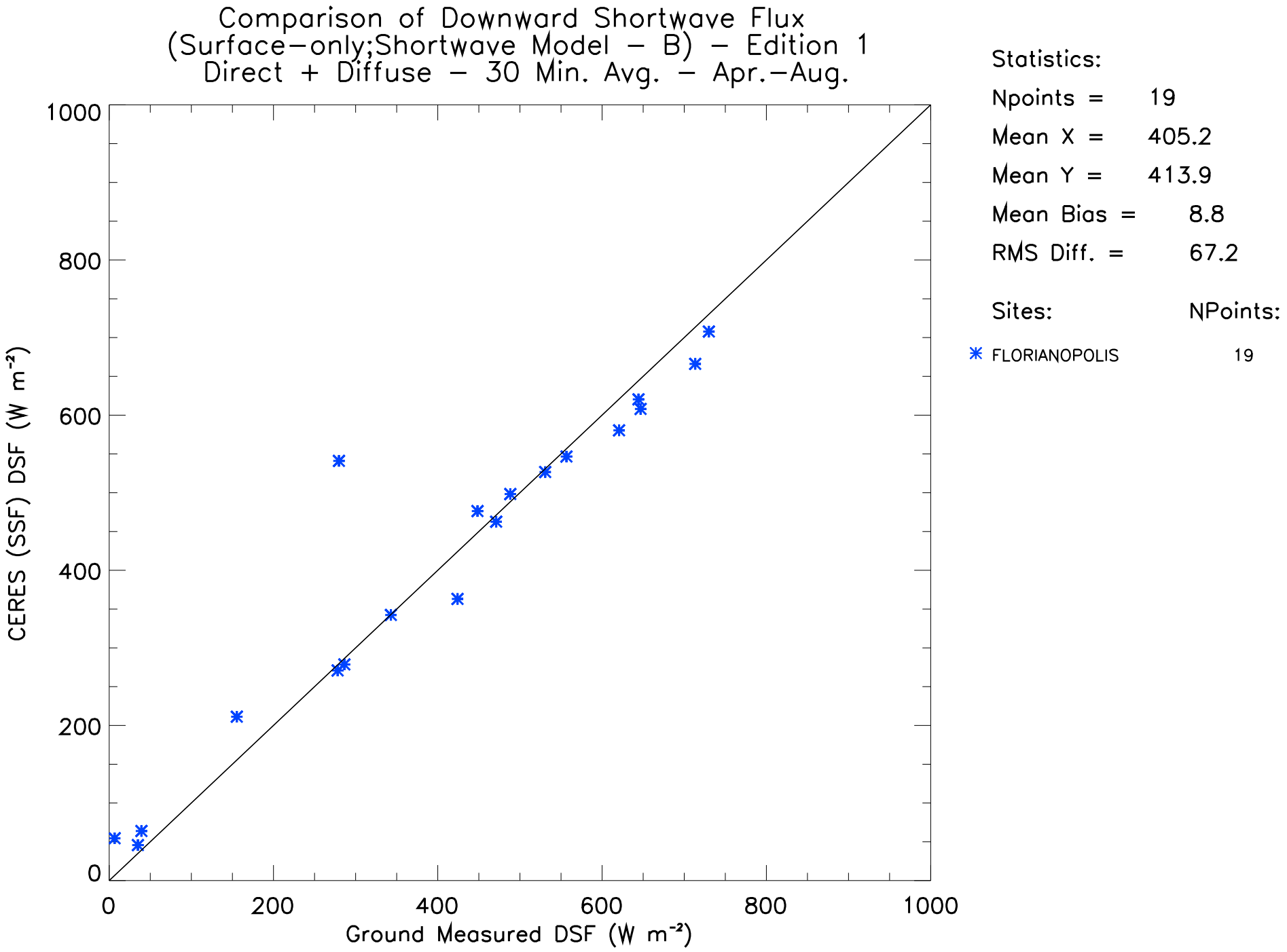

Comparison of Downward Shortwave Flux – 30 Min. Avg.
(Surface–only;Shortwave Model – B) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 989
Mean X = 533.8
Mean Y = 545.0
Mean Bias = 11.1
RMS Diff. = 49.3
Sites: NPoints:
LARNED 17
HILLSBORO 13
LEROY 16
PLEVNA 33
HALSTEAD 18
ELK FALLS 34
COLDWATER 52
ASHTON 39
TYRO 46
BYRON 63
PAWHUSKA 43
LAMONT 38
RINGWOOD 58
VICI EF 74
MORRIS 81
MEEKER 64
CORDELL 100
CYRIL 118
SEMINOLE 82

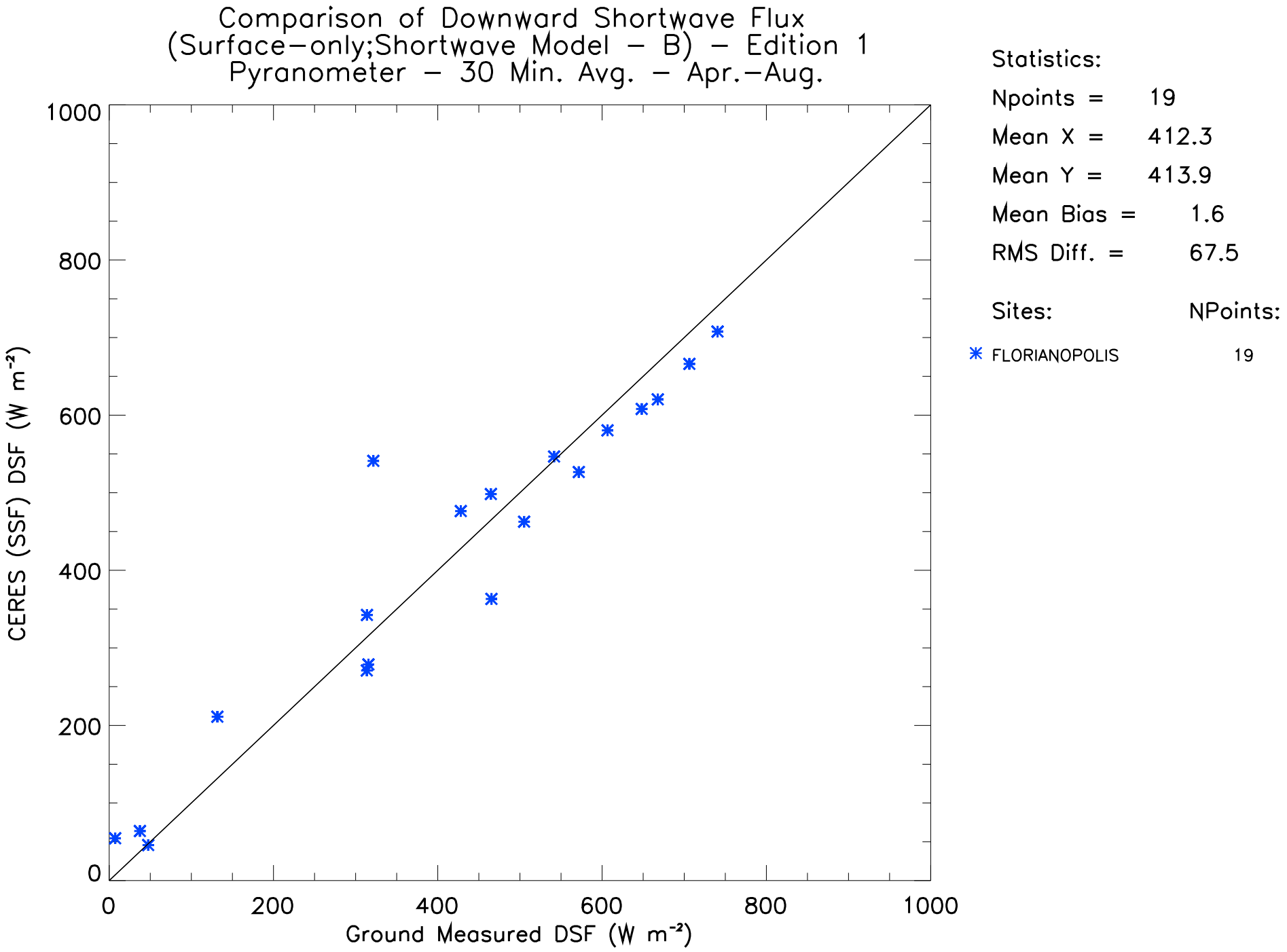

Comparison of Downward Shortwave Flux – 30 Min. Avg.
(Surface–only;Shortwave Model – B) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 57
Mean X = 632.3
Mean Y = 684.1
Mean Bias = 51.8
RMS Diff. = 78.0
Sites: NPoints:
BERMUDA 34
KWAJALEIN 12
SAMOA 11

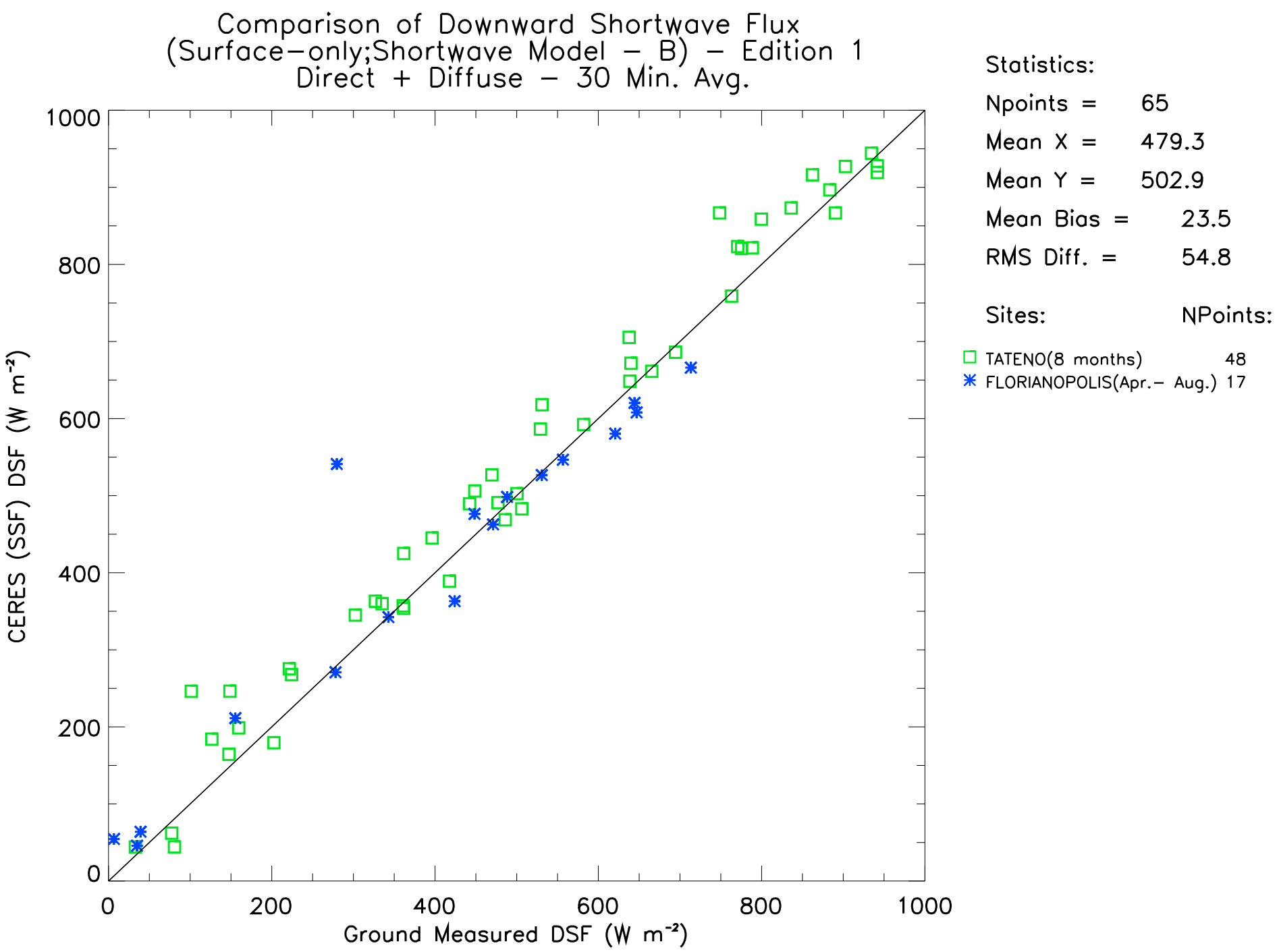

Comparison of Downward Shortwave Flux – 30 Min. Avg.
(Surface–only;Shortwave Model – B) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 92
Mean X = 389.5
Mean Y = 465.0
Mean Bias = 75.5
RMS Diff. = 160.7
Sites: NPoints:
TATENO 48
ALICE SPRINGS 17
FLORIANOPOLIS 27


Comparison of Downward Shortwave Flux
(Surface-only;Shortwave Model - B) - Edition 1
Direct + Diffuse - 30 Min. Avg. - Jan.-Mar.
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 8
Mean X = 364.9
Mean Y = 480.9
Mean Bias = 116.1
RMS Diff. = 171.5
Sites:
NPoints:
FLORIANOPOLIS 8


Comparison of Downward Shortwave Flux
(Surface-only;Shortwave Model - B) - Edition 1
Pyranometer - 30 Min. Avg. - Jan.-Mar.
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 8
Mean X = 504.1
Mean Y = 480.9
Mean Bias = -23.2
RMS Diff. = 60.7
Sites: NPoints:
FLORIANOPOLIS 8


Comparison of Downward Shortwave Flux
(Surface-only;Shortwave Model - B) - Edition 1
Direct + Diffuse - 30 Min. Avg. - Apr.-Aug.
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 19
Mean X = 405.2
Mean Y = 413.9
Mean Bias = 8.8
RMS Diff. = 67.2
Sites: NPoints:
FLORIANOPOLIS 19


Comparison of Downward Shortwave Flux
(Surface-only;Shortwave Model - B) - Edition 1
Pyranometer - 30 Min. Avg. - Apr.-Aug.
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 19
Mean X = 412.3
Mean Y = 413.9
Mean Bias = 1.6
RMS Diff. = 67.5
Sites: NPoints:
FLORIANOPOLIS 19

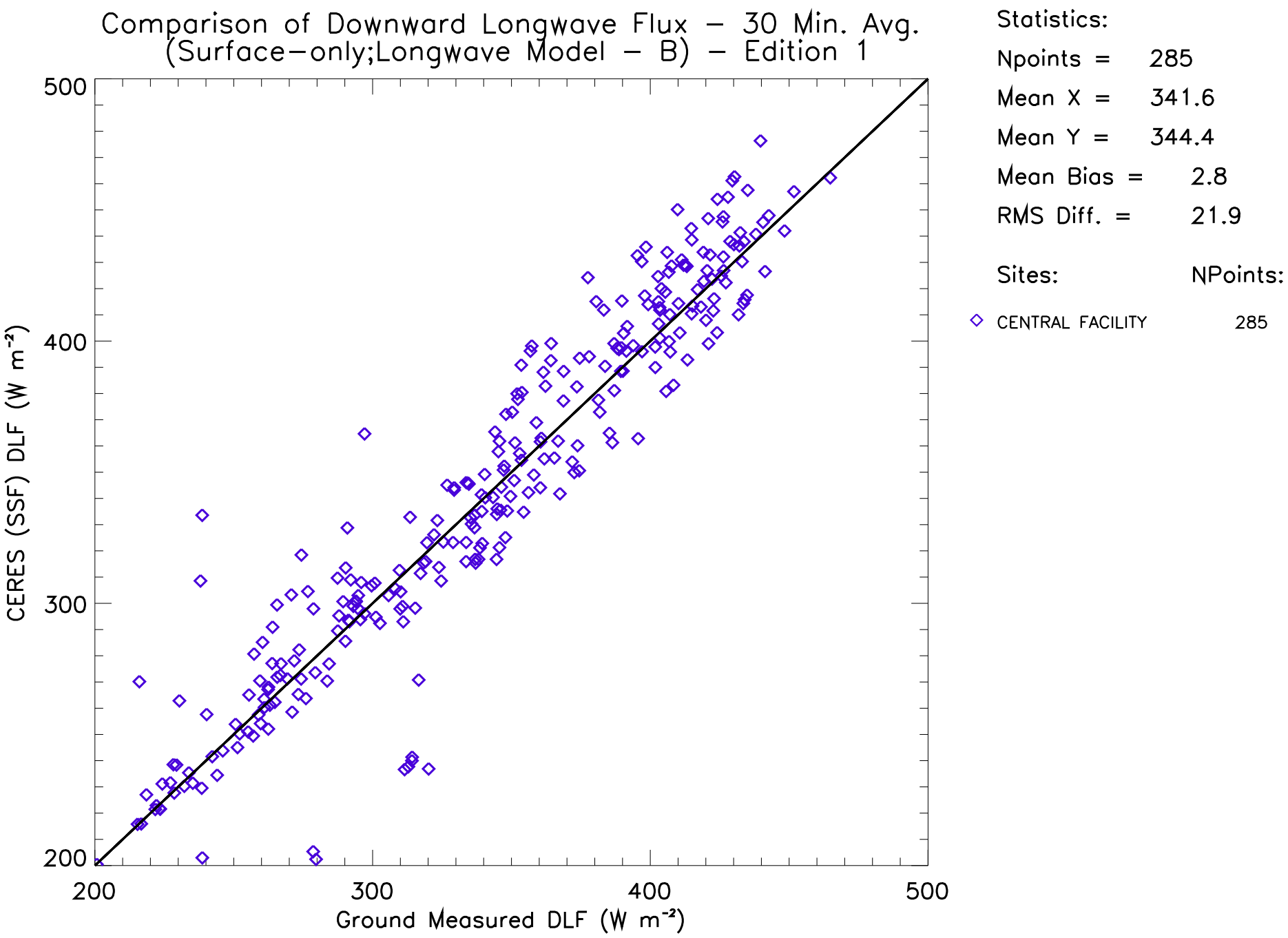

Comparison of Downward Shortwave Flux
(Surface-only;Shortwave Model - B) - Edition 1
Direct + Diffuse - 30 Min. Avg.
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 65
Mean X = 479.3
Mean Y = 502.9
Mean Bias = 23.5
RMS Diff. = 54.8
Sites: NPoints:
TATENO(8 months) 48
FLORIANOPOLIS(Apr.- Aug.) 17

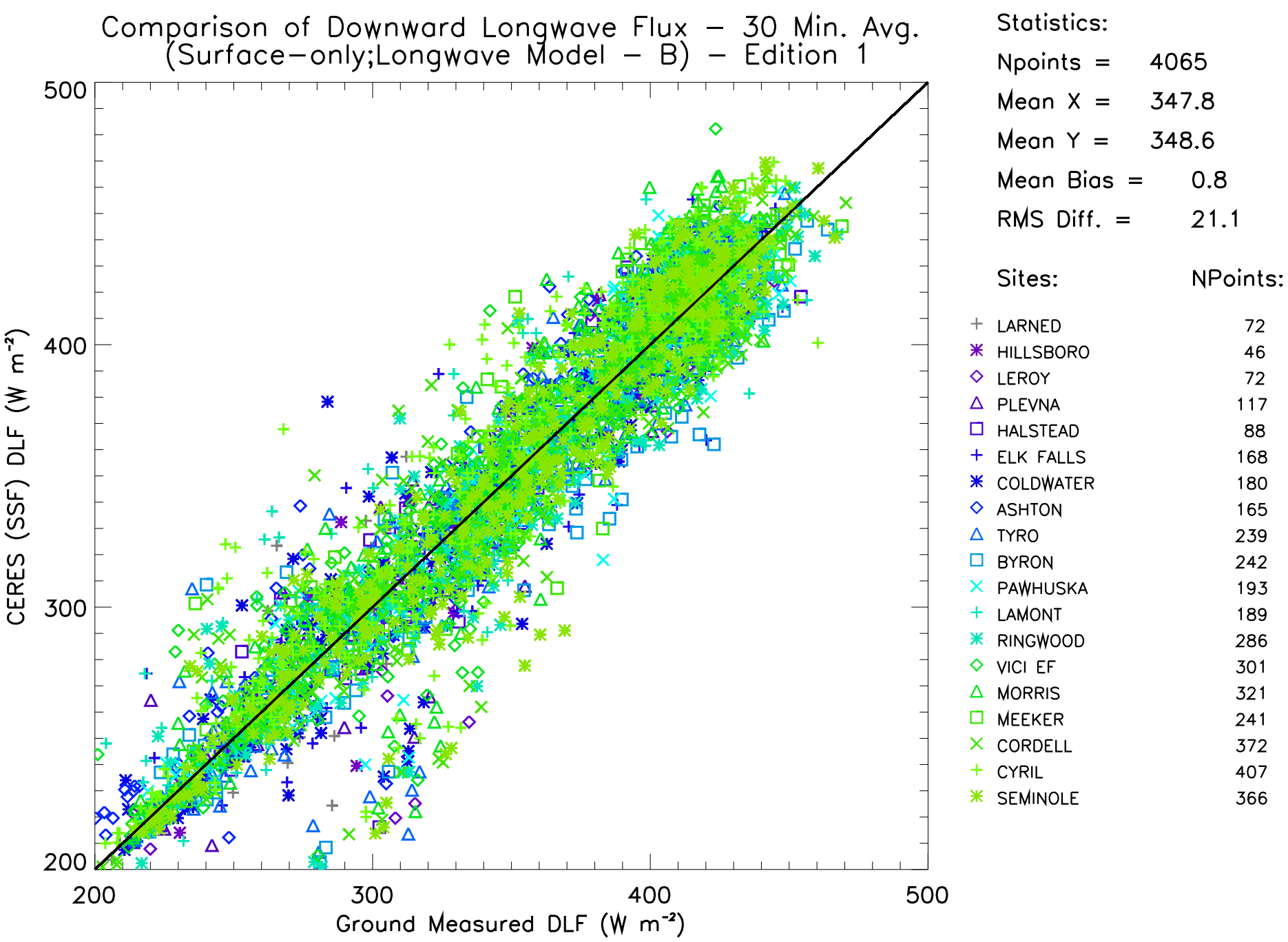
Shortwave Comparisons (Model A)

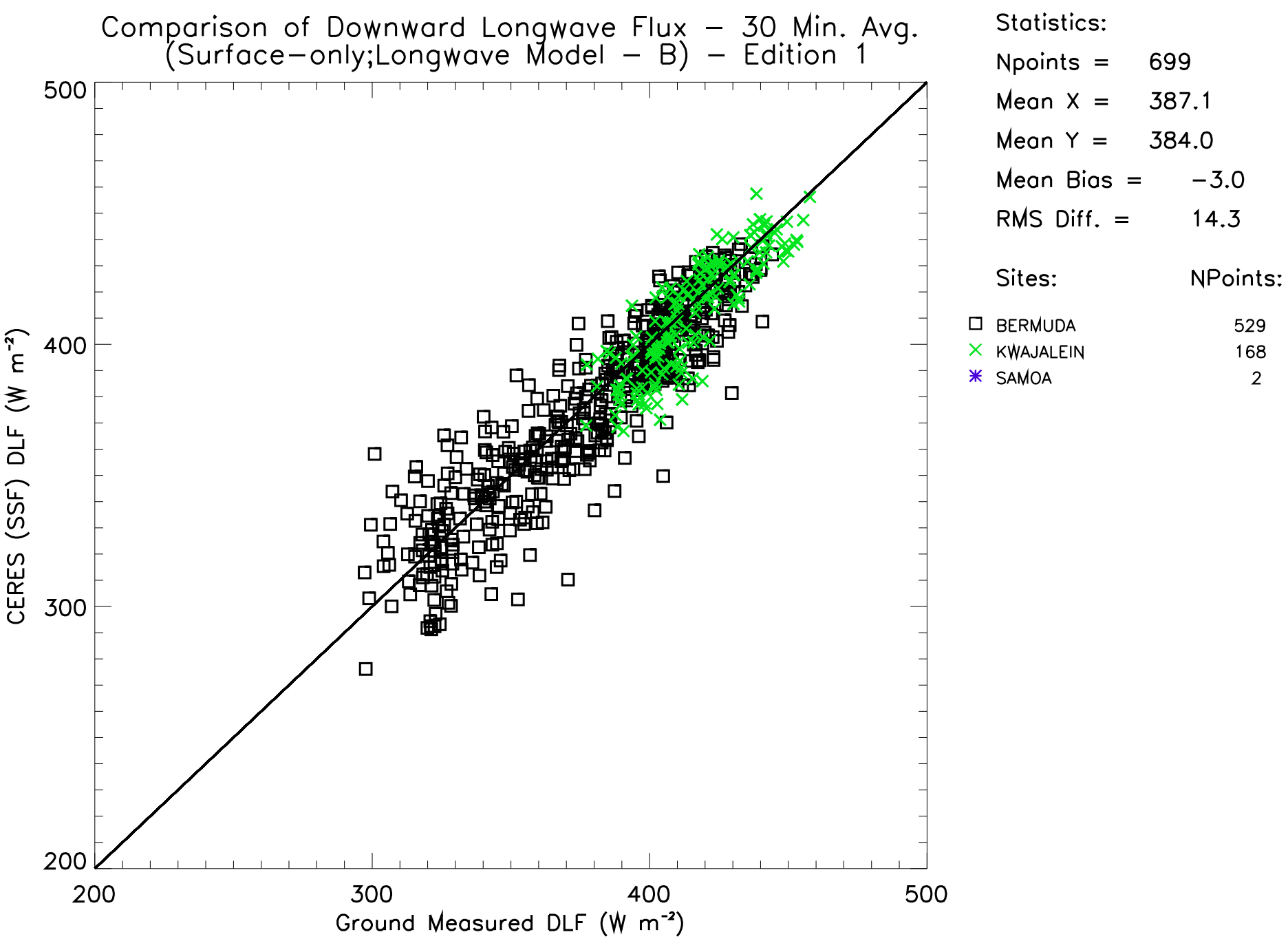
Surface Site	Number of Points	Mean Bias(Wm^{-2})	RMS Difference (Wm^{-2})
ARM Central Facility	57	34.1	51.2
ARM Extended Facilities	960	41.7	67.5
CMDL Facilities	51	64.4	82.7
BSRN Facilities	62	53.9	76.9

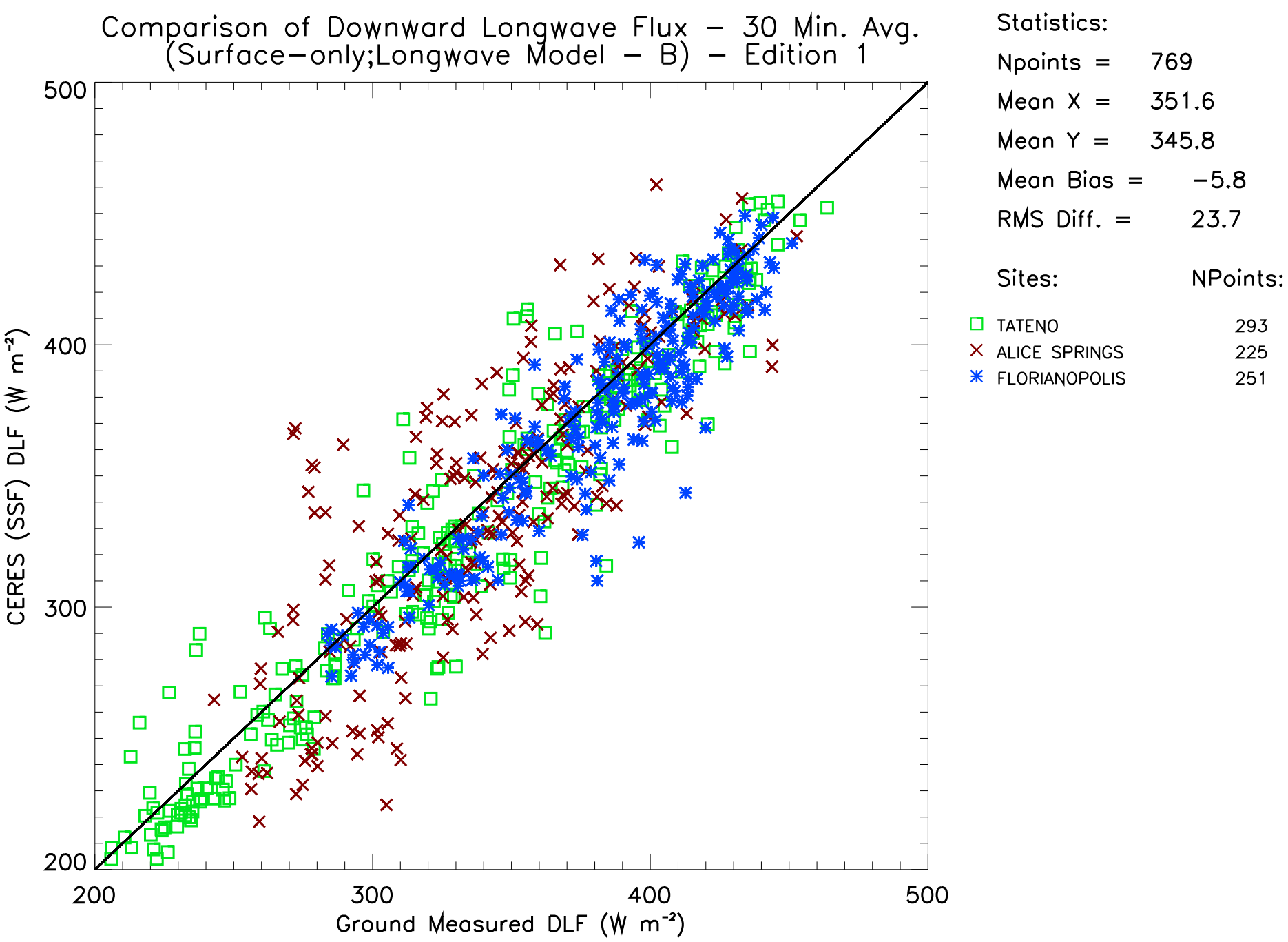
Shortwave Comparisons (Model B)

Surface Site	Number of Points	Mean Bias(Wm^{-2})	RMS Difference (Wm^{-2})
ARM Central Facility	60	2.9	35.0
ARM Extended Facilities	989	11.1	49.3
CMDL Facilities	57	51.8	78.0
BSRN Facilities	65	23.5	54.8


Comparison of Downward Longwave Flux – 30 Min. Avg.
(Surface–only;Longwave Model – B) – Edition 1
CERES (SSF) DLF (W m⁻²)
Ground Measured DLF (W m⁻²)
200
300
400
500
Statistics:
Npoints = 285
Mean X = 341.6
Mean Y = 344.4
Mean Bias = 2.8
RMS Diff. = 21.9
Sites:
NPoints:
CENTRAL FACILITY 285

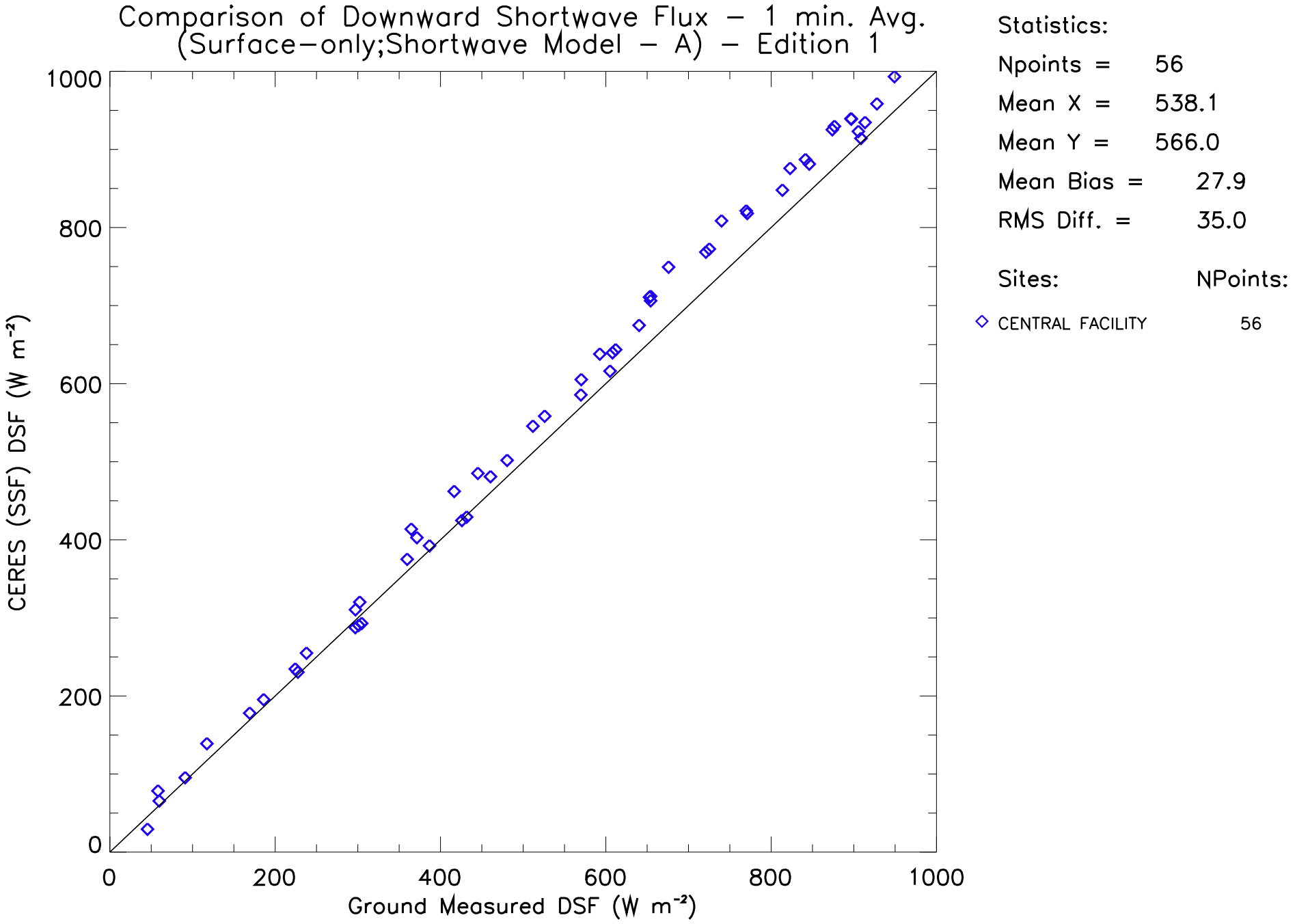

Comparison of Downward Longwave Flux – 30 Min. Avg.
(Surface–only;Longwave Model – B) – Edition 1
CERES (SSF) DLF (W m⁻²)
Ground Measured DLF (W m⁻²)
200
300
400
500
Statistics:
Npoints = 4065
Mean X = 347.8
Mean Y = 348.6
Mean Bias = 0.8
RMS Diff. = 21.1
Sites: NPoints:
LARNED 72
HILLSBORO 46
LEROY 72
PLEVNA 117
HALSTEAD 88
ELK FALLS 168
COLDWATER 180
ASHTON 165
TYRO 239
BYRON 242
PAWHUSKA 193
LAMONT 189
RINGWOOD 286
VICI EF 301
MORRIS 321
MEEKER 241
CORDELL 372
CYRIL 407
SEMINOLE 366

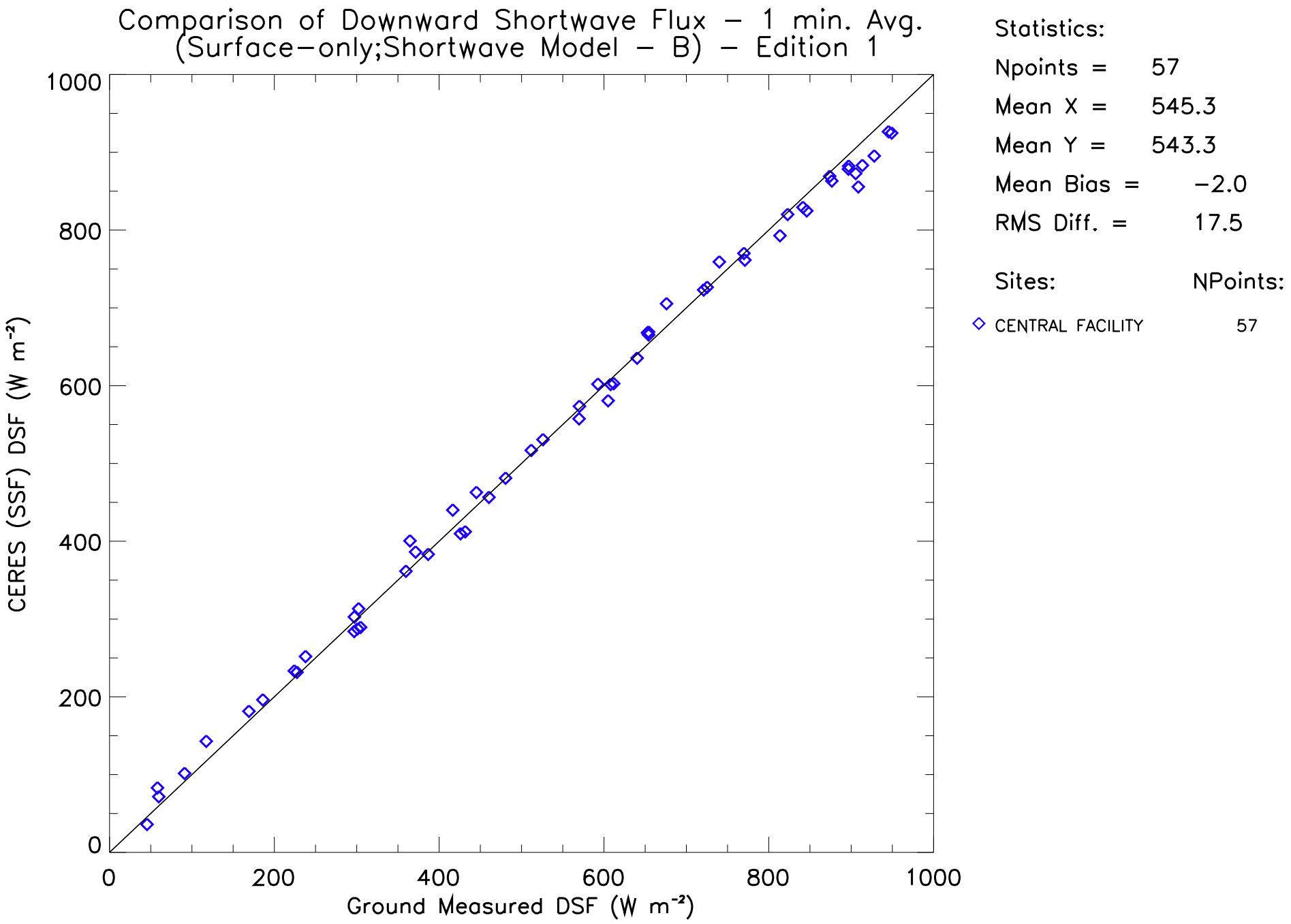

Comparison of Downward Longwave Flux – 30 Min. Avg.
(Surface–only;Longwave Model – B) – Edition 1
CERES (SSF) DLF (W m⁻²)
Ground Measured DLF (W m⁻²)
200
300
400
500
Statistics:
Npoints = 699
Mean X = 387.1
Mean Y = 384.0
Mean Bias = −3.0
RMS Diff. = 14.3
Sites: NPoints:
BERMUDA 529
KWAJALEIN 168
SAMOA 2

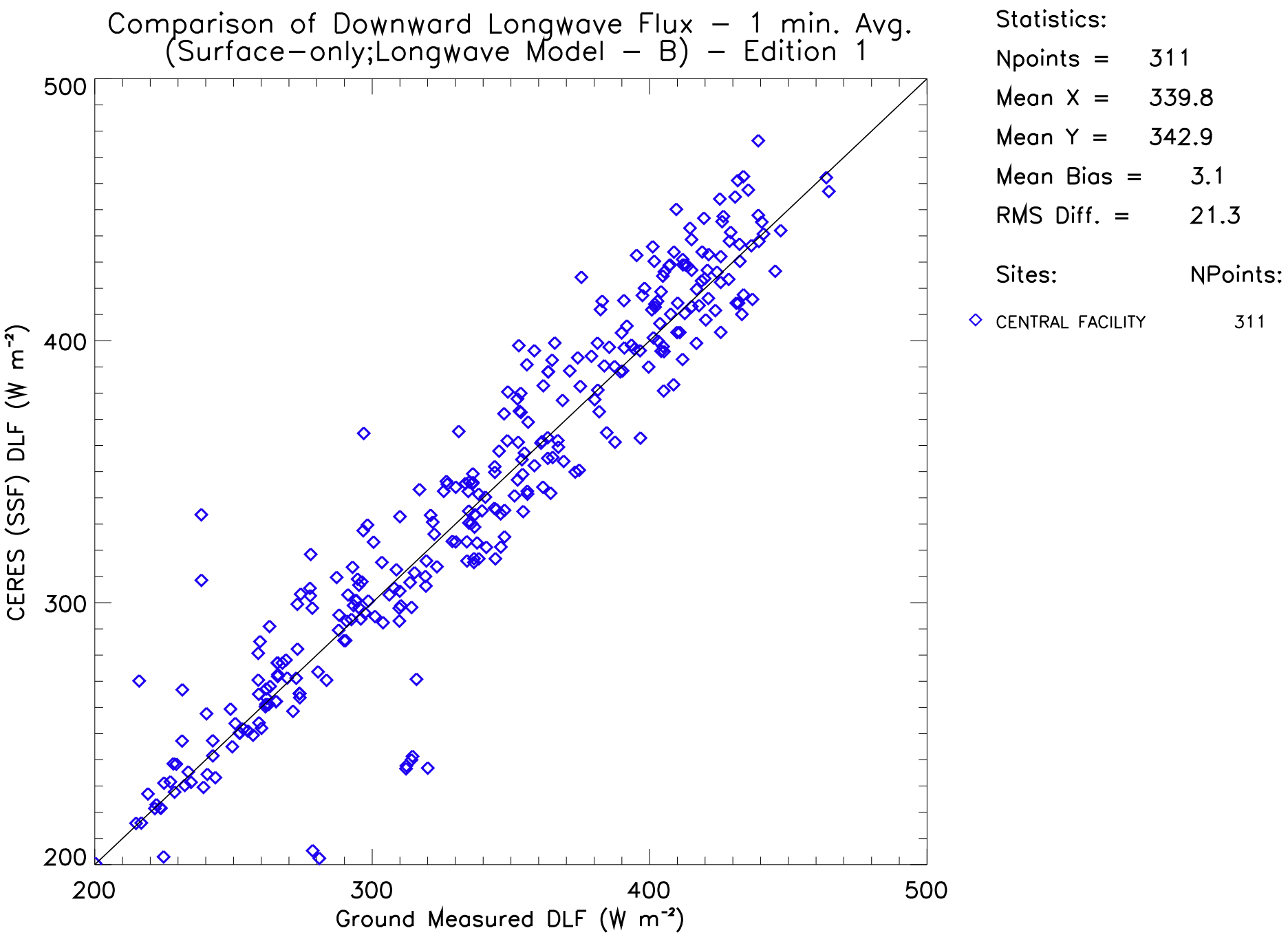

Comparison of Downward Longwave Flux – 30 Min. Avg.
(Surface–only;Longwave Model – B) – Edition 1
CERES (SSF) DLF (W m⁻²)
Ground Measured DLF (W m⁻²)
200
300
400
500
Statistics:
Npoints = 769
Mean X = 351.6
Mean Y = 345.8
Mean Bias = −5.8
RMS Diff. = 23.7
Sites: NPoints:
TATENO 293
ALICE SPRINGS 225
FLORIANOPOLIS 251

Longwave Comparisons (Model A)

Surface Site	Number of Points	Mean Bias(Wm^{-2})	RMS Difference (Wm^{-2})
ARM Central Facility	285	2.8	21.9
ARM Extended Facilities	4065	0.8	21.1
CMDL Facilities	699	−3.0	14.3
BSRN Facilities	769	−5.8	23.7


Comparison of Downward Shortwave Flux – 1 min. Avg.
(Surface–only;Shortwave Model – A) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 56
Mean X = 538.1
Mean Y = 566.0
Mean Bias = 27.9
RMS Diff. = 35.0
Sites: NPoints:
CENTRAL FACILITY 56


Comparison of Downward Shortwave Flux – 1 min. Avg.
(Surface–only;Shortwave Model – B) – Edition 1
CERES (SSF) DSF (W m⁻²)
Ground Measured DSF (W m⁻²)
0
200
400
600
800
1000
Statistics:
Npoints = 57
Mean X = 545.3
Mean Y = 543.3
Mean Bias = −2.0
RMS Diff. = 17.5
Sites: NPoints:
CENTRAL FACILITY 57


Comparison of Downward Longwave Flux – 1 min. Avg.
(Surface–only;Longwave Model – B) – Edition 1
CERES (SSF) DLF (W m⁻²)
Ground Measured DLF (W m⁻²)
200
300
400
500
Statistics:
Npoints = 311
Mean X = 339.8
Mean Y = 342.9
Mean Bias = 3.1
RMS Diff. = 21.3
Sites: NPoints:
CENTRAL FACILITY 311

Conclusions

1) The comparison of the Shortwave models are in reasonable good agreement with the surface data
2) Shortwave Model A has a high bias of approximately 30 W/m/m compared with shortwave Model B
3) 30 minute averaging of the shortwave surface measurements introduces a significant rms for the shortwave data.
4) Longwave Model B is in good agreement with the surface measurements.