Diurnal Cycle of Surface Radiation Budget

G. L. Smith, P. E. Mlynczak,
S. K. Gupta and P. W. Stackhouse

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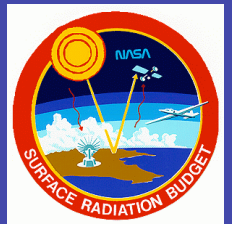
Princeton, 3-5 May 2005



Data Set

- Surface Radiation Budget Data Set.
- 1^{o} Resolution in Lat/Long equal area.
- 12 Year set: July 1983 - June 1995
- Used Monthly Means for July.
- Surface radiation flux components:
  Upward, Downward and Net
  Shortwave and Longwave
  and Net Total

Computation of Diurnal Cycle

- Data given for every 3 hours GMT for each $1^{o}x1^{o}$ region
- Use cubic spline to interpolate for very hour of local time for each region
- This gives diurnal cycle for each region

Study for July

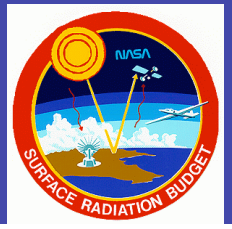
Diurnal cycle is strongest over land in summer and Northern Hemisphere has more land than Southern Hemisphere.

Partition Earth into Land and Ocean.

Ignore Coastal or Mixed regions.

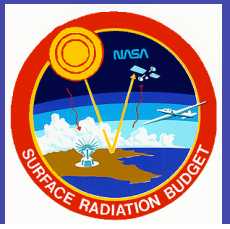
Principle Component/ Empirical Orthogonal Function Analysis

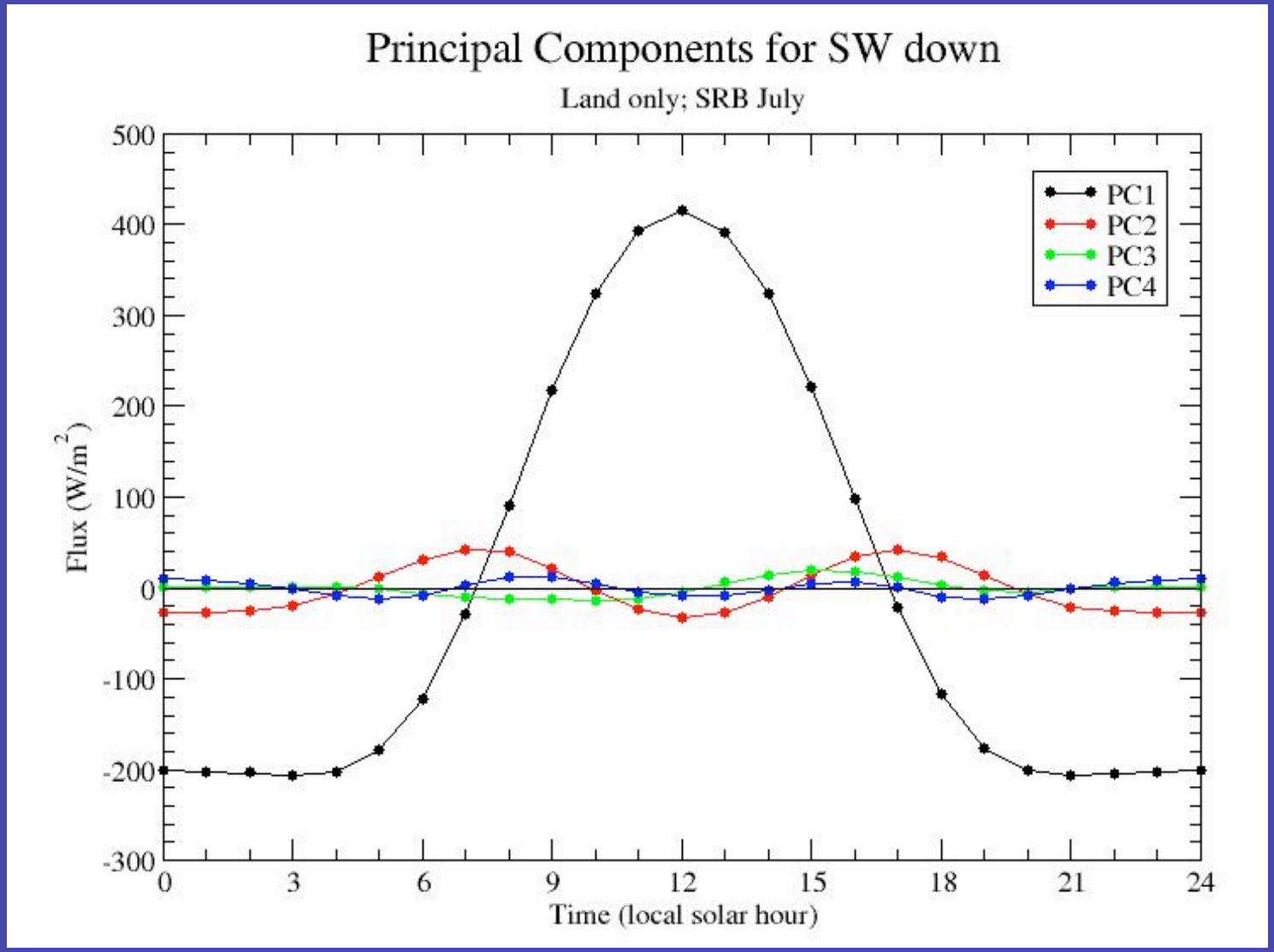
$$y(x,t) = \sum PC_i(t) x EOF_i(x)$$



Eigenvalues for Land

Parameter	λ_1	λ_2	λ_3
SWD	0.984	0.013	0.002
SWU	0.977	0.011	0.008
SWN	0.981	0.014	0.002
LWD	0.926	0.036	0.017
LWU	0.975	0.013	0.007
LWN	0.945	0.023	0.018
TotalNet	0.980	0.015	0.002





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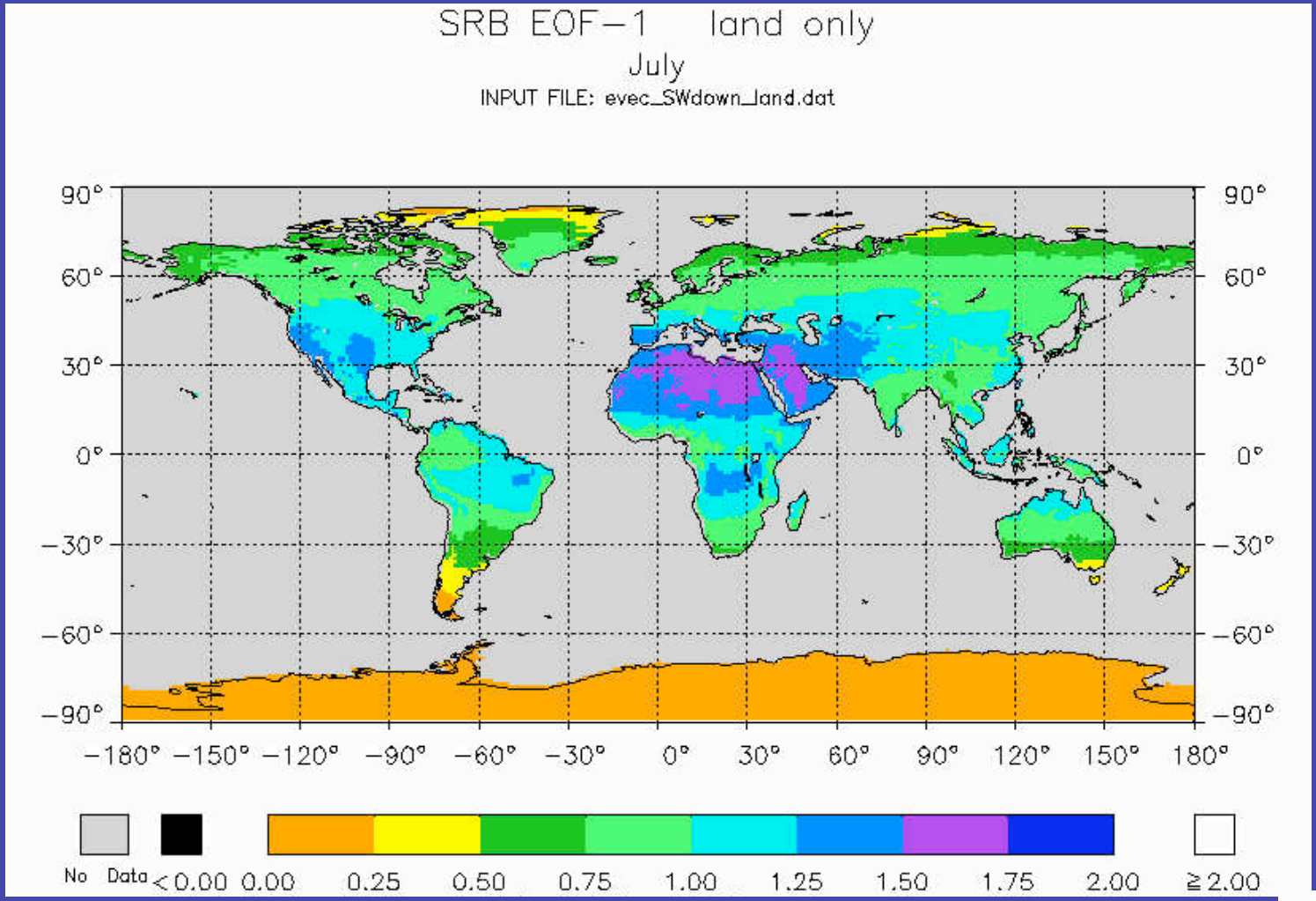
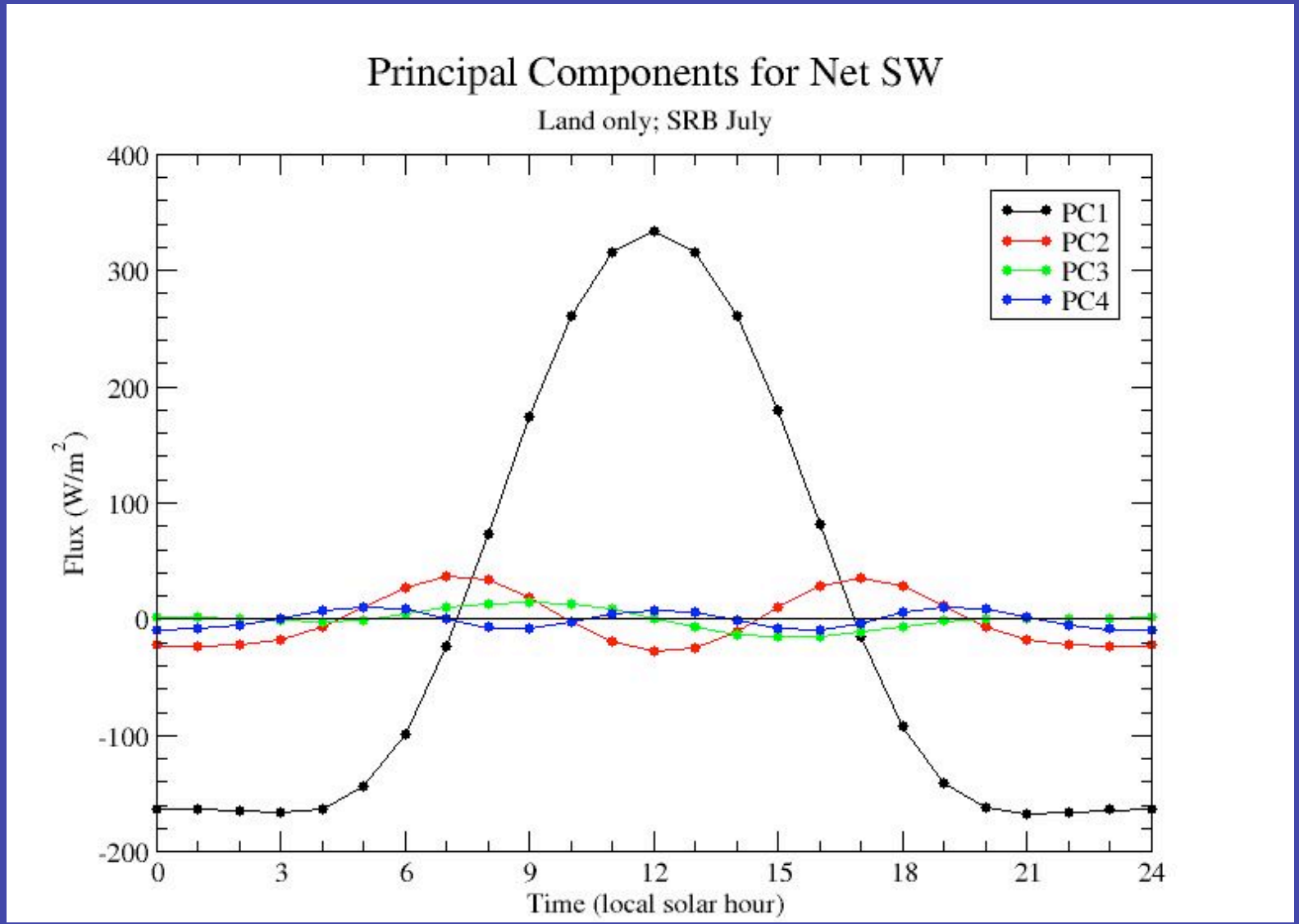
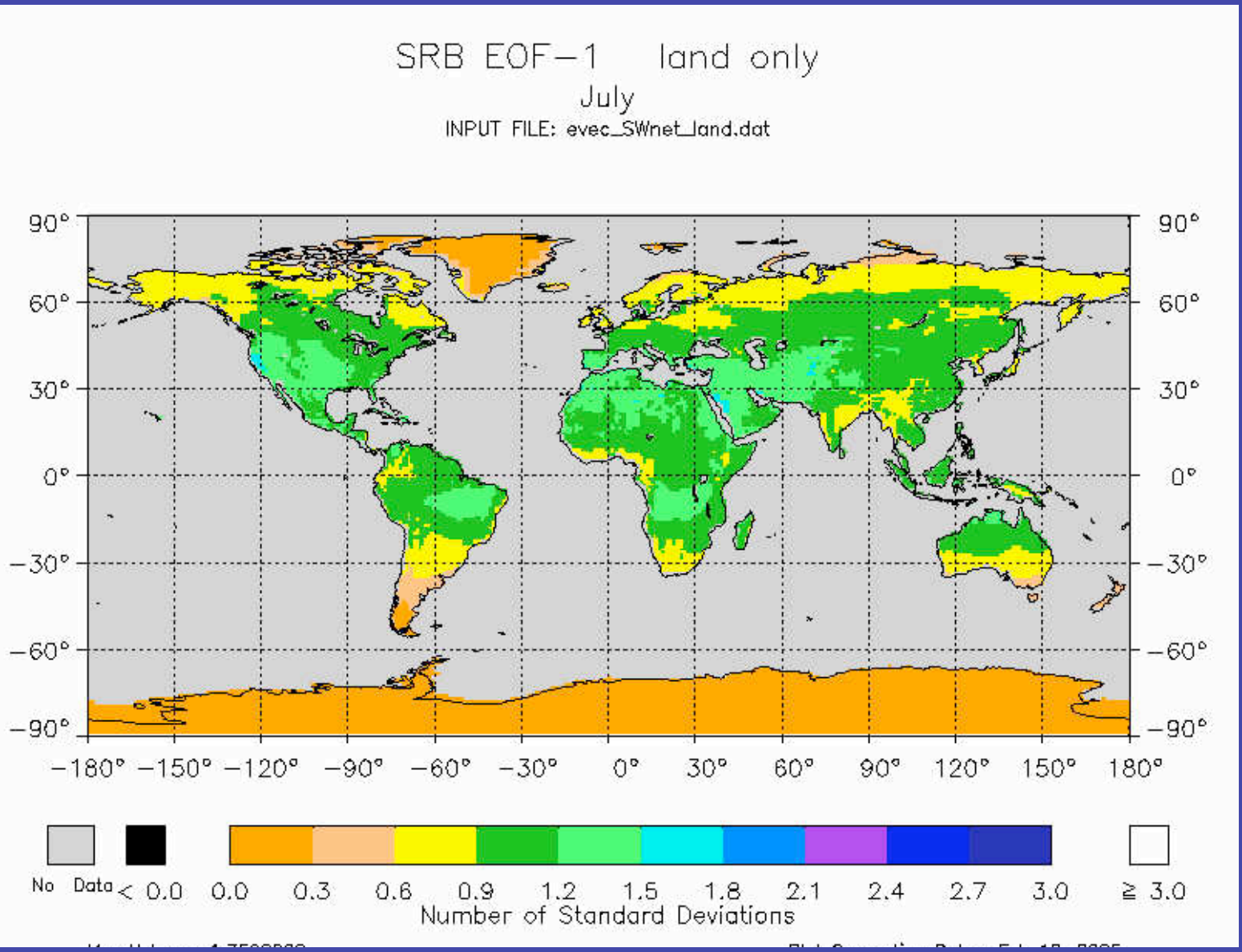
SURFACE RADIATION BUDGET

Downward Shortwave EOF-1

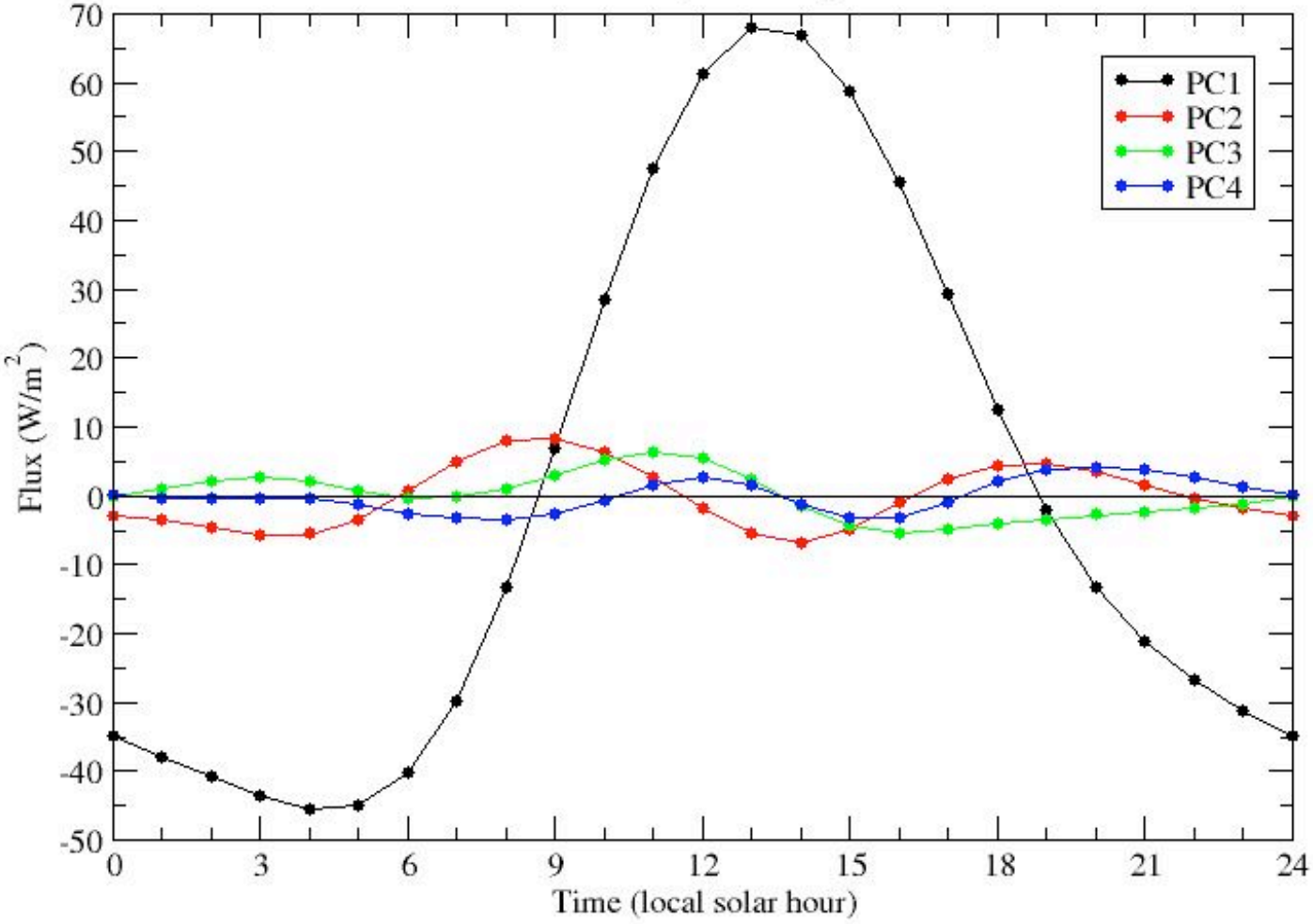



Principal Components for Net SW
Land only; SRB July
Flux (W/m^2)
Time (local solar hour)
PC1
PC2
PC3
PC4
400
300
200
100
0
-100
-200
0
3
6
9
12
15
18
21
24

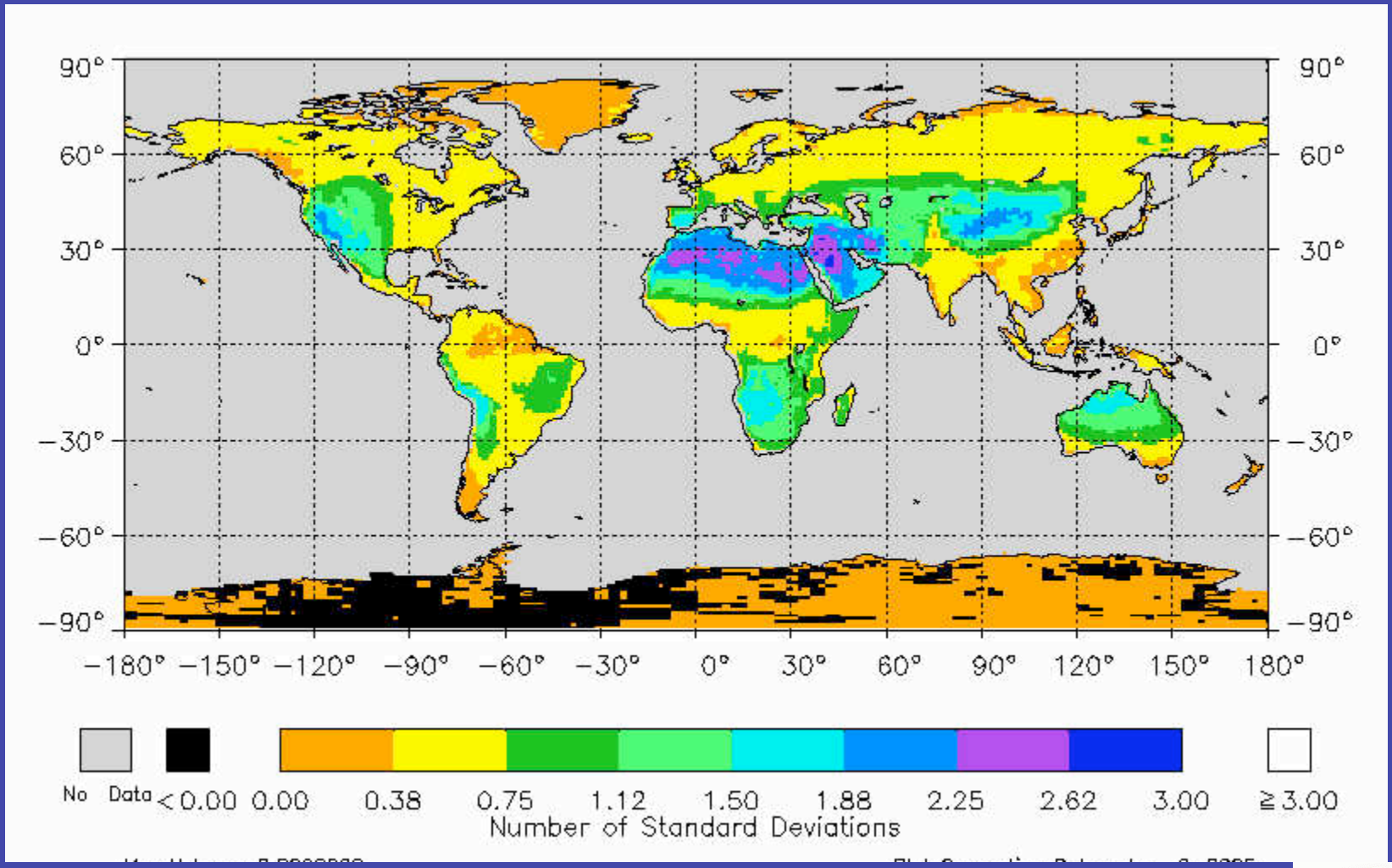

SRB EOF−1 land only
July
INPUT FILE: evec_SWnet_land.dat
90°
60°
30°
0°
−30°
−60°
−90°
−180° −150° −120° −90° −60° −30° 0° 30° 60° 90° 120° 150° 180°
No Data
< 0.0
0.0 0.3 0.6 0.9 1.2 1.5 1.8 2.1 2.4 2.7 3.0
≥ 3.0
Number of Standard Deviations

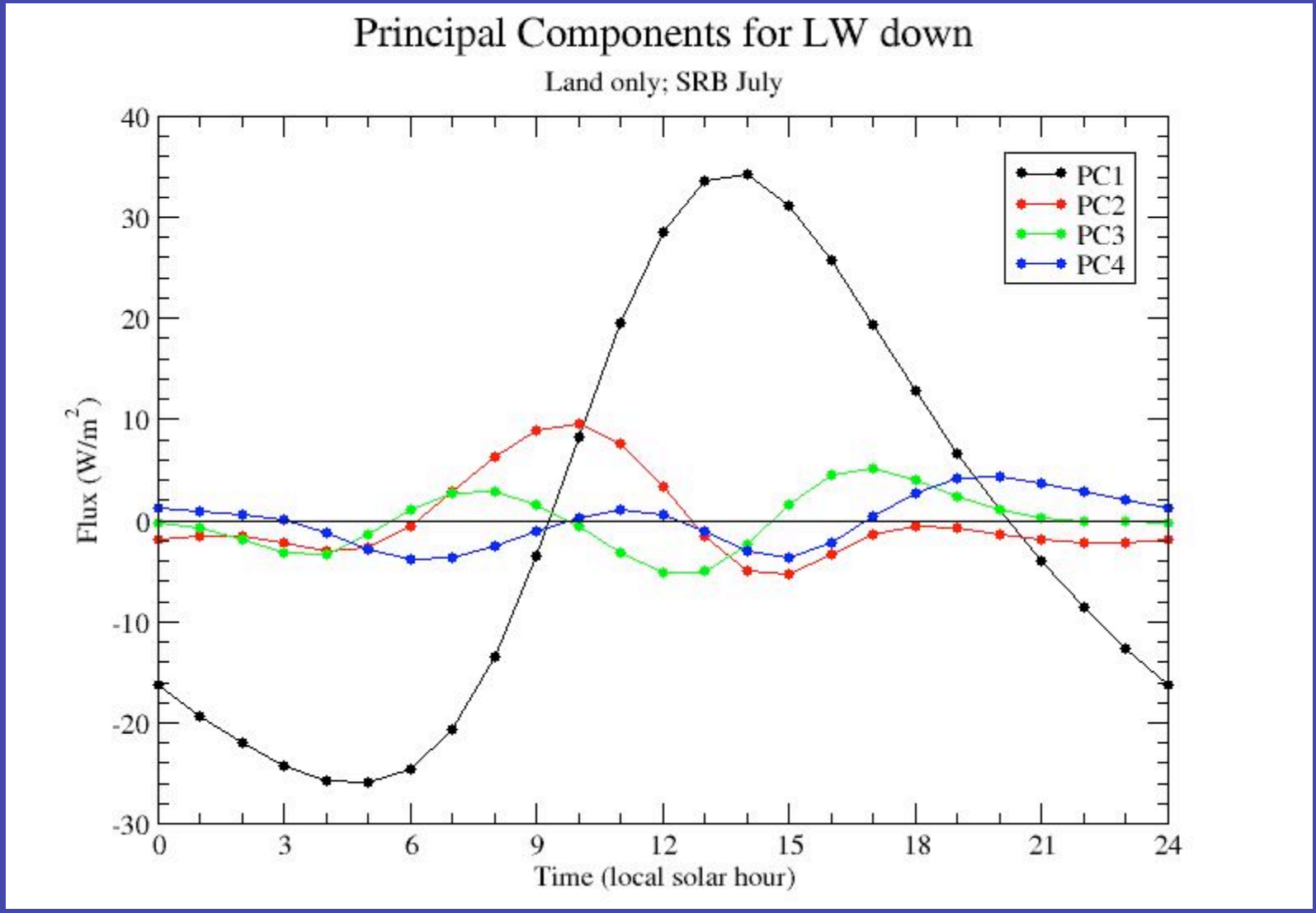
Principal Components for LW up

Land only; SRB July



Up Longwave EOF-1, Land





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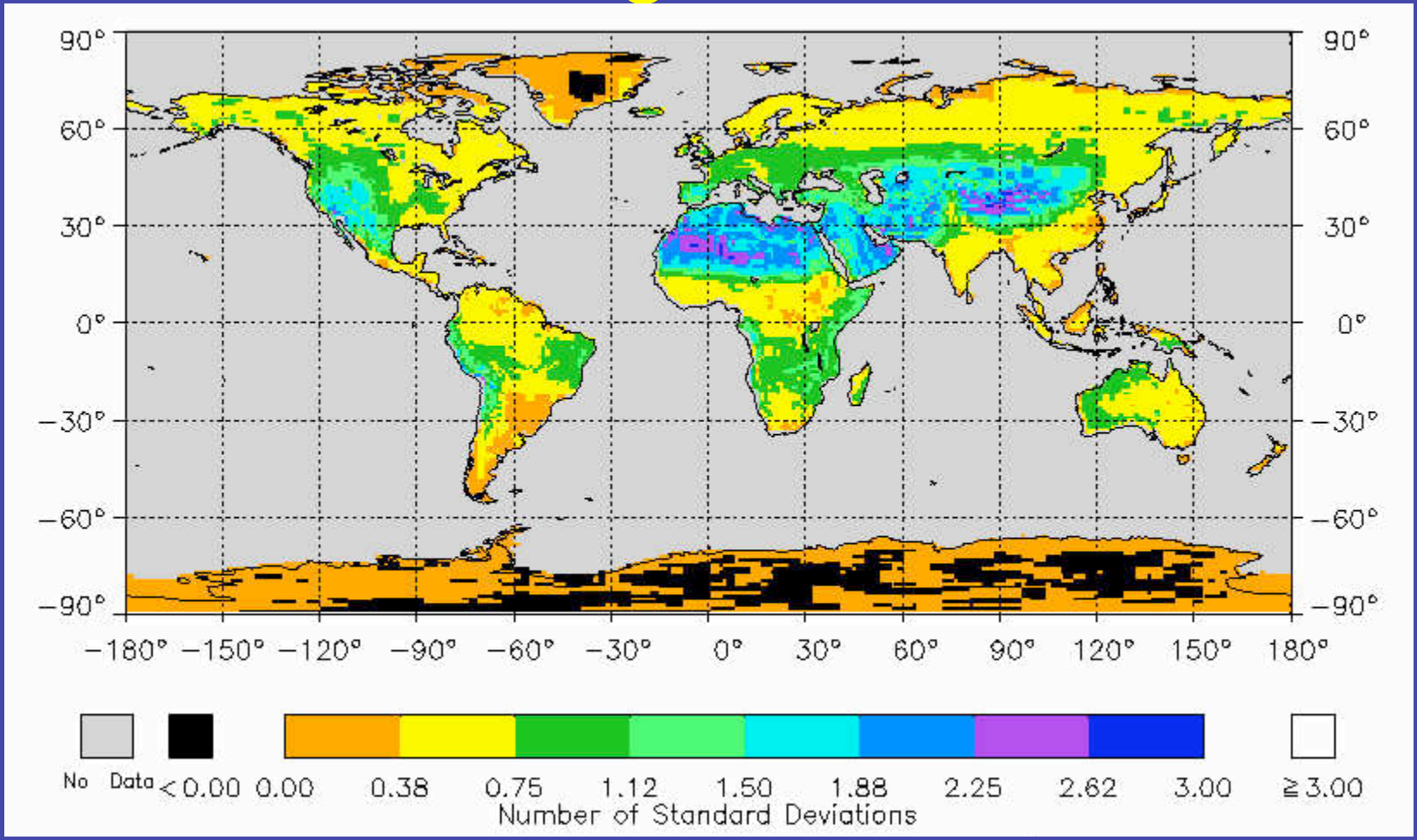
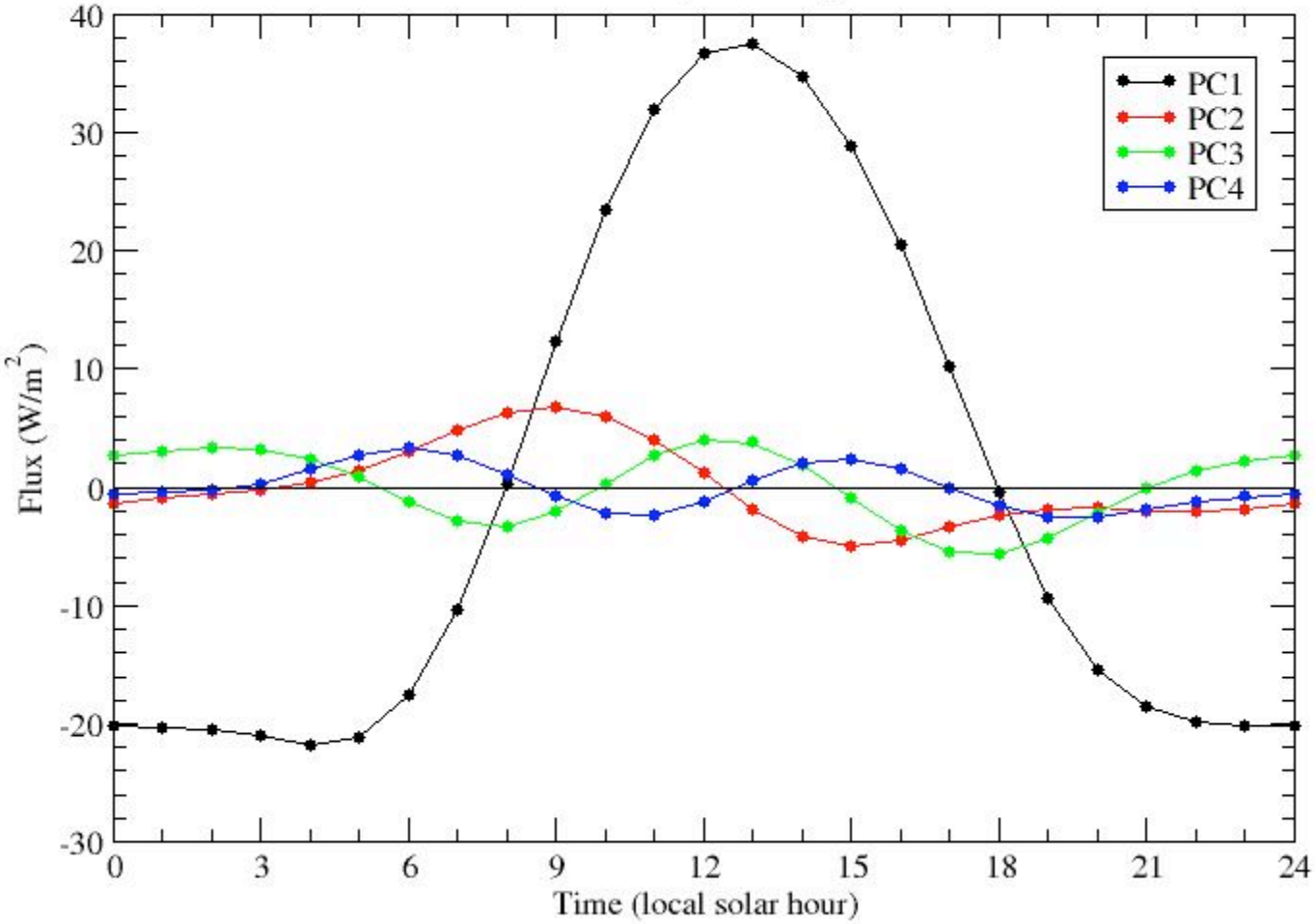
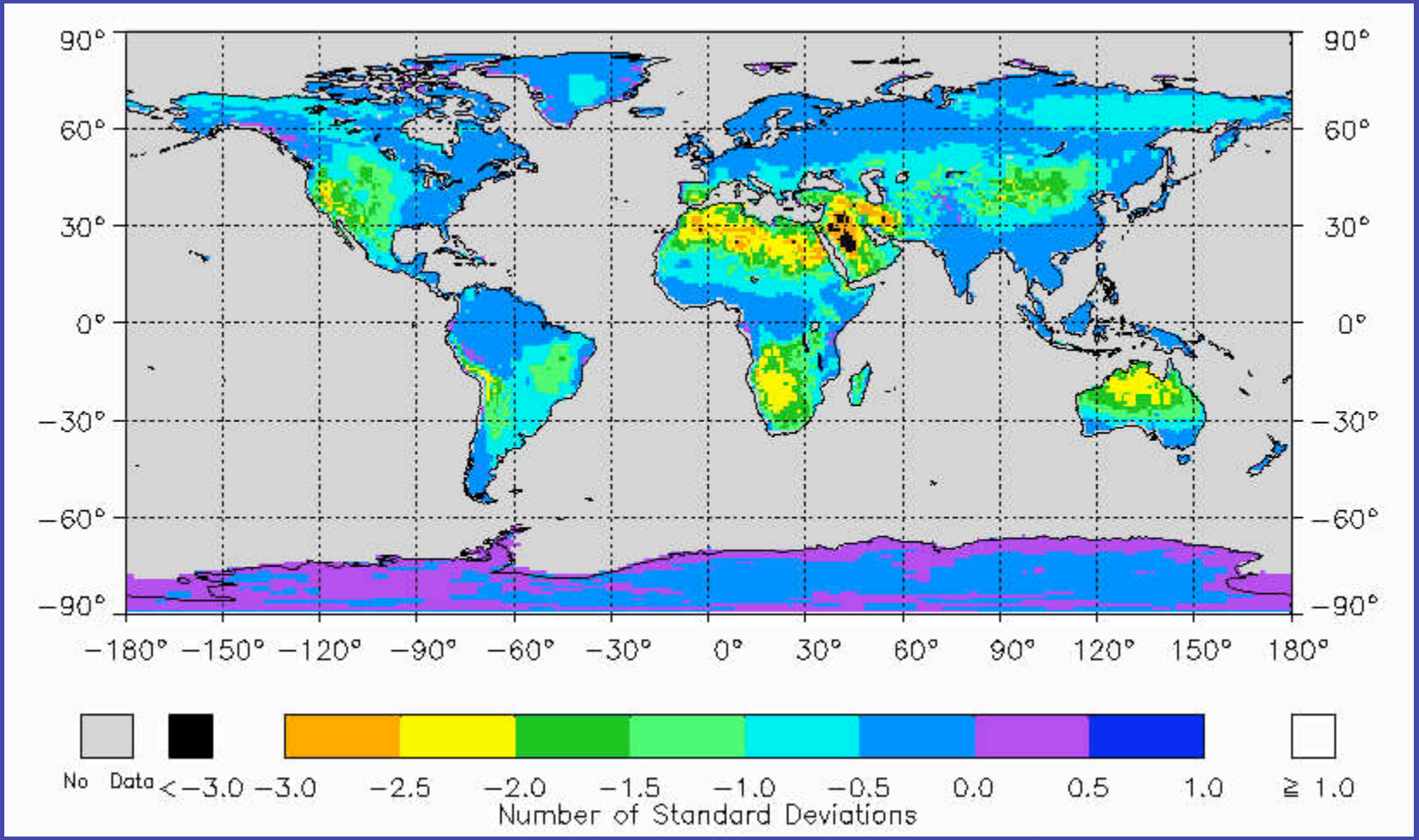
SURFACE RADIATION BUDGET

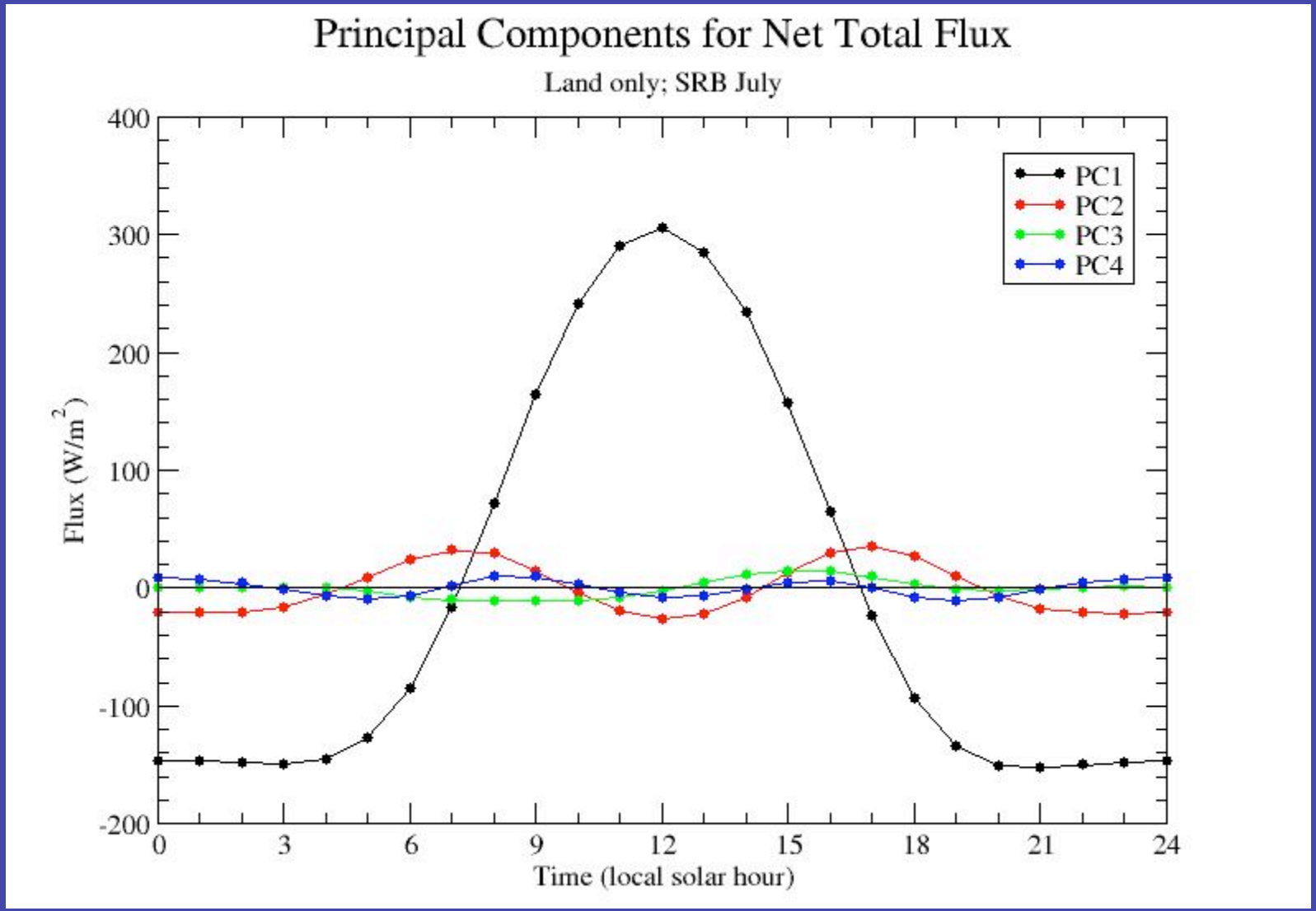
Downward Longwave EOF-1. Land



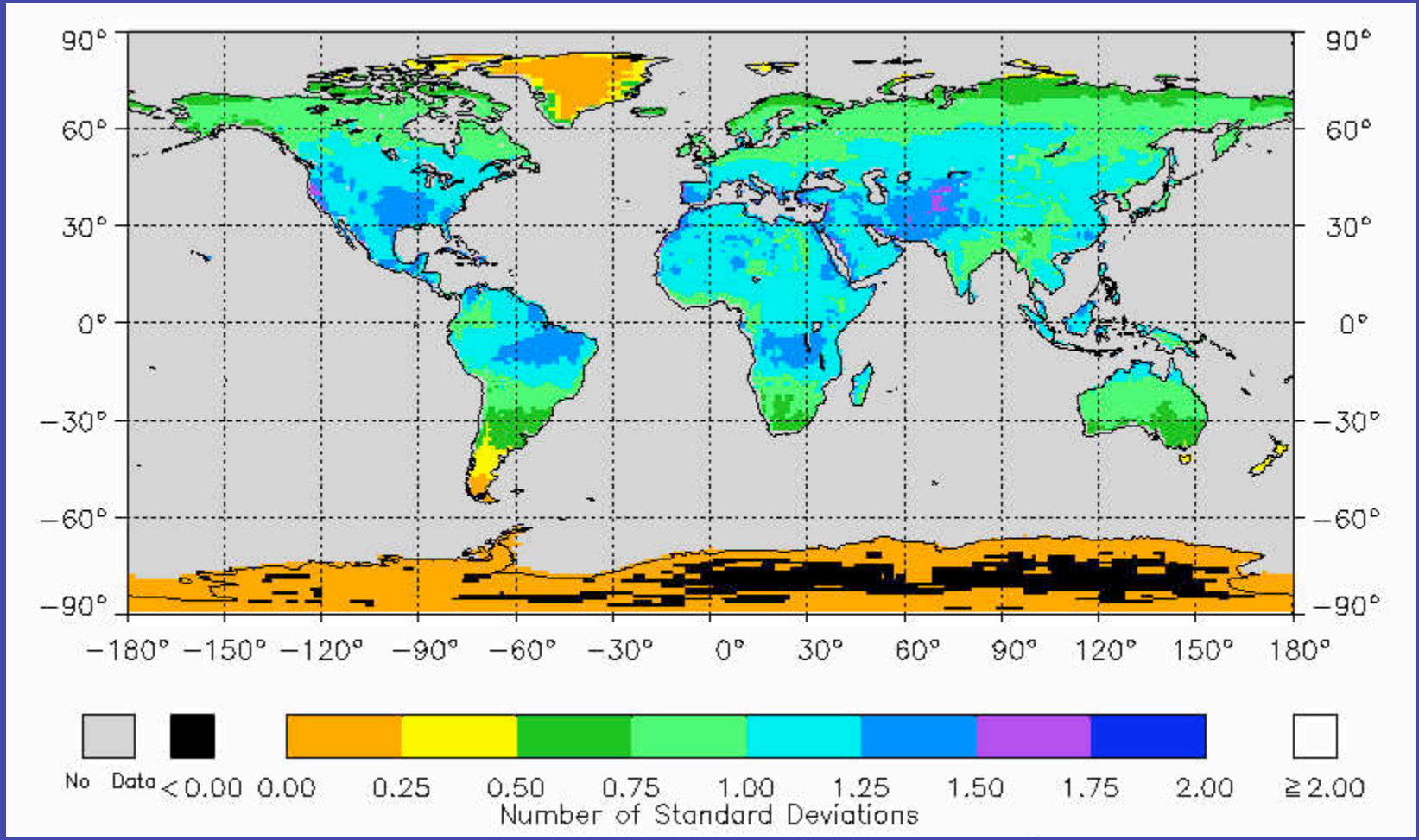

Principal Components for LW net
Land only; SRB July
PC1
PC2
PC3
PC4
Flux (W/m^2)
Time (local solar hour)
40
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24

Net Longwave EOF-1, Land



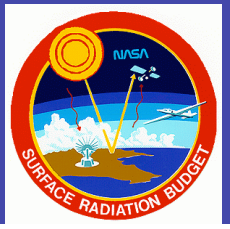
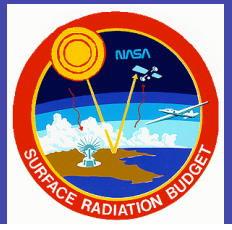

Principal Components for Net Total Flux
Land only; SRB July
PC1
PC2
PC3
PC4
Flux (W/m^2)
400
300
200
100
0
-100
-200
0
3
6
9
12
15
18
21
24
Time (local solar hour)

Net Total Radiation EOF-1, Land



Conclusions

- SW Down and SW Net are very symmetrtic about noon: there is little indication of cloudiness variation with time of day
- LW shows a shift from noon, indicating warming of surface and of atmosphere (expected)
- The first e-value is 95%+ for each component, showing one pattern strongly dominates each component of SRB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