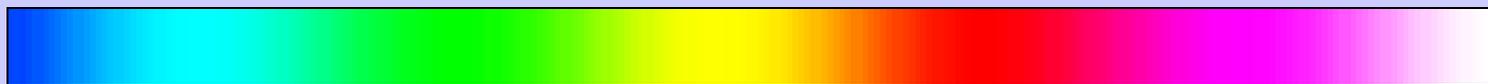
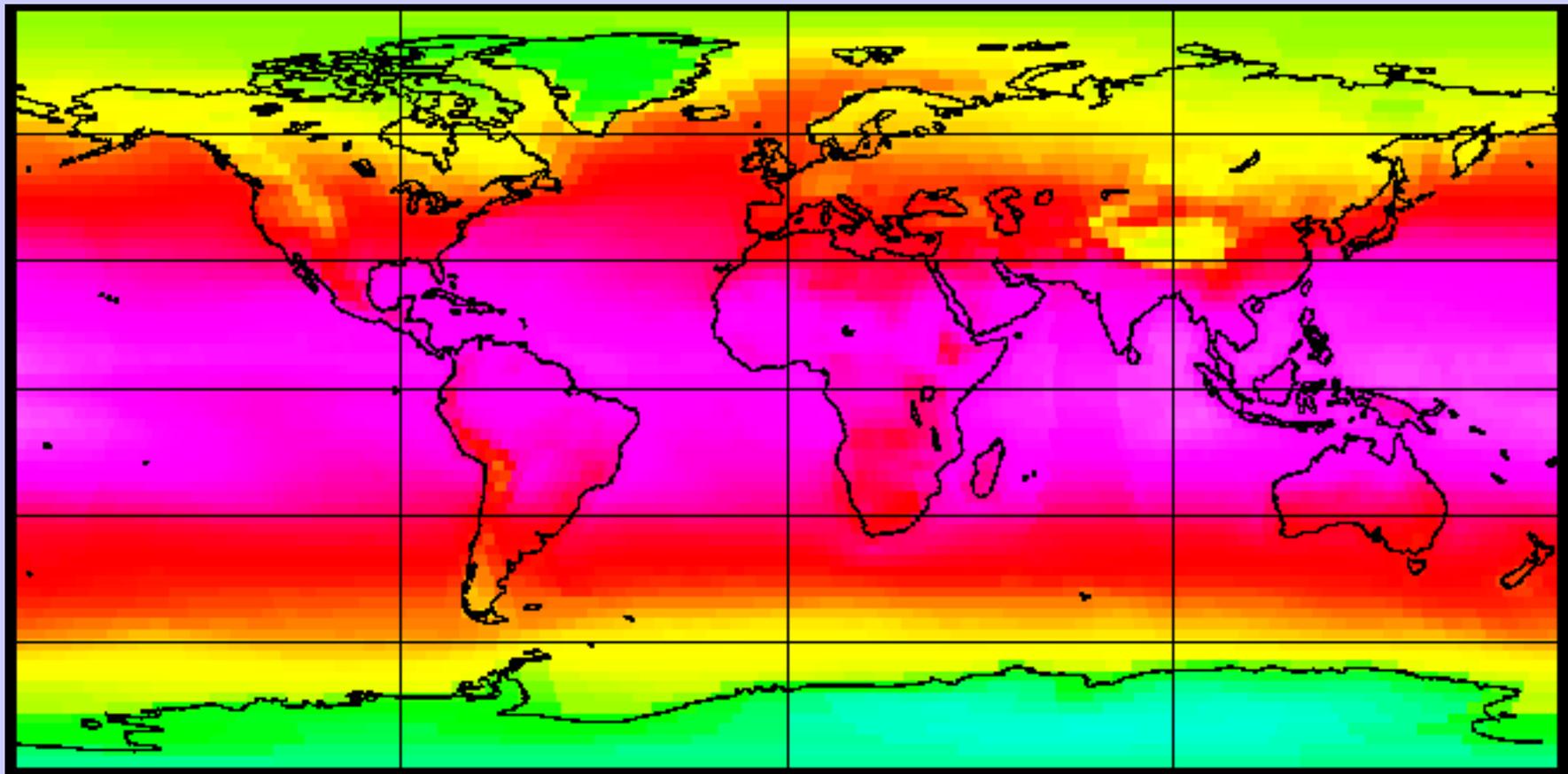


Longwave Surface Radiation and Climate

Lou Smith, Anne Wilber, David
Kratz, Shashi Gupta and Paul
Stackhouse

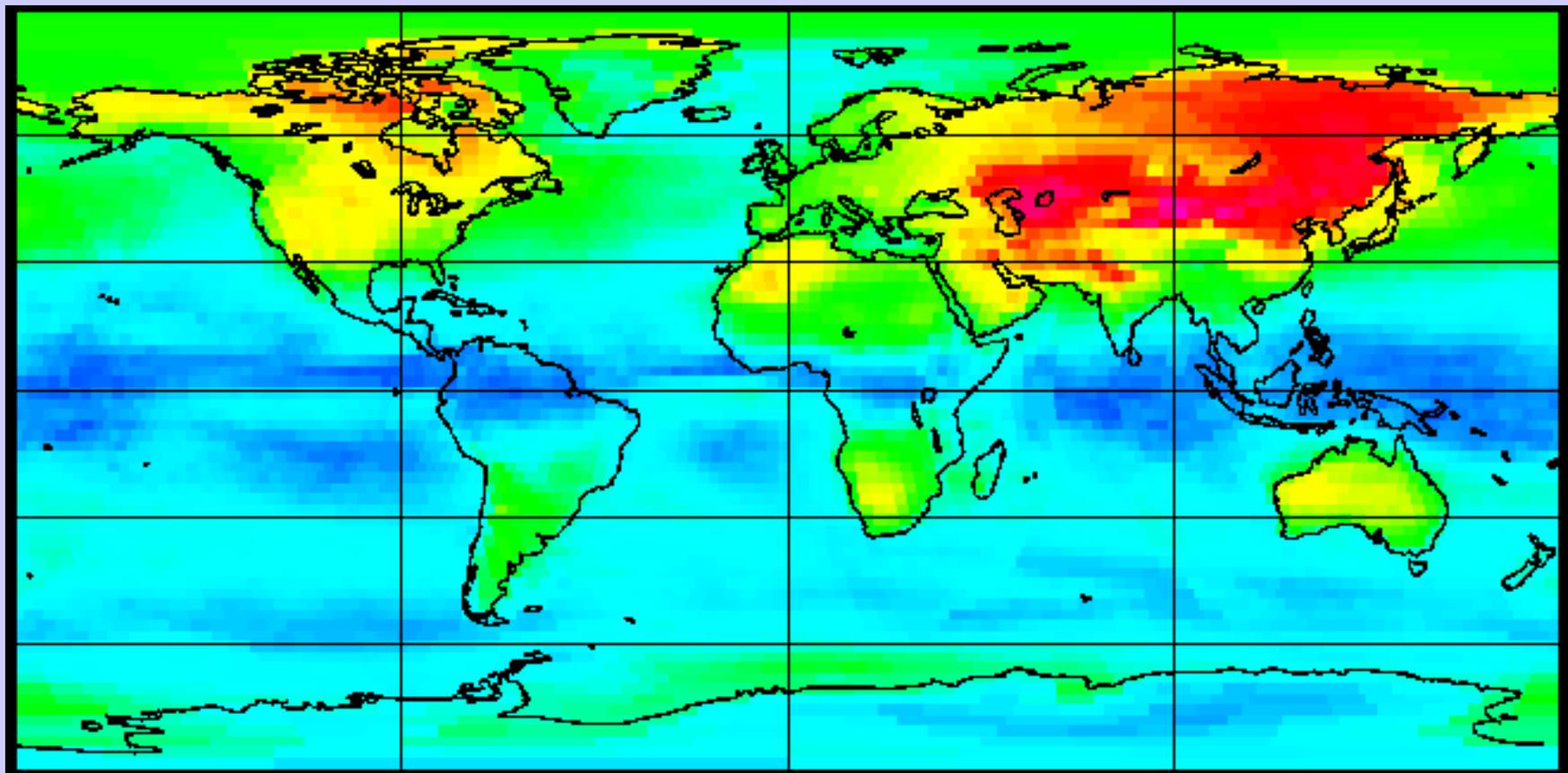
QUESTION:

- What is the Climatological Relation of the Surface Downward Longwave Flux to the Surface Upward Longwave Flux?
- We Use the Surface Radiation Budget Data Set of NASA Langley Research Center to Examine this Question.



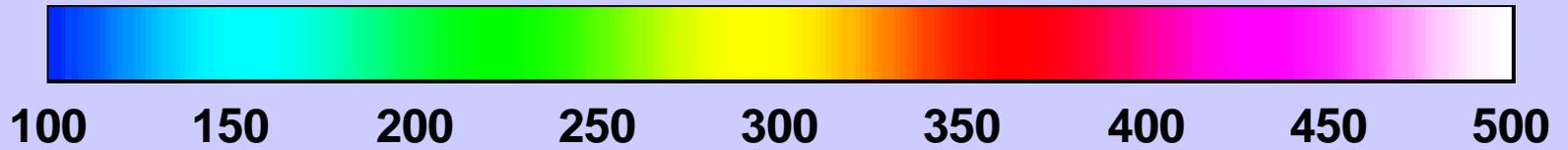
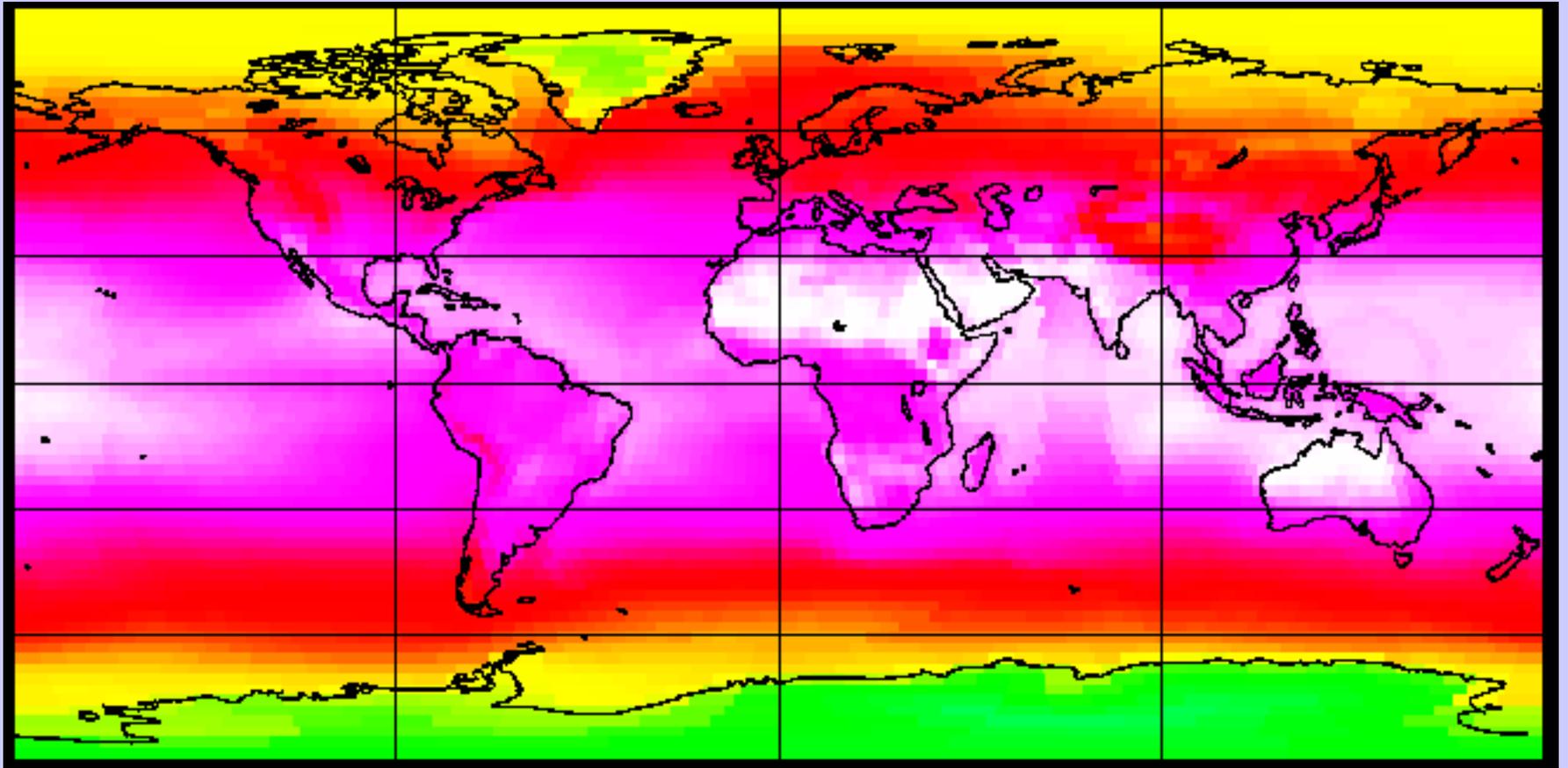
100 150 200 250 300 350 400 450 500

Mean Annual Downward Longwave Radiation Flux (W m^{-2})

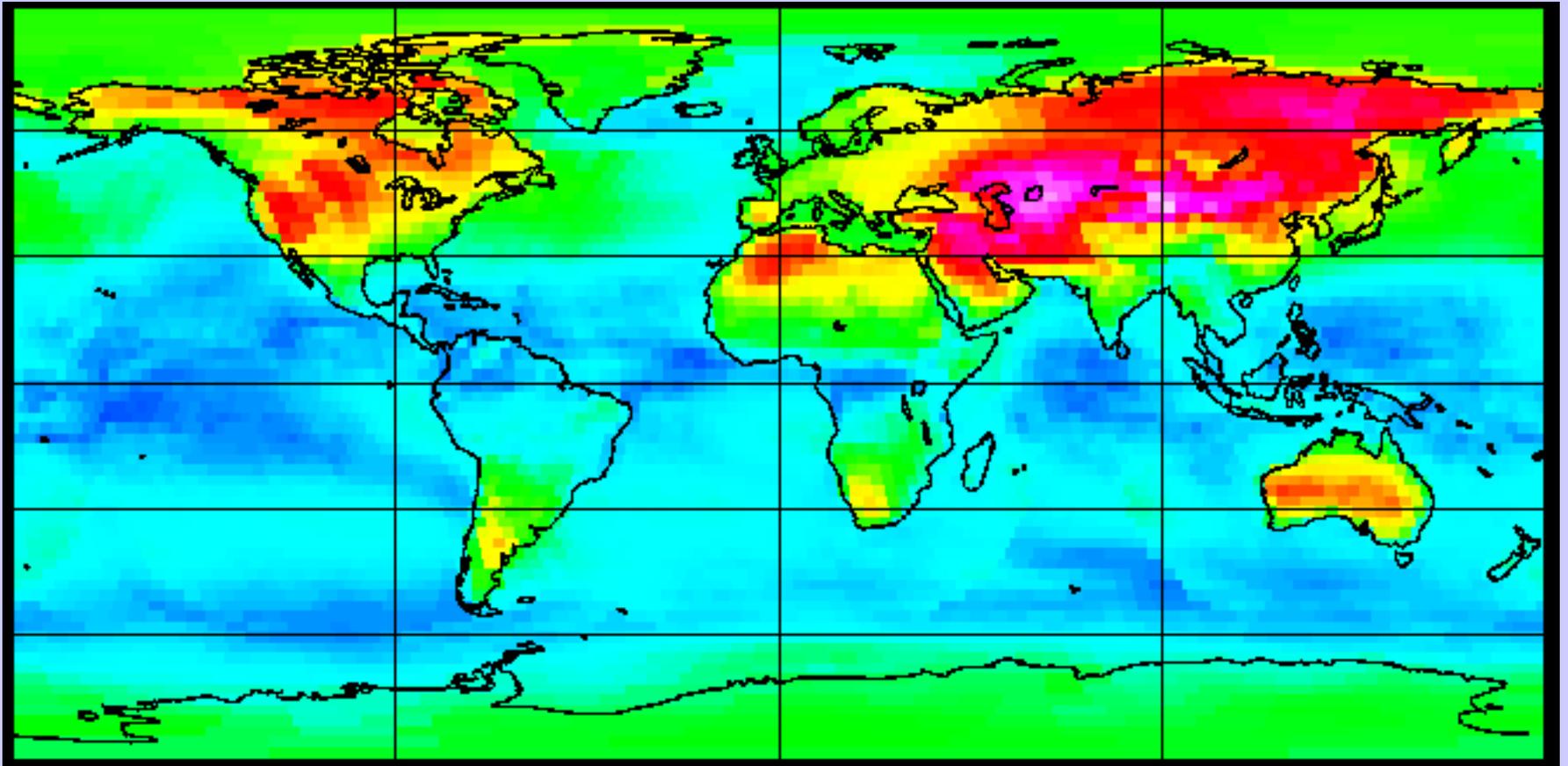


0 50 100 150 200 250 300

Range of Annual Downward Longwave Radiation Flux (W m^{-2})

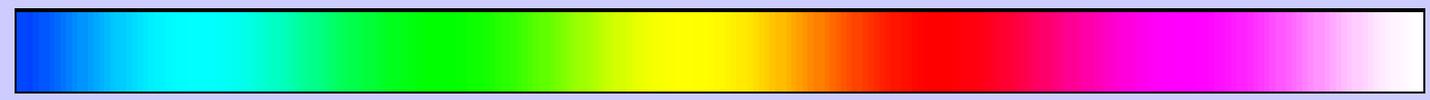
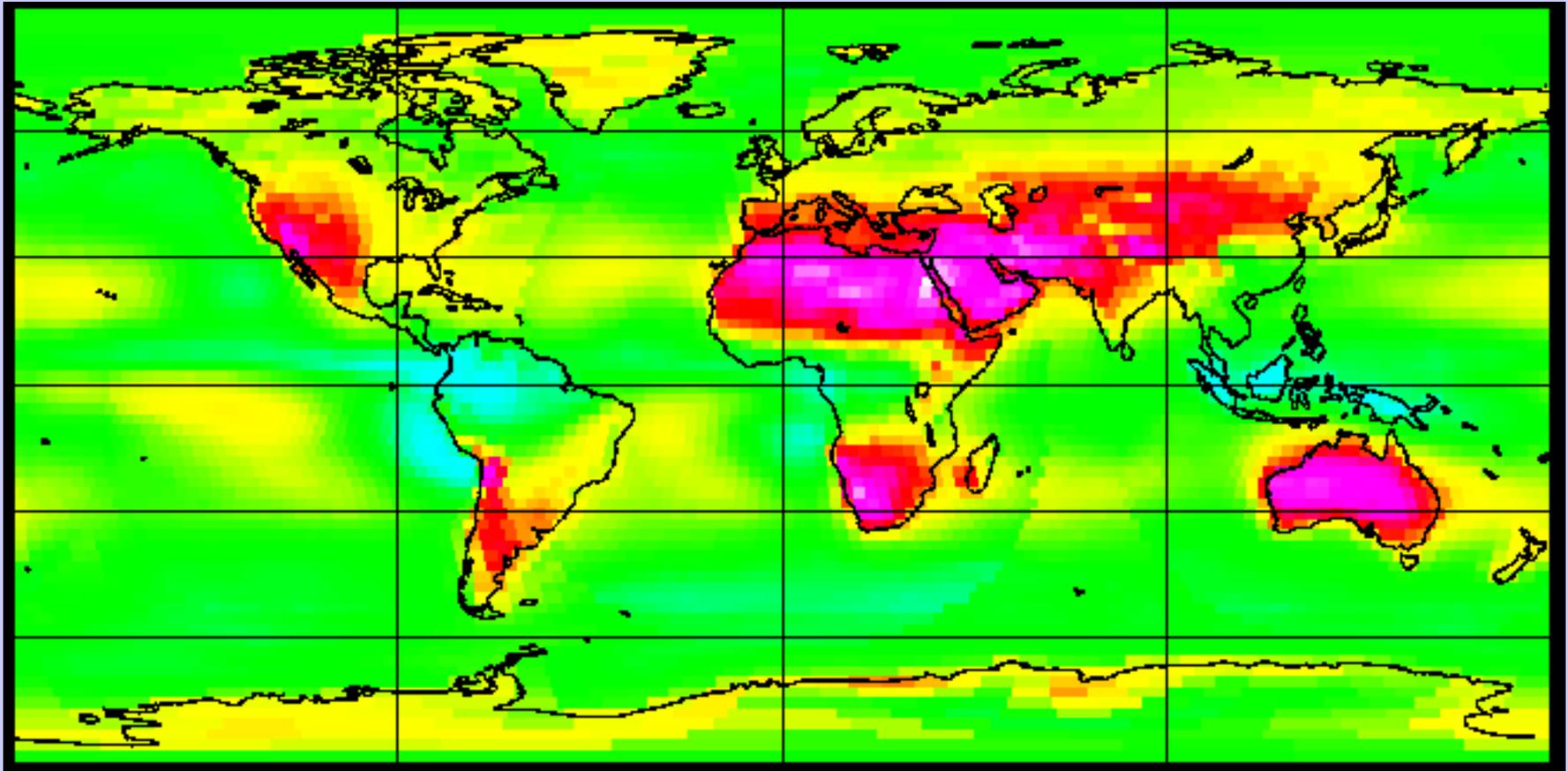


Mean Annual Upward Longwave Radiation Flux (W m^{-2})



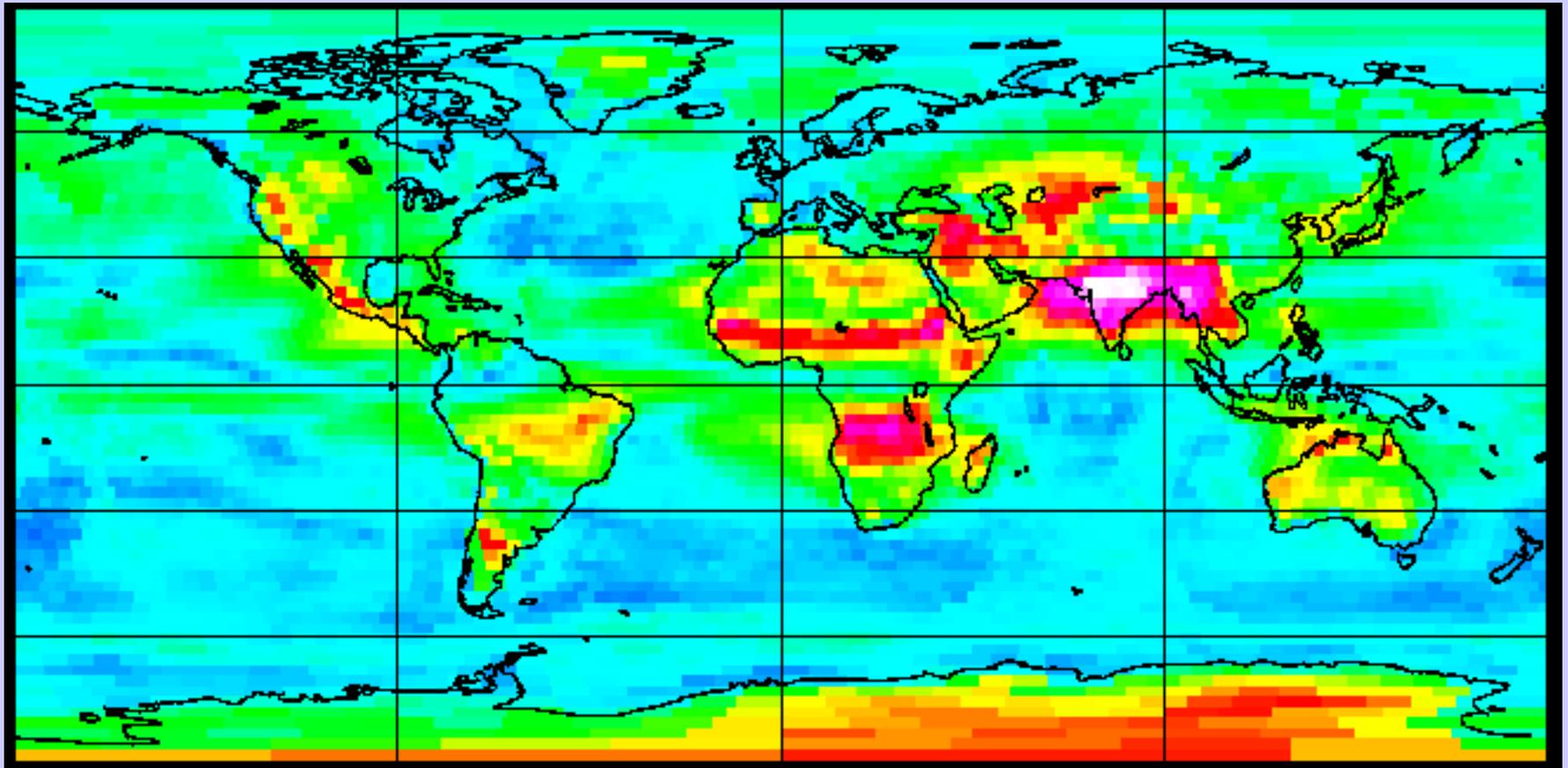
0 50 100 150 200 250 300

Range of Annual Upward Longwave Radiation Flux (W m^{-2})



0 20 40 60 80 100 120

Mean Annual Net Longwave Radiation Flux (W m^{-2})



0 20 40 60 80 100

Range of Annual Net Longwave Radiation Flux (W m^{-2})

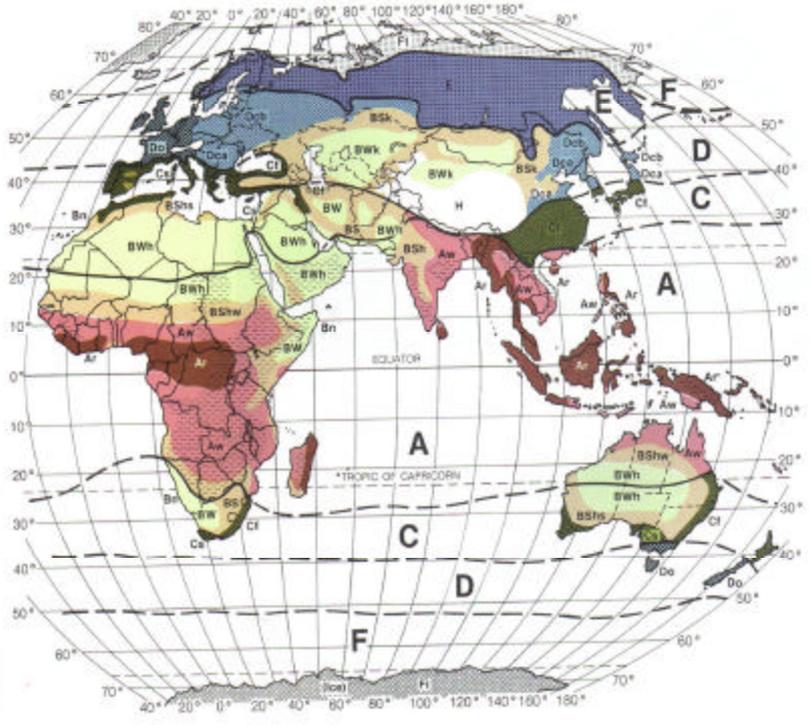
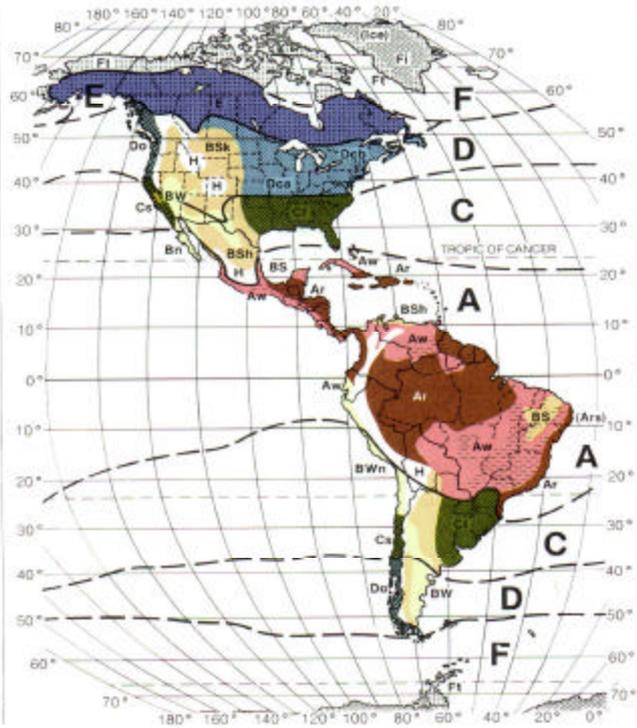
The Net Surface Longwave Flux is much smaller than the upward and downward components. The patterns of map of annual range appear to match those of the climate classifications

Groups and Types of Climate

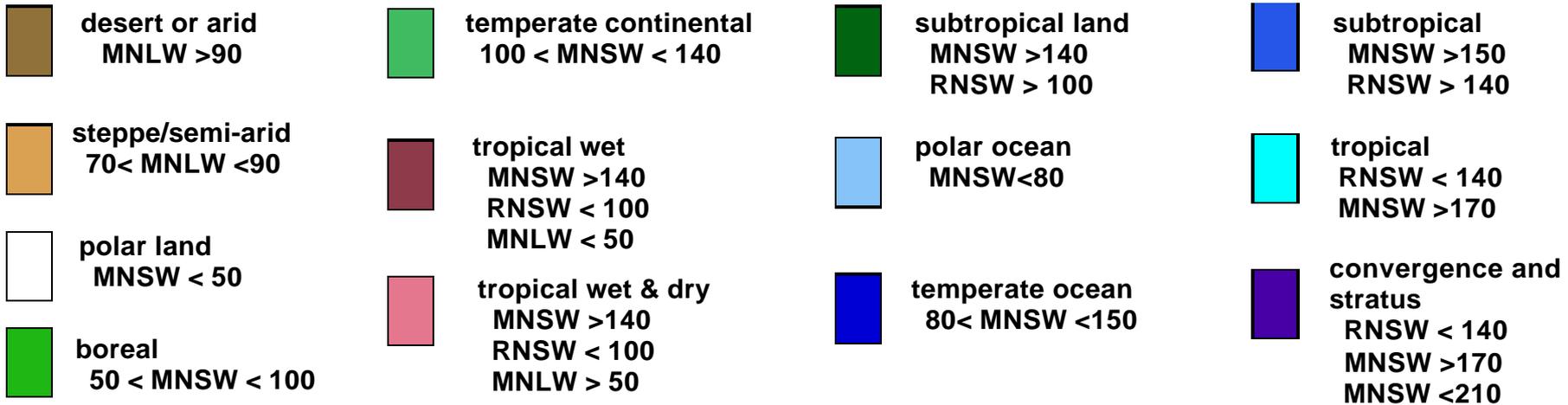
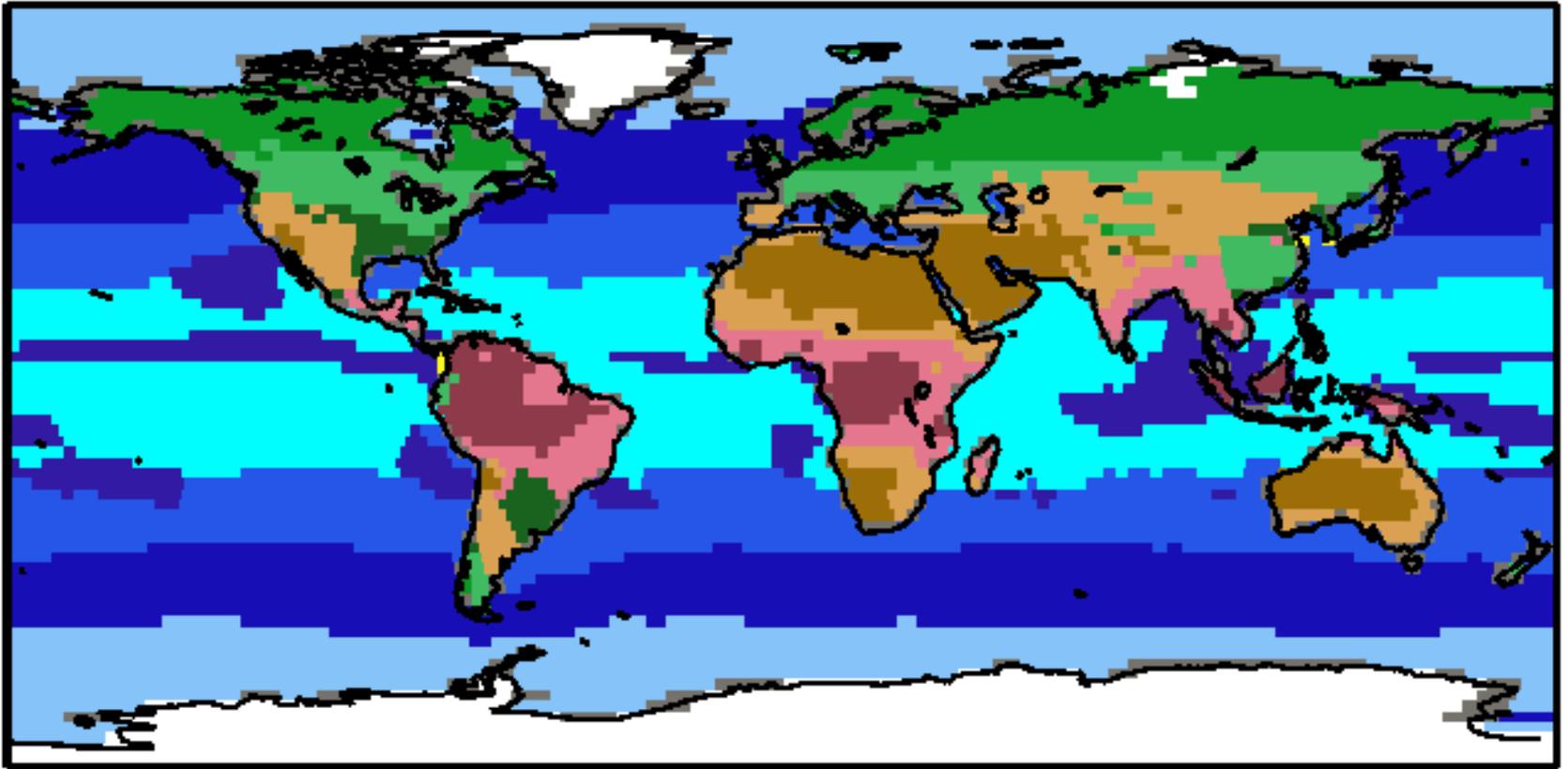
Groups	Types
A Tropical humid	Ar Tropical wet
	Aw Tropical wet-and-dry
B Dry	BW Desert or arid
	BS Steppe or semiarid
C Subtropical	Csh Subtropical dry summer
	Ch Subtropical humid
D Temperate	Dc Temperate oceanic
	Ds Temperate continental
E Boreal	E Boreal
F Polar	Ft Tundra
	Fi Ice cap
H Highland	H

Extensive tropical uplands in A climates over 2000 ft (610 m) in elevation

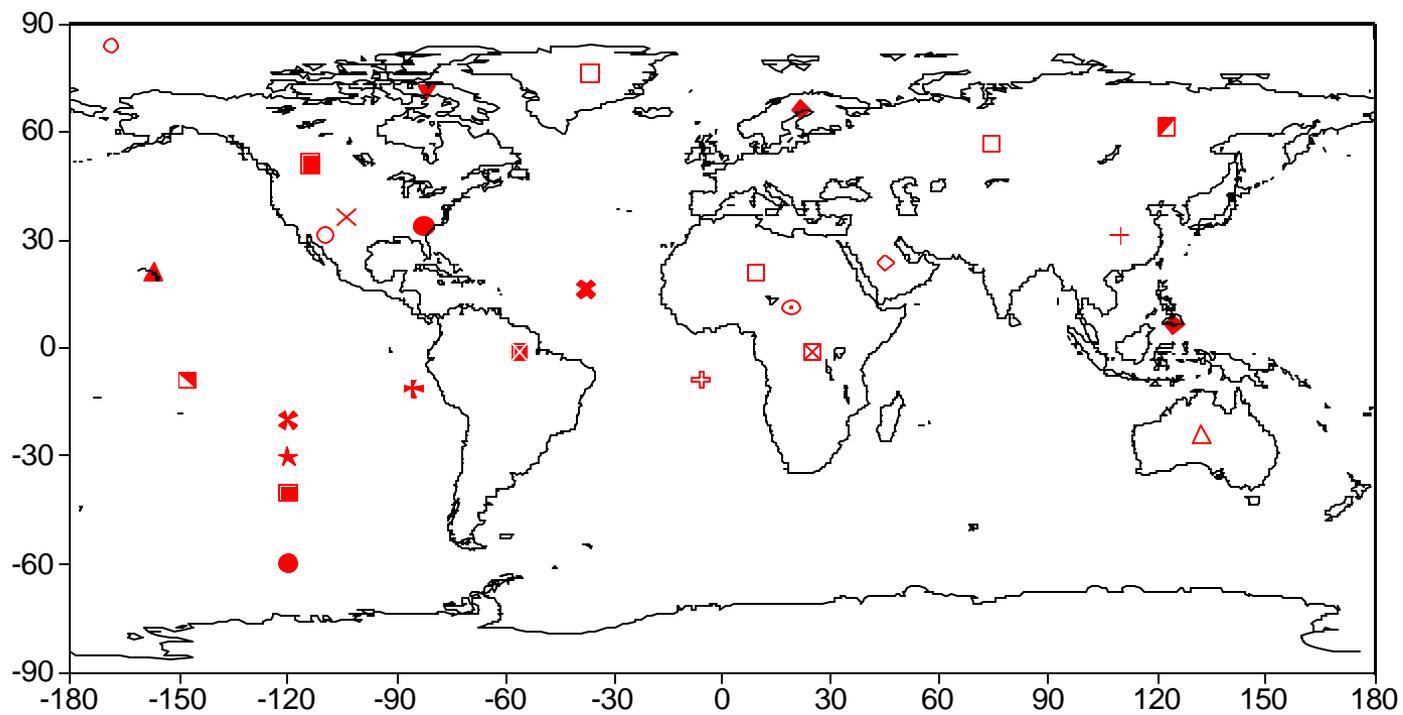
0 500 1000 1500 2000 2500 M
0 100 200 300 400 Km
Scale at latitude 35°



Climate Classification Map of Trewartha and Horne (1980)

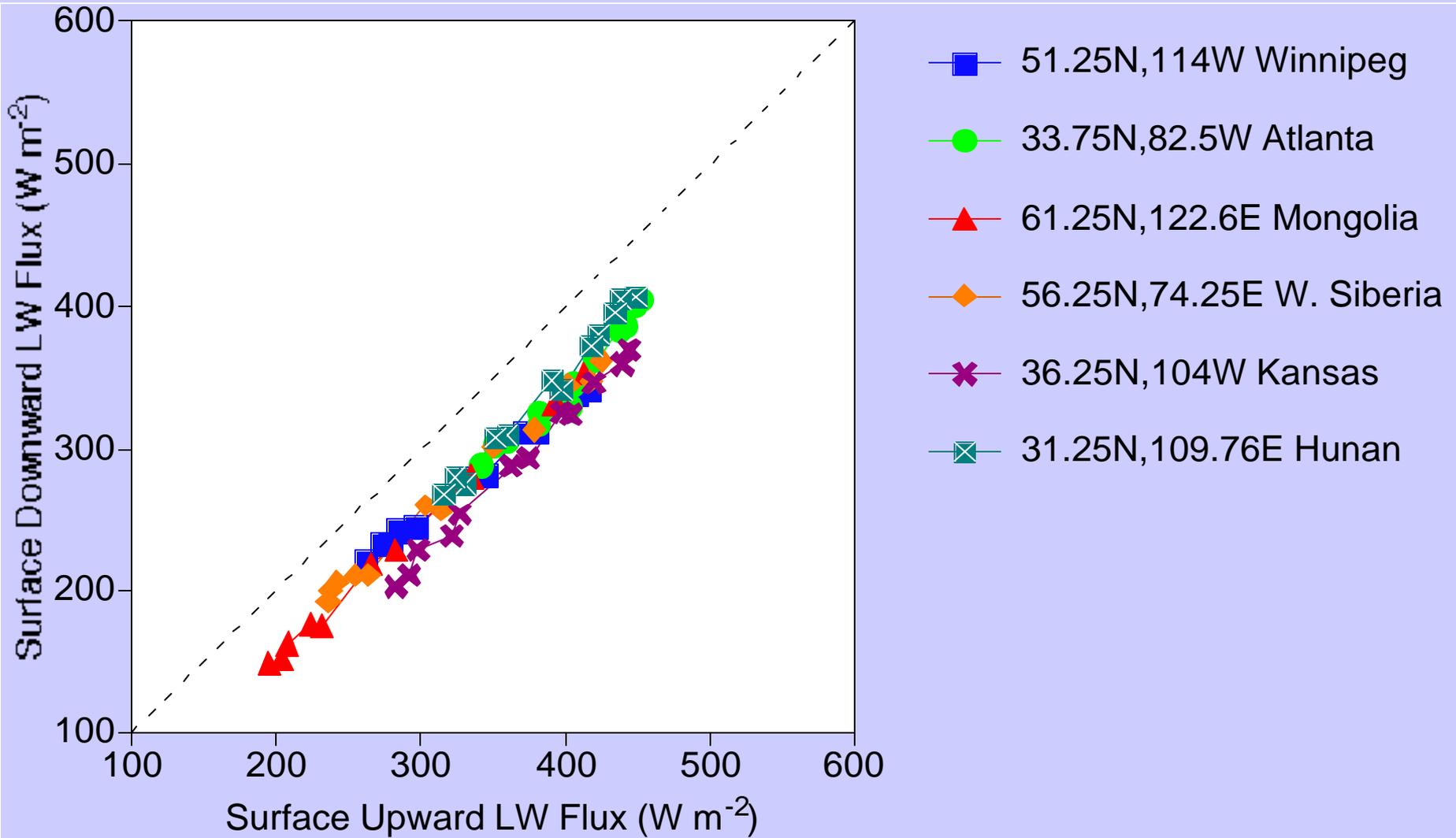


We selected a number of sites representing many climate classes and plotted monthly means of Downward Longwave vs Upward Longwave Flux for each site.

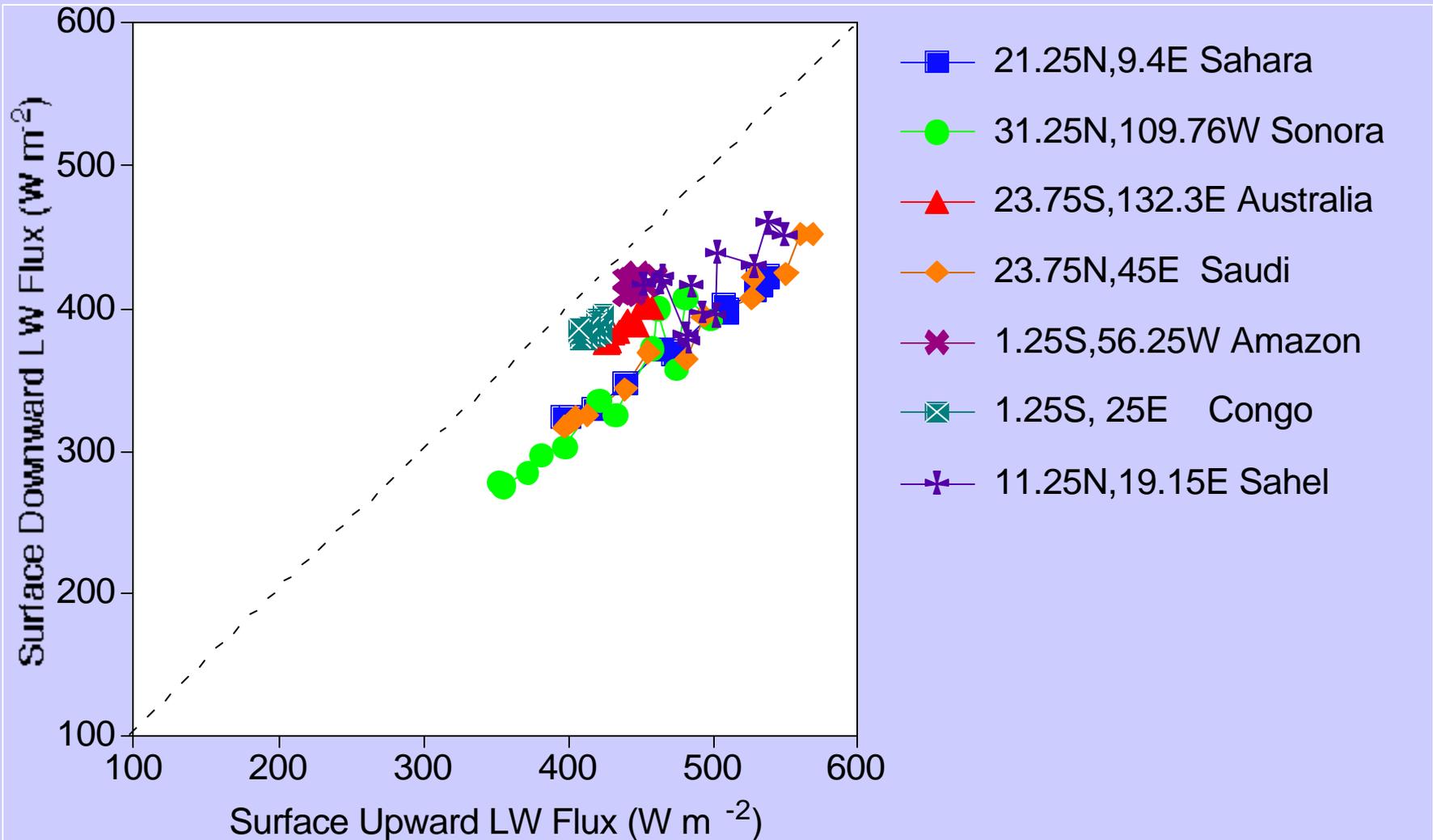


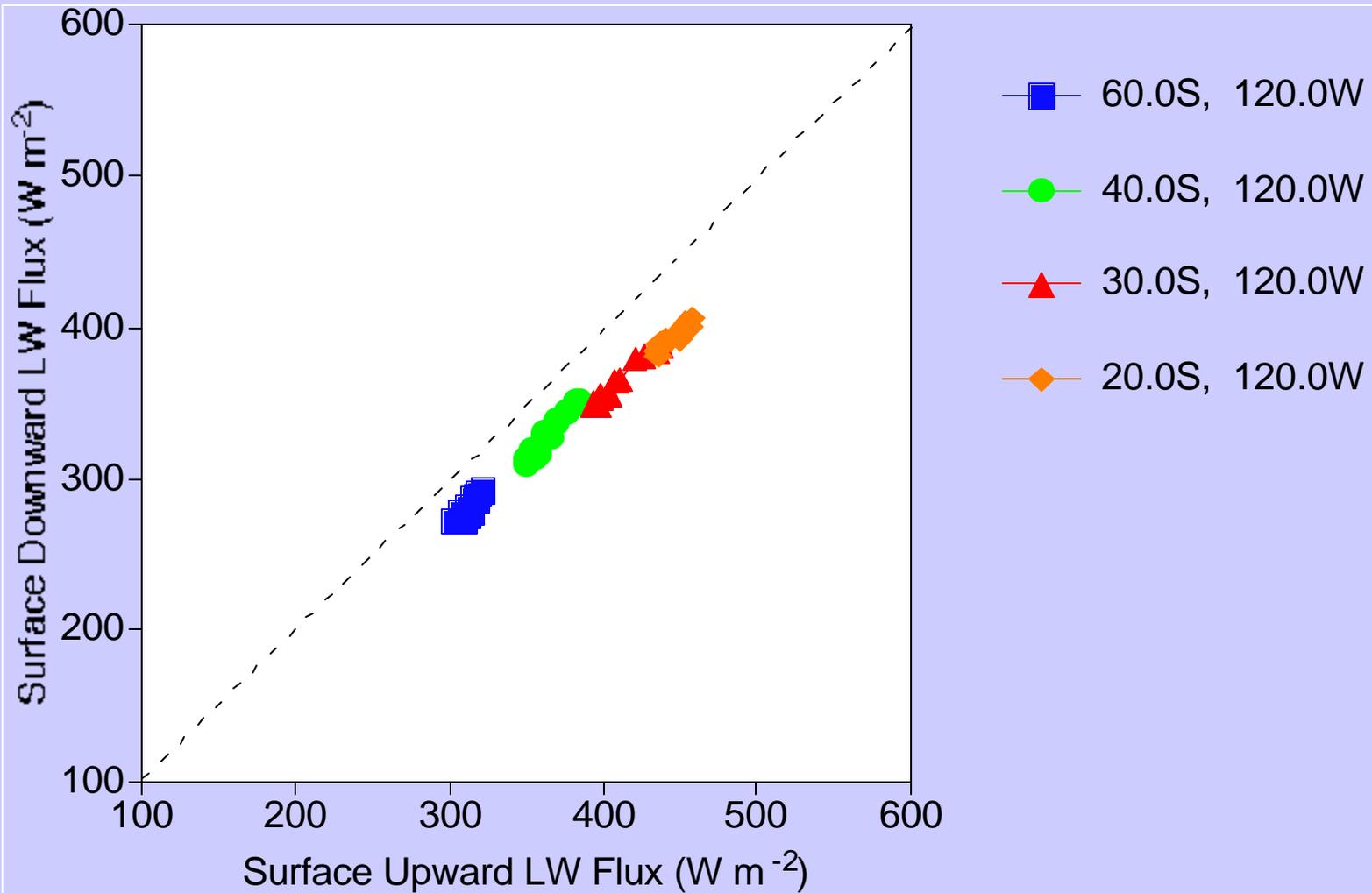
- | | | |
|-----------------------------|---------------------------|-----------------------------|
| ■ 51.25N, 114W Winnipeg | ⊠ 1.25S, 25E Congo | ✱ 11.25S, 85.53W Pacific |
| ● 33.75N, 82.5W Atlanta | ○ 11.25N, 19.15E Sahel | ✱ 20.0S, 120.0W |
| ▲ 21.25N, 157.16W Hawaii | ▣ 61.25N, 122.6E Mongolia | ★ 30.0S, 120.0W |
| ◆ 6.25N, 124.6E Borneo | □ 56.25N, 74.25E Siberia | ▣ 40.0S, 120.0W |
| □ 21.25N, 9.4E Sahara | × 36.25N, 104W Kansas | ● 60.0S, 120.0W |
| ○ 31.25N, 109.76W Sonora | + 31.25N, 109.76E Hunan | ▼ 71.25N, 82.17W Baffin Isl |
| △ 23.75S, 132.3E Australian | ⊕ 8.75S, 6.34W Atlantic | ◆ 66.25N, 21.72E Sweden |
| ◇ 23.75N, 45E Saudi | ✱ 16.25N, 37.83W Atlantic | □ 76.25N, 37.06W Greenland |
| ⊠ 1.25S, 56.25W Amazon | ▣ 8.75S, 148.3W Pacific | ○ 83.75N, 168.75W Arctic |

Locations of Sites Studied

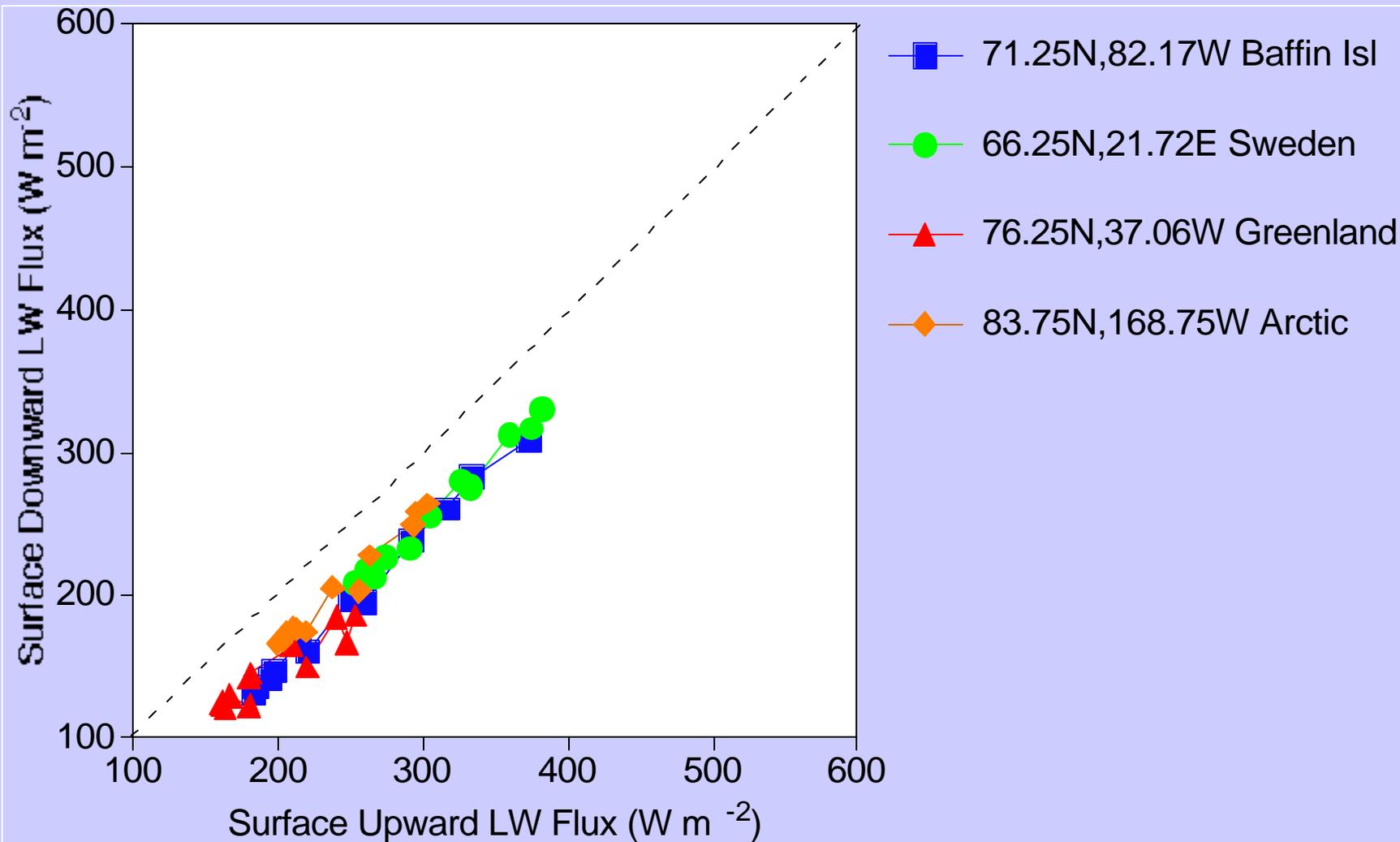


Downward Longwave Flux as Function of Upward Flux for Several Continental Locations

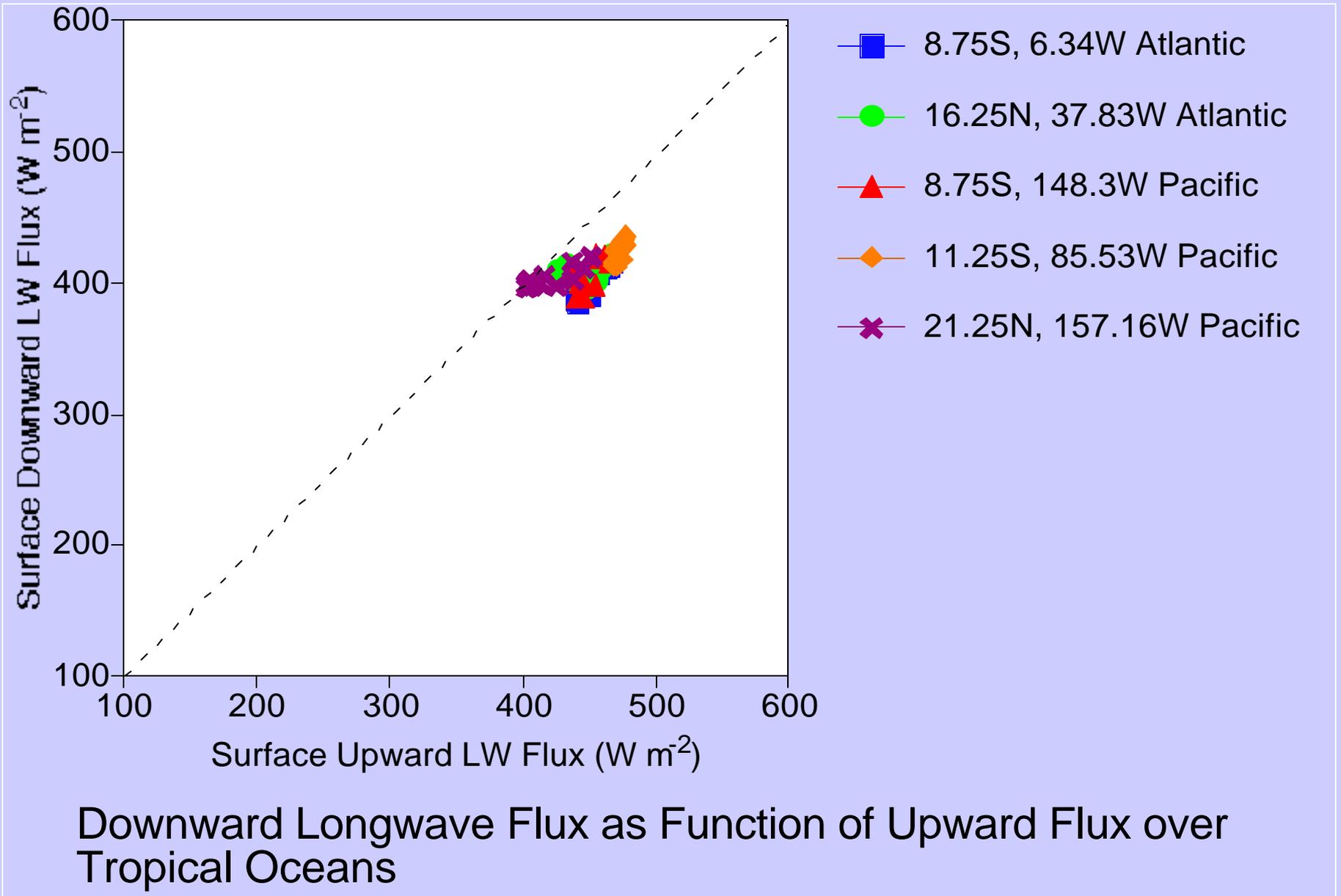


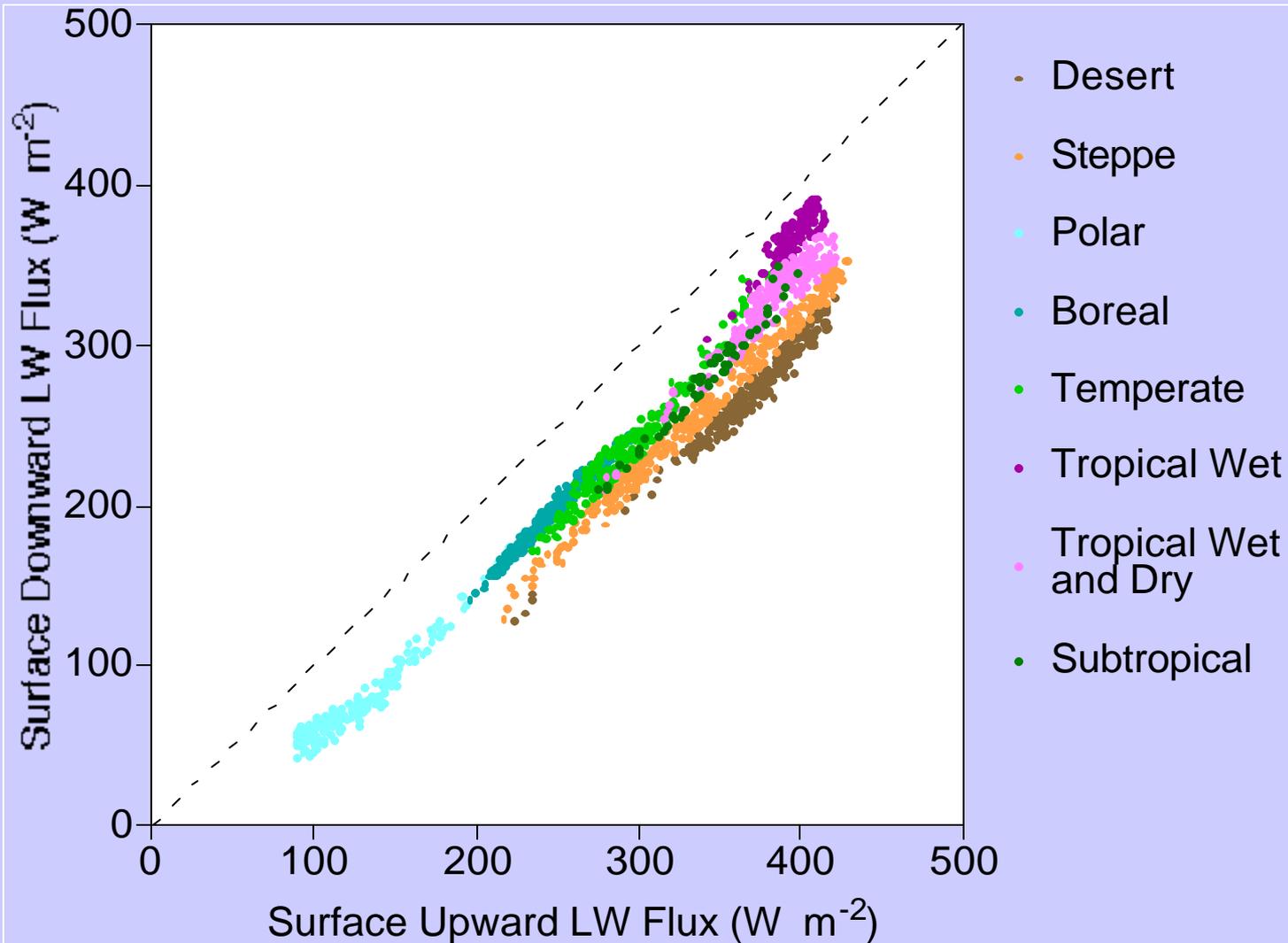


Downward Longwave Flux as Function of Upward Flux over South Pacific for Several Latitudes

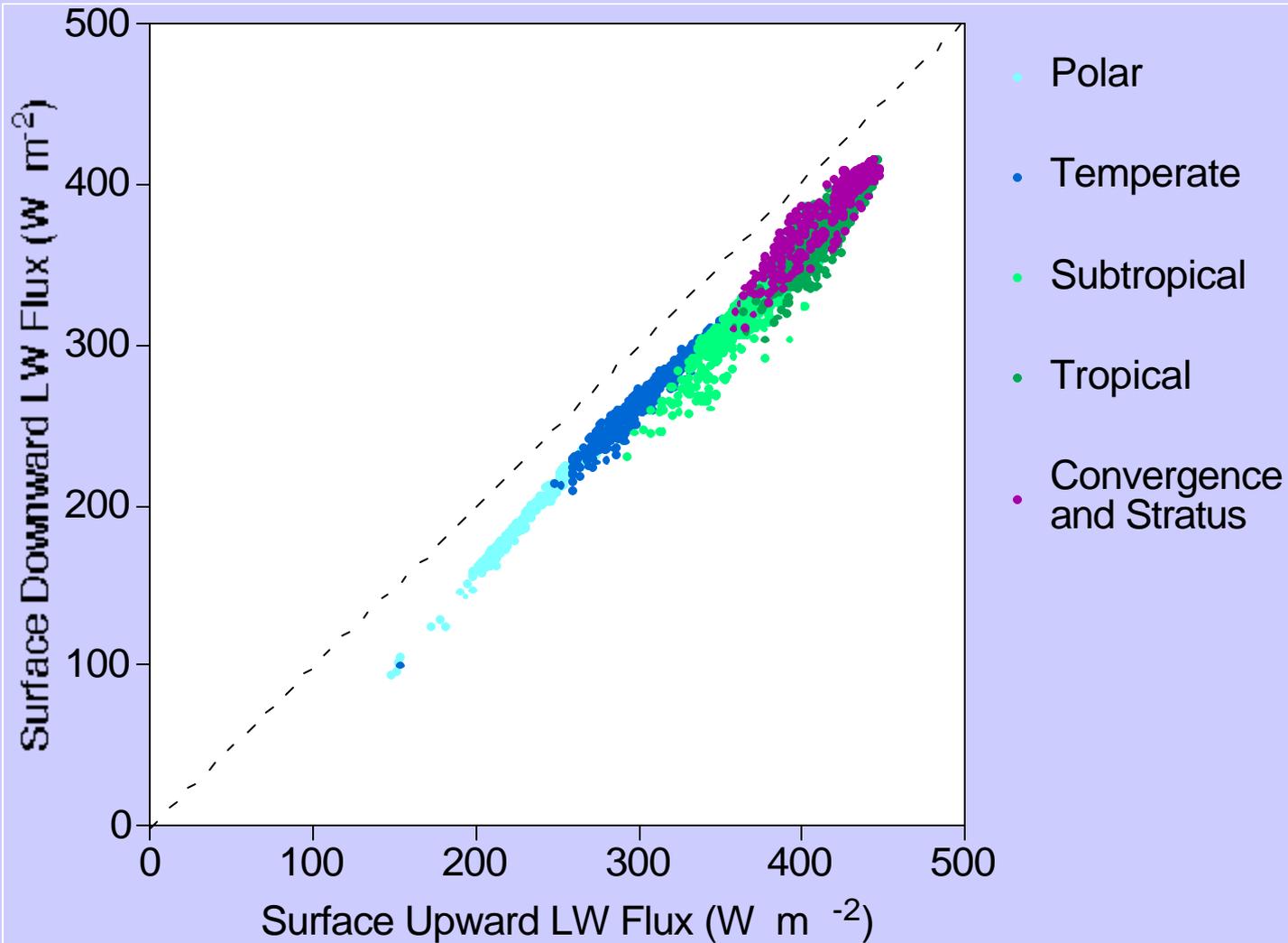


Downward Longwave Flux as Function of Upward Flux for High Latitudes





Annual Mean Downward Longwave Flux as Function of Mean Upward Flux Separated by Climate Type for Land



Annual Mean Downward Longwave Flux as Function of Mean Upward Flux Separated by Climate Type for Ocean

The annual cycle of Downward vs Upward Longwave Flux at the surface is a characteristic of the climate class.

CONCLUSIONS:

- The relation between monthly mean downward and upward longwave surface fluxes of region is a characteristic of its climate classification.
- A plot of regional annual mean Downward Longwave Flux vs Upward Flux is partitioned into various climate classes.
- The annual range on monthly mean Net Surface Longwave Flux is a characteristic of the climate class.