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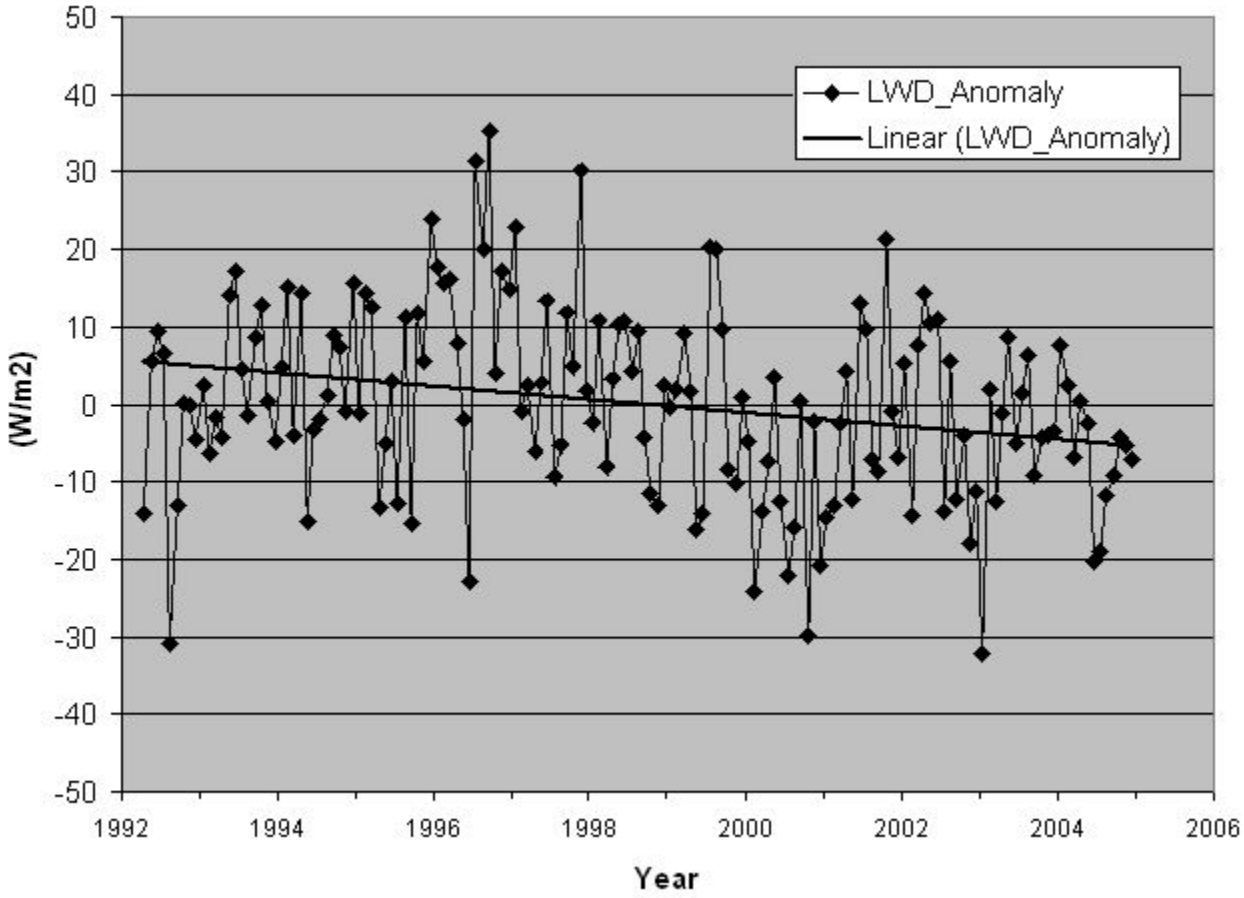
How to Treat Changes in PIR Pyrgeometer Calibrations?

LWD Trend at Neumayer



1. Pyrgeometer gets ventilated. No temperature differences between dome and body are taken into account.
2. The temperature dependence of the thermopile is neglected.

$$L = \frac{V}{C} + \sigma T^4$$

L = long-wave radiation
V = thermopile output
C = calibration coefficient
σ = Stephan Boltzmann constant
T = pyrgeometer temperature

Word Radiation Center (WRC)

1. Pyrgeometer gets ventilated. Nevertheless, temperature differences between dome and body are taken into account.
2. The temperature dependence of the thermopile is ***not*** neglected.

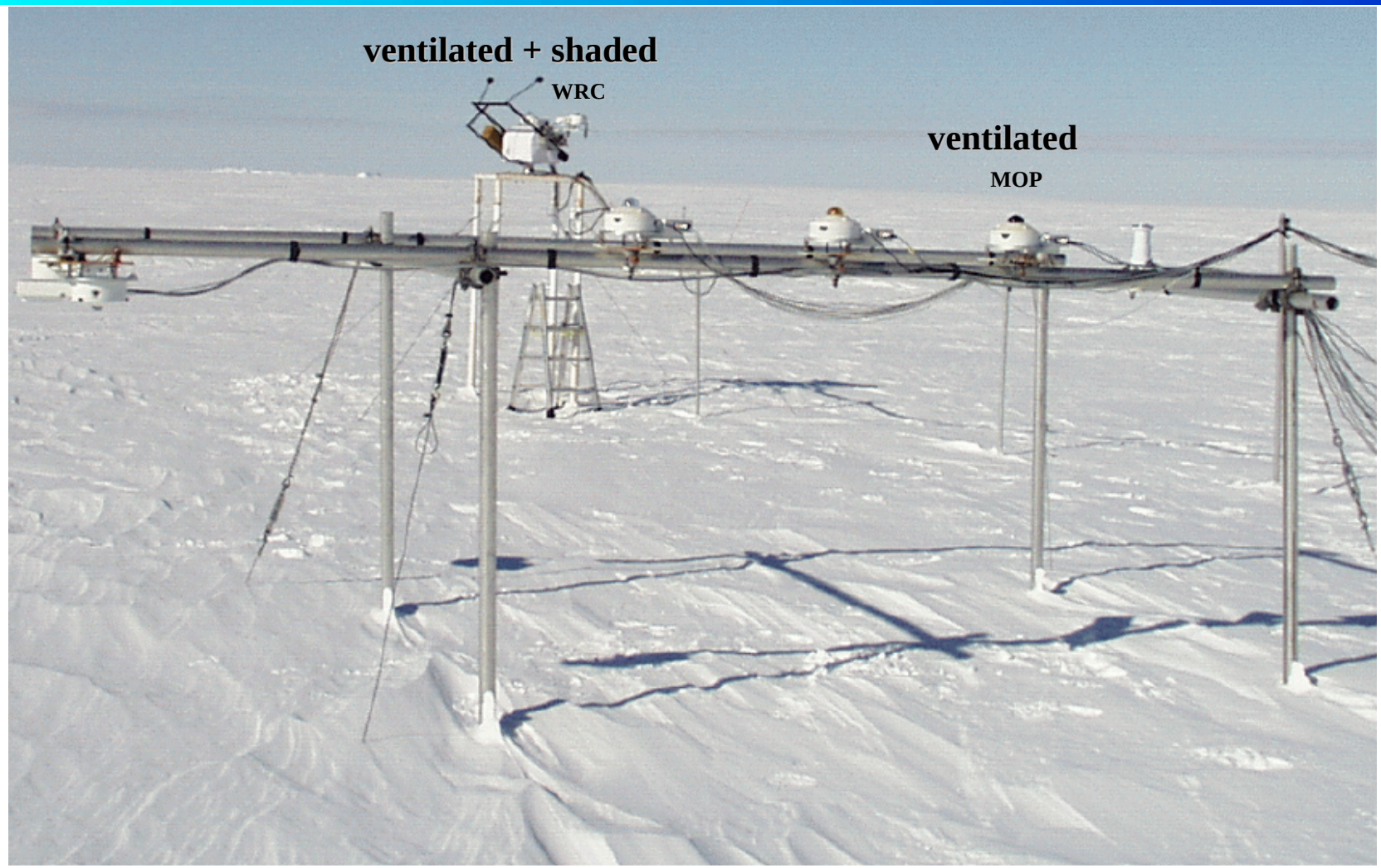
$$L = \frac{V}{C} + k_1 \frac{V}{C} \sigma T_B^3 + k_2 \sigma T_B^4 + k_3 (\sigma T_D^4 - \sigma T_B^4)$$

$k_1 \sim 0.2$ $k_2 \sim 1$ $k_3 \sim 5$

L = long-wave radiation
V = thermopile output
C = calibration coefficient
k_n = calibration coefficients

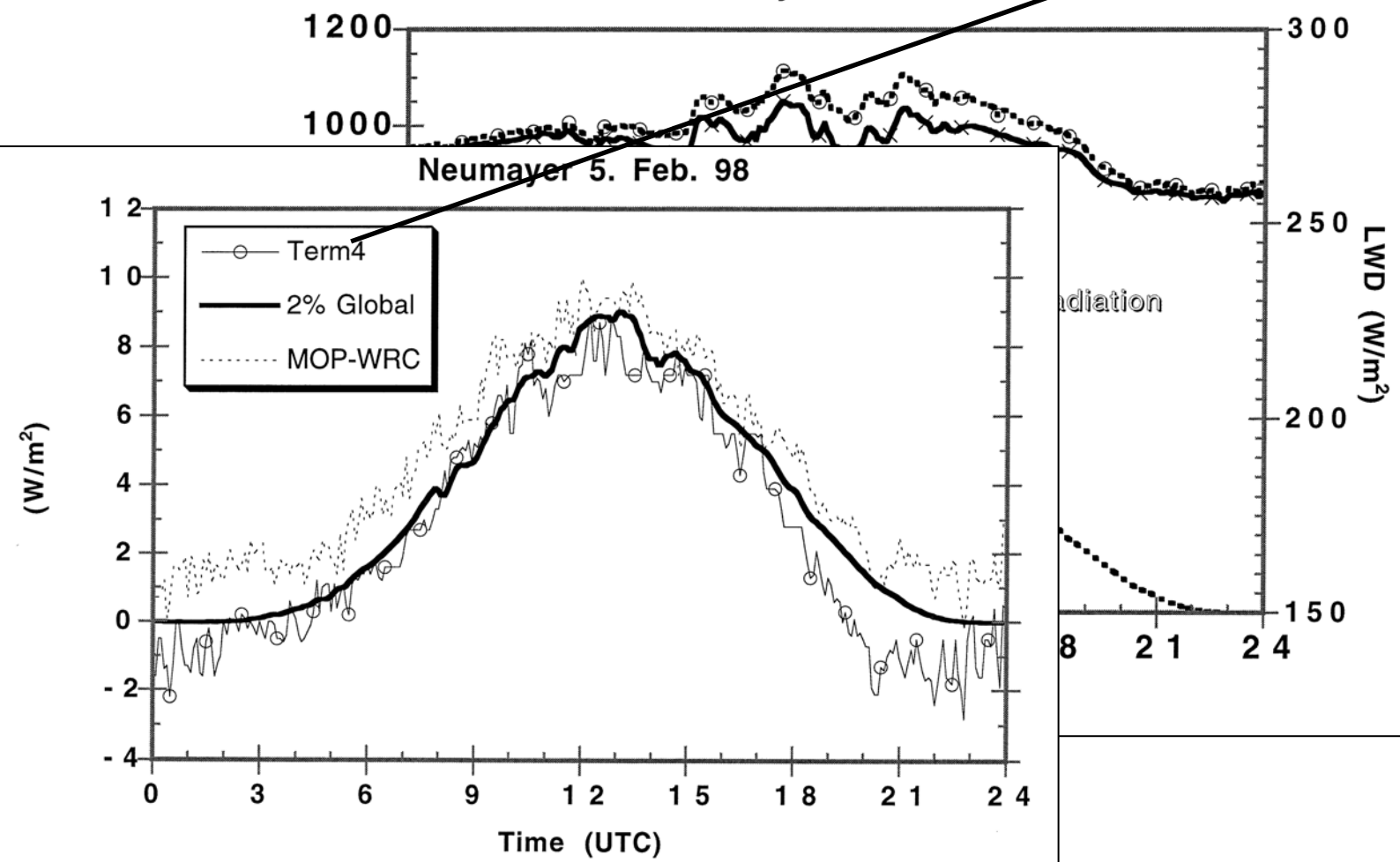
σ = Stephan Boltzmann constant
T_D = dome temperature
T_B = body temperature

Experimental Setup

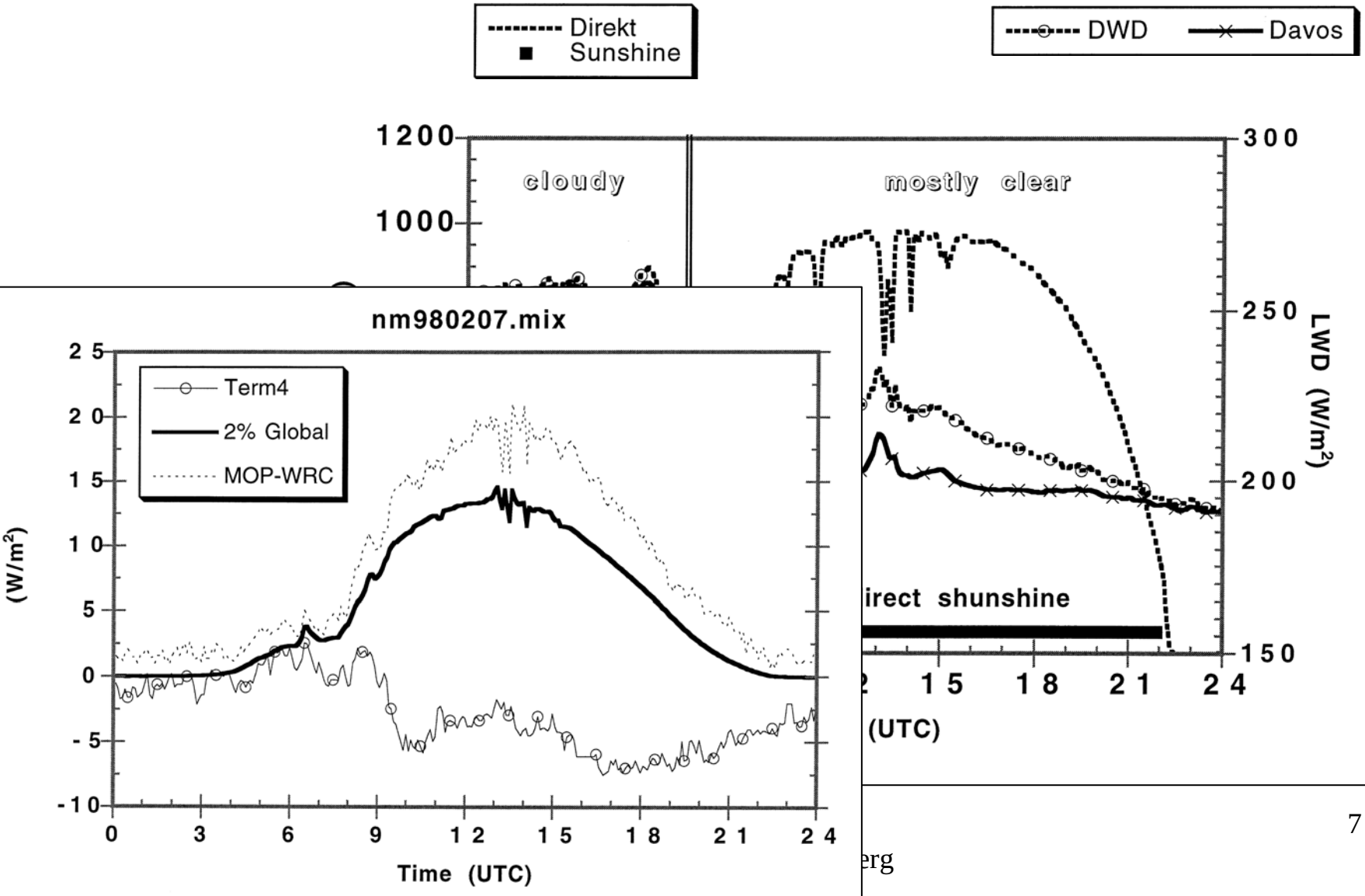


Impact of Diffuse Solar Radiation

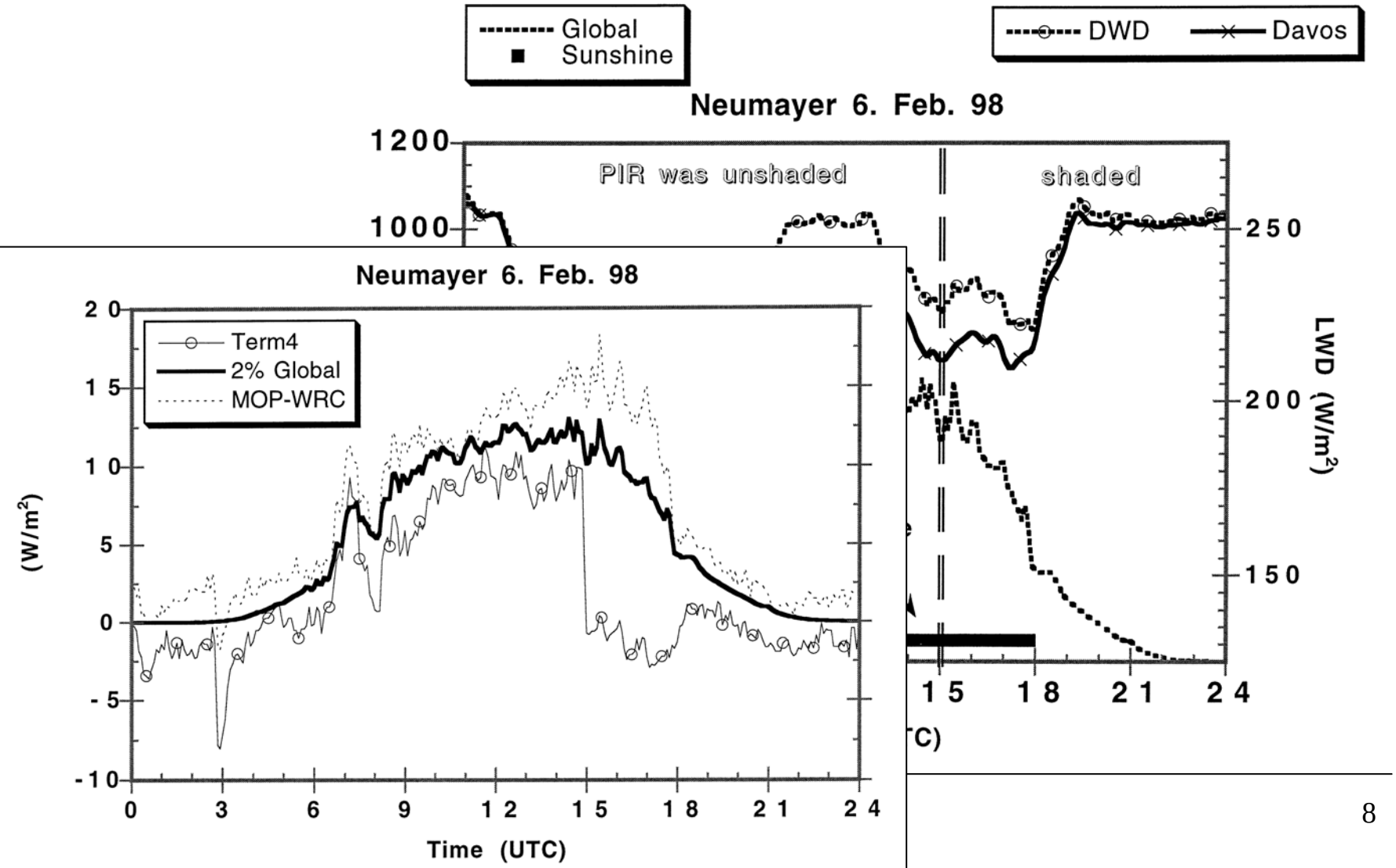
$$L = \frac{V}{C} + k_1 \frac{V}{C} \sigma T_B^3 + k_2 \sigma T_B^4 + k_3 (\sigma T_D^4 - \sigma T_B^4)$$



Impact of Direct Solar Radiation



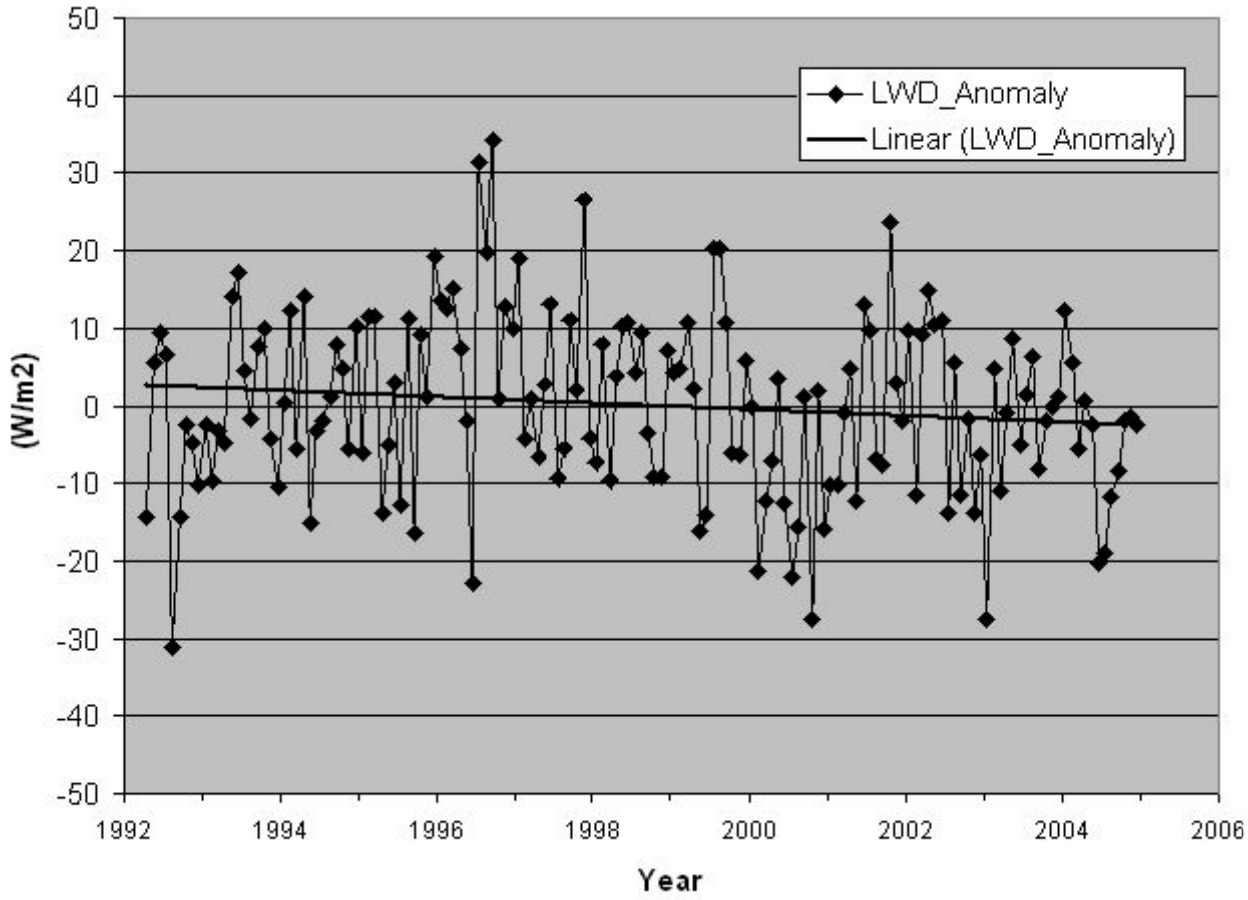
Impact of Shading



Conclusions

1. PIR pyrgeometer have a certain cross sensitivity to solar radiation mainly based on the differential uptake of solar radiation by the pyrgeometer body and pyrgeometer dome.
2. Temperature differences within the PIR pyrgeometer are small (order of 1k) but important!!! They have to be taken into account within the calibration procedure!!!
3. Temperature differences within the dome are less important.
4. Temperature differences can be reduced by shading the dome of the upward looking PIR pyrgeometer. However, the remaining temperature differences are still important and have to be taken into account.
5. Properly calibrated pyrgeometers can be used unshaded.
6. Unshaded pyrgeometers calibrated without taking care to the temperature differences overestimate the long-wave radiation by a small fraction of the solar radiation. At Neumayer, this fraction was found to be rather constant and ranges within the order of 2-3%.

LWD Trend at Neumayer



Questions and Outlook for BSRN

1. Which BSRN-stations did which calibration procedure?
2. Have there been stations changing their calibration procedure like Neumayer and Ny Ålesund?
3. Is the homogenization of the data allowed by:

$$L\Downarrow_{corrected} = L\Downarrow_{uncorrected} - 0.03 * K\Downarrow$$

?

$$L\Uparrow_{corrected} = L\Uparrow_{uncorrected} - 0.03 * K\Uparrow$$

... Ende