Chapter 6

Conclusions, Recommendations and Future Work

The thermal offset in PSP's can be characterized by placing one single thermistor on the inner dome and another one in the body of the instrument. There is a relationship between the thermal offset and the difference in temperature to the forth power

$$Offset = A\sigma(T_d^4 - T_b^4) + B, \tag{6.1}$$

where T_d is the temperature of the inner dome, T_b is the temperature of the body of the instrument next to the detector cold junction and A and B are coefficients derived from nighttime data. A and B depend on the instrument and its ventilation. However this relationship, that works fine during nighttime, must be modified to take into account the absorption of solar radiation by the dome thermistor when determining the thermal offset during daytime. Equation 6.1 becomes,

$$Offset = A\sigma(T_d^4 - T_b^4) - B\sqrt{E} + C, \tag{6.2}$$

where E is the diffuse irradiance measured by the PSP and C is a regression coefficient derived from capping experiments on the instruments. It is strongly recommended to derive the coefficients using about one month of data

To correct the thermal offset in historical data sets two relationships were derived using the net IR output from a PIR and the cloud cover fraction determined using the Long/Ackermann algorithm,

$$Offset = A(netIR) \tag{6.3}$$

$$Offset = B(CF) + C \tag{6.4}$$

where CF is the cloud cover fraction ranging from 0% to 100%, coefficients A, B and C are derived monthly from nighttime data and depend on the instrument, ventilation and location of the instrument. These two relationships were derived using data taken from September 2000 to March 2001 at the radiometric facility at NASA Langley Reseach Center and validated using ARM data from the SGP facility from July 1999 to January 2001. This analysis show that both techniques can be used to estimate the offset in historical PSP data. The net IR technique is recommended whenever PIR data is available, as it is a simple method. This method is expected to correct between 60 and 100% of the offset error depending on cloud cover. The cloud cover fraction technique can be used when PIR data is not available. It requires some analysis of the nighttime offset in order to derive the coefficients. It has been proven to give consistent results with the net IR technique.

This work has proven that the thermal offset in pyranometer can be corrected making small modifications to the instruments. This research has also proven that the thermal offset can be corrected in non-modified PSP's and in historical data. At least 60% of the offset can be corrected using PIR or CF data. However validation data from several sites would be required to give a more precise correction figure. As a future work it is recommended to place at least two modified PSP, two B&W, two regular PSP and two PIR at two or more sites to compare their measurements. In that way the accuracy of the correction can be determined. It is also recommended to create a standard reference for diffuse irradiance. The cloud cover relationship must be improved eliminating the influence of high clouds and low clouds and test it at other latitudes with different climate conditions.

Vita

Bernardo Antonio Carnicero Domínguez was born on September 22, 1974, in Soria, Spain. He grew up in Molinos de Duero (Soria), Spain. He graduated as a Mechanical Engineer at Centro Politécnico Superior de Ingenieros de Zaragoza in Spain. He spent the summer 1998 as a trainee in the Thermal Radiation Group in the Mechanical Engineering Department at Virginia Tech directed by Dr. J. R. Mahan. In fall 1999 he joined the Master of Science program in the Mechanical Engineering Department at Virginia Tech. After spending one year at NASA Langley Research Center in Hampton Virgina for the research of his Master, mentored by Dr. Martial Haeffelin, he graduated in June 2001 with a Master of Science in Mechanical Engineering.

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