Development of a Diffuse Horizontal Shortwave Irradiance Standard for the BSRN and ARM

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The second diffuse horizontal irradiance intensive observation period (IOP) was held October 8-16, 2003, at the central facility of the Southern Great Plains Atmospheric Radiation Measurement (ARM) site. The measurements were made using five Sci-Tec trackers that carry shading devices. These trackers were mounted together on top of the radiation calibration facility. Fifteen pyranometers from five manufacturers sent by eleven institutions participated. There were stock instruments, modified stock instruments, and a few prototypes. The goal of this study is to find a working standard for diffuse horizontal irradiance for the ARM community and the Baseline Surface Radiation network (BSRN). There was a mix of clear, overcast, and partly cloudy skies that allowed us to assess performance differences for these conditions. Nighttime conditions also allowed us to determine the behavior of the offsets of the pyranometers as a function of the thermopile signal from an Eppley pyrgeometer. This net infrared measurement is a proxy for the cooling of the dome that occurs through radiation exchange with the sky. The dome and case temperature difference in a pyranometer is thought to cause the negative offsets that affect both day and nighttime measurements. Using the nighttime-based correction we validated the predicted offset during the daytime by comparing to a instantaneous capping of each pyranometer. The prediction was within 1 Wm^2 for 12 of the 14 instruments that could be capped. On cloudy days measurements agreed within 2% of the mean except for the stock Eppley precision spectral pyranometer (PSP). On two very clear days with solar noon values of diffuse only in the 60-70 Wm^2 range, there was much disagreement. Eight of the pyranometers agreed within about 1 Wm^2; four were eliminated from consideration as part of the standard because of inconsistent biases with this group of eight, noisy signals or inability to correct the offset; three were higher than the group of eight, but could not be eliminated for obvious reasons (Figure 1). We are still seeking the cause of these differences.

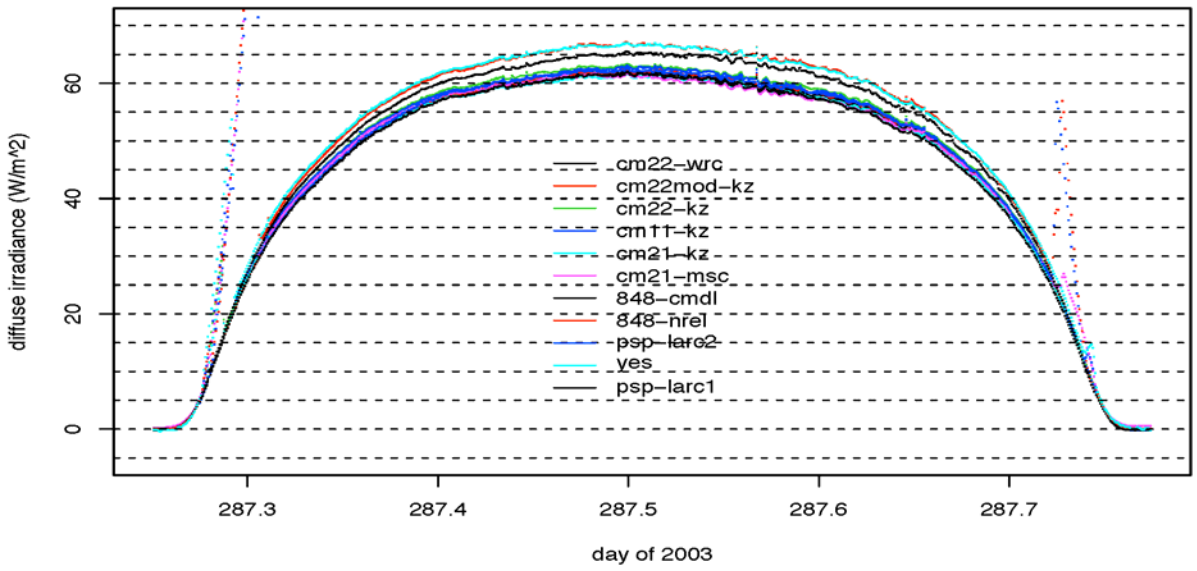

Figure 1. Eight pyranometers agree to within ±1 Wm^2, and three, which read high, cannot yet be eliminated based on spectral sensitivities, angular response differences, or geometrical considerations.