Solar Radiometric Data Quality Assessment of SIRS, SKYRAD and GNDRAD Measurements

Tom Stoffel, Aron Habte, Ibrahim Reda, Stephen Wilcox, Mark Kuchenuiter, Peter Gotseff and Mary Anderberg

National Renewable Energy Laboratory

Abstract

Solar irradiance measurements from SIRS, SKYRAD, and GNDRAD are made with pyrheliometers and pyranometers, with mercury-based detectors (Figure 1). These pyranometers are calibrated annually at the SGP Radiometer Calibration Facility using absolute cavity radiometers traceable to the World Radiometric Reference (WRR). Data quality assessments of the downwelling irradiances are based on the SGP/Radiometer Calibration Facility using absolute cavity radiometers traceable to the World Radiometric Reference (WRR)². This poster summarizes the basis for assessing the broadband solar irradiance data available from the SIRS, SKYRAD, and GNDRAD measurement systems and provides examples of data inspections.

Introduction:

Solar radiation is the driving force for the earth’s weather and climate. Understanding the elements of this dynamic energy balance requires accurate measurements of broadband solar irradiance. Since the mid-1990’s the ARM Program has deployed pyrheliometers and pyranometers for the measurement of direct normal irradiance (DNI), global horizontal irradiance (GHI), diffuse horizontal irradiance (DHI), and upwelling shortwave (US) radiation at permanent and mobile field research sites. The quality of these measurements is determined by the radiometer design, installation method, and operation and maintenance practices. Once a measurement is collected, the quality of the resulting data must be assessed with respect to a measurement reference. All broadband shortwave radiometers used by the ARM Program have calibration traceability to the World Radiometric Reference (WRR).³ This poster summarizes the basis for assessing the broadband solar irradiance data available from the SIRS, SKYRAD, and GNDRAD measurement systems and provides examples of data inspections.

Examples of Data quality Assessment:

Data Quality:

- Left most chart shows the most severe flags from among the three components at each time interval. Least error in the dark blue and greatest error in red.

The remaining three charts represent the relative solar irradiances for each of the three major components. Kd, Kt, and Kf charts show clearness range where dark blue least clear and red greatest clear.

Examples of Instrument Failures:

- Improper Instrument Alignment:
  - Right - Tilted and Time Drifted tracker.
  - Left - Plotted showing tracker conditions before corrective action.

Conclusion:

- ARM has “research-quality” 1-minute broadband solar irradiance data since 1997.
- Data quality begins with radiometer performance specifications, installation, and O&M practices (including calibration).
- We perform broadband outdoor calibration and/or provide procedures and schedules of calibration to site operations.
- We have developed automated data quality assessment tools (such as SERI-QC) now used by the Data Quality Office.
- We have identified failure modes and corrective actions.

Reference: