Eppley Precision Spectral Pyranometer (PSP)

The Eppley Precision Spectral Pyranometer (PSP) is a World Meteorological Organization First Class Radiometer, designed for the measurement of total solar radiation (the sum of direct and diffuse). It comprises a rectangular multi-junction wire-wound Eppley thermopile glued to the back of the sensor disk. This disk is coated with Parson's black lacquer (for non-wavelength selective absorption). The dome consists of a pair of precision ground and polished hemispheres of Schott optical glass. Both hemispheres are made of clear WG295 glass which is uniformly transparent to energy between 0.285 to 2.8µm. Included is a spirit level, adjustable leveling screws and a desiccator that can be readily inspected. The instrument has a cast bronze body with a white enameled guard disk (shield).

Specifications

- Sensitivity: approximately 9 µV/Wm^{-2}.
- Impedance: approximately 650 Ohms.
- Temperature Dependence: ±1% over ambient temperature range -20 to +40°C.
- Linearity: ±0.5% from 0 to 2800 Wm^{-2}.
- Response time: 1 second (1/e signal).
- Cosine Response: ±1% from normalization 0-70° zenith angle; ±3% 70-80° zenith angle.
- Weight: 7 pounds.
- Orientation: Performance is not affected by orientation or tilt.

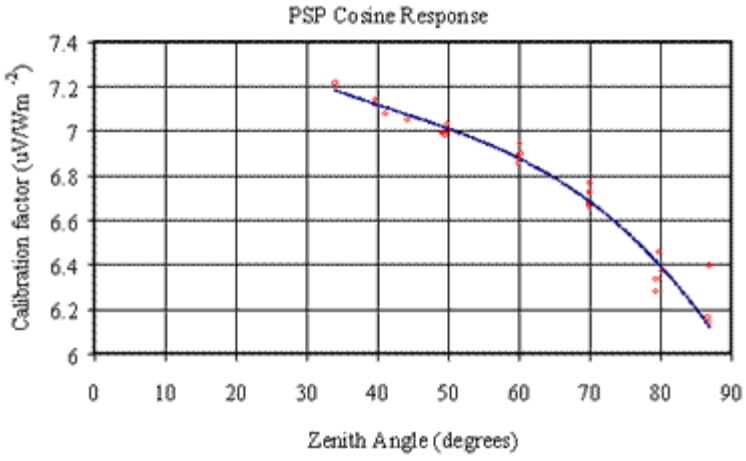
Accuracy

The absolute accuracy of calibration is ±3-4%. The relative accuracy of calibration is about ±2%. Deviation from a true cosine response is the reason for the large absolute uncertainty in calibration.

Field performance

Yearly calibrations are useful because the responsivity of PSPs has been observed to deteriorate over time. The most accuracy way to calibrate a pyranometer is to measure the direct normal beam irradiation with an Absolute Cavity Radiometer and the diffuse irradiance with a black and white pyranometer shaded by a disk. The direct normal data are projected onto the horizontal surface and the diffuse values are added to obtain the best estimate of the total (global) irradiance on the horizontal surface.

Cosine response of a PSP



For a PSP, the calibration factor varies with zenith angle. The cosine response of a pyranometer that has been in the field for 20 years is shown in the above figure. Each data point is the average calibration factor of data within a 10° bin, centered at the zenith angle of the data point, on a clear day in August or September, 1999. Because of the change in calibration factor with zenith angle, the National Renewable Energy Laboratory defines the calibration factor of a PSP as the average of calibration numbers obtained when the zenith angle is between 45° and 55°. The UO SRML currently uses calibration numbers obtained with the NREL definition. For the pyranometer in shown in the above figure the calibration factor is 7.00 $\mu V/Wm^{-2}$, although the calibration number varies depending on the zenith angle. Notice that for any given zenith angle the standard deviation is much smaller than the overall standard deviation.

Precision Infrared Pyranometer

MODEL
PIR

The Precision Infrared Radiometer (Pyrgeometer) is intended for measurement, separately, of downwelling or upwelling longwave irradiance. Unlike instruments that measure the shortwave (solar) irradiance, there is no official ISO/WMO classification of pyrgeometers which are designed to measure the longwave (infrared) irradiance from the sky. The PIR comprises the same wirewound thermopile detector and temperature compensation circuitry as found in the SPP pyranometers. This thermopile detector is used to measure the "net radiation" of the PIR and a case thermistor (YSI 44031) is used to determine the outgoing radiation from the case. A dome thermistor is included if one wishes to measure the dome temperature as compared to the case temperature to make any "corrections" to the final result.

SPECIFICATIONS

Application	Working Standard or Network Measurements
Traceability	World Infrared Standard Group (WISG) & International Practical Temperature Scale (IPTS)
Field of View	180° (2π sr)
Spectral Range	approx. 4-50 microns
Sensitivity	approx. 3 μV / Wm^{-2}
Impedance	approx. 700 Ω
Operating Temperature	-50 to +80 °C
Temperature Response	0.5% (-30 to +50°C)
95% Response Time	5 seconds
Stability	1% per year
Linearity	0.5%
Zero Offset	2 Wm^{-2}
Uncertainty	5 Wm^{-2}

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