SR05 sunshine duration sensor

Sunshine duration measurement according to the WMO "pyranometric method"

SR05 is a solar radiation sensor, a pyranometer, that is applied in most common solar radiation observations. It complies with the spectrally flat Class C specifications of the ISO 9060 standard and the WMO Guide. SR05 pyranometer may be used with suitable software as sunshine duration sensor. This pyranometric method has been approved by WMO and is increasingly popular, because of its simplicity, easy instrument calibration and high instrument stability.

Introduction

SR05 is a solar radiation sensor that is applied in general observations. It measures the solar radiation received by a plane surface from a 180° field of view angle. This quantity, expressed in W/m^2, is called "hemispherical" solar radiation. Measuring in a horizontal position it is known as global horizontal irradiance or GHI. Using an SR05 series pyranometer, such as the analogue SR05-A1 or digital SR05-D2A2, is easy. The pyranometer can be connected directly to commonly used data logging systems.

Sunshine duration

The World Meteorological Organization, WMO, defines sunshine hours as "the sum of the time intervals (in hours) during which the direct normal solar irradiance exceeds a threshold of 120 W/m^2". For the most accurate measurement of this quantity tracker-based systems with a pyrheliometer are employed.

Figure 1 SR05 spectrally flat Class B sunshine duration sensor/pyranometer.

The pyranometric method

WMO has approved the “pyranometric method” to calculate sunshine duration from pyranometer measurements in WMO-No. 8, Guide to Meteorological Instruments and Methods of Observation. This implies that SR05 as well as any other pyranometer may be used, in combination with appropriate software, to measure sunshine duration. Sunshine hours are estimated by comparing the 10-minute mean Global Horizontal Irradiance (GHI) with the solar radiation outside the earth’s atmosphere on a horizontal surface at that time and location (G_0).

Programming

The algorithm for sunshine duration involves:
– local time (typically from GPS)
– day of the year (typically from GPS)
– geographical coordinates (typically from GPS)
– GHI (from pyranometer)

Benefits of the pyranometric method

Many meteorological stations employ a pyranometer. Not only in that case, but even if a new pyranometer must be purchased, the pyranometric method is much more cost-effective than using a dedicated sunshine duration sensor. A further advantage is that the standardized calibration of pyranometers according to ISO 9847 is applicable. In addition, the instrument stability of pyranometers is much better than that of sunshine duration sensors based on photodiodes. Model SR05 offers a non-stability of < 1 %/yr. Higher class pyranometers such as model SR20 reach < 0.5 %/yr. Competing instruments employing photodiodes attain non-stabilities no better than < 2 %/yr. In summary:
– method is standardized by WMO
– normal pyranometer calibration may be used (no return to the factory required)
– better instrument stability than photodiode based sunshine duration sensors
– cost effective (combined with GHI), low-maintenance, easy calibration
– any ISO / WMO compliant pyranometer may be employed

Figure 1 Pyranometer in use with LI19 read-out unit.

Table 1 SR05-A1 specifications.

measurand 1	hemispherical solar radiation
measurand 2	sunshine duration
measurement method (for measurand 2)	WMO pyranometric method
requirements (for measurand 2)	– local time – day of the year – geographical coordinates
ISO classification	spectrally flat Class C (second class) pyranometer
calibration uncertainty	< 2.4 % (k=2)
non-stability	< 1 %/yr *
rated operating temperature range	-40 to +80 °C
standard cable length	3 m

* Other pyranometer models may be used as well, non-stability of < 0.5 %/yr is attainable.

Measurement uncertainty

The measurement uncertainty strongly depends on the measurement site and season. An estimate of achievable accuracy at mid-latitude sites is ± 2 hr/day (k = 2). With optimization to local conditions this can be improved to ± 0.6 hr/day[1]. Although this does not meet uncertainty requirements for WMO stations (specifying the larger of 0.1 h or 2 %), WMO does state that "individual applications may have less stringent requirements"[2]. Competing instruments, which typically specify an accuracy > 90 %, do not comply to WMO either.

Application note

The relevant algorithm is described in WMO manual WMO-No. 8, Guide to Meteorological Instruments and Methods of Observation, paragraph 8.1.4 b. Hukx has issued its own application note.
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See also

View our complete product range of sensors; other pyranometer models may be used for sunshine duration measurement as well.

Standards

Applicable instrument classification standards are ISO 9060 and WMO-No. 8. Pyranometer calibration is according to ISO 9847.

References

1. Emanuele Vuerich et al, (2012), Updating and development of methods for worldwide accurate measurements of sunshine duration, presented at TECO-2012, published on internet, accessed 20 July 2022.
2. WMO-No. 8, (2018), Guide to Meteorological Instruments and Methods of Observation, 2018 edition, Annex 1.A, subscript point 5, and 8.1.3, published on internet, accessed 20 July 2022.

About Hukx

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