

Protocol of the intercomparison at Poprad-Ganovce, SHMU Slovakia from May 29 to June 3, 2025 with the travelling reference spectroradiometer QASUME from PMOD/WRC

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The purpose of the visit was the comparison of global solar ultraviolet irradiance measurements between the spectroradiometers operated by IGF, SHMU, HungaroMet and the travel reference spectroradiometer QASUME. The measurement site is located at Poprad-Ganovce; Latitude 49.03° N, Longitude 20.32° E and altitude 706 m.a.s.l.

The horizon of the measurement site is free down to at least 85° solar zenith angle (SZA). Measurements between 3:00 UT and 18:30 UT were analysed.

QASUME was installed at Poprad-Ganovce in the afternoon of May 29, 2025. The spectroradiometers participating to the comparison were one single Brewer MKIV #097 (SHMU) and three double Brewer spectrophotometers MKIII, #152 (Met.Hu), #207 (IGF), and #225 (SHMU). The intercomparison lasted 4 1/2 days, from the morning of Friday May 30 to the morning of Tuesday June 3.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. Three lamps (T153061, T68523, and T61251) were used to obtain an absolute spectral irradiance calibration traceable to the primary reference held at PMOD/WRC, which is traceable to PTB. The daily mean responsivity of the instrument based on these calibrations varied by less than 1 % during the intercomparison period. The internal temperature of QASUME was 28.0 ± 0.5 °C and the diffuser head was heated to a temperature of 28.9 ± 0.5 °C.

The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the matSHIC analysis were between ± 50 pm in the spectral range 300 nm to 400 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 nm to 363 nm, every 0.5 nm, and 3.0 seconds between each wavelength increment.

DOY	Date	DAY	Weather	Comment (times are in UT)
149	29-May	Thursday	Clear Sky with cirrus, sahara dust, very diffuse	Installed at 15:00
150	30-May	Friday	Clear sky, small Cu developing in the afternoon, rain in the late afternoon	Start UV measurements at 2:30 7:35 Calibration T153061 T68523
151	31-May	Saturday	Mix of sun and clouds, windy	Calibration at 8:05 T153061 synchronisation problems with Br152, fixed at 10:30
152	01-Jun	Sunday	Very hazy, some rain in the afternoon	Calibration at 8:35, T153061
153	02-Jun	Monday	Clear Sky in the morning, Cu growing, occasional rain starts	calibration at 9:05, T61251
154	03-Jun	Tuesday	Overcast, rain	Campaign end at 7:00 UT

Results and conclusions:**Brewer #152**

- The solar spectra were calculated from the UVdoyyy.152 files using the UVR14825.152 spectral responsivity file. No Temperature or angular response correction are applied.
- 76 synchronous solar spectra are available from the comparison period. Due to an old uv.rtn routine the measurements before 31 May were delayed by about 10 seconds (3 nm) and therefore were removed from the intercomparison.
- Brewer #152 is underestimating solar spectra by about -5%, relative to QASUME.
- During morning and afternoon when the sun is not obscured by clouds, a diurnal variation in the ratios to QASUME is observed which is due to the angular response error of the Brewer. See for example morning of 31 May, morning of 1st June, morning of 2nd June.
- The wavelength alignment is good, well within 0.02 nm of the reference high spectral solar spectrum TSIS-1 HSRS.

Brewer #207

- The solar spectra were retrieved from EUBREWNET. These solar spectra are identical if processed directly from the UVdoyyy.207 files using the UVR14825.207 spectral responsivity file. No Temperature or angular response correction are applied.
- 88 synchronous solar spectra are available from the comparison period.
- Brewer #207 is underestimating solar spectra by about -10%, relative to QASUME.
- The solar spectra of Brewer #207 show an unexplained decrease at short wavelengths of up to 30% relative to QASUME, with the decrease occurring at increasing wavelengths when the SZA increases. This

behaviour was observed on all days, irrespective of atmospheric conditions (overcast or clear skies).

- The wavelength alignment is good, well within 0.02 nm of the reference high spectral solar spectrum TSIS-1 HSRS.
- A revised dataset using response file UVR19825 was submitted after the campaign, which gave an average agreement with QASUME of -2 %.

Brewer #225

- The solar spectra were processed by the operator.
- 77 synchronous solar spectra are available from the comparison period.
- Brewer #225 is underestimating solar spectra by about -5%, relative to QASUME, with a slight spectral dependency (ratio decreasing with increasing wavelength).
- During the morning of 2 June a diurnal variation in the ratios to QASUME is observed which is due to the angular response error of the Brewer.
- The wavelength alignment is good, well within 0.02 nm of the reference high spectral solar spectrum TSIS-1 HSRS.

Brewer #097

- The solar spectra were processed by the operator.
- 82 synchronous solar spectra are available from the comparison period.
- Brewer #097 is a single brewer and measures only up to 325 nm.
- Brewer #097 is underestimating solar spectra by about -8% relative to QASUME in the range 310 nm to 325 nm.
- At wavelengths shorter than 310 nm spectral stray light over-estimates solar UV radiation significantly, especially at large SZA.
- During the morning of 2 June a diurnal variation in the ratios to QASUME is observed which is due to the angular response error of the Brewer.
- The wavelength alignment at wavelengths shorter than 325 nm is good, well within 0.02 nm of the reference high spectral solar spectrum TSIS-1 HSRS.

Recommendations:

Brewers using the default global diffuser entrance optic have an angular response that deviates significantly from the ideal lambertian (cosine) response. In consequence the measured global solar radiation is too low by up to 10%, depending on the individual Brewer. Therefore it is recommended that Brewers apply a cosine correction to the global solar irradiance measurements.

Comments from the local operators:

Brewer #207:

After coming back to Warsaw and operating Brewer 207 I noticed the difference in UV compare to Brewer 064 at Belsk. Brewer 207 was in average 9% lower than 064. Before travel to Poprad they were in agreement. I suspect that something may have gone wrong with the UV calibration of 207 during the campaign with 017 before the QASUME campaign. Therefore, I generated a new UVR file for 207 based on measurements from brewer 064, which is very stable when it comes to UV measurements. The revised dataset is based on this new UV response file (UVR19825.207).

UV Index Poprad-Ganovce, May-June 2025













































