

# Protocol of the intercomparison at Reading, U.K. from May 25 to 29, 2022 with the travelling reference spectroradiometer QASUME from PMOD/WRC

Report prepared by Gregor Hülsen

Operator: Gregor Hülsen, Christian Thomann

The purpose of the visit was the comparison of global solar irradiance measurements between the Bentham DM150 spectroradiometer operated at the University of Reading by the Univ. of Manchester and the travel reference spectroradiometer QASUME. The measurement site is located at the University of Reading; Latitude 51.441 N, Longitude 0.937 W and altitude 50 m.a.s.l.

The horizon of the measurement site is free down to at least 85° solar zenith angle (SZA). Measurements between 6:00 UT and 18:00 UT have been analysed.

QASUME was installed in the afternoon of May 25, 2022. The spectroradiometer was installed within 1 m of the entrance optic of the local spectroradiometer. The intercomparison between QASUME and the local spectroradiometer lasted four days, from morning of May 26 to evening of May 29.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. Three lamps (T68522, T68523 and T16573) 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  $26.95 \pm 0.05$  °C and the diffuser head was heated to a temperature of  $28.61 \pm 0.53$  °C. The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the matSHIC analysis were between  $\pm 50$  pm in the spectral range 290 to 500 nm.

**Protocol:**

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 500 nm, every 0.5 nm, and 3.0 seconds between each wavelength increment. QASUME recorded the spectra in 30 min intervals with 0.25 nm increments.

DOY	Date	Day	Weather	Comments (times in UT)
145	25. May	Wednesday	Overcast with rain	Installed at 13:00
146	26. May	Thursday	Mostly overcast with mix of sun and clouds	11:51 Calibration (T68523)
147	27. May	Friday	Mix of sun and clouds in the morning, clear sky in the afternoon from about 12 UT onwards	10:24 Calibration (T68523, T16573) Rotated UKR entrance optic for the 16:30 scan
148	28. May	Saturday	Clear sky in the morning, mix of sun and clouds after 10:00 UT.	11:25 Calibration (T68523)
149	29. May	Sunday	Mostly overcast sky	16:50 Calibration (T68522, T68523) 17:30: End of campaign

**Results:**

In total 98 synchronised simultaneous spectra from QASUME and the local spectroradiometer are available from the measurement period. Measurements between 5:00 UT and 19:30 UT have been analysed (SZA smaller than 80°).

**Remarks:**

1. A diurnal variation was observed on 27-29 May, during a period of clear skies without clouds in front of the sun. This diurnal variation is unknown. The tilt mounting of the entrance optics in the roof of the shelter was checked and looks fine within the uncertainty of the measurement. The variability also doesn't indicate a large cosine error. The diurnal variability is small during the overcast sky periods.
2. The measurements between the local spectroradiometer and QASUME agreed to within  $\pm 5\%$ , with a minor spectral dependence.

**Local Operator:** John Rimmer, Richard Kift

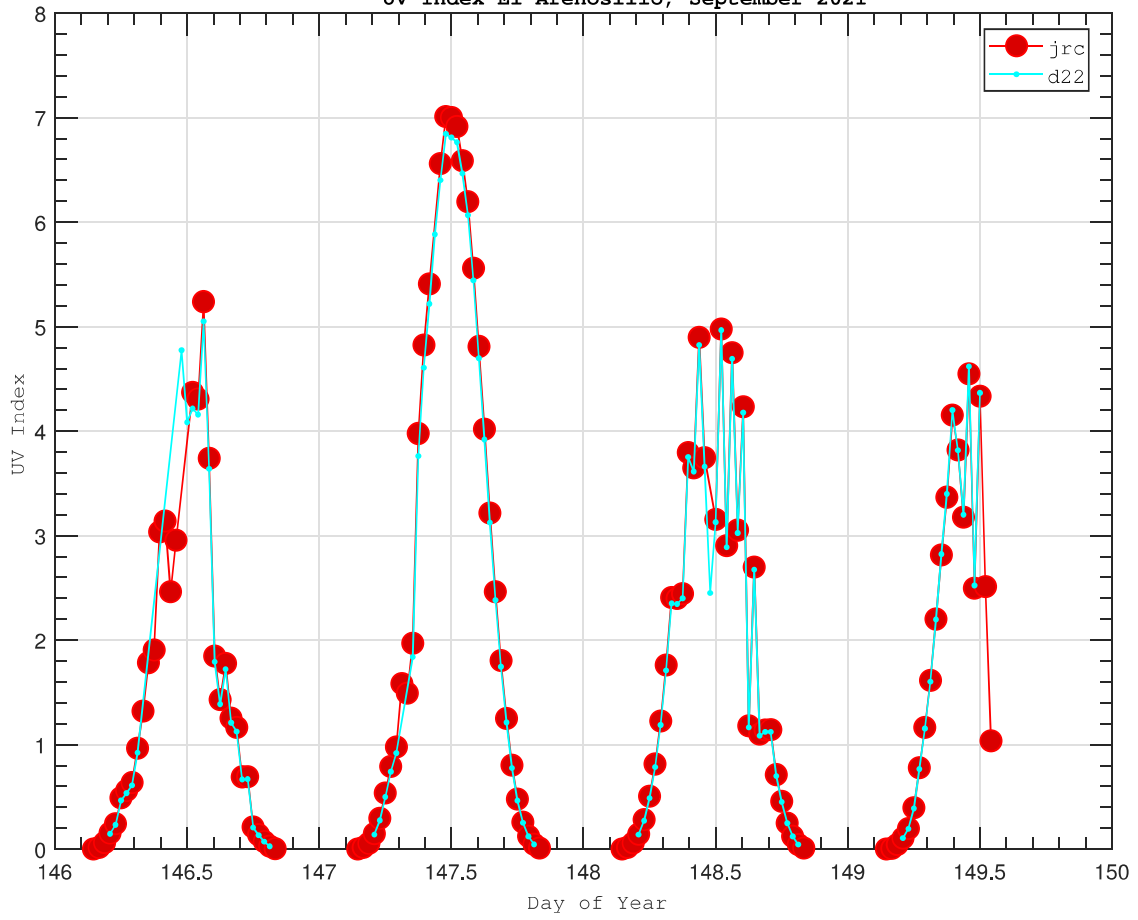
**Comments from the operator:**

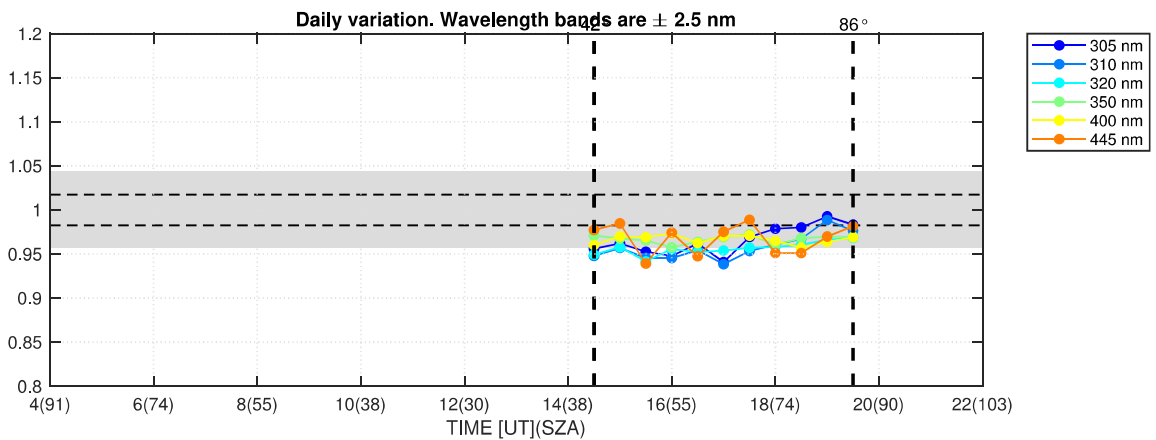
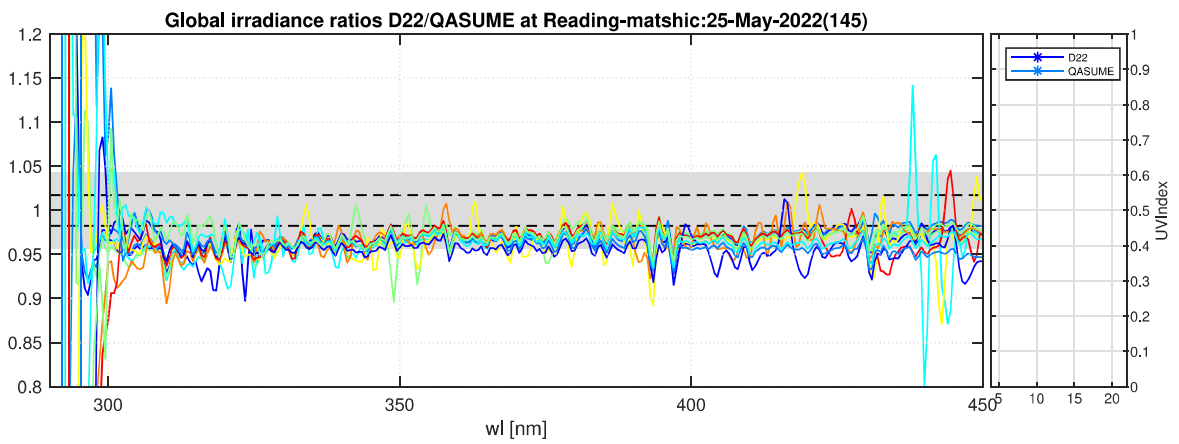
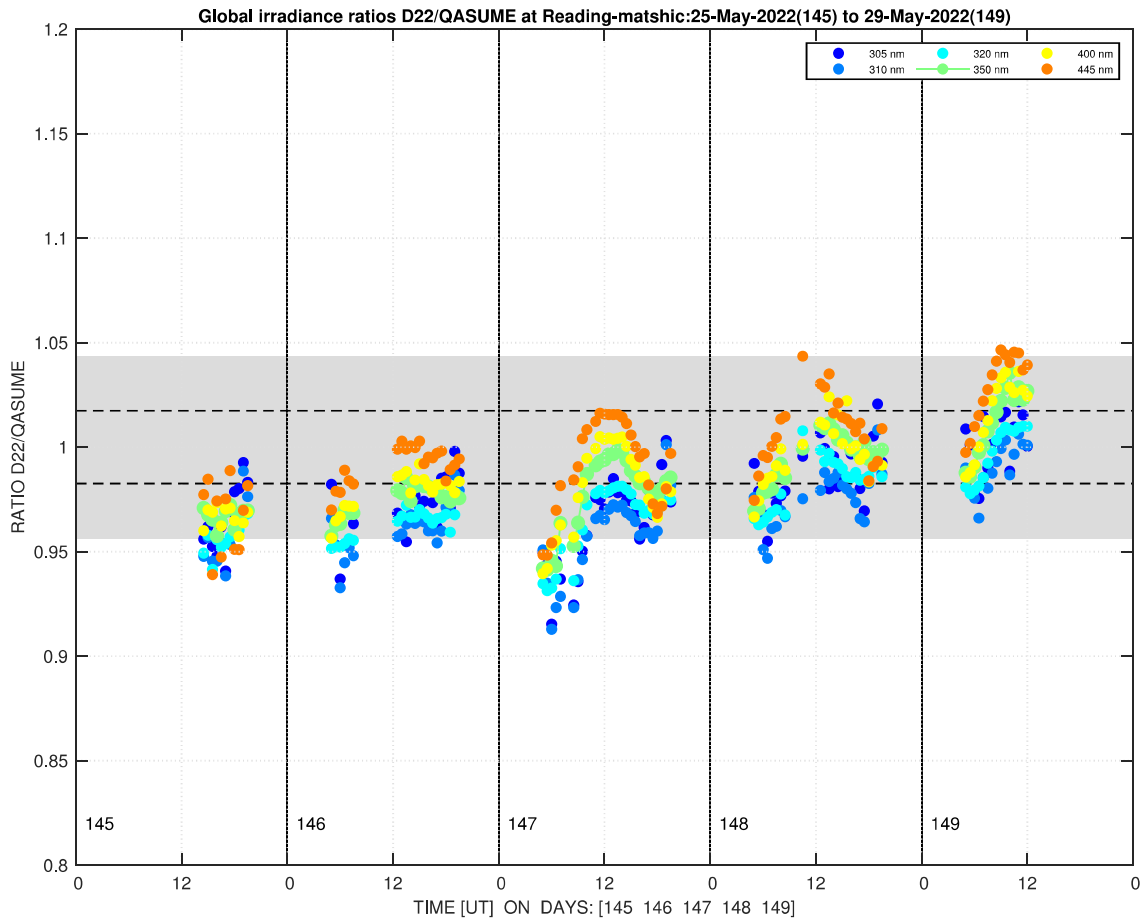
We are in general agreement with the report and pleased with confirmation that our measurements are within the expected uncertainties of the intercomparison.

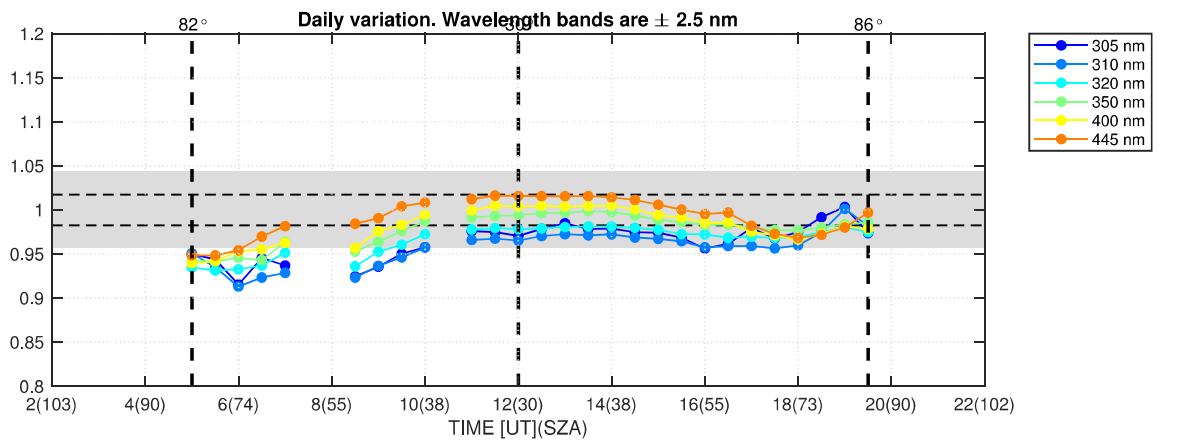
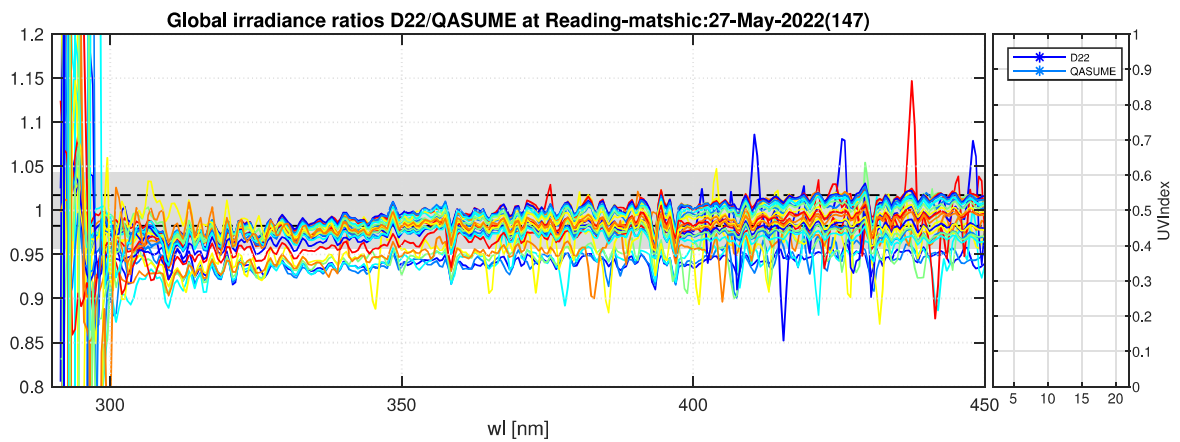
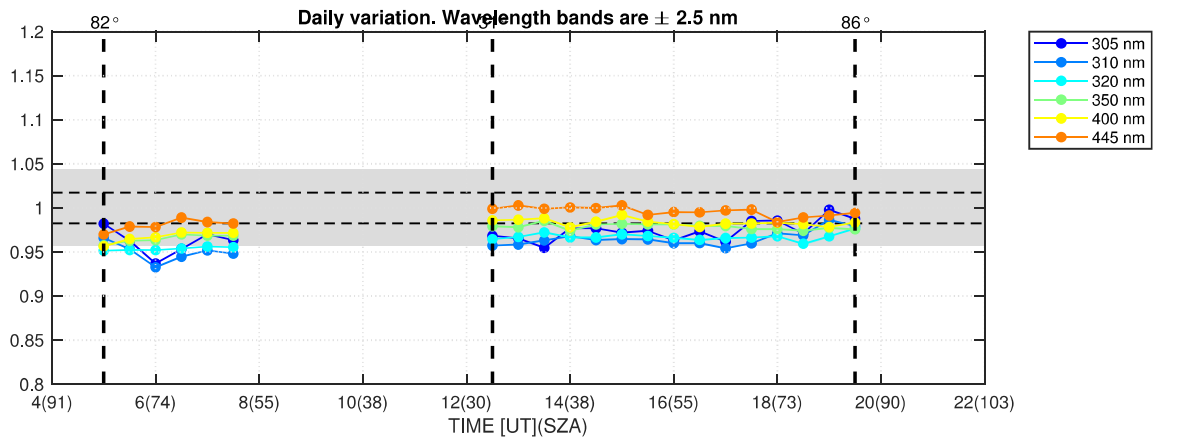
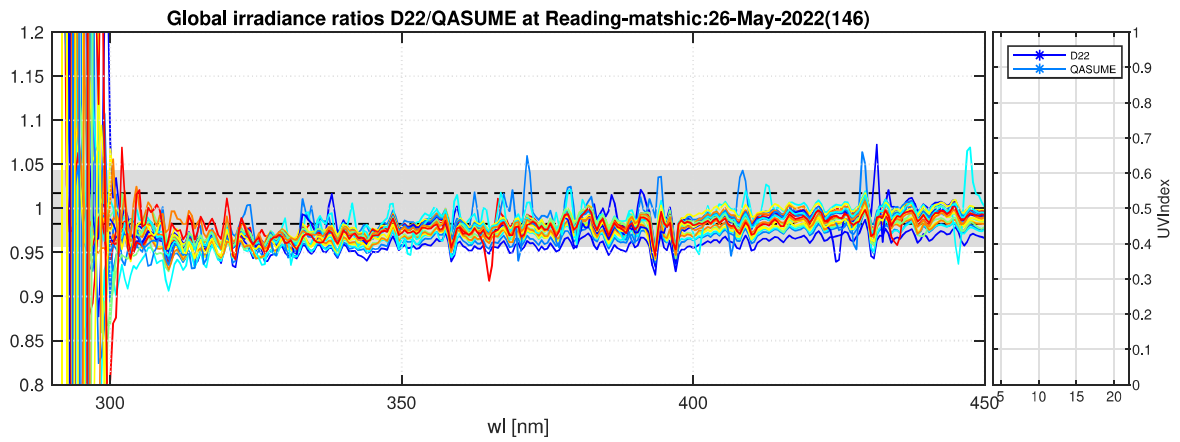
With respect to Remark 2, we note that our calibration is traceable to NIST and we have had a longstanding (decades) difference to PTB-traceable instruments of 2-3% with minor wavelength dependency. We note that this is also apparent in the current intercomparison and gives us confidence that our internal calibration consistency has remained constant over this long time period.

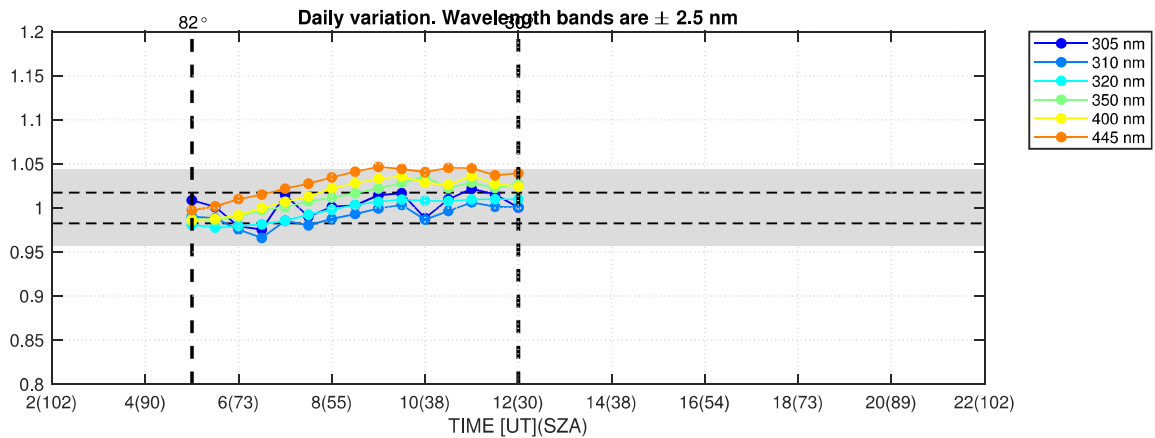
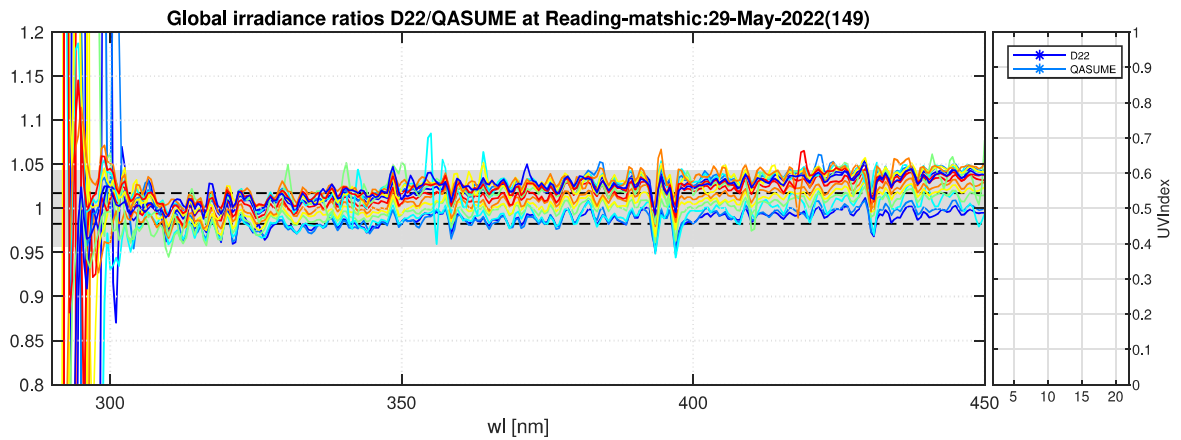
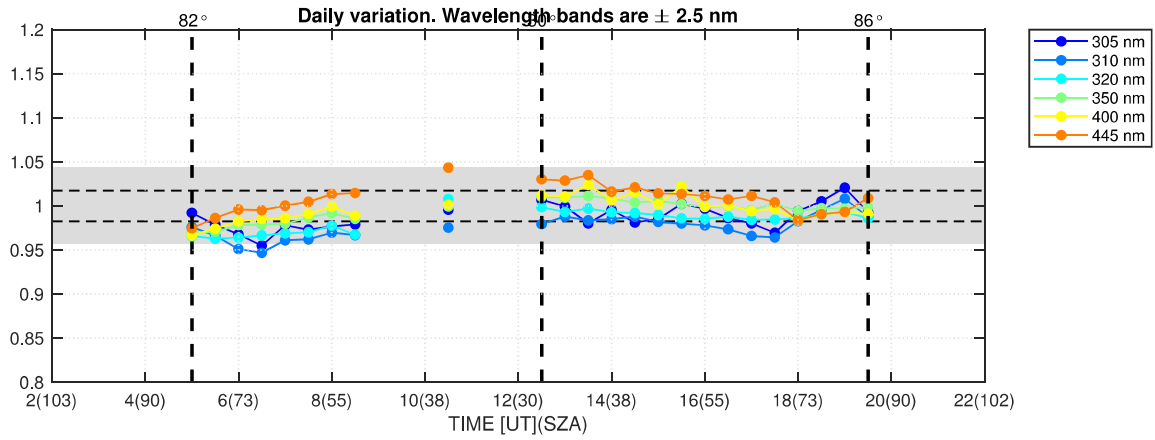
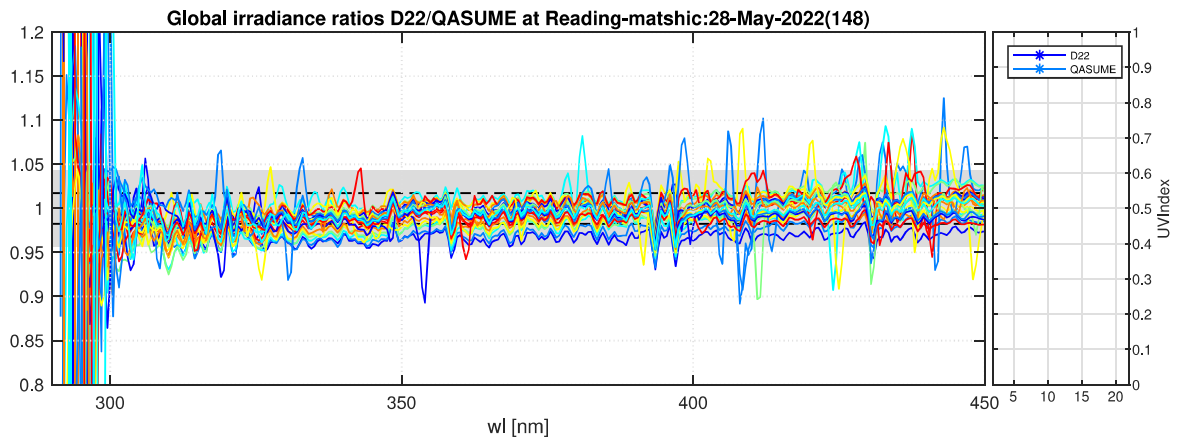
With respect to Remark 1, we agree that there does not appear to be a large cosine error, and this was checked during the QASUME visit. The source of the observed small diurnal variation is under investigation.

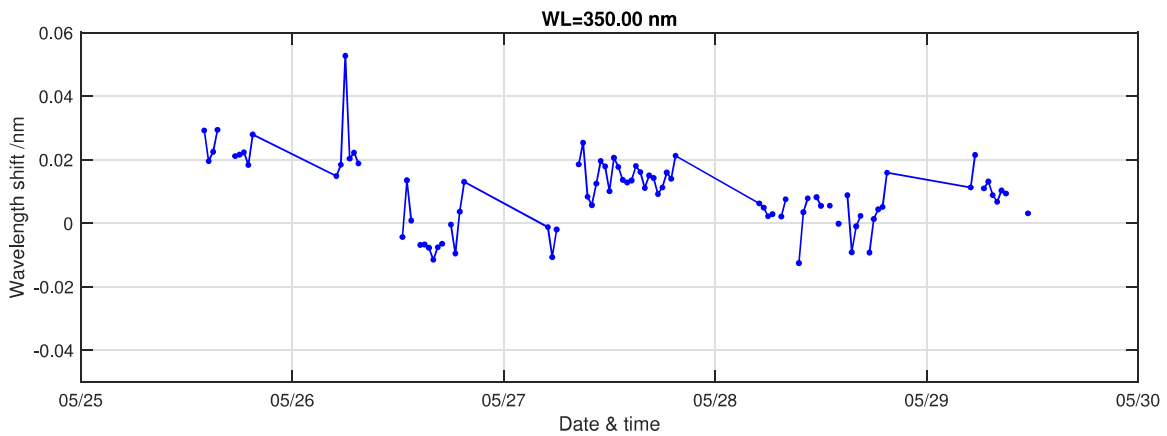
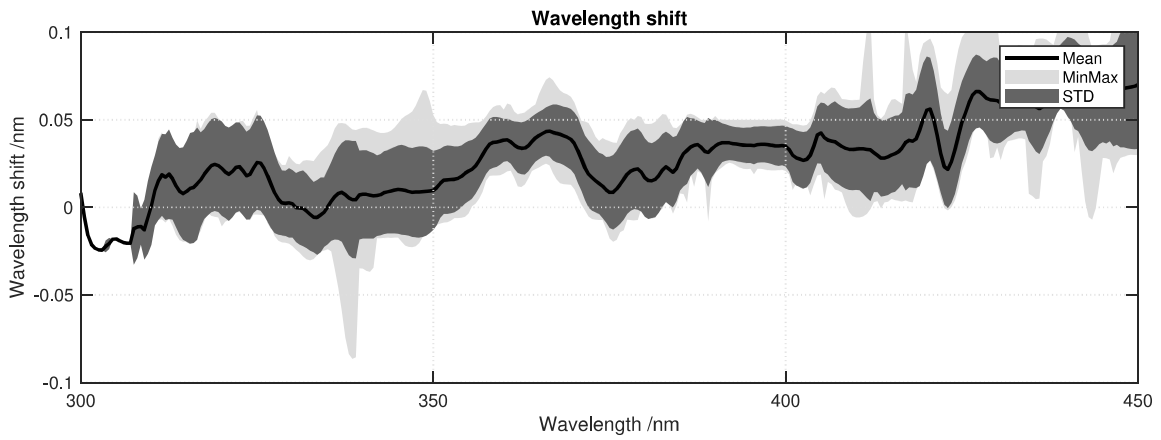
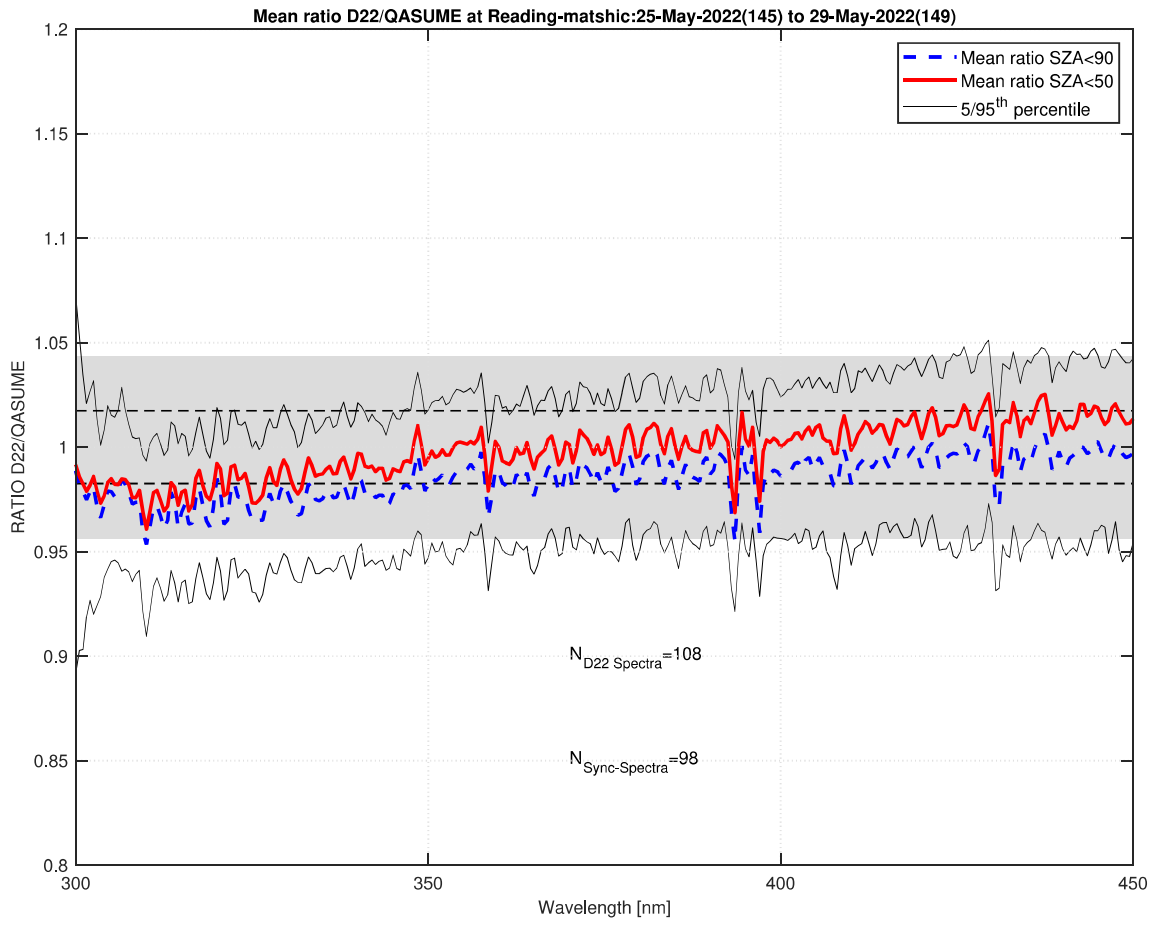
UV Index El Arenosillo, September 2021













Qasume stability, Reading, May 2022

