

Protocol of the intercomparison at Reading, U.K. from August 19
to 24, 2018 with the travelling reference spectroradiometer
QASUME from PMOD/WRC

Report prepared by Julian Gröbner

Operator: Julian Gröbner

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 August 19, 2018. The spectroradiometer was installed within 2m of the entrance optic of the local spectroradiometer. The local spectroradiometer was refurbished since the last visit in 2012. The intercomparison between QASUME and the local spectroradiometer lasted five days, from morning of August 20 to noon of August 24.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. Two lamps (T68523 and T68522) 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 28.03 ± 0.08 °C and the diffuser head was heated to a temperature of 29.21 ± 0.37 °C.

The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the matSHIC analysis were between ± 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)
231	19 August	Sunday	mix of sun and clouds	Installed at 16:30
232	20 Aug.	Monday	Overcast with mix of sun and clouds	10:07 Calibration (T68523)
233	21 Aug.	Tuesday	Overcast in the morning, clear sky in the afternoon from about 12 UT onwards	9:45 Calibration (T68523)
234	22 Aug.	Wednesday	Overcast with some raindrops	UKR entrance optic levelled after 14:14
235	23 Aug.	Thursday	Rain until 8:50. Then mix of sun and clouds, hazy	13:20 Calibration (T68522, T68523)
236	24 August	Friday	Clear Sky, Hazy, some clouds	8:52, Calibration, T68523 10:00 UT End of campaign

Results:

In total 87 synchronised simultaneous spectra from QASUME and the local spectroradiometer are available from the measurement period. Measurements between 6:00 UT and 18:00 UT have been analysed (SZA smaller than 85°).

The spectra from the local spectroradiometer represent a **revised dataset**: the local lamp calibration system was exchanged with the previous system in 2015, resulting in a spectrally constant offset of -10% in irradiance. This offset was corrected for this report, pending a quantitative determination during a future laboratory investigation planned for the end of 2018.

Remarks:

1. A significant diurnal variation was observed on the afternoon of 21 August, during a period of clear skies without clouds in front of the sun. This diurnal variation could be traced to a tilted mounting of the entrance optics in the roof of the shelter of the instrument (towards south-east). The entrance optic was levelled in the afternoon of 22 August when this problem was understood.
2. During the remaining two days the measurements between the local spectroradiometer and QASUME agreed to within $\pm 5\%$, with a minor spectral dependence.
3. An unexplained shift of about 5% was observed in the afternoon of 23 August after a recalibration of the local spectroradiometer.

Local Operator: John Rimmer

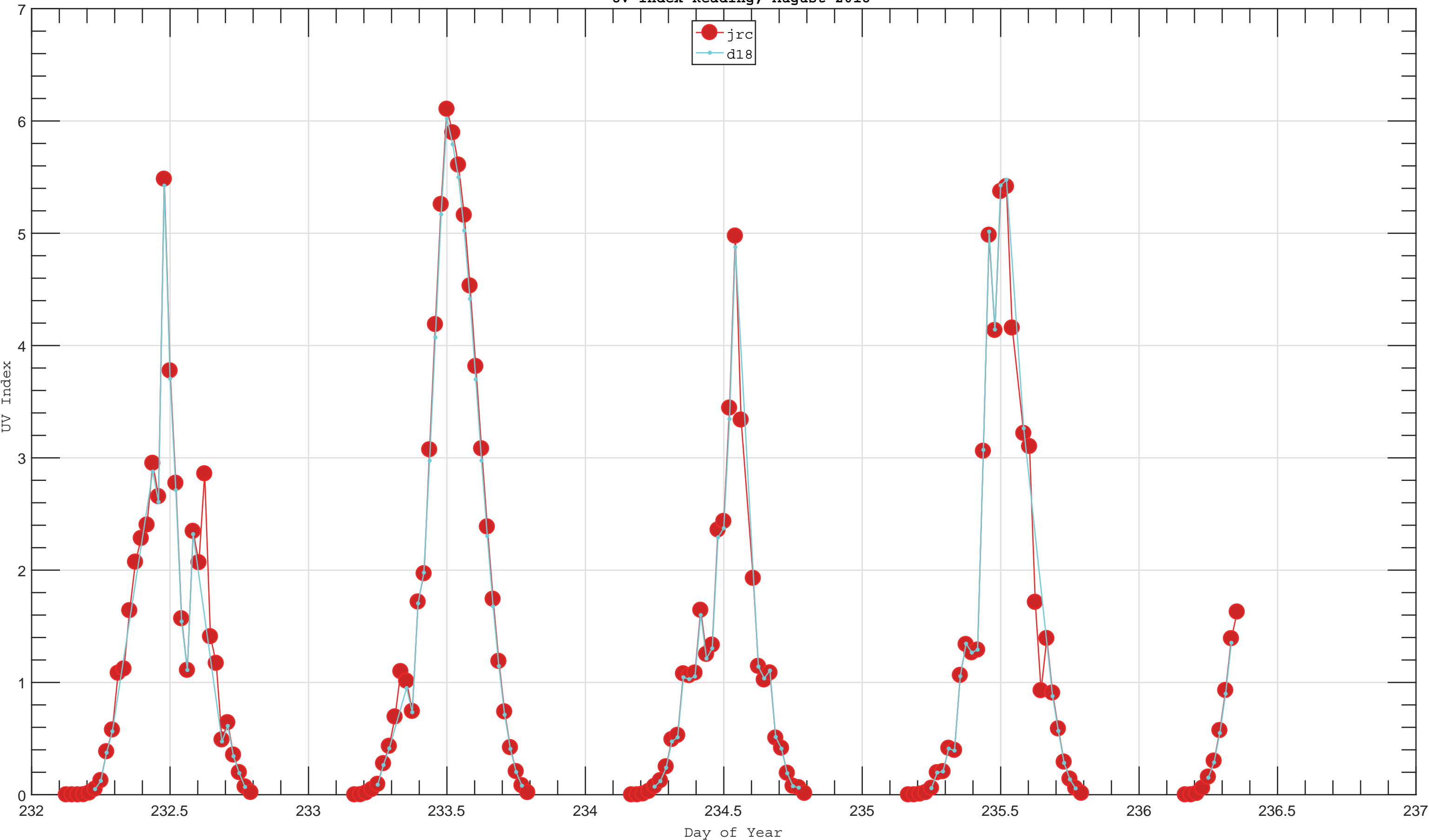
Comments from the operator:

In 2015 the local 200W calibration lamp setup was upgraded. The new system is mechanically different from the old and it was noted at the time that there was an anomaly in the calibration transfer from the old to the new. In order to determine which set was correct, rather than remove the instrument from site, it was decided to check against QASUME at the next visit which was originally planned for that year. Unfortunately, the QASUME calibration had to be postponed because of funding issues but the intensity ratios relating to the anomaly were saved. During this calibration it was determined that the new set was subject to the (~10%) anomaly and the saved ratios were applied to make the correction. Now that a systematic error has been quantified, the affected data can be re-processed and the cause can be properly investigated.

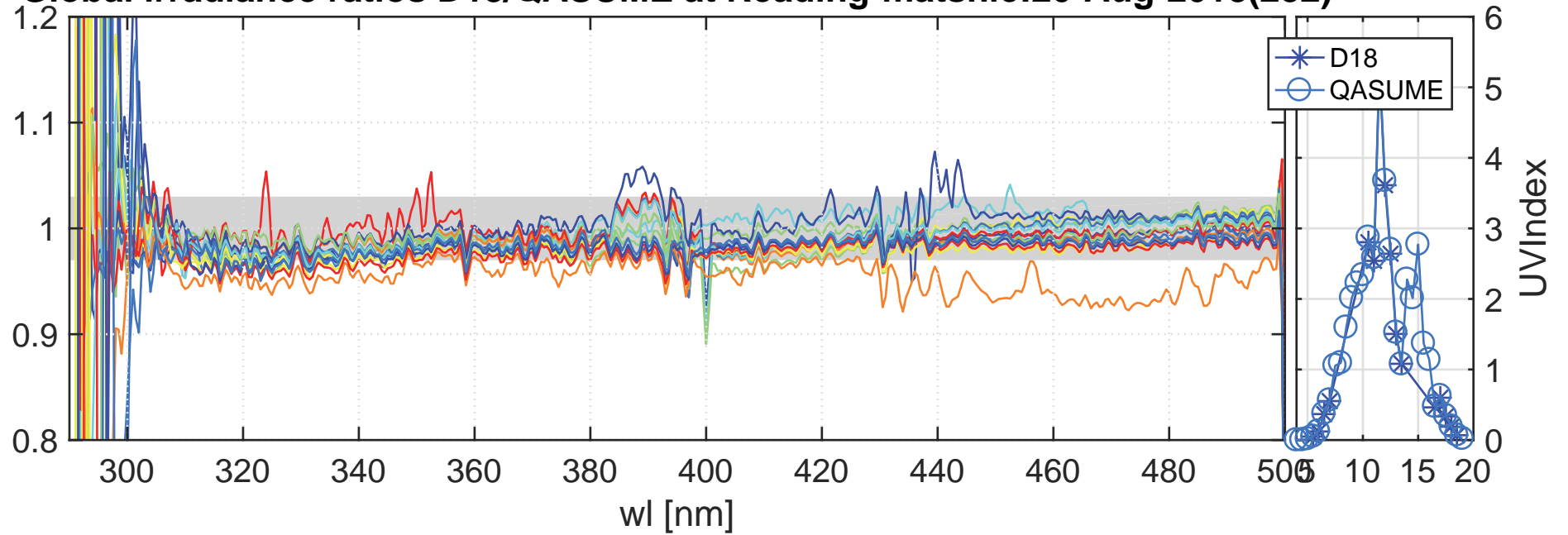
The entrance optic is designed to be a unique fitting which results in a horizontal diffuser, however due to the unusually long, hot summer, the surrounding structure to which the mount was fixed had warped resulting in a slightly tilted diffuser. It should be noted that the resulting diurnal variation was limited to the visible at high SZA but had little effect on the UV which is highly diffuse. The standard operating procedures for the site have been updated to ensure this does not re-occur.

The unexpected shift on 23rd August cannot be fully explained except to say that at the next calibration the shift was reversed.

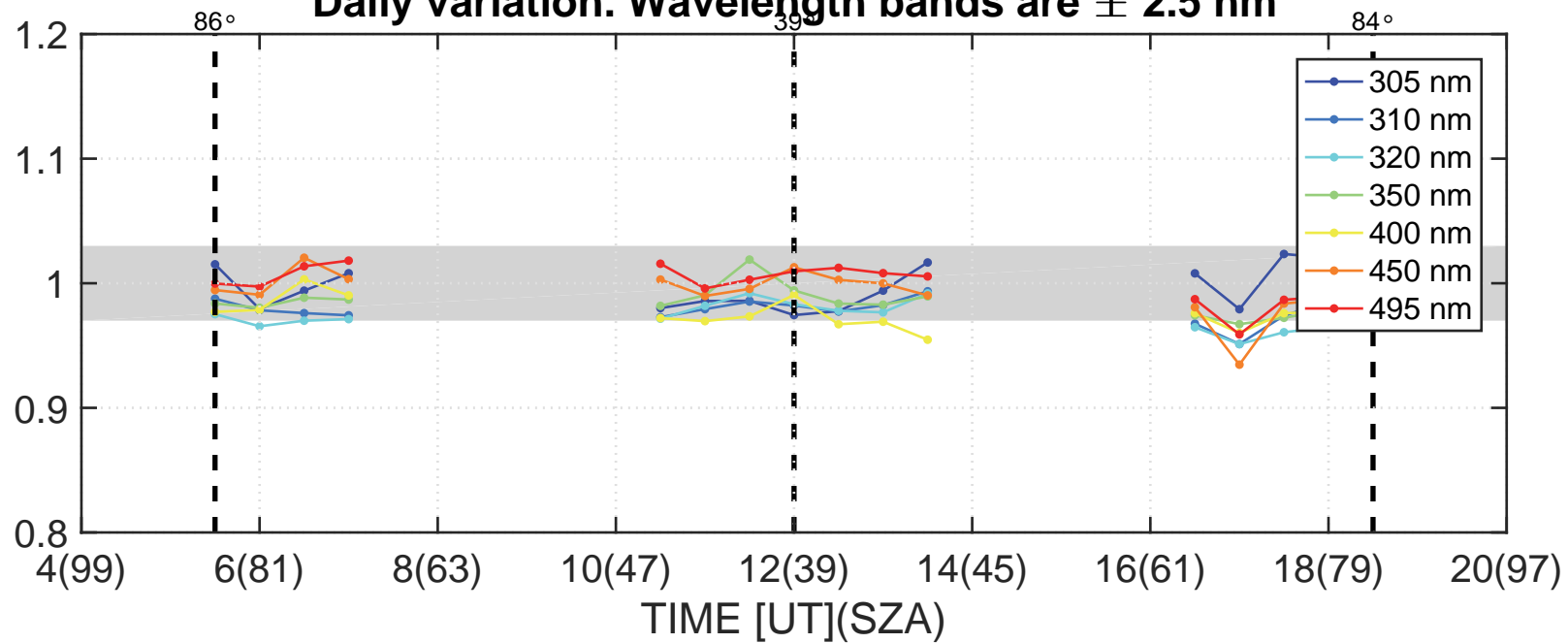
UV Index Reading, August 2018



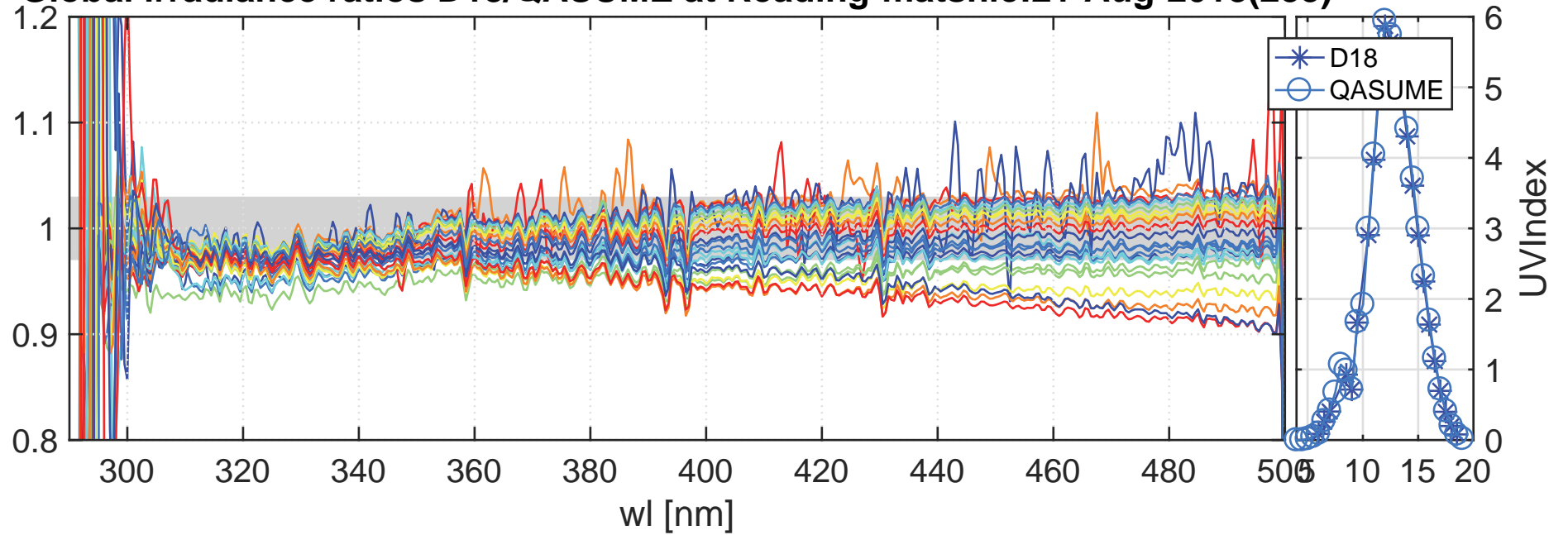
Global irradiance ratios D18/QASUME at Reading-matshic:20-Aug-2018(232)



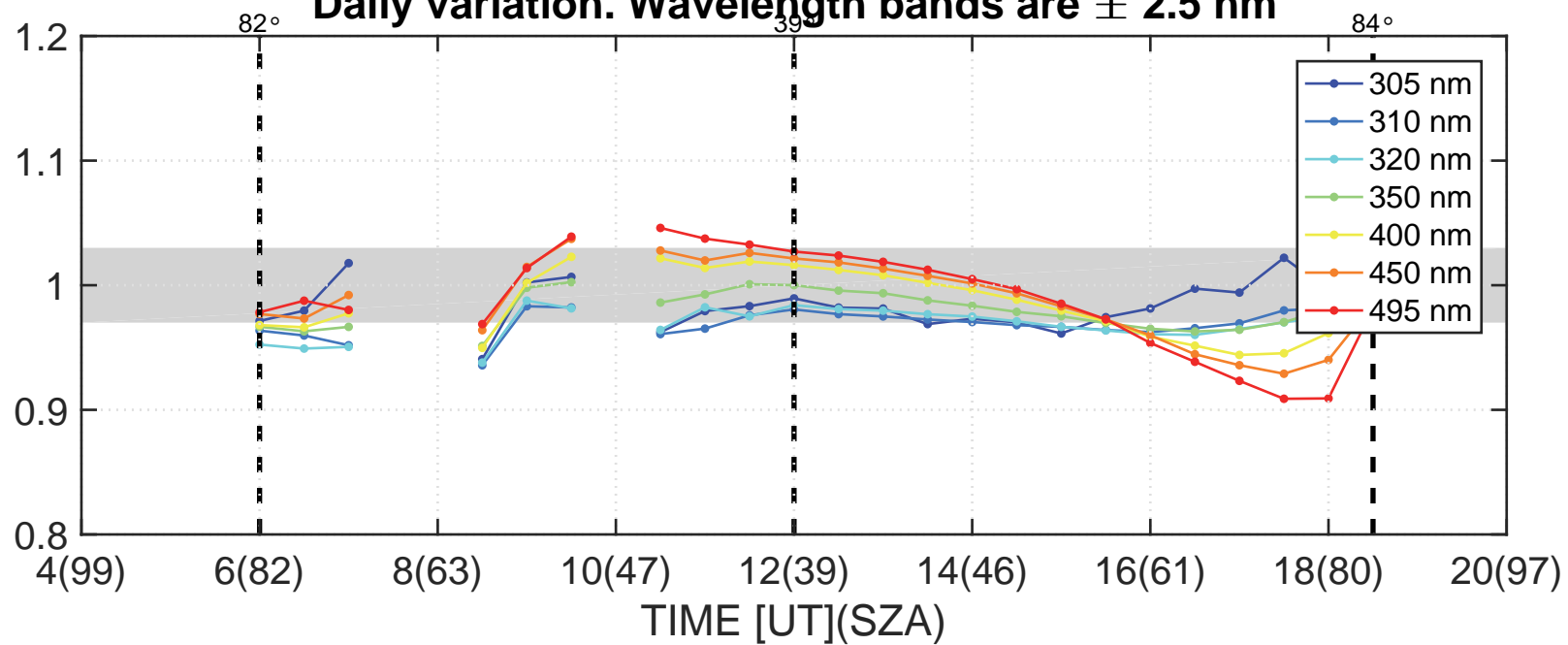
Daily variation. Wavelength bands are ± 2.5 nm



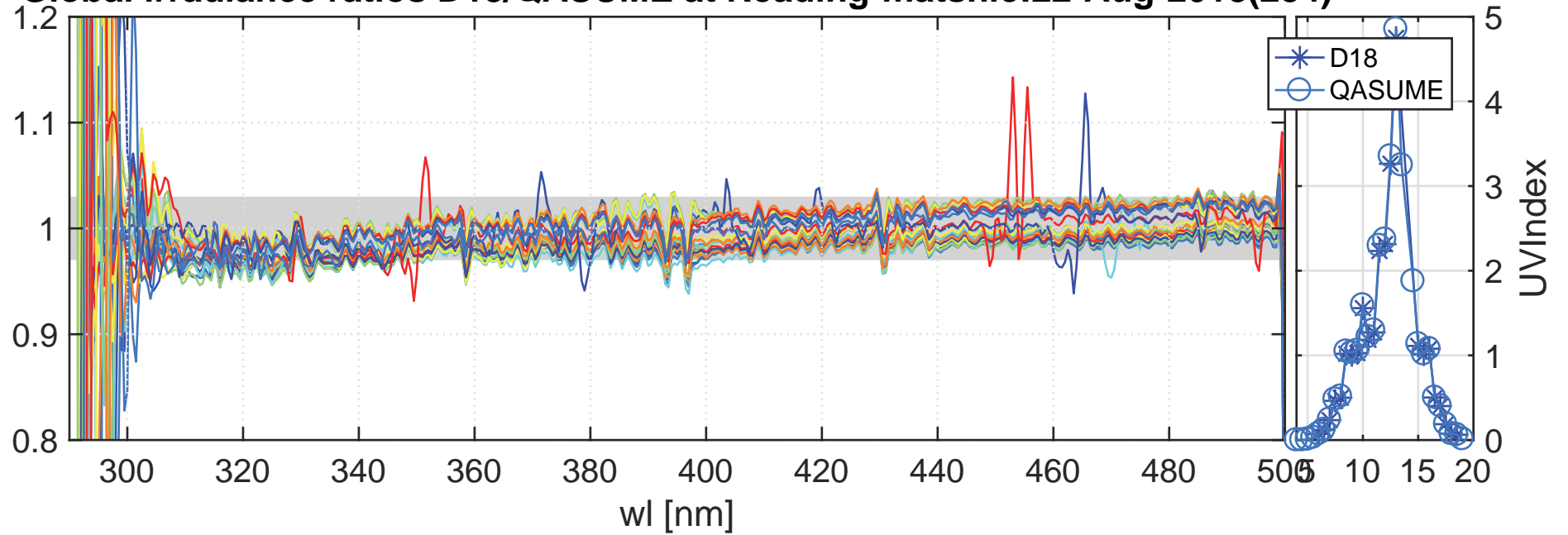
Global irradiance ratios D18/QASUME at Reading-matshic:21-Aug-2018(233)



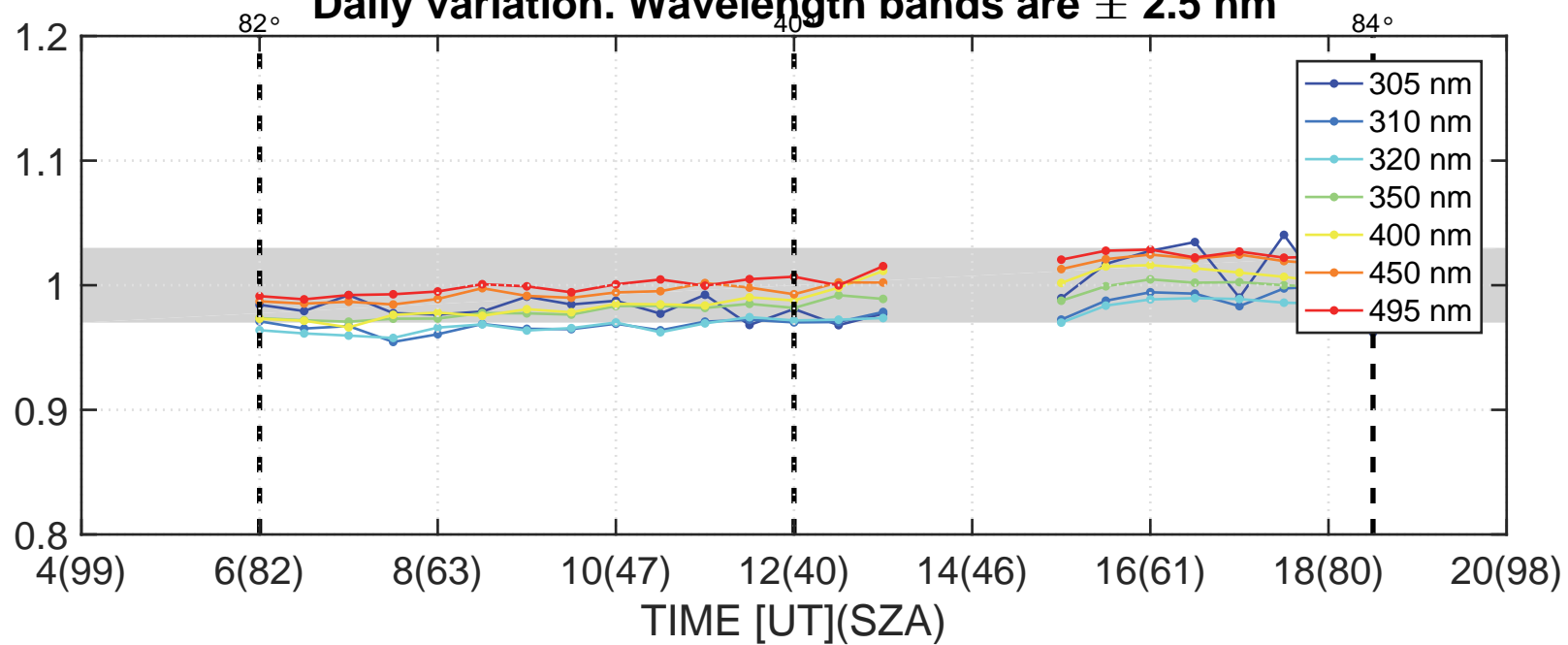
Daily variation. Wavelength bands are ± 2.5 nm



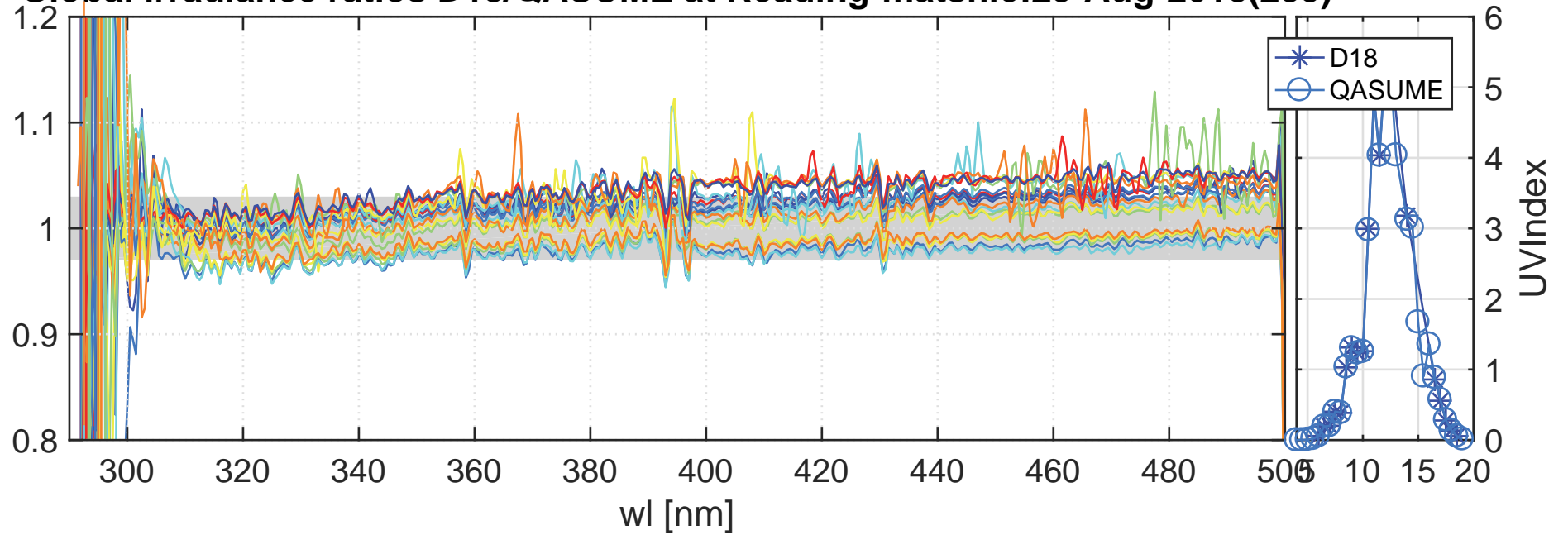
Global irradiance ratios D18/QASUME at Reading-matshic:22-Aug-2018(234)



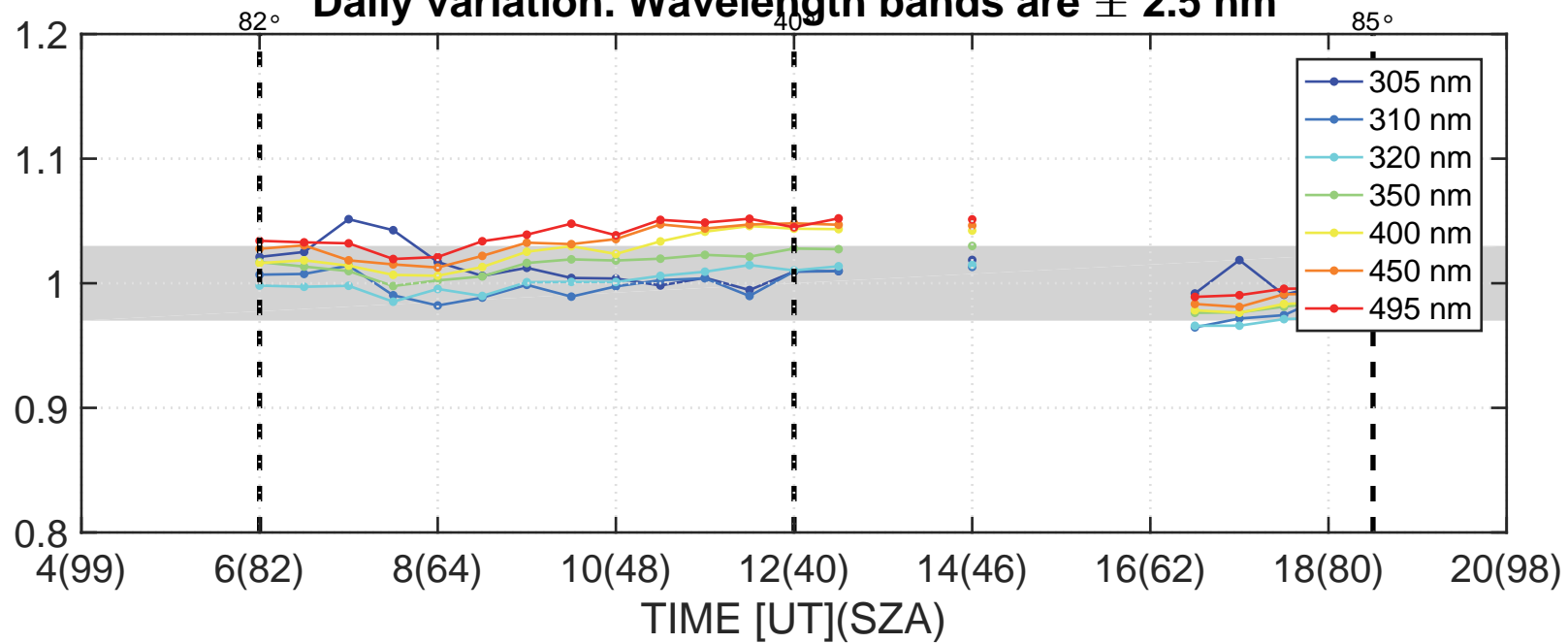
Daily variation. Wavelength bands are ± 2.5 nm



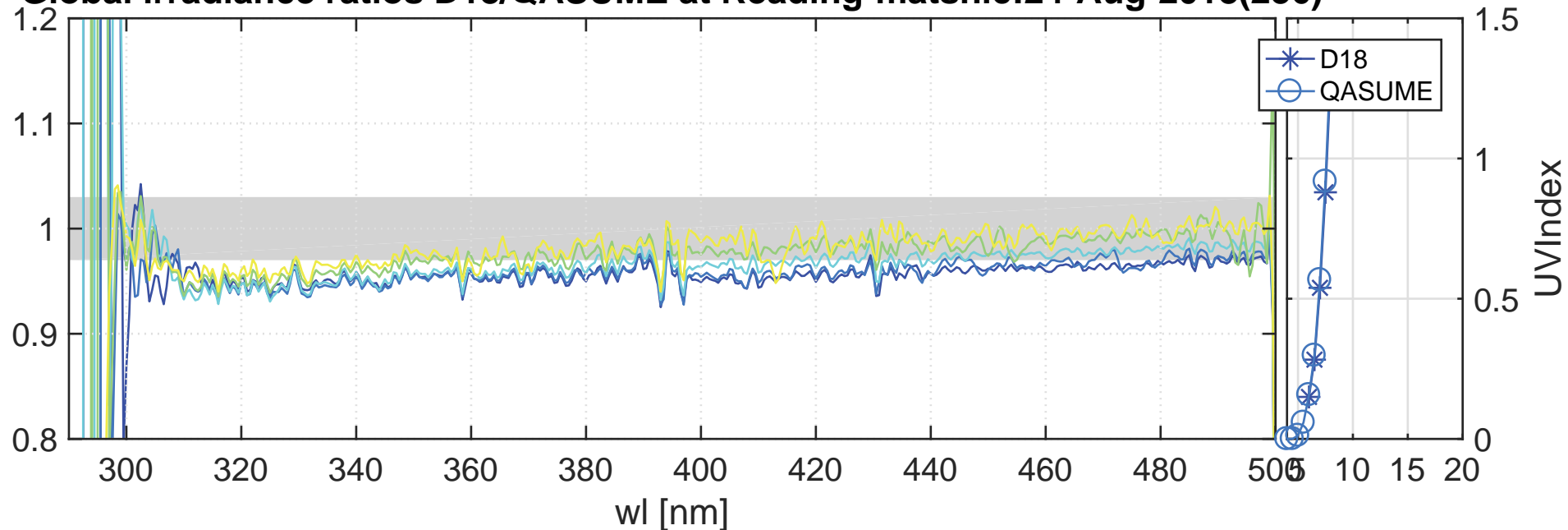
Global irradiance ratios D18/QASUME at Reading-matshic:23-Aug-2018(235)



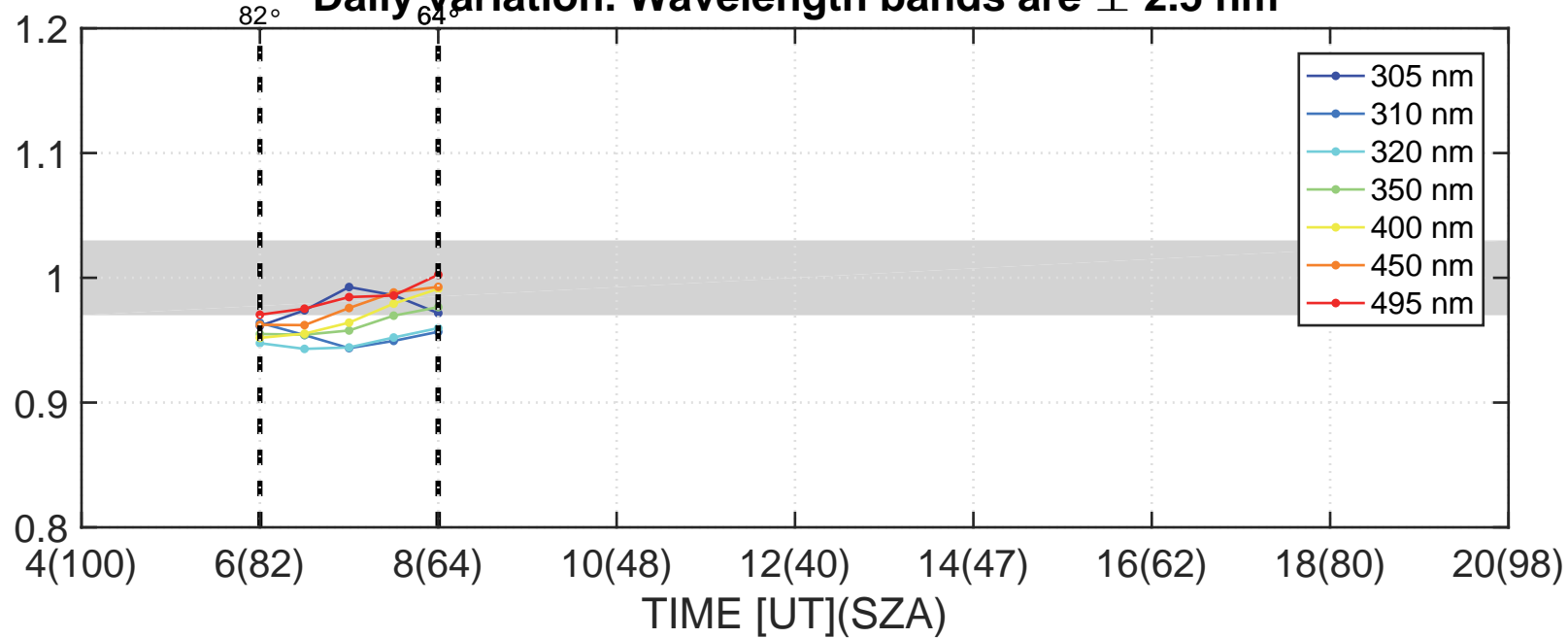
Daily variation. Wavelength bands are ± 2.5 nm



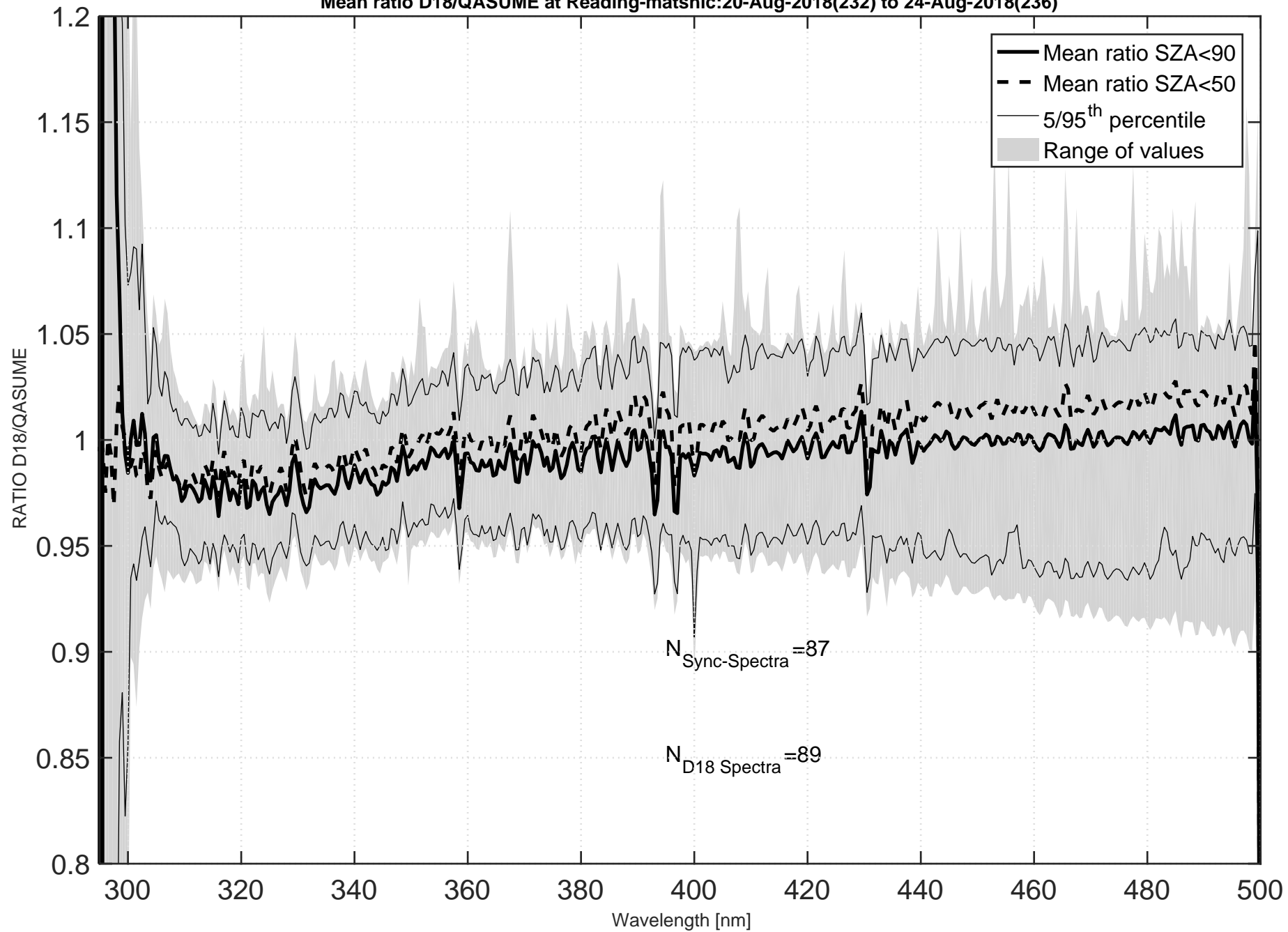
Global irradiance ratios D18/QASUME at Reading-matshic:24-Aug-2018(236)



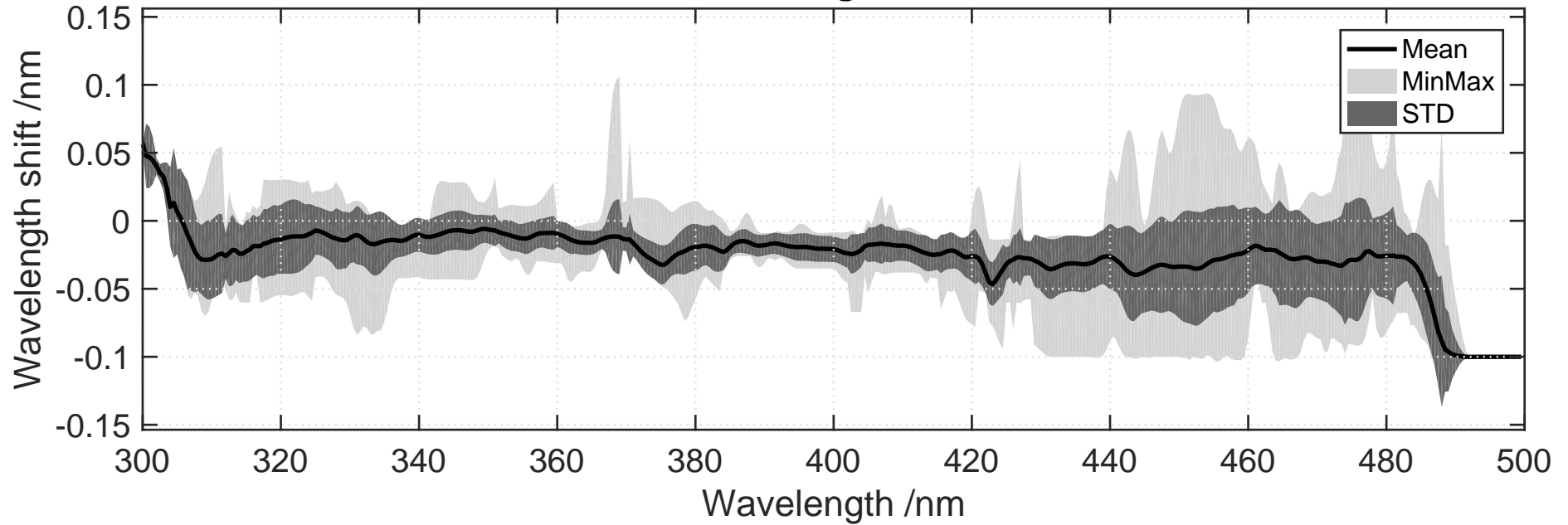
Daily variation. Wavelength bands are ± 2.5 nm



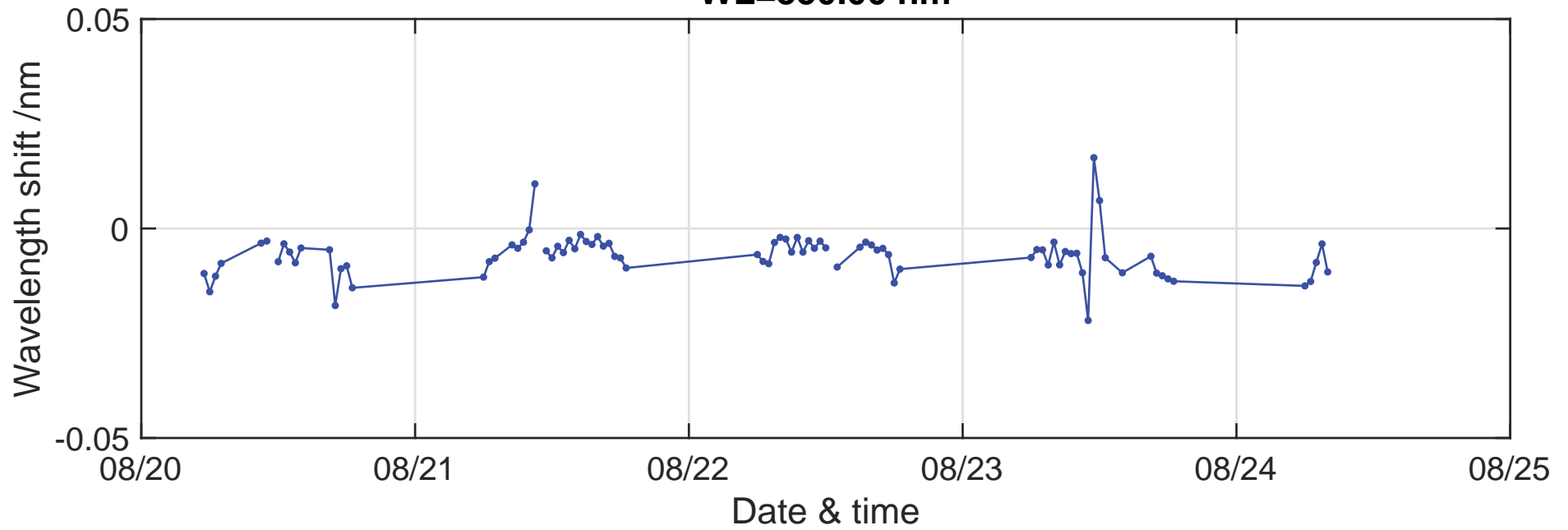
Mean ratio D18/QASUME at Reading-matshic:20-Aug-2018(232) to 24-Aug-2018(236)



Wavelength shift



WL=350.00 nm



Qasume Responsivity Change, August 2018, Reading

