

Protocol of the solar UV intercomparison at PMOD/WRC,
Davos, Switzerland from July 20 to July 31, 2026, with the
travelling reference spectroradiometer QASUME from
PMOD/WRC

Report prepared by Gregor Hülsen

Operator: Gregor Hülsen

The purpose of the visit was the comparison of spectral global solar irradiance measurements between the 5 spectrophotometers participating at the 21st Regional Brewer Calibration Center – Europe (RBCC-E) Campaign and the travel reference spectroradiometer QASUME. The measurement site is located at Davos; Latitude 46.813 N, Longitude 9.845 E and altitude 1585 m a.s.l.

The horizon of the measurement site is free down to at least 80° solar zenith angle (SZA). Measurements between 6:30 UT and 18:00 UT have been analysed.

QASUMEII was installed in the Garden of PMOD/WRC, in line to the Brewer spectrophotometers with the entrance optic of QASUMEII between 2 and 10 m away from the other instruments. The measurement campaign lasted ten days. Solar UV measurements were acquired from morning of July 20 to the afternoon of July 31.

QASUMEII was calibrated several times during the intercomparison period using a portable calibration system. Lamp T157285 was 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 wavelength shifts relative to the QASUMEFTS (Gröbner et al., 2017) spectrum as retrieved from the MatSHIC analysis were between ± 50 nm in the spectral range 290 to 400 nm.

Table 1: Participating Brewer spectrophotometers; 3 single and 7 double monochromators.

Instrument ID	Institution	Operator	Country
#016-MKII	KMI	Alexander Mangold	Belgium
#038-MKIV	PMOD/WRC	Julian Gröbner	Switzerland
#040-MKII	PMOD/WRC, MeteoCH	Franz Zeilinger	Switzerland
#072-MKII	PMOD/WRC, MeteoCH	Franz Zeilinger	Switzerland
#156-MKIII	PMOD/WRC, MeteoCH	Franz Zeilinger	Switzerland
#163-MKIII (ISQ)	PMOD/WRC	Julian Gröbner	Switzerland
#185-MKIII (IZ3)	AEMET IZAÑA	Alberto Redondas	Spain
#240-MKII	Privat	Pavel Babal	The Netherland
#257-MKIII	AEMET IZAÑA	Alberto Redondas	Spain

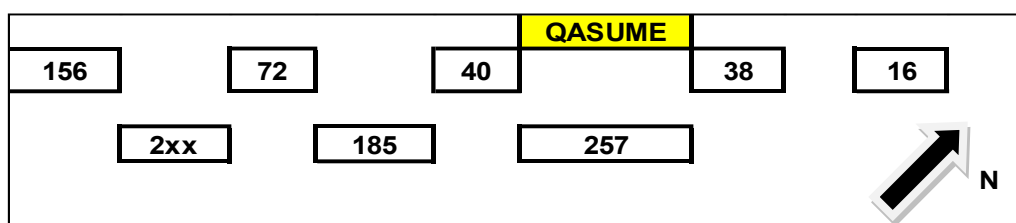


Figure 1: Setup at PMOD/WRC in the garden measurement field.

Brewer 163 is installed on the roof of the PMOD/WRC building.

Brewer 40, 72 and 156 from MeteoCH and 2xx are not recording any UV measurements.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 400 nm, every 0.5 nm, and 3 seconds between each wavelength increment.

The official UV days were scheduled from 27 to 31 July. However, UV scans were performed throughout the campaign.

DOY	Date	DAY	Weather	Comment (time in UT)
181	30-Jun			Setup Qasumell in Garden PMOD
201	20-Jul	Monday	Mostly Clear sky	Start RBCCE
202	21-Jul	Tuesday	Mix of sun & clouds	Calibrated: 9:51 using T157825
203	22-Jul	Wednesday	Clear sky morning	
204	23-Jul	Thursday	Mix of sun & clouds	
205	24-Jul	Friday	Mostly Clear sky	
206	25-Jul	Saturday	Mix of sun & clouds	
207	26-Jul	Sunday	Mix of sun & clouds	
208	27-Jul	Monday	Mix of sun & clouds	
209	28-Jul	Tuesday	Clear sky	
210	29-Jul	Wednesday	Mix of sun & clouds	Calibrated: 09:12 using T157825
211	30-Jul	Thursday	Clear sky	
212	31-Jul	Friday	Mix of sun & clouds	End of Campaign: 8:40

Results:

Up to 74 synchronised simultaneous spectra from QASUMElI and the Brewer spectrophotometers are available from the measurement period. Measurements between 6:30 and 18:00 UT have been analysed (SZA smaller than 90°) using matSHIC.

Remarks:

The comparison between the Brewers and QASUME was very successful, and consistent with the results obtained in previous visits (see Figure 2-6 of the Annex).

No UV data is available for Brewers 40, 72, 156 and 240.

Data Processing:

- The data from Brewers 16, 38 and 163 were processed by the responsible operator. Brewer 38 incl. a cosine correction.
- The data from Brewers 16, 163 and 257 were also processed with Eubrewnet Level 1.5.
- The data from Brewer 185 was processed with Eubrewnet Level 2 (cosine correction & matshic).
- The data from Brewer 38 was calculated first without temperature correction. From this comparison the correction coefficient was derived in relation to the internal temperature of the Brewer. Thereafter the data was recalculated using a temperature correction with a factor of 0.5 %/°C for T>40 °C.

More information can be found here:

<https://eubrewnet.aemet.es/dokuwiki/doku.php?id=codes:uvaccess>

https://eubrewnet.aemet.es/dokuwiki/doku.php?id=codes:uvaccess#process_uv1

https://eubrewnet.aemet.es/dokuwiki/doku.php?id=codes:uvaccess#uv_corrections_flag

<https://drive.google.com/file/d/1RitZadF38CQhpnoA3vFugaHFSlaDys4p/view?usp=sharing>

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Conclusion:

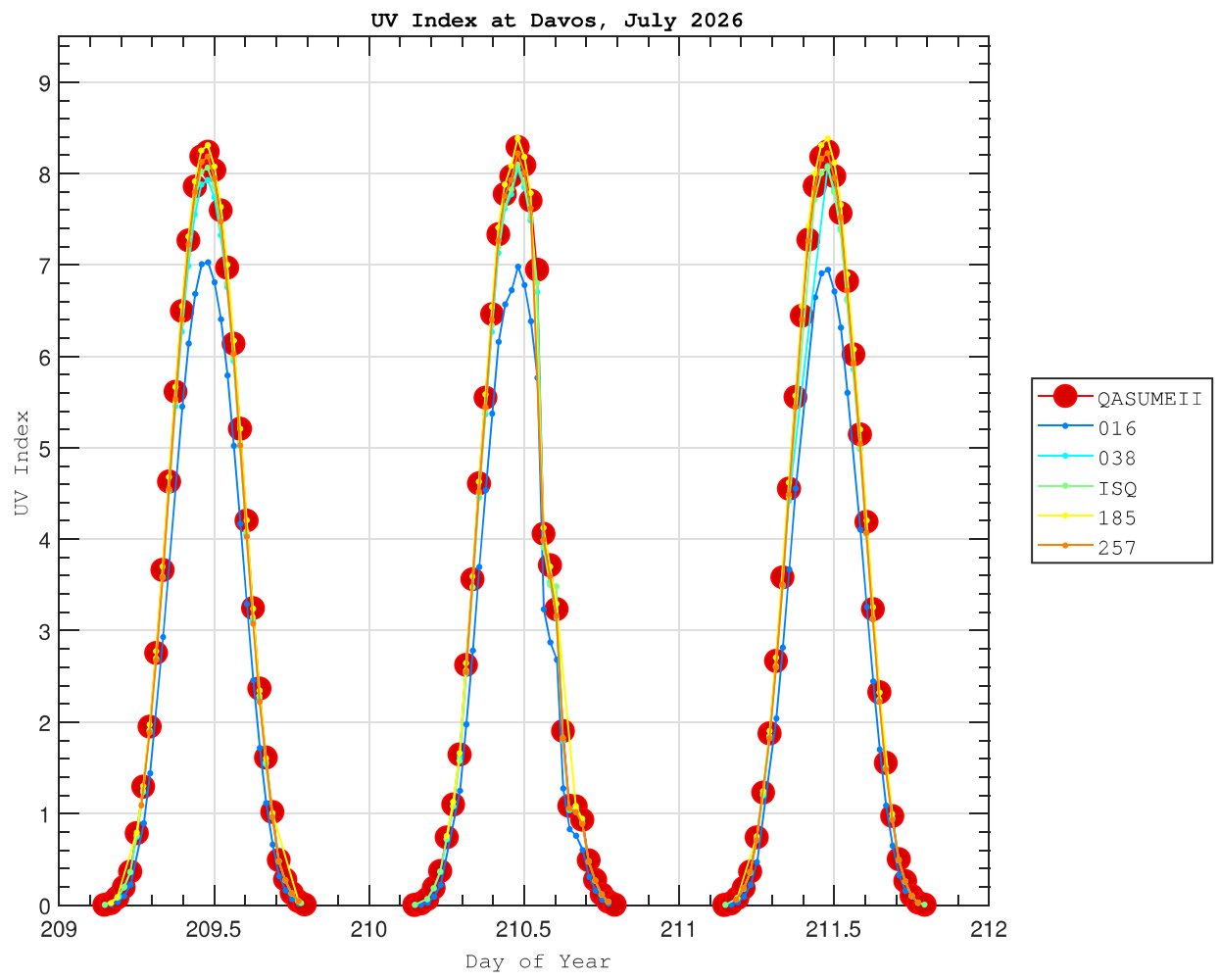
The angular response correction was applied to the solar UV spectra of 2 Brewers and shows a considerable improvement to the comparison to QASUME. Remaining uncertainties are the stray-light for single monochromator Brewers and the uncorrected temperature dependence of most Brewers.

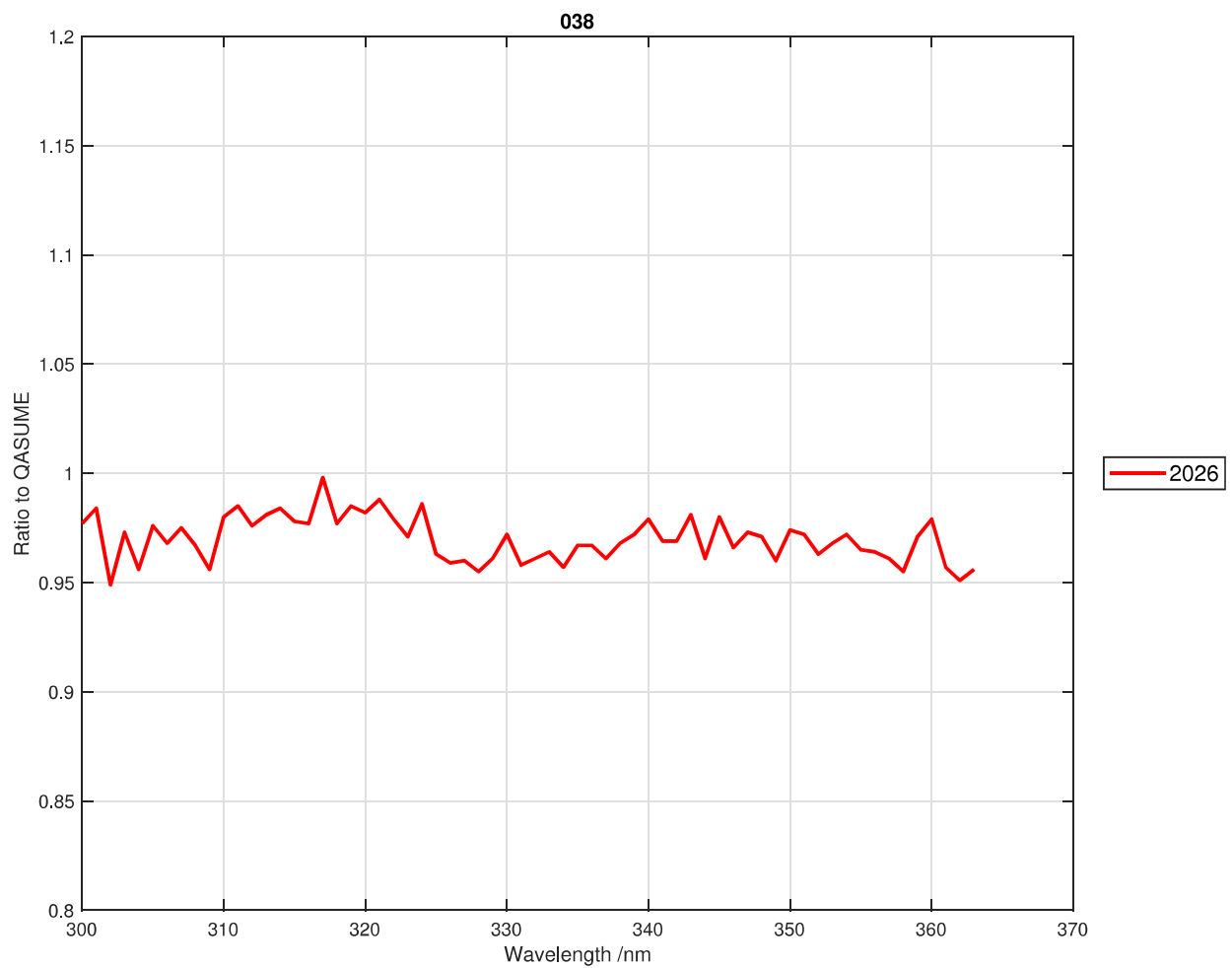
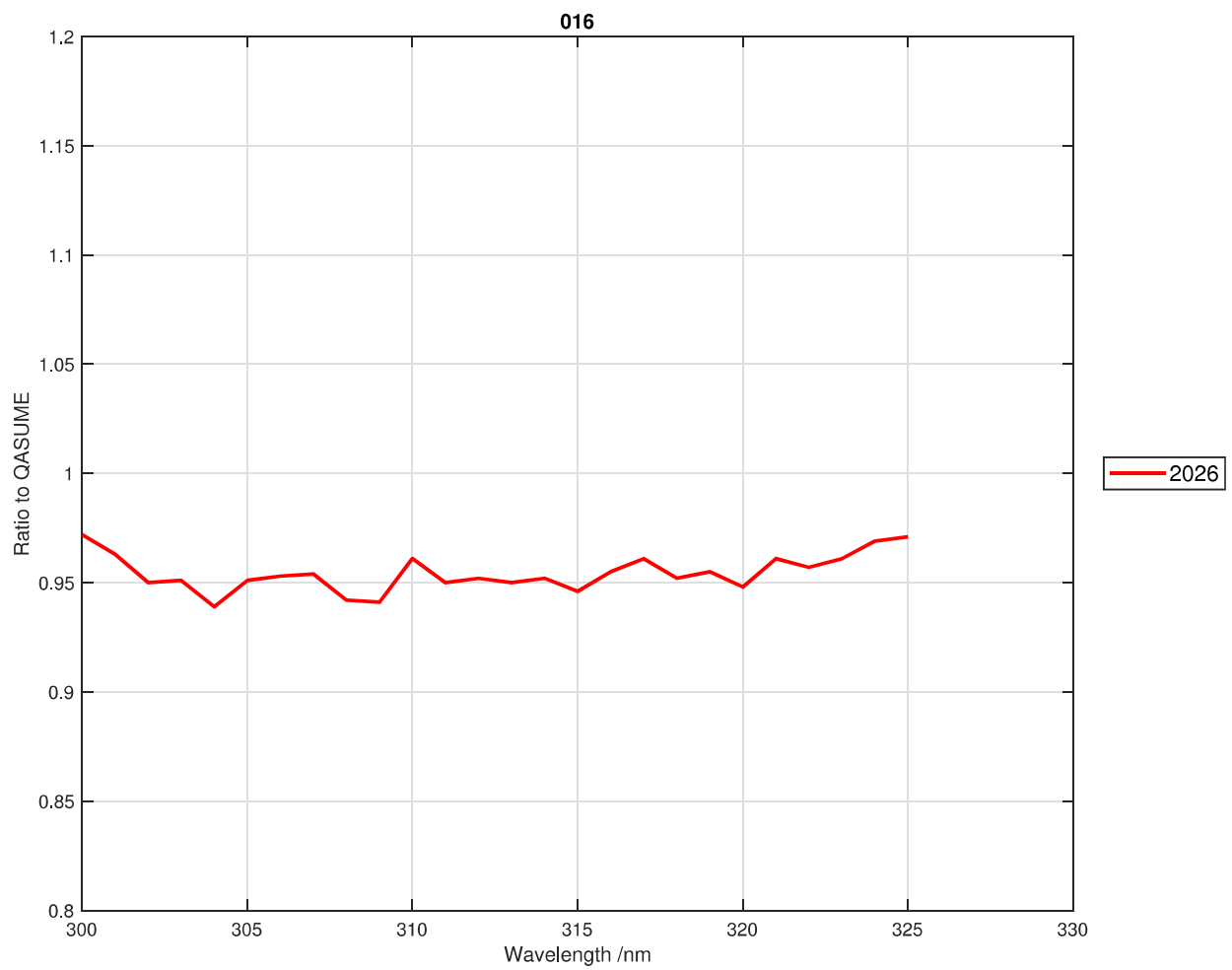
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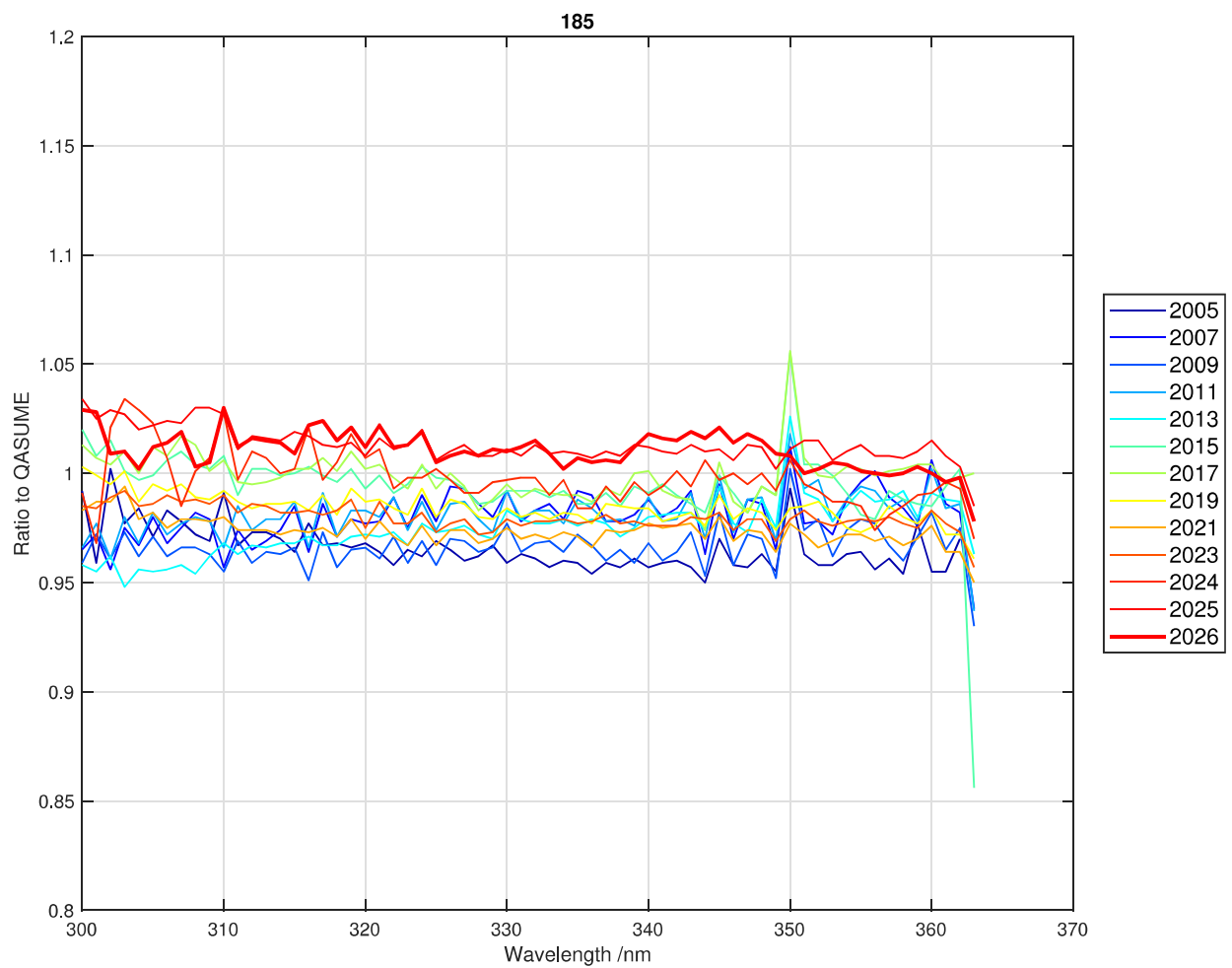
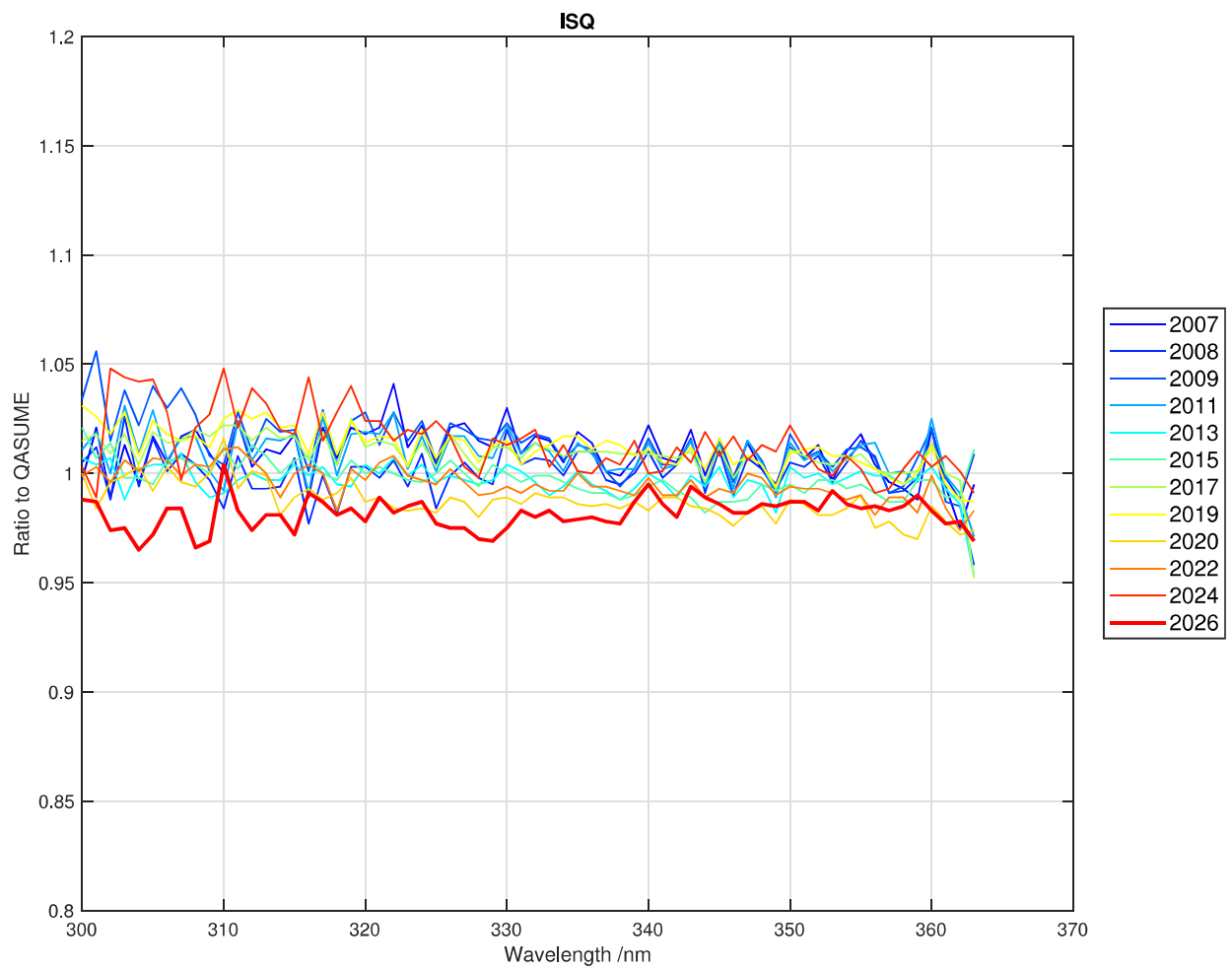
Gröbner, J., Kröger, I., Egli, L., Hülsen, G., Riechelmann, S., and Sperfeld, P.: The high-resolution extraterrestrial solar spectrum (QASUMEFTS) determined from ground-based solar irradiance measurements, *Atmos. Meas. Tech.*, 10, 3375-3383, <https://doi.org/10.5194/amt-10-3375-2017>, 2017.

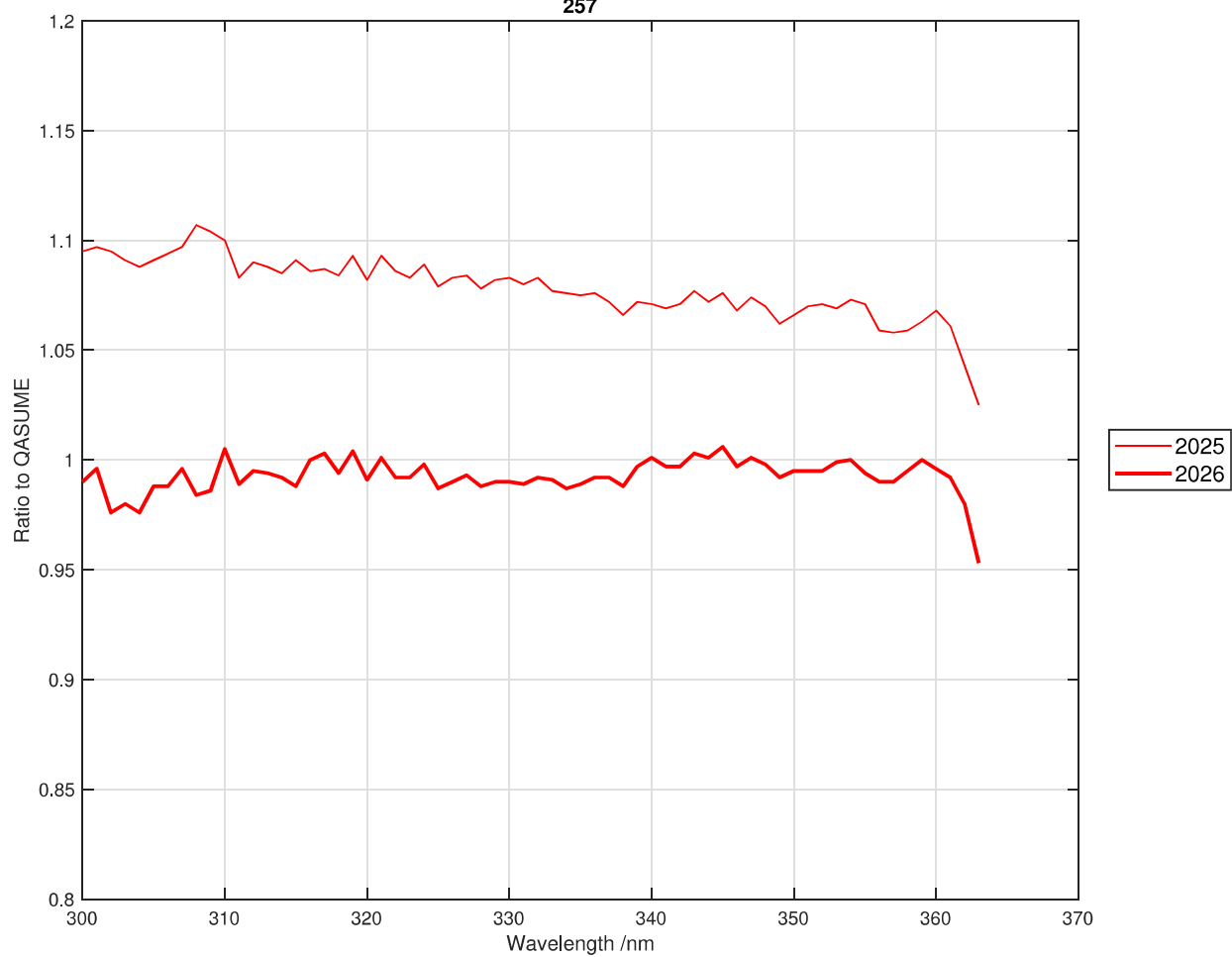
Appendix

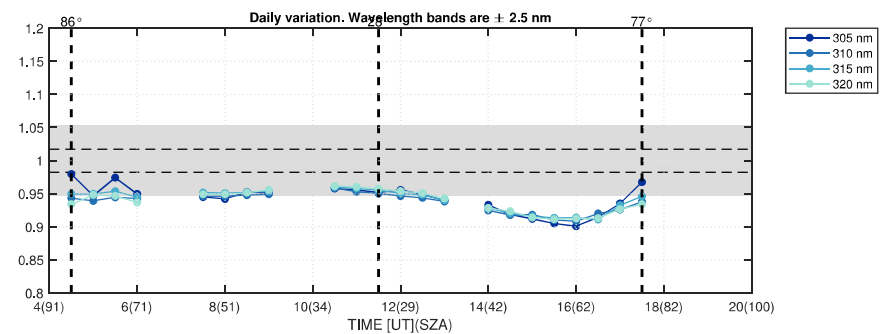
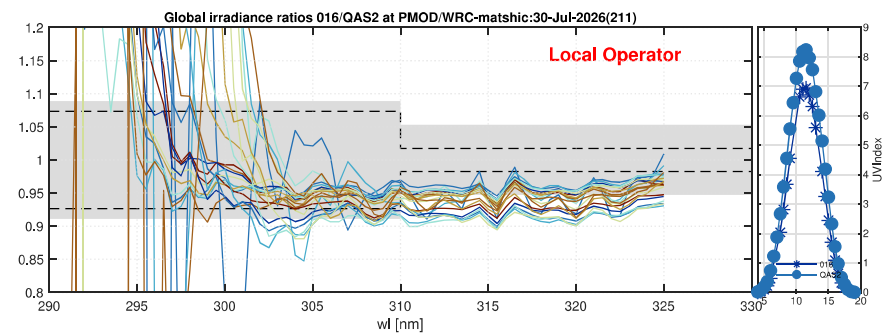
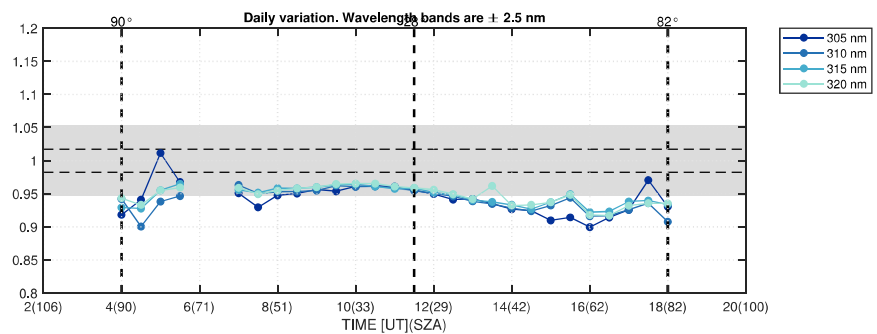
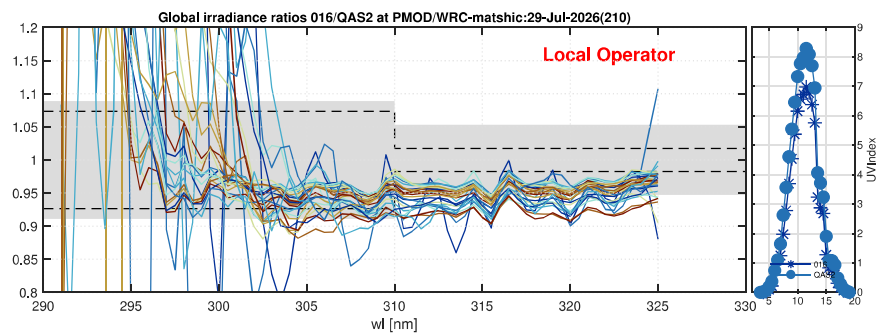
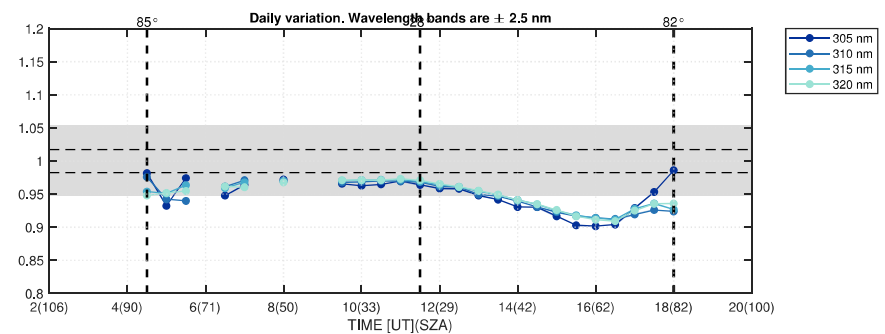
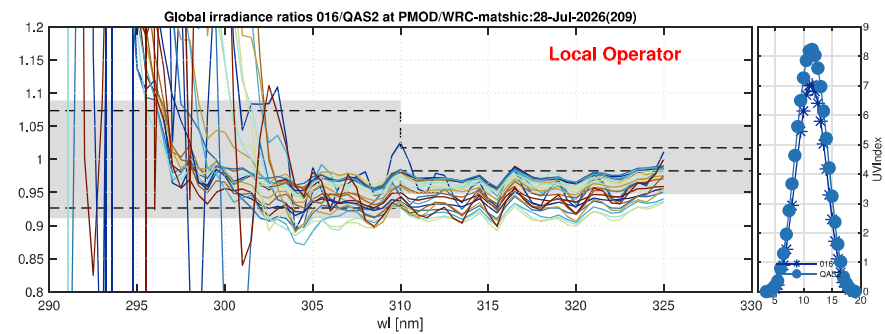
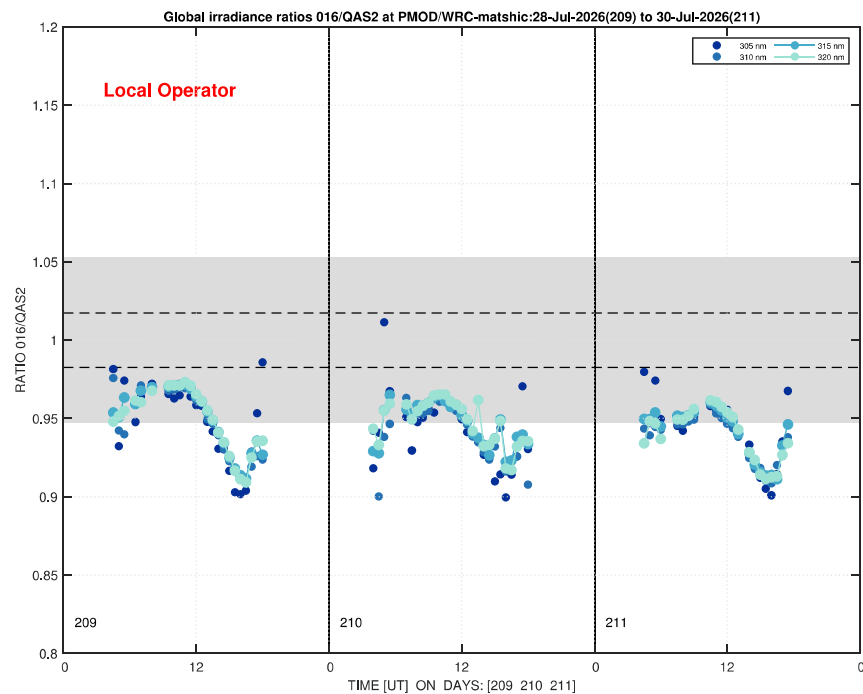
Detailed results for all Brewer spectrophotometers with respect to the reference spectroradiometer QASUME

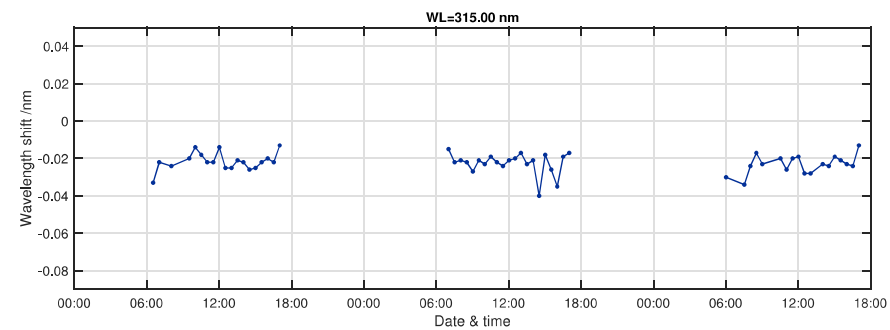
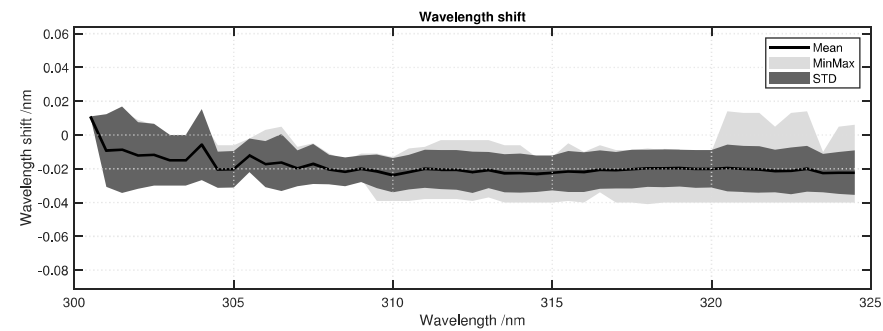
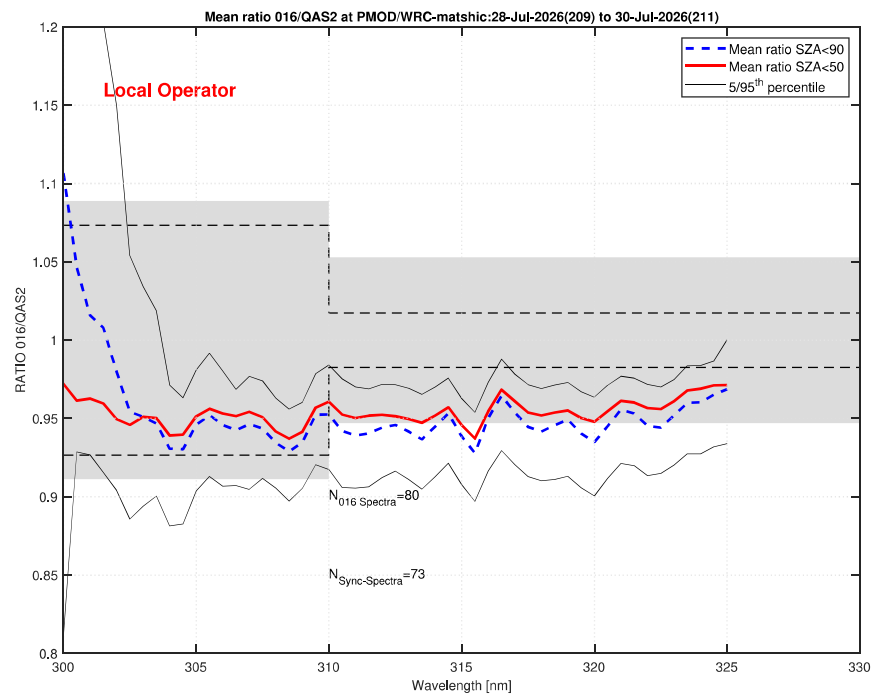


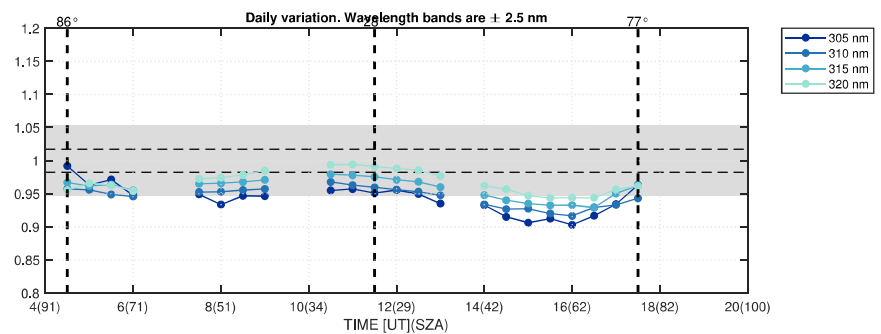
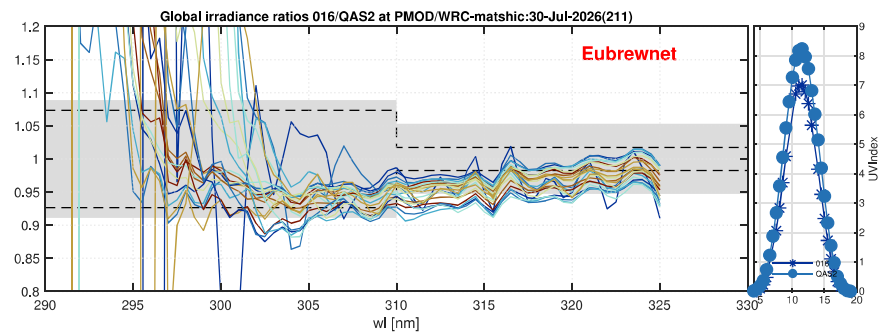
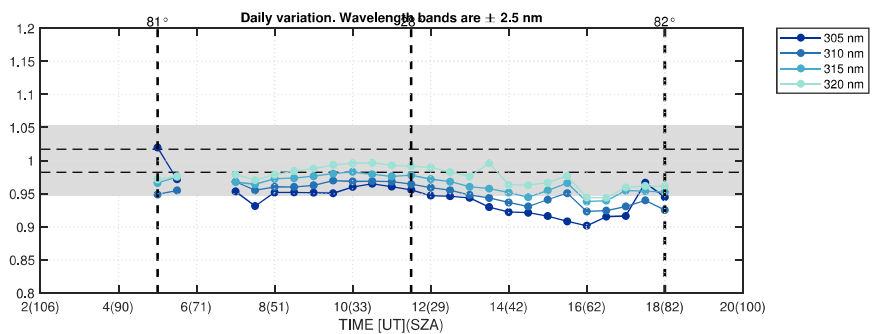
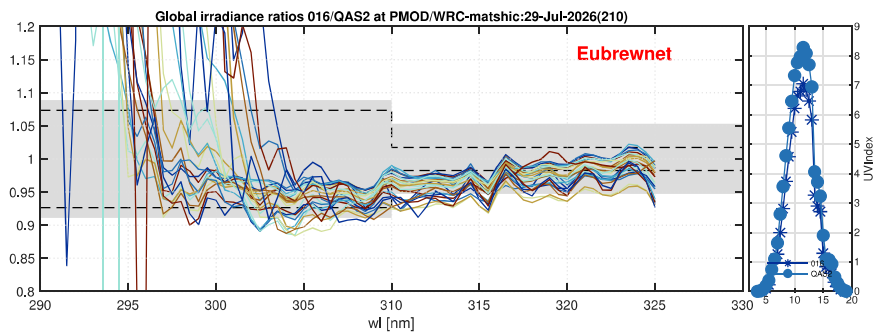
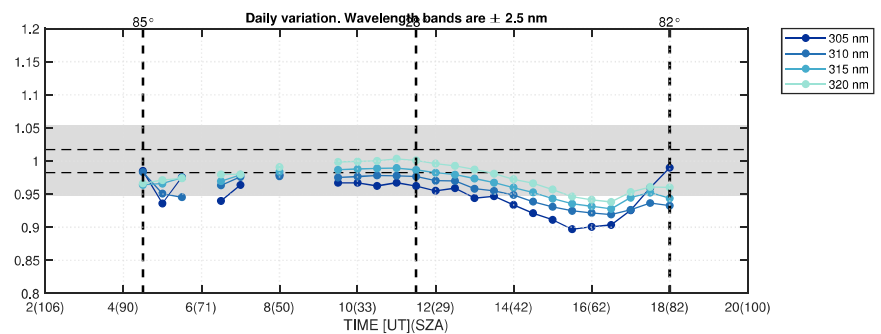
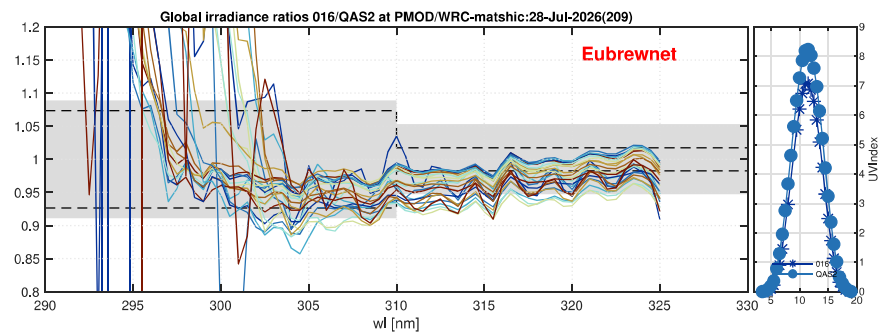
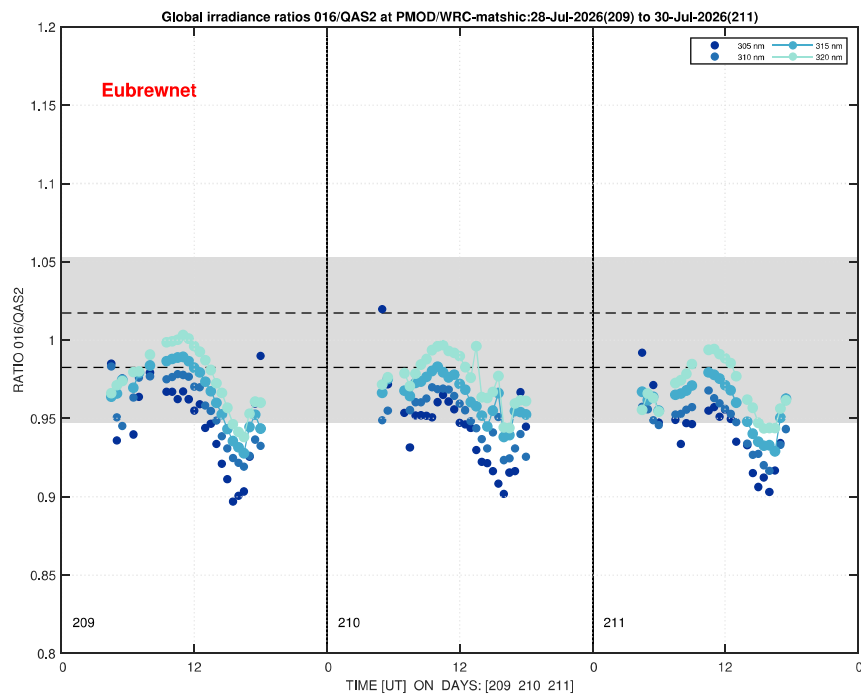


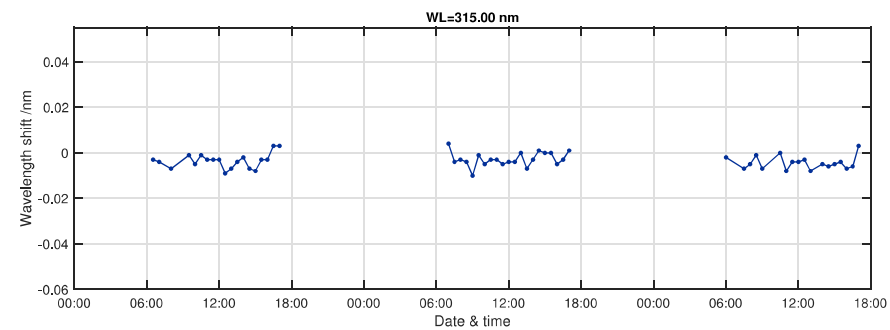
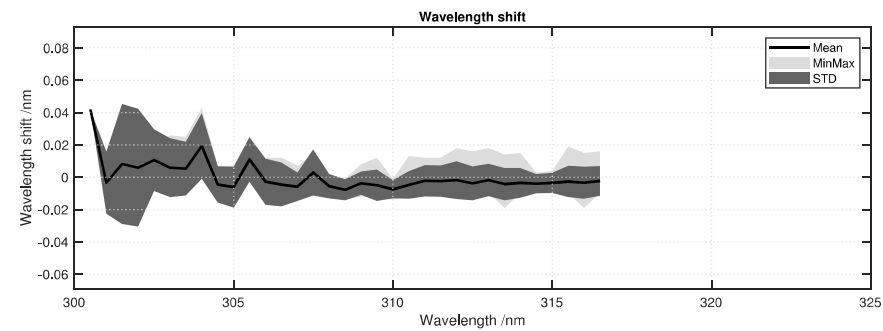
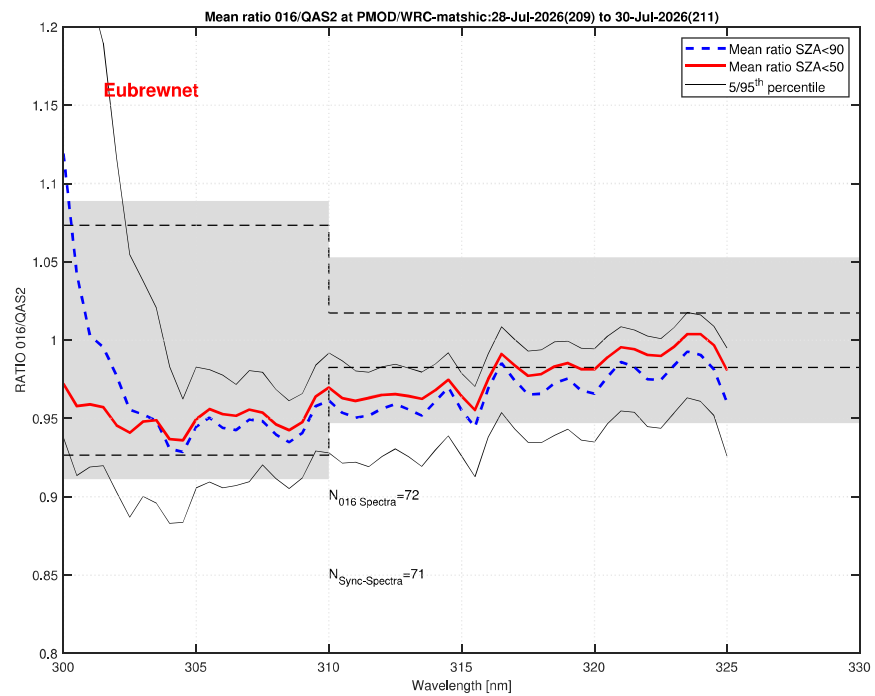


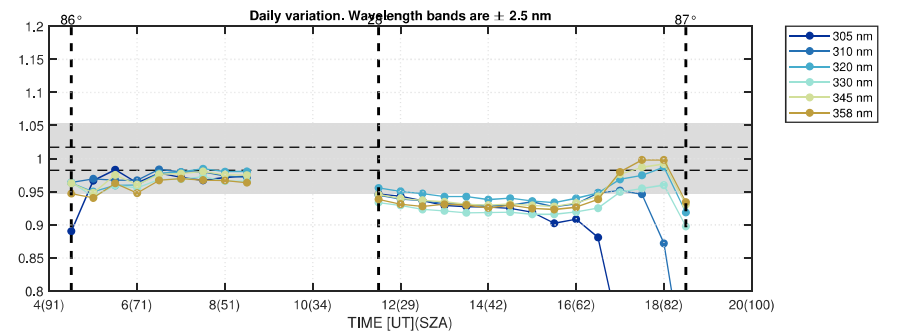
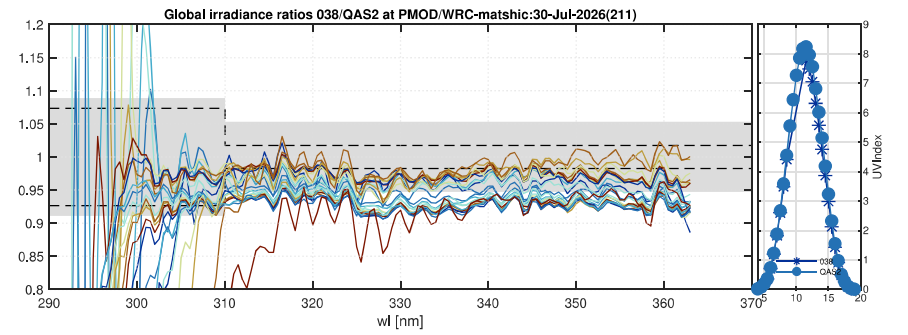
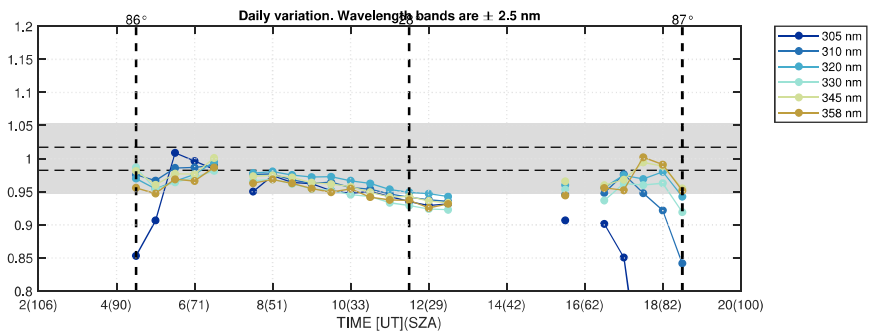
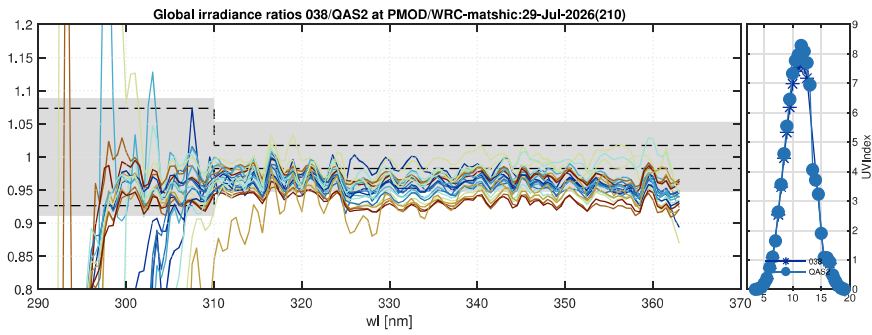
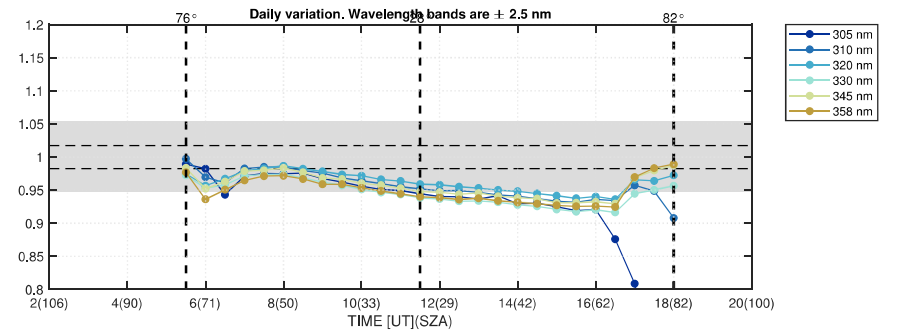
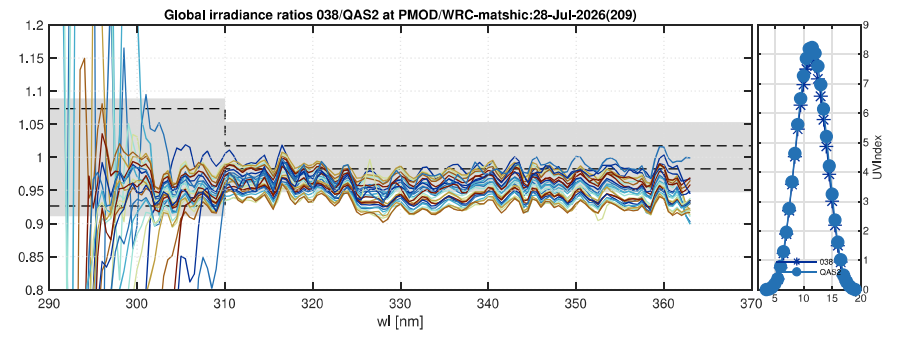
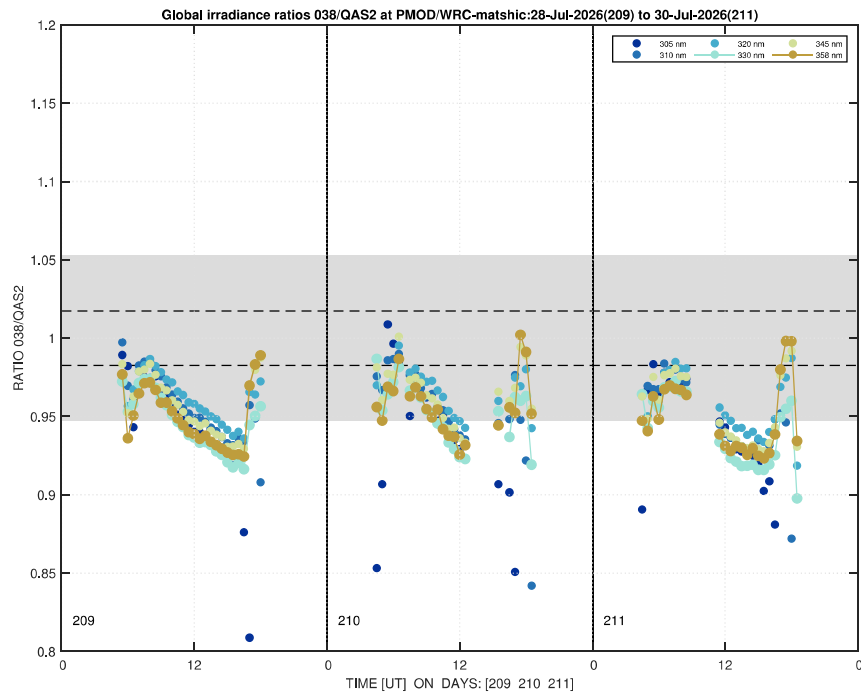


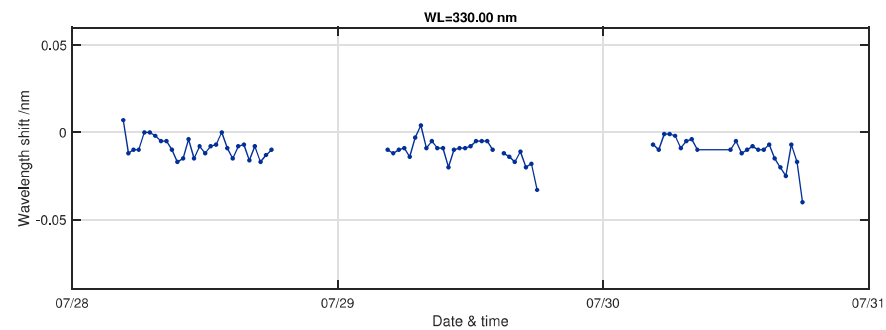
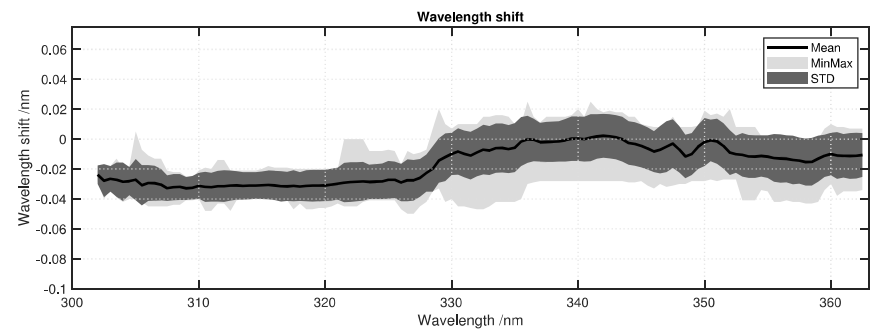
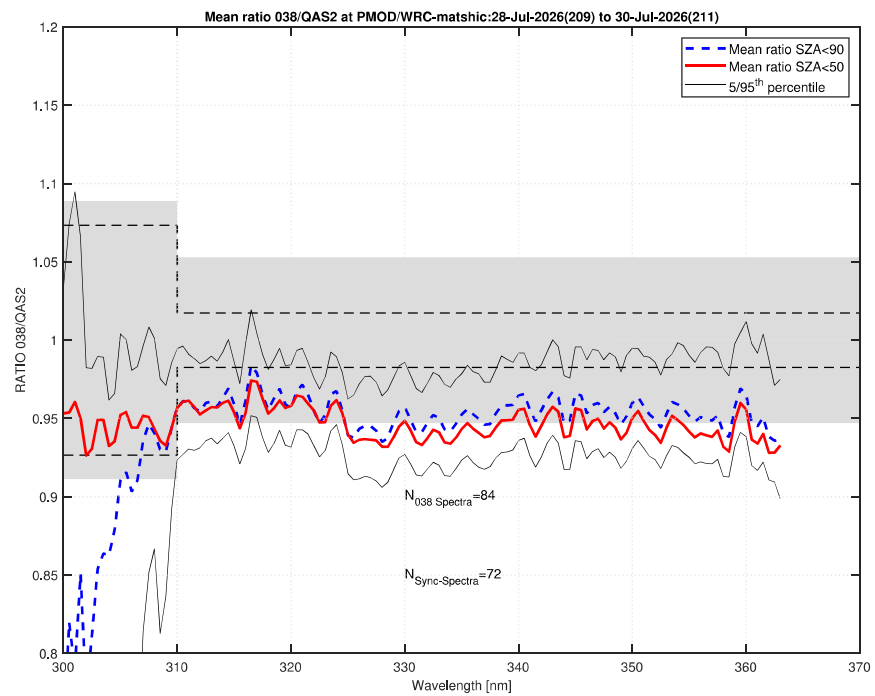


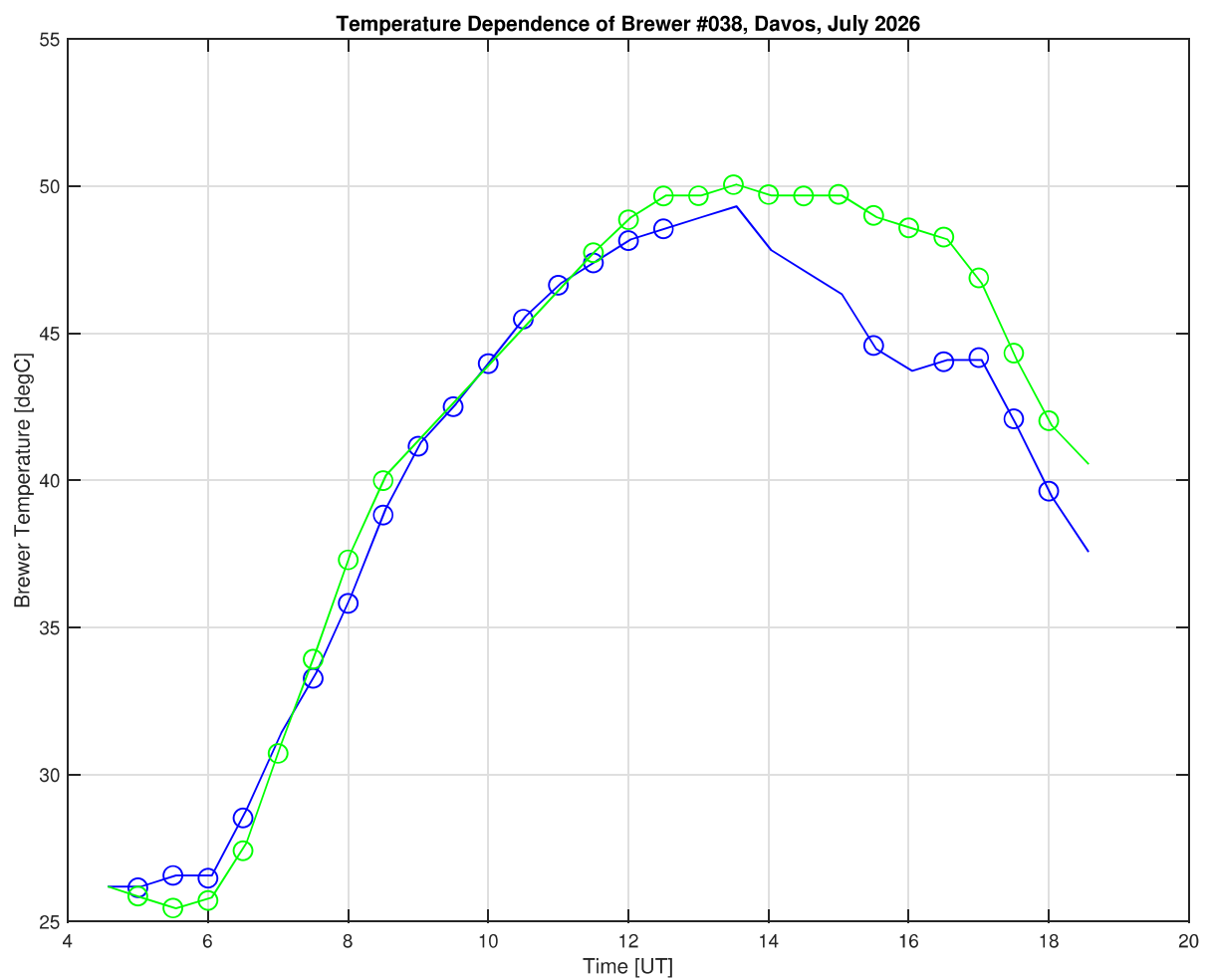
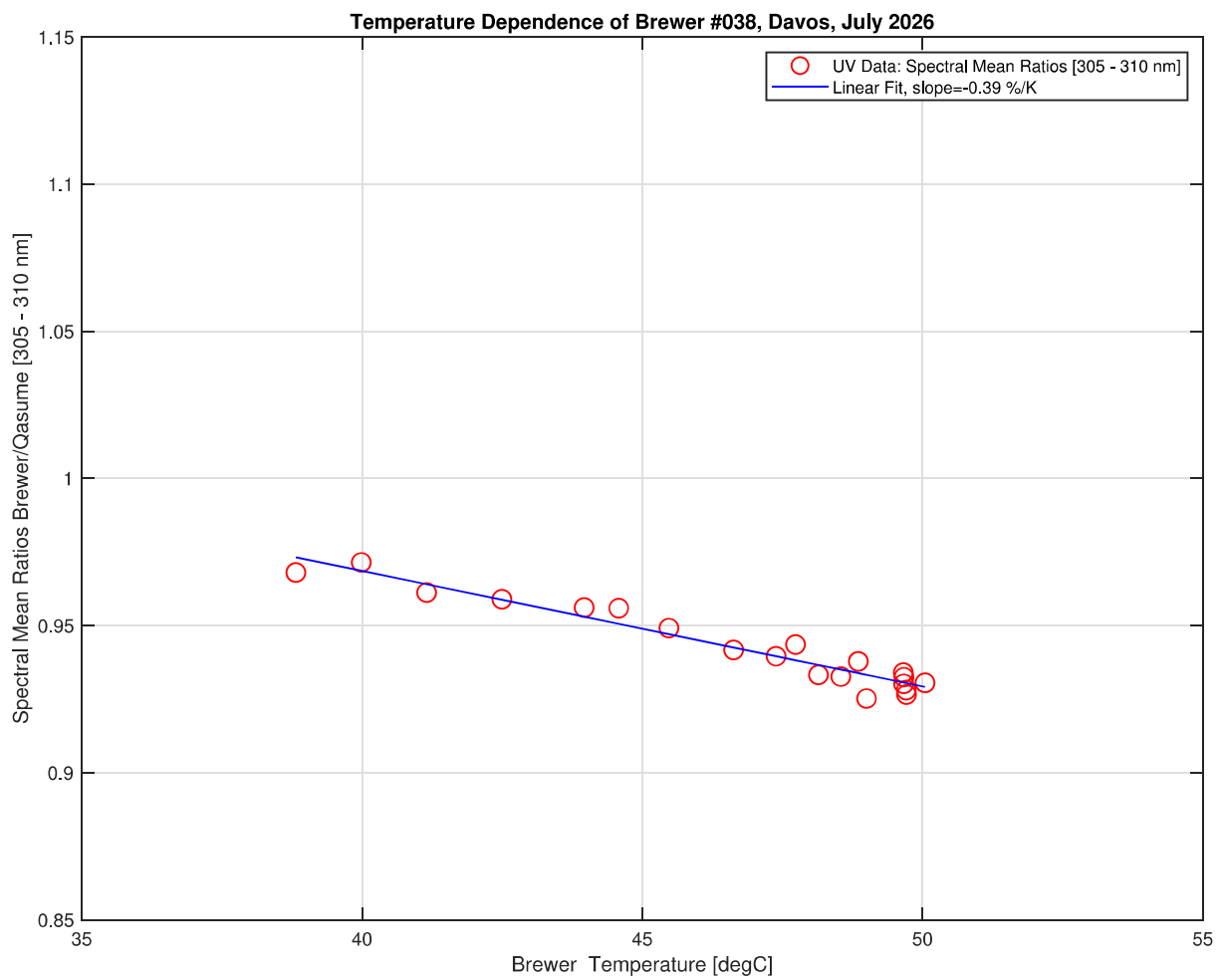


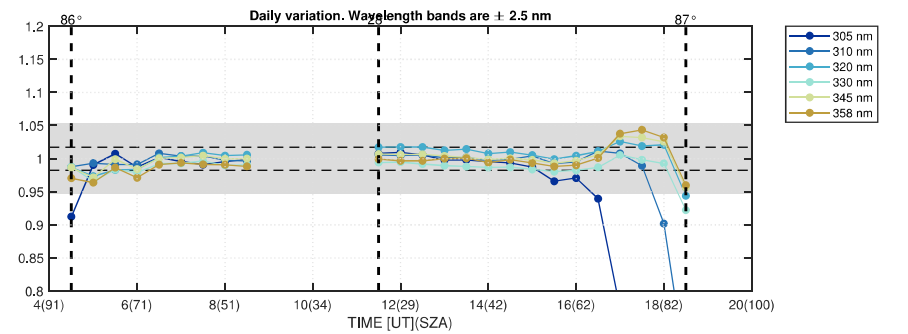
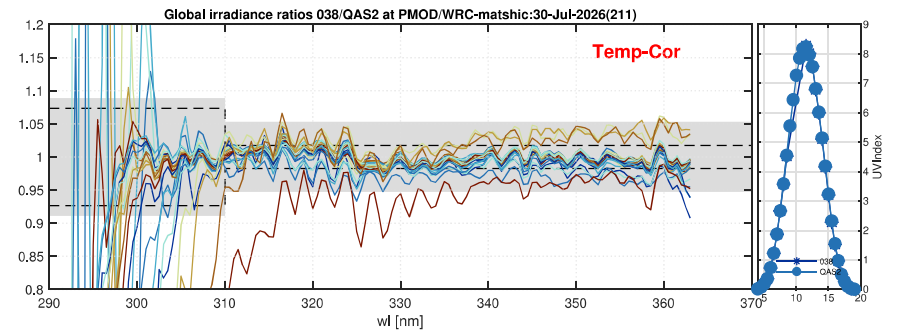
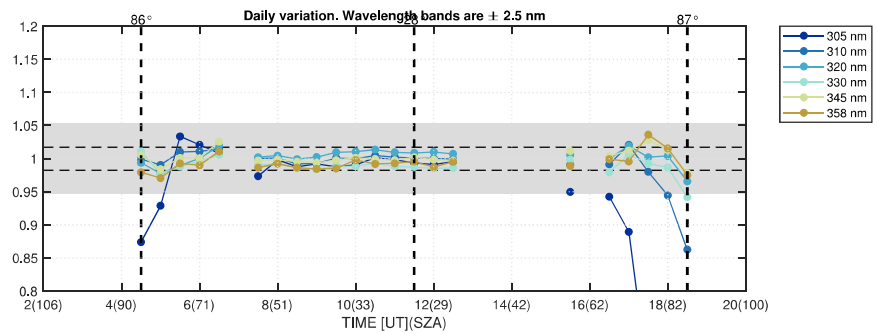
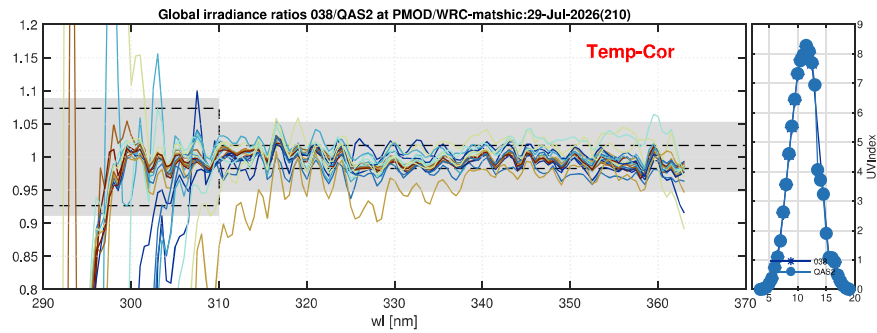
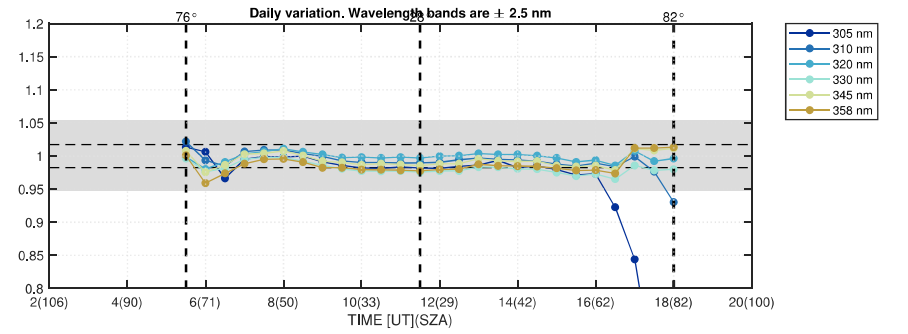
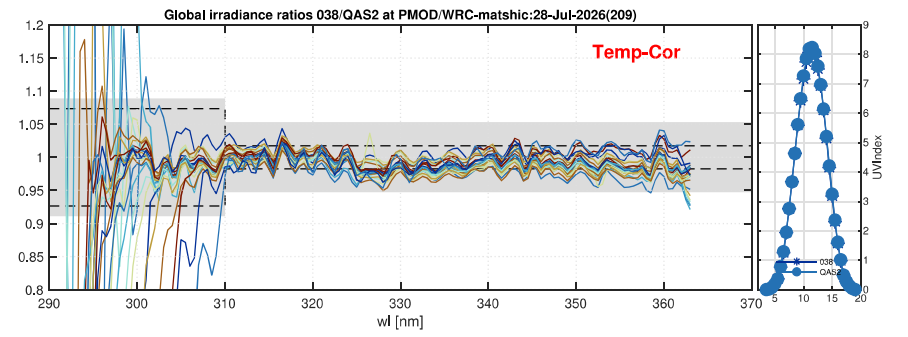
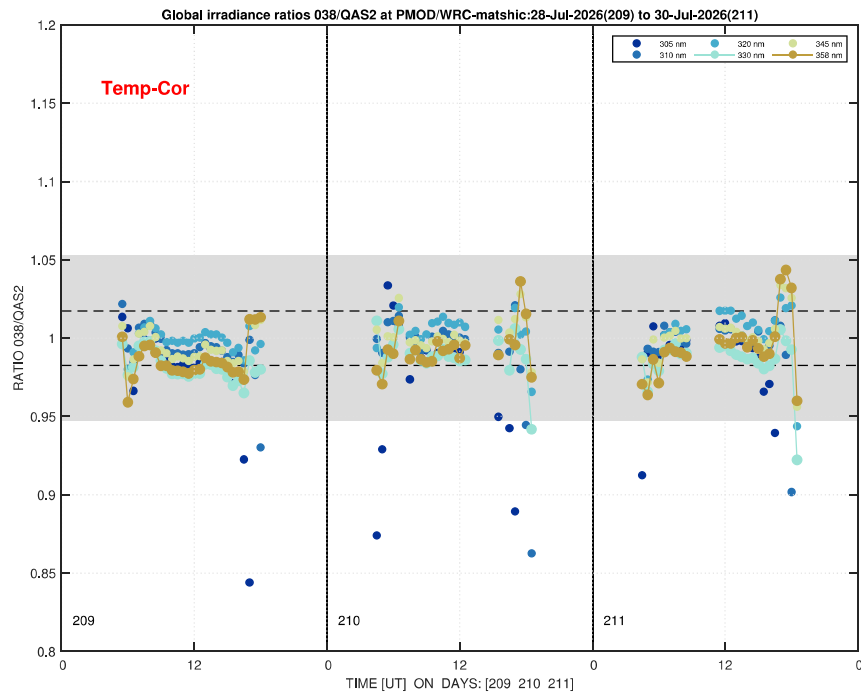


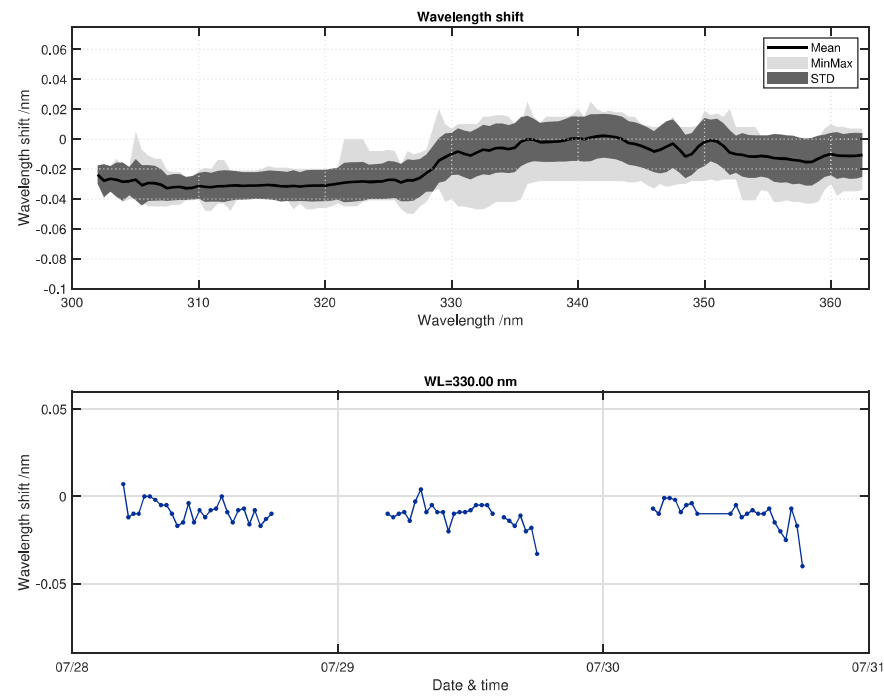
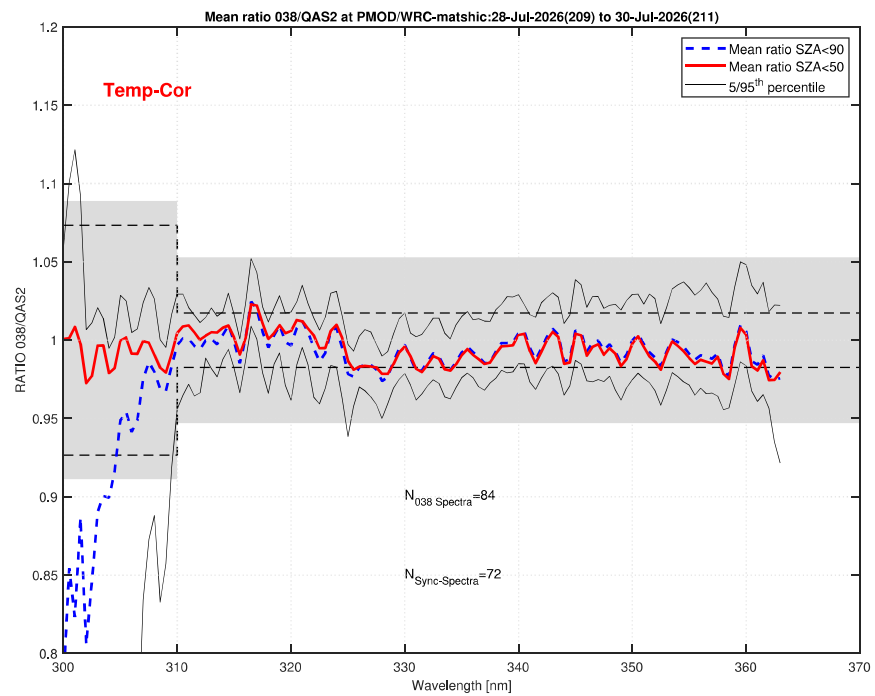


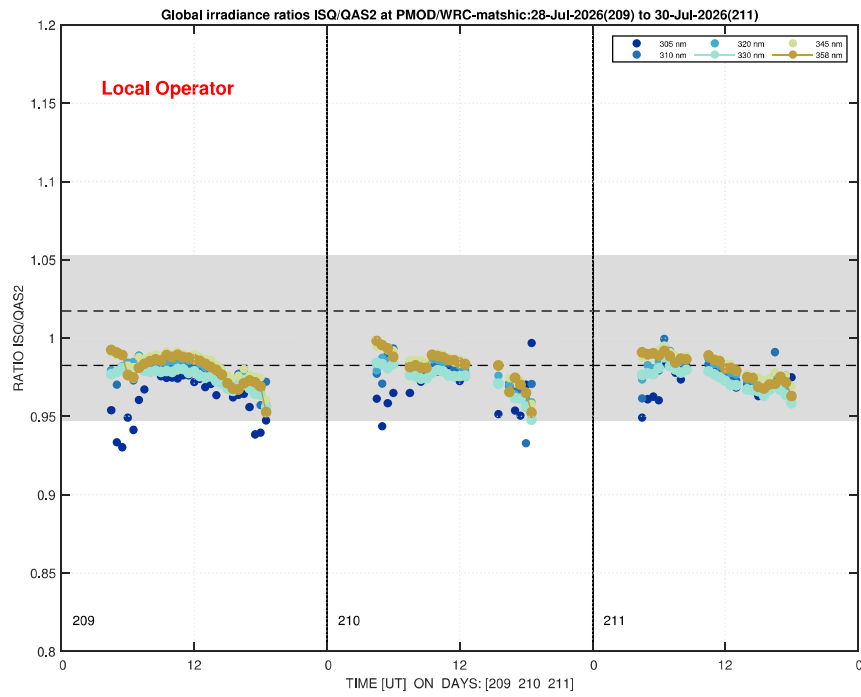












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