

Protocol of the intercomparison at FMI, Helsinki, Finland on June
11 to 15, 2018 with the travelling reference spectroradiometer
QASUME from PMOD/WRC

Report prepared by Luca Egli

Operator: Luca Egli

The purpose of the visit was the comparison of global solar irradiance measurements between the Brewer spectrophotometer operated by FMI and the travel reference spectroradiometer QASUME. The measurement site is located at Helsinki; Latitude 60.20 N, Longitude 24.96 E 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 1:30 UT and 20:00 UT have been analysed.

QASUME was installed on the measurement platform of FMI-Helsinki in the evening of June 10, 2018. The spectroradiometer was installed next to the Brewer spectrophotometer "FIJ" with the entrance optic of QASUME within 2 m to "FIJ". The Brewer Spectrometer #107 is a double monochromator MkIII. The intercomparison between QASUME and the Brewer Spectrometer lasted five days, from morning of June 11th to the afternoon of June 15th.

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 25.29 ± 0.11 °C and the diffuser head was heated to a temperature of 28.96 ± 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 400 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 400 nm, every 0.5 nm, and 3.0 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)
161	10. Jun	Sunday	Moving clouds	Installed at 14:30
162	11. Jun	Monday	Overcast with cirrus with some clear periods in the afternoon	8:43 Calibration (T68523) 12:04 Calibration (T68522)
163	12 Jun	Tuesday	Overcast in the morning, clear sky in the afternoon from 11:30	9:32 Calibration (T68522)
164	13 Jun	Wednesday	Clear sky in the morning until 9:00, moving clouds in the afternoon	8:01 Calibration (T68522) 8:58 Calibration (T16573)
165	14 Jun	Thursday	Clear sky with some cirrus in the evening	8:35 Calibration (T68522)
166	15 Jun	Friday	Mostly overcast with cirrus	13:01 Calibration (T68522) 13:26 End of campaign

Results:

In total 159/177 synchronised simultaneous spectra from QASUME and FIJ are available from the measurement period. Measurements between 1:30 and 20:00 UT have been analysed (SZA smaller than 90°).

Spectra from Monday morning between 1:30 UT and 4:00 UT have been removed due to disactivated heating of the QASUME entrance optics.

Some individual spectra affected by fast moving clouds have been additionally removed.

Remarks:**FIJ:**

1. The ratios between FIJ and QASUME have on average an offset of -1 %, based on the responsivity obtained by the laboratory calibration of FIJ in the week after the campaign. During the campaign, the FIJ data was post processed with calibration from March 2018, resulting in an averaged offset of -3%.
2. The diurnal variation of the FIJ to QASUME ratio is less than ± 2 % on overcasted days and less than ± 2.5 % on the sunny day. This indicates that the cosine and temperature corrections are well implemented.
3. During the clear sky day (Doy 165) a slight azimuth dependency of around 2 % was observed.
4. For all solar scans the wavelength shifts of the FIJ is between ± 50 pm in the spectral range 290 to 365 nm.

Recommendation (FIJ):

The change of the responsivity of about -2% within two month suggests that the monitoring of the instrument's responsivity should be continued with lamp calibrations in the laboratory as already done by the local operator. In order to investigate the temporal evolution of the responsivity change, the Brewer may be calibrated once a month until a stabilization of the responsivity within 1% is achieved. It is further recommended that every three or four months, a second calibration lamp should be used to monitor the stability of the mostly used (working) calibration lamp. In case that the two lamps differ by more than 1 % a third lamp may be used for comparison with the other two lamps.

The change of the responsivity needs to be considered during post processing of the data.

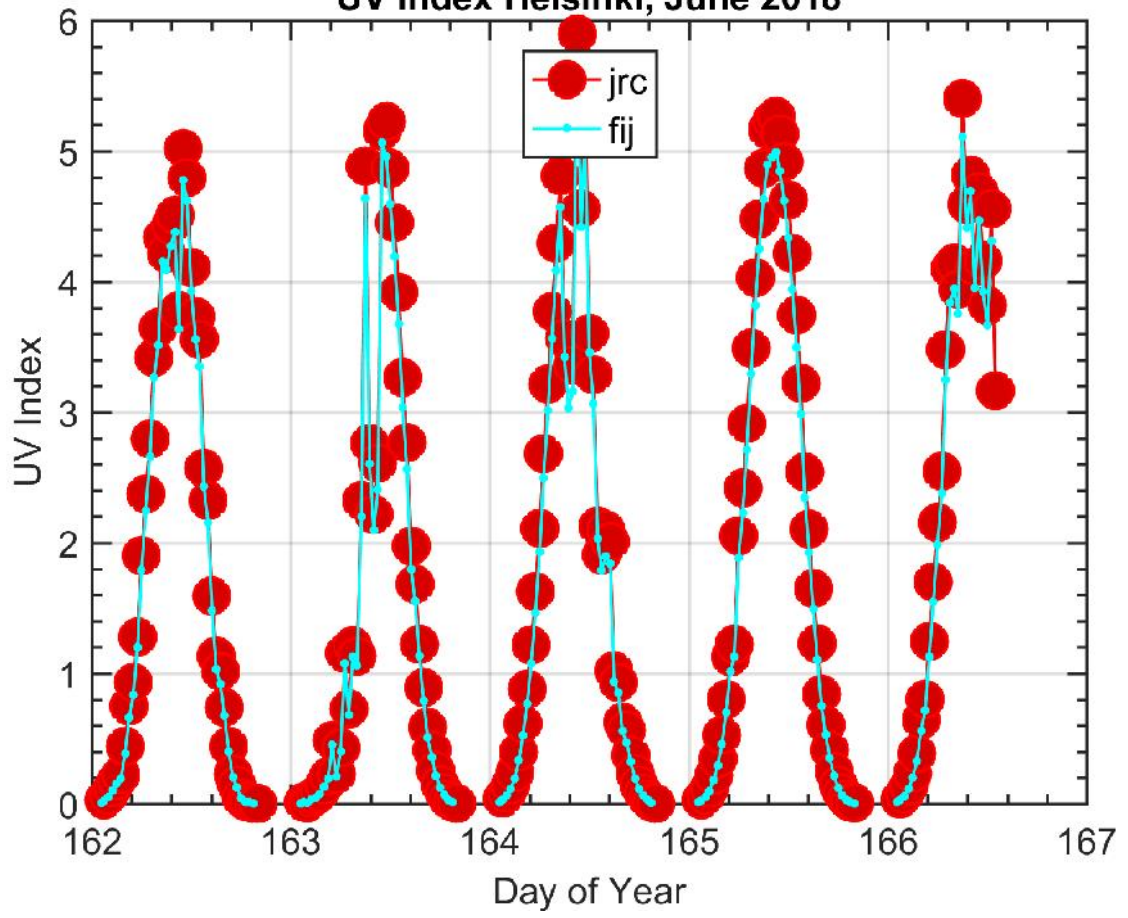
In order to exclude any azimuth dependency, the levelling of the Brewer should be controlled after each laboratory calibration and reinstalling on the platform.

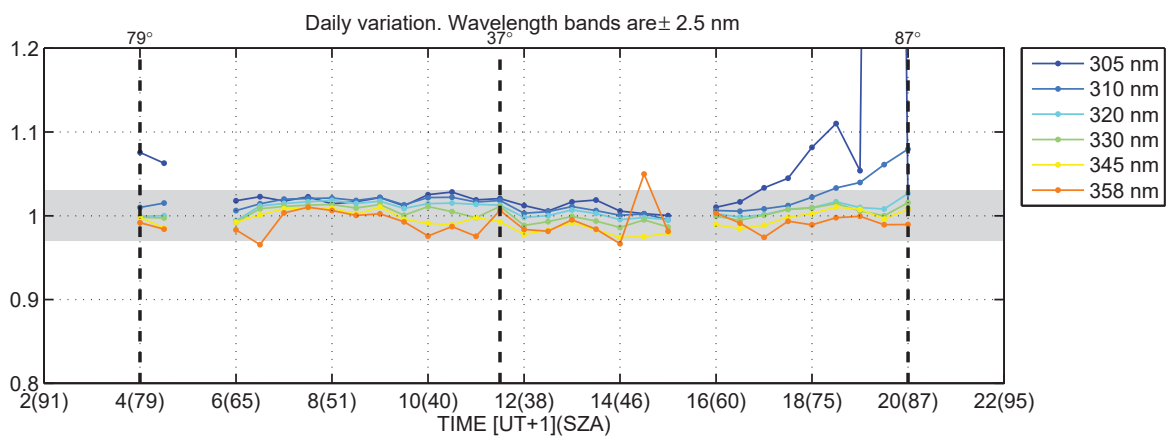
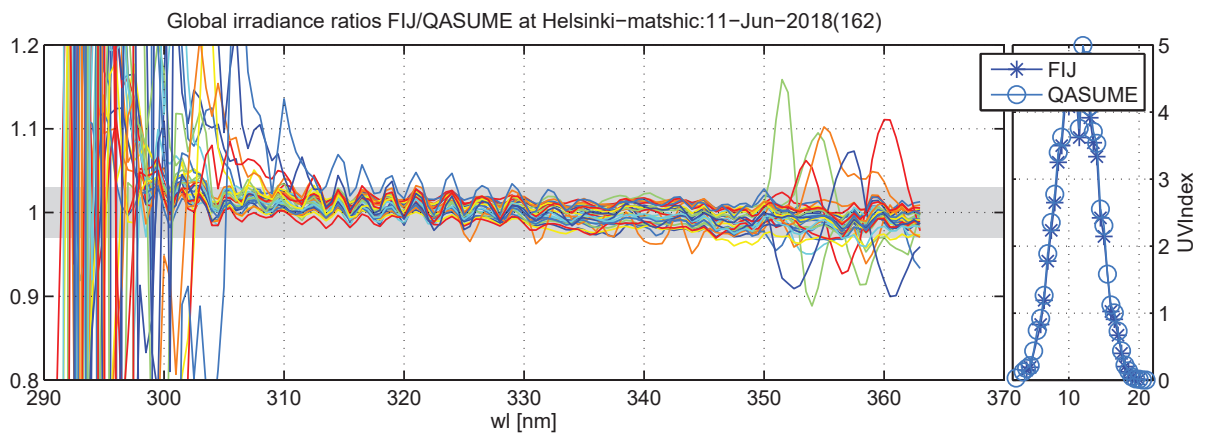
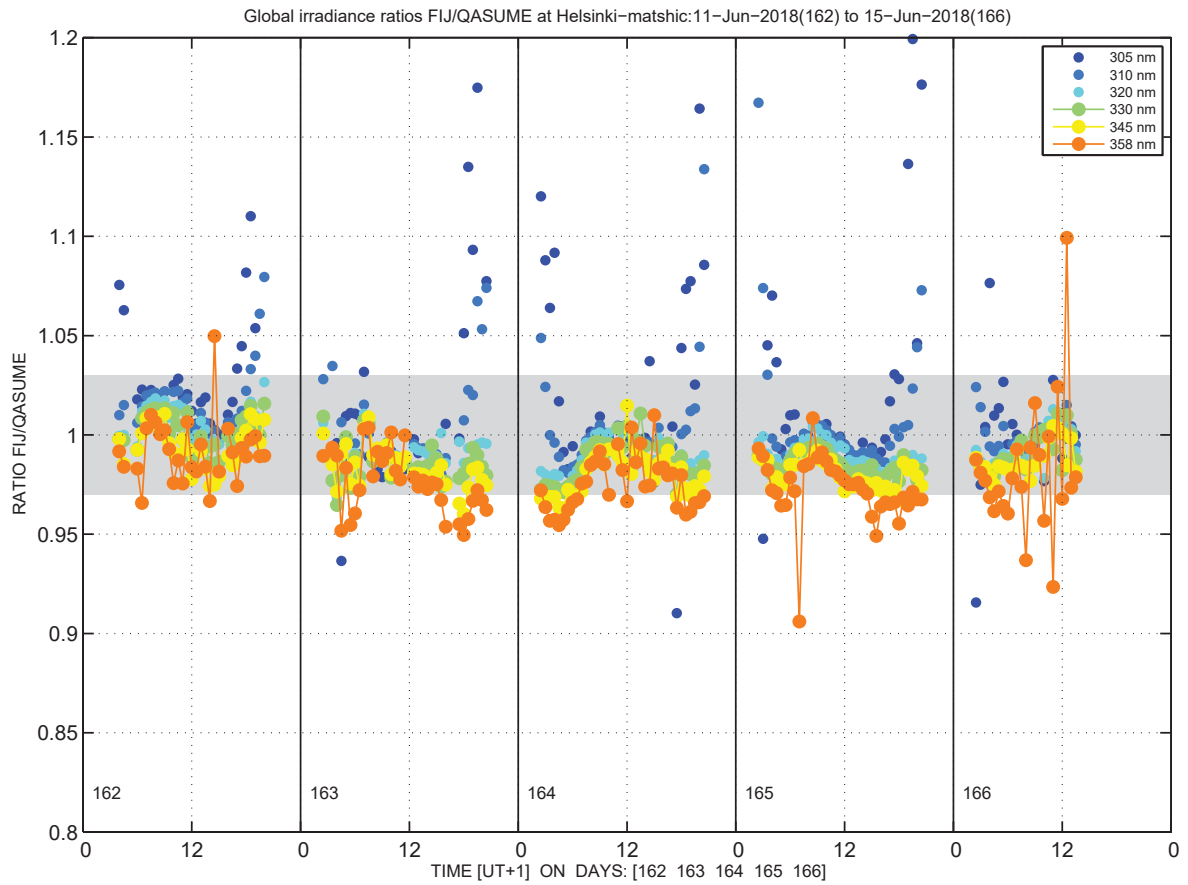
FMI Operator: Anu Heikkilä

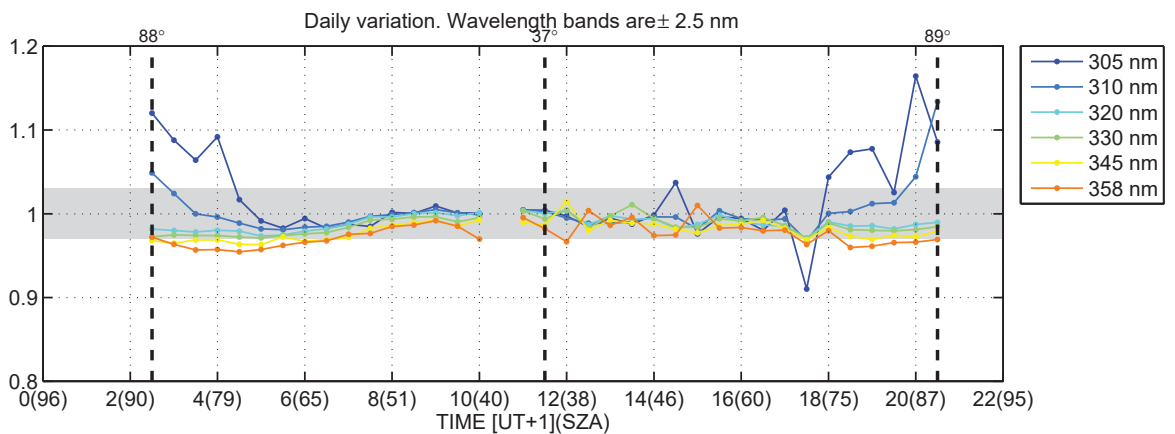
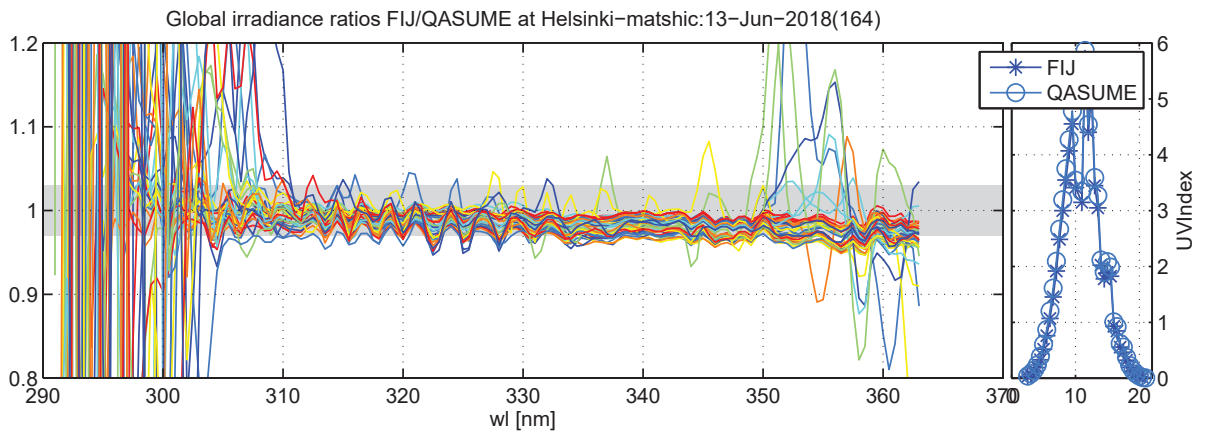
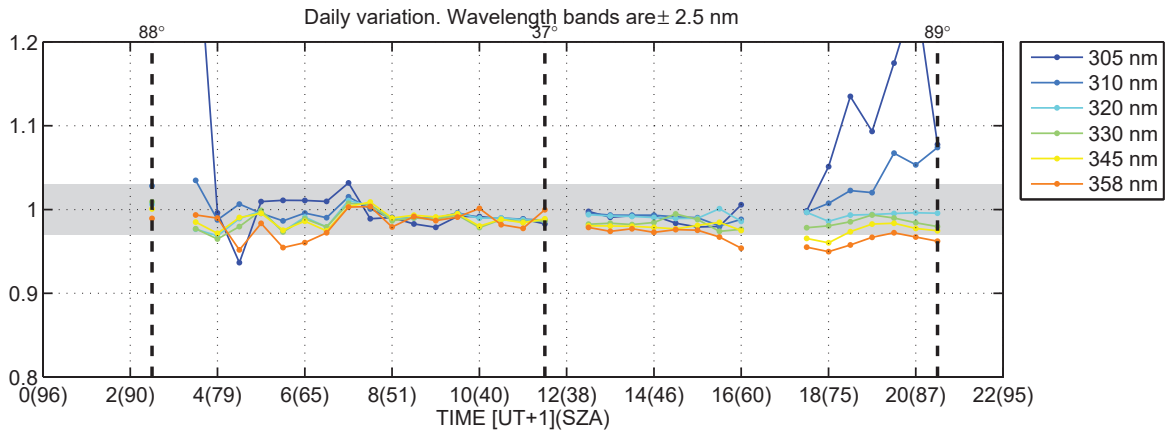
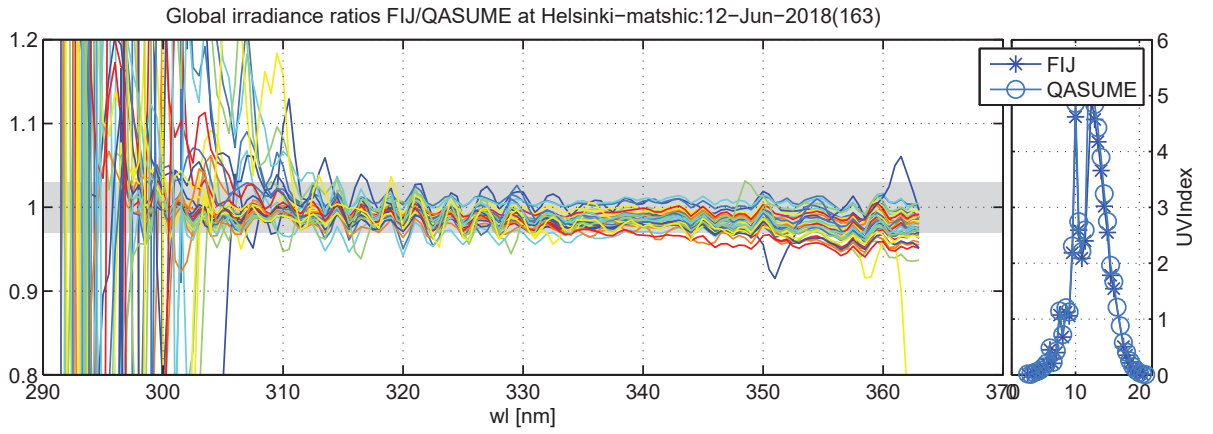
Comments from the operator:

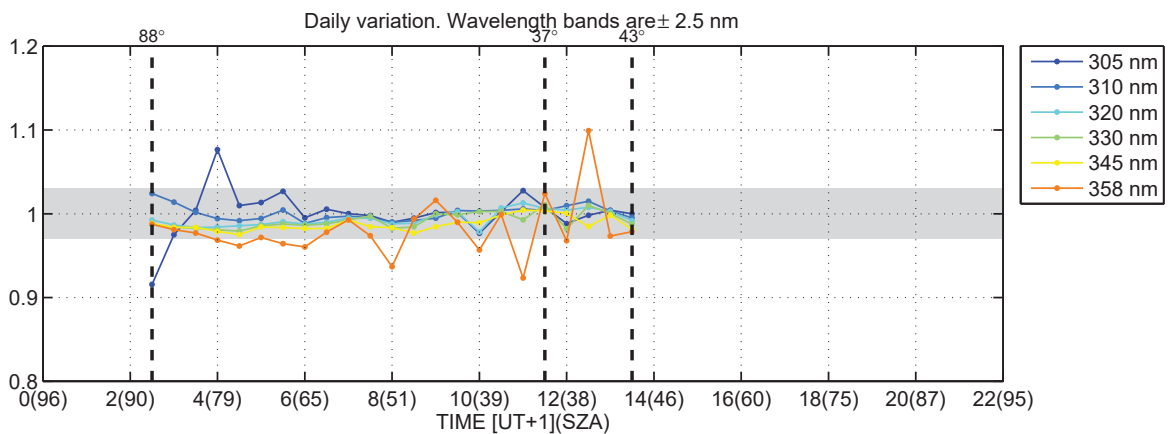
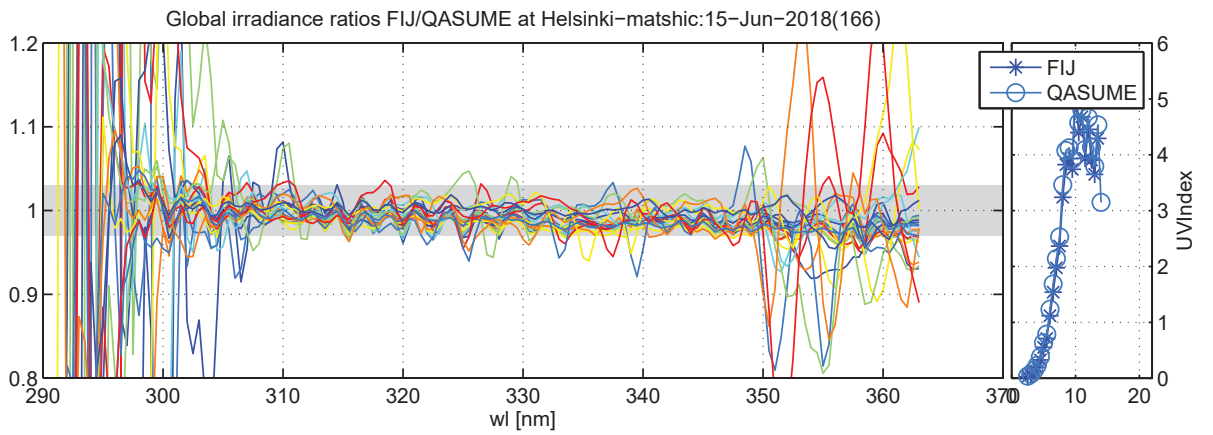
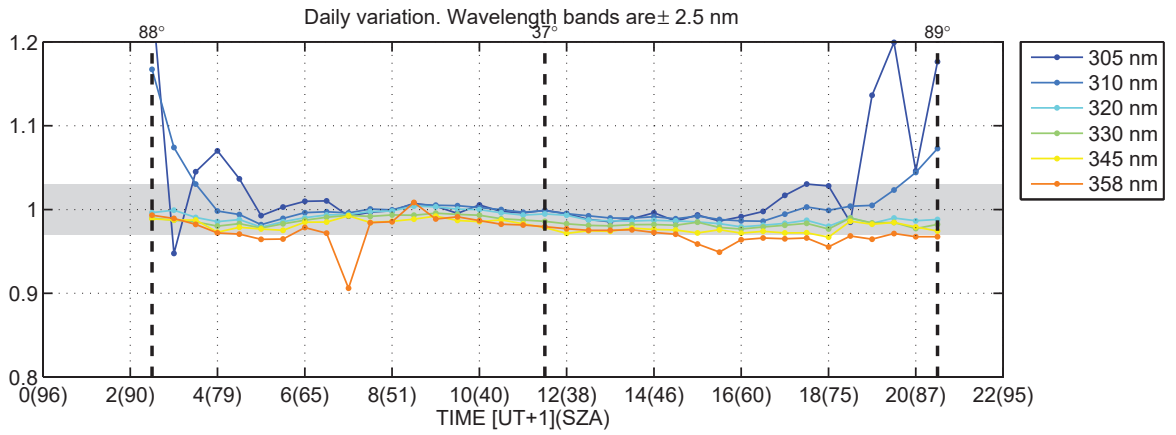
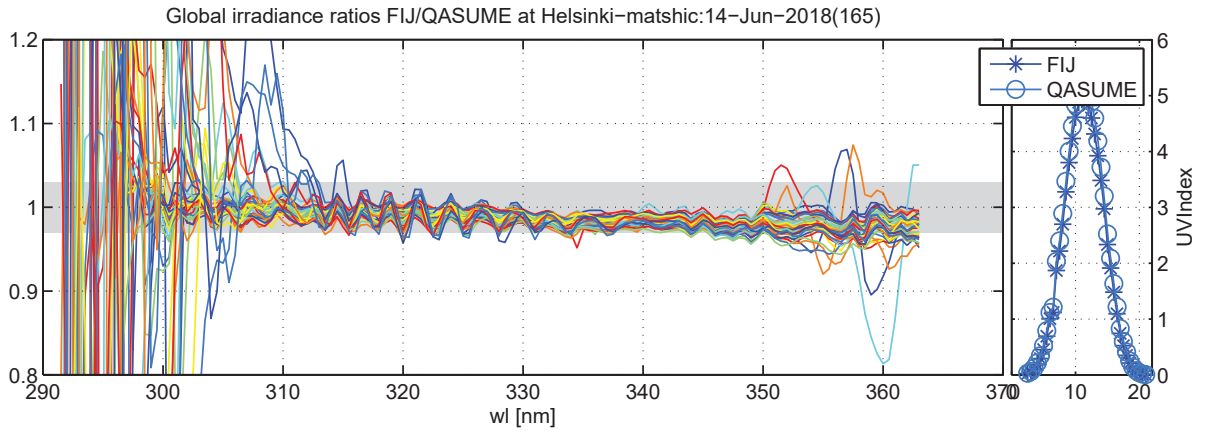
No further remarks by the operator.

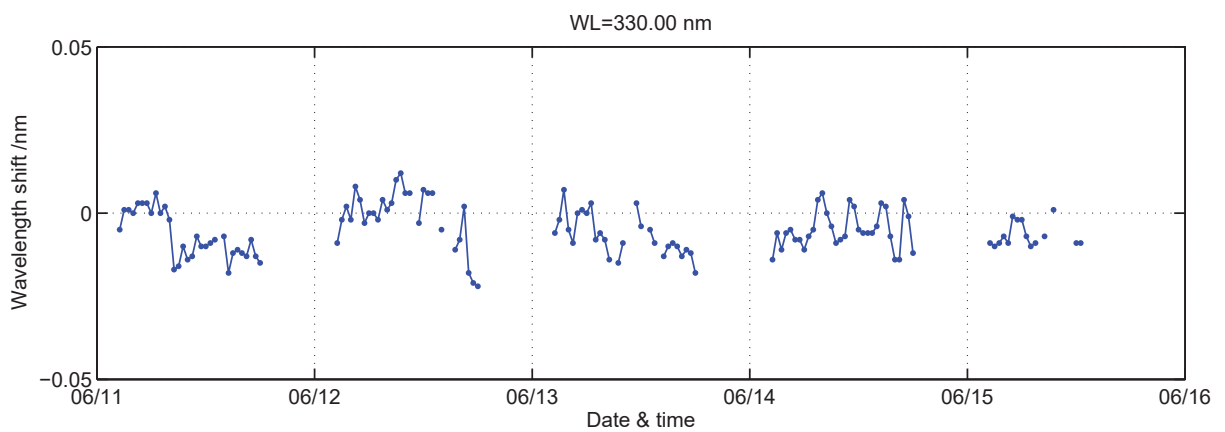
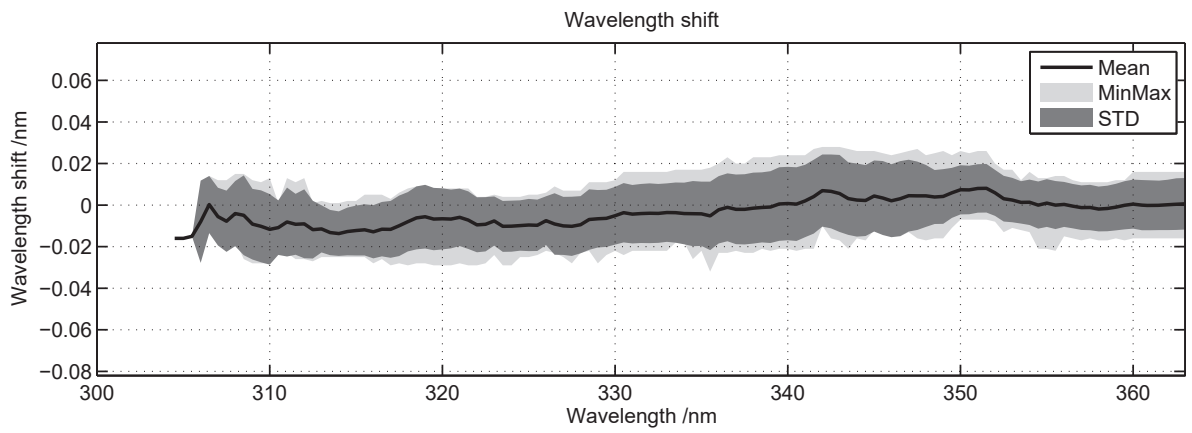
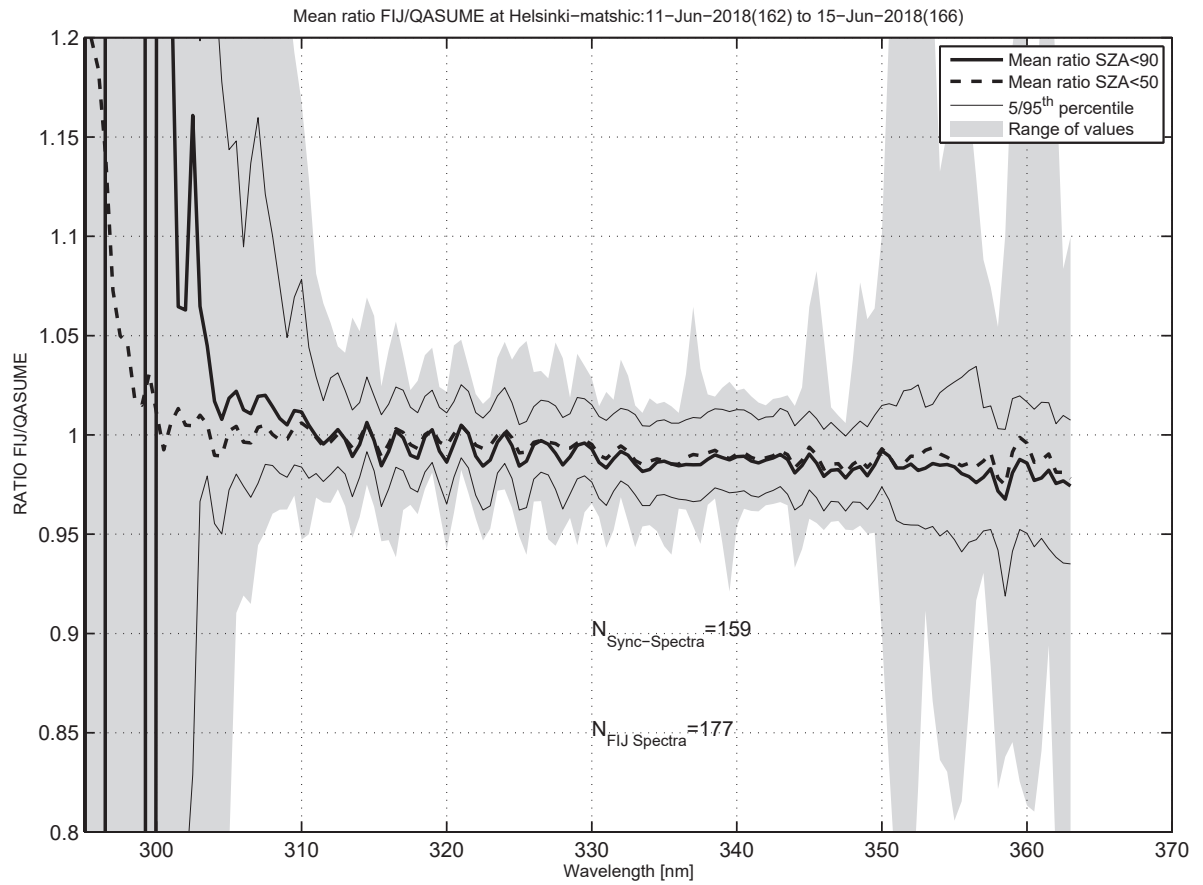
UV Index Helsinki, June 2018

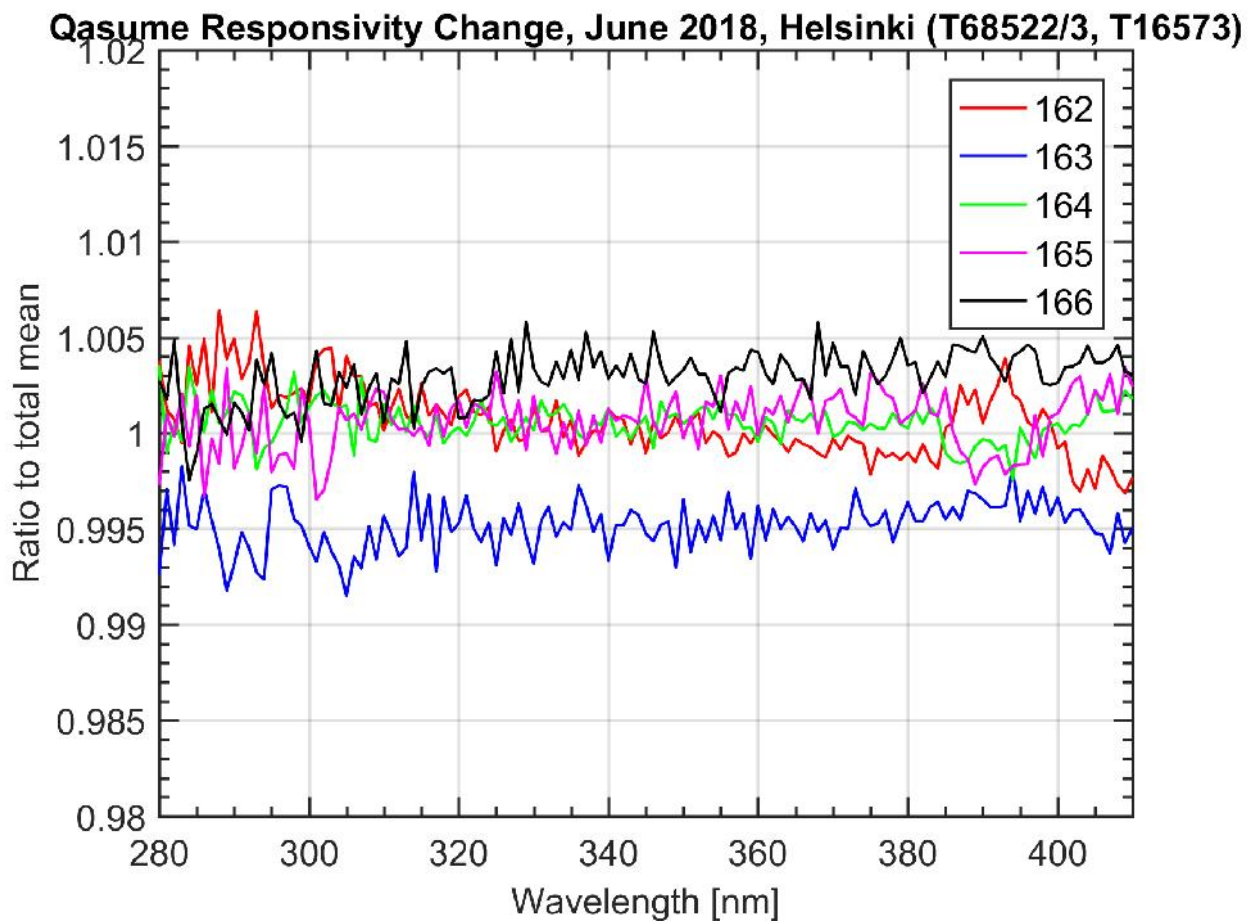
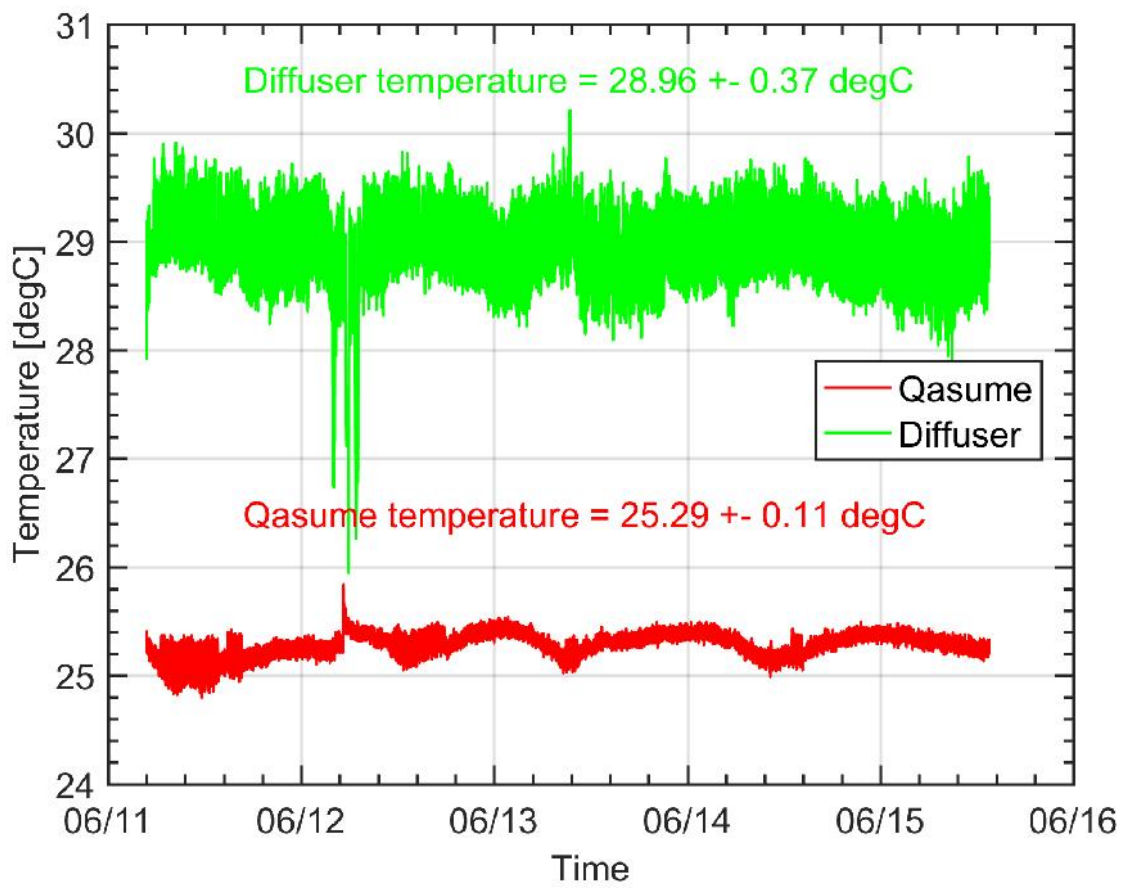














FIJ

QASUME

mod vrc