Protocol of the intercomparison at PMOD/WRC, Switzerland on May 21 to 24, 2007 with the travelling reference spectroradiometer QASUME from PMOD/WRC

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The purpose of the visit was the comparison of global solar irradiance measurements between the spectroradiometer operated by PMOD/WRC and the travel reference spectroradiometer QASUME[†]. The measurement site is located at Davos; Latitude 46.82 N, Longitude 9.85 E and altitude 1580 m.a.s.l.
The horizon of the measurement site is free down to 70° solar zenith angle (SZA). Measurements between 5:00 UT and 17:00 UT have been analysed.

QASUME was started at Davos in the morning of May 21, 2007. The spectroradiometer was installed in line to the Br #163 with the entrance optic of QASUME within 2 m of Brewer. The spectroradiometer in use at Davos is a Brewer #163 double monochromator. The intercomparison between QASUME and the Brewer spectroradiometer lasted four days, from morning of May 21 to the noon of May 24.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. One lamp (T68523) 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 internal temperature of QASUME was 25 °C on day 21-22; changed to 16 °C on days 22-23 and finally set to 20 °C on days 23-24. The diffuser head was heated to a temperature of 26.2±1.2 °C.
The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the SHICRivm analysis were between ±50 pm in the spectral range 290 to 400 nm.

[†] The QASUME spectroradiometer B5503 is made available by the Physical and Chemical Exposure Unit of the Joint Research Centre of the European Commission, Ispra, Italy through a collaboration agreement with PMOD/WRC.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 400 nm, every 0.25 nm, and 1.5 seconds between each wavelength increment.

May 21 (141) Monday:

QASUME was installed on the measurement site at 7:00 UT. The internal temperature of QASUME reached its nominal temperature at 8:00 UT.

Synchronised measurements are available from 12:00 to 18:00 UT. Weather conditions were mix of sun and clouds with cumulus clouds and haze and occasional rain after 15:00 UT.

QASUME was calibrated at 13:42 UT. No scan was ever missing because of the calibrations.

May 22 (142) Tuesday:

Synchronised measurements are available from 4:30 to 18:00 UT. Weather conditions were mostly cloudy and rain showers occurred between 12:50 and 14:45 UT.

The internal temperature of QASUME was reduced to finally ~16 °C, starting from 8:40 UT.

QASUME was calibrated at 15:12 UT at an internal temperature of 19.1 °C.

May 23 (143) Wednesday:

Synchronised scans are available from 4:30 to 18:00 UT. Weather conditions were a mix of sun and clouds. In the afternoon the more and more cumulus clouds formatted with a few rain drops at 15:15.

The internal temperature of QASUME was increased to finally ~20 °C, starting from 15.15 UT.

QASUME was calibrated at 14:41 UT at an internal temperature of 17.8 °C.

May 24 (144) Thursday:

Synchronised scans are available from 4:30 to 11:30 UT. The weather conditions were a mix of sun and clouds with cumulus clouds.

QASUME was calibrated at 10:12 UT at an internal temperature of 21.4 °C.

End of the campaign at 11:50 UT.

Results:

In total 63 synchronised simultaneous spectra from QASUME and Br 163 are available from the measurement period. Measurements between 5:30 and 17:00 UT has been analysed (SZA smaller than 75°).

Remarks:

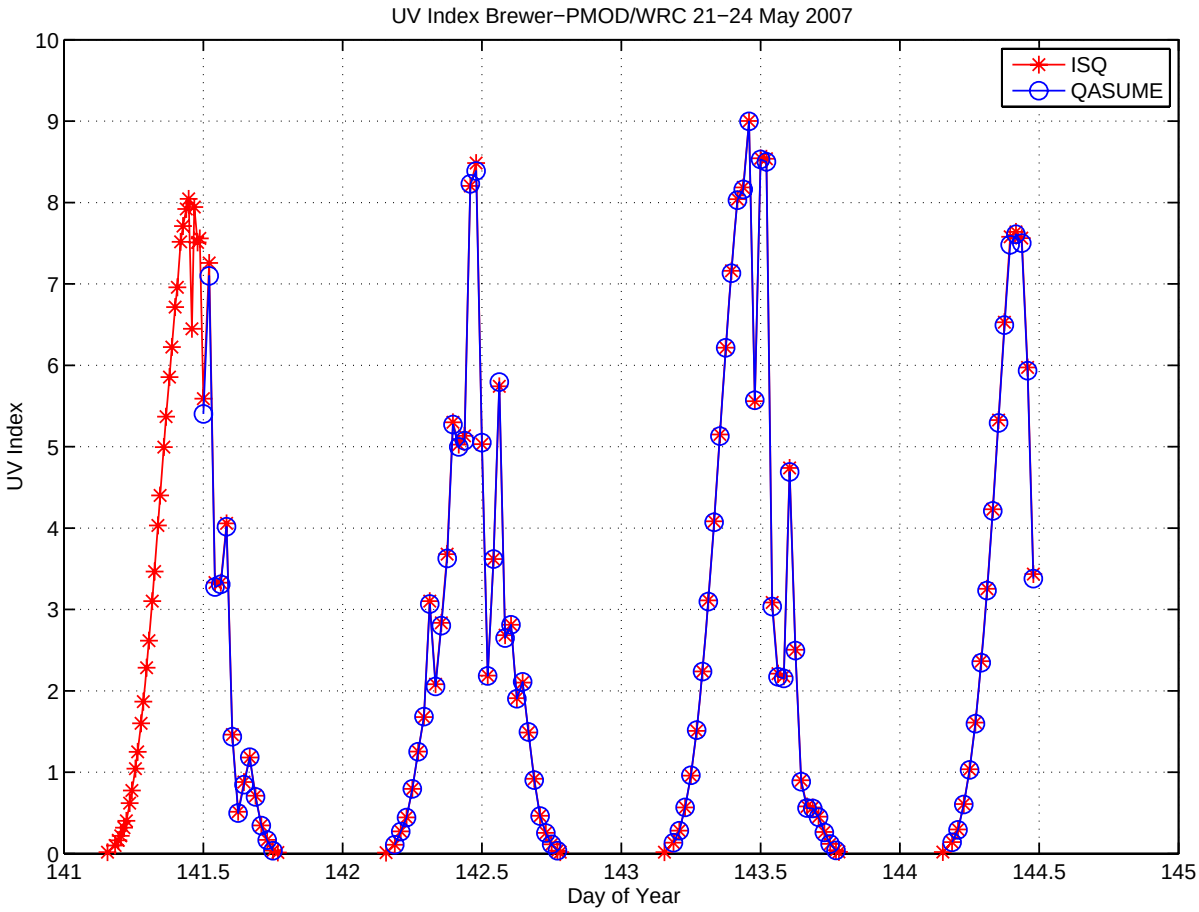
1. The ratios between 167 and QASUME have on average no offset with variability below ±2 %.
2. For all solar scans the wavelength shifts of the Br 163 are below ±50 pm.
3. The internal temperature changes of QASUME lead to changes in the responsivity of the instrument (see table 1 and 2) which should be taken into account when looking at point 1.

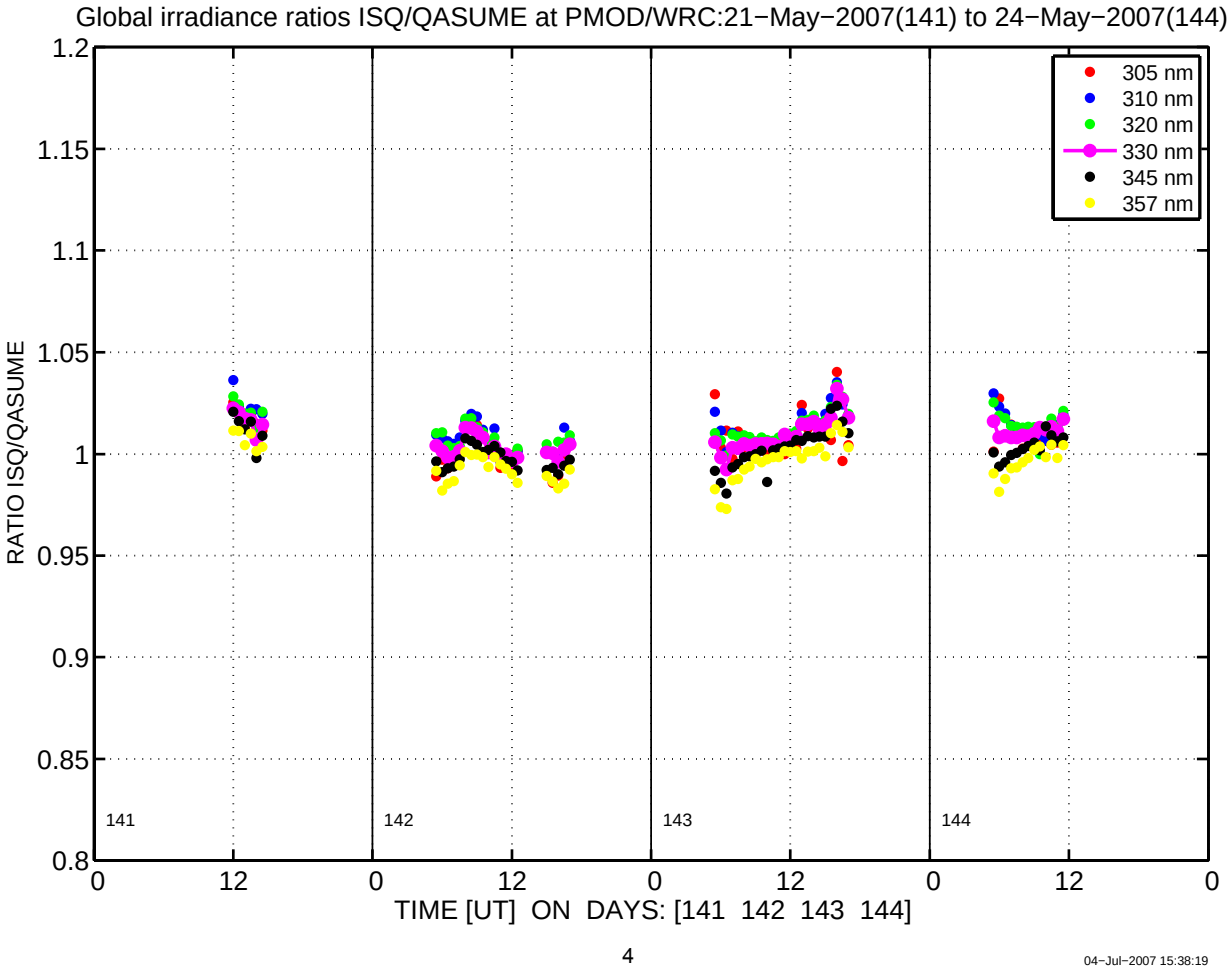
Table 1: Responsivity change due to temperature change

	142/141	143/141	144/141
Res change [%]	+1.8	+1.7	+1.2
Temp. change [°C]	-7.7	-9	-5.4

Table 2: Responsivity change due to temperature change

	143/142	144/142	144/143
Res change [%]	-0.1	-0.6	-0.5
Temp. change [°C]	-1.3	+2.3	+3.6





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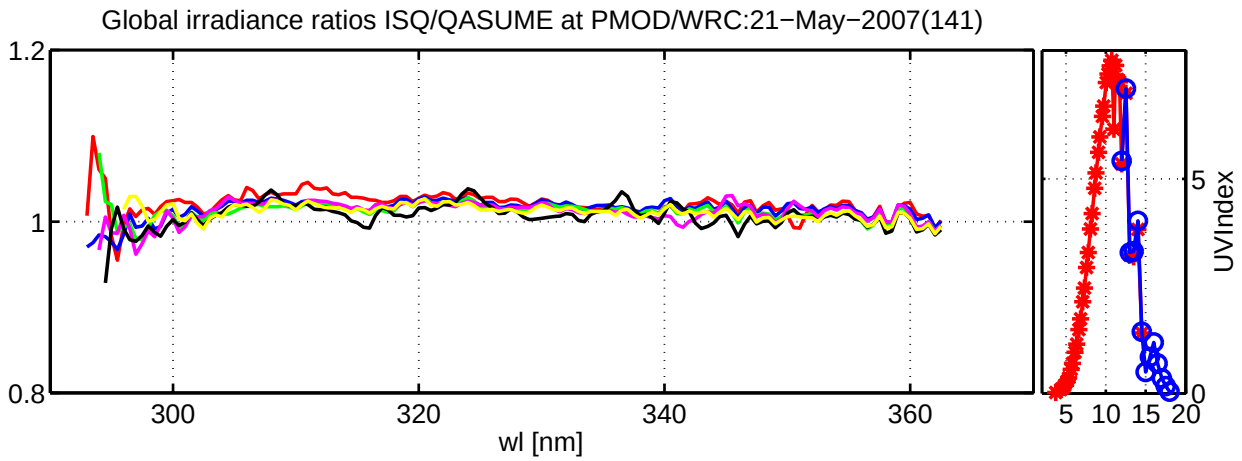

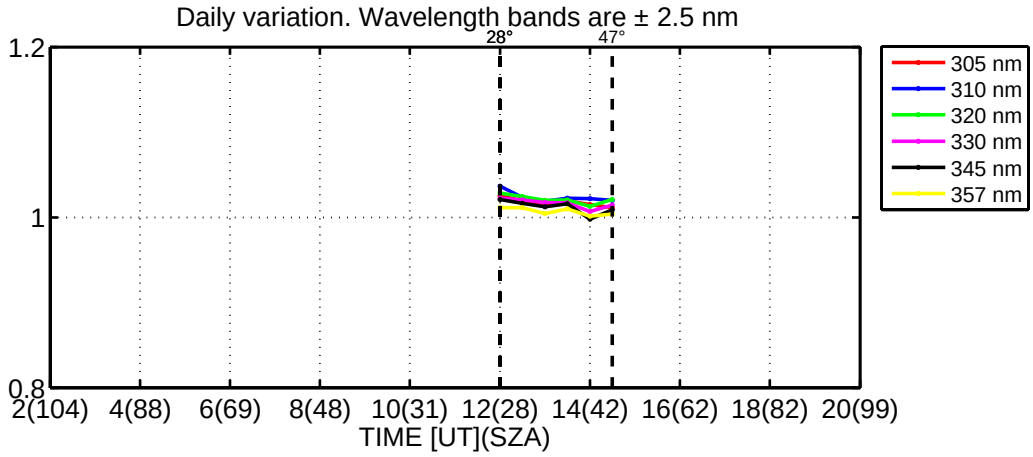

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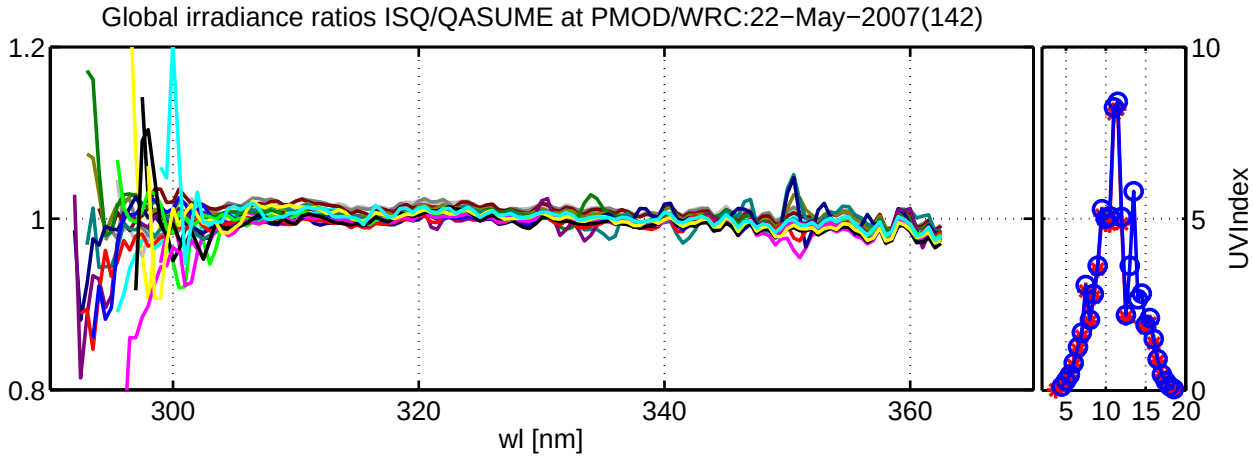

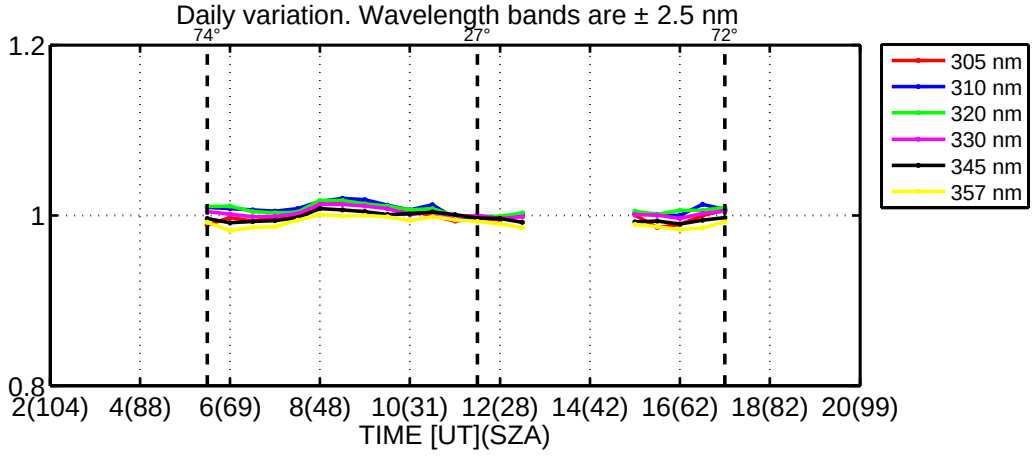

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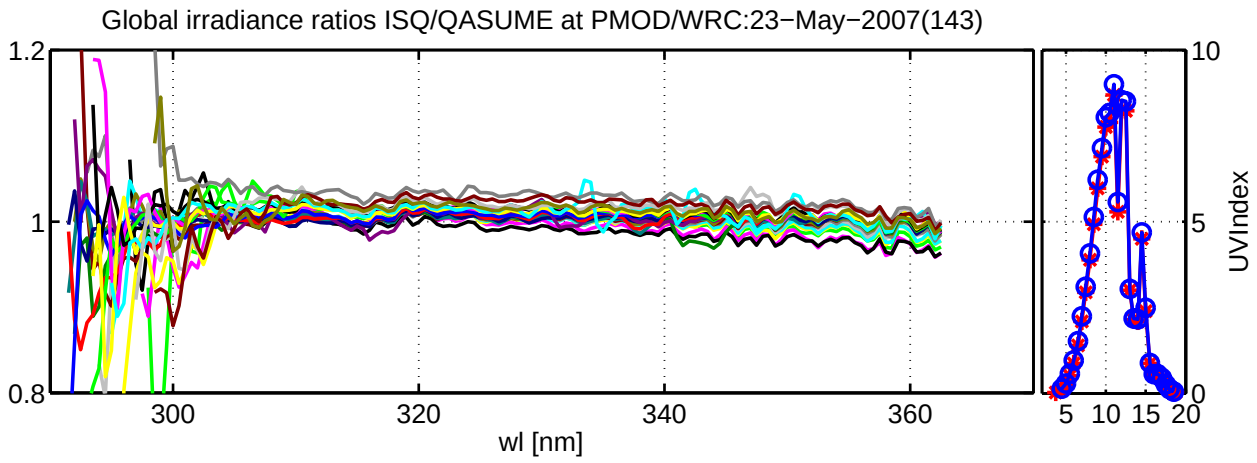

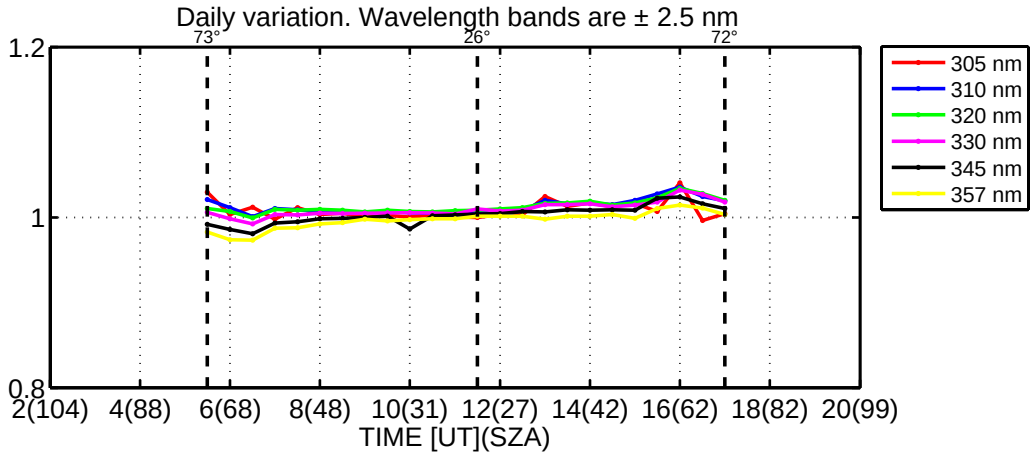

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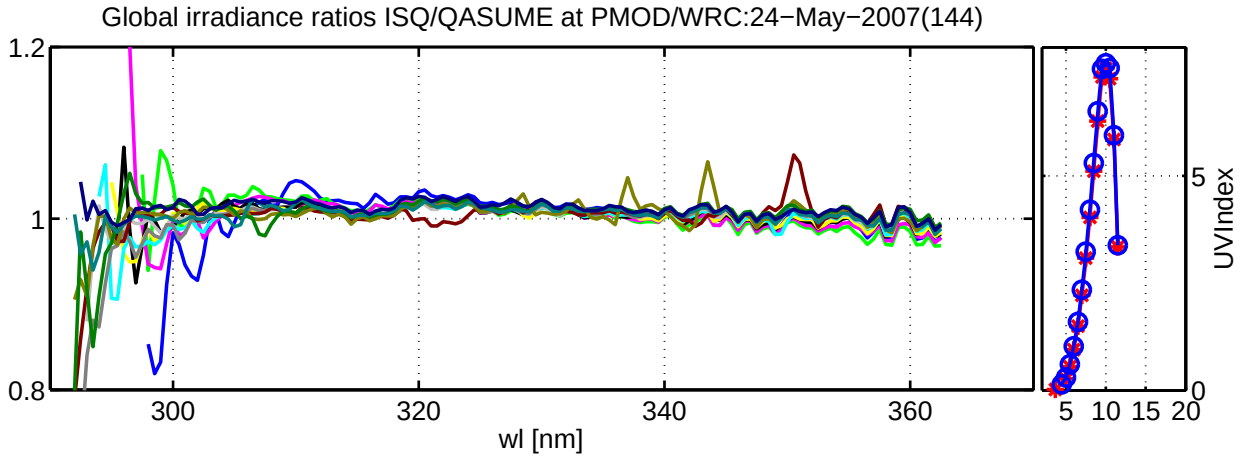

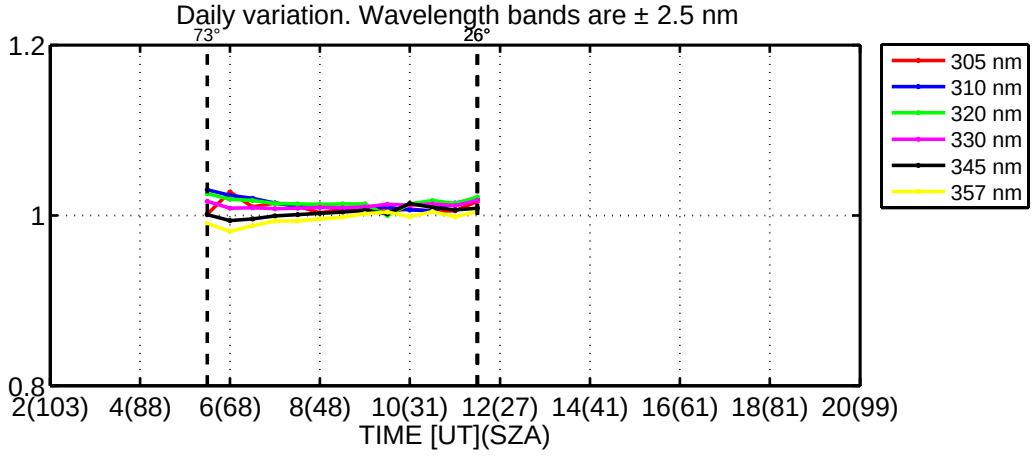

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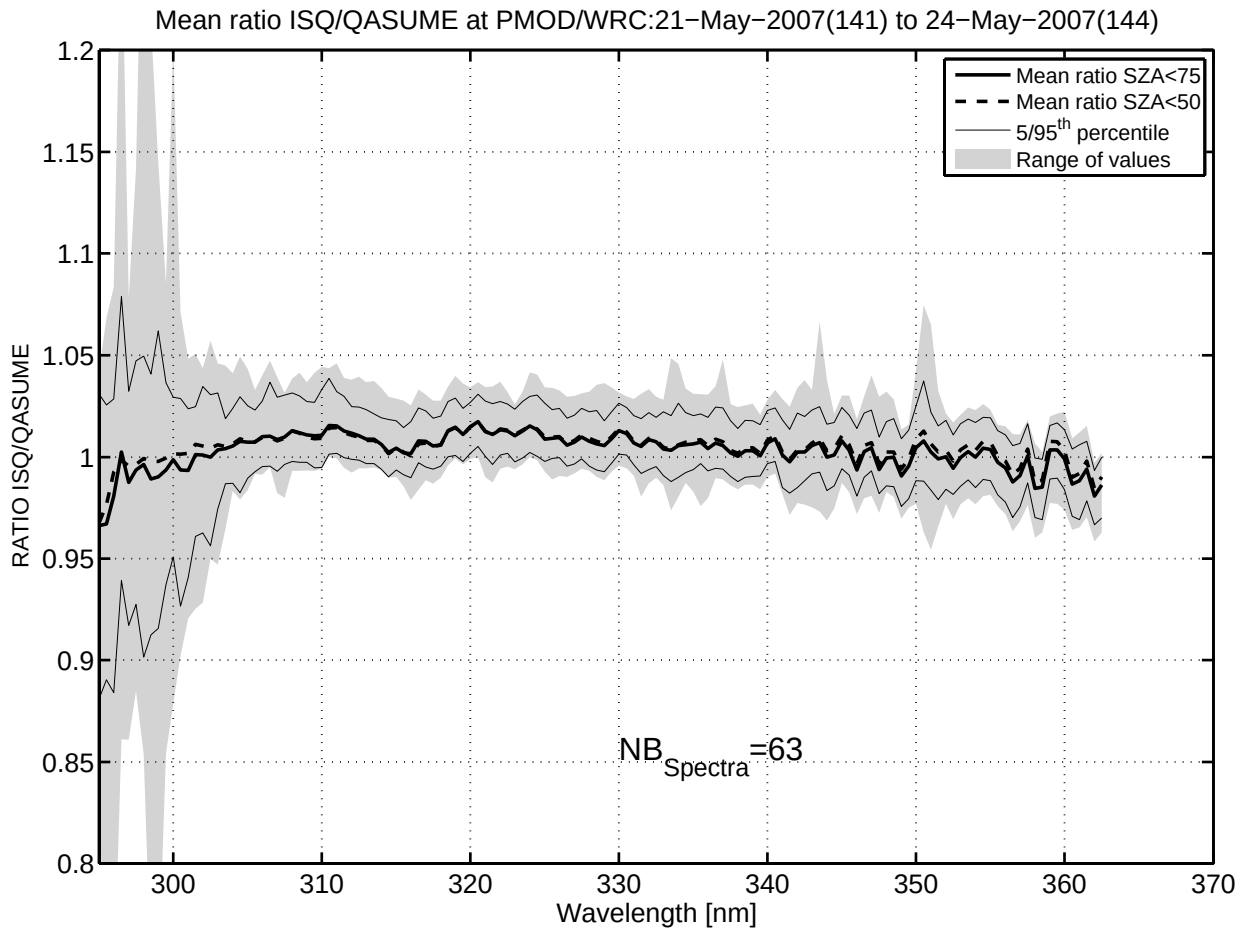
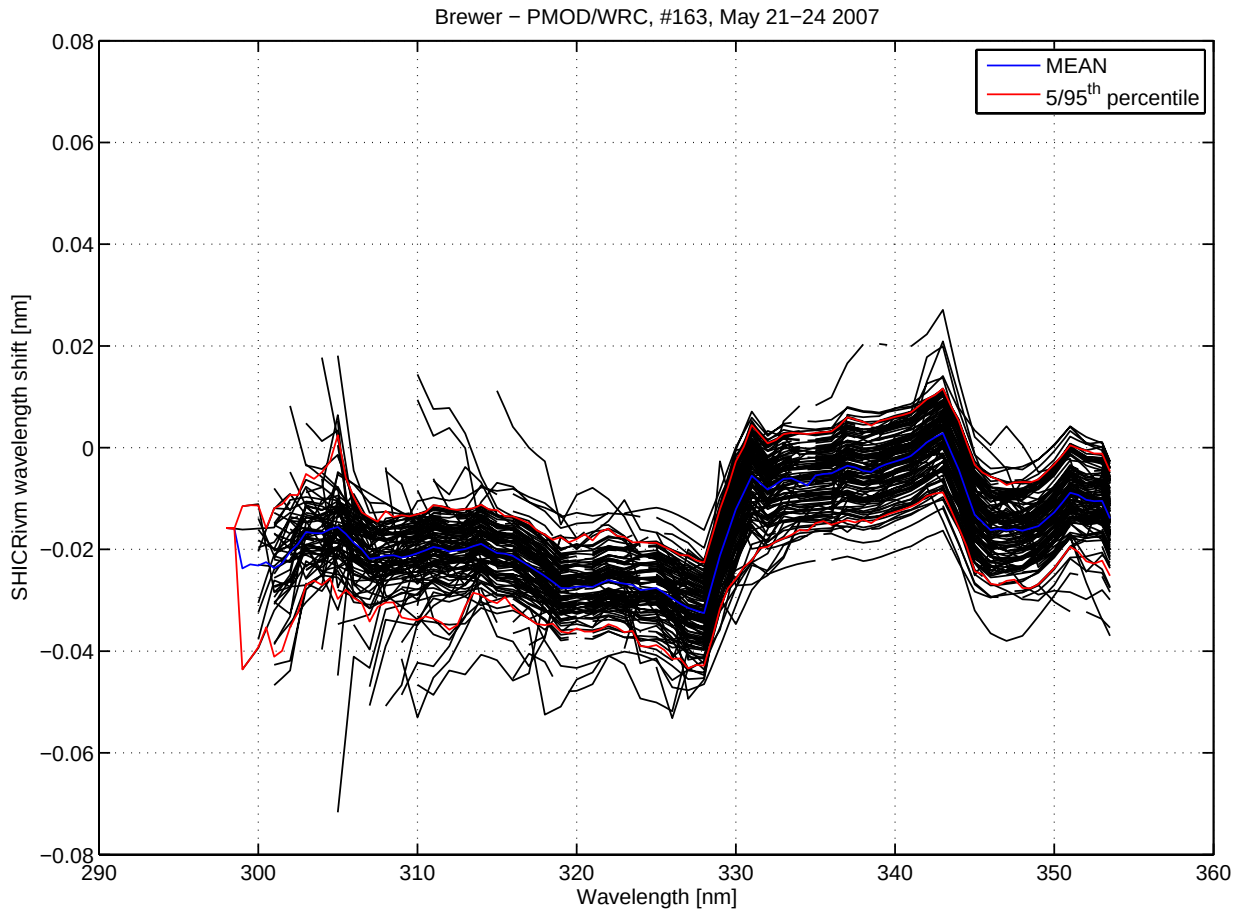
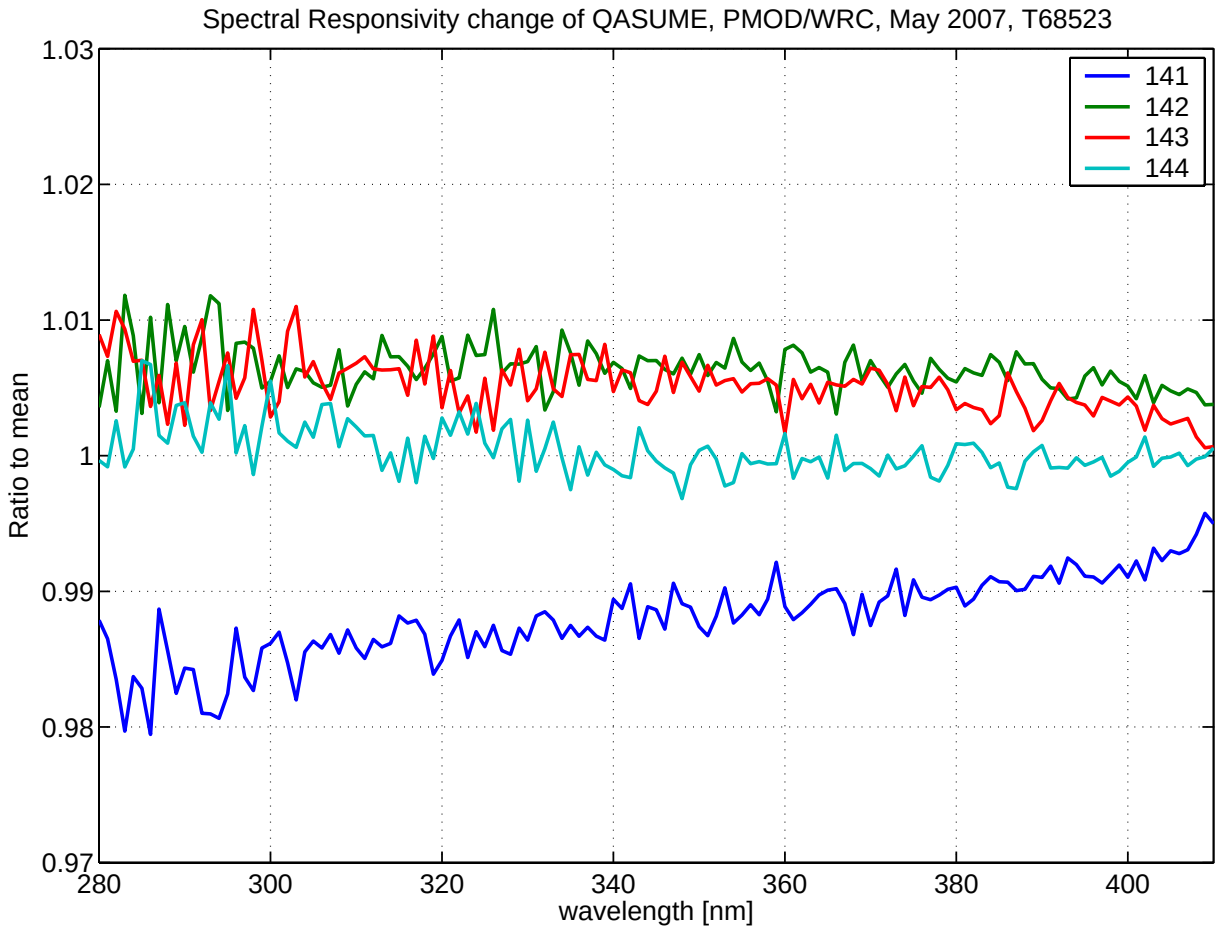
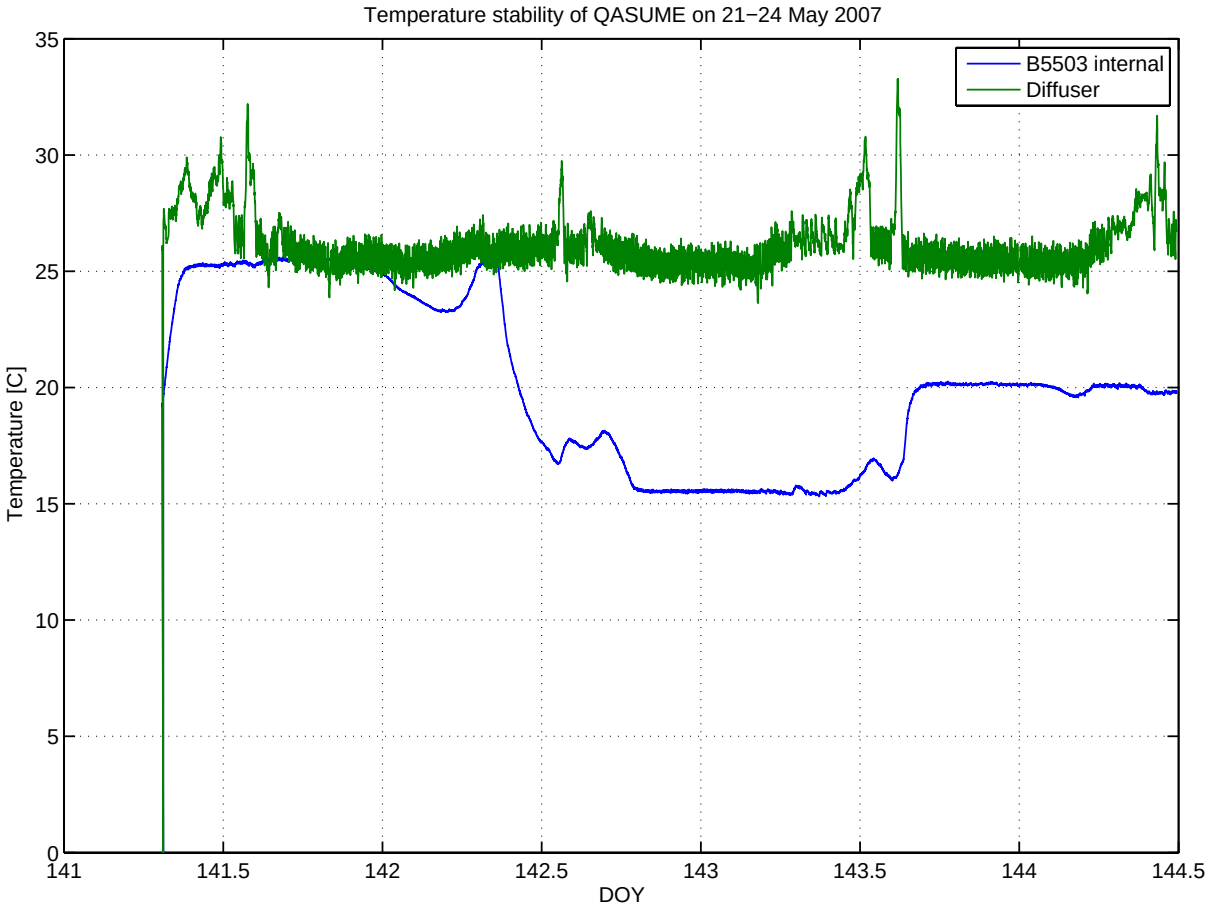

Mean ratio ISQ/QASUME at PMOD/WRC:21−May−2007(141) to 24−May−2007(144)
Mean ratio SZA<75
Mean ratio SZA<50
5/95th percentile
Range of values
RATIO ISQ/QASUME
NBSpectra=63
Wavelength [nm]


Brewer − PMOD/WRC, #163, May 21−24 2007
MEAN
5/95th percentile
SHICRivm wavelength shift [nm]
Wavelength [nm]


Spectral Responsivity change of QASUME, PMOD/WRC, May 2007, T68523
Ratio to mean
wavelength [nm]
141
142
143
144
1.03
1.02
1.01
1
0.99
0.98
0.97
280
300
320
340
360
380
400


Temperature stability of QASUME on 21−24 May 2007
Temperature [C]
DOY
B5503 internal
Diffuser
35
30
25
20
15
10
5
0
141
141.5
142
142.5
143
143.5
144
144.5