Protocol of the intercomparison at ARPA, Aosta, Italy on September 18 to 21, 2006 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 AAO operated by the Sezione Agenti Fisici - Radiazione Ultravioletta Solare, Agenzia Regionale per la Protezione dell'Ambiente (ARPA) and the travel reference spectroradiometer QASUME. The measurement site is located at Valle d'Aosta; Latitude 45.74 N, Longitude 7.34 E and altitude 569 m.a.s.l.
The horizon of the measurement site is free down to at least 80° solar zenith angle (SZA). Measurements between 6:00 UT and 17:00 UT have been analysed.

QASUME arrived at ARPA at noon of September 18, 2006. The spectroradiometer was installed in line to the AAO instrument with the entrance optic of QASUME within 2 m of AAO. The spectroradiometer in use at AAO is a Bentham DTMc300 double monochromator. The intercomparison between QASUME and the ARPA spectroradiometer lasted three days, from morning of September 19 to the afternoon of September 06.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. Two lamps (T68524 and T61252) 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 24.8±0.1 °C. The diffuser head was heated to a temperature of 26.7±1.6 °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 500 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 500 nm, every 0.25 nm, and 1.5 seconds between each wavelength increment.

September 18 (261):

QASUME was installed on the measurement site at 12:00 UT. The internal temperature of QASUME reached its nominal temperature at 13:30 UT. Synchronised measurements are available from 13:30 to 19:00 UT. Weather conditions were clear sky with a few cirrus clouds.

QASUME was calibrated at 15:55 UT. The scan at 16:00 UT is missing.

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September 19 (262):

Synchronised measurements are available from 4:30 to 19:30 UT. Weather conditions were clear sky with a few cirrus clouds and haze.

QASUME was calibrated after sunset at 17:25 UT. The scan at 17:30 UT is missing.

September 20 (263):

Synchronised scans are available from 4:30 to 19:30 UT. Weather conditions were clear sky with a few cirrus clouds and haze. The AAO diffuser head was rotated by 180° at 13:55 UT and rotated back to 0° at 14:55 UT.

September 21 (264):

Synchronised scans are available from 4:30 to 15:00 UT. The weather conditions were a mix of sun and clouds with stratus cumulus clouds.

QASUME was calibrated at 15:24 and 15:49 UT. The ARPA reference lamp was measured at 16:13 UT.

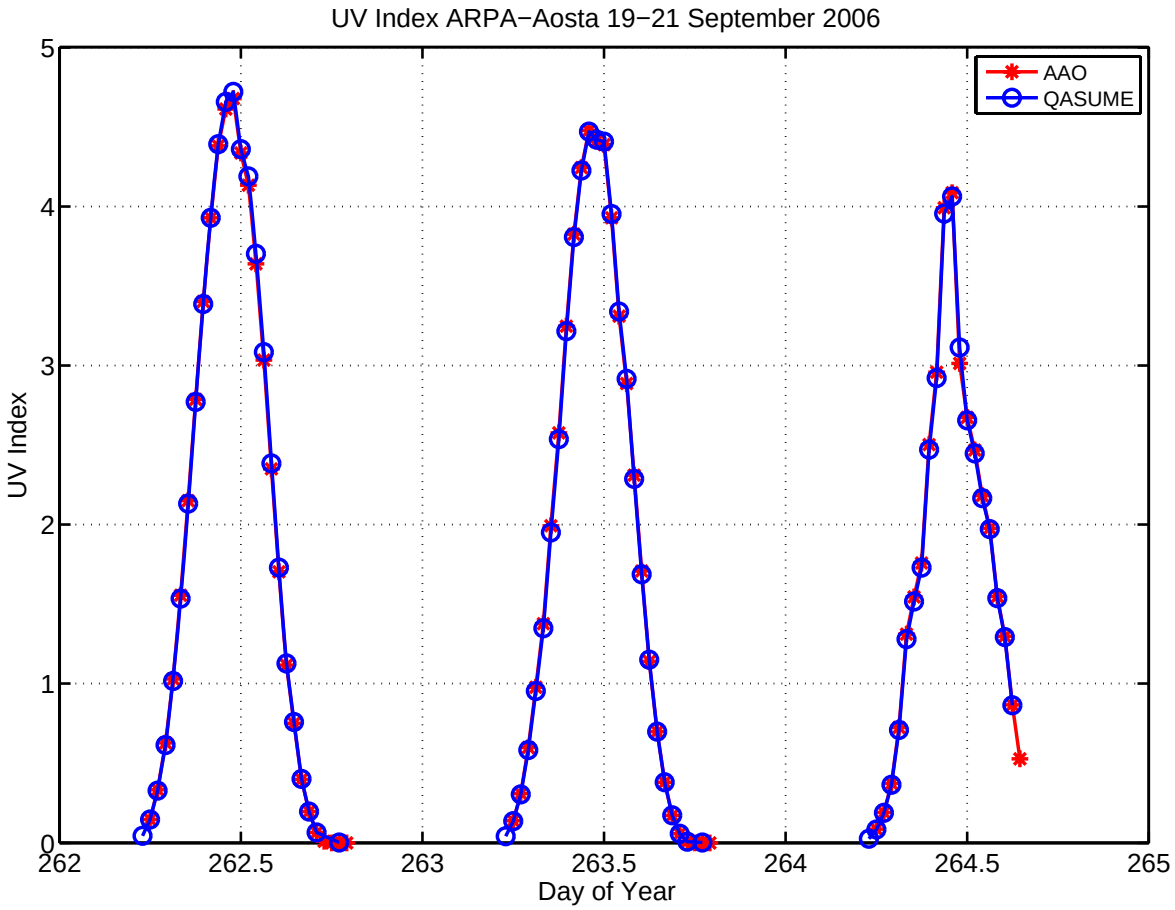
End of the campaign at 16:30 UT.

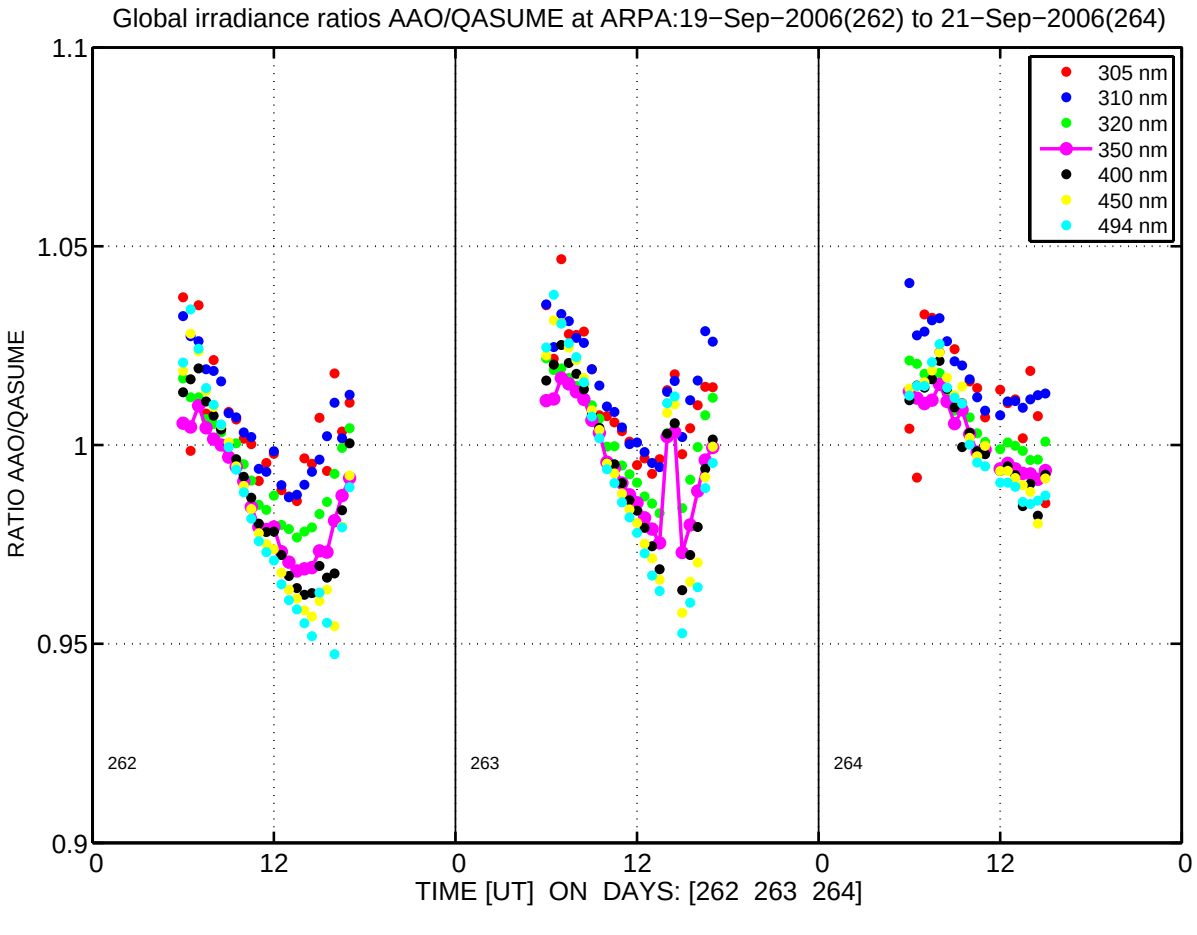
Results:

In total 64 synchronised simultaneous spectra from QASUME and AAO are available from the measurement period. Measurements between 6:00 and 17:00 UT have been analysed (SZA smaller than 85°).

Remarks:

1. The ratios between AAO and QASUME show a spectral structure of ±2 % duo to lamp certificate of the AAO lamp. The mean ratio is 1.00 with a variability of ±3 %.
2. The AAO reference lamp ($schreder_{10}$) was measured with the QASUME spectroradiometer. The spectral structure is in agreement with the structure observed in the solar measurements.
3. The diurnal variability of 8 % is probably due to an azimuth dependence of the directional response of the AAO diffuser head.
4. The AAO diffuser head was rotated by 180° on day 263 for the scans at 14:00 and 14:30 UT. These scans visualise the azimuth error of the AAO diffuser.
5. For all solar scans the wavelength shifts of the AAO are below ±30 pm.





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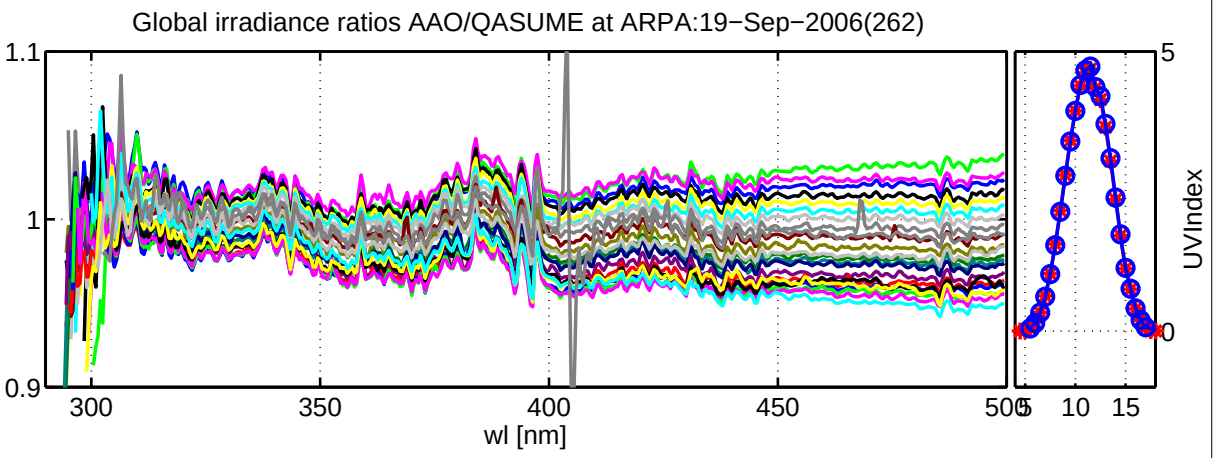

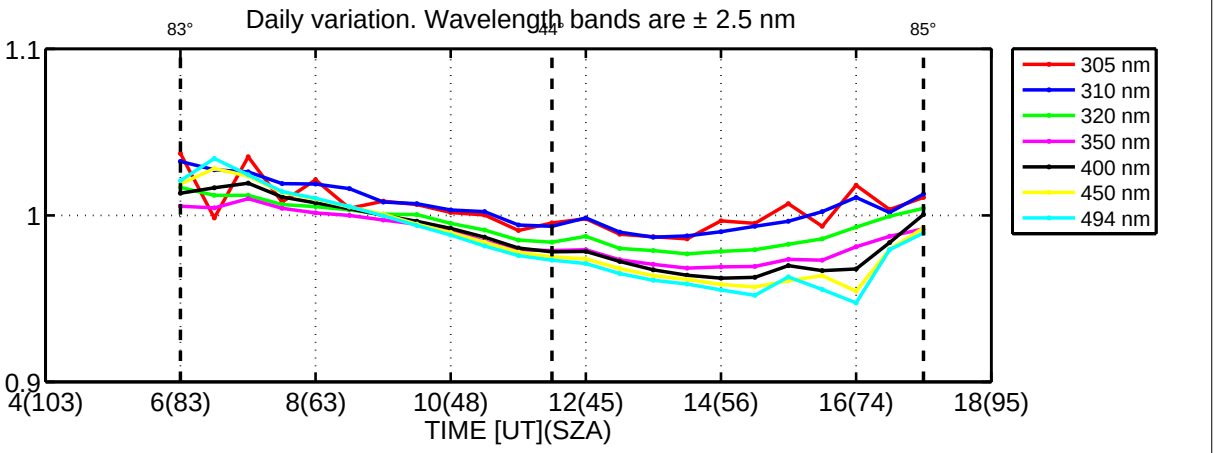

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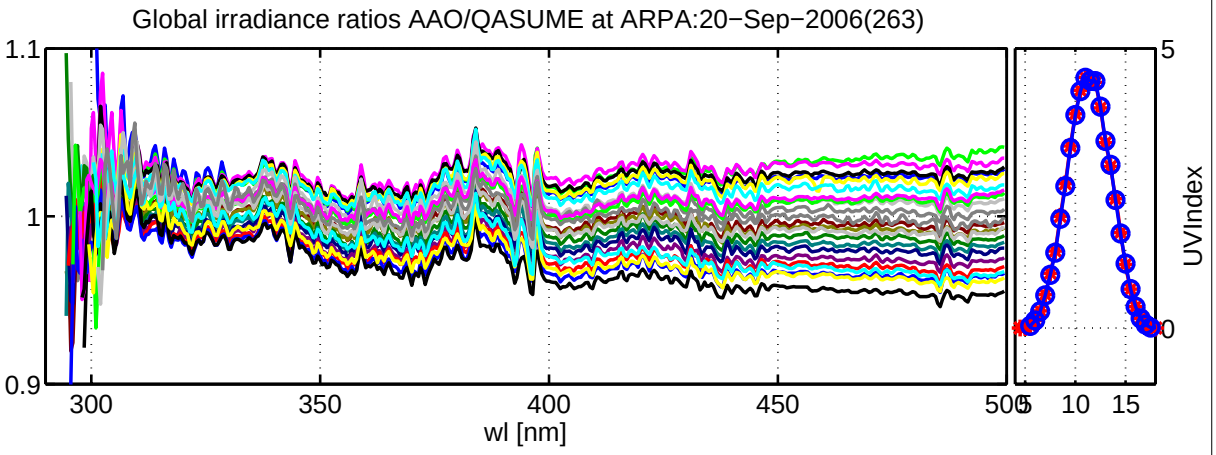

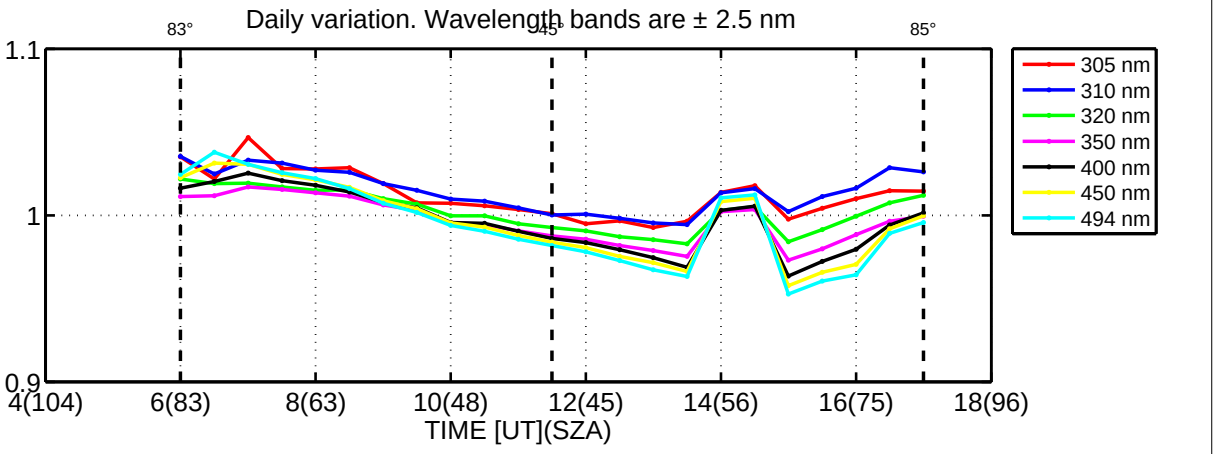

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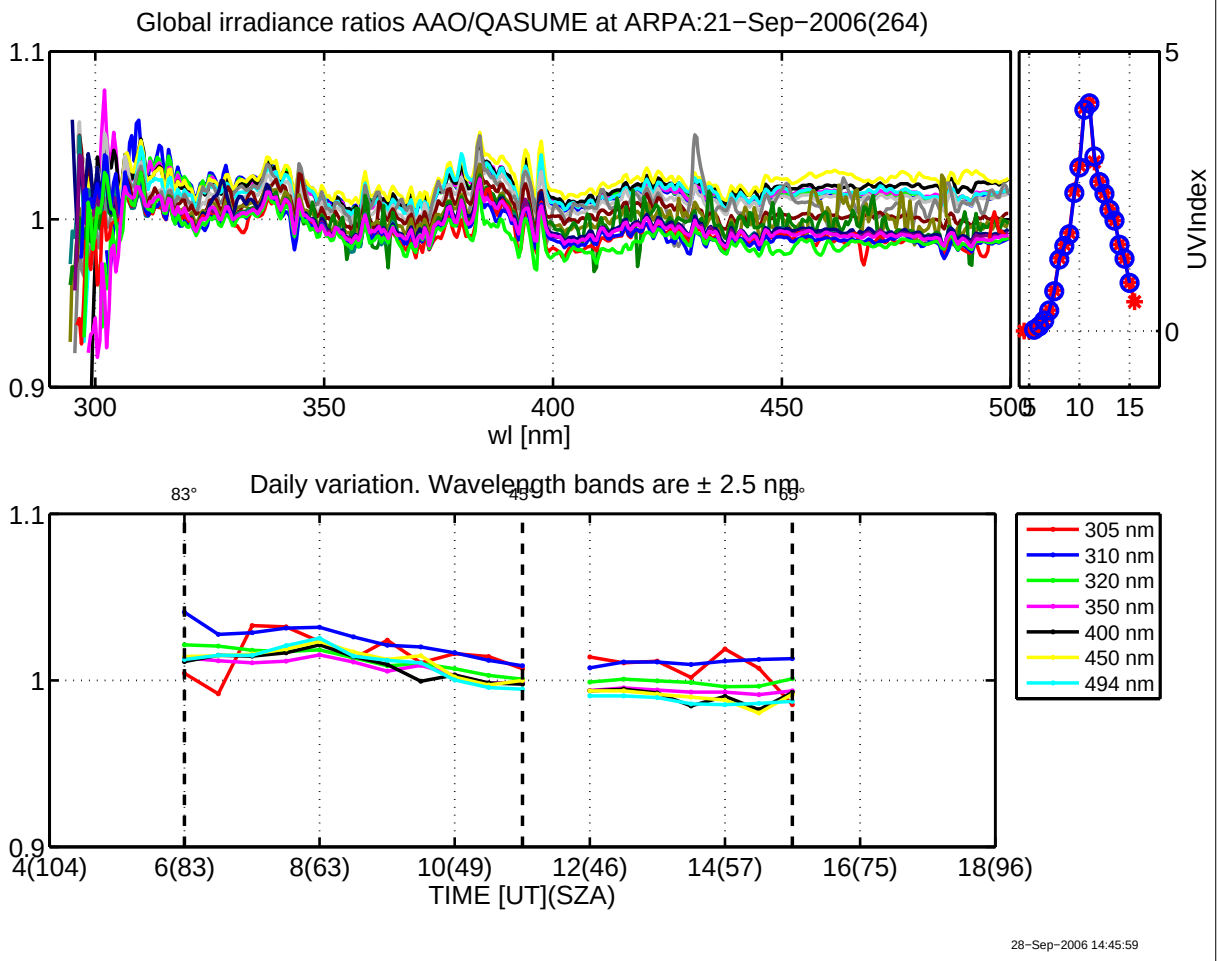
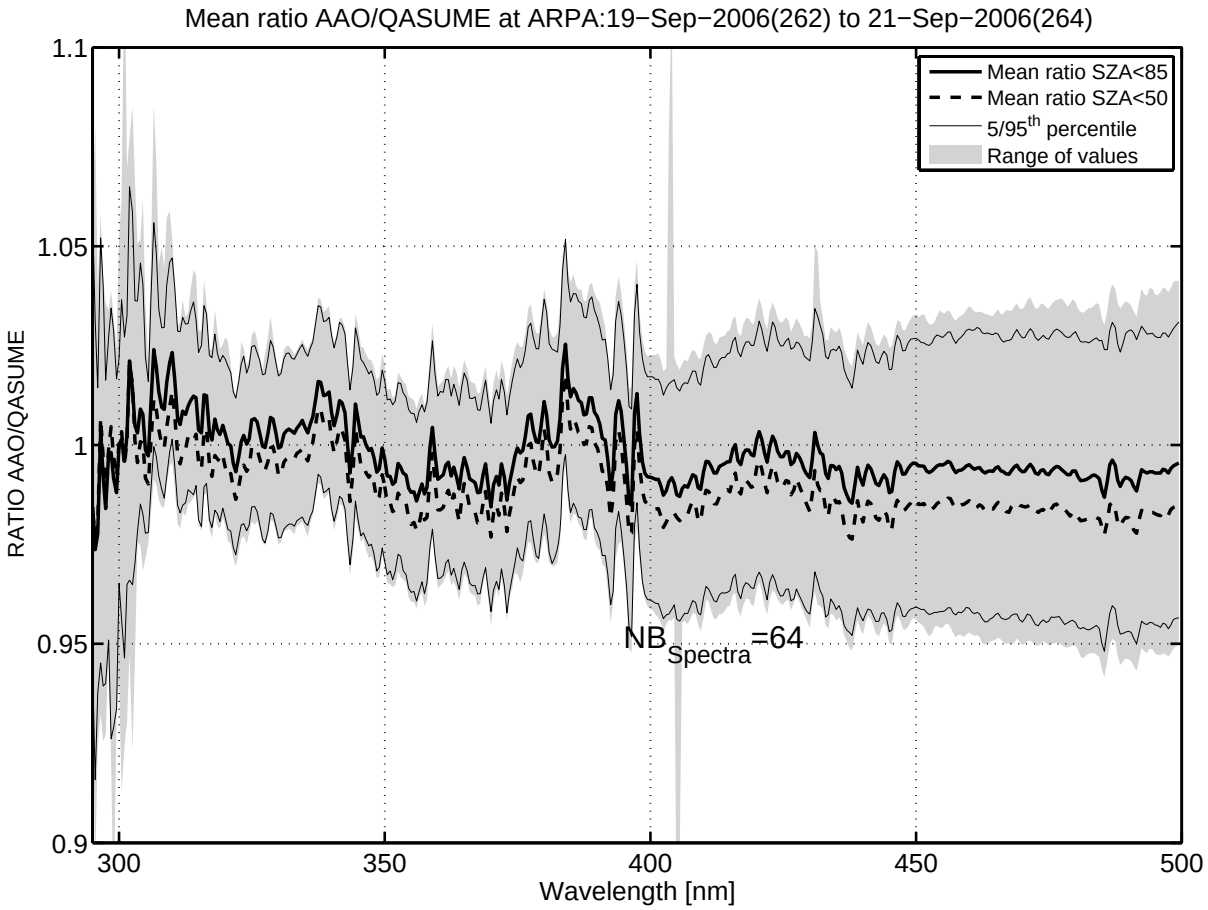
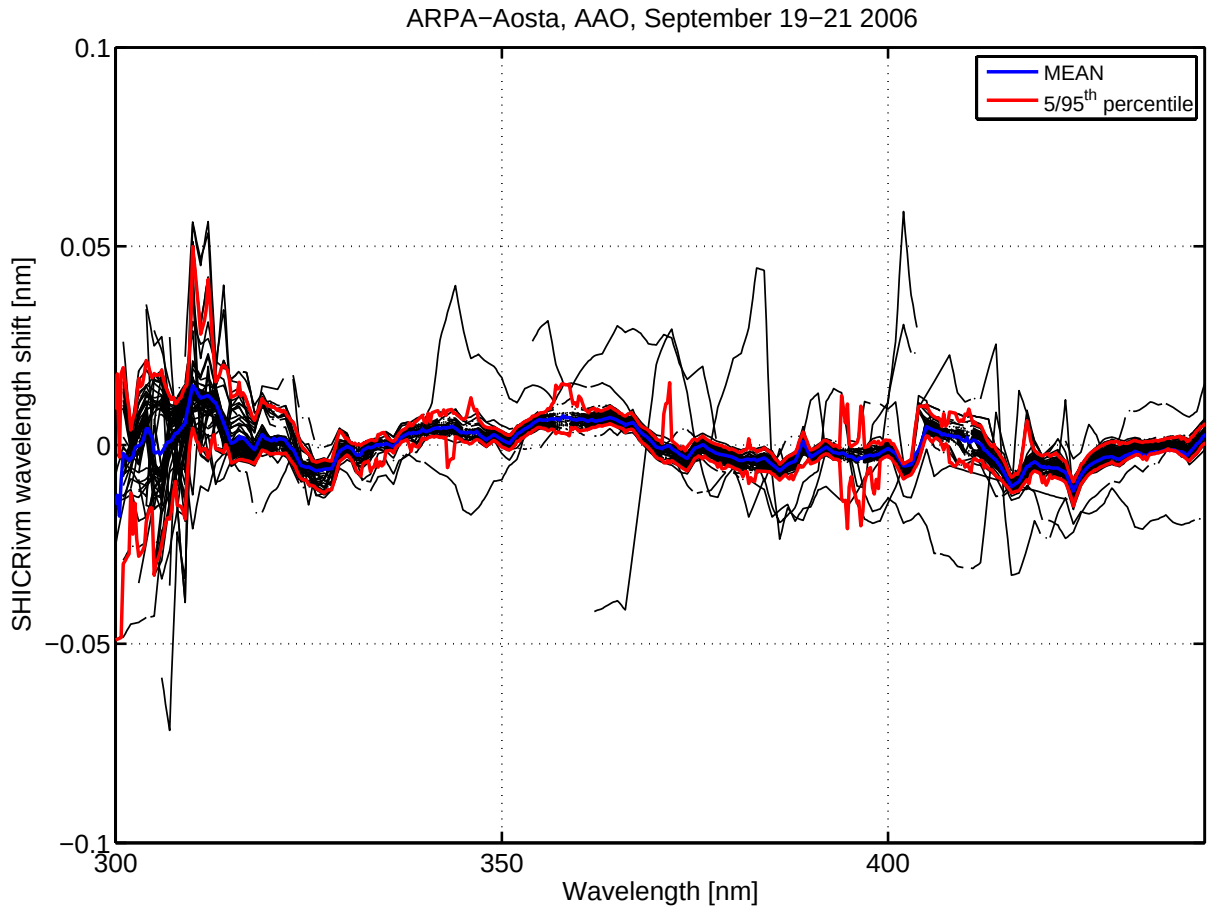
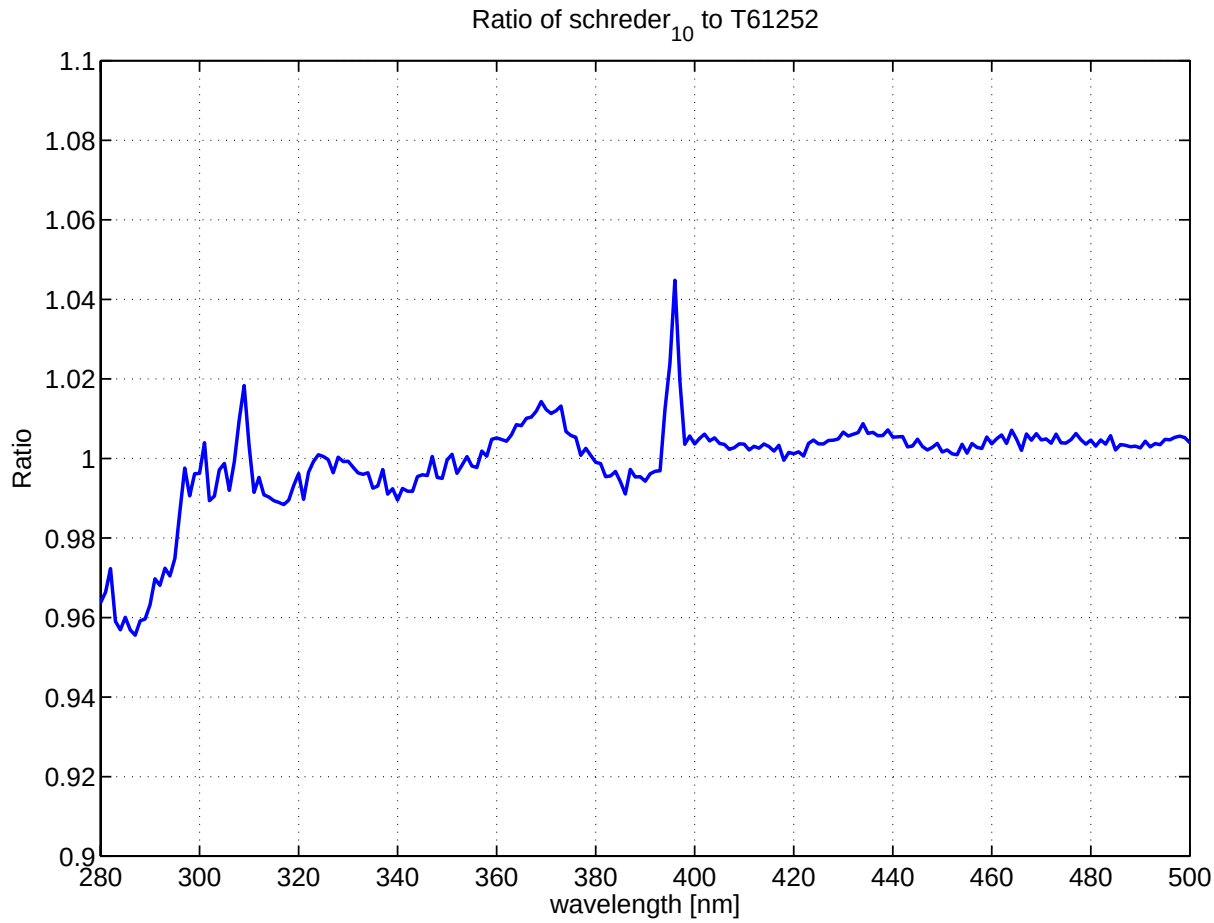
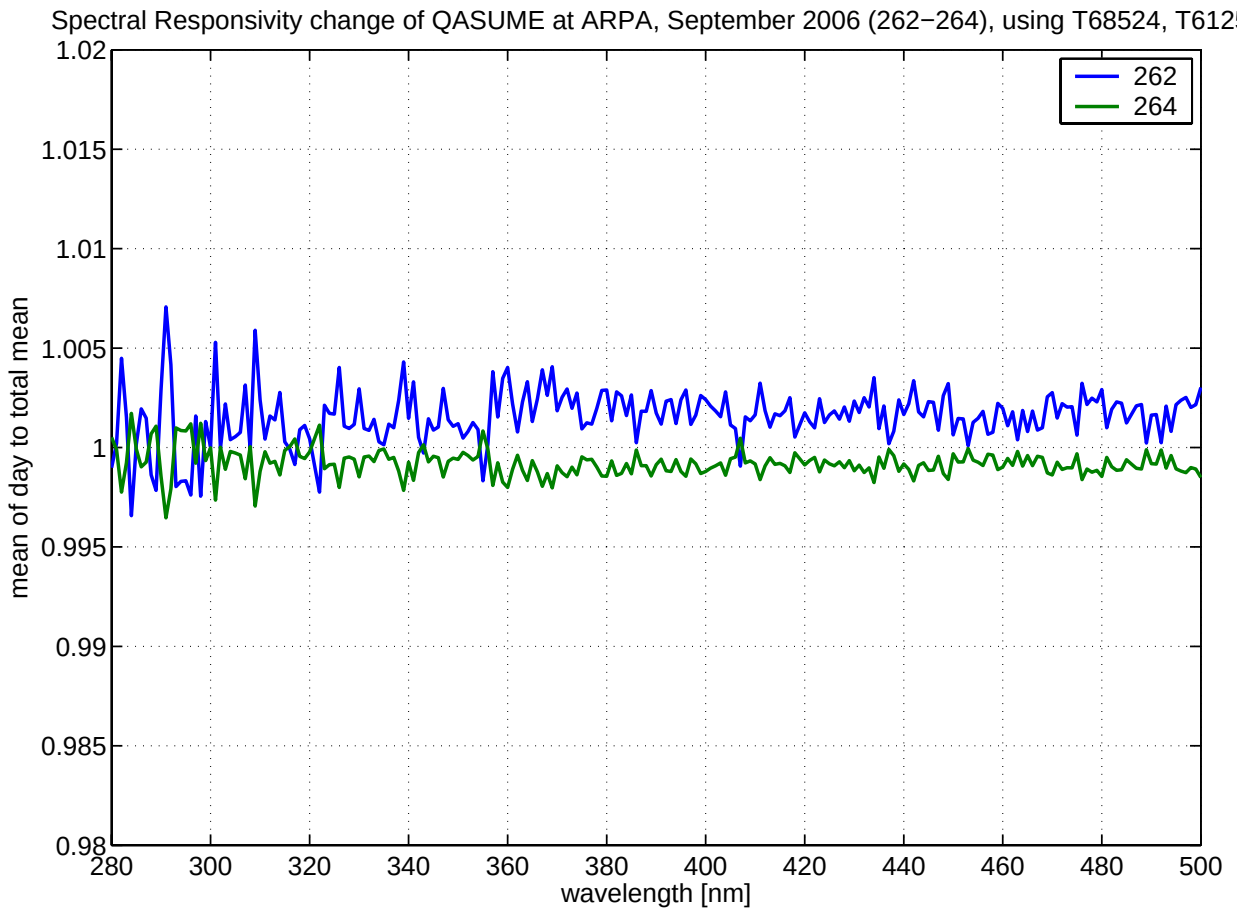
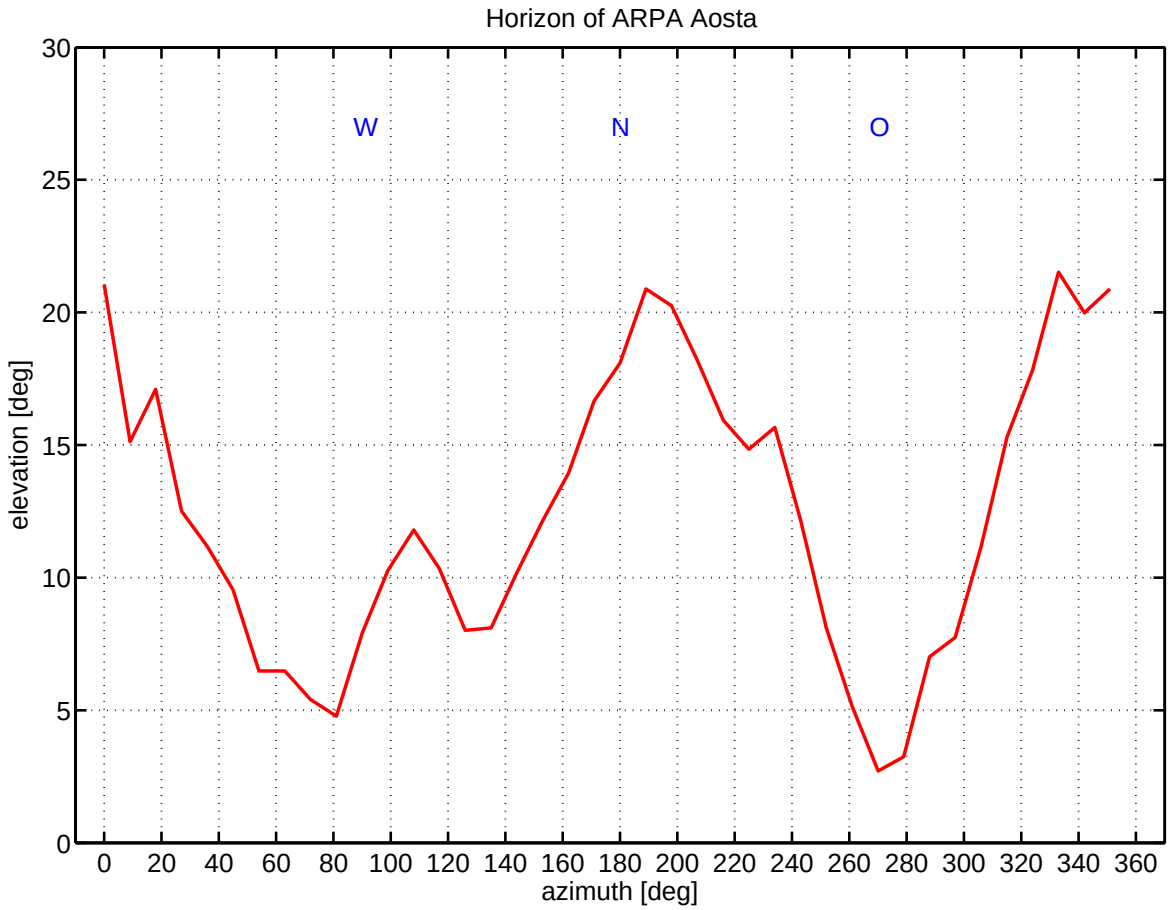

Global irradiance ratios AAO/QASUME at ARPA:21−Sep−2006(264)
1.1
1
0.9
300
350
400
450
500
wl [nm]
5
0
UVIndex
5
10
15
Daily variation. Wavelength bands are ± 2.5 nm
83°
45°
69°
1.1
1
0.9
4(104)
6(83)
8(63)
10(49)
12(46)
14(57)
16(75)
18(96)
TIME [UT](SZA)
305 nm
310 nm
320 nm
350 nm
400 nm
450 nm
494 nm
28−Sep−2006 14:45:59

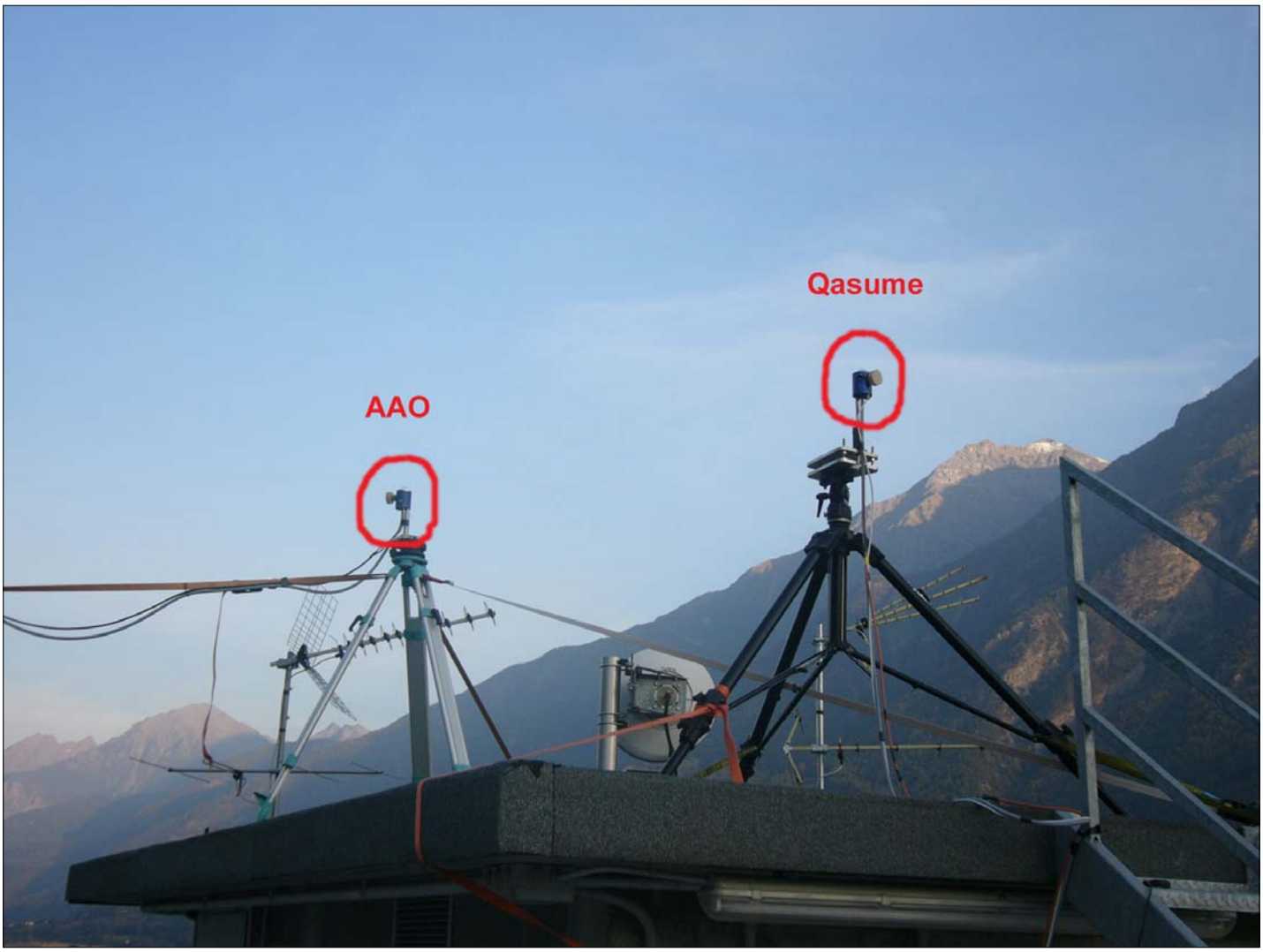

Mean ratio AAO/QASUME at ARPA:19−Sep−2006(262) to 21−Sep−2006(264)
1.1
1.05
1
0.95
0.9
RATIO AAO/QASUME
300
350
400
450
500
Wavelength [nm]
Mean ratio SZA<85
Mean ratio SZA<50
5/95th percentile
Range of values
NBSpectra=64


ARPA−Aosta, AAO, September 19−21 2006
MEAN
5/95th percentile
SHICRivm wavelength shift [nm]
Wavelength [nm]
0.1
0.05
0
−0.05
−0.1
300
350
400


Ratio of schreder10 to T61252
Ratio
wavelength [nm]
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
0.94
0.92
0.9
280
300
320
340
360
380
400
420
440
460
480
500


Spectral Responsivity change of QASUME at ARPA, September 2006 (262−264), using T68524, T61252
262
264
mean of day to total mean
wavelength [nm]
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
280
300
320
340
360
380
400
420
440
460
480
500


Horizon of ARPA Aosta
W
N
O
elevation [deg]
azimuth [deg]
30
25
20
15
10
5
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360


Qasume
AAO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