Protocol of the intercomparison at RIVM, Bilthoven, the Netherlands on July 03 to 06, 2006 with the travelling standard spectroradiometer B5503 from PMOD/WRC within the project QASUME

Report prepared by Gregor Hülsen

Operator: Julian Gröbner, Gregor Hülsen

The purpose of the visit was the comparison of global solar irradiance measurements between the spectroradiometers NLA and NLR operated by the Laboratory of Radiation Research, National Institute of Public Health and the Environment (RIVM) and the travel standard B5503. The measurement site is located at Bilthoven; Latitude 52.12 N, Longitude 5.19 E and altitude 4 m.a.s.l. on top of a seven-storeyed building.
The horizon of the measurement site is free down to at least 85° solar zenith angle (SZA). Measurements between 3:30 UT and 20:00 UT have been analysed.

B5503 arrived at RIVM in the afternoon of July 03, 2006. The spectroradiometer was installed in line to the NLA instrument with the entrance optic of B5503 within 2 m of NLA. The distance to the NLR was more than 200 m. The spectroradiometers in use at RIVM are DILOR double monochromators. The intercomparison between B5503 and the RIVM spectroradiometers lasted three days, from morning of July 04 to the evening of July 06.

B5503 was calibrated several times during the intercomparison period using a portable calibration system. Two lamps (T68523 and T68524) 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 B5503 was 25.2±0.2 °C. The diffuser head was heated to a temperature of 28.9±3.3 °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 450 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 450 nm, every 0.5 nm, and 4 seconds between each wavelength increment.

July 03 (184):

B5503 was installed on the measurement site at 14:00 UT. A synchronised measurement is available at 18:00 UT when the internal temperature of B5503 reached its nominal temperature. Weather conditions were a mix of sun and clouds.

July 04 (185):

Synchronised measurements are available from 3:30 to 20:00 UT. Weather conditions were clear sky with a few cirrus clouds and haze especially in afternoon.

B5503 was calibrated at 12:46 UT between the scans. The scan at 17:00 UT is missing for the NLR spectrometer.

July 05 (186):

Synchronised scans are available from 3:30 to 20:00 UT. The weather conditions were hazy and mix of sun and clouds, a thunderstorm from 9:45 till 10:05 UT, some little rain till 11:50 UT and afterwards a mix of sun and clouds.

B5503 was calibrated at 12:46 UT.

July 06 (187):

Synchronised scans are available from 3:30 to 18:00 UT. The weather conditions were a mix of sun and clouds during the day and clear sky with a cirrus clouds and haze in the late afternoon till evening.

B5503 was calibrated at 9:46 UT.

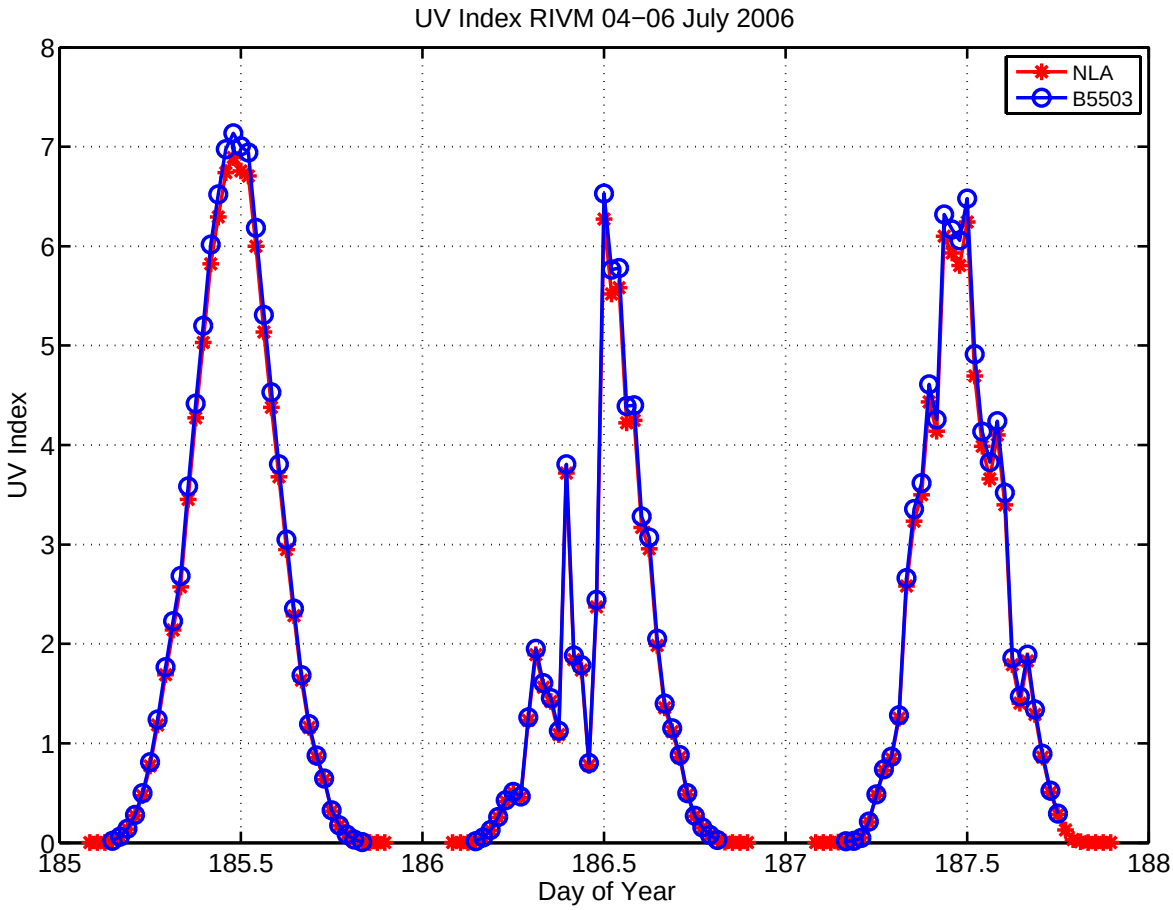
End of the campaign: after the 18:00 UT scan.

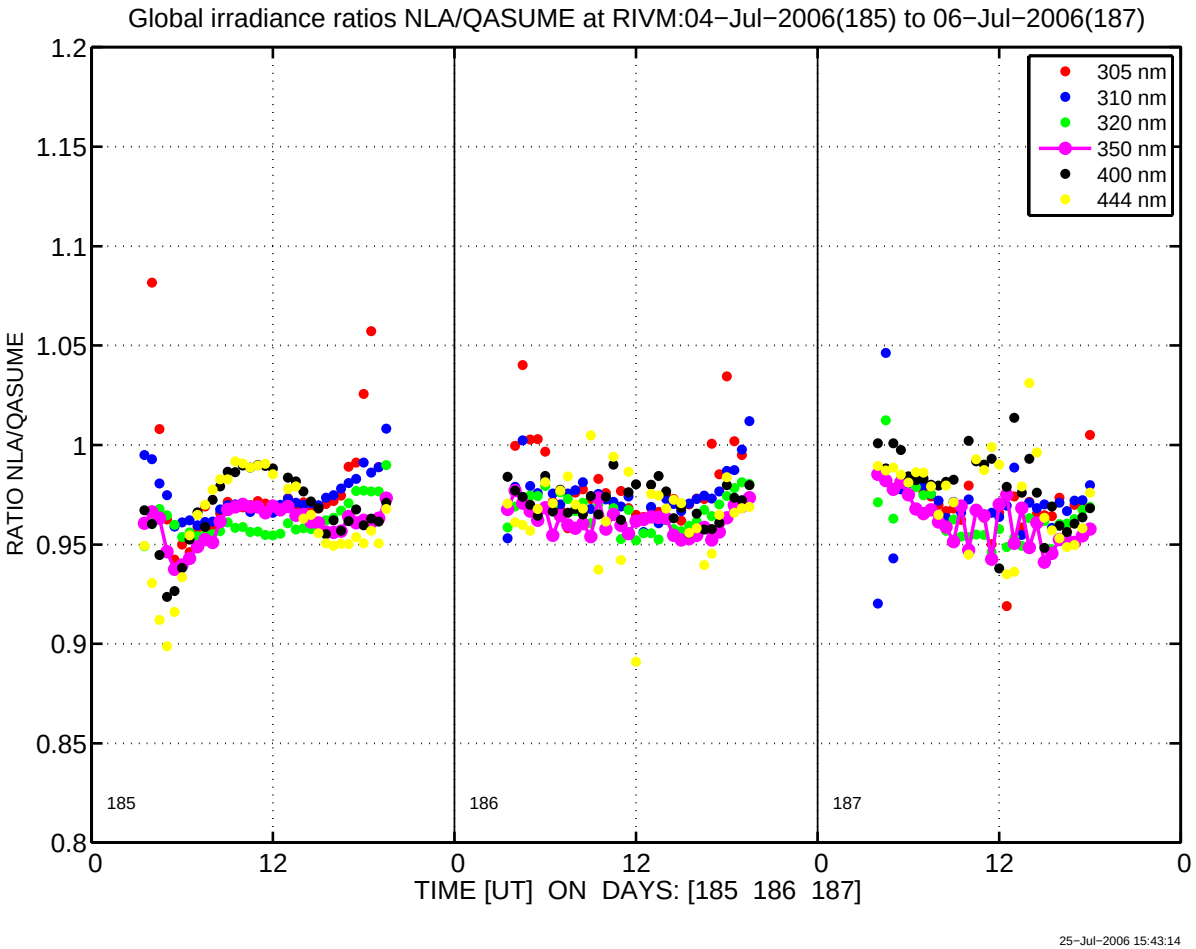
Results:

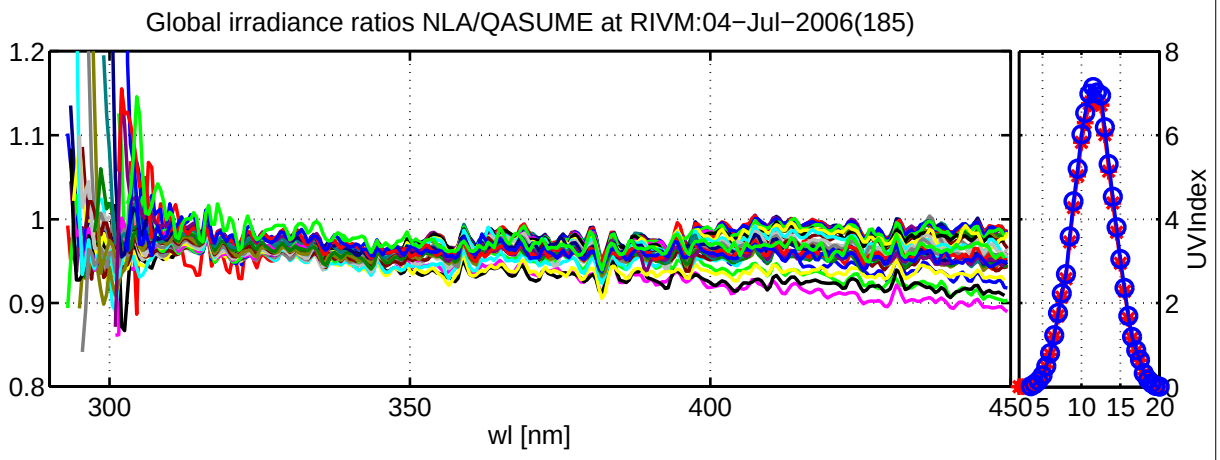
In total 95 synchronised simultaneous spectra from B5503 and NLA (one less for the NLR) are available from the measurement period. Because of the good location of the instrument all measurements between 3:30 and 20:00 UT have been analysed (SZA smaller than 90°).

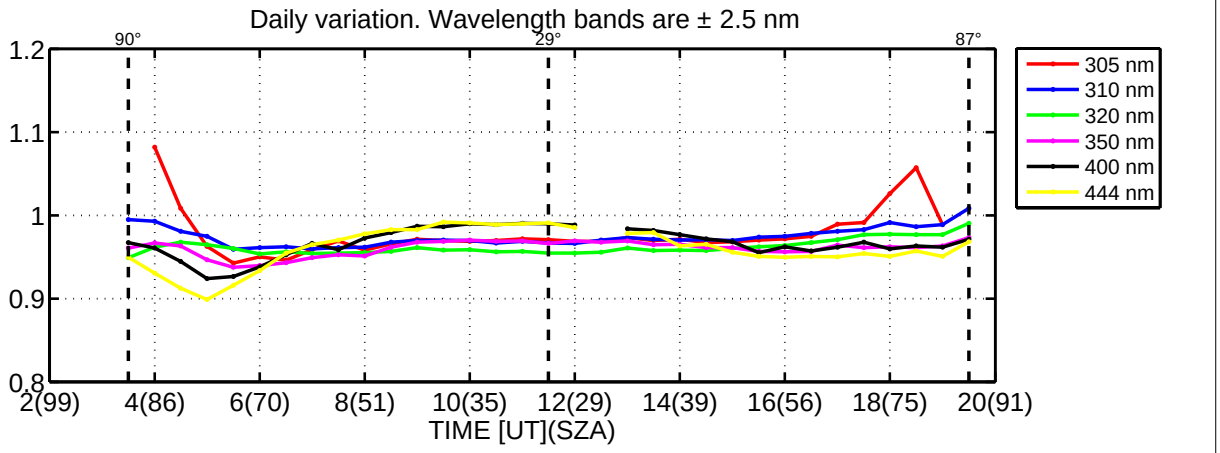
Remarks:

1. The ratios between NLA and B5503 are spectrally flat between 300 to 450 nm with a mean ratio of 0.97 and a variability of 1 %.
2. The morning measurements on July 04 show a variation of 5 to 10 %, especially for wavelength greater than 400 nm.
3. On average the diurnal variability is less than 3 %.
4. For all solar scans the wavelength shifts of the NLA are below ±30 pm, but show variability above 400 nm.


UV Index RIVM 04−06 July 2006
NLA
B5503
UV Index
Day of Year
0
1
2
3
4
5
6
7
8
185
185.5
186
186.5
187
187.5
188


Global irradiance ratios NLA/QASUME at RIVM:04−Jul−2006(185) to 06−Jul−2006(187)
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
RATIO NLA/QASUME
TIME [UT] ON DAYS: [185 186 187]
185
186
187
0.8
0.85
0.9
0.95
1
1.05
1.1
1.15
1.2
0
12
25−Jul−2006 15:43:14





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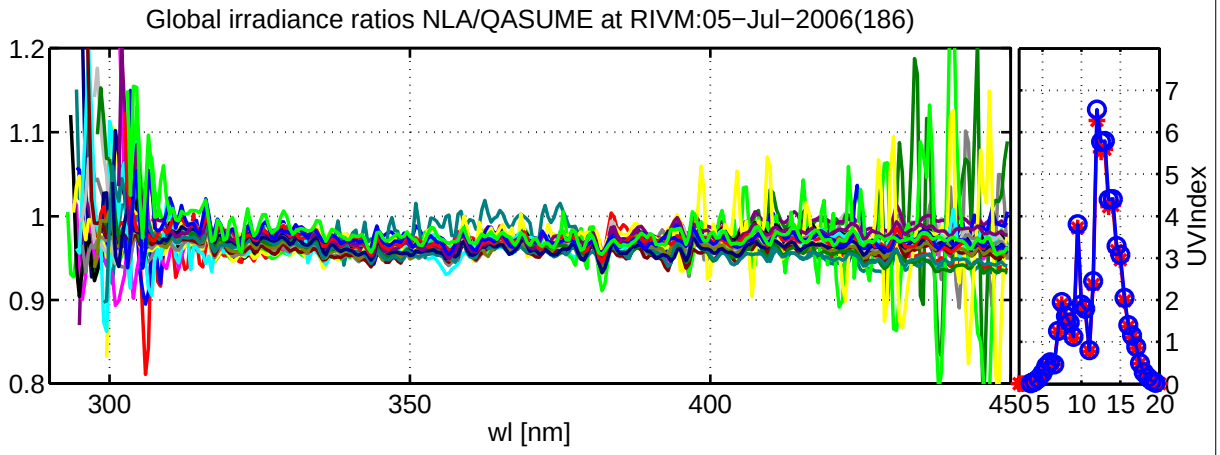

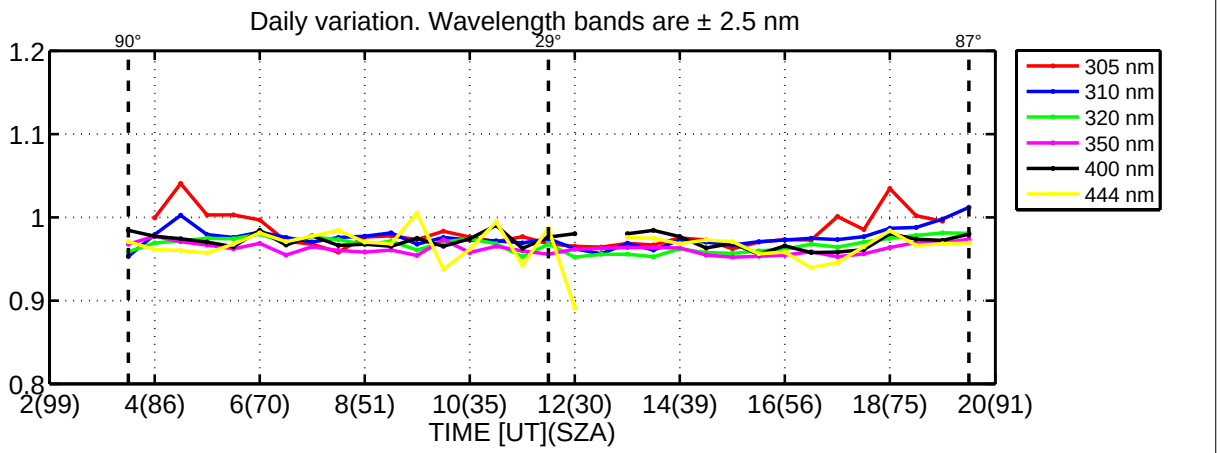

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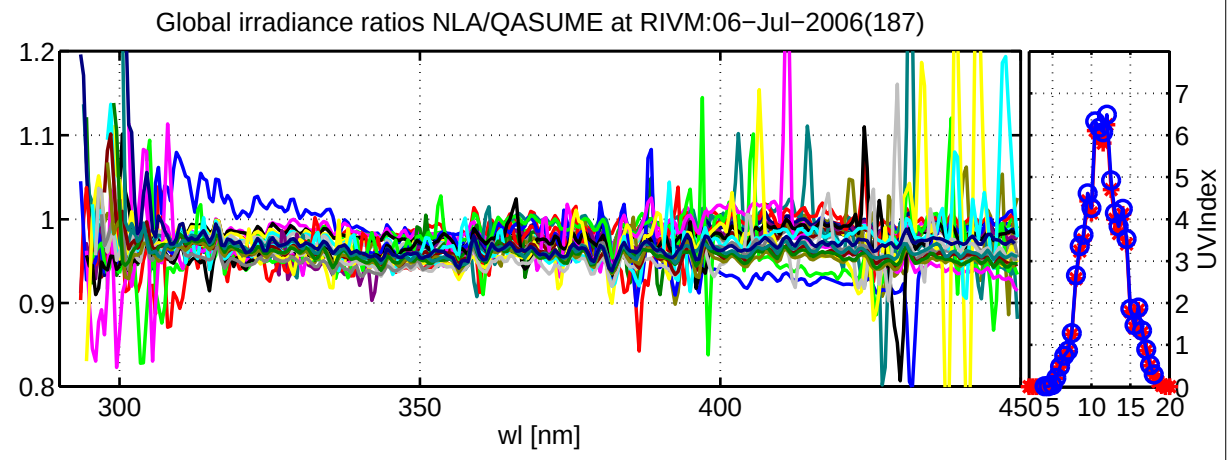

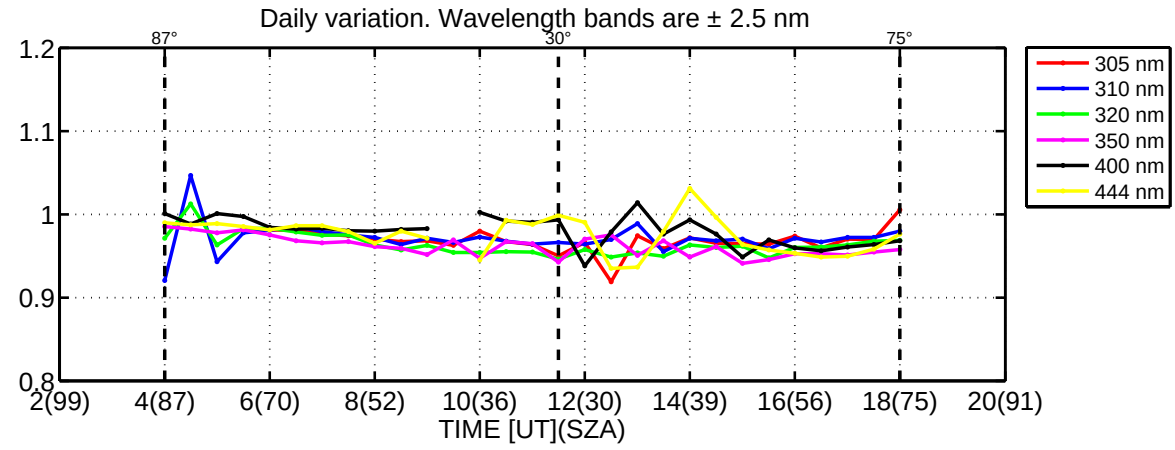

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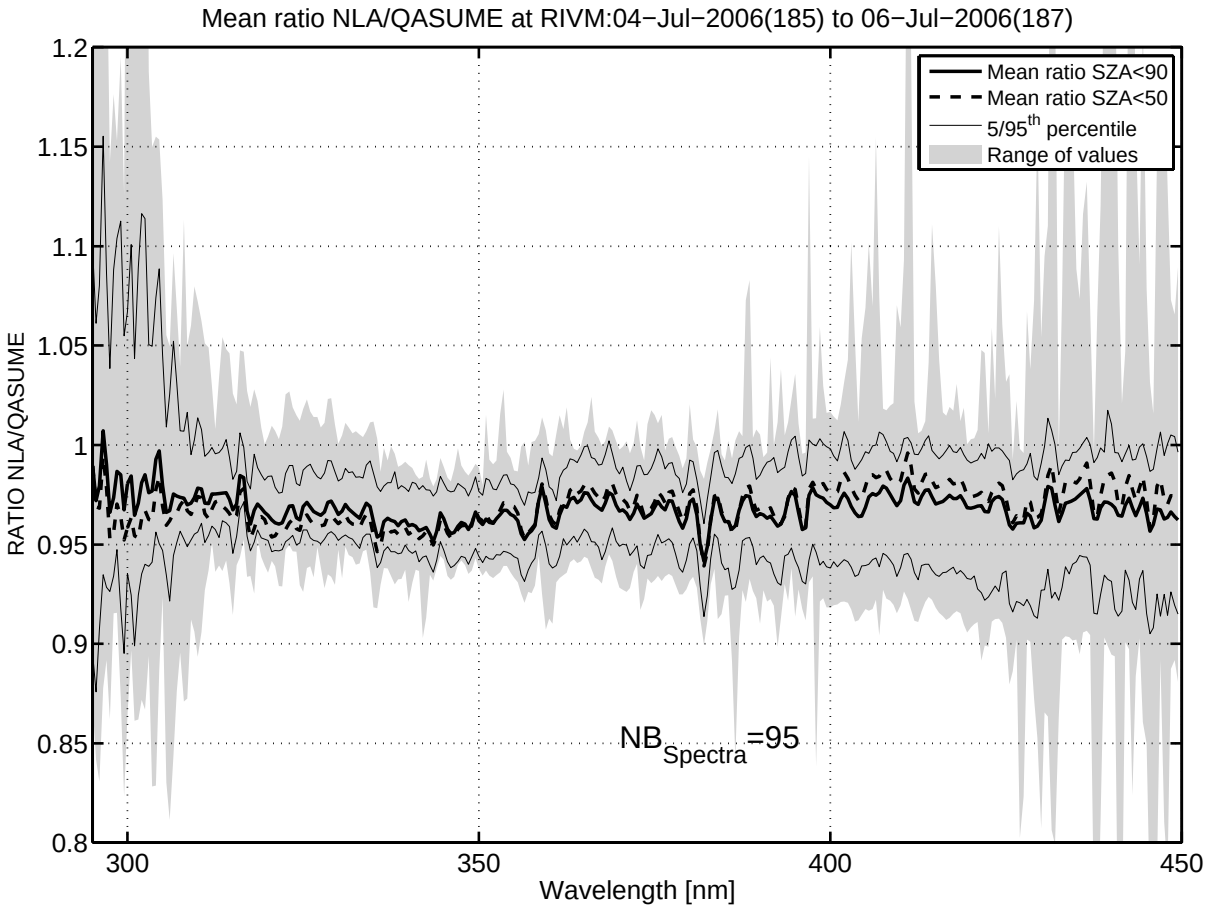
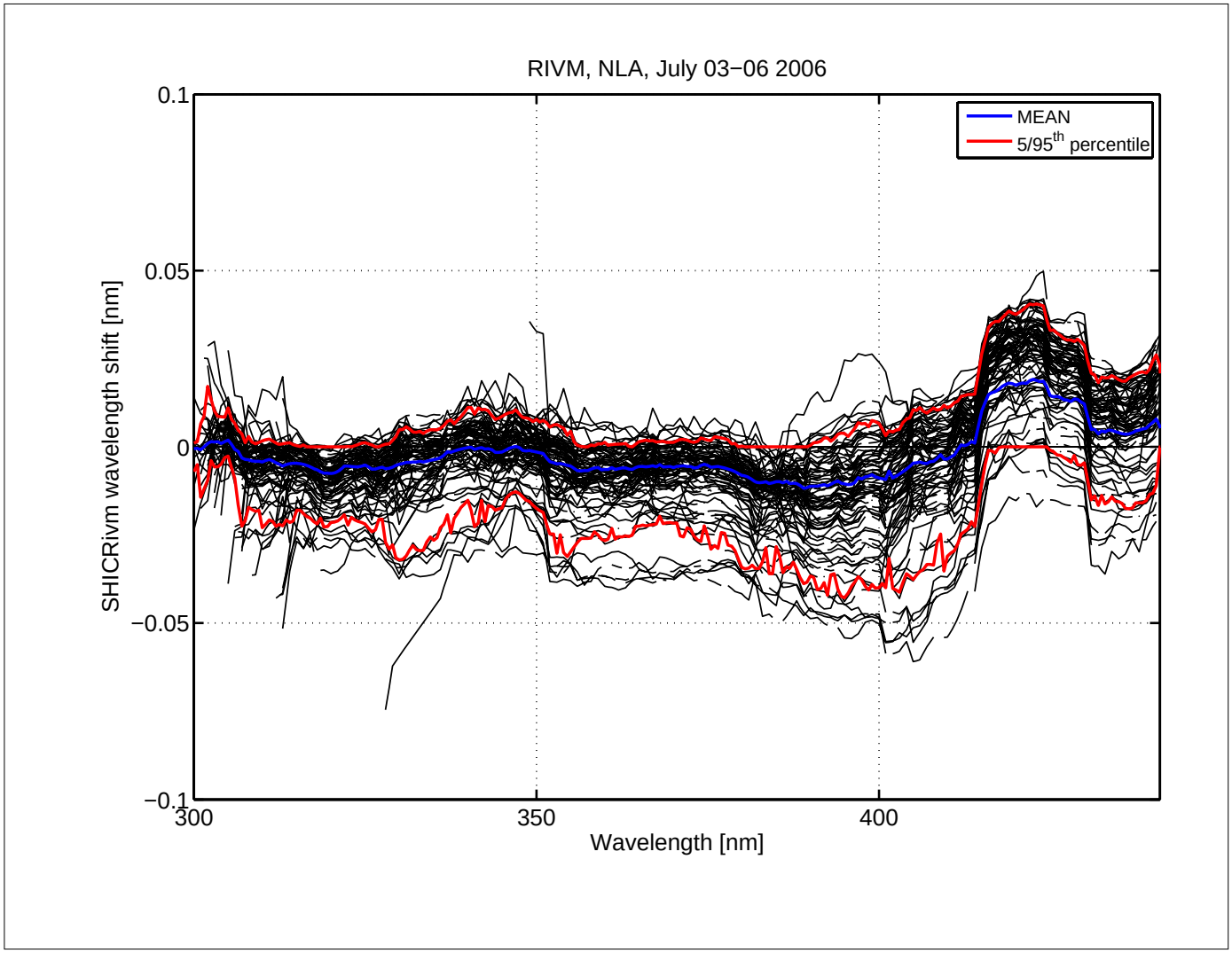
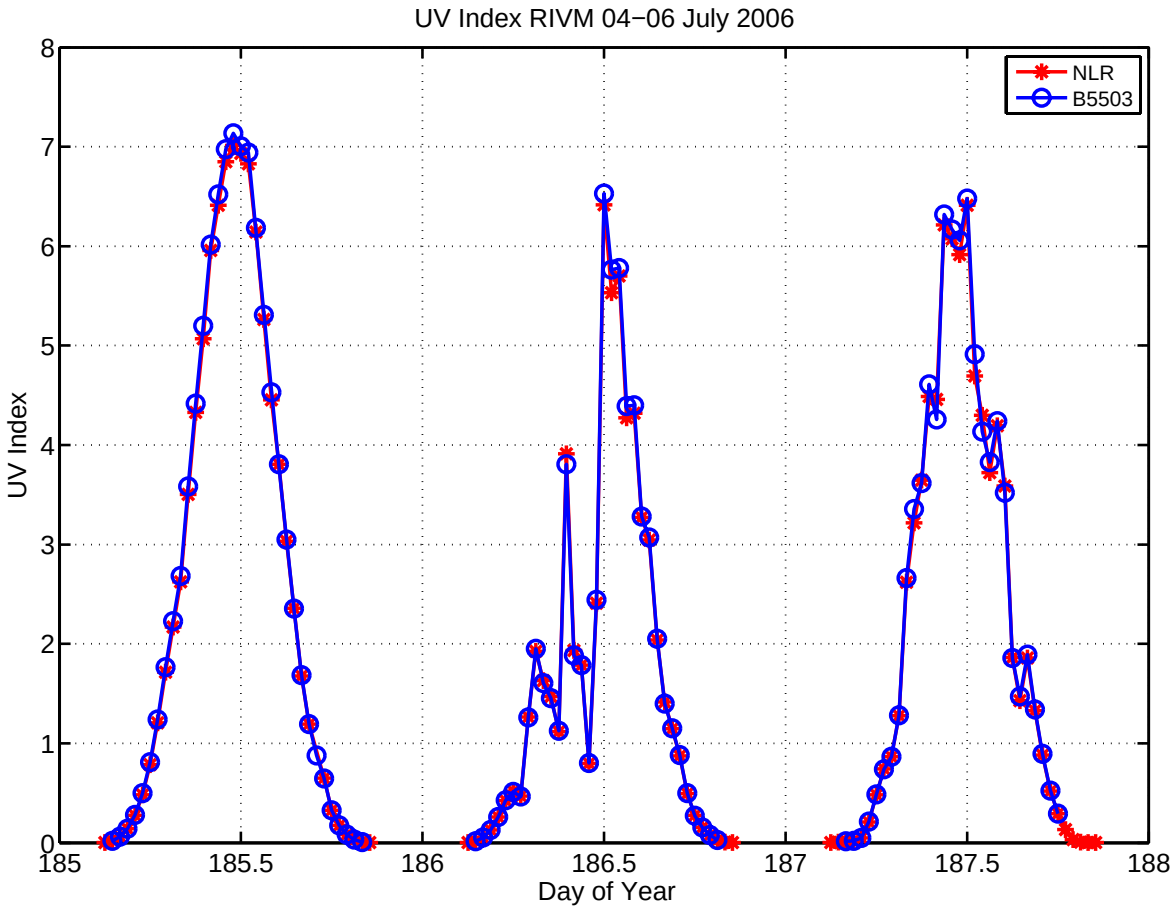
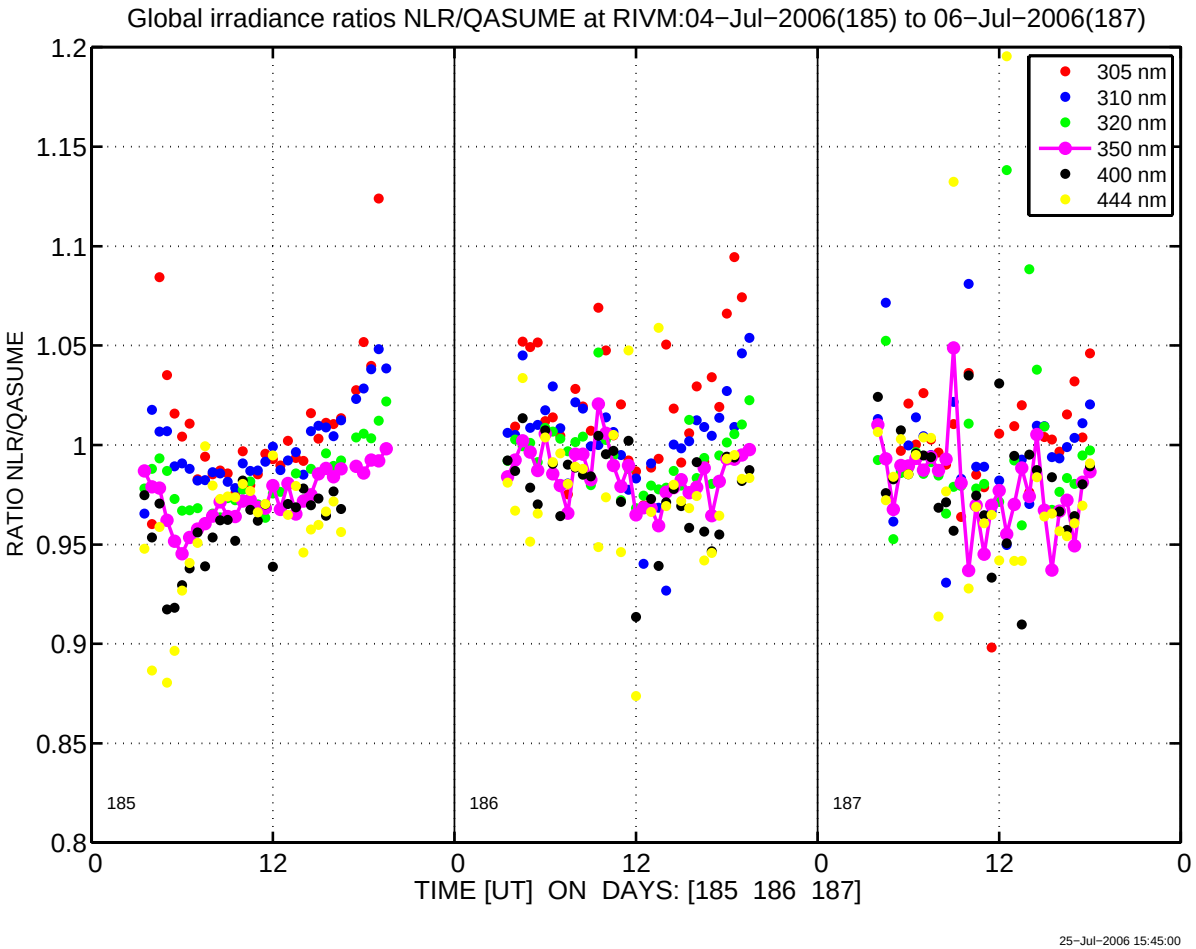
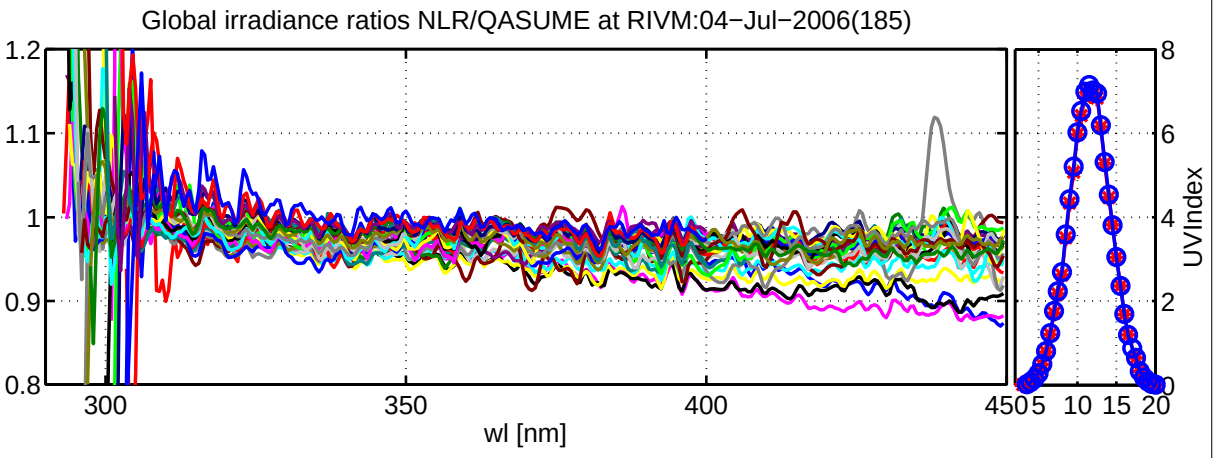
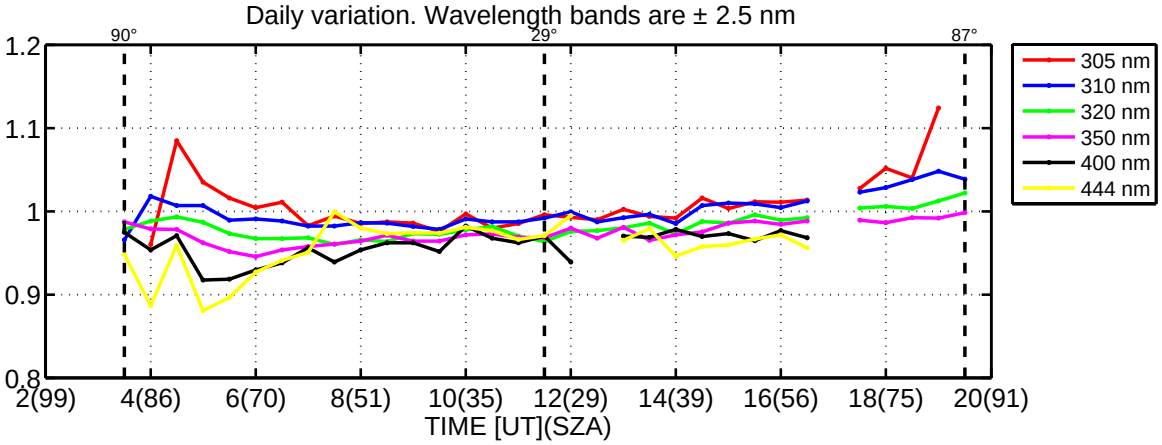



RIVM, NLA, July 03−06 2006
MEAN
5/95th percentile
SHICRivm wavelength shift [nm]
0.1
0.05
0
−0.05
−0.1
300
350
400
Wavelength [nm]


UV Index RIVM 04−06 July 2006
NLR
B5503
UV Index
Day of Year
0
1
2
3
4
5
6
7
8
185
185.5
186
186.5
187
187.5
188


Global irradiance ratios NLR/QASUME at RIVM:04−Jul−2006(185) to 06−Jul−2006(187)
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
RATIO NLR/QASUME
TIME [UT] ON DAYS: [185 186 187]
185
186
187
0.8
0.85
0.9
0.95
1
1.05
1.1
1.15
1.2
0
12
25−Jul−2006 15:45:00





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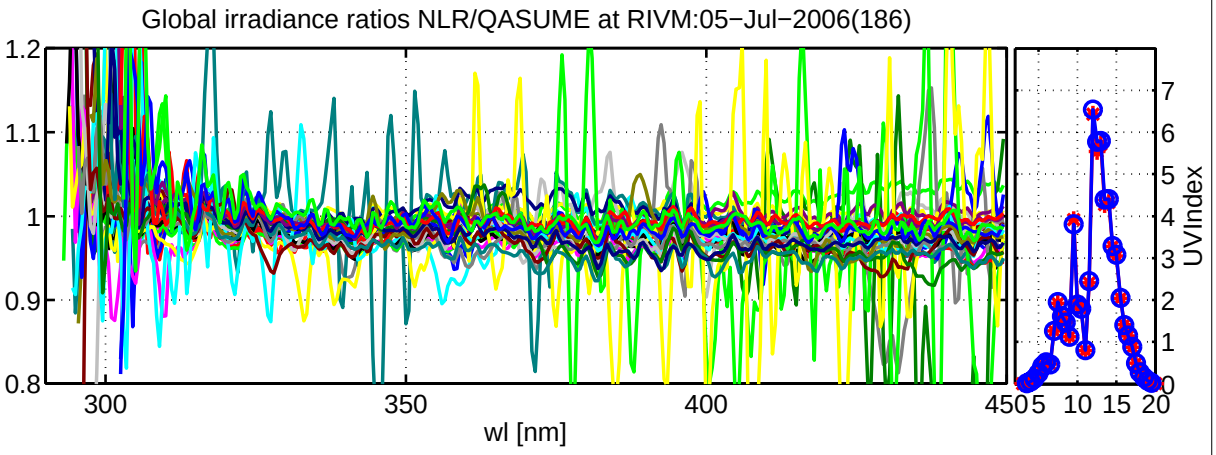

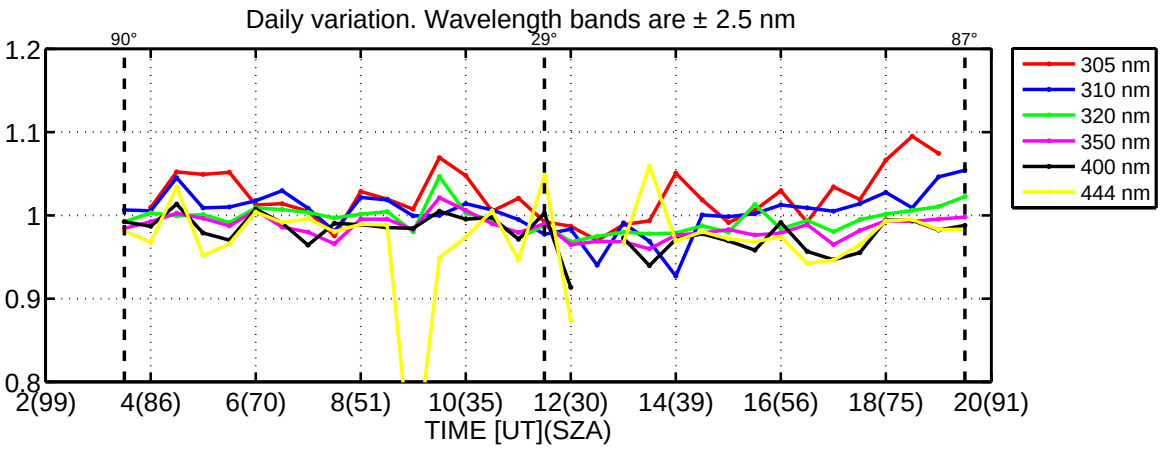

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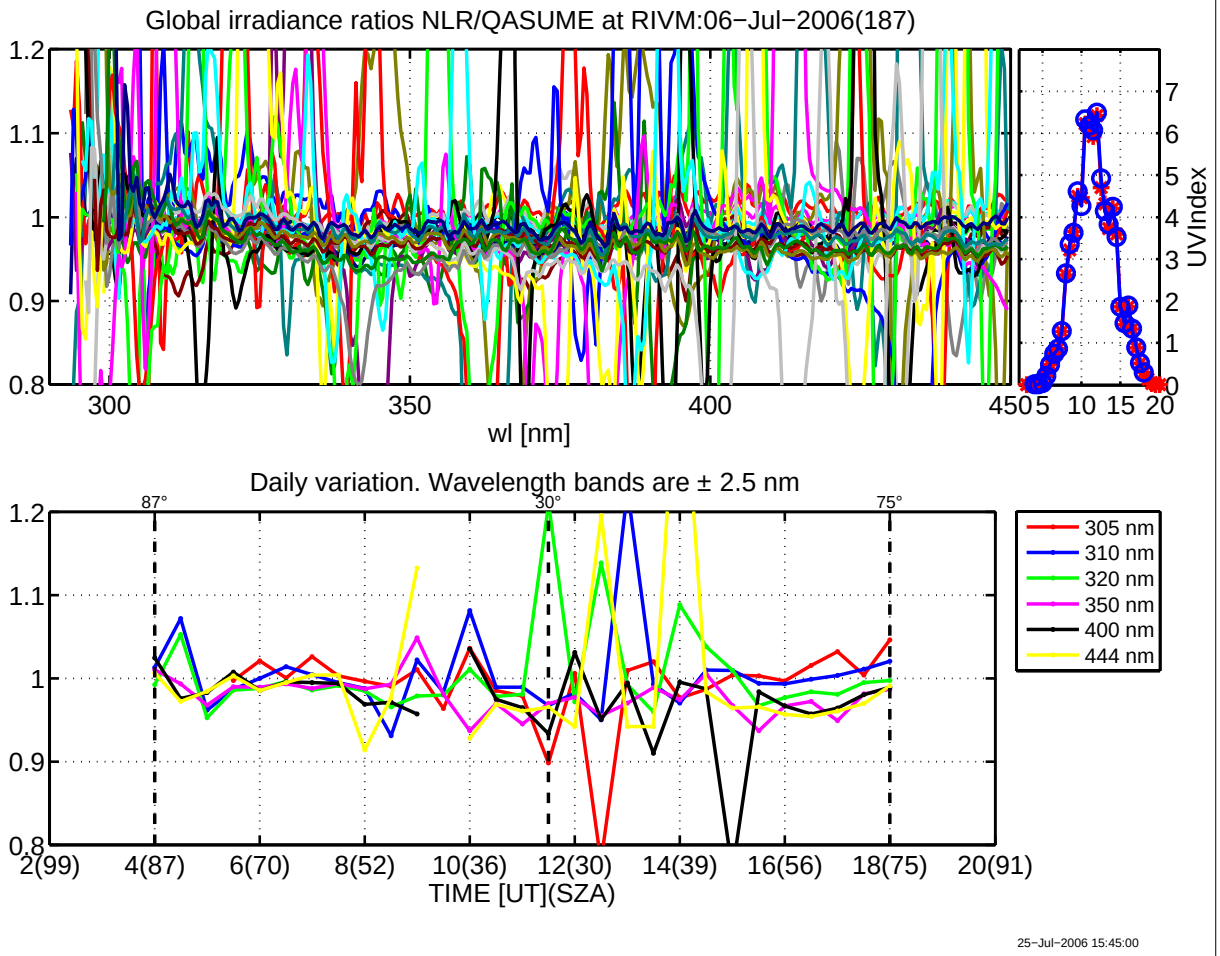
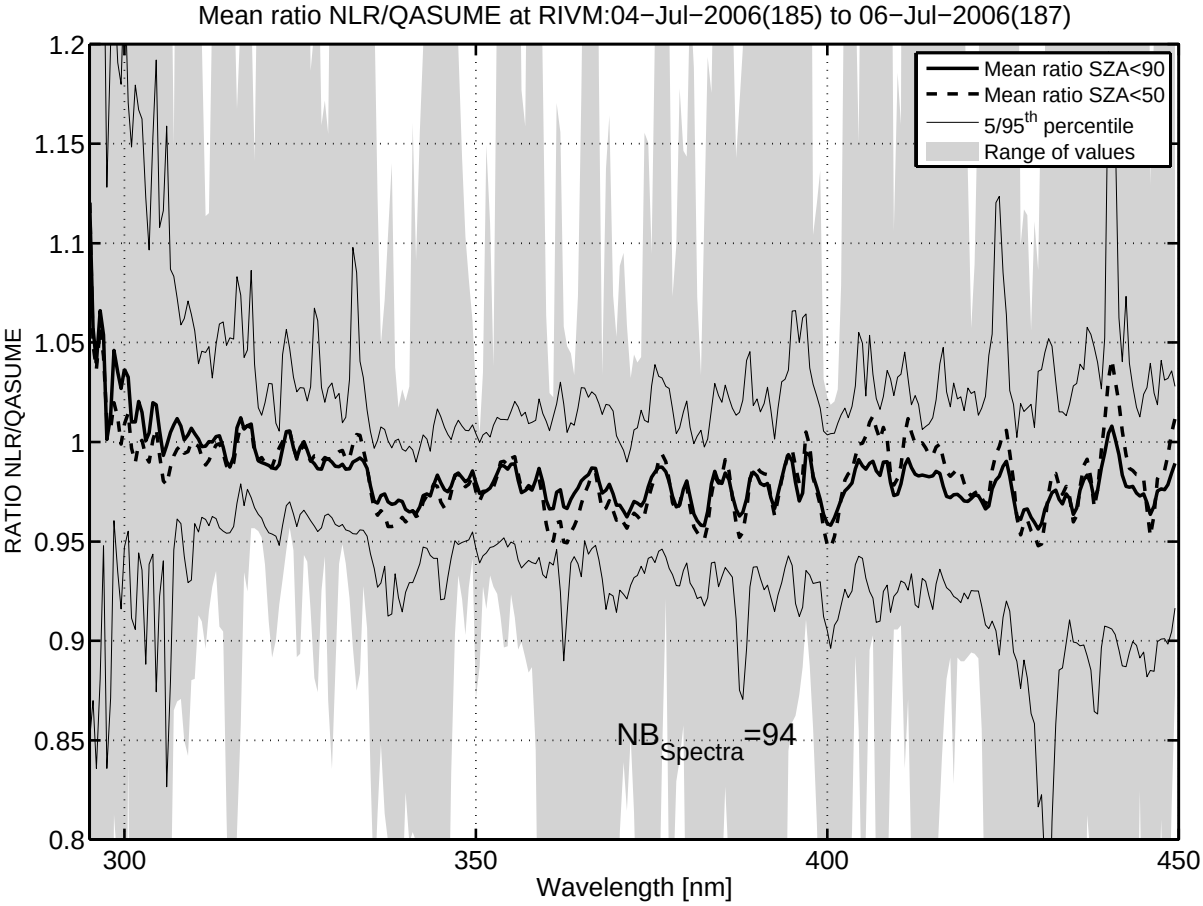
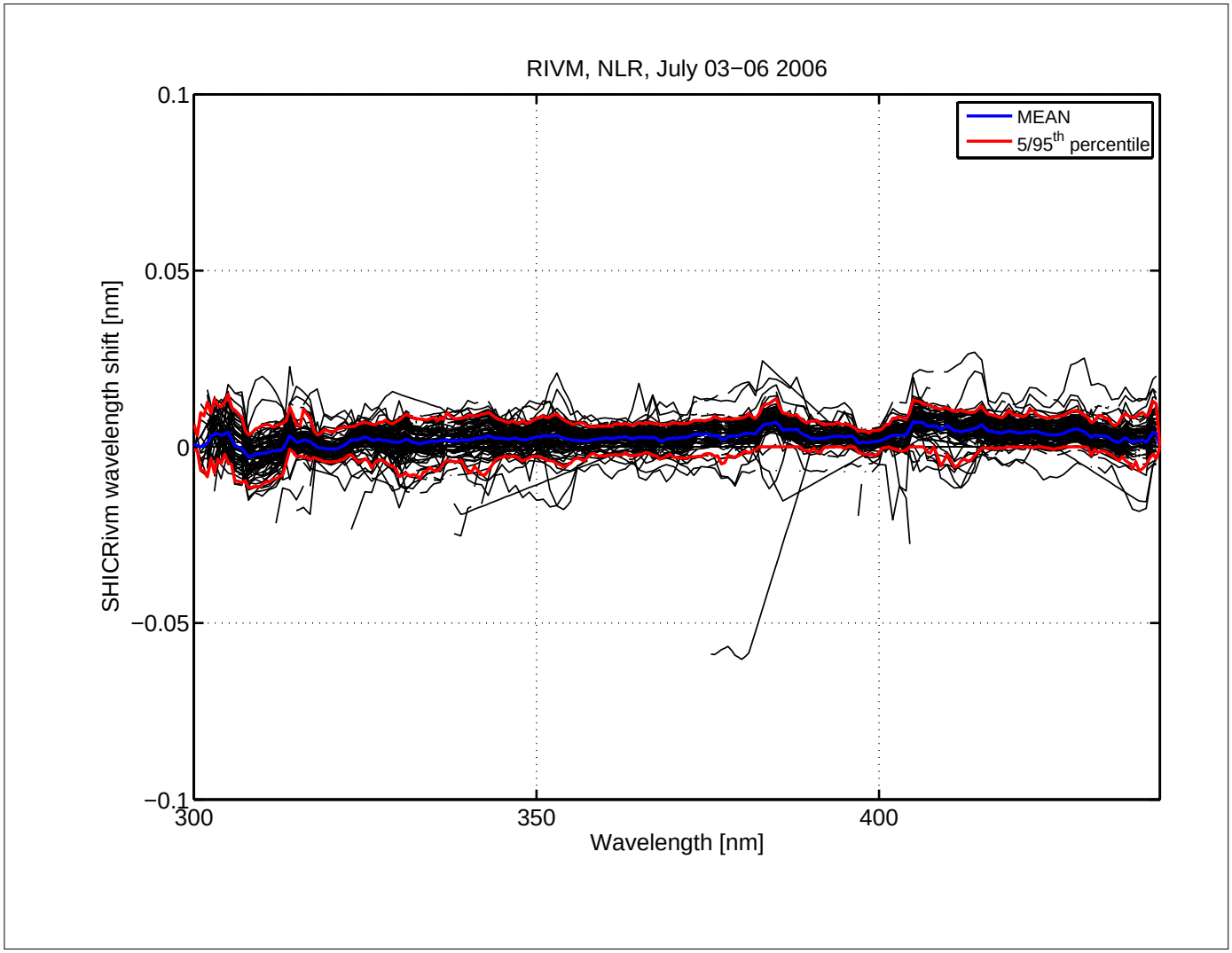
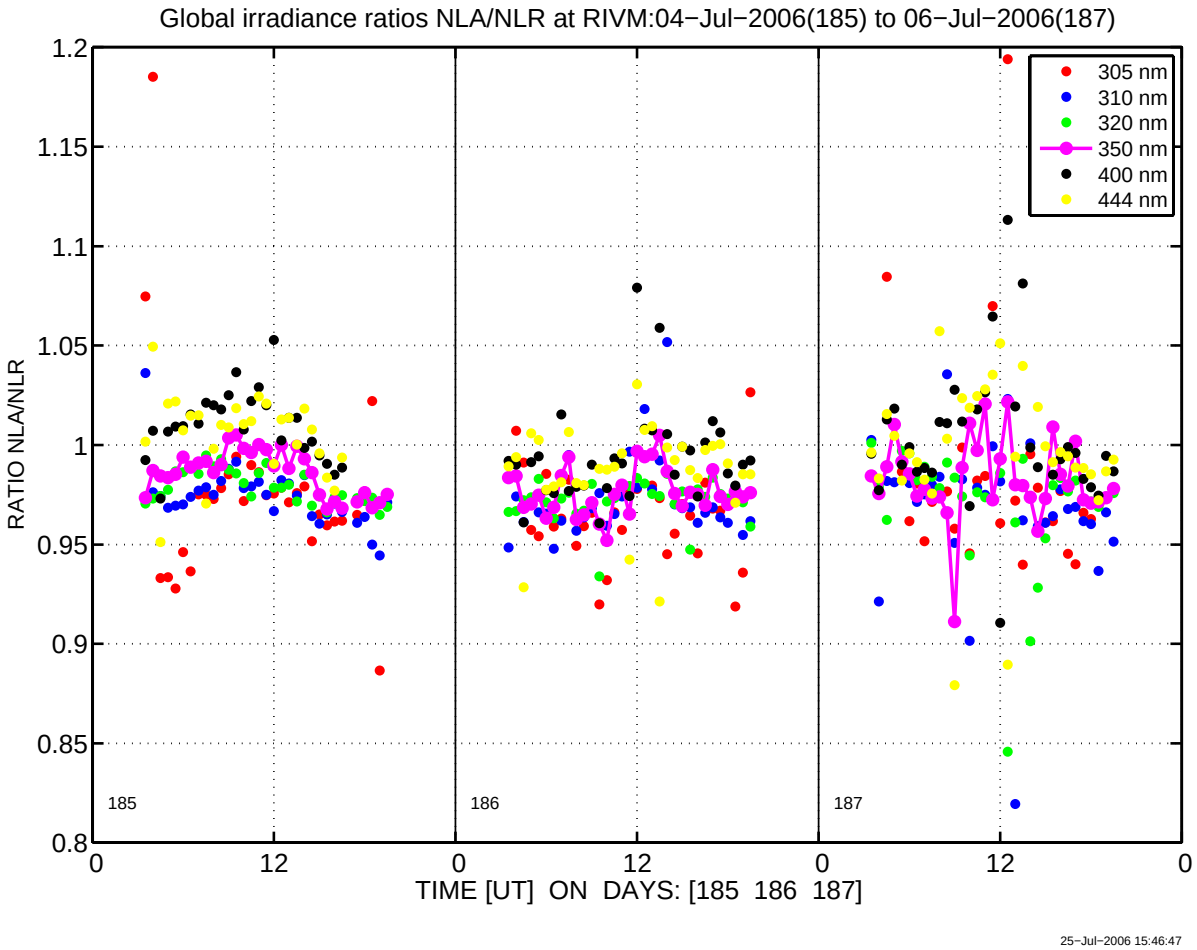
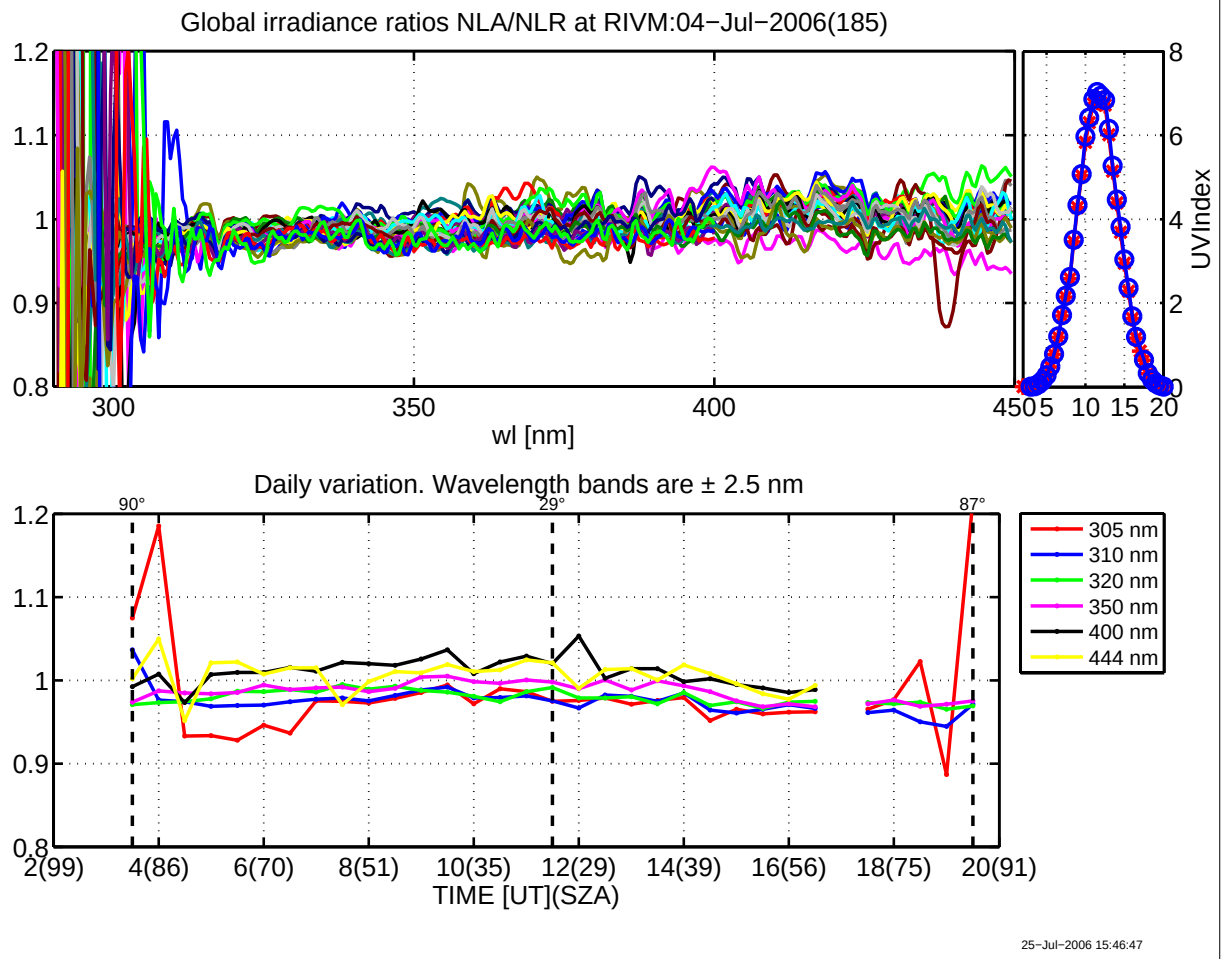
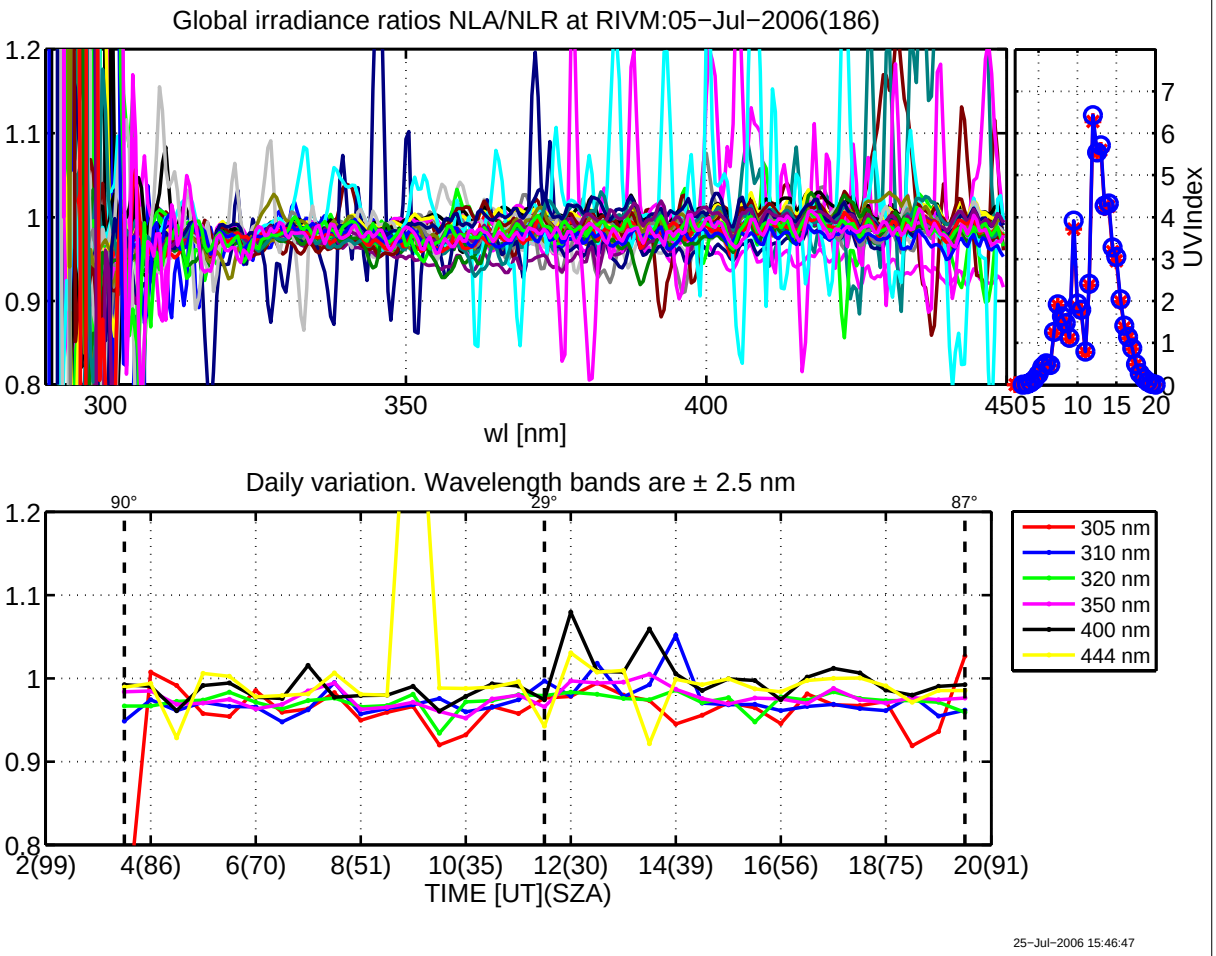

Global irradiance ratios NLR/QASUME at RIVM:06−Jul−2006(187)
wl [nm]
UVIndex
Daily variation. Wavelength bands are ± 2.5 nm
87°
30°
75°
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
2(99)
4(87)
6(70)
8(52)
10(36)
12(30)
14(39)
16(56)
18(75)
20(91)
TIME [UT](SZA)
25−Jul−2006 15:45:00

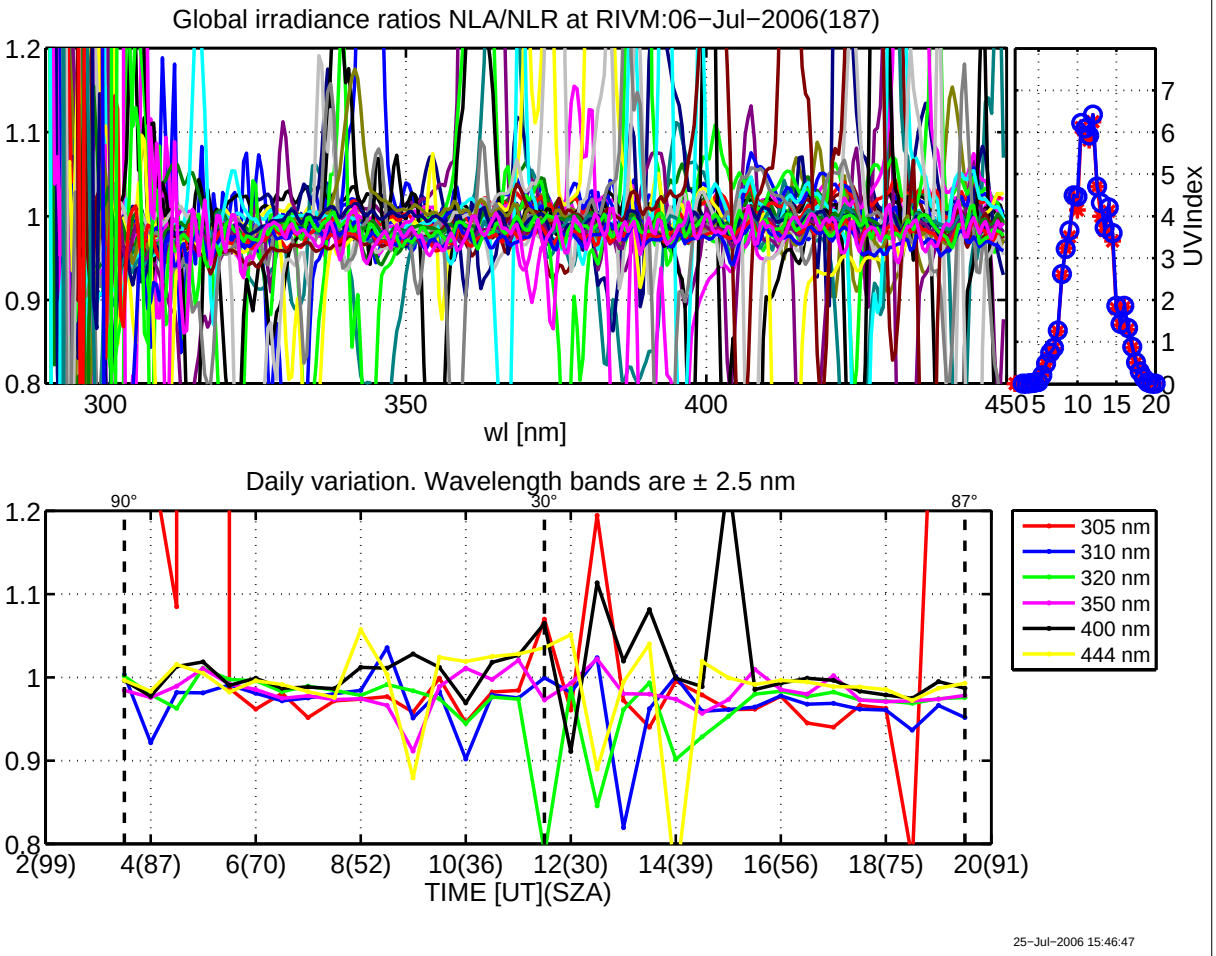

Mean ratio NLR/QASUME at RIVM:04−Jul−2006(185) to 06−Jul−2006(187)
Mean ratio SZA<90
Mean ratio SZA<50
5/95th percentile
Range of values
RATIO NLR/QASUME
NBSpectra=94
Wavelength [nm]

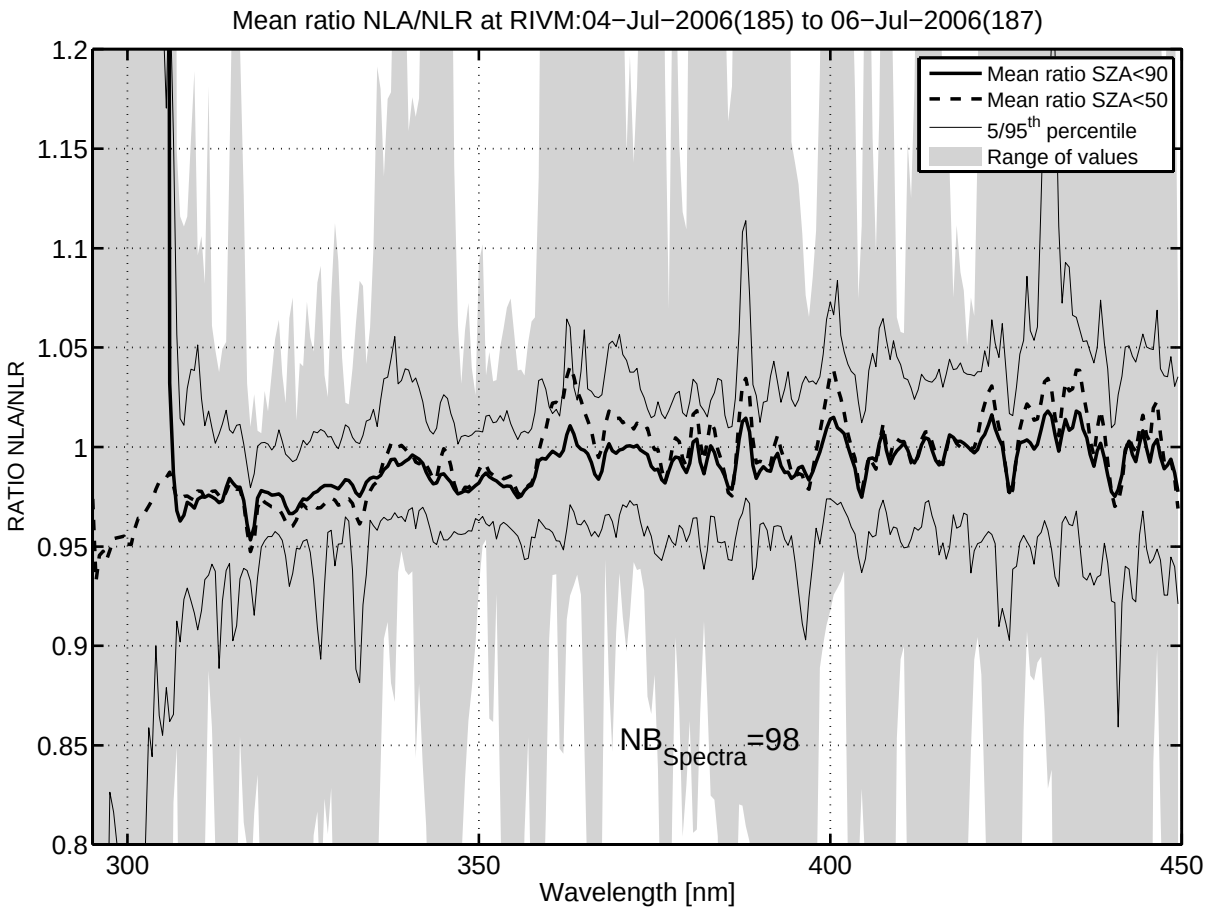

RIVM, NLR, July 03−06 2006
MEAN
5/95th percentile
SHICRivm wavelength shift [nm]
0.1
0.05
0
−0.05
−0.1
300
350
400
Wavelength [nm]

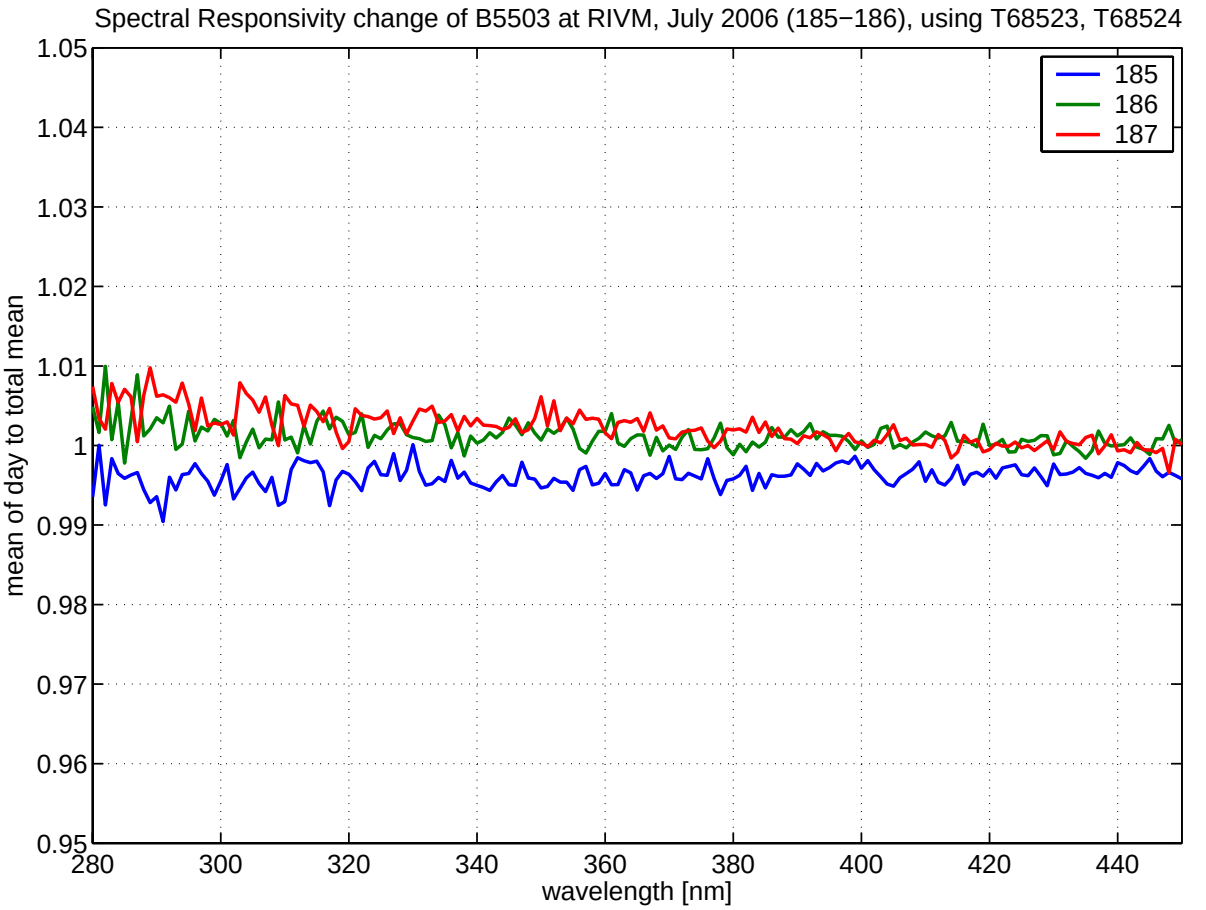

Global irradiance ratios NLA/NLR at RIVM:04−Jul−2006(185) to 06−Jul−2006(187)
RATIO NLA/NLR
TIME [UT] ON DAYS: [185 186 187]
185
186
187
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
25−Jul−2006 15:46:47

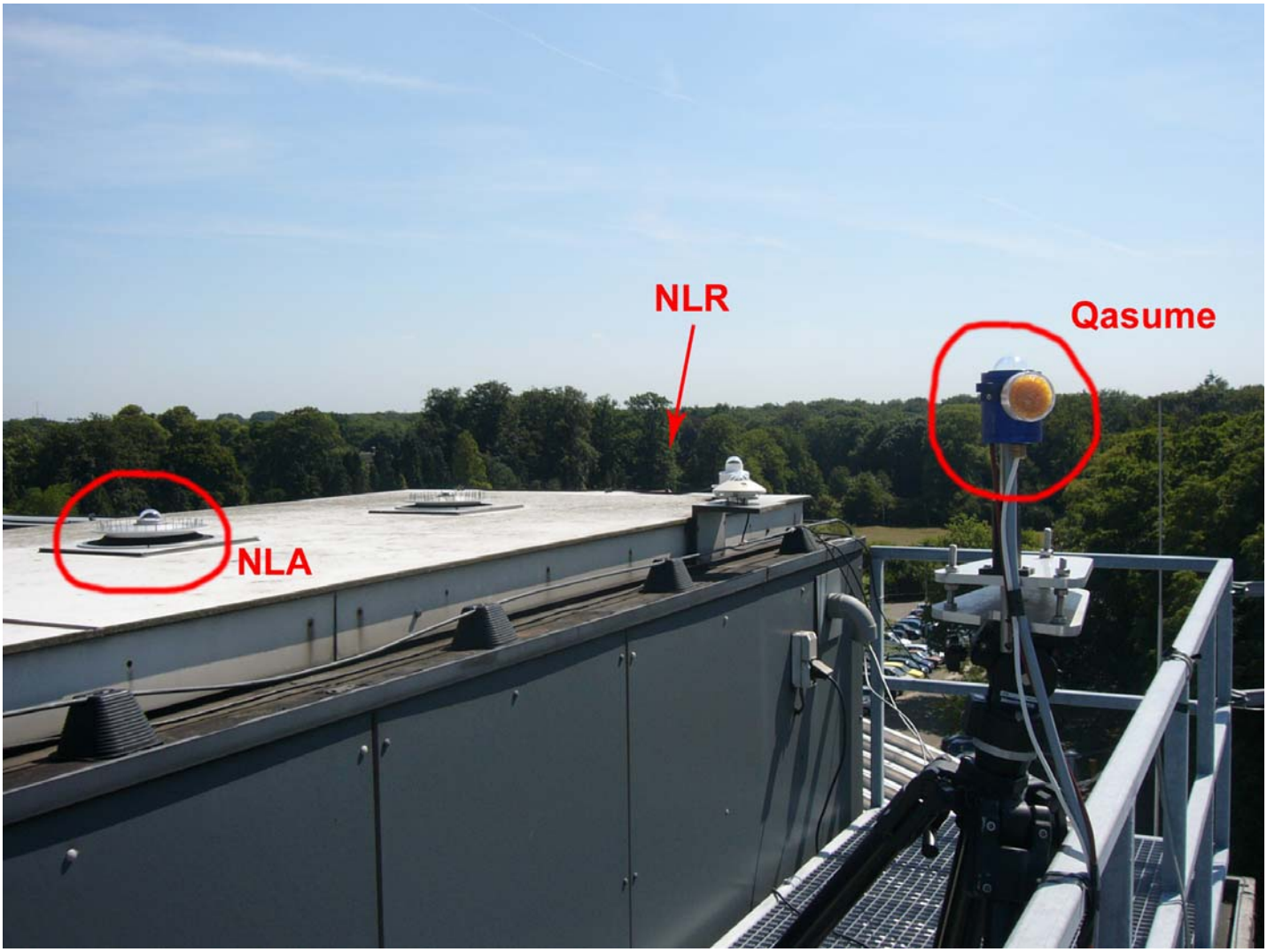

Global irradiance ratios NLA/NLR at RIVM:04−Jul−2006(185)
wl [nm]
UVIndex
Daily variation. Wavelength bands are ± 2.5 nm
90°
29°
87°
TIME [UT](SZA)
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
25−Jul−2006 15:46:47

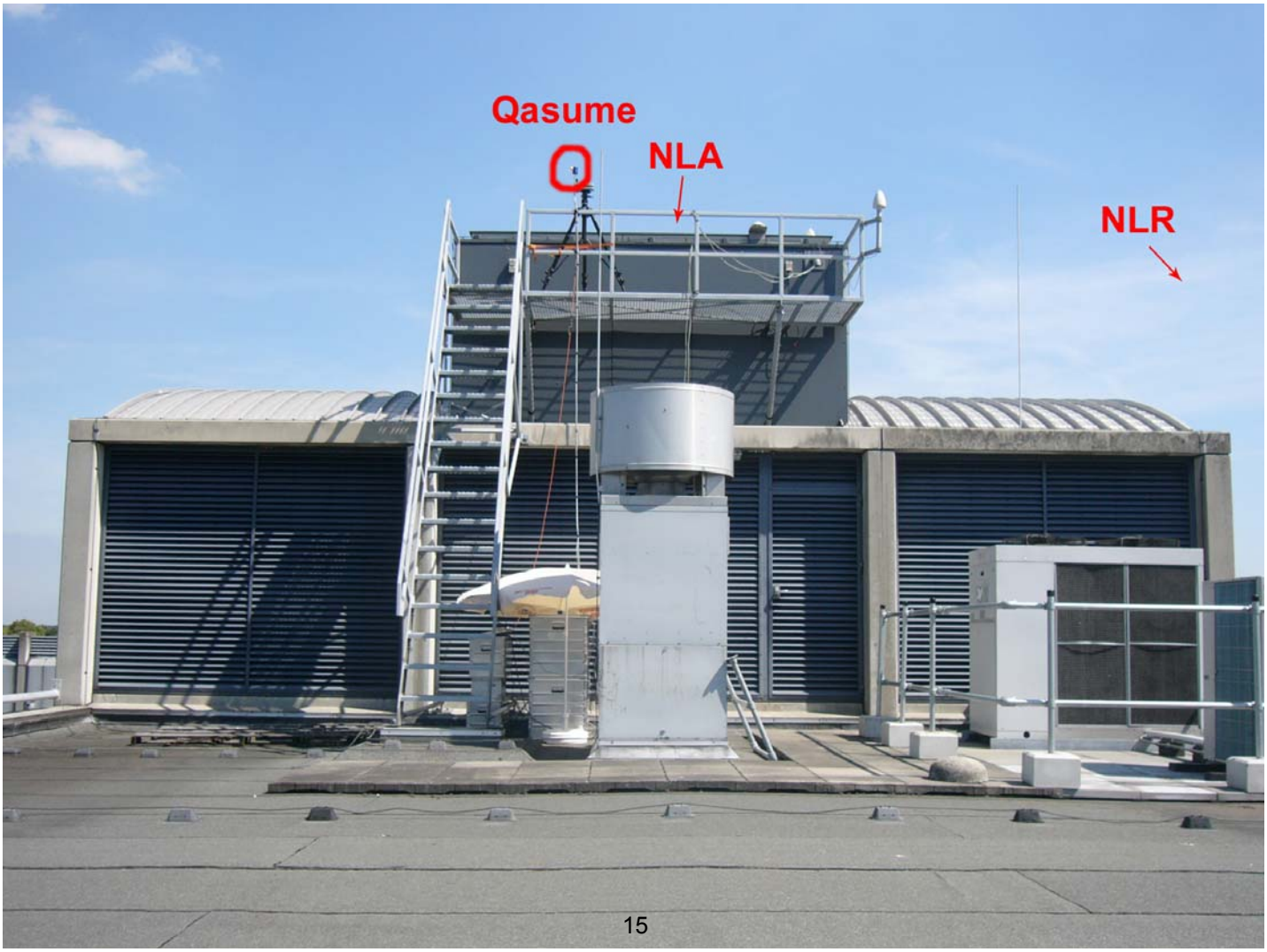

Global irradiance ratios NLA/NLR at RIVM:05−Jul−2006(186)
wl [nm]
UVIndex
Daily variation. Wavelength bands are ± 2.5 nm
90°
29°
87°
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
2(99)
4(86)
6(70)
8(51)
10(35)
12(30)
14(39)
16(56)
18(75)
20(91)
TIME [UT](SZA)
25−Jul−2006 15:46:47


Global irradiance ratios NLA/NLR at RIVM:06−Jul−2006(187)
wl [nm]
UVIndex
Daily variation. Wavelength bands are ± 2.5 nm
90°
30°
87°
305 nm
310 nm
320 nm
350 nm
400 nm
444 nm
2(99)
4(87)
6(70)
8(52)
10(36)
12(30)
14(39)
16(56)
18(75)
20(91)
TIME [UT](SZA)
25−Jul−2006 15:46:47


Mean ratio NLA/NLR at RIVM:04−Jul−2006(185) to 06−Jul−2006(187)
Mean ratio SZA<90
Mean ratio SZA<50
5/95th percentile
Range of values
RATIO NLA/NLR
NBSpectra=98
Wavelength [nm]
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
300
350
400
450


Spectral Responsivity change of B5503 at RIVM, July 2006 (185−186), using T68523, T68524
185
186
187
mean of day to total mean
wavelength [nm]
1.05
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
280
300
320
340
360
380
400
420
440


NLR
Qasume
NLA


Qasume
NLA
NLR