

Protocol of the intercomparison at Université de La Réunion,
Saint-Denis, France on April 08 to 17, 2013 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 FUR operated and managed by the Université de La Réunion and the travel reference spectroradiometer QASUME. The measurement site is located in Saint-Denis; Latitude 20.90 S, Longitude 55.49 E and altitude 80 m.a.s.l..

The horizon of the measurement site is free down to at least 85° solar zenith angle (SZA). Measurements between 2:30 UT and 14:00 UT have been analysed.

QASUME was installed at Saint Denis at noon of April 08, 2013. The spectroradiometer was installed next to the FUR instrument with the entrance optic of QASUME within 2 m of FUR. The spectroradiometer in use at FUR is a Bentham DM300 double monochromator. The intercomparison between QASUME and the FUR spectroradiometer lasted eight days, from the morning of April 8 to evening of April 16.

QASUME was calibrated several times during the intercomparison period using a portable calibration system. Three lamps (T68522, T68523 and T61251) 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 26.0 ± 0.1 °C and the diffuser head was heated to a temperature of 29.5 ± 2.1 °C.

The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the SHICRivm analysis were between ± 50 pm in the spectral range 280 to 450 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 280 to 450 nm, every 0.25 nm, and 1.5 seconds between each wavelength increment.

DOY	Date	DAY	Weather	Comment (times are in UT)
98	08. Apr	Monday	Mix of Sun & Clouds	Installed at 7:00
99	09. Apr	Tuesday	Mostly Clear Sky	7:49 calibration using T68522 10:19 calibration using T68523
100	10. Apr	Wednesday	Mostly Clear Sky	6:48 calibration using T68523
101	11. Apr	Thursday	Mostly Clear Sky	5:19 calibration using T68523 14:00 Slit Fct. Measurement
102	12. Apr	Friday	Mostly Clear Sky Clouds in the afternoon	4:49 calibration using T68523 11:49 calibration using T68522 13:56 calibration using T68522
103	13. Apr	Saturday	Mix of Sun & Clouds	
104	14. Apr	Sunday	Mix of Sun & Clouds	11 - 13: ARF Measurement
105	15. Apr	Monday	Morning: Clear Sky Mix of Sun & Clouds	4:19 calibration using T68523 12:49 calibration using T68523
106	16. Apr	Tuesday	Mix of Sun & Clouds	12:19 calibration using T68522 12:35 calibration using T68523 12:55 calibration using T61251 Qasume -> Laboratory
107	17. Apr	Wednesday		GS1024 calibration End of Campaign: 5:00

Results:

In total 147 synchronised simultaneous spectra from QASUME and FUR are available from the measurement period. Measurements between 2:30 and 14:00 UT have been analysed (SZA smaller than 90°).

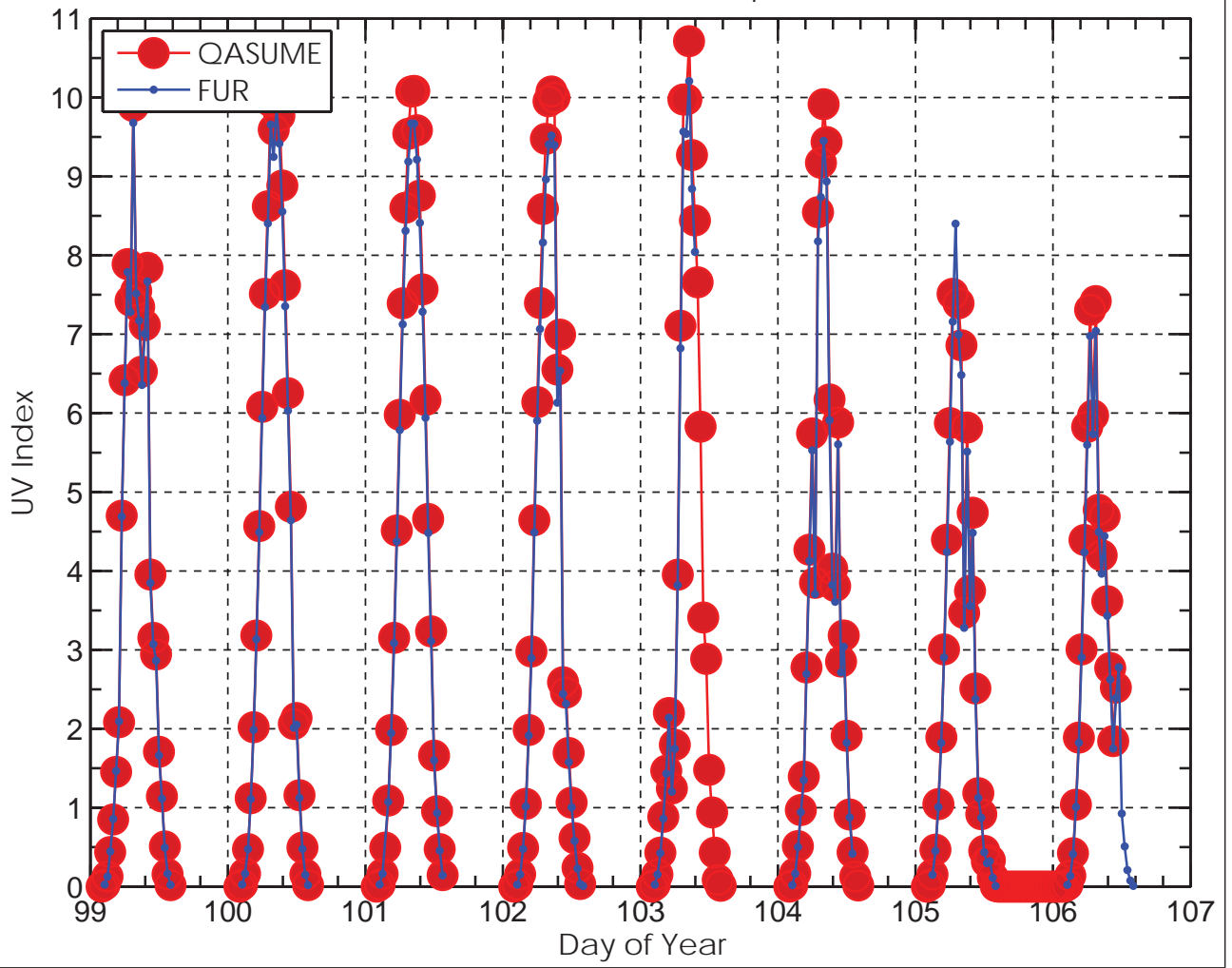
Remarks:

1. The ratios between FUR and QASUME have on average an offset of -2 %.
2. The diurnal variation of FUR to QASUME ratio is $\pm 2\%$.
3. On 9th April the variability of the spectral ratios of FUR to QASUME is higher than on the other days. The reasons are probably fast moving clouds together with a small difference in the synchronization of the two instruments.
4. The FUR instrument was calibrated several times during the campaign using a CL6 lamp. At the beginning and at the end of the campaign it was calibrated using a 1000 W FEL transfer standard. The dataset of FUR is based on the last 1000 W FEL calibration.

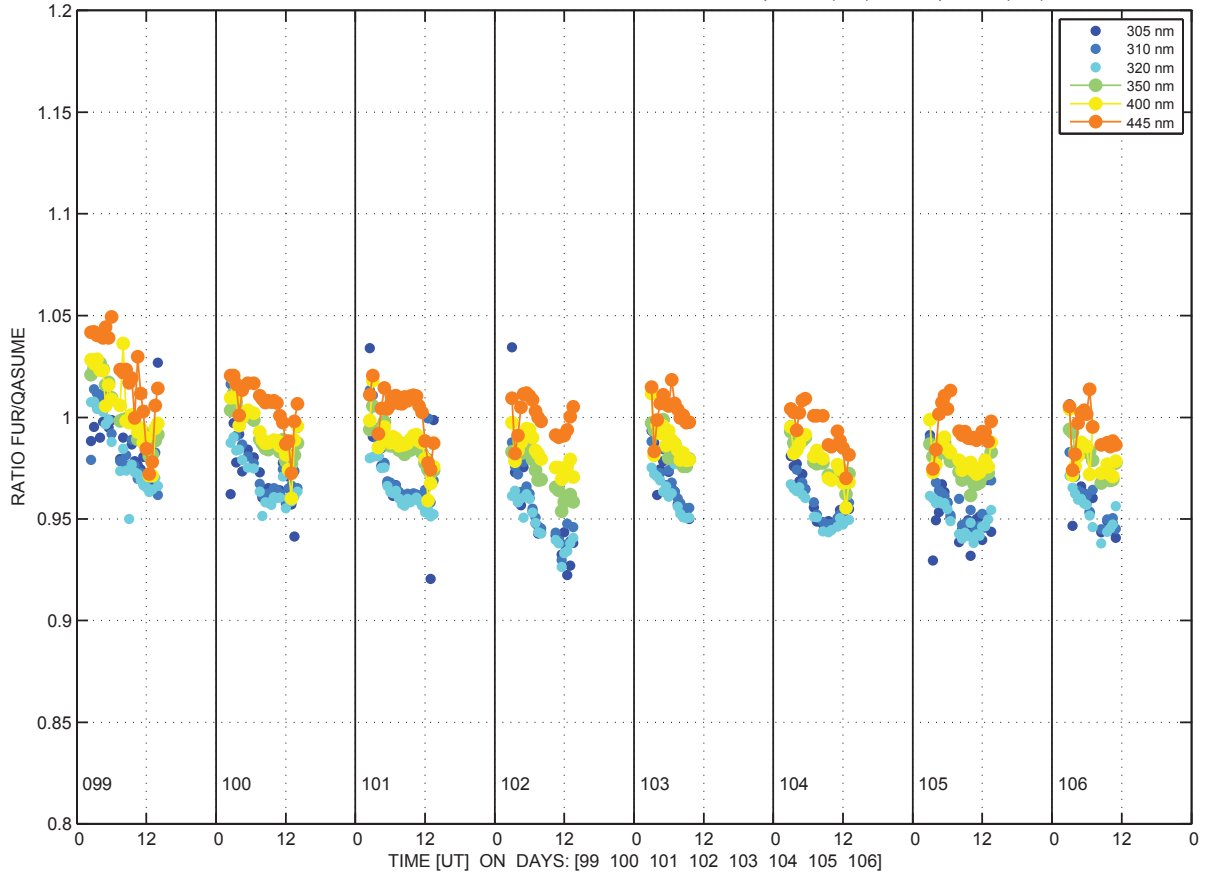
Additional Measurements

1. The slit function of FUR was measured using a Diode Laser (Crystalaser DL375-005-SO, 372 nm).
2. The Angular Response Function of the entrance optic of FUR was measured on 14th April. The Diffuse Cosine Error of the D6-ENVIRO diffuser (Bentham) used by the FUR instrument is 1.01.
3. The 1000 W FEL transfer standard GS1034 was measured using the QASUME system in the laboratory at Saint Denis.

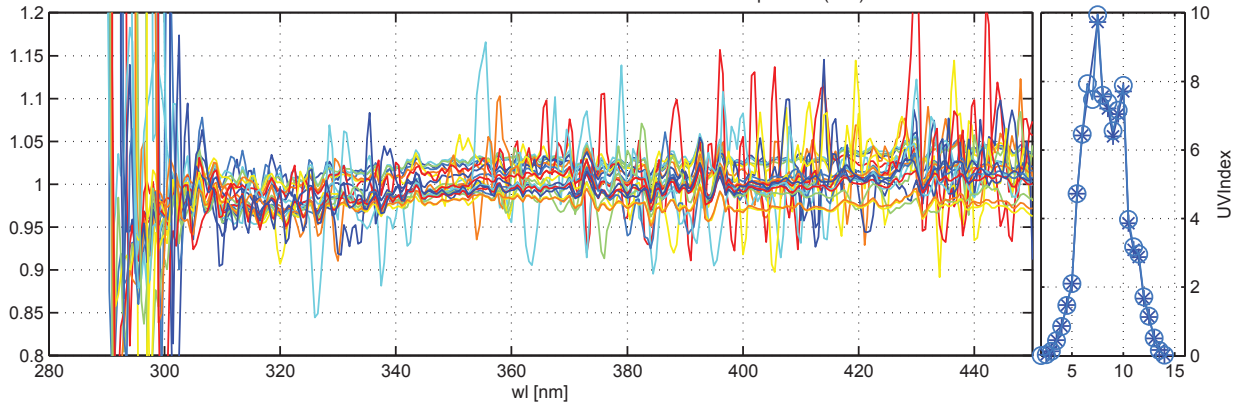
UV Index La Reunion, April 2013



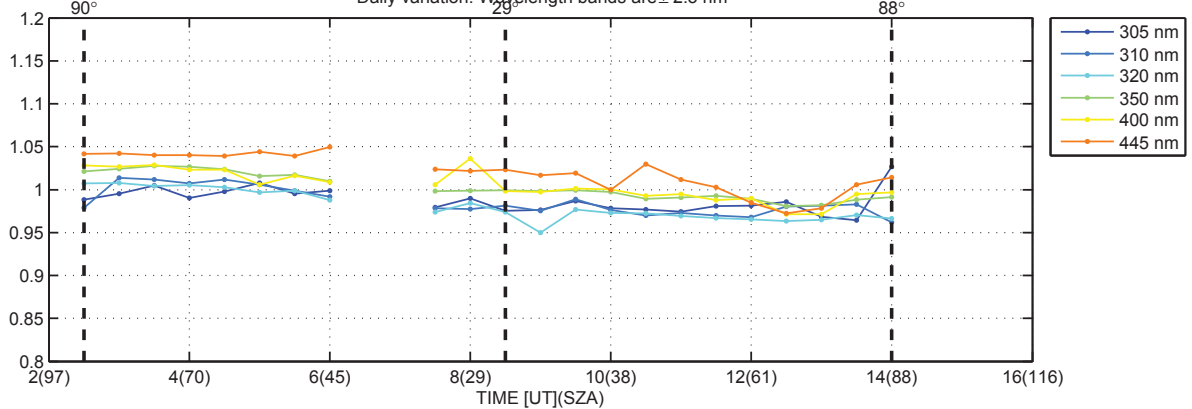
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:09-Apr-2013(099) to 16-Apr-2013(106)



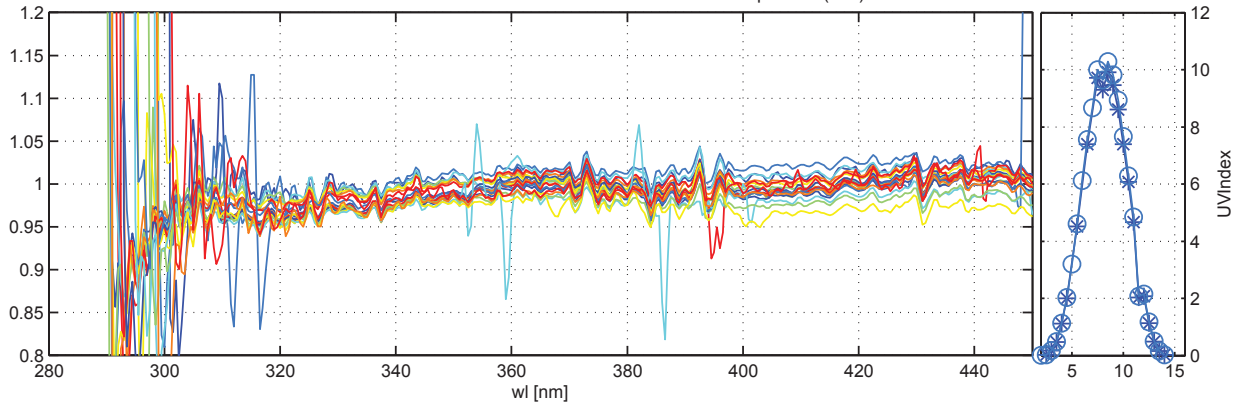
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:09-Apr-2013(099)



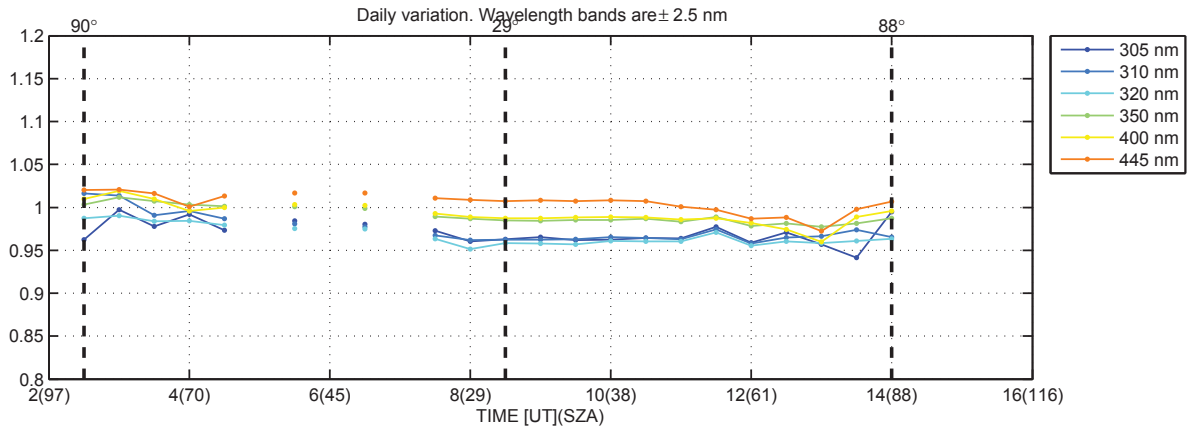
Daily variation. Wavelength bands are ± 2.5 nm



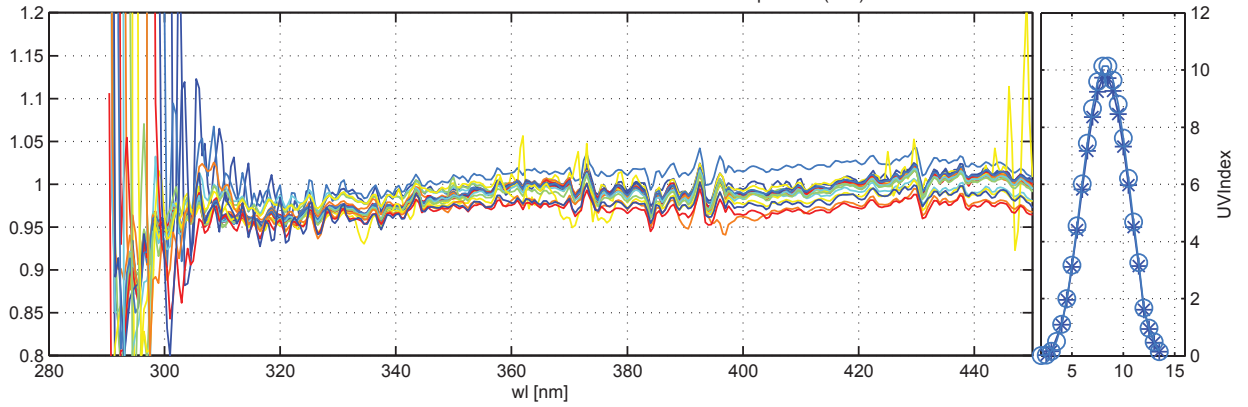
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:10-Apr-2013(100)



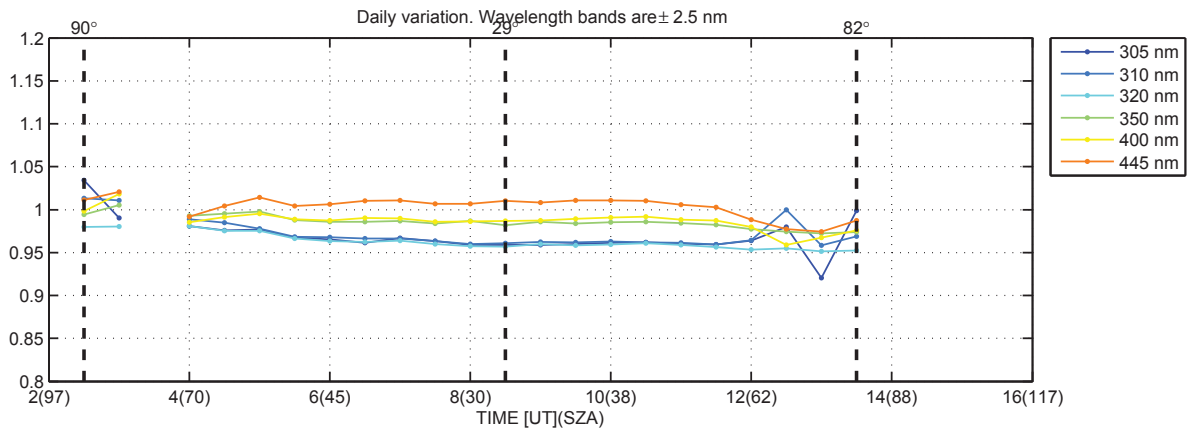
Daily variation. Wavelength bands are ± 2.5 nm



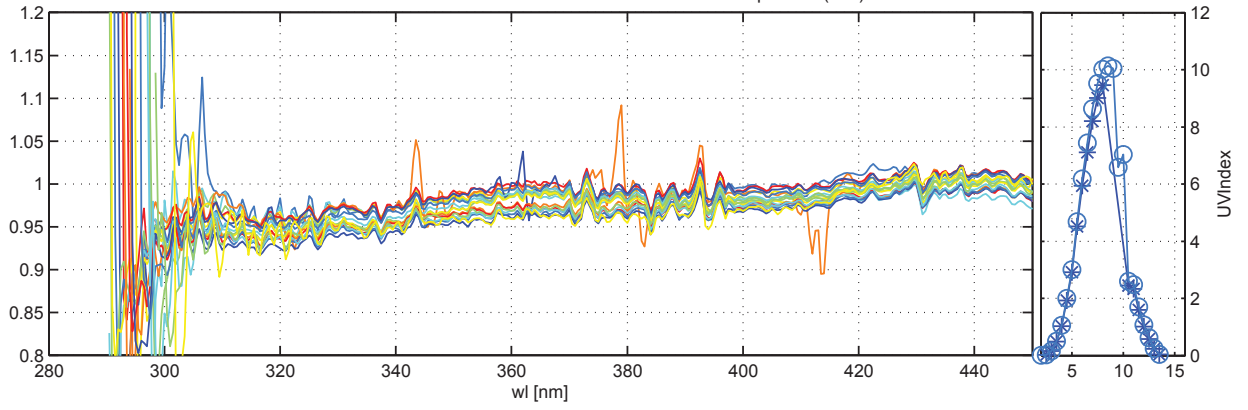
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:11-Apr-2013(101)



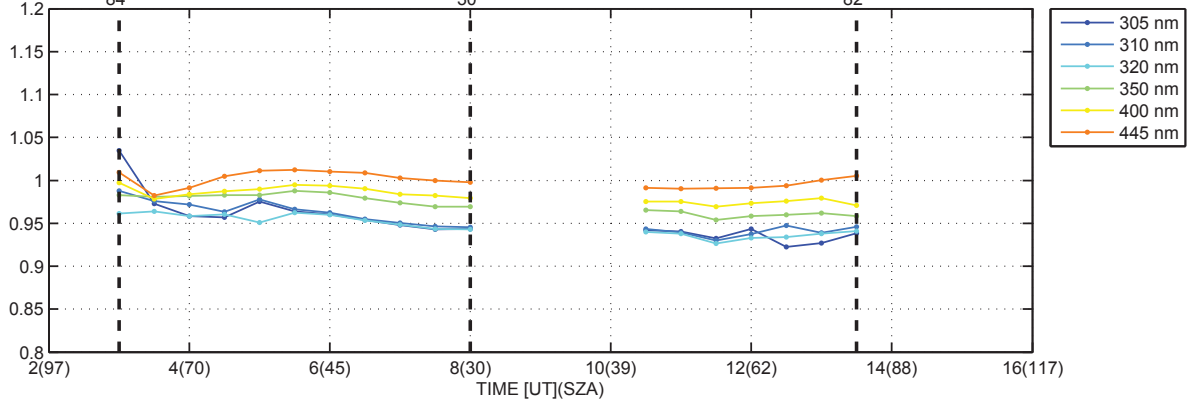
Daily variation. Wavelength bands are ± 2.5 nm



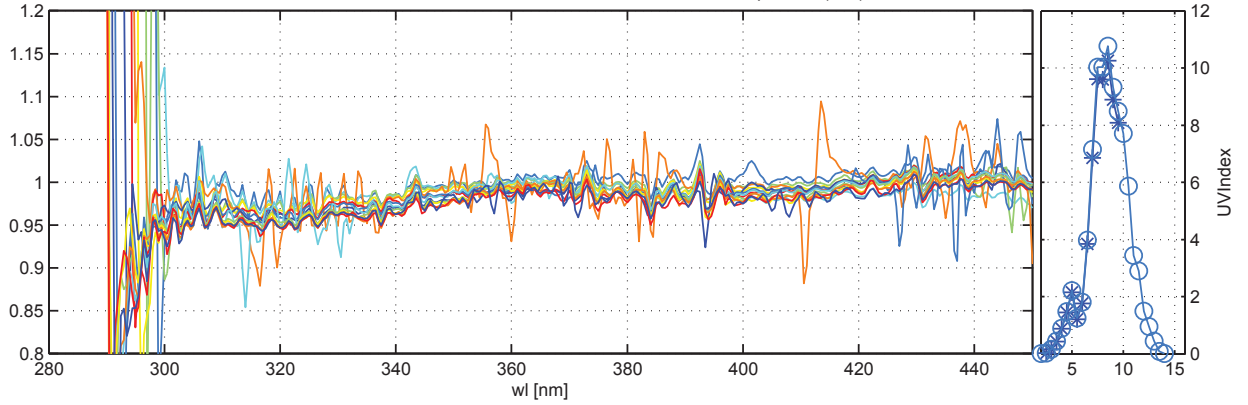
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:12-Apr-2013(102)



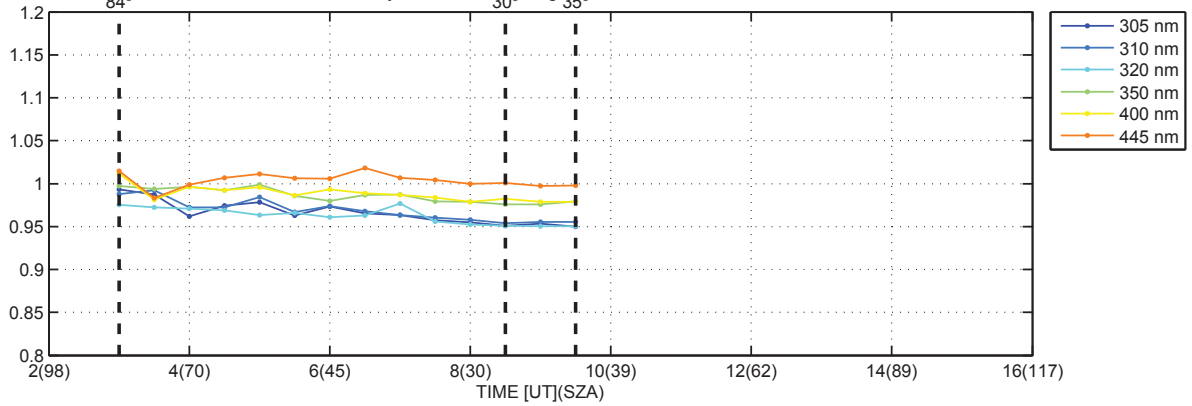
Daily variation. Wavelength bands are ± 2.5 nm



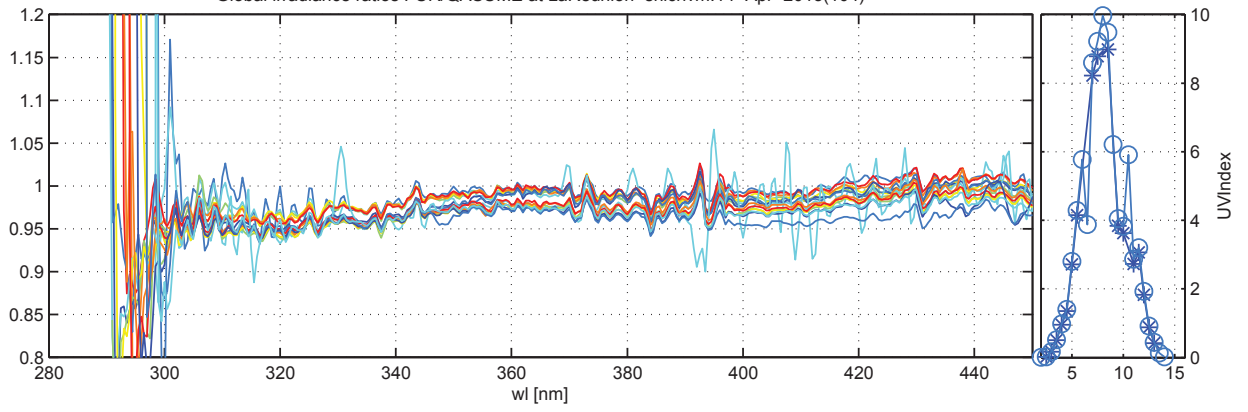
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:13-Apr-2013(103)



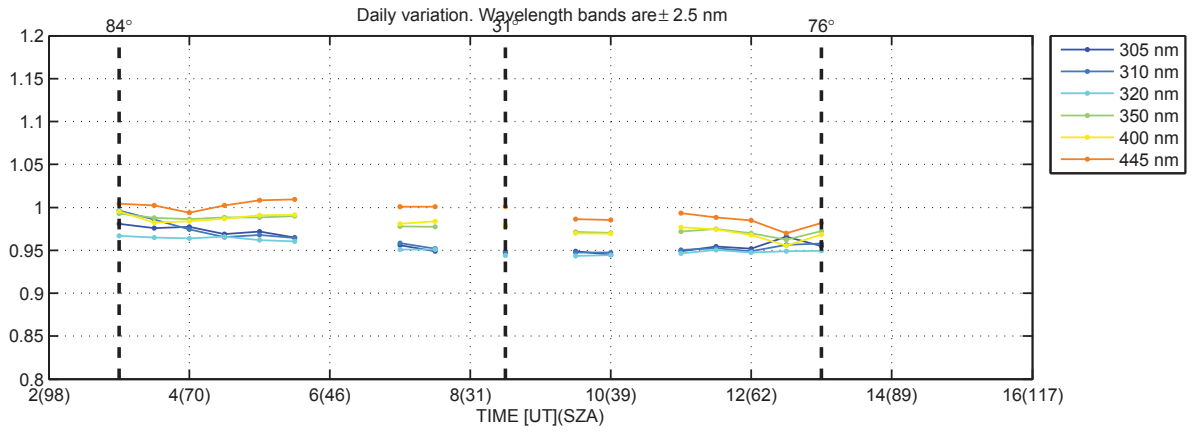
Daily variation. Wavelength bands are ± 2.5 nm



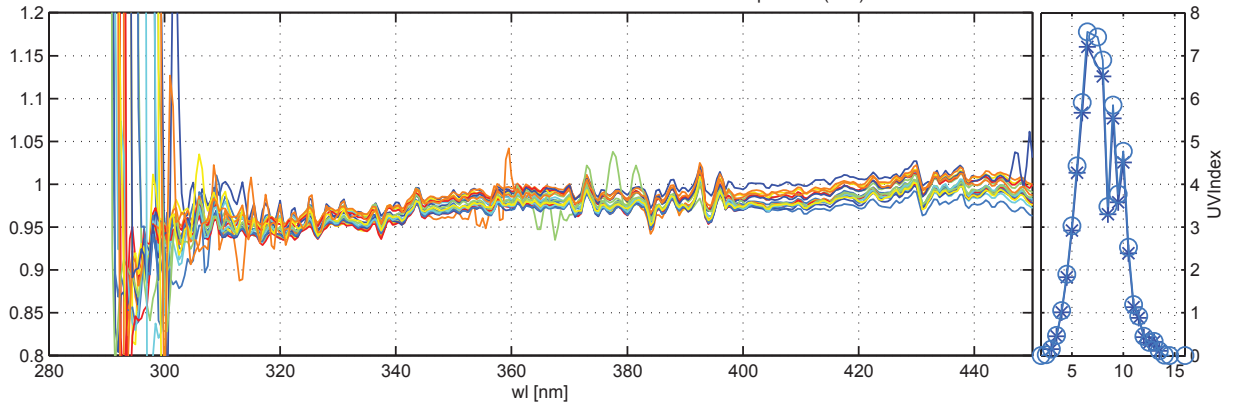
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:14-Apr-2013(104)



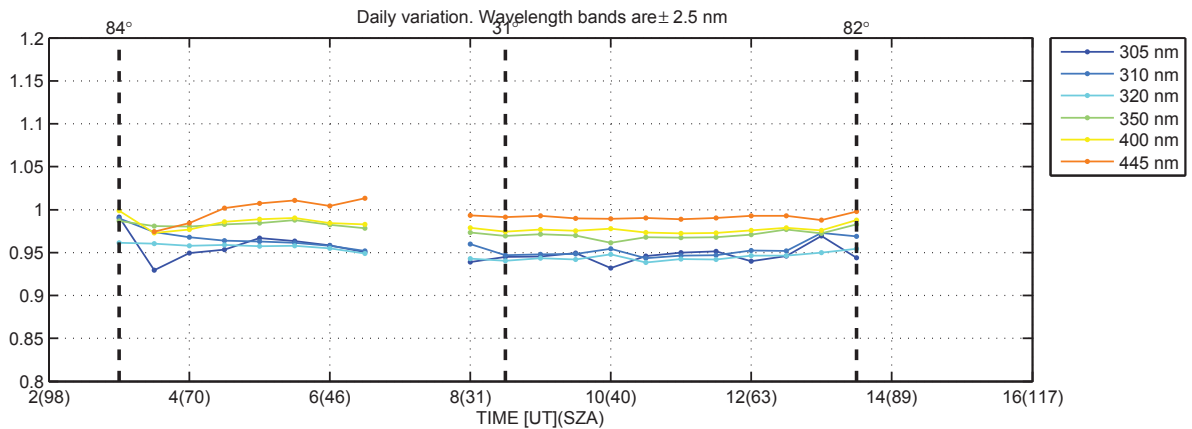
Daily variation. Wavelength bands are ± 2.5 nm

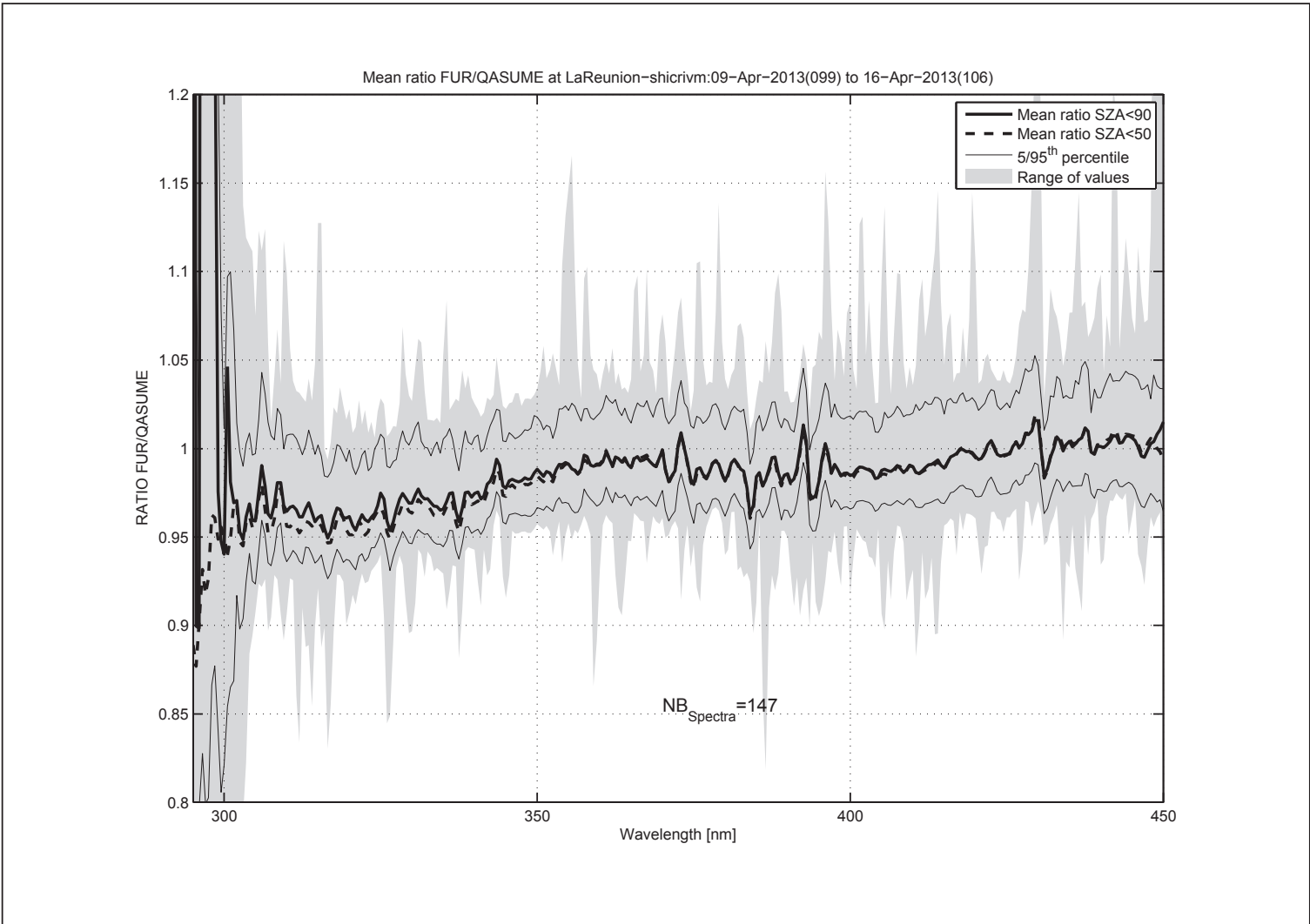
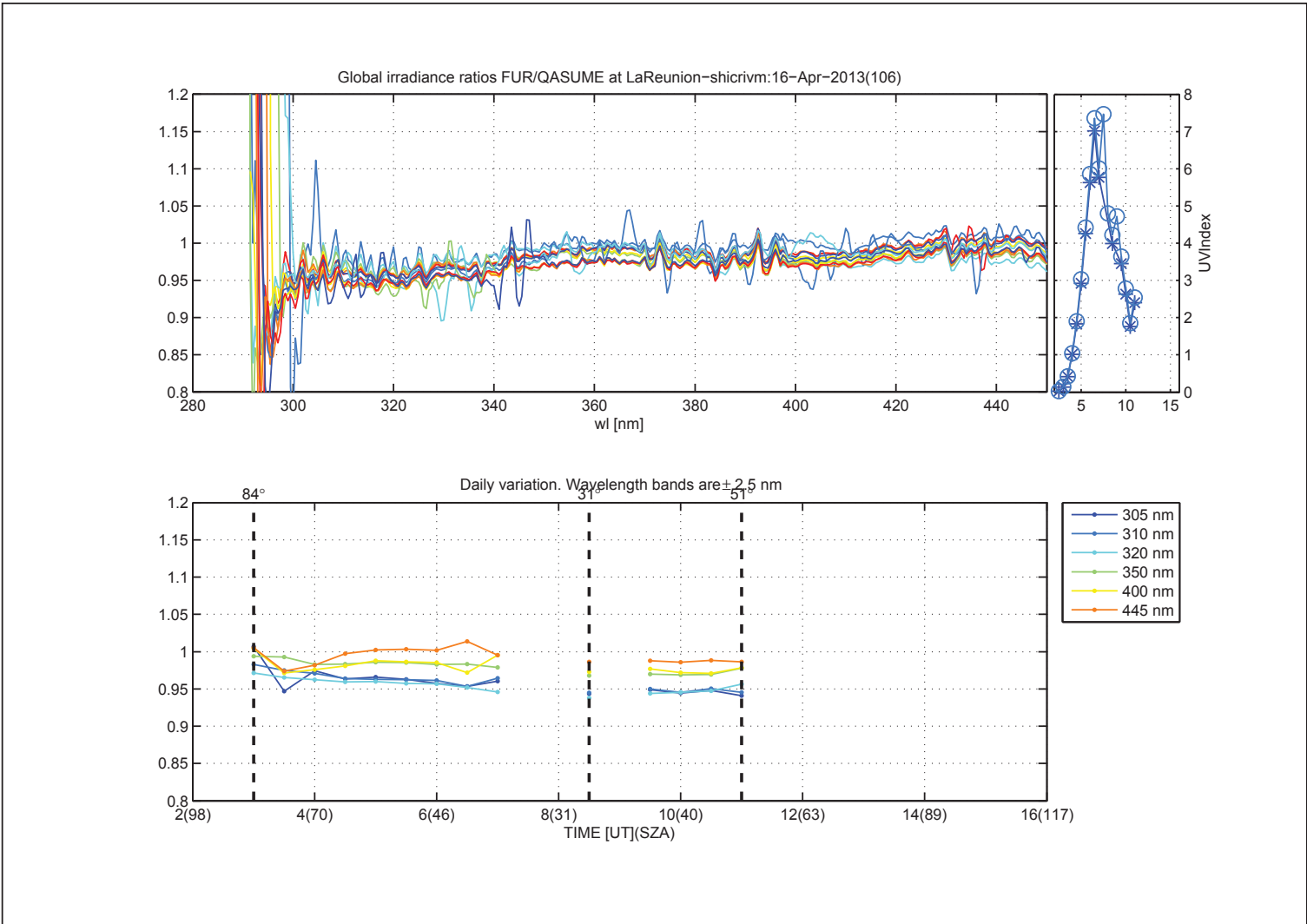


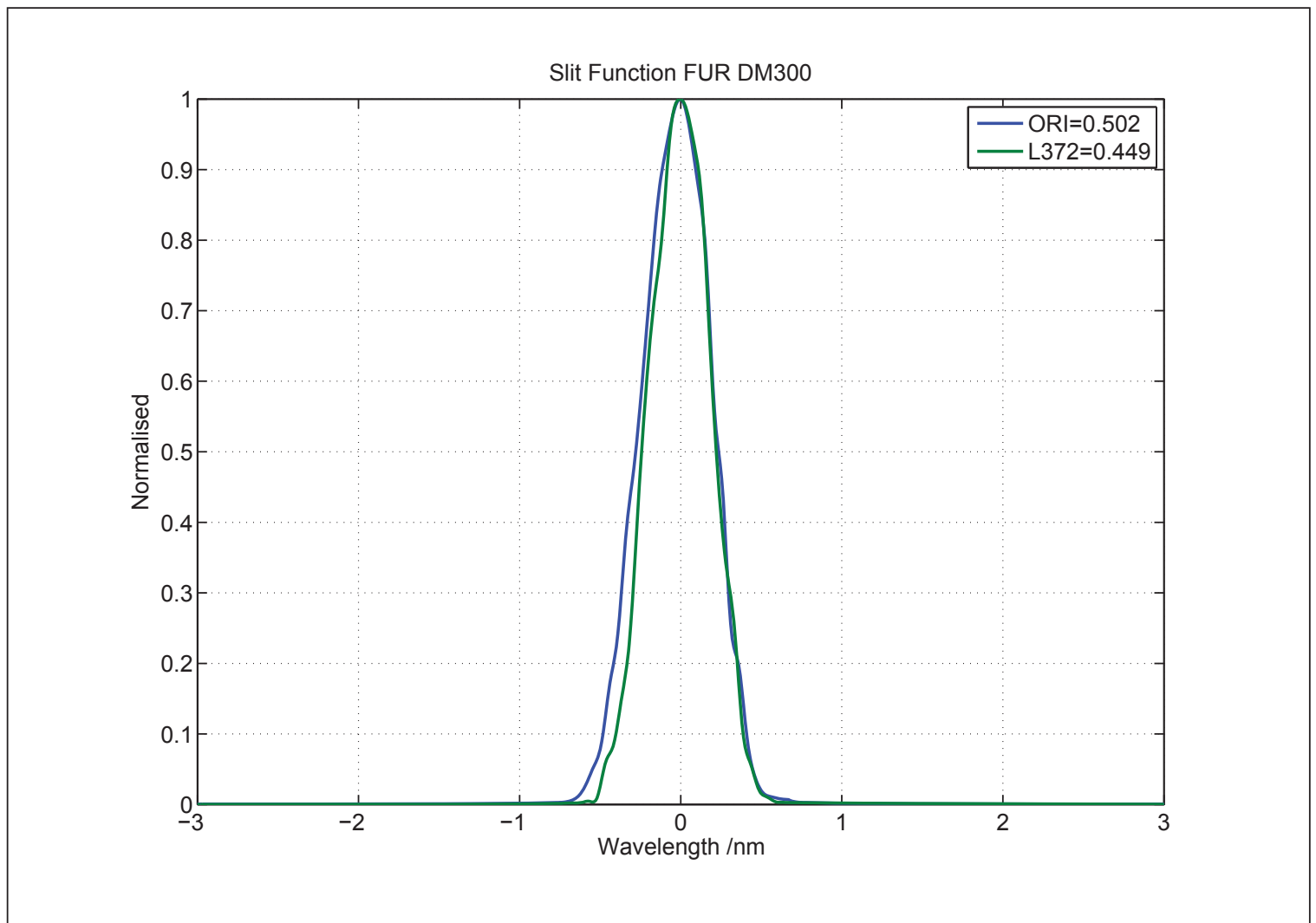
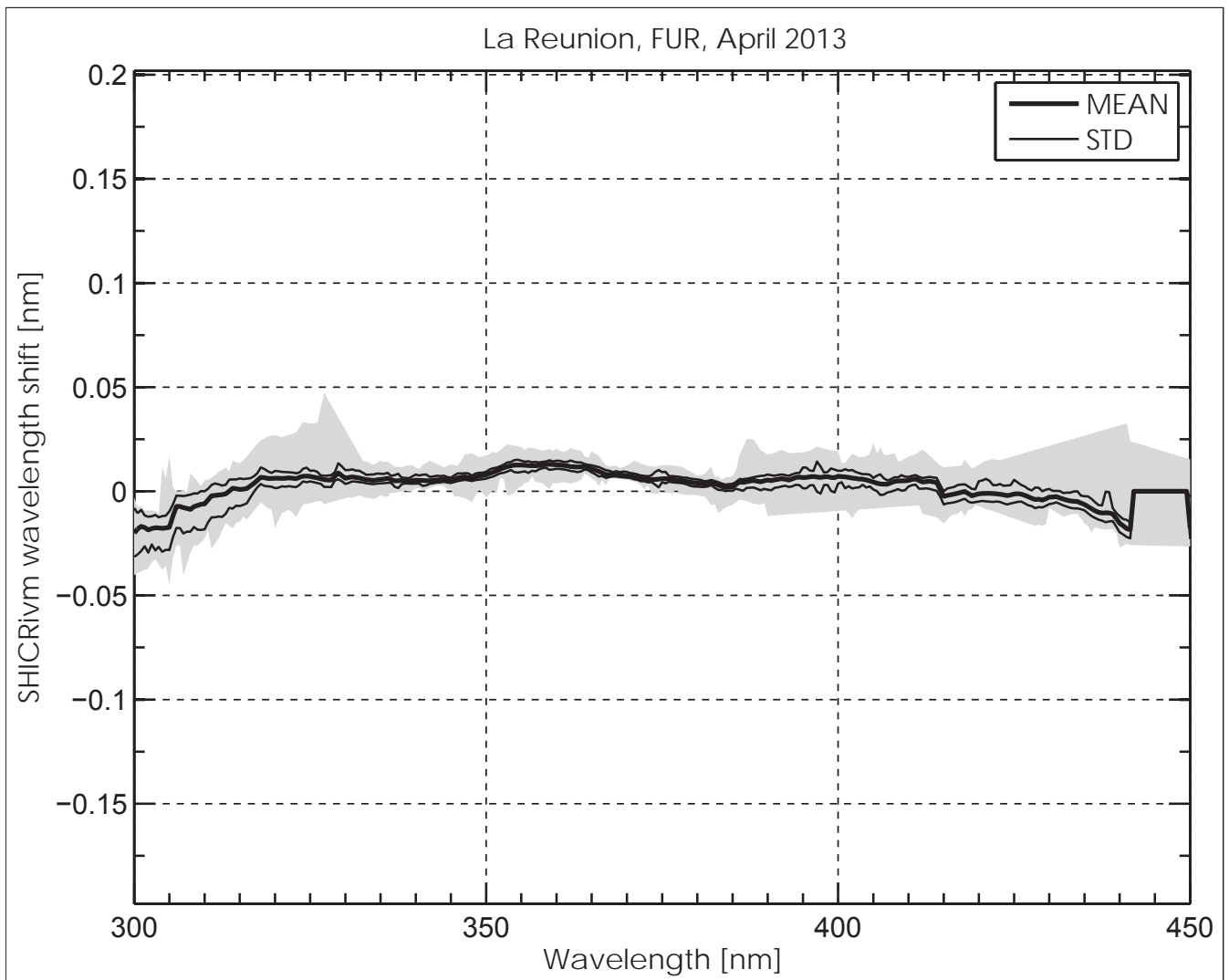
Global irradiance ratios FUR/QASUME at LaReunion-shicrivm:15-Apr-2013(105)



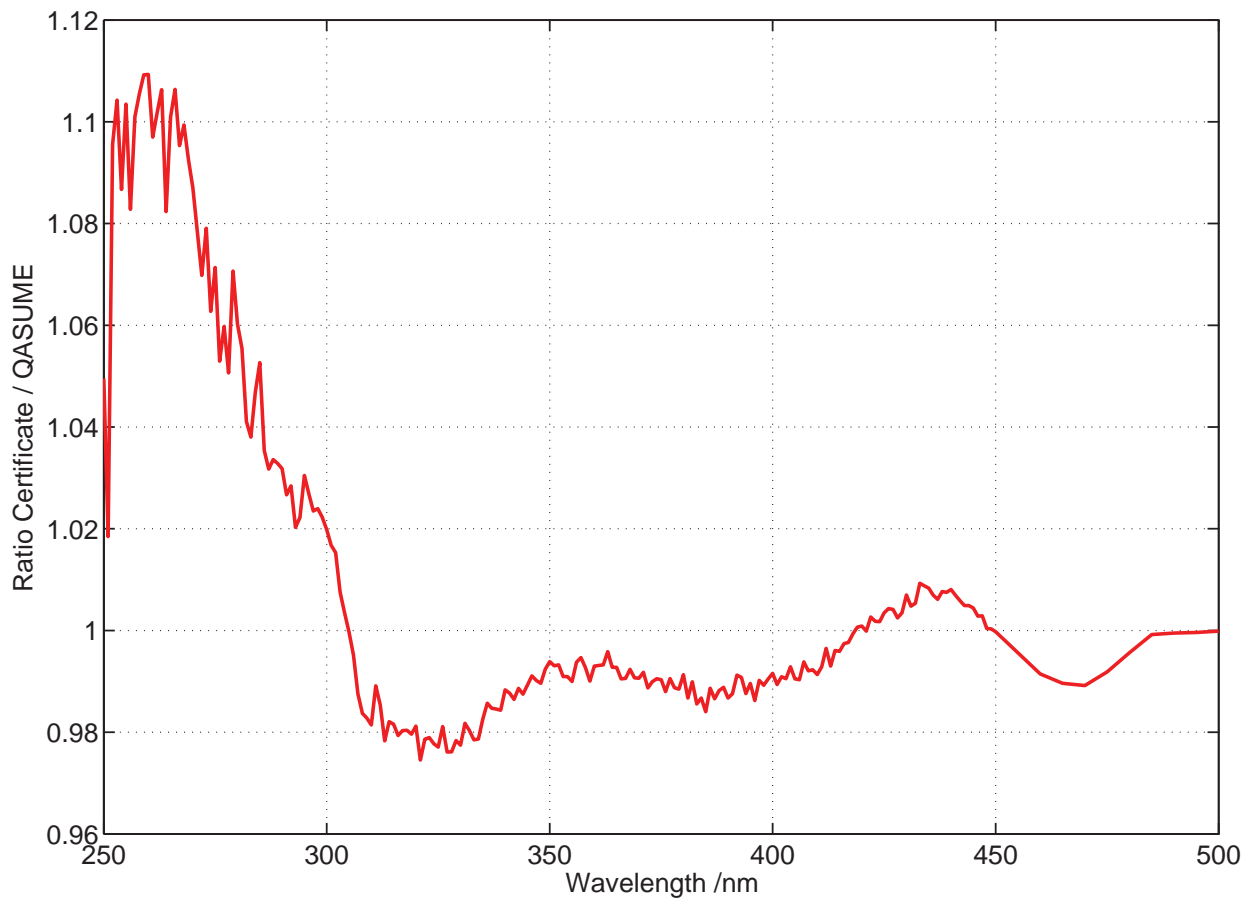
Daily variation. Wavelength bands are ± 2.5 nm

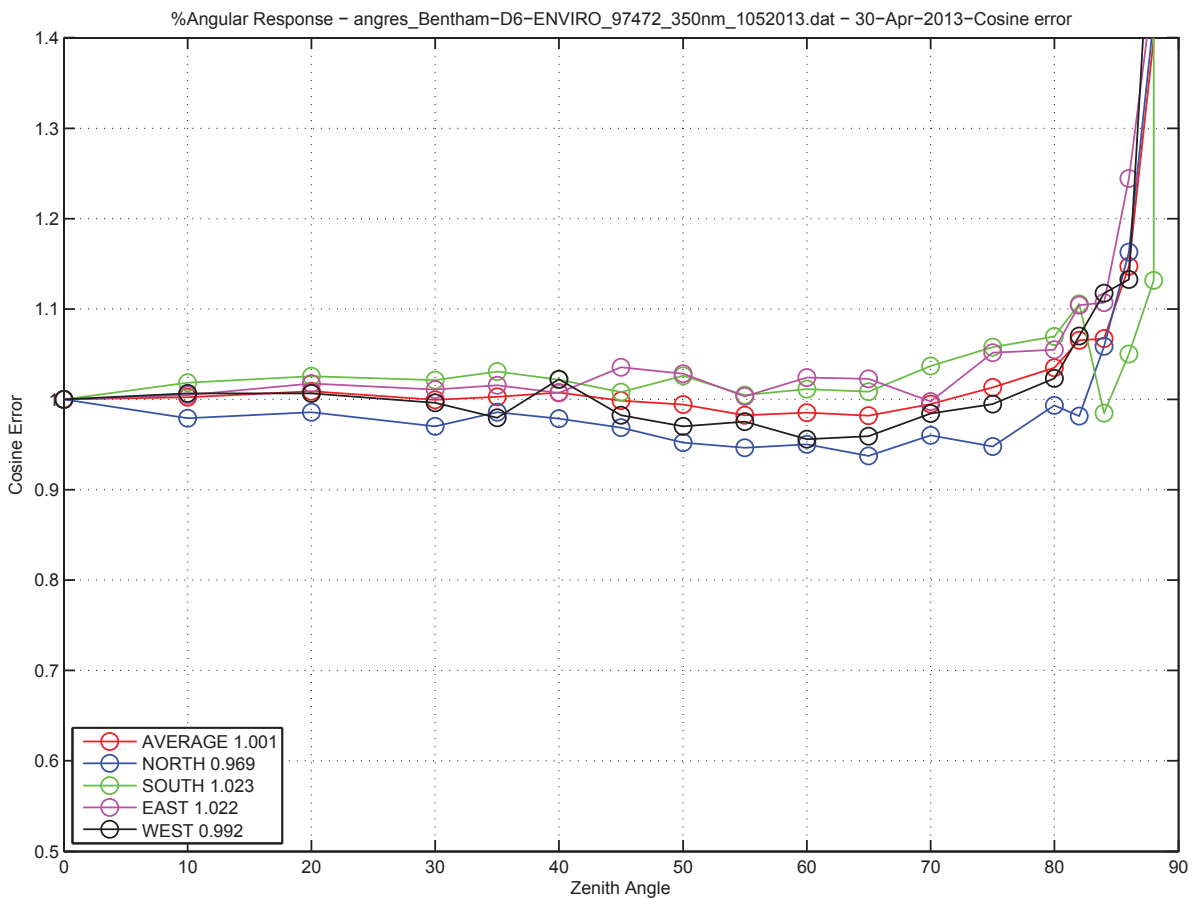
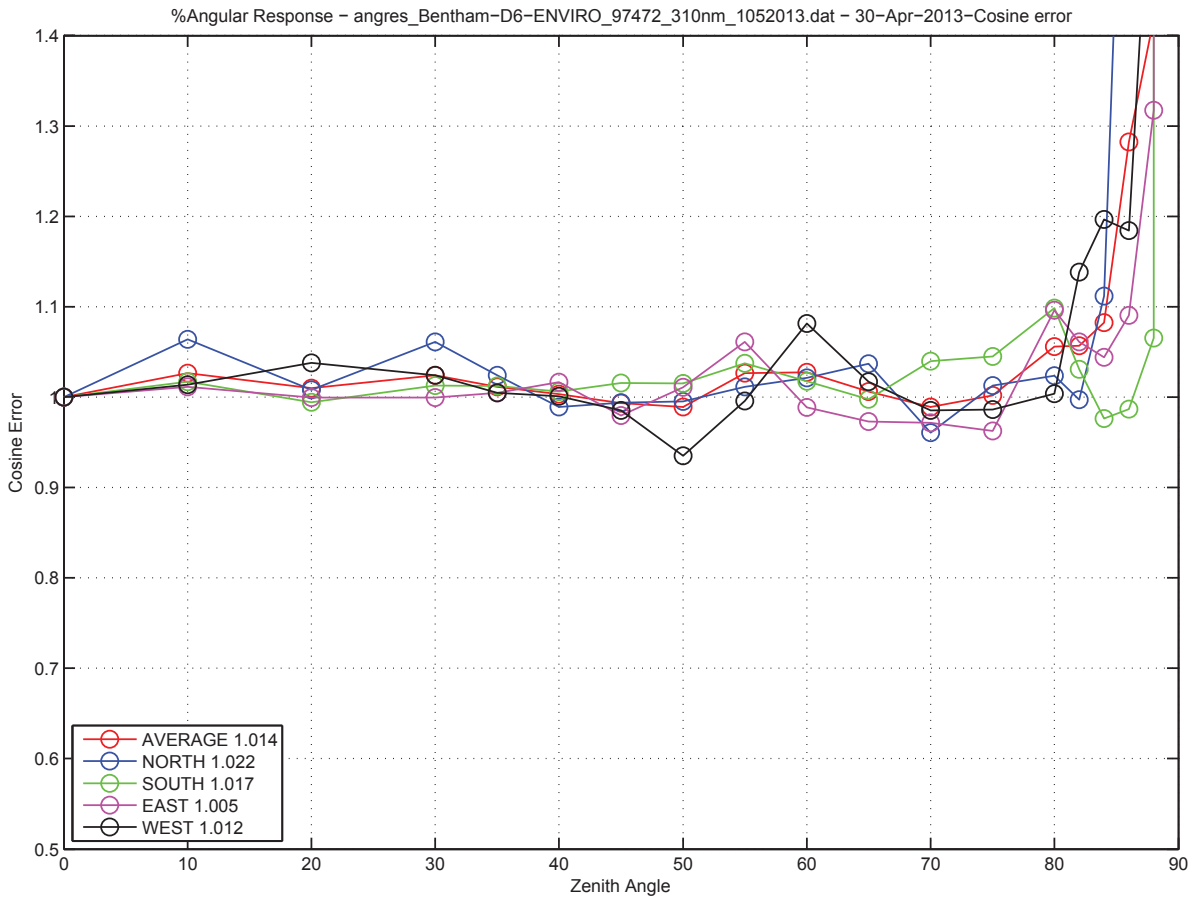


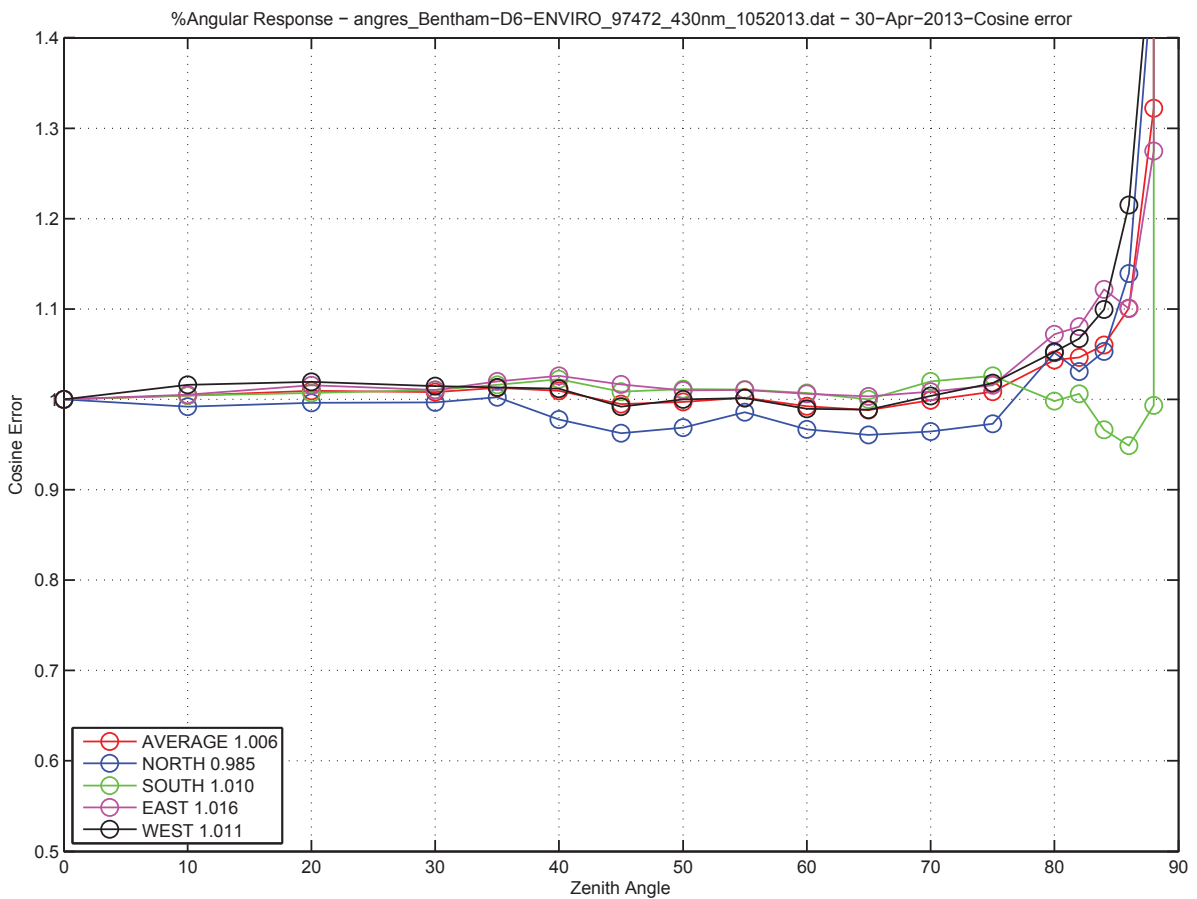
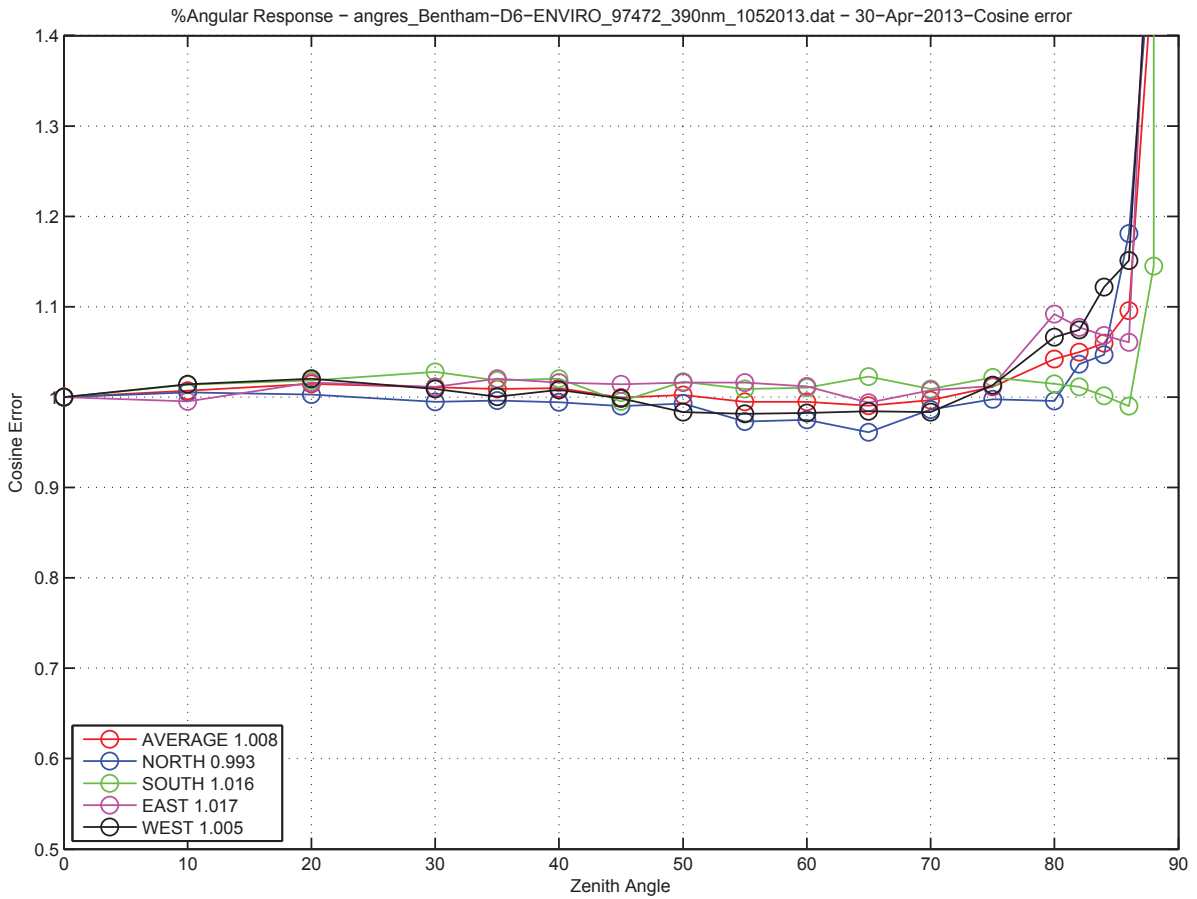




GS1034 Measured La Reunion UL1072013.B5503







Qasume Responsivity Change, April 2013, La Reunion (T68522, T65823, T61251)

