

Protocol of the intercomparison at the ČHMÚ Observatory, Hradec
Králové, Czech Republik, May, 14-16 2004 with the travelling
standard spectroradiometer B5503 from ECUV within the project
QASUME

Report prepared by Julian Gröbner

Operator: Julian Gröbner

The purpose of the visit was the comparison of global solar irradiance measurements between the spectroradiometer operated by ČHMÚ (CZH) and B5503 within the project QASUME. The measurement site is located at Hradec Králové; Latitude 50.18 N, Longitude 15.84 E and altitude 280 m.a.s.l.. The horizon of the measurement site is generally unobstructed down to 85° in all directions. Some close trees in the south limit the horizon to about 80°.

B5503 arrived at Hradec Králové in the morning of May 14, 2004. The spectroradiometer was installed on the solar radiation measurement platform of the observatory at about 10 meters from the ground. The spectroradiometer in use at ČHMÚ is a Brewer #098 MKIV single monochromator. The intercomparison between B5503 and the local spectroradiometer lasted two and a half days, from the afternoon of May 14 to the evening of May 16.

B5503 was calibrated several times during the intercomparison period using a portable calibration system. Two lamps were used to obtain an absolute spectral calibration traceable to the primary reference held at ECUV which is traceable to PTB: T53063 (100 W) and T61251 (250 W). The internal temperature of B5503 was 24.6°C and varied by less than 0.4 °C. The diffuser head was heated to a temperature of 25±1°C.

The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the SHICRivm analysis were between ± 50pm in the spectral range 310 to 400 nm.

Protocol:

The measurement protocol was to measure one solar irradiance spectrum every 30 minutes from 290 to 325 nm, every 0.5 nm, and 3 seconds between each wavelength increment.

May 14 (135):

Arrival and setup of the instrument in the morning. After the instrument stabilised, measurements were initiated at 13:30 UT. Weather conditions during the afternoon were a mix of sun and clouds.

B5503 was calibrated at 14:00 using T53061 and T61251.

May 15 (136):

Synchronised measurements are available from 4:30 to 14:00 UT. B5503 missed the 8:00 UT scan. Weather conditions from 4:30 to 9:00 are a mix

of sun and clouds. Dark rain clouds move in after 9:00 UT. Rain starts at 14:00 UT and last till the evening.

Calibration from 5:35 to 5:50 UT: T61251.

May 16 (137):

Synchronised measurements are available from 5:00 to 17:30 UT. Weather conditions were a mix of sun and fast moving clouds during the whole day. The 10:00 UT scan was disturbed due to a fast moving cloud. The 14:00 UT scan was unsynchronised after 322 nm due to a delay in the CZH instrument.

The directional response of CZH is measured during the late evening (see graph).

May 17 (138):

The slit function of CZH is measured with a HeCd Laser at 325 nm (see graphs).

Results:

52 synchronised scans are available from the measurement period.

The following analysis has used the newly measured slit function of CZH, differences to using the original slit function are insignificant. The new slit function has a full width at half maximum (FWHM) of 0.52 nm compared to 0.57 nm for the previously used one.

The wavelength shifts of the submitted solar spectra of the CZH spectroradiometer retrieved through the SHICRivm analysis were stable to within 30 pm. The absolute wavelength shift relative to the extraterrestrial spectrum used by the SHICRivm software was between -10 to +30 pm.

The directional response measurement has shown a marked asymmetry between the forward and backward plane of the diffuser. Tests did show that changing the position of the zenith prism from its original position of 2114 steps to 2118 steps would significantly improve the homogeneity of the directional response.

The intercomparison of the global irradiance measured by the two instruments can be summarized as follows:

- Global irradiances at wavelengths above 305 nm measured by CZH were between 1% higher to 5% lower than those measured by B5503 on the three days.
- Diurnal variations with amplitude of about 3% were observed at wavelengths longer than 305 nm. At 305 nm, the ratio CZH to B5503 increase by up to 15% between SZA of 65° to 79°.
- A 4% wavelength dependence of the spectral ratios is observed; the average ratio is 1.00 at 305 nm and decreases to about 0.96 at 325 nm. Between 305 and 300 nm, the ratio increases by about 35%, probably due to internal stray light of the single monochromator.

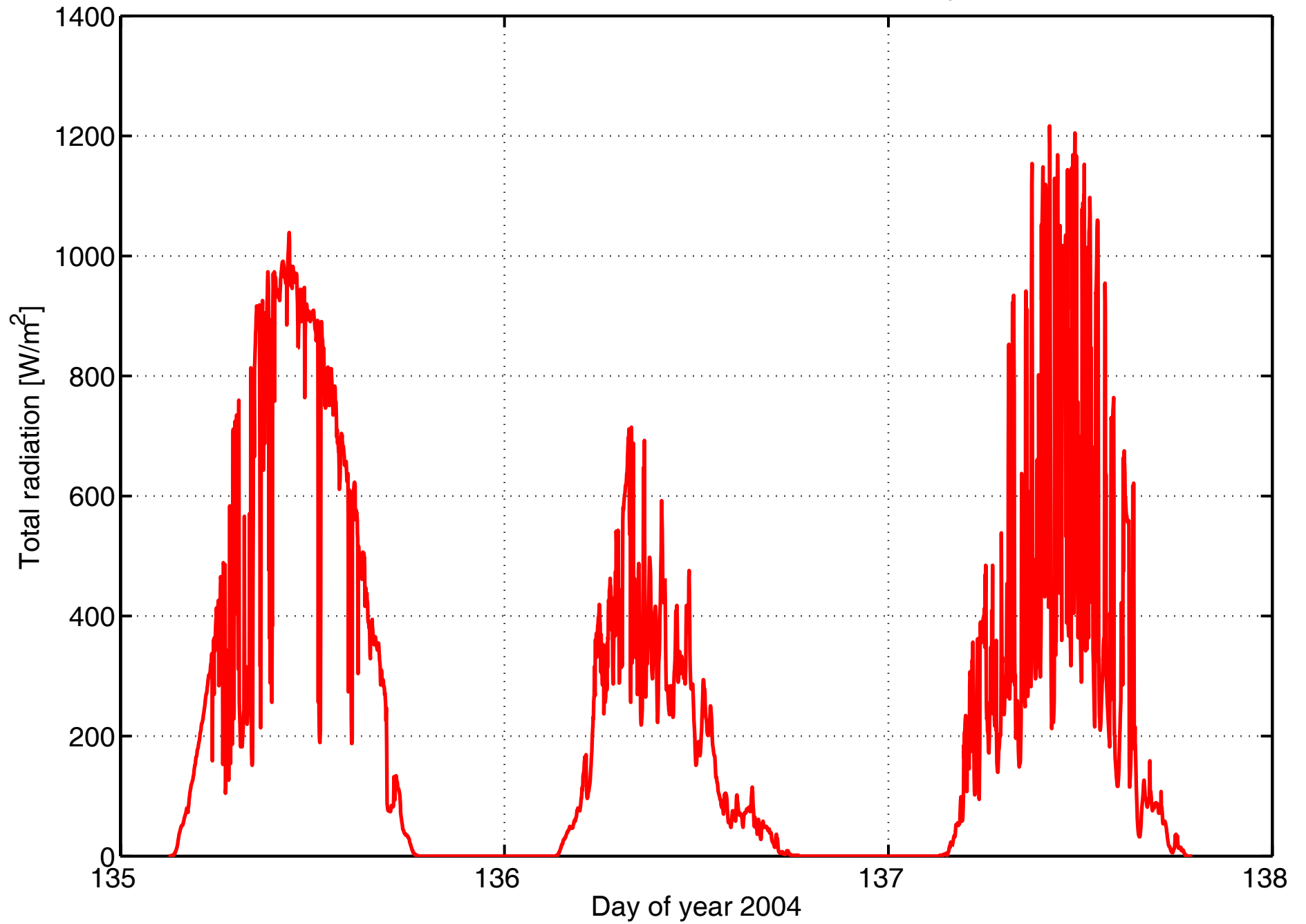
Conclusion:

At wavelengths longer than 305 nm, CZH measures global solar irradiance on average 2-3% lower than B5503; a 4% spectral wavelength dependence of the spectral ratios CZH to B5503 is observed. Above 305

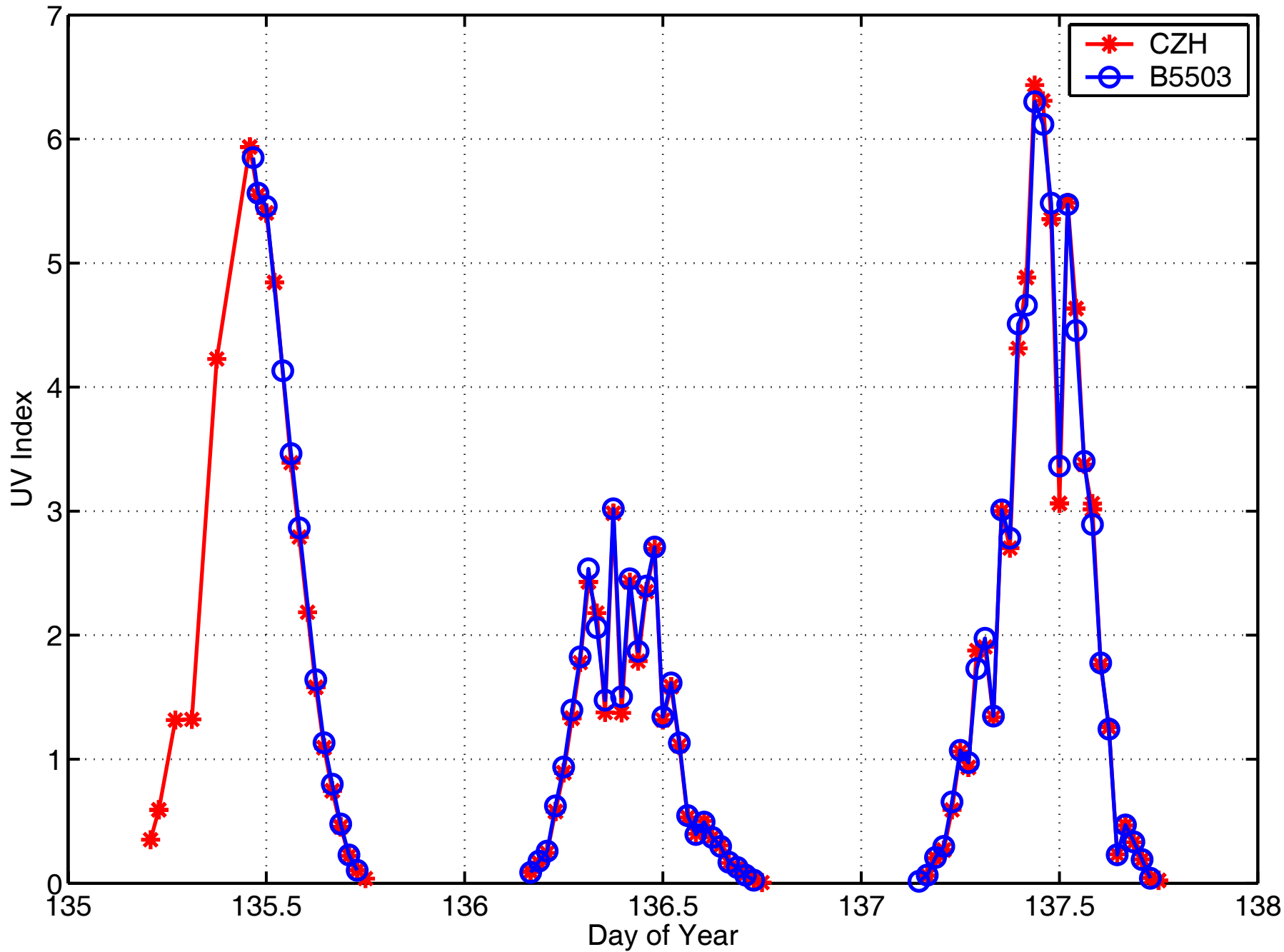
nm, the variability between the two spectroradiometers was 3% or less during the three-day measurement period. At 300 nm, CZH overestimates global solar irradiance by a factor between 1.02 to 3 dependent on the SZA.

Comments from the local operator:

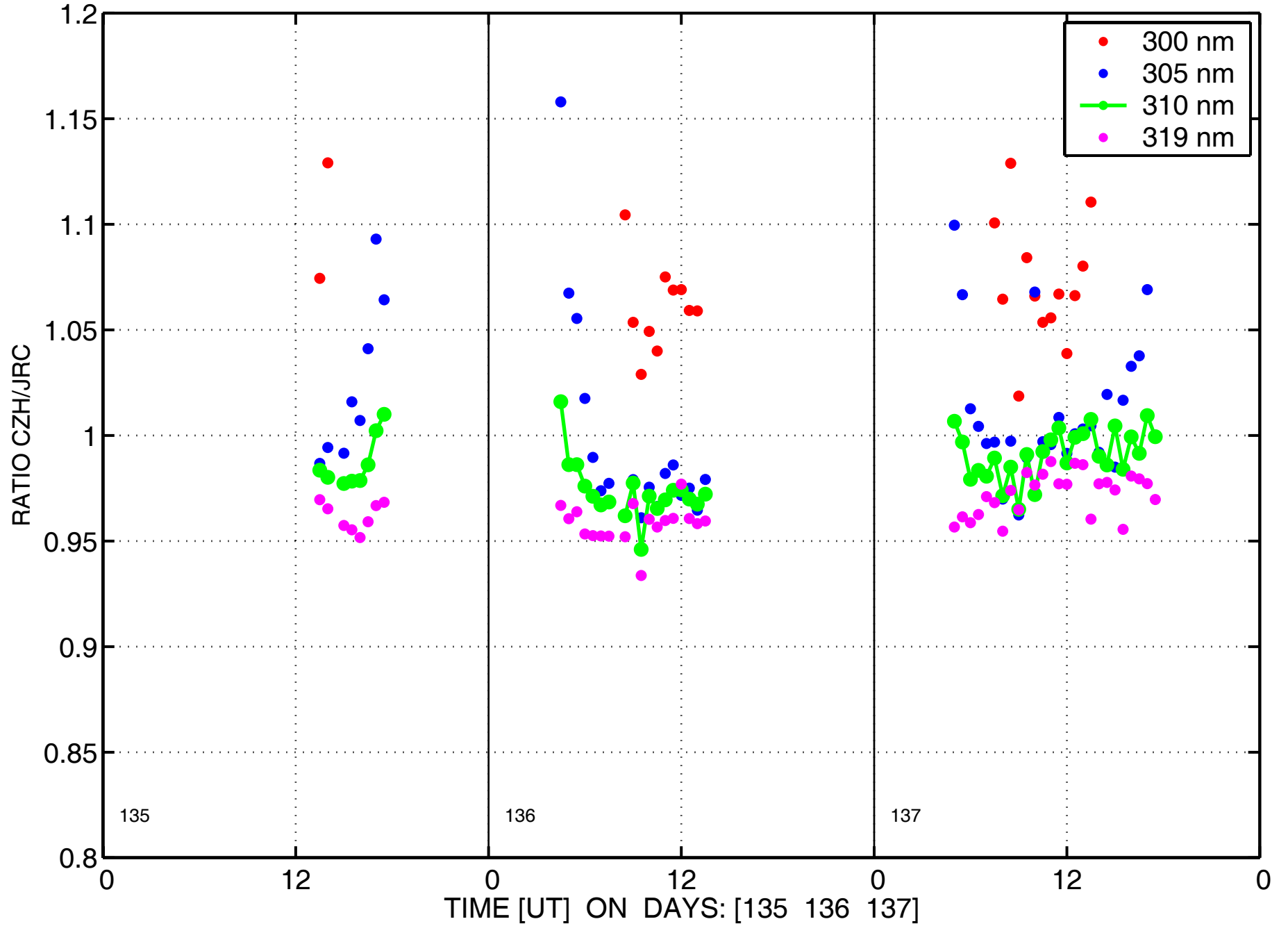
Total solar Radiation Hradec Kralove 14–16 May 2004



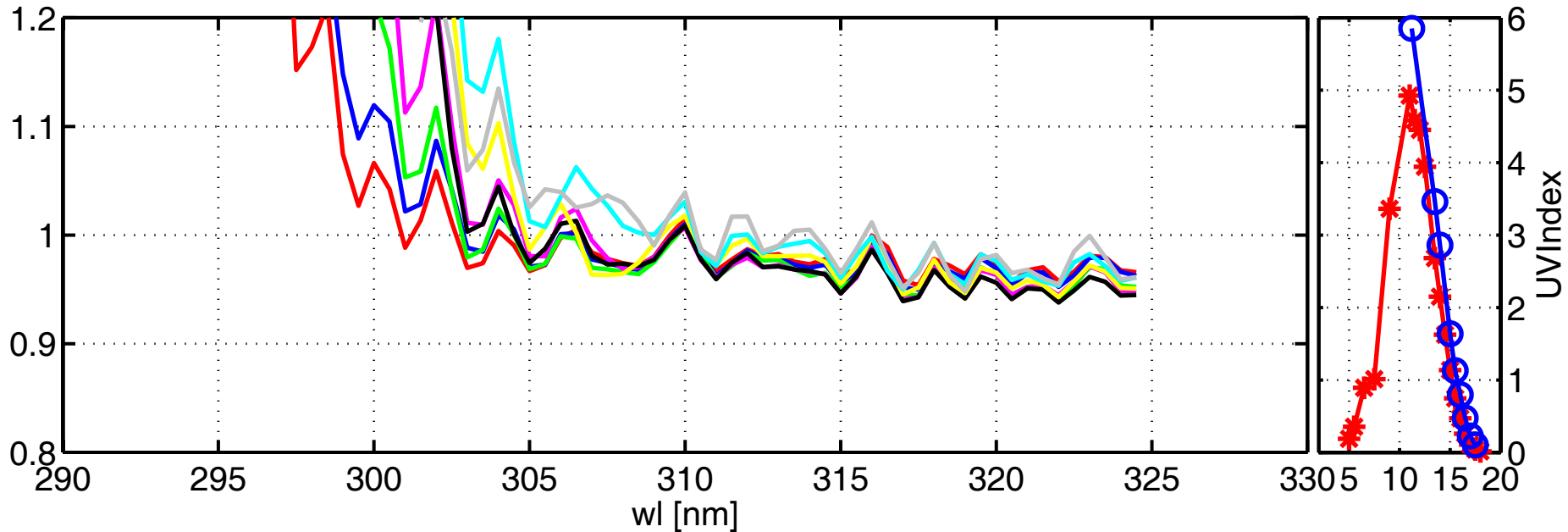
UV Index Hradec Kralove May 14–16 2004



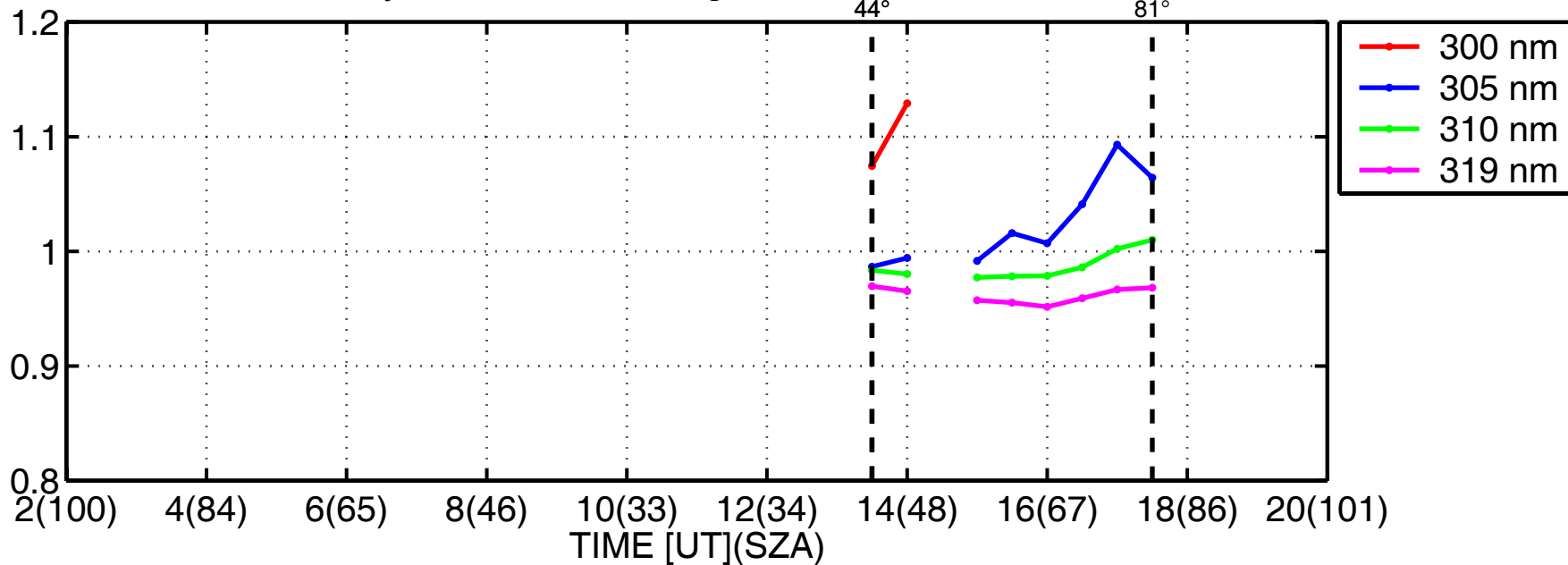
Global irradiance ratios CZH/JRC at Hradec Kralove:14-May-2004(135) to 16-May-2004(137)



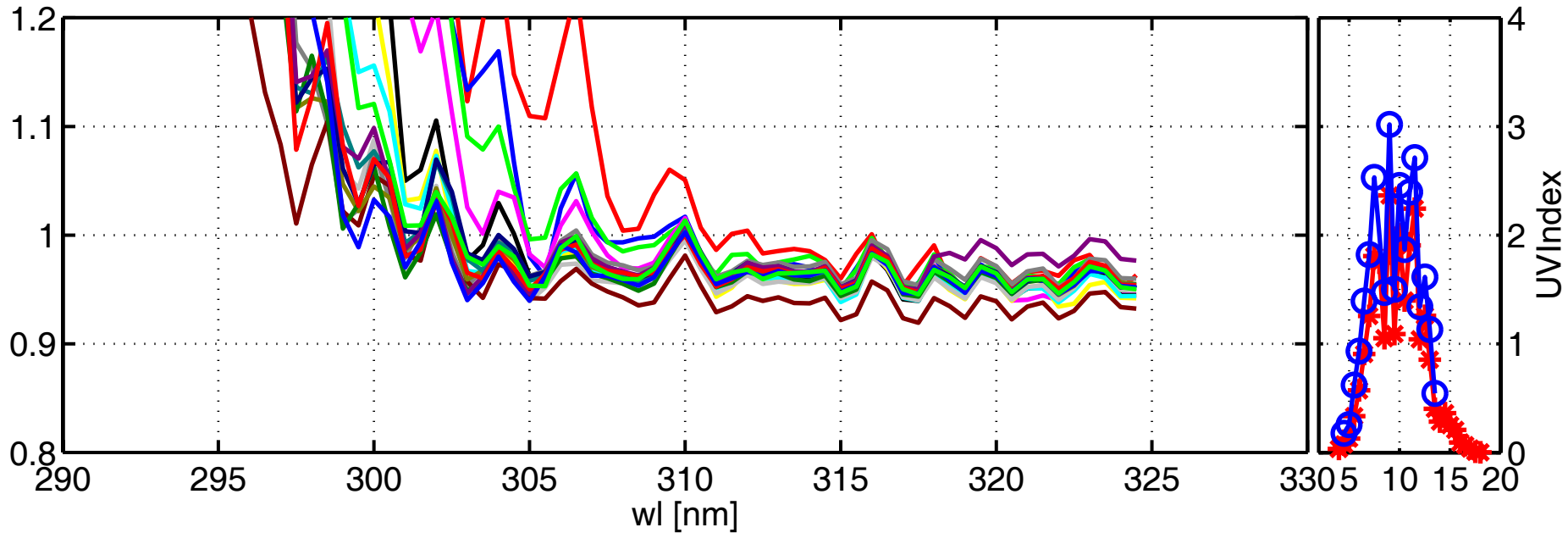
Global irradiance ratios CZH/JRC at Hradec Kralove:14-May-2004(135)



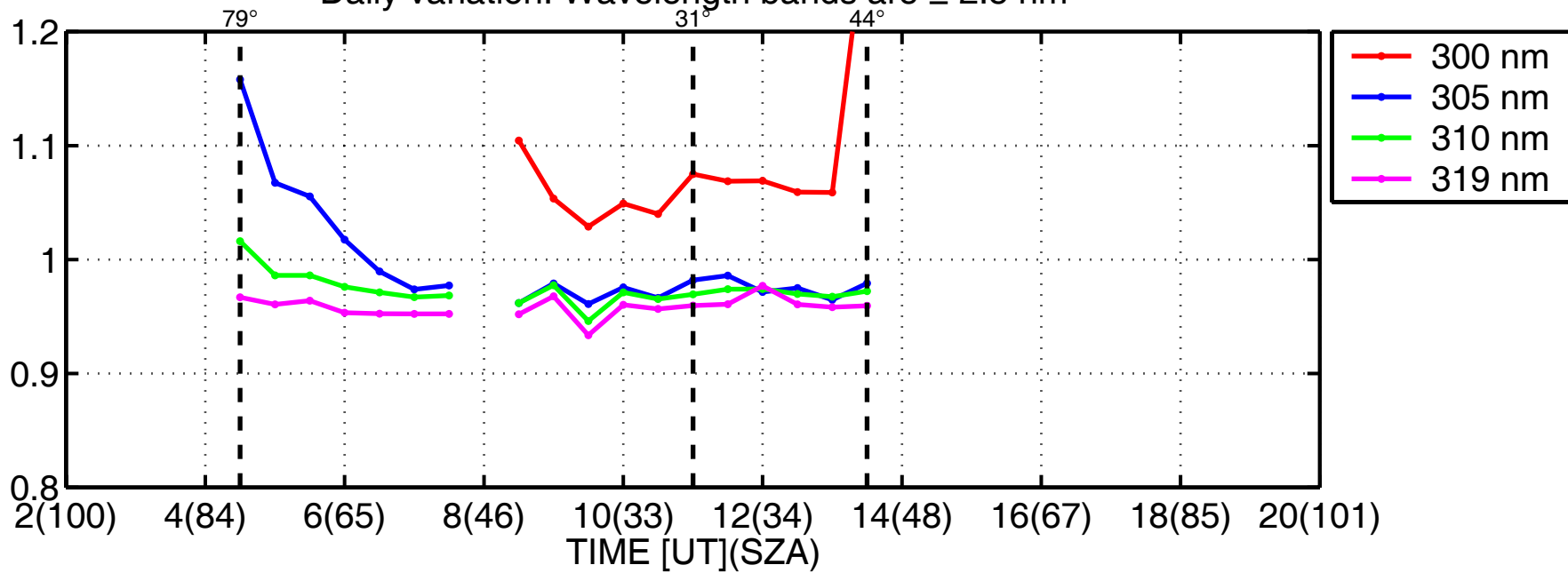
Daily variation. Wavelength bands are ± 2.5 nm



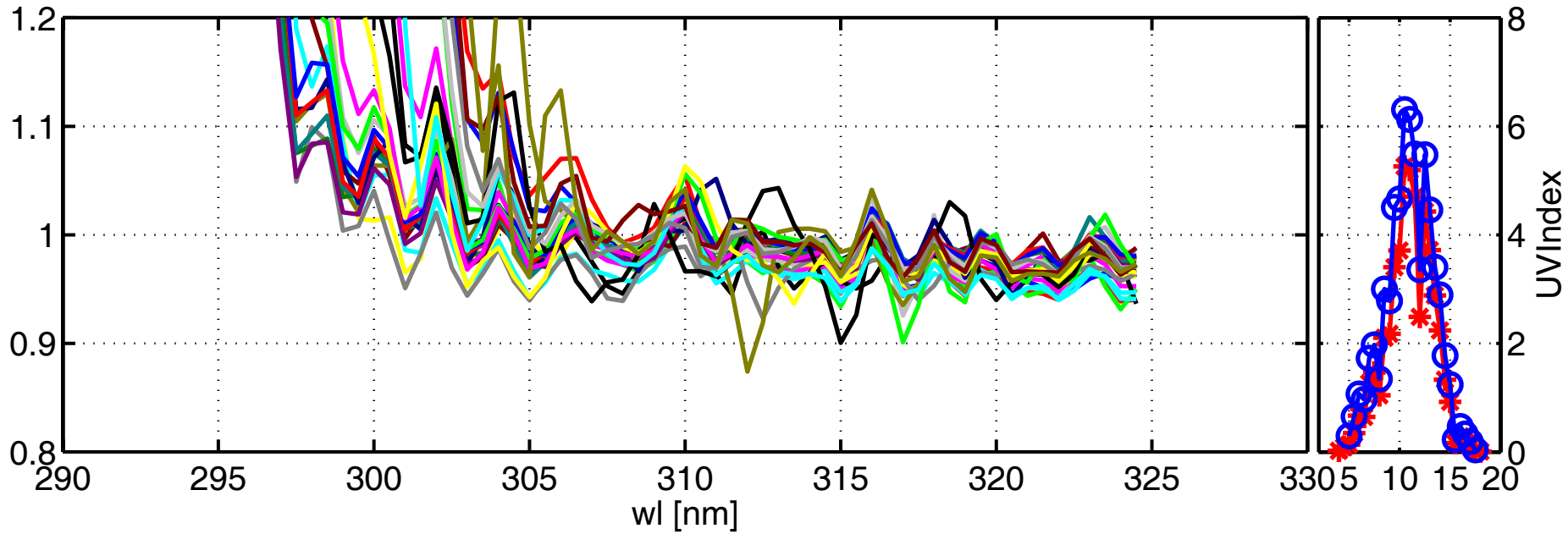
Global irradiance ratios CZH/JRC at Hradec Kralove:15-May-2004(136)



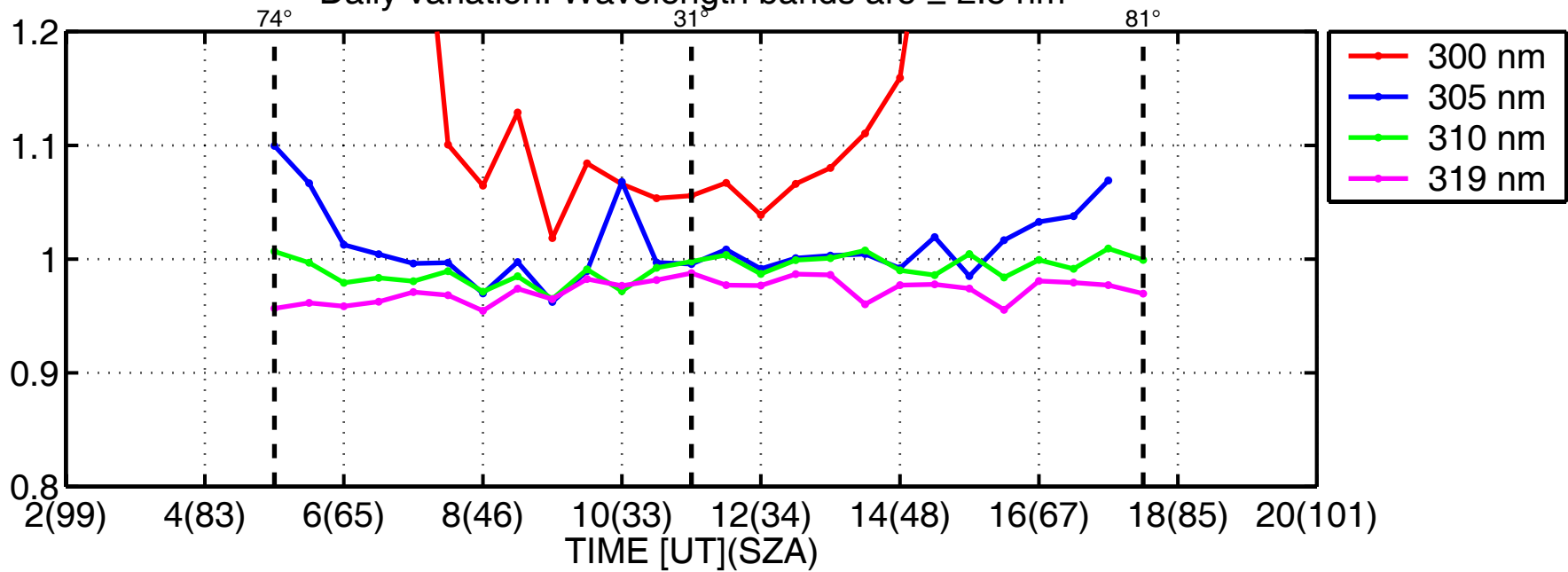
Daily variation. Wavelength bands are ± 2.5 nm



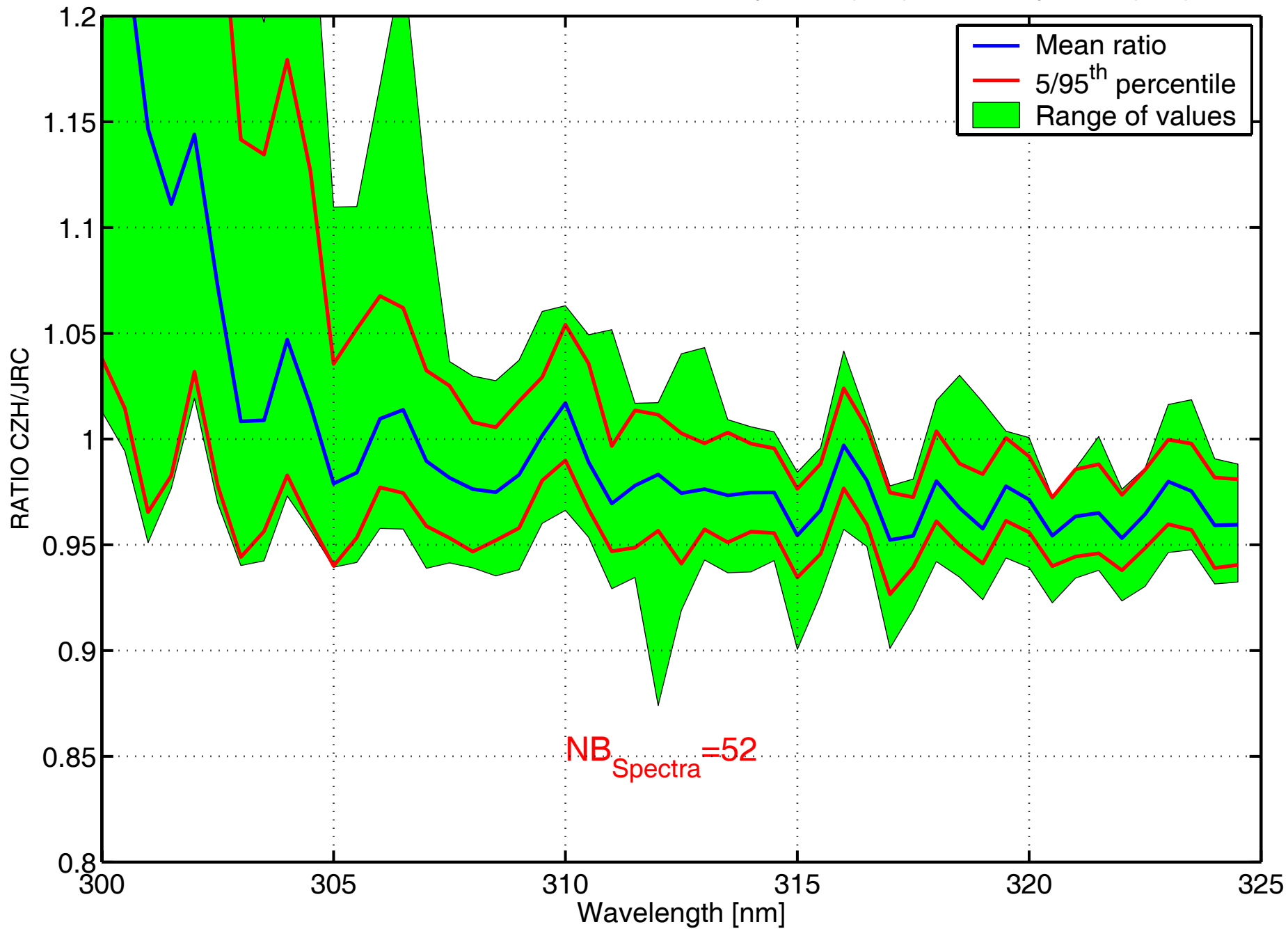
Global irradiance ratios CZH/JRC at Hradec Kralove:16-May-2004(137)



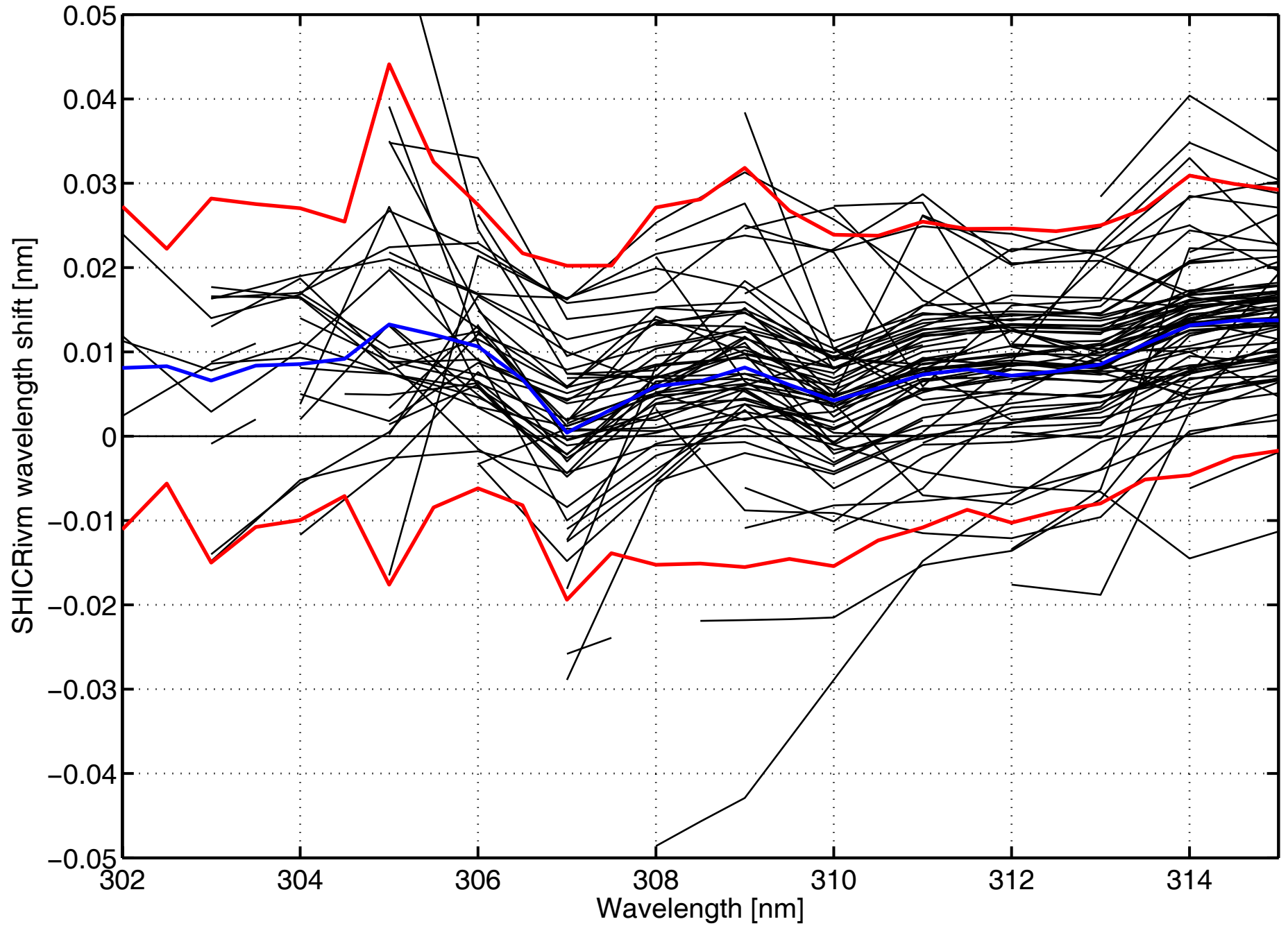
Daily variation. Wavelength bands are ± 2.5 nm



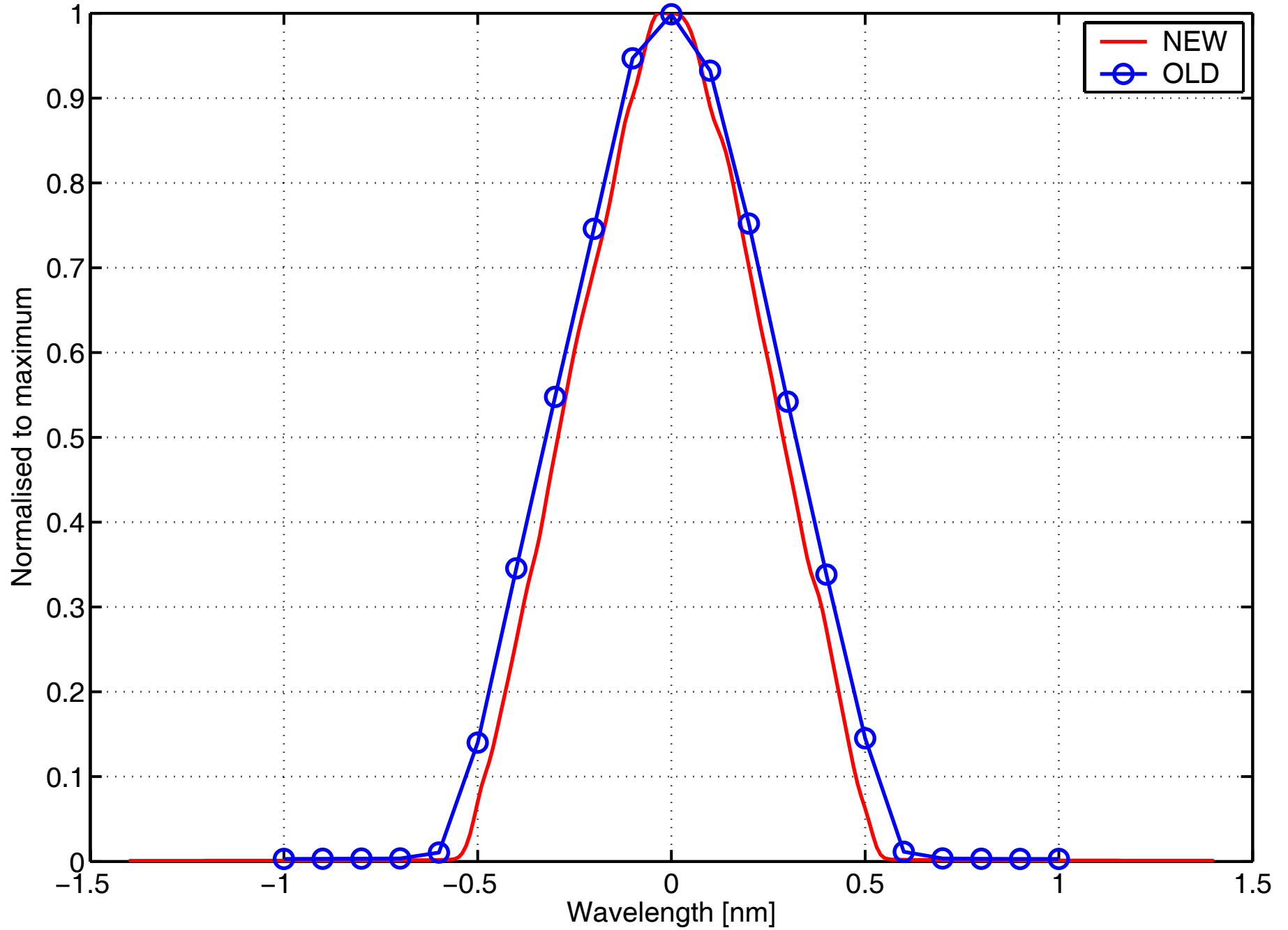
Mean ratio CZH/JRC at Hradec Kralove:14-May-2004(135) to 16-May-2004(137)



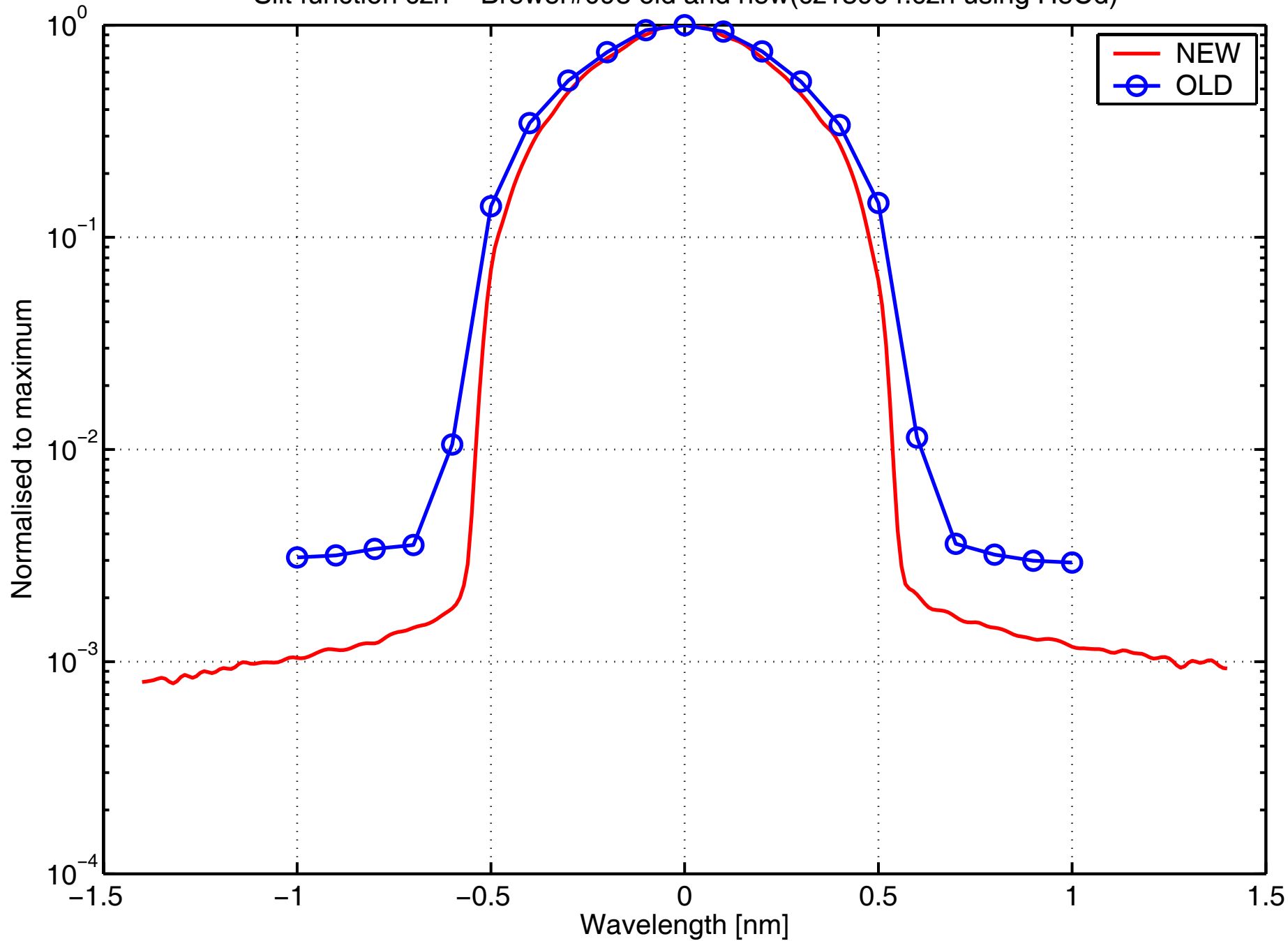
CZH - Hradec Kralove May 14-16 2004



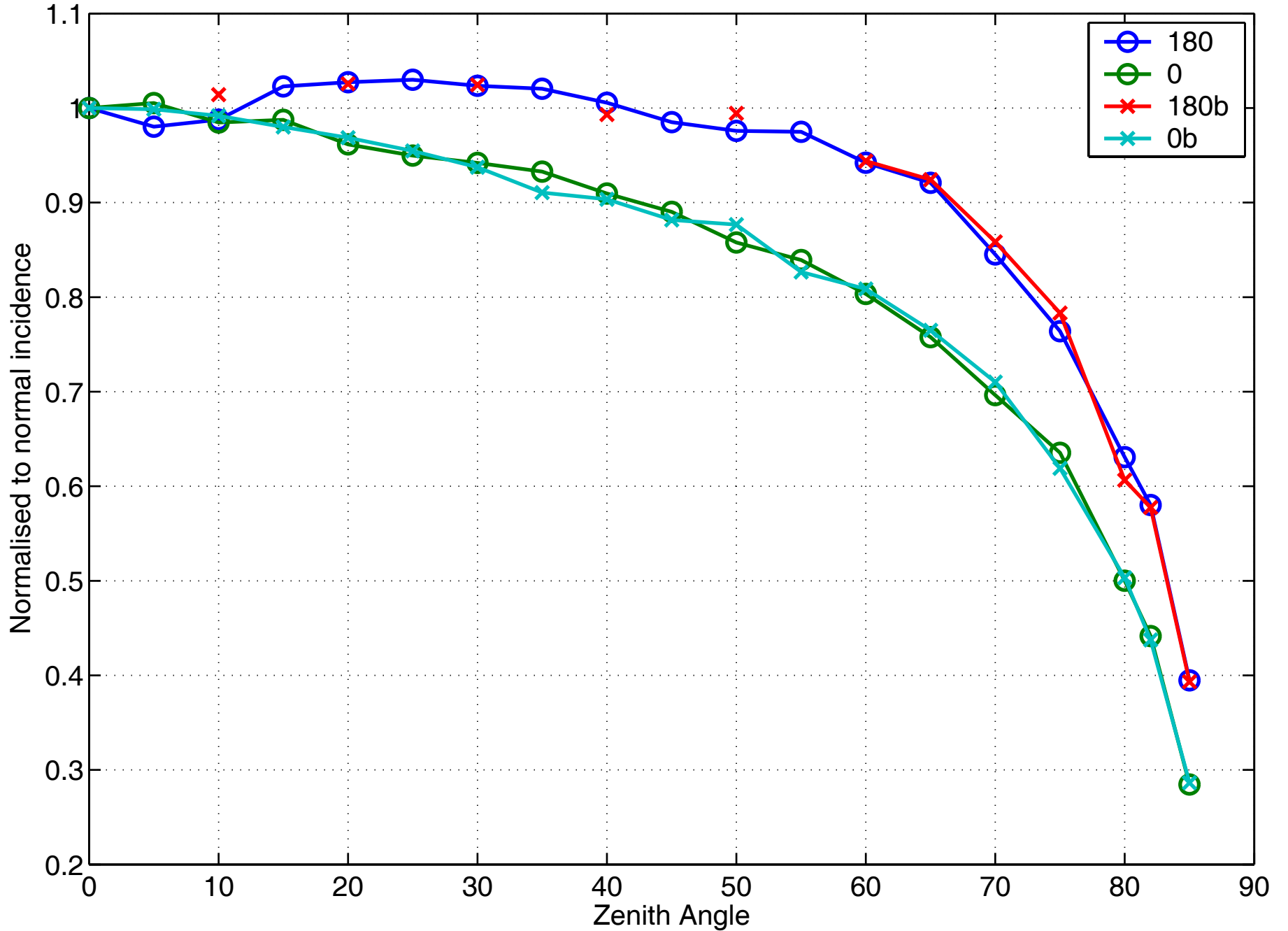
Slit function czh – Brewer#098 old and new(cz13904.czh using HeCd)



Slit function czh – Brewer#098 old and new(cz13904.czh using HeCd)



Cosinus Error Br#098 17/5/2004 Hradec Kralove, Zenith prism at 2114



Cosinus Error Br#098 17/5/2004 Hradec Kralove, Zenith Prism at 2118

