

Protocol of the intercomparison at Sodankylä Observatory, Finnish Meteorological Institute, June, 1-3, 2003 with the travelling standard spectroradiometer B5503 from ECUV within the project QASUME

Report prepared by Julian Gröbner

Operators: Stelios Kazadzis , Josef Schreder

The purpose of the visit was the comparison of global solar irradiance measurements between the spectroradiometer operated by FMI (FIS) and the travel standard B5503. The measurement site is located at Sodankylä; Latitude 67.37 N, Longitude 26.63 E and altitude 179 m.a.s.l..

The horizon of the measurement site is free down to about 85° solar zenith angle (SZA) in all directions.

B5503 arrived at Sodankylä in the evening of May 31, 2003. The spectroradiometer was installed in the observatory and turned on and left over night. On June 1, at 5:00 UT B5503 was installed on the roof at 1.5 m distance from the FIS instrument. The spectroradiometer in use at Sodankylä is a Brewer #37 single monochromator. The intercomparison between B5503 and the spectroradiometer from FMI lasted three days, from the morning of June 1 to noon of June 3.

B5503 was calibrated several times during the intercomparison period using a 100 W portable calibration system. Four 100 W lamps (T53063, T38986, T57825, T57824) were used to obtain an absolute spectral calibration traceable to the primary reference held at ECUV, 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. These variations were taken into account on a daily basis. Observed diurnal variations of the responsivity were 2% or less and were not taken into account. The internal temperature of B5503 was 25.5 ± 0.2 °C. The diffuser head was heated to a temperature of 27 ± 7 °C.

The wavelength shifts relative to an extraterrestrial spectrum as retrieved from the SHICRivm analysis were between ± 50 pm 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.

June 1 (152):

At 5:00 UT B5503 was installed on the measurement platform beside the FIS spectroradiometer. Synchronised scans started at 8:30 UT. FIS missed the 13:30 scan. Measurements proceeded until 18:00 UT. The calibration schedule of B5503 was from 6:00 to 8:20 UT, 10:35 UT, 11:05 UT, and 18:05 to 18:45 UT. The weather conditions were mostly clear of clouds with some scattered clouds during the day.

June 2 (153):

Synchronised scans are available from 2:30 to 18:00 UT. JRC missed the 3:30 UT scan due to wrong time synchronisation. The 2:30 UT scan was perturbed by some shadows falling on the FIS dome. The weather conditions were clear sky without clouds until 16:00 when some clouds moved partly in front of the sun.

Lamp measurements from B5503 at 3:10, 3:40, 4:10, 11:10, 11:40, 12:10, and from 17:40 to 19:00 UT.

June 3 (154):

Synchronised scans are available from 2:30 to 11:00 UT. The weather conditions were clear sky in the early morning with an increasing cloud coverage until 11:00 UT. After 11:00 heavy rain started.

Lamp measurements from B5503 at 3:40, 4:10, 7:10, 7:40, and 8:10 UT.

Results:

67 synchronised simultaneous spectra from B5503 and FIS are available from the measurement period. The wavelength shifts of the submitted solar spectra of the FIS spectroradiometer retrieved through the SHICRivm analysis were constant to within 20 pm. The absolute wavelength shift (relative to the extraterrestrial spectrum used by SHICRivm) is between 0 and +30 pm in the wavelength range 305 to 321 nm.

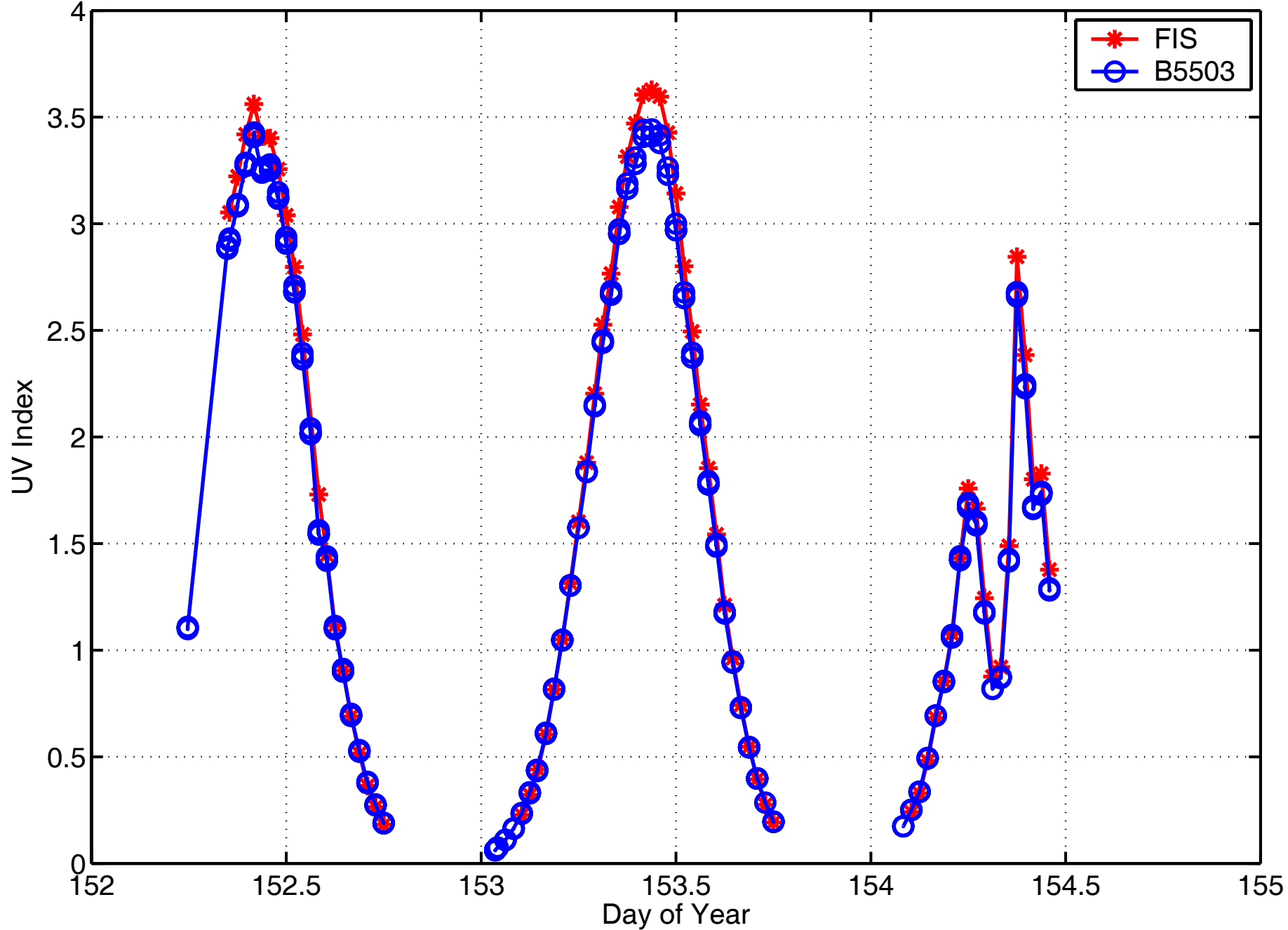
The intercomparison of the global irradiance measured by the two instruments can be summarized as follows:

- Global irradiances measured by FIS were between 0% to 10% higher than those measured by B5503 for wavelengths longer than 305 nm. Below 305 nm, the measurements of FIS measure too high irradiances which could be due to internal stray light of the single monochromator. At 300 nm, the irradiances measured by FIS are between 2.5 and 1.15 times higher than those measured by B5503. The highest differences occur at high SZA which is consistent with the assumption that these differences are due to stray light within FIS.
- The spectral ratios between FIS and B5503 decrease by 3 to 4% between 305 and 325 nm. This decrease was observed on all measurement days and seems independent of the weather conditions and the time of day.
- A diurnal variability of 4% amplitude independent of wavelength was observed on June 3 (153).

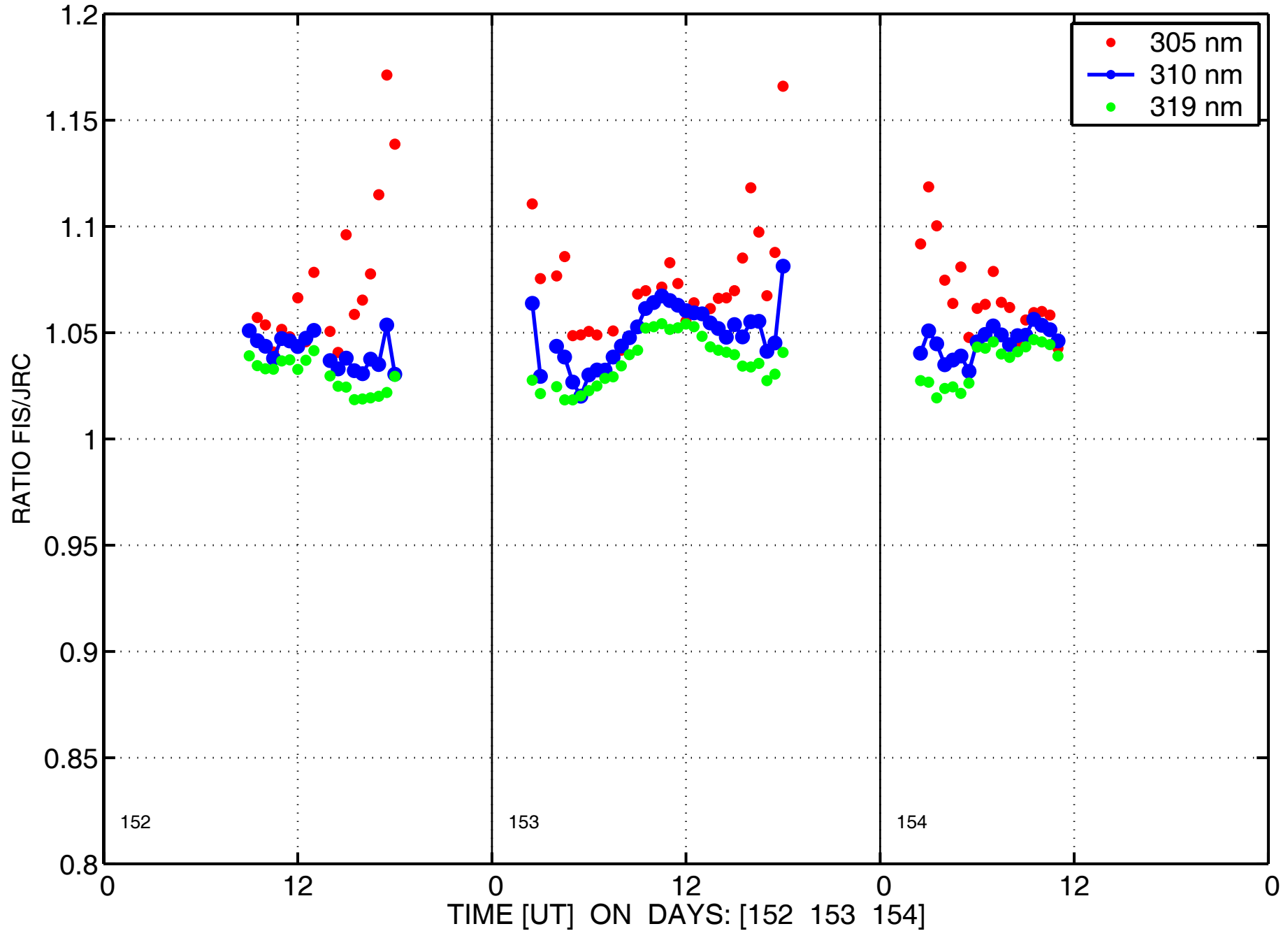
Conclusion:

At wavelengths longer than 305 nm, FIS measures global solar irradiance on average 5% higher than B5503. The variability between the two spectroradiometers seems to be independent of wavelength and was 5% or less during the three-day measurement period. Below 305 nm, FIS overestimates global solar irradiance by a factor between 1.05 to 2.5 dependent on the SZA and wavelength.

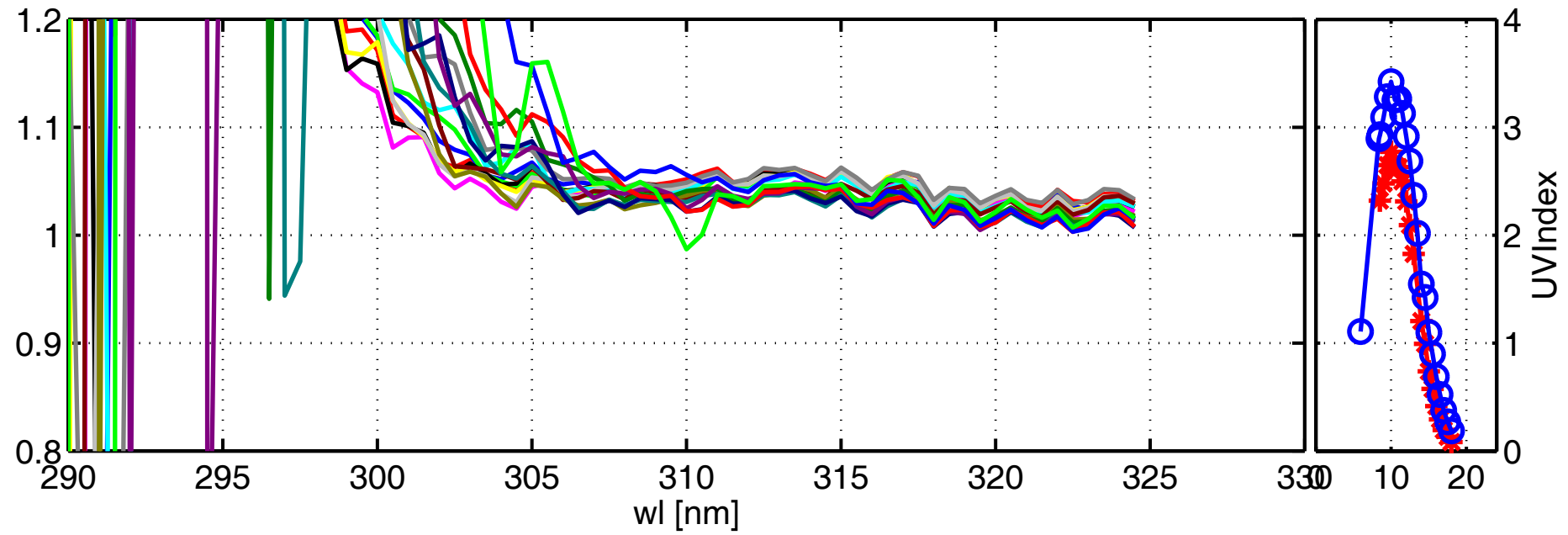
UV Index Sodankyla June 1-3 2003



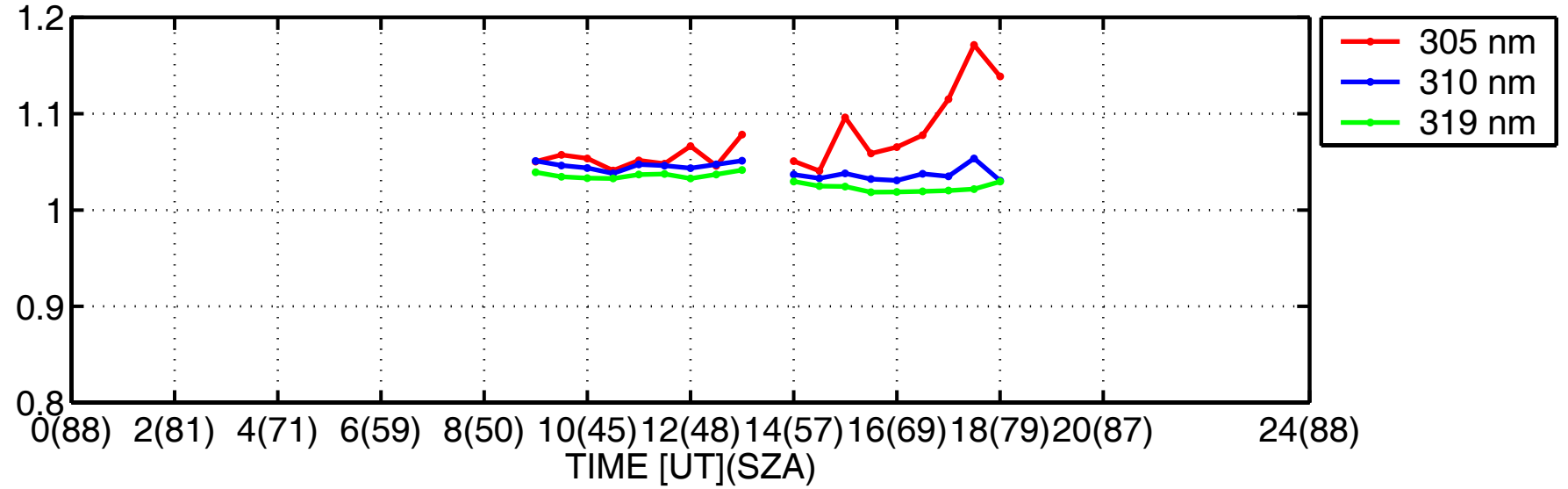
Global irradiance ratios FIS/JRC at Sodankyla:01-Jun-2003(152) to 03-Jun-2003(154)



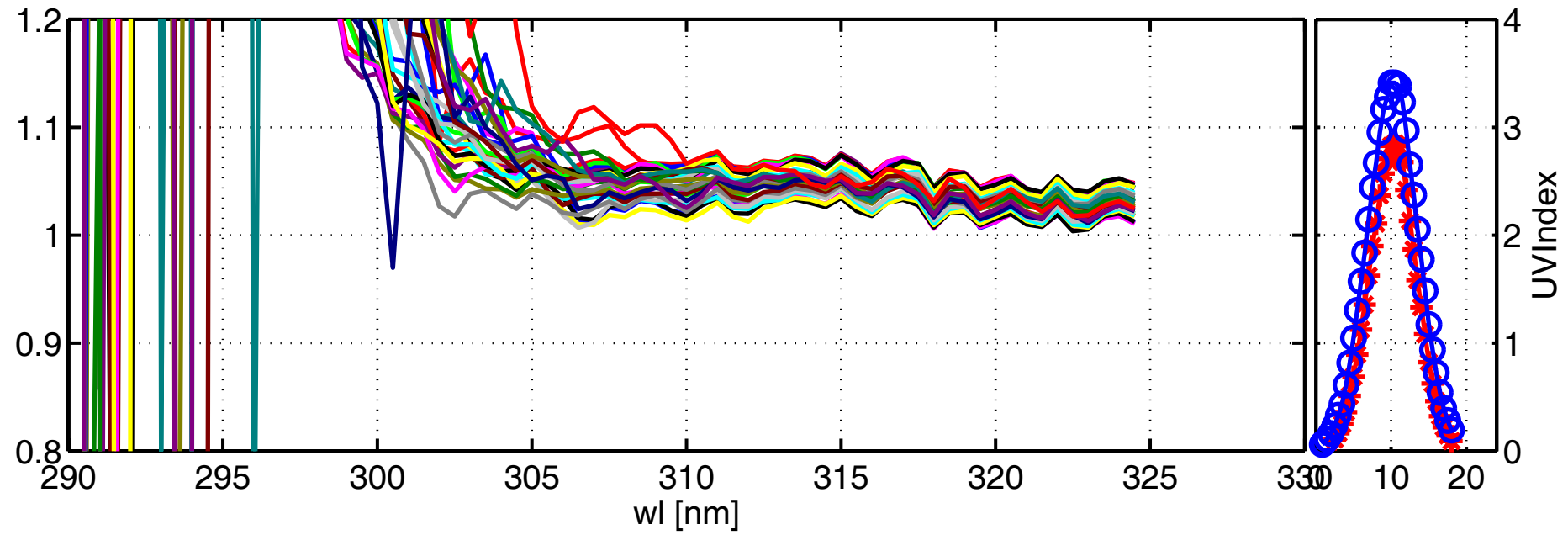
Global irradiance ratios FIS/JRC at Sodankyla:01-Jun-2003(152)



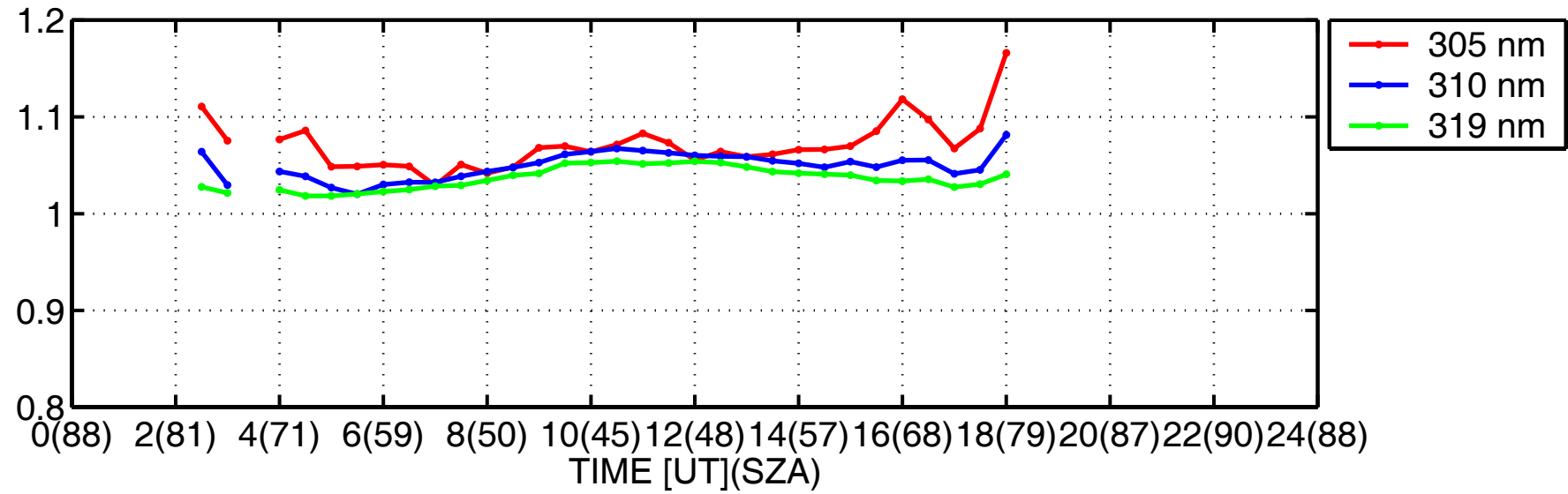
Daily variation. Wavelength bands are ± 2.5 nm



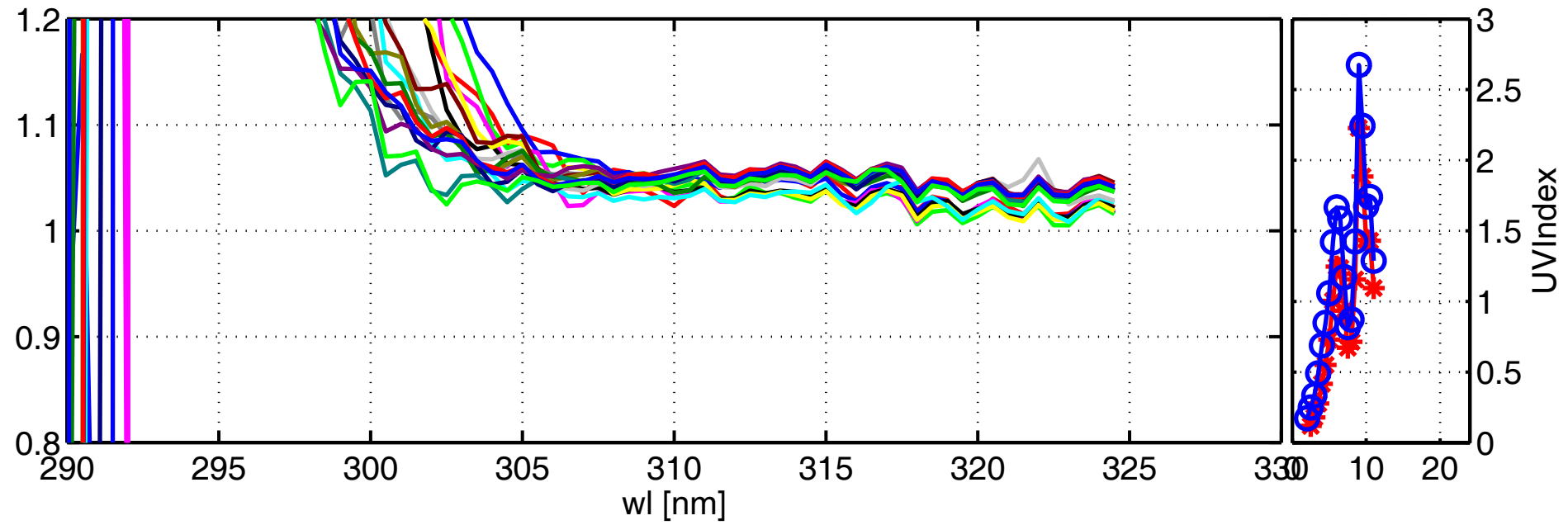
Global irradiance ratios FIS/JRC at Sodankyla:02-Jun-2003(153)



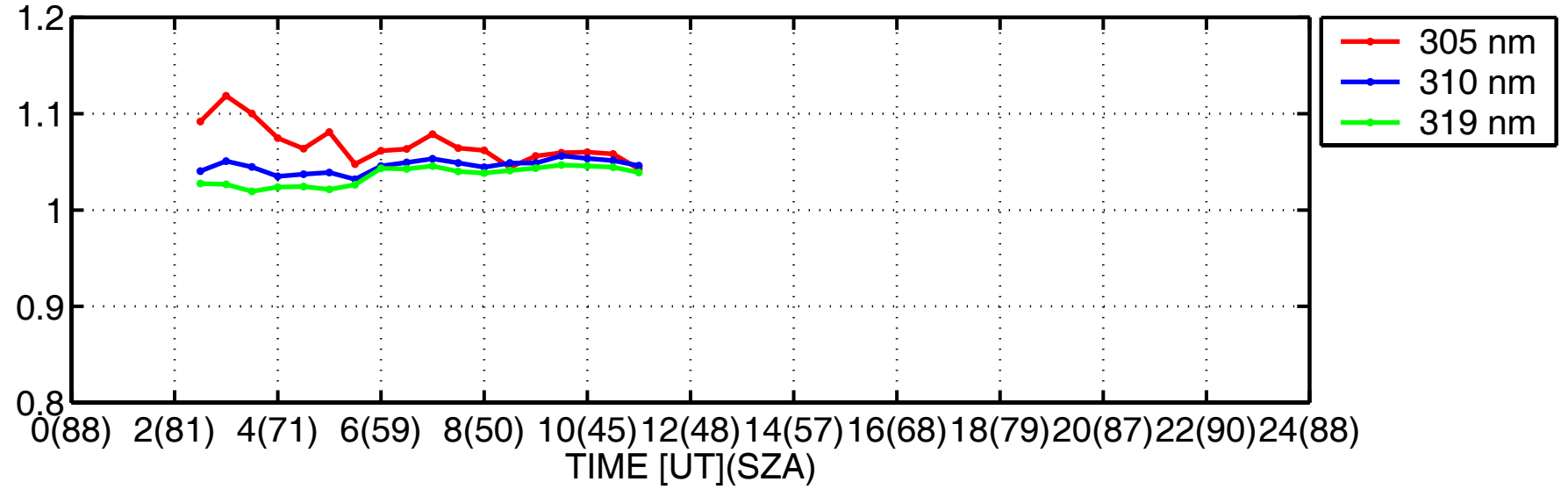
Daily variation. Wavelength bands are ± 2.5 nm



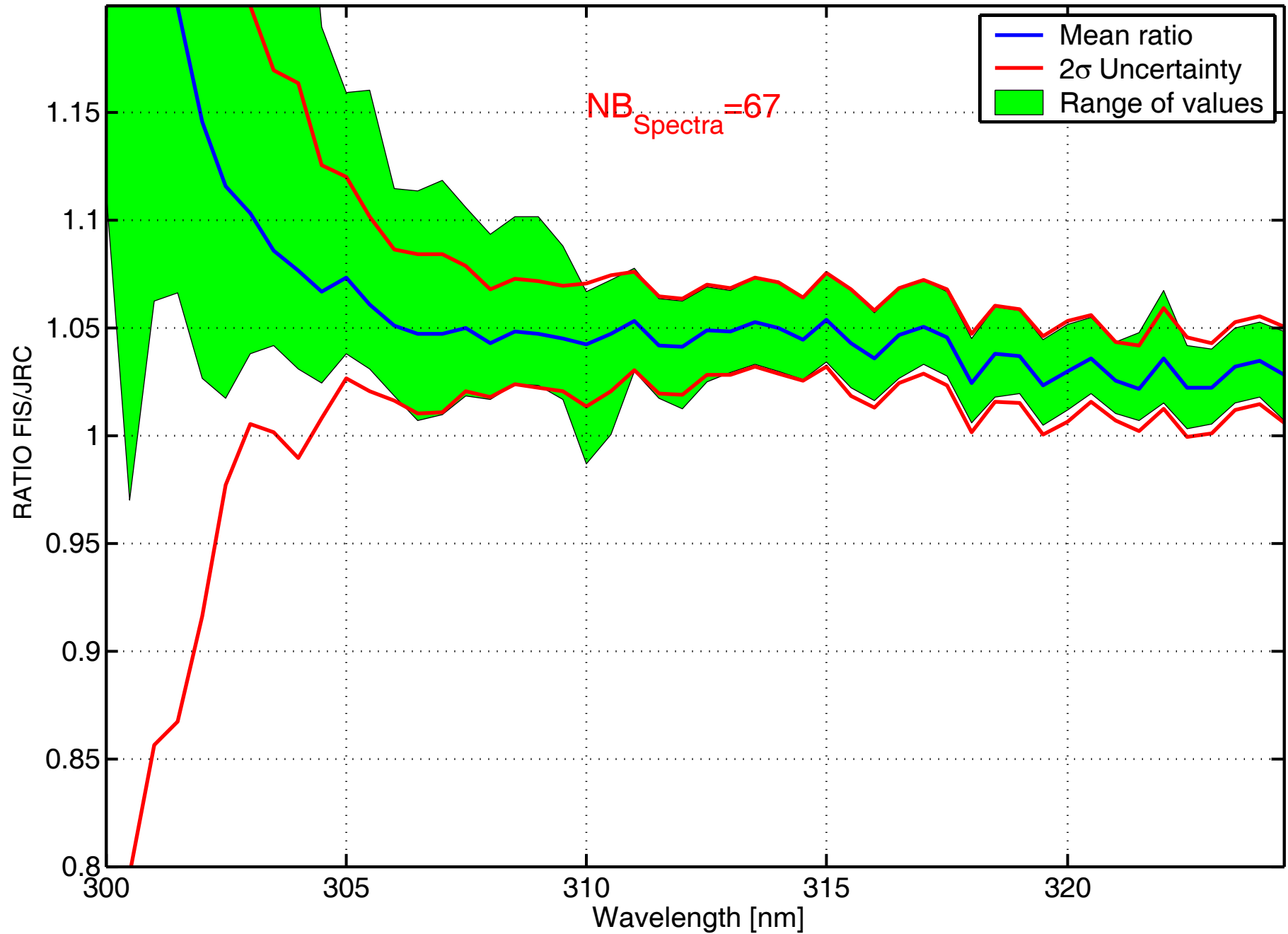
Global irradiance ratios FIS/JRC at Sodankyla:03-Jun-2003(154)



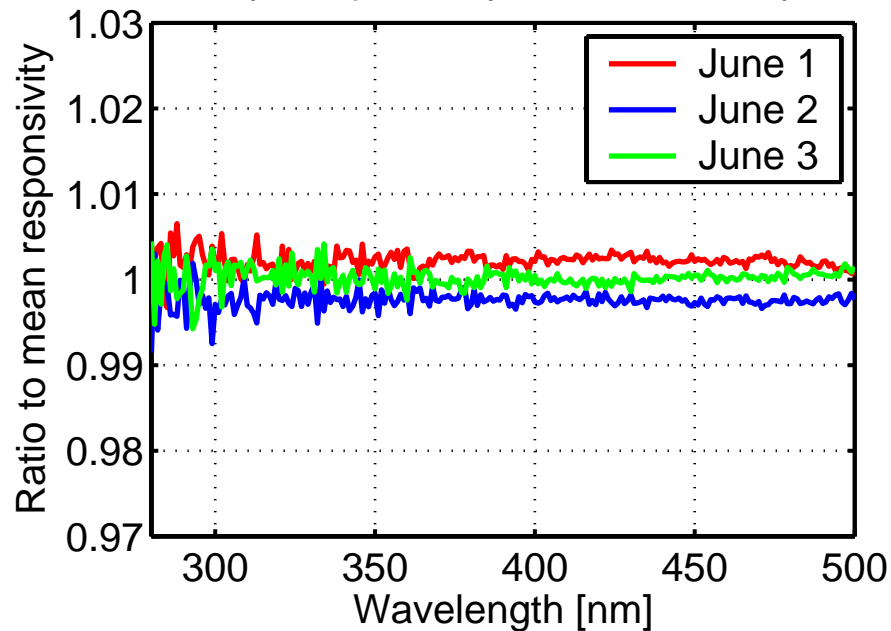
Daily variation. Wavelength bands are ± 2.5 nm



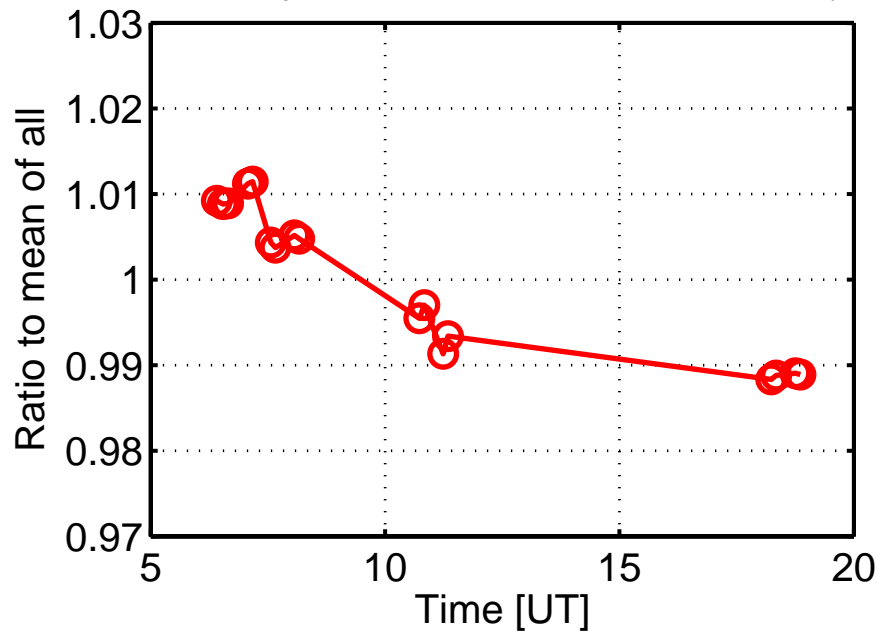
Mean ratio FIS/JRC at Sodankyla:01-Jun-2003(152) to 03-Jun-2003(154)



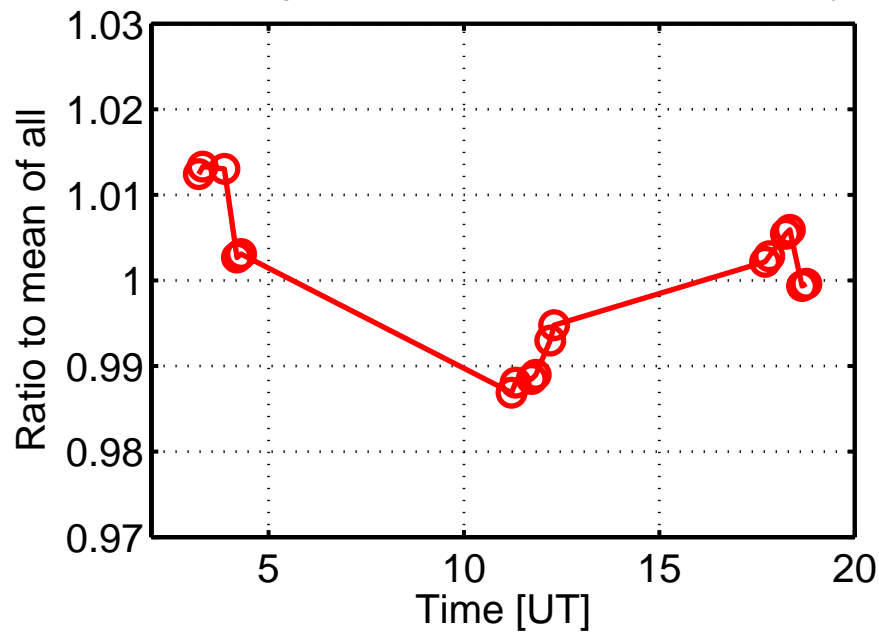
Mean daily Responsivity B5503 Sodankyla 2003



B5503 lamp measurements June 1 2003 (152)



B5503 lamp measurements June 2 2003 (153)



B5503 lamp measurements June 3 2003 (154)

