

Report
From the COST-726 Short Term Scientific Mission
Calibration of broadband UV radiometers, and comparison of the agreement between
the calibration facilities in JRC and INTA
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The Short Term Scientific Mission's reporter took place during five working days (13-17, December 2004). The actions made during this mission can be summarised as follows:

- The discussion and adoption by INTA, of the calibration procedures and QA/QC used by the ECUV for broadband UV radiometers calibrations and maintenance.
- Determination of the relative spectral response of the photodiode used as reference in El Arenosillo for broadband radiometer calibration.
- Determination of the relative spectral response and angular response of the YES radiometer UVB-1 s/n:941208 from INTA
- Determination of the calibration matrix as a function of solar zenith angle and total ozone content by using the measured relative spectral response of the YES radiometer measured at ECUV in combination with radiative model calculations.
- Estimation of the calibration factor of the YES radiometer through simultaneous solar irradiance measurements with the ECUV reference, Brewer #163.

- Comparison of the results of these actions with the ones obtained in El Arenosillo before this STSM.

Laboratory characterization:

1. INTA's photodiode spectral response characterization:

At El Arenosillo's laboratory, a Hamamatsu S2281 photodiode and a low noise photosensor amplifier Hamamatsu C2719 is used as the reference for broadband relative spectral response characterization. Before coming to ECUV, we had the relative spectral response of this photodiode provided by the manufacturer (as a general response for these photodiode types) and the certificate by a Spanish company (CIDA) but in the range from 365 nm up to 1100 nm that it is mostly out of the range used for our purposes.

In figure 1 is shown these three relative spectral responses.

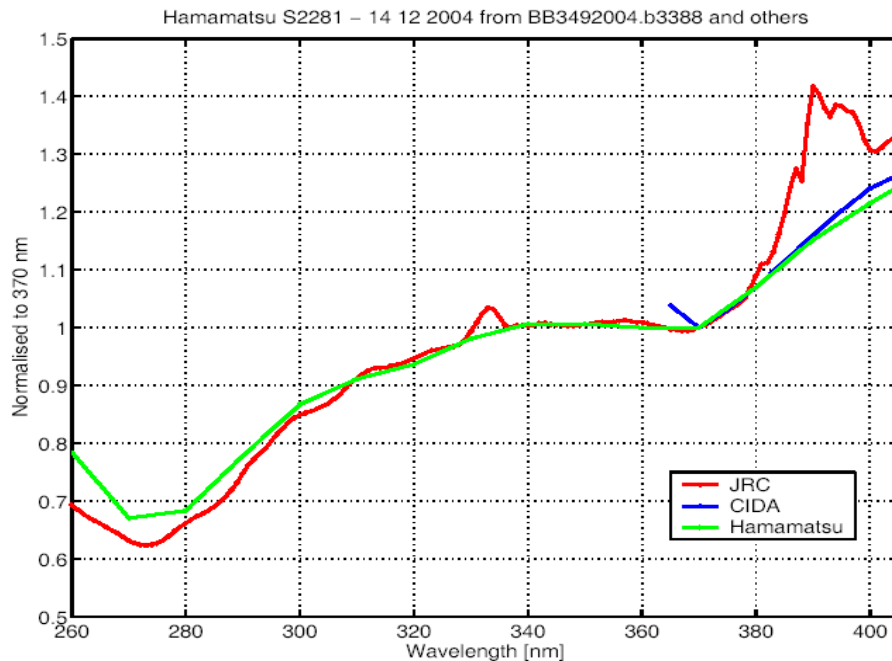


Figure 1. Relative spectral response of the photodiode S2281 provided by Hamamatsu, the one calculated by CIDA and the calibration obtained at JRC.

Up to now, the measured relative spectral response for this photodiode was not available and this is the most important starting point to start with the two laboratory comparisons.

INTA will use the ECUV calibration from 250 nm up to 380 nm and if necessary the one certificated by the Spanish company CIDA could be used in the range from 370 nm up to 1100 nm.

2. YES UVB-1 s/n:941208 relative spectral response:

The relative spectral response of the YES radiometer was obtained from two scans from 400 nm down to 260 nm with 1 nm decrements.

This relative spectral response is similar to the one measured previously in the laboratory of El Arenosillo using the photodiode calibration of ECUV. These two responses estimated in both laboratories shows a significant difference with the one provided by the manufacturer (Yankee Environmental System) when it was bought (see figure 2).

Figure 2 shows the three relative spectral responses for the YES 941208 measured at ECUV, El Arenosillo and the one provided by YES.

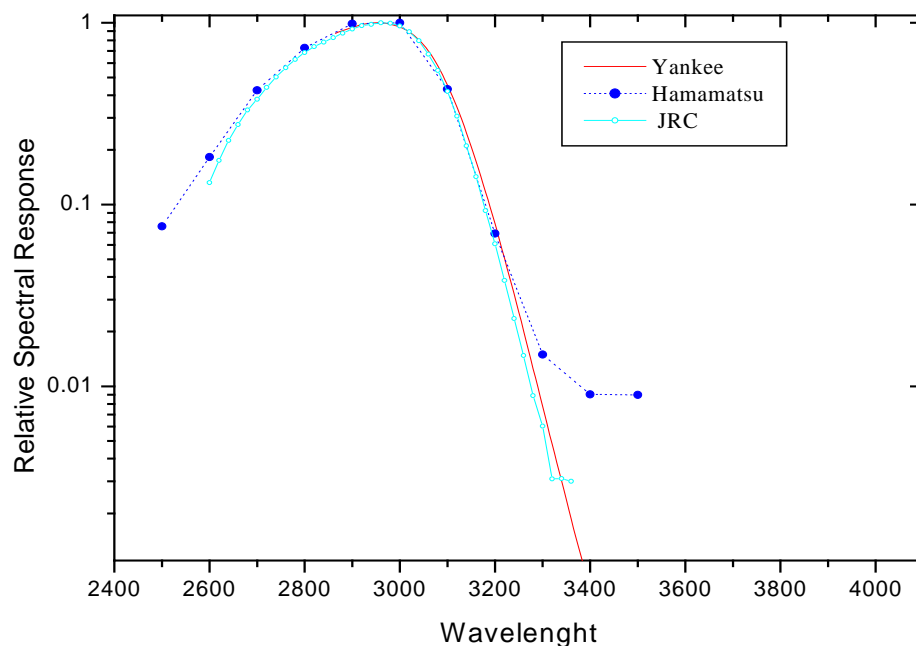


Figure 2. Relative spectral response provided by Yankee, the one calculated at El Arenosillo with the by using as reference a photodiode from Hamamatsu and the calibration obtained at JRC.

3. YES UVB-1 s/n:941208 angular response characterization.

The angular response of the YES radiometer was estimated at ECUV by a fully automatic system with a high resolution. The results obtained agree well with the ones obtained at El Arenosillo by using a manual facility with not so good resolution. The two measurements start to differ noticeably at zenith angles above 70 degrees.

Figure 3 and 4 show the angular response and the cosine error estimated for the direct component of the radiation.

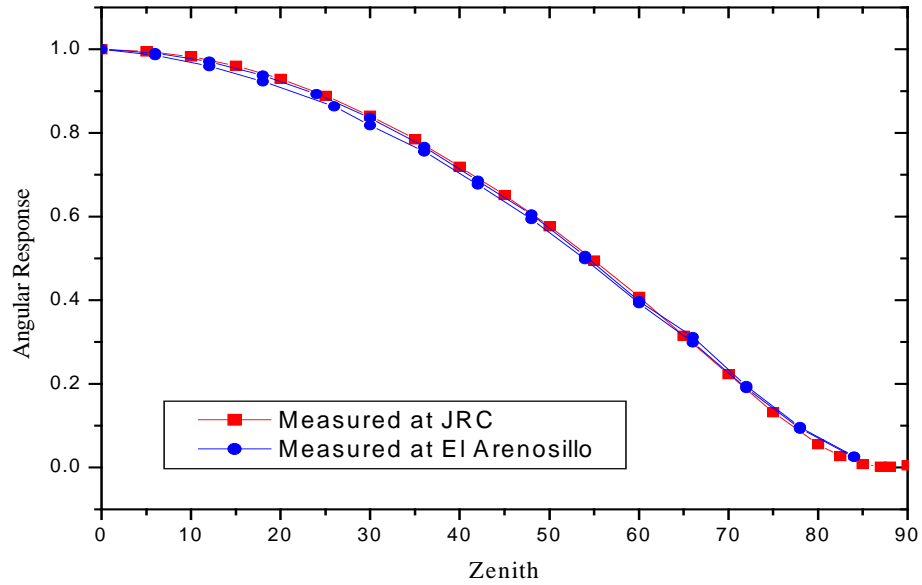


Figure 3.- Angular response of the YES 941208 measured at El Arenosillo and JRC

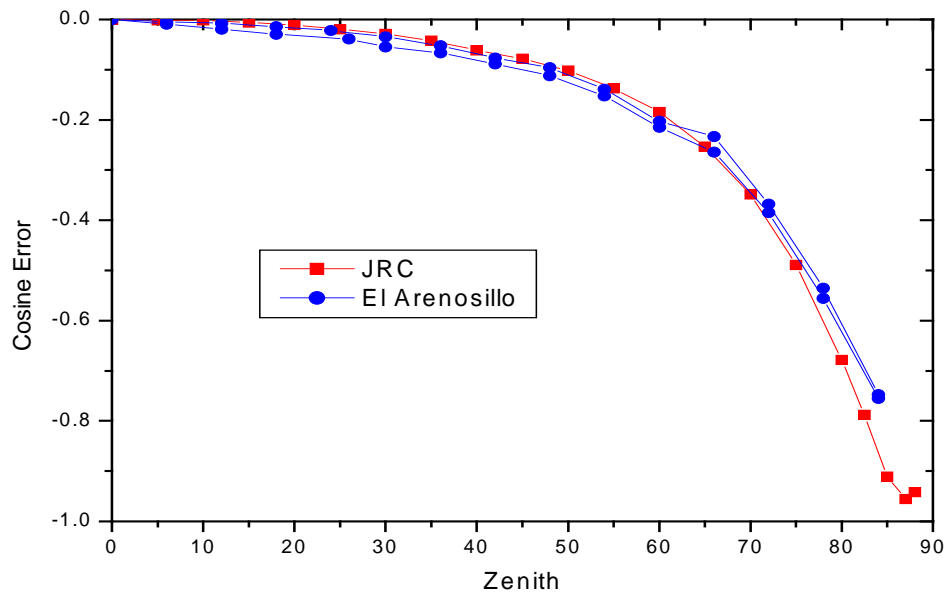


Figure 4.- Cosine error calculated for the direct component of the YES 941208 at El Arenosillo and JRC

Outdoor calibration:

4. YES absolute calibration factor from outdoor measurements vs double Brewer #163.

Two days with changing cloudiness but without rain were used to obtain a calibration factor for the YES radiometer 941208 which is traceable to the ECUV irradiance scale. Due to the low solar zenith angles (SZA), the calibration is limited to SZA higher than 69 deg. The double Brewer in ECUV has a very

good angular response due to a new diffuser to improve the angular response (Julian Gröbner, "Improved entrance optic for global irradiance measurements with a Brewer spectrophotometer", Applied Optics / Vol.42, No.18 /June 2003) and therefore needs no cosine correction.

At this SZA, the estimated calibration factor are:

Day of Year 350 : O₃=315 DU : CF=1.385 V/(Wm⁻²)
352 : O₃=275 DU : CF=1.395 V/(Wm⁻²)

Conclusions:

- The applicant found the time spent in the host institute very productive due to interest and the very high scientific level of Dr Julian Gröbner in the knowledge in UV field and instrumentation, and the good infrastructures.
- Common procedures for the broadband characterization and calibration were adopted .
- The photodiode used in the laboratory of El Arenosillo, Spain for the same purposes as in ECUV was calibrated based on the ECUV reference. This photodiode calibration will play a very important role in the calibration of UV broadband radiometers in Spain.
- It was characterized the angular response and the relative spectral response of the YES UVB-1 s/n:941208 and the calibration factor matrix as a function of the solar zenith angle and the ozone content.
- Due to the limitation in the solar elevation during the dates of the visit and the number of quasi-simultaneous measurements vs the Brewer used as reference, the calibration matrix could only by used as preliminary checking with the one that will be calculated at El Arenosillo based on the new relative spectral response.