National Renewable Energy Laboratory

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Memo

Subject: Calibration of SRRL Baseline Measurement System (BMS) Global UVB Radiometers
Instruments: Kipp & Zonen UV-S-B-T s/n 010538 and CUVB1 s/n 952010, EKO MS-210W s/n S92096.04, Yankee UVB-1 s/n 930401 and s/n 921106, and Solar Light 501A s/n 1898

NREL PV Radiometric Measurements Task monitored the millivolt output of six (6) BMS Global UVB Radiometers while measuring the spectral distribution of natural sunlight in global horizontal incidence mode on 26 October 2007 from 280 nm and 400 nm at 2nm steps using an Optronic Laboratories OL-756 (double monochromator UV spectroradiometer). The millivolt output from the BMS Radiometers were recorded by the BMS CR23X datalogger.

The OL-756 spectrometer calibrated against NREL's National Institute of Standards and Technology (NIST) Standard of spectral irradiance F597 on 26 October 2007.

The spectra were integrated between 280 nm and 315 nm to produce the total power under each spectral distribution. All data were used to compute the calibration factors shown in Table 1.

Table 1. October 26, 2007 NREL Global UVB Calibration Summary

Time (MST)	**Spectrum W/m^2**	**UV-S-B-T V (avg.)**	**W/m^2/V**	**CUVB1 V (avg.)**	**W/m^2/V**	**MS-210W mV (avg.)**	**W/m^2/mV**
12:23	0.8603891	1.1518	0.7470	-0.2232	-3.8548	0.6539	1.3157
12:25	0.8598602	1.1423	0.7527	-0.2212	-3.8869	0.6491	1.3248
12:27	0.8624166	1.1355	0.7595	-0.2198	-3.9242	0.6460	1.3351
12:29	0.8612286	1.1281	0.7634	-0.2181	-3.9484	0.6419	1.3418
12:31	0.8651701	1.1277	0.7672	-0.2180	-3.9696	0.6415	1.3486
12:33	0.8607447	1.1167	0.7708	-0.2156	-3.9924	0.6357	1.3539
		Avg.	**0.760**		**-3.929**		**1.3367**
		Sigma	0.0090		0.0517		0.0145

Time (MST)	**Spectrum W/m^2**	**UVB-1 V (avg.)**	**W/m^2/V** s/n 930401	**501A V (avg.)**	**W/m^2/V**	**UVB-1 V (avg.)**	**W/m^2/V** s/n 921106
12:23	0.8603891	0.8156	1.0550	0.4930	1.7452	0.8223	1.0463
12:25	0.8598602	0.8091	1.0627	0.4888	1.7592	0.8151	1.0549
12:27	0.8624166	0.8041	1.0725	0.4859	1.7748	0.8109	1.0635
12:29	0.8612286	0.7985	1.0785	0.4825	1.7848	0.8053	1.0695
12:31	0.8651701	0.7981	1.0841	0.4823	1.7940	0.8047	1.0752
12:33	0.8607447	0.7900	1.0896	0.4773	1.8032	0.7968	1.0803
		Avg.	**1.074**		**1.777**		**1.065**
		Sigma	0.0131		0.0218		0.0127

The erythema response for the 501A was determined by multiplying the spectra from 280-400nm by the CIE 1987 Erythema Action Spectrum (shown in Figure 2) and then integrating under the entire curve to produce the total power under each spectral distribution. All data were used to compute the erythema calibration factors shown in Table 2.

Table 2. October 26, 2007 NREL Global Erythema Calibration Summary

Time (MST)	Erythema Spectrum W/m^2	Erythema Spectrum MED/Hr	Erythema Spectrum Index	501A V (avg.)	Erythema MED/Hr/V	Erythema Index/V
12:23	0.11453	1.96451	4.58125	0.4930	3.9848	9.2926
12:25	0.11445	1.96312	4.57800	0.4888	4.0163	9.3660
12:27	0.11477	1.96859	4.59075	0.4859	4.0513	9.4477
12:29	0.11461	1.96591	4.58451	0.4825	4.0742	9.5010
12:31	0.11514	1.97503	4.60576	0.4823	4.0953	9.5503
12:33	0.11457	1.96510	4.58261	0.4773	4.1168	9.6003
				Avg.	**4.056**	**9.460**
				Sigma	0.0495	0.1154

Note: 1 MED/Hr = 0.0583 Erythema-W/m^2 and 1 Index = 0.025 Erythema-W/m^2

UNCERTAINTY

The estimated uncertainty in the OL-756 spectral irradiance calibration is ±4.0% from 300 nm to 400nm. The accuracy of the CR23X data logger was about 0.8%. Estimated uncertainty in the derived calibration factor is ±4.8% (limit of error). Spectral data is provided below.

Figure 1. Measured Spectral Distributions indicated by OL-756 UV Spectroradiometer 26 Oct 2007

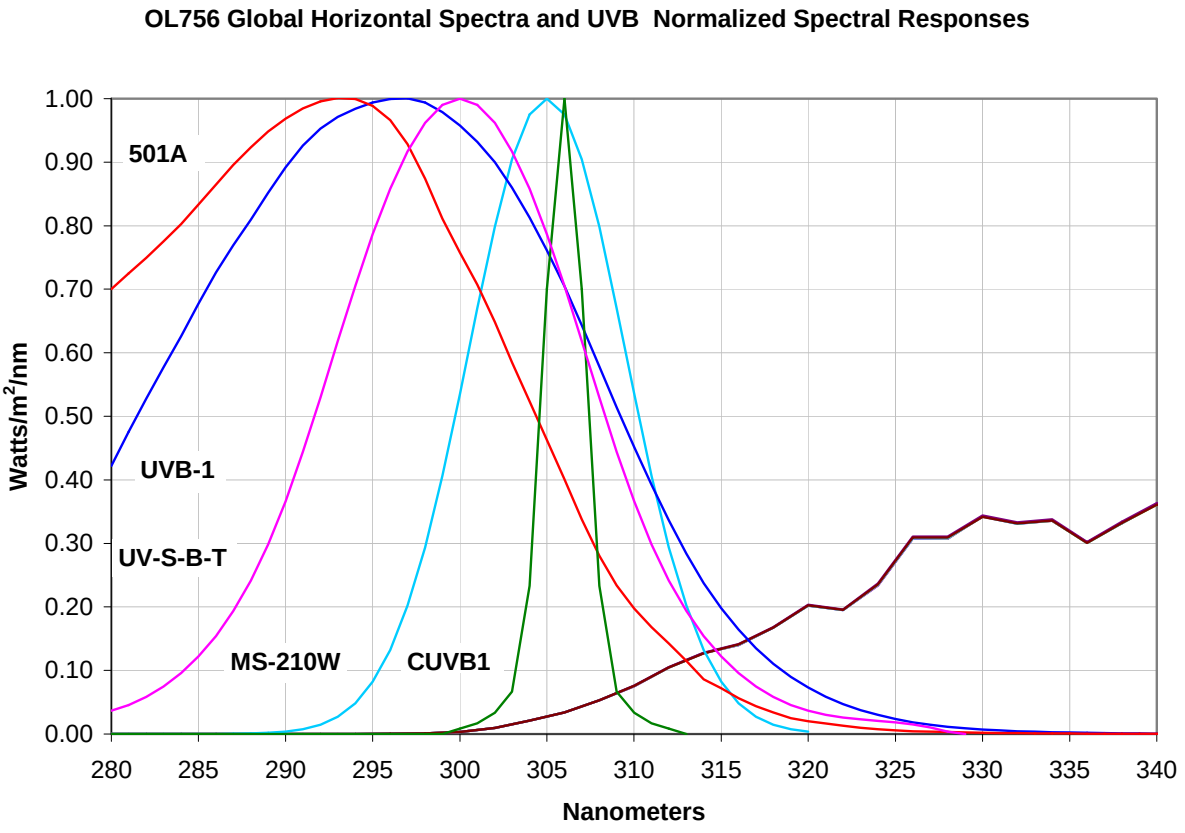
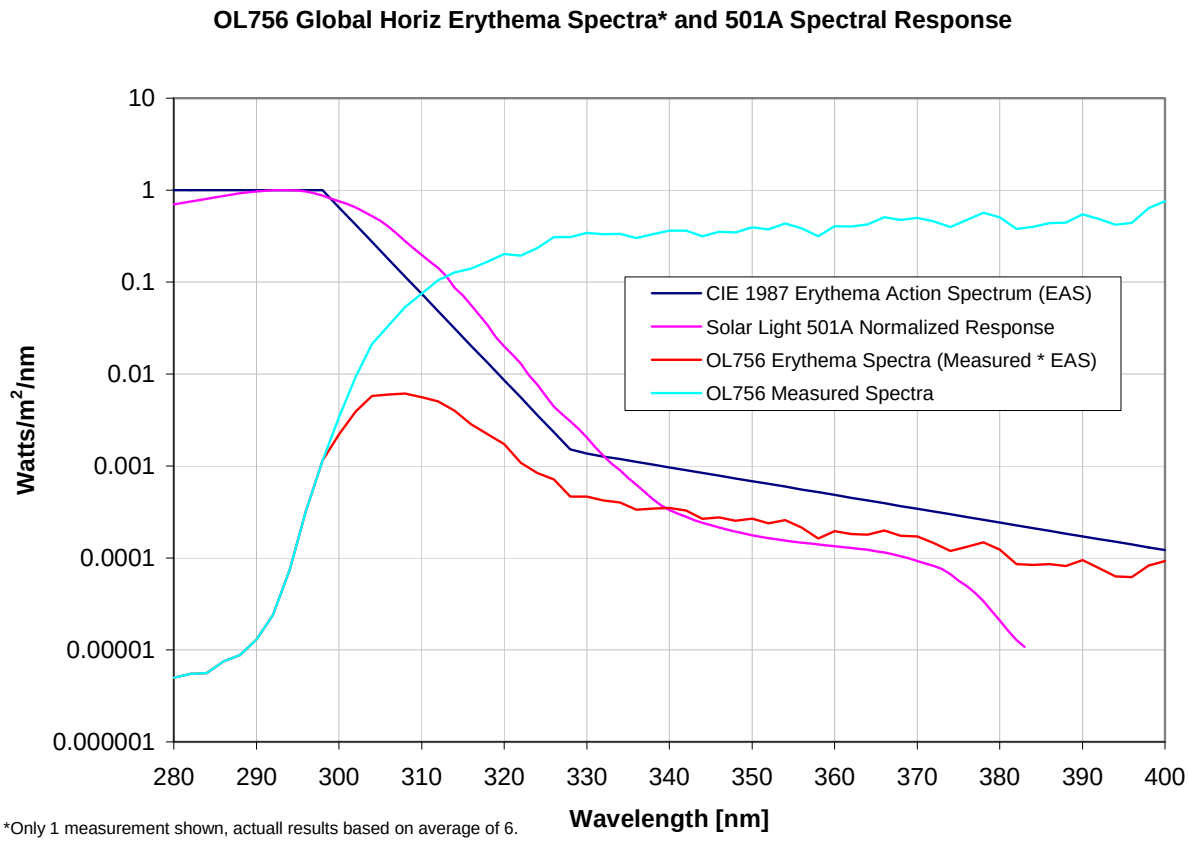


Figure 2. Derived Erythema Spectral Distributions indicated by OL-756 on 26 Oct 2007



*Only 1 measurement shown, actuall results based on average of 6.