



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 29 August 2005 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 was calibrated against NREL's National Institute of Standards and Technology (NIST) Standard of spectral irradiance F571 on 9 August 2005.

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. August 29, 2005 NREL Global UVB Calibration Summary

Time (MST)	Spectrum W/m <sup>2</sup>	UV-S-B-T V (avg.)	W/m <sup>2</sup> /V	CUVB1 V (avg.)	W/m <sup>2</sup> /V	MS-210W mV (avg.)	W/m <sup>2</sup> /mV
11:46	1.447843	2.2113	0.6547	-0.4100	-3.5312	1.6428	0.8813
11:48	1.446972	2.2151	0.6532	-0.4108	-3.5219	1.6459	0.8791
11:50	1.441807	2.2139	0.6512	-0.4107	-3.5107	1.6461	0.8759
11:52	1.429692	2.2096	0.6470	-0.4100	-3.4869	1.6433	0.8700
11:54	1.420579	2.2052	0.6442	-0.4092	-3.4720	1.6415	0.8654
11:56	1.413666	2.2019	0.6420	-0.4087	-3.4589	1.6397	0.8621
		<b>Avg.</b>	<b>0.649</b>		<b>-3.497</b>		<b>0.872</b>
		<b>Sigma</b>	<b>0.0051</b>		<b>0.0288</b>		<b>0.0077</b>

Time (MST)	Spectrum W/m <sup>2</sup>	UVB-1 V (avg.)	W/m <sup>2</sup> /V s/n 930401	501A V (avg.)	W/m <sup>2</sup> /V	UVB-1 V (avg.)	W/m <sup>2</sup> /V s/n 921106
11:46	1.447843	1.5778	0.9176	0.8615	1.6806	1.5928	0.9090
11:48	1.446972	1.5808	0.9153	0.8632	1.6763	1.6019	0.9033
11:50	1.441807	1.5806	0.9122	0.8627	1.6713	1.6035	0.8992
11:52	1.429692	1.5771	0.9065	0.8610	1.6605	1.6016	0.8926
11:54	1.420579	1.5739	0.9026	0.8591	1.6536	1.5991	0.8884
11:56	1.413666	1.5719	0.8993	0.8577	1.6481	1.5966	0.8854
		<b>Avg.</b>	<b>0.909</b>		<b>1.665</b>		<b>0.896</b>
		<b>Sigma</b>	<b>0.0073</b>		<b>0.0130</b>		<b>0.0091</b>

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. August 29, 2005 NREL Global Erythema Calibration Summary

Time (MST)	Erythema Spectrum W/m <sup>2</sup>	Erythema Spectrum MED/Hr	Erythema Spectrum Index	501A V (avg.)	Erythema MED/Hr/V	Erythema Index/V
11:46	0.19668	3.37353	7.86707	0.8615	3.9160	9.1321
11:48	0.19658	3.37185	7.86314	0.8632	3.9064	9.1096
11:50	0.19586	3.35960	7.83458	0.8627	3.8944	9.0817
11:52	0.19417	3.33048	7.76668	0.8610	3.8682	9.0207
11:54	0.19290	3.30871	7.71592	0.8591	3.8514	8.9816
11:56	0.19206	3.29429	7.68229	0.8577	3.8406	8.9564
				<b>Avg.</b>	<b>3.880</b>	<b>9.047</b>
				<b>Sigma</b>	<b>0.0307</b>	<b>0.0715</b>

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

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 29 Aug 2005

OL756 Global Horizontal Spectra and UVB Normalized Spectral Responses

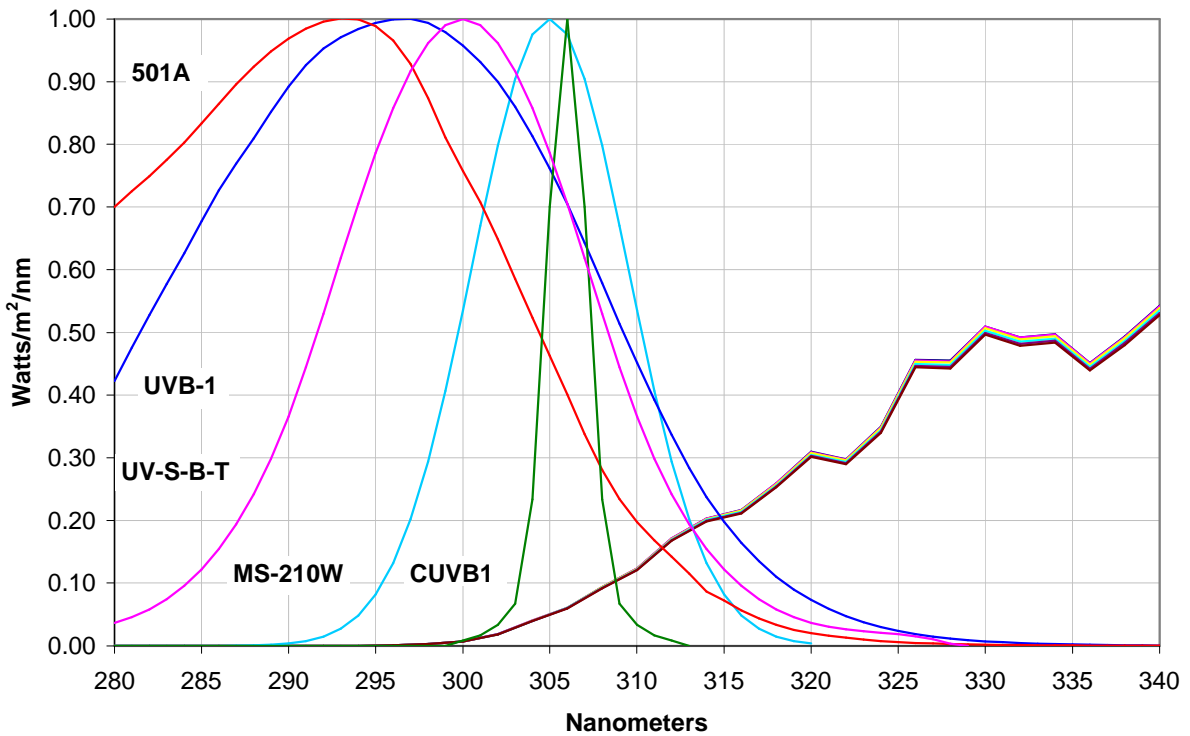


Figure 2. Derived Erythema Spectral Distributions indicated by OL-756 on 29 Aug 2005

