

Calibration Certificate

No. 2008-92-10-3

Calibration Item

UVB Pyranometer

Manufacturer	Yankee Environmental Systems, Inc.
Type	UVB-1
Serial number	010938

Customer

PMOD/WRC
Dorfstrasse 33
7260 Davos Dorf
Switzerland

Calibration Mark

2008-92-10-3

Date of calibration

14 July, 2008

Davos Dorf, 24 September, 2008

Dr. Gregor Hülsen
In charge of calibration

Dr. Julian Gröbner
Head UV Center

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Calibration procedure

The directional response $\text{Angres}(\Theta)$ of the test instrument was measured using a collimated horizontal beam from a 1000 W Xe-Lamp and rotating the instrument around a vertical axis passing through the center of its receiver surface (Hülsen and Gröbner, 2007). A WG295 filter was placed in the beam path to remove all light below approximately 300 nm. The distance between the source and the receiver surface was about 3 m. The cable connector defines the North orientation and should point to North. The directional response was normalised at normal incidence.

Angular response $\text{Angres}(\Theta)$: – angles_yes010938_1962008.dat –

Zenith angle Θ	Average	North plane	South plane	East plane	West plane	u
0	1.00000	1.00000	1.00000	1.00000	1.00000	0.02651
5	0.98790	1.00861	1.00319	0.97439	0.96542	0.02574
10	0.97479	0.99469	0.98707	0.96624	0.95115	0.02632
15	0.95135	0.96656	0.96149	0.94712	0.93023	0.02622
20	0.91551	0.92546	0.92220	0.91252	0.90187	0.02551
25	0.87606	0.88376	0.88380	0.87763	0.85907	0.02575
30	0.82784	0.84084	0.83302	0.82852	0.80900	0.02543
35	0.77169	0.78110	0.76895	0.78353	0.75320	0.02455
40	0.70566	0.71756	0.70118	0.71546	0.68844	0.02317
45	0.63617	0.64441	0.63586	0.64809	0.61633	0.02155
50	0.55701	0.56543	0.55446	0.56518	0.54298	0.01955
55	0.47359	0.47897	0.47071	0.48099	0.46368	0.01710
60	0.38816	0.39256	0.38448	0.39418	0.38141	0.01442
65	0.30186	0.30421	0.29905	0.30620	0.29796	0.01174
70	0.21619	0.21931	0.21308	0.21894	0.21343	0.00857
75	0.13464	0.13700	0.13204	0.13706	0.13244	0.00566
80	0.06431	0.06605	0.06207	0.06636	0.06275	0.00285
82	0.03531	0.03627	0.03467	0.03627	0.03402	0.00169
85	0.01162	0.01220	0.01138	0.01216	0.01072	0.00065
87	0.00252	0.00225	0.00305	0.00199	0.00278	0.00020
88	0.00296	0.00243	0.00371	0.00232	0.00339	0.00032
90	0.00821	0.00657	0.01000	0.00728	0.00898	1.00000

Cosine Error f_d :

$$f_d = 2 \int_0^{\pi/2} \text{Angres}(\Theta) \sin(\Theta) d\Theta$$

	Cosine Error f_d
North plane	0.85
South plane	0.83
East plane	0.84
West plane	0.82
Average	0.83
u	0.02

The diffuse (isotropic) cosine error f_d is obtained by integrating the directional response for each plane assuming no azimuth dependence and an isotropic radiation distribution.

The reported expanded uncertainty of measurement **u** is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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Measurement conditions:

Room temperature $21.4 \pm 0.8^\circ \text{C}$
Room humidity $46.3 \pm 1.0 \%$
Dark signal $0.006508 \pm 0.001307 \text{ V}$
Maximum intensity 0.557 V

References

G. Hülsen and J. Gröbner. Characterization and calibration of ultraviolet broadband radiometers measuring erythemally weighted irradiance. *Appl. Optics*, 46:5877–5886, 2007.

Measurement summary:

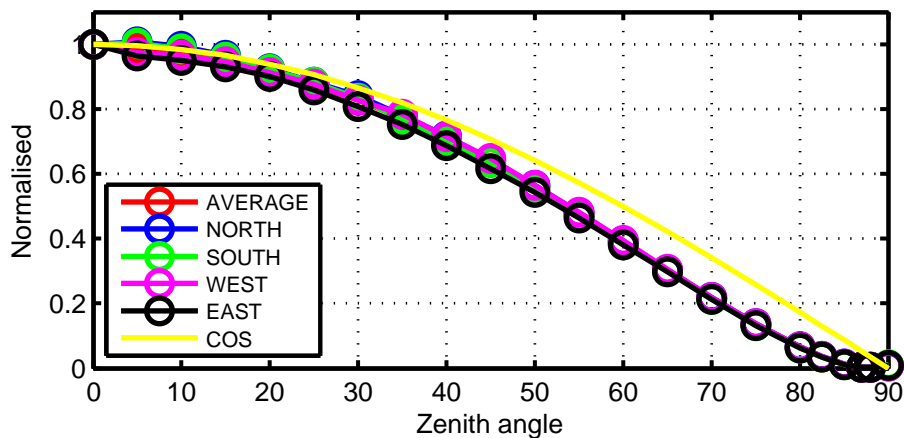


Figure 1: Directional response in all four planes

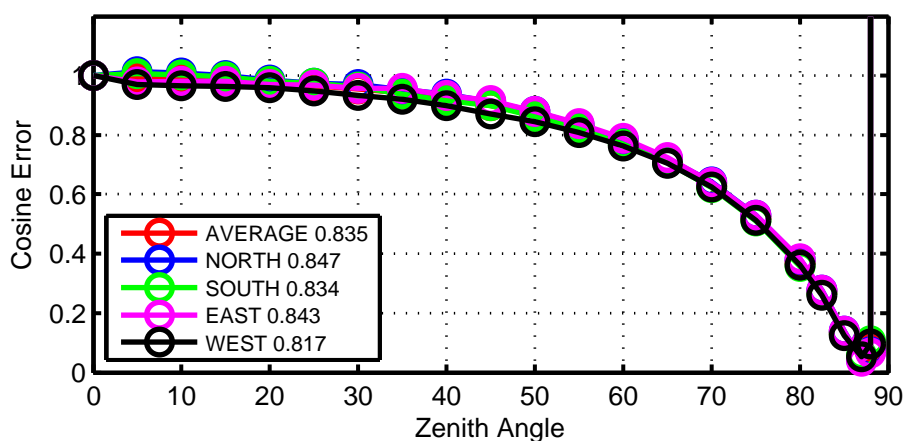


Figure 2: Cosine error in all four planes