Figure 7 Description of calibration set-ups at AIST

A PRELIMINARY STUDY OF THE INDOOR CALIBRATION FOR SKY RADIOMETER

S Igari, J. Kokubo, H. Zhou, Y. Xue, N. Manako, H. Kuze

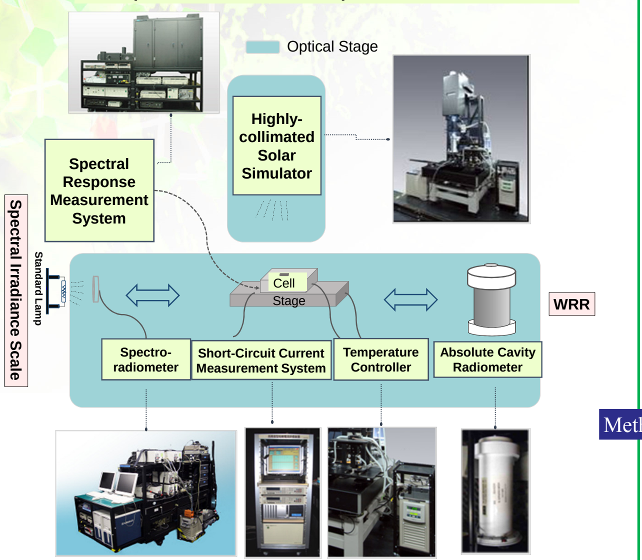
(National Institute of Advanced Industrial Science and Technology (AIST))
(Center for Environmental Remote Sensing, Chiba University)

abstract

The accuracy of the solid view angle of sky radiometer is very important in retrieving aerosol single scattering albedo. One of the methods for obtaining the solid view angle is to measure the spectral irradiance of a uniform light source which radiance is known, indoors, based on the relation between radiance and irradiance. However, the accuracy of using this method is influenced by some measurement uncertainties, especially, those of the extraterrestrial solar spectrum from different sources. In this study, a new method was proposed in order to improve the accuracy of the solid view angle. Estimation.

methods

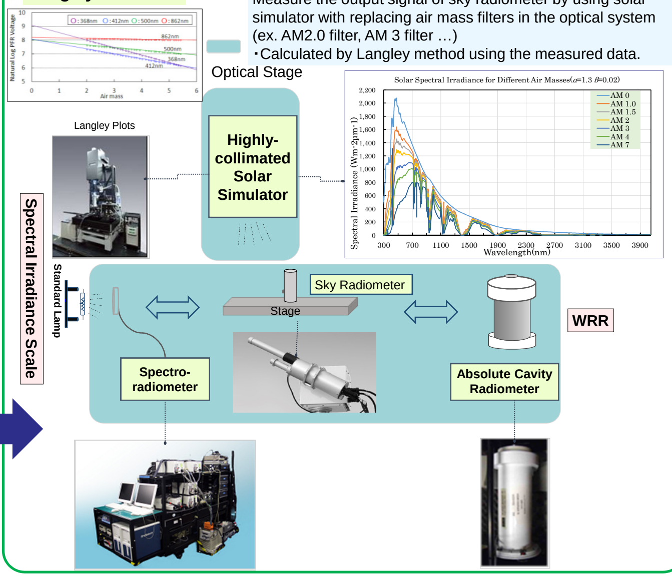
Description of calibration set-ups of Reference PV Device



Method 1

Langley Method

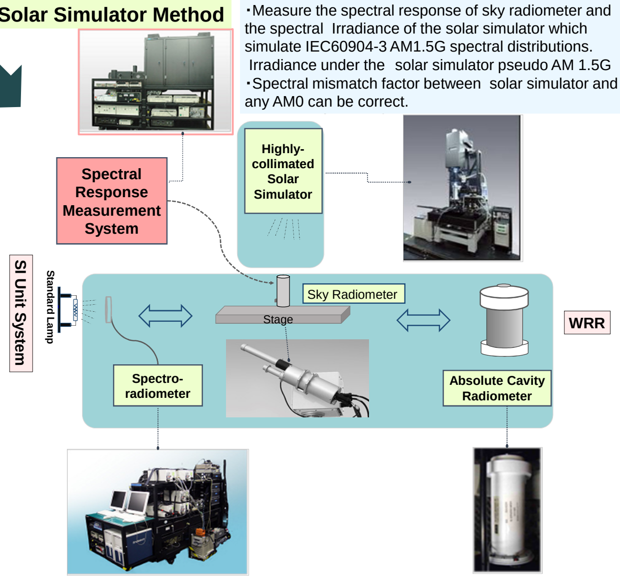
Measure the output signal of sky radiometer by using solar simulator with replacing air mass filters in the optical system (ex. AM2.0 filter, AM 3 filter …)
・Calculated by Langley method using the measured data.



Method 2

Solar Simulator Method

・Measure the spectral response of sky radiometer and the spectral Irradiance of the solar simulator which simulate IEC60904-3 AM1.5G spectral distributions. Irradiance under the solar simulator pseudo AM 1.5G
・Spectral mismatch factor between solar simulator and any AM0 can be correct.



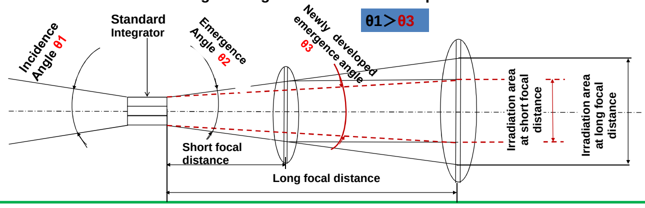
Mismatch factor is calculated as follows.

$$MM = \frac{\int_{\lambda_1}^{\lambda_2} E_{ss}(\lambda_i) \times SR(\lambda_i) d\lambda}{\int_{\lambda_1}^{\lambda_2} E_{ref}(\lambda_i) \times SR(\lambda_i) d\lambda} \quad (i = 0, 1 \ldots\ldots n) \qquad \text{Formula 1}$$

(λ_1, λ_2) is bandwidth from λ_1 to λ_2 of sky radiometer's spectral responsivity.
$E_{ss}(\lambda_i)$ is the spectral irradiance of the solar simulator at wavelength λ_i.
$E_{ref}(\lambda_i)$ is the reference spectral irradiance at wavelength λ_i
$R(\lambda_i)$ is the spectral responsivity of sky radiometer at wavelength λ_i

Development of optical system to establish both light parallelism and irradiation efficiency

- Usual integrator design prioritizing irradiation efficiency : same incidence/emergence angle
- High parallel light to reduce the ratio of incidence/emergence angle designed at long focal distance
- To prevent the drop of illuminance due to light scattering, integrator with small diameter and high strength needs to be developed



Develop Highly-collimated solar simulator to calibrate irradiance using absolute cavity radiometer

- ・IEC60904-9 Class AAA
- ・Wavelength range:280 - 2500 nm
- ・Ray Parallelism :0.58° (Half angle)
- ・View angle : 5°
- ・Temporal stability : 0.1 %/hour

Patent:498288(Japan)
8016439(USA)

Irradiance with more than100mW/cm^2 and high uniformity (<±0.7% 5.0cm^2)

Source of uncertainty	Value of standard uncertainty%	
	Absolute Cavity Radiometer	Standard Lamp
1 Calibration of Absolute Cavity Radiometer /Spectral Irradiance Standard Lamp	0.100	1.400
2 Repeatability of measuring reference solar cell	0.120	0.120
3 Uncertainty due to multiple reflection correction factor	0.080	0.080
4 Uncertainty due to Spectral mismatch correction factor	0.316	0.316
Combined relative standard uncertainty	0.361	1.442
Expanded uncertainty	0.72	2.88

Conclusion

・Indoor calibration of the sky radiometer is possible to change the spectrum of solar simulator theoretically.
・When spectral responsivity of the sky radiometer is measured, spectral mismatch correction between solar simulator and any reference spectrum becomes possible.