Validation of Cosine Error Determination

Since appropriate laboratory data are not available, we calculated the cosine error of the SUV-100 spectroradiometer from measurements with a test apparatus and by comparing measured and modeled spectral irradiance at 600 nm. The procedure is described in detail by *Bernhard et al*. [2004] using data of the SUV-100 instrument at the South Pole. Here we present a comparison of results of the test apparatus and the model-based parameterization for the instrument at McMurdo. The analysis is similar to that described in Section S2.3.2 of *Bernhard et al*. [2004]. The measurements with the test apparatus were performed in February 2000 before upgrading the instrument's cosine collector. At the time of the measurement, the instrument's cosine error $f_B(\theta, \lambda, \varphi)$ was depending on azimuth angle φ and wavelength λ, in addition to zenith angle θ.

Figure 1 shows $f_B(\theta, \lambda, \varphi)$ versus wavelength for a zenith angle of $\theta = 70°$ and four azimuth angles. The drop in the response at 505 nm is caused by a Wood anomaly [*Palmer*, 2002], and is well reproduced by both measurement and parameterization. At $\varphi = 0°$ and $\varphi = 90°$, the agreement of both data sets is almost ideal. At $\varphi = 180°$ and 270°, there is a difference of about 4-7%. This level of agreement is acceptable, though not ideal, and indicates that the model-based approach is feasible for determining the instrument's cosine and azimuth errors. Below 340 nm, the measurement becomes unreliable due to low signal levels. Below this wavelength, the parameterization is also problematic, partly because of the small contribution of direct solar beam to global irradiance and partly because of the increasing influence of ozone absorption.

We calculated the mean cosine error at $\theta = 70°$ by averaging the test apparatus results over all azimuth angles (broken line with triangles in Figure 1). The error is almost independent of wavelength and on average –1.9%. The average cosine error at 70° of the parameterization is –2.4%, and independent of wavelength by construction.

References

Bernhard, G., C.R. Booth, and J.C. Ehramjian (2004), Version 2 data of the National Science Foundation's Ultraviolet Radiation Monitoring Network: South Pole, *J. Geophys. Res*., *109*, D21207, doi:10.1029/2004JD004937.

Palmer C. (2002), Diffraction grating handbook, Richardson Grating Laboratory, Rochester, New York, available at http://www.gratinglab.com.

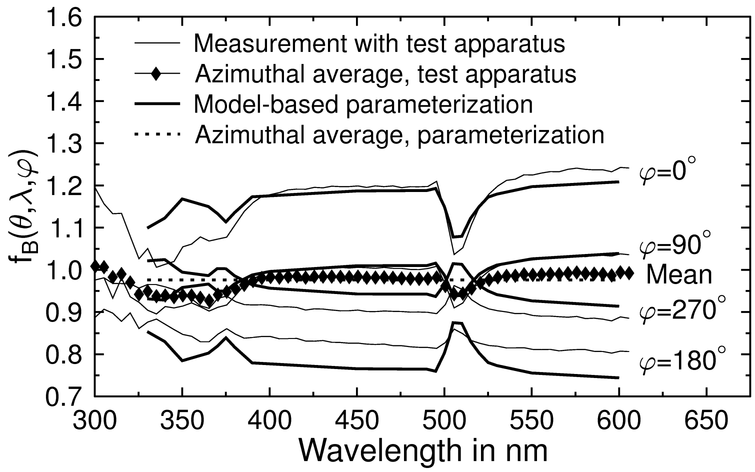

Figure 1. Cosine error $f_B(\theta,\lambda,\varphi)$ at $\theta = 70°$ as a function of wavelength for the azimuth angles φ = 0°, 90°, 180°, and 270°. Thin lines indicate results obtained from measurements with the test apparatus during the site visit at McMurdo in February 2000. Thick lines are based on the parameterization. The lines labeled "Mean" give the azimuthally averaged cosine error based on measurement and parameterization.