CORRESPONDENCE

Comments on "A Model for Solar Irradiance and Radiance at the Bottom and Top of a Cloudless Atmosphere"

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In the paper by Justus and Paris (1985), they show a comparison of their hourly values of direct normal irradiance, measured with a pyrheliometer in cloudless conditions, with their corresponding model values calculated by integrating over the solar spectrum. For 290 data points, they found a measured mean hourly value of 2960 kJ m^{-2}, a calculated mean of 2911 kJ m^{-2}, and an rms error about a one-to-one regression line of 2.5% of the observed mean.

My comment is with respect to the authors' finding that the measured mean was only 1.7% greater than the calculated mean. Because the 5.7° field of view of the pyrheliometer used for measuring direct normal irradiance includes not only the direct radiant energy within the sun's ~0.5° subtended angle but also the circumsolar irradiance within a ~3° annulus around the sun, measured values are always greater than calculated values. The average contribution of circumsolar irradiance in the pyrheliometer's field of view, however, has been found to be greater than 4% and as much as 10% of the actual direct normal irradiance, rather than only about 2% (Watt Engineering Ltd., 1978, Baker and Kuhn, 1984). The latter authors analyzed measurements and calculations of direct irradiance and showed that the difference, or circumsolar irradiance, depends on solar zenith angle, aerosol optical depth, water vapor and characteristics of aerosol size distributions. Additional work at the University of Michigan corroborates an average percentage greater than 2%. It also discloses a seasonal variation consisting of summer minima and winter maxima, however, that may be partly responsible for the smaller percentage found by Justus and Paris.

REFERENCES

Baker, C. B., and W. R. Kuhn, 1984: Measurements of circumsolar radiation and its variation with water vapor, aerosols and solar zenith angle. *IRS84: Current Problems in Atmospheric Radiation,* G. Fiocco, Ed., A. Deepak Publications, 62–65.

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Watt Engineering Ltd., 1978: On the nature and distribution of solar radiation. Rep. HCP/T 2552-01, U.S. Dept. of Energy, 256 pp.