

On the Radiation Tables of Elsasser and Culbertson

WILFORD G. ZDUNKOWSKI

Dept. of Meteorology, University of Utah, Salt Lake City

Recently, Staley and Jurica (1970) presented tables of isothermal flux emissivities which were obtained by computing isothermal fluxes using the temperature dependent generalized absorption coefficients due to Elsasser and Culbertson (1960). Staley and Jurica pointed out that the computation of isothermal fluxes using Elsasser's and Culbertson's radiation tables directly results in incorrect values. They observed that the modified radiation tables due to Zdunkowski *et al.* (1966) yield the proper isothermal fluxes. This statement was verified by Zdunkowski *et al.* for all absorption bands, optical pathlengths and temperatures listed by Elsasser and Culbertson although the results were not publicized.

The purpose of this note is to point out that the modified, as well as the original, radiation tables by Elsasser and Culbertson for the computation of fluxes F are based on an approximate solution of the radiative transfer equation, i.e.,

$$F = - \int d\nu \int_{u_0}^{u_1} B_\nu(T(u)) \frac{\partial \tau_f [L_\nu(T)(u-u_0)]}{\partial u} du,$$

where ν is wavenumber, B_ν the monochromatic hemispheric blackbody flux, τ_f the flux transmission function,

L the generalized absorption coefficient, T temperature ($^{\circ}\text{K}$) and u the optical pathlength of the radiating gas.

The exact form of the above equation, however, requires that the argument of the transmission function contains the integral over the optical pathlength with L occurring under the integral sign. It seems very difficult, if not impossible, to solve in an exact manner the radiative transfer equation in its complete form by a simple two-dimensional u, T table of Elsasser type construction if the generalized absorption coefficient varies with temperature. Bowling¹ (1970) comes to a similar conclusion and proposes an alternate procedure to correct the radiation tables of Elsasser and Culbertson. Details will be given by Bowling in a future paper.

REFERENCES

- Elsasser, W. M., and M. F. Culbertson, 1960: Atmospheric radiation tables. *Meteor. Monogr.*, 4, No. 23, 1-43.
 Staley, D. O., and G. M. Jurica, 1970: Flux emissivity tables for water vapor, carbon dioxide and ozone. *J. Appl. Meteor.*, 9, 365-372.
 Zdunkowski, W. G., R. E. Barth and F. A. Lombardo, 1966: Discussion on the atmospheric radiation tables by Elsasser and Culbertson. *Pure Appl. Geophys.*, 63, 211-219.

¹ Bowling, S. A., 1970: Personal communication. Geophysical Institute, University of Alaska College, Alaska 99701.