

RELATIONSHIP BETWEEN THE SPECTRAL LINE BASED WEIGHTED-SUM-OF-GRAY-GASES MODEL AND THE FULL SPECTRUM K-DISTRIBUTION MODEL

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ABSTRACT. The relationship between the spectral line based weighted-sum-of-gray-gases (SLW) model and the full-spectrum k -distribution (FSK) model in isothermal and homogeneous media is investigated in this paper. The SLW transfer equation can be derived from the FSK transfer equation expressed in the k -distribution function without approximation. It confirms that the SLW model is equivalent to the FSK model in the k -distribution form. The numerical implementation of the SLW relies on a discretization of the absorption cross section whereas the FSK model finds the spectrally integrated intensity by integration over the smoothly-varying cumulative- k distribution function using a Gaussian quadrature scheme. The latter is therefore in general more efficient as fewer gray gases are required to achieve a prescribed accuracy. Sample numerical calculations were conducted to demonstrate the different efficiency of these two methods. The FSK model is more efficient than the SLW model in radiation transfer in H₂O; however, the two models perform similarly in CO₂.