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ON THE COMPROMISE BETWEEN ACCURACY AND COMPUTATIONAL COST FOR DIFFERENT GLOBAL SPECTRAL MODELS

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ABSTRACT. This paper presents an analysis of the performance of the three most common global spectral models for gas radiation, the weighted-sum-of-gray-gases (WSGG), the spectral line-based WSGG (SLW), and the full-spectrum k-distribution (FSK) models, when applied with the same number J of gray gases or quadrature nodes. The main purpose of the work is to assess and compare the accuracy of these models at a same level of computational cost. Values of $J = 3$ to $J = 8$ are considered. Decoupled, one-dimensional calculations on a purely H_2O participating medium are carried out, with the line-by-line (LBL) method serving as the reference. The rank-correlated approach is used for the SLW and FSK models, and new correlations based on a high-resolution database are generated for the WSGG model. Of the three models, the WSGG generally performs the worst, and the FSK, the best, even for $J = 3$. For this smallest J, the SLW model yields very large errors, but starting from $J = 4$ its accuracy is comparable to that of the FSK model. Increasing J tends to reduce the errors of these two models, but it has no effect on the WSGG model for $J > 4$.

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