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PERFORMANCE REPORT

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Attached is a copy of a conference presentation that was given at the DOE Atmospheric Radiation Measurement (ARM) Science Team Meeting in San Diego, CA in February 1995. The research reported at the meeting was carried out under the auspices of the NASA Cooperative Agreement Number NCC 2-817. The Cooperative Agreement is a three year agreement and this presentation represents the performance report for the second year.

USE OF ARM MEASUREMENTS TO IMPROVE RADIATIVE TRANSFER MODELS USED IN CLIMATE MODELS

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1. INTRODUCTION

The demands of accurate predictions of radiative transfer for climate applications are well-documented. While much effort is being devoted to evaluating the accuracy of the GCM radiative transfer schemes, the problem of developing accurate, computationally efficient schemes for climate models still remains. This paper discusses our efforts in developing accurate and fast computational methods for global and regional climate models.

2. RADIATIVE TRANSFER MODEL

We have used the two-stream model developed by Toon et al. (1989), that is computationally efficient and has been tested in a number of applications (e.g. Westphal, et al. 1992). The model assumes horizontally homogeneity and a number of vertically inhomogeneous layers. In the solar wavelengths the model uses the two-stream approximation in a generalized framework as described by Meador and Weaver (1980). In the infrared it performs a direct integration in the case of no scattering and uses a two-stream source function approximation technique to include scattering if needed.

The model is used to calculate the solar and infrared fluxes and heating rates in the earth's atmosphere. The absorption by gases is treated by an exponential K-distribution technique with values taken from Pollack et al. (1975) for the solar spectrum and from Clough and Mlawer, (see extended abstract from this meeting) for the infrared spectrum. The treatment of the water vapor continuum is discussed below. The model has 26 solar wavelengths regions and 16 infrared wavelength regions, while the number of probability intervals (which represent the actual number of separate calculations needed) is 77 in the solar and 256 in the infrared.

The model is capable of treating aerosols and clouds in both the solar and the infrared. The properties of the aerosols and clouds are described by a particle size distribution and the Mie equations are integrated to evaluate the radiative properties.

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4. COMPARISON TO LINE BY LINE CALCULATIONS

We have compared the results of the model to the results of line by line calculations provided by Tony Clough of AER. The results are shown in Figure 1.

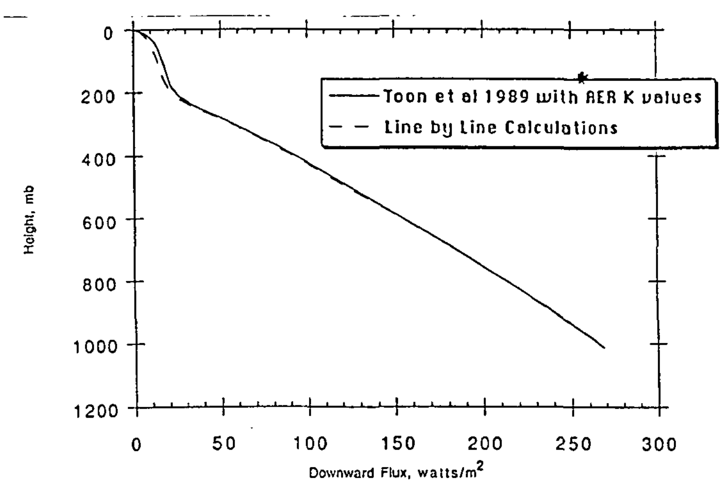

FIGURE 1: Comparison of the two-stream model (RADTST) and the line-by-line result (LBLRTM).

The results show that the model can reproduce the fluxes from the line by line calculations extremely well.

5. FUTURE WORK

We are currently extending the K- distribution method to produce a complete set of gas absorption coefficients for the entire infrared spectrum. The new HITRAN-92 data base is being used to derive the K-distributions and coefficients at specific temperatures and pressures for the major atmospheric trace gases. The problems include accounting for the overlap of different atmospheric gases; accounting for the line behavior in both high and low pressures, and choosing the appropriate spectral intervals. Our goal is to have a computationally efficient model that will be accurate from the surface up to 60 km.

We will present more detailed results at the meeting.

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