Intercomparison of shortwave radiative transfer schemes in global aerosol modeling: Results from the AeroCom Radiative Transfer Experiment


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Abstract. In this study we examine the performance of 29 global model radiative transfer schemes in cloud-free conditions with prescribed gaseous absorbers and no aerosols (Rayleigh atmosphere), with prescribed scattering aerosols, and with more absorbing aerosols. Results are compared to benchmark results from high-resolution line-by-line radiation models. For purely scattering aerosols, model bias relative to the line-by-line models in the top-of-the-atmosphere aerosol radiative forcing ranges from roughly -20 to 10%, with underestimates at higher and lower sun elevation, respectively. Inter-model diversity (standard deviation) increases from ~10 to 20% as sun elevation increases. At high sun elevation, the diversity in aerosol radiative forcing decreases as aerosol absorption increases (by ~4%), indicating that multiple-scattering is more uncertain than aerosol absorption in the models considered. Multi-stream models generally perform better than simpler two-stream schemes in calculating aerosol radiative forcing. Overall, model performance is generally the same or slightly better than results from previous radiation scheme intercomparisons. However, the inter-model diversity in aerosol radiative forcing remains large, primarily as a result of the treatment of multiple-scattering. Results indicate that global models that estimate aerosol radiative forcing may be subject to persistent biases introduced by their radiation schemes, particularly for regional aerosol forcing.