International Intercomparison of Three-Dimensional Atmospheric Radiative Transfer - Applications and Methods Comparison

R. F. Cahalan
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland

Introduction

Three-dimensional (3-D) radiative transfer applications in the earth's atmosphere are reviewed, emphasizing the wide spectrum of scales important to remote sensing and modeling of cloud fields. We define the "plane-parallel bias," a measure of the importance of 3-D cloud structure in large-scale models, and "independent pixel errors" that quantify the significance of 3-D effects in remote sensing. A variety of approaches in current use in 3-D radiative transfer, and issues of speed, accuracy, and flexibility are summarized.

The International Intercomparison of 3-D Radiation Codes (I3RC) is described. I3RC is a 3-phase effort jointly funded by the U.S. Department of Energy (DOE) and National Aeronautics and Space Administration (NASA), and organized to (1) understand the errors and limits of 3-D methods, (2) provide 'baseline' cases for future 3-D code development, (3) promote sharing of 3-D tools, (4) derive guidelines for 3-D tool selection, and (5) improve atmospheric science education.

Selected results are discussed from three cloud fields: a one-dimensional (1-D) field of bar clouds, a two-dimensional (2-D) radar-derived field, and a 3-D Landsat-derived field, for two monochromatic wavelengths (one conservative, one absorptive) and two solar zenith angles (0, 60 degrees).

Participating methods include Monte Carlo, SHDOM, and other discrete ordinates codes, and approximate methods including discrete-angle, diffusion, and stochastic methods. Twenty-one groups from several countries, including Canada, Germany, Russia, and the United States, participate. Results are at http://i3rc.gsfc.nasa.gov/ . Phase 2 is under way, and focuses on cloud fields computed by two cloud-resolving models. See the i3rc website for details.

Corresponding Author

R. F. Cahalan, Robert.Cahalan@gsfc.nasa.gov, (301) 614-5390