IRS2012-413
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012
© Author(s) 2012

Computation of top-of-atmosphere thermal radiances and fluxes: The importance of 3D radiative transfer for the EarthCARE satellite mission

J. Cole (2) and H. Barker (1)

(1) Environment Canada, Cloud Physics and Severe Weather Research Section, Toronto, Ontario, Canada (howard.barker@ec.gc.ca), (2) Environment Canada, CCCma, Victoria, BC, Canada

The ultimate goal of the EarthCARE satellite mission is to retrieve cloud and aerosol properties accurately enough to be able to use them to initialize radiative transfer models and compute broadband top-of-atmosphere (TOA) radiative fluxes to within 10 W m-2 of "observed" values over 10 km x 10 km domains. In order to assess whether retrieved quantities are accurate enough to reach this goal, one can use retrieved fields to either: i) compute fluxes and compare them to estimated values from angular direction models (ADMs); or ii) compute radiances and compare them directly to those measured by EarthCARE's broadband radiometer. For the longwave portion of the spectrum 3D radiances can be computed very efficiently using the backward Monte Carlo method. This method is, however, much less efficient for fluxes. Nevertheless, fluxes and radiance are computed using 1D techniques and results compared to 3D solutions. While a multitude of potential errors can lead to errors in TOA radiances and fluxes, e.g., retrieval errors, we focus in this presentation on errors one can expect in the tropics due to use of the Independent Column Approximation (ICA) as opposed to full 3D radiative transfer.

To perform these tests we use output from a well resolved (250 m) large domain (3200 km x 256 km), cloud system-resolving model (CSRM). The lower boundary condition using in the simulation was a time-invariant ocean with sinusoidally varying temperature along the longer axis with single maxima and minima across the domain. This resulted in a range of cloud types that may be encountered in the tropics (deep convection over warm water transitioning to boundary layer clouds over cooler regions). The simulation output is used as input for the radiative transfer calculations (ICA and 3D) and statistics aggregated to illustrate the magnitude of the differences. To put these differences due to radiative transfer calculation methods into context results will also be show in which uncertainties are applied to the cloud system resolving model output to mimic retrieval uncertainties.