AeroCom Radiative Transfer Experiment

Organization:

Organizers

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Goal: To assess AeroCom global model solar radiative transfer routines in support of the AeroCom Direct Forcing inter-comparison study

Introduction and Motivation:

There is considerable diversity in aerosol radiative forcing estimates from both global aerosol models and satellite retrievals. The proposed AeroCom Prescribed Forcing experiment seeks to facilitate the quantification of processes and assumptions in host models which may contribute to some of the variability in model direct aerosol radiative forcing estimates. Here we propose and additional, simple model inter-comparison study with prescribed standard atmospheres and surface albedo to test global model solar radiative transfer routines *without aerosols or clouds*. This experiment will reveal how each model treats Rayleigh scattering, ozone absorption, and water-vapor absorption and will facilitate analysis of the AeroCom Prescribed Forcing experiment results.

In order to avoid coding errors (e.g. when exporting the radiative transfer routing), we propse to use the same global GCM/CTM as set up for the AeroCom A2-ZERO experiment. For this experiment, this setup will be run for just one day by manipulating the radiative transfer code. We suggest to make a few changes to the radiative transfer routing: the surface albedo, ozone mixing ration, and water vapor mixing ratio.

At minimum, we request interested models to participate in CASE I (Rayleigh Scattering Atmosphere; see below). However, we also encourage interested models to also participate in CASE II (Atmosphere with Aerosols).

Experimental Setup

CASE I: Rayleigh Scattering Atmosphere

Following *Halthore et al.* [2005], to assess the radiative transfer routine in each host model, participating modeling groups must perform two one-day (01 Jan 2006) simulations, each with one of two *aerosol-and cloud- free* prescribed standard atmospheres (i.e. O_3 and water vapor profiles prescribed globally from the AFGL tropical and sub-arctic winter standard atmospheres). For each one-day simulation, surface albedo must be prescribed at 0.2 globally. AFGL standard atmospheres for ozone and water vapor are given in the attached text files (*saw.txt* and *tropical.txt*). Diagnostics (see below) will be examined for two specific sun elevations (solar zenith angles of 30 and 75 degrees) for each standard atmosphere simulation.

CASE II: Atmosphere with Aerosols
Again following *Halthore et al.* [2005], we augment CASE I by specifying an aerosol loading (both lower absorption and higher absorption. Again, surface albedo is prescribed at 0.2 globally, and we again consider the two standard atmospheres (Tropical and sub-Arctic Winter), and diagnostics will be analyzed at 30 and 75 degree solar zenith angles.

Purely Scattering Case Specifications:
- AOT = 0.2 at 550 nm (lowest 2 km)
- Asymmetry factor $g = 0.7$ (wavelength independent)
- Single scattering albedo $\omega_0 = 1.0$ (wavelength independent)
- Ångstrøm exponent is 1.0

Absorbing Case Specifications:
- AOT = 0.2 at 550 nm (lowest 2 km)
- Asymmetry factor $g = 0.7$ (wavelength independent)
- Single scattering albedo $\omega_0 = 0.8$ (wavelength independent)
- Ångstrøm exponent is 1.0

Requested Diagnostics
All data needs to be submitted in netCDF format, following the CF convention and should be post-processed with the CMOR rewriting tool (http://www-pcmdi.llnl.gov/software-portal/cmor/). Specific CMOR tables for the AeroCom A2 can be used for the experiments described here and can be downloaded at http://www-lscedods.cea.fr/aerocom/CMOR/.

The diagnostics are summarized in an excel table, available via the AeroCom website: http://nansen.ipsl.jussieu.fr/AEROCOM/AEROCOM_diagnostics.xls under the DIRECT FORCING diagnostics package.

For each simulation day (one for each standard atmosphere; tropical and sub-arctic), instantaneous output of 2D fields at one model time-step are required for each of the three diagnostics requested. Ideally this could be the first time step, but at noon UTC or at the last time step is equivalent and can be submitted as well.

CASE I Diagnostics
The four diagnostics requested for the *aerosol-and-cloud-free* atmosphere are:
- SW downwelling flux at the top of the atmosphere
- SW downwelling surface flux clear sky
- VIS (0.2-0.7 µm) downwelling surface flux in clear sky
- SW downwelling diffuse flux in clear sky

These diagnostics are also examined for the A2-ZERO experiment and are part of the DIRECT-FORCING diagnostics package, and this experiment is thus a simple extension of that experiment. In total, for CASE I a total of 8 numbers will be compared (4 for TROP and 4 for SAW standard atmospheres).

CASE II Diagnostics

The four diagnostics requested for the *cloud-free* atmosphere are (note: aerosols are specified here as per CASE II specifications):

- SW downwelling flux at the top of the atmosphere
- SW downwelling surface flux clear sky
- VIS (0.2-0.7 μm) downwelling surface flux in clear sky
- SW downwelling diffuse flux in clear sky

These diagnostics are also examined for the A2-ZERO experiment and are part of the DIRECT-FORCING diagnostics package, and this experiment is thus a simple extension of that experiment. For each standard atmosphere (TROP and SAW), these 4 diagnostics will be examined for (a) Purely-scattering aerosol and (b) Absorbing aerosol. In total, 16 numbers will be compared.

The time frame for completion and submission of results is December 2009.

References and Data Sets

Halthore, R.N. *et. al.*, (2005), Intercomparison of shortwave radiative transfer codes and measurements, *J. Geophys. Res.*, *110*, D11206, doi:10.1029/2004JD005293.

<u>AFGL standard atmospheres files:</u> *saw.txt*, *tropical.txt*