Atmos. Chem. Phys. Discuss., 11, C12499–C12502, 2011
www.atmos-chem-phys-discuss.net/11/C12499/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulation of mineral dust aerosol with piecewise log-normal approximation (PLA) in CanAM4-PAM" *by* Y. Peng et al.

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Received and published: 30 November 2011

This paper gives a concise description of a new dust aerosol scheme for the Canadian Atmospheric Model (CanAM4), along with extensive validation against selected observational datasets. CanAM4 has been run in both a climatological mode and in a nudged mode for particular meteorological years. The latter allows for case studies that include short term observations, and the authors include a comparison to dust surface concentration measurements for the Spring seasons of 2000 and 2001 over an extended region including Beijing and northern China. The year 2000 simulation is also used to place CanAM4 in the context of the aerosol intercomparison project AERO-

COM. In particular, results for the dust mass budget, lifecycle and global mean optical depth are all within AEROCOM norms. Climatological mode validation is based on comparison to MODIS and MISR single wavelength (visible) standard AOD retrievals, as well datasets of dust surface concentration and deposition. The clear-sky direct dust radiative forcing (affect) is computed for the nudged 2001 simulation and compares well to an observational study based on CERES-MODIS shortwave fluxes.

This paper should be of interest to other global dust modeling efforts, in particular those pursuing improved representations of size segregated dust distributions. It also serves the important purpose of describing a new component of the CanAM4 general circulation/climate model. I recommend it proceed towards acceptance for publication with some minor additions and clarifications.

(1) Inclusion of AERONET - While AERONET is mentioned in the introduction, comparisons to AERONET derived AODs are not included in the current manuscript. Of special interest is a long record site on the Azores in the Atlantic, downwind of easterly Saharan dust plumes, as well as various sites on the Arabian peninsula. Data from sites near Beijing, if available, could nicely augment the northern China case study. In addition to direct beam attenuation retrievals of AOD, AERONET almucantar inversions provide some information on aerosol size distribution and composition, which may prove useful in further analysis of the dust scheme presented in the paper.

(2) Inclusion of MODIS Deep Blue aerosol retrievals - The authors should include mention of the Deep Blue MODIS AOD retrievals over bright (desert) surfaces, available now for both Terra and Aqua in MODIS Collection 5.1. A comparison to Deep Blue AOD might be included as well, or, if not, a brief explanation of why MISR (or the Donkelaar MODIS/MISR combined product) is preferred over Deep Blue.

(3) Discussion of the potential for additional satellite based information - The authors indicate that satellite retrievals have difficulty discriminating amongst various aerosol types. MISR, however, does attempt to report AOD by aerosol type. Whether the type-

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specific retrievals are of sufficient accuracy is not clear. The standard MODIS ocean product includes small mode and large mode aerosol fractions, as well as Angstrom exponents at two wavelengths. A comparison of Angstrom exponents (also included in the Deep Blue product) might help further validate the dust size distributions. These topics may be appropriate for inclusion in a subsequent study.

(4) Further discussion of vegetation cover - The vegetation cover is stated as being based on an 1850-2005 land surface model climatology. Since the model is being evaluated against present day surface and satellite observations, it may be more suitable to use a much shorter time period, for example, 2000 - present. Land surface changes over interannual and decadal time scales are relevant for dust emissions. For example, the Aral Sea has rapidly receded over the last five decades and is now a significant dust source. Mention of potential issues related to vegetation variability could be included.

Technical changes

The total simulated annual mean dust burden is for year 2000, which is consistent with estimates from other models. — The total simulated annual mean dust burden is for the year 2000, which is consistent with estimates from other models.

The simulated aerosol optical depth (AOD) is compared with several satellite observations and shows good agreements. — The simulated aerosol optical depth (AOD) is compared with several satellite observations and shows good agreement.

and applied into the model as a climatological input field. — and included in the model as a climatological input field.

Both wind components are predicted in model at each time step. — Both wind components are predicted in the model at each time step.

In equation 5, does f(R, w) indicate the surface roughness and soil wetness dependence of the threshold wind velocity, or an additional factor? In the former case it might be written just as U*(R, w).

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mineralogical composition and the mixing state with anthropogenic aerosols, which will be left for the future study. — mineralogical composition and the mixing state with anthropogenic aerosols, which will be left for a future study.

In the model, emission, transport as well as deposition of dust aerosols are parameterized in terms of the size distribution of particles. — In the model, emission, and transport, as well as deposition of dust aerosols are parameterized in terms of the size distribution of particles.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 26477, 2011.