Atmos. Chem. Phys. Discuss., 12, C4304–C4305, 2012
www.atmos-chem-phys-discuss.net/12/C4304/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Radiative impacts of cloud heterogeneity and overlap in an atmospheric General Circulation Model" *by* L. Oreopoulos et al.

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Received and published: 5 July 2012

General comments

This paper is generally well written. It follows previous literature examining the effect of cloud vertical overlap and horizontal inhomogeneity on top of atmosphere cloud radiative effects (CREs). This is done using diagnostic radiative transfer calculations in two versions of the GEOS-5 model with the difference being the cloud scheme used in the model. This allows the authors to examine the sensitivity of the CRE to assumed cloud structure to the underlying simulated cloud field, which is rather different between the two versions of the model.

General comments

1. The discussion in Section 5.1, and associated figures, would benefit from the in-

clusion of the change in cloud fraction and the change in the overcast cloud fluxes (Eq. 12). The current discussion is somewhat qualitative and could be made more quantitative by using the actual changes in the terms that make up CRE.

It would also be interesting to have some indication of the change in the horizontal inhomogeneity of the vertically integrated water path or optical thickness for all experiments. Although not defined for each layer in the homogeneous cases there can be some variability in the vertical integrals for these cases which affect the radiation.

2. For the latitude and time varying decorrelation lengths do you have a sense if the shift in the simulations, e.g., deep convection around the tropics, follows a similar timing and position around the equator in its shift poleward.

3. At the end of Section 5.1 you point out that both the longwave and shortwave CRE can not both be tuned to observations using just horizontal homogeneity and vertical overlap. Could you expand this discussion somewhat? You seem to be talking about global means but are regions, potentially dominated by particular types of clouds, in which it is possible.

4. How does the magnitude and sign of the sensitivities in CRE compare to previously published results?

5. The zonal mean cloud amount in Fig. 9 are significantly different. Could you comment on the realism of both? Although the focus of this paper is on the sensitivity to different model configurations if the cloud structure are completely unrealistic then the lack of sensitivity in CRE for a particular version of the model is a symptom of poorly simulated clouds.

Specific comments

Abstract, line 24: "atmospheric" -> "atmospheric layers"

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12287, 2012.