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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The influence of cloud top variability from radar measurements on 3-D radiative transfer" *by* F. Richter et al.

Anonymous Referee #1

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This paper studies the cloud top variability and its impact on radiative transfer. It is claimed that the general -5/3 power law is not applicable to the variability of cloud top fields. It is shown that the cloud top heterogeneity can generally reduce the cloud albedo. The paper is interesting and has potential impact on remote sensing and the radiative transfer though cloud in climate models. I therefore recommend publishing this paper with minor revisions.

1. My main concern is the conclusion of large deviation from -5/3 power law, since the three sample clouds are all simulated from one dimensional time series with IAAFT algorithm. Is it possible to calculate the spectrum power from real cloud data? At least in Fig.1, I can feel (maybe I am wrong) the difference in variability between the simulated cloud and the one dimensional time series of the real cloud. I am not familiar

with IAAFT, but the authors mentioned that IAAFT is similar to the method of Baker & Davis (1992), as I know in Baker Davis (1992) the cloud is simulated using the inverse Furious transformation based on a certain assumed spectrum power value. In other words the simulated cloud field should follow the same spectrum power law as the assumed value.

2. 8088, the authors had summarized the progress in cloud simulation, one work by Raisanen et al. (2004, QJRMS p2047) should be included, since to my knowledge such cloud generator method is the most plausible scheme for climate models.

3. 8089, line 6, in order to make a clear description, it is better to add a sentence: the temperature ranges of the sample clouds are all above 263 K.

4. 8090, lines 18-25, it is not very clear, what does it mean that gamma is the spectrum of 2-D field?

5. 8091, it is better to give a brief definition for 'subadiatic'. It is not clear why LWC is subadiatic but the effective radius is adiatic. As we know LWC, effective radius and particle number concentration are physically associated together.

6. 8091, line 10, it is confused for suddenly appearing of a weighting function, weight for what?

7. 8093, the authors mentioned that Rayleigh scattering is included in the Monte Carla simulation, but how about the gaseous absorption? For solar radiation O3, H2O and C2O are important. I am not sure the Rayleigh scattering can be simulated well without including the gaseous absorption. The authors should present a simple explanation or include the gaseous absorption in their Monte Carlo calculations. Today many Monte Carlo models can account for the gaseous absorption. Another question is about the cloud droplet optical property. Which parameterization is used? I assume the authors not using Mie calculation for droplet optical properties directly.

8. Fig. 4, it is not clear that the homogeneous cloud refers smoothing out only the

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cloud top turbulence structure only or smoothing out both of the turbulence structure and the vertical inhomogeneous structures for LWC and effective radius. If it is latter, the difference in albedo might be due to the vertical inhomogeneity. I believe Li et al. (1994, JAS p2542) is the first work studying the radiative impact corresponding to cloud vertical inhomogeneity. That work is better to be mentioned here in order to show a comparison which effect is more important.

9. 8094, line 18-19, the sentence of 'enhances the increase' is not very clear, increase of what?

10. 8094, could the authors simply illustrate definition of penetrate depth, it seems very important in their discussion.

11. Fig. 7, I don't understand the difference bars shown in Fig. 7. If the number of injecting photon is large enough the reflection should be fairly determined. The relative error is proportional to $1/\sqrt{N}$, where N is the number of injecting photon. Please present a clear description.

12. The discussion of this work is main for boundary cloud which has big impact on radiation budget in climate models. I wonder if such heterogenous cloud effect can be considered in climate models through a proper parameterization. Could the authors bring out some idea in their revised version? This is beyond the scope of this work, just a curiosity of mine.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8087, 2007.