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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of model resolution on entrainment (inversion heights), cloud-radiation interactions, and cloud radiative forcing" *by* H. Guo et al.

Anonymous Referee #3

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Main comment: The paper addresses a very important subject, the effect of using a complete radiation scheme in the explicit modelling of the physics of a stratocumulus deck (Sc), usually represented by simple approximations by Large-Eddy modellers. However, my impression it that it fails in providing a clear picture of the effect of using such a detailed radiation package and it is limited to comenting descriptively the figures without much physical insight, providing rather known conclusions on the effects of resolution changing in LES of Sc. My view is that the paper contains good material (simulations) deserving publication but not under the present form. Clarifications on the use of the radiation scheme should be given, especially addressed to LES modellers. The major issues detailed below should be addressed.

Major issues:

1) In the introduction a criticism is made on how previous LES studies have dealt with the radiation forcing. It is fair raising this issue, but the authors do not justify in what aspects the previous approaches were unphysical or lacking of realism. Instead when the radiation scheme used in the paper is introduced in section 2, it is not compared with the simplified form traditionally used in LES, so that it can convince LES modellers to do the effort of switching to a more efficient and realistic radiation scheme.

2) The microphysics and their interaction with the radiation are not presented in the paper. Some graphics on how this interaction takes place would be welcome, so that the strong assumption of clouds with drops of constant radius would be justified. Why should such a complicated radiation scheme be used in such a simple cloud?

3) Are all the components (H2Ov, O3, CO2 and others) that the scheme can treat explicitly taken into account in the simulation? If so, what is their effect and should LES from now consider them? If not, what is the sense of using this radiation scheme? Please clarify.

4) A Sc is mainly driven by cooling at its top (radiative and evaporative) and by the turbulence convection downwards that this cooling generates. Nothing is said about the details in the simulation of these processes, nor are the turbulent fluxes shown - especially at the inversion layer. The entrainment issue is not addressed in detail. The vertical profiles of turbulent fluxes in function of the resolution should be shown, with a zoom at the inversion layer. Also the TKE should be plotted, since this is a major quantitity in terms of diagnosis and parameterization.

5) The authors show very soon that the main issue is the vertical resolution. I believe they should the stick to variation in the vertical resolution, elaborating much more on this part. They say that integral quantities like Zi or LWP do not change respect delta_z=10 m when they go to resolutions of 5 or 25 m. However, LES in inversions (or in strongly stably stratified layers in general) rely very much on the SGS scheme,

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that can explain more than 50% of the turbulent flux in the entrainment layer. Nothing has been shown on this issue. Besides, the explicit flux depends also strongly on the advection scheme that has been used, specially for the positively defined quantities, such as cloud water. What has been the advection scheme used? What effects can be attributed to it? These points can be explored taking advantage of the simulations at 5, 10 and 25 m of vertical resolution

6) How can the reader figure out how realistic these simulations are? There is not any comparison to observations or already validated simulations

I believe that the stated conclusions cannot firmly taken until the previous issues are clearly addressed. In the same sense I will not make minor comments since I expect the paper to be extensively rewritten.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20399, 2008.