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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Monte Carlo-based subgrid parameterization of vertical velocity and stratiform cloud microphysics in ECHAM5.5-HAM2" *by* J. Tonttila et al.

Anonymous Referee #2

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General comments

This manuscript describes a Monte-Carlo-based subgrid parameterization of vertical velocity and stratiform cloud microphysics. The basic idea is to account for horizontal subgrid cloud variability by decomposing each GCM column into separate subcolumns. The approach typically focuses on radiation (McICA). In this work, the authors generalize the procedure to include vertical velocity for cloud drop activation and certain microphysical processes. This is an important extension of the McICA methodology. The manuscript is generally clear and well written. However, at times, it does read a little like a technical report. The manuscript would benefit from a more in-depth

analysis of the results presented in Section 5.

Specific comments

P5486, lines 1-5. Provide additional details here.

P5487, lines 10-18. Expand the discussion of the retuning procedure. In particular, what are the parameters that are being adjusted to control autoconversion and accretion? It would be useful to add equations showing the autoconversion and accretion formulations in use. Both factors have been retuned to lower values in SUBWRT. Does this reduce the efficiency of the conversion of cloud water to rain? Could the model be retuned by only changing one of the two parameter ccraut or ccauloc?

Figure 4e: the impact of the retuning is particularly striking over marine stratocumulus regions. It would be interesting to analyze this in more details.

Section 5.2: I'd recommend to add a comparison of TOA radiative fluxes with satellite observations, for example CERES-EBAF (Loeb et al. 2009, doi:10.1175/2008JCLI2637.1).

Section 5: how do the overall climatologies of REF and SUBWRT compare? Is there any significant improvement in SUBWRT?

P5492, line 23: Guo et al. (2010, doi:10.5194/gmd-3-475-2010) went further using a skewed PDF that consistently treats vertical velocity and thermodynamic (cloud) subgrid variations.

P5493, lines 1-7. It would indeed be very interesting to explore the impact of the subgrid variability on the indirect aerosol effects. Both the treatment of subgrid vertical velocity and the modification of the autoconversion as part of the retuning could impact the indirect effect. Some impact has been documented in other relevant works, for example Rotstayn (2000, doi:10.1029/2000JD900129), Golaz et al. (2011, doi:10.1175/2010JCLI3945.1), Wang et al. (2012, doi:10.1029/2012GL052204).

P5493, lines 7-8: how frequently is the actual CDNC overridden by the imposed minimum value in the radiation?

Technical corrections

P5478, line 14: this is only speculated in this work. Maybe it does not belong in the abstract.

P5478, lines 17-20: beyond radiative properties, CCN also impact the dynamics of clouds by altering precipitation efficiency.

P5482, line 26: What is the added computational cost of the current approach?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 5477, 2013.