

Interactive comment on “Adjoint sensitivity of global cloud droplet number to aerosol and dynamical parameters” by V. A. Karydis et al.

Anonymous Referee #2

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General Comments

There are still uncertainties of aerosol indirect forcing for future climate prediction. Some of the uncertainties stem from uncertain parameters in cloud microphysics parameterizations in climate models. This study examines the sensitivity of cloud droplet number to some important parameters in a cloud droplet activation parameterization by using an adjoint approach implemented in two global Chemical Transport Models (CTMs). Sensitivity is compared for the two CTMs with different aerosol treatments and emissions. This is an interesting study. The manuscript is in general well written, although there are a number of places where the text needs to be clarified and improved. I recommend the publication of this manuscript after my general and specific comments below are addressed.

General Comments

This study examines the sensitivity of cloud droplet number concentration (CNDC) at surface and compares modeled CDNC with observations. However, it is known that the cloud droplets in low-level warm clouds are above surface (e.g., 700-900 hPa). The CNDC in this study is diagnosed instead of predicted. All these tend to overestimate CDNC. The impact of these assumptions on model results needs to be discussed.

Specific Comments

1. P12083. L6, “climate sensitivity”: Climate sensitivity usually is defined as the surface temperature change due to a doubling of CO₂ concentration. Do you really mean this?
2. P12083. L13, “microphysical processes”: Do you mean aerosol or cloud microphysics or both?
3. P12083. It is worthy mentioning the work of Liu and Wang (Environ. Res. Lett, 2010, doi: 10.1088/1748-9326/5/4/044010) which examined the sensitivity of indirect forcing to hygroscopicity of organic aerosols.
4. P12084. L19, “...through discrete model evaluation,..” This is not clear.
5. P12087. L9. please define “the critical supersaturation of the particle”.
6. P12088. L17. “adjoint forcing”. What do you mean “forcing”?
7. P12093. L3. “the first model level”. It is better to use “the lowest model level” since some models define the first level at model top (i.e., level increases from top to bottom).
8. P12093. L14. Can you compare the emissions of SO₂, BC and POC used in the two CTMs, especially in East Asia?
9. P12096. L19. Add “of” in between “change” and “the updraft velocity”
10. P12097. L14. Is it “CCN” or “CN”?
11. P12098. L16-17. “. . .to anthropogenic and biomass burning aerosol hygroscopic

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icity". Do you mean "to hygroscopicity of specific species" or "to bulk (volume-mean) hygroscopicity of anthropogenic and biomass burning aerosols, since anthropogenic and biomass burning aerosols have several different species.

12. P12099. L3. "~1". what is the unit of 1?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12081, 2012.

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