

Interactive comment on “Aerosol direct radiative forcing based on GEOS-Chem-APM and uncertainties” by X. Ma et al.

Anonymous Referee #2

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Aerosol direct radiative forcing based on GEOS-Chem-APM and uncertainties By Ma, et al. (Atmos. Chem. Phys. Discuss., 12, 193–240, 2012)

General Comments

Aerosol effect on climate remains one of the largest uncertainties in projecting future climate change. This work uses the GEOS-Chem-APM model to investigate the aerosol direct radiative forcing and its uncertainties to a number of parameters. This work is relevant to the scope of Atmos. Chem. Phys. I have a few general comments and a number of specific comments that the authors need to address:

General Comments

1. There have been a lot of studies before to investigate aerosol direct radiative forcing.

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The authors need to make it clear in the introduction what are new in the study and how the methods and/or conclusions from this study differ from previous ones.

2. There is some assumptions regarding the pre-industrial aerosols in this study, i.e., assume all biomass burning aerosols are from the anthropogenic source. Certainly this assumption is not correct. There were a lot of biomass burning emissions in the pre-industrial times (e.g., year 1850 or 1750), and in some regions (e.g., U.S.) the pre-industrial emissions were higher than present emissions. The more robust way is to run simulations with pre-industrial emissions. From the flux difference between present-day and pre-industrial day simulations to derive the direct radiative forcing.

3. Cloud fields (cloud fraction, cloud water) play an important role in the all-sky aerosol direct radiative effect and radiative forcing. It seems that the cloud effects in this study may be underestimated. The authors should add some discussions of cloud fields used in the model.

Specific Comments

1. P195. There are a few places saying the AeroCom project aiming to “reduce” the uncertainties. I don’t think this is the achievable goal for AeroCom. The more realistic goal is to quantify the uncertainties.
2. P196. L12. About Stier et al. (2007). “the values of refractive index”. Is it for BC? The number “1.21 W m⁻²” and other numbers here, are they global annual means?
3. P196 and 197, when you are discussing the uncertainties of aerosol direct forcing, you need to cite the Liu et al. (Uncertainties in global aerosol simulations: Assessment using three meteorological datasets. JGR, 112, D11212, doi:10.1029/2006JD008216, 2007). This work found that the uncertainties of aerosol direct forcing can be more than a factor of 2 with different sets of input assimilated meteorology (because of differences in cloud fields which are not usually assimilated).
4. P197, L18–20. I don’t think the predicted aerosol in models is more accurate than the

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prescribed aerosol in global climate models. The prescribed aerosol in global climate models is usually taken from global aerosol-climate models or from global chemistry transport models. The reason that prescribed aerosol is used in global climate models is to save computer time since climate models need to run for decades to century long.

5. P197, L21. That emission in GEOS-Chem is kept up to date does not necessarily mean that emissions is consistent with the real conditions and thus biases in emissions are reduced.

6. P199, L28. The “refractive index” of all aerosol species? Please give the values you use in the model.

7. P202, Section 3.1. The emissions are not for 2006. Right?

8. P202, L15-16. Since your model considers aerosol microphysics, do you still need the e-folding time of 1.2 days for the aging of carbonaceous aerosol?

9. P202, L18-29. Please give the size bins for dust and sea salt used in the model, and also the total emissions for dust and seas salt.

10. P203, L10. “SP”. Please define it when in the first time use it.

11. P203, L23. “The fraction of sulfate from anthropogenic aerosols”. Be explicit.

12. P205, Section 3.2. I would suggest comparing modeled AAOD or SSA with AERONET data.

13. P207, L1-5. Compare these numbers with other modeling studies (e.g., Liu et al., 2007) and satellite studies (e.g., Yu H, et al., A review of measurement-based assessment of aerosol direct radiative effect and forcing, Atmos. Chem. Phys., 6, 613-666, 2006).

14. P209 L8. Change “cloud radius” to “cloud effective radius”

15. P210, L25-27. What are the mode diameters you used for POC and BC in the

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control simulations? I think these information should be added in the section 2 (model description).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 193, 2012.

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