Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-1084-RC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of Near-Source Coagulation of Biomass Burning Aerosols on Global Predictions of Aerosol Size Distributions and Implications for Aerosol Radiative Effects" *by* Emily Ramnarine et al.

Anonymous Referee #1

Received and published: 11 January 2019

This study used a sub-grid coagulation parameterization for biomass burning plumes in the GEOS-Chem-TOMAS global aerosol microphysical model and showed large impacts of biomass burning sub-grid coagulation on aerosol number concentrations, aerosol size distributions, and aerosol direct and first indirect effects. The authors found sub-grid coagulation reduced the impact of biomass burning aerosols on number concentrations of particles larger than 80 nm by 37% globally and that this reduction changed estimates of aerosol direct and first indirect effects of biomass burning aerosols by 4% (from -206 mW m-2 to -214 mW m-2) and by 43% (from -76 mW m-2

to -43 mW m-2), respectively. The authors demonstrated that the inclusion of biomass burning sub-grid coagulation significantly reduced the sensitivity of aerosol number concentrations, CCN concentrations, and aerosol-cloud interactions to the treatment of aerosol size distributions at emissions.

The topic of this work is interesting and well suited to the scope of Atmospheric Chemistry and Physics. The manuscript is well written and the findings by the authors will be useful for estimating aerosol-climate interactions more accurately. Overall, the manuscript should be accepted by this journal after minor revisions. Some minor comments, which should be addressed before acceptance, are described below.

Minor comments:

1. Page 1, Lines 23-24:

external mixing –> external mixing of black carbon

internal mixing –> internal mixing of black carbon

2. Page 2, Lines 20-21:

Please add the following reference: H. Matsui (2016), doi:10.1002/2015JD023998.

3. Page 4, Line 24:

Please add a few sentences on the treatment of SOA formation in the global aerosol model.

4. Page 4, Lines 23-31:

Please clarify gaseous and aerosol species considered in the biomass burning emissions in the author's global model.

5. Page 6, Line 24:

In equation (1), 84.56 should be 84.576, based on Sakamoto et al. (2016).

6. Page 7, Line 16:

In Sakamoto et al. (2016), their parameterization is based on their simulations conducted for 5 hours during biomass burning emissions. This parameterization was extended to 24 and 12 hours in the current study. Can the authors justify this extension?

I suggest the authors to confirm this extension does not overestimate sub-grid coagulation rate (because coagulation rate will be slower with time) and to add some discussions to the text.

7. Page 7, Lines 26-29:

Scatterplots and correlation coefficients may be useful.

8. Page 8, Line 4:

Please add a sentence that the two assumptions of mixing state have the same aerosol number concentrations and size distributions in total.

9. Figure 2 and related figures:

The main focus of this study is the inclusion of sub-grid coagulation. So, I think the difference between SubCoag and noSubCoag is the most important point in this discussion (rather than the differences from noBB). How about adding plots on the difference between SubCoag and noSubCoag (absolute value or percent)? The authors can add similar difference plots (between SubCoag and noSubCoag) to other figures (Figures 4 and 7-9).

10. Figure 6:

This is a nice figure and should be used to summarize conclusions obtained in this study. I suggest the authors to move this figure to the last paragraph of section 3.3 (after Figure 9).

Similar to comment 9, differences between SubCoag and noSubCoag can be added to

this figure. Adding them will make the impact of sub-grid coagulation on DRE and AIE clearer.

11. Page 19, Line 19 – Page 20, Line 6:

Please clarify how the authors estimated the statistic values in this paragraph (131%, 79%, 64%, 62%, and 49%).

12. Page 21, Lines 21-25:

Can the authors add some statistics for more quantitative discussions of this paragraph?

13. Section 3.4:

In addition to the points raised by the authors, I suggest to add the following two points to this section.

Firstly, the simulations made by the authors are for year 2010 only. Biomass burning emissions and meteorological conditions have large year-to-year variability. Please add some discussions on the features of biomass burning emission in 2010 (compared with other years) and on their potential impacts on the estimation of sub-grid coagulation importance.

Secondly, the uncertainty ranges of DRE and AIE in this study (e.g. Figure 6) were estimated from sensitivity simulations with changing single parameter at one time (e.g., median size of emissions, sigma of emissions, mixing state, sugcoag timescale, biomass burning emission data). However, in the real atmospheric conditions, multiple parameters change simultaneously. Therefore, the uncertainty ranges of DRE and AIE in the real atmosphere might be larger than those estimated with single parameter change (conducted in this study). The authors can add discussions on the potential importance of this effect.

14. Page 23, Line 26:

the estimated DRE –> the estimated DRE (increases cooling)

15. Page 24, Line 2:

Sakamoto et al. (2017) –> Sakamoto et al. (2016)

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1084, 2018.