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Atmospheric
Chemistry
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Discussions

Interactive comment on “Anthropogenic influence on SOA and the resulting radiative forcing” *by* C. R. Hoyle et al.

Anonymous Referee #1

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The article presents results from a global simulation of SOA in the Oslo CTM2 for pre-industrial and present-day conditions. Estimates of SOA radiative forcing are also presented. SOA precursors in the model include monoterpenes, sesquiterpenes, aromatics, isoprene, and others. The predicted SOA burden of 0.52 to 0.7 Tg for the present day is consistent with other models. However, the production of SOA may be on the high side. Two major concerns are the high rate of SOA production and including sulfate in the organic partitioning medium. The SOA model is described in Hoyle et al. (2007).

Comments

1. Page 18912, Line 15 (abstract): Add a comment/clarify that the radiative forcing

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being mentioned is the difference between pre-industrial and present day conditions.

2. Page 18914, Line 6: The same meteorology was used for the present day and pre-industrial simulations. The effects of changes in meteorology on SOA formation may be beyond the scope of this work, but the authors should mention the potential effects. Changes in temperature could have pronounced effects since biogenic emissions and SOA partitioning are both temperature sensitive.

3. Page 18915: Partitioning of SOA into sulfate should be justified with observational or experimental evidence since it is the main focus of the paper and the authors suggest that the mass of aerosol available for partitioning may be the most significant cause of the increase in SOA between pre-industrial and present-day times. Although chamber experiments are often performed with ammonium sulfate seed, that does not mean the organics partition into that medium. The main focus of the paper should be shifted toward the SOA results where sulfate is not included in the partitioning medium.

4. Table 4: Articles cited in this table do not reflect the most recent SOA modeling work since many of them are missing major SOA sources. Liao and Seinfeld (2005) and Chung and Seinfeld (2002) did not include the recent isoprene or aromatic yield data. This lack of representation was acknowledged earlier in the article (page 18913). Although the goal of Table 4 is perhaps to compare to other model results for both the present day and pre-industrial times, the works cited do not include our latest understanding of SOA and its precursors.

Consider how the results in Hoyle et al. 2008 (the work under review here) compare to this quick look at three other studies that use the 2-product Odum model for SOA formation in the present-day (note that some quantities are in different units):

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Study	Isoprene emissions	SOA production	SOA from isoprene	SOA burden
Tsigaridis 2007	467 TgC/yr	18.6 Tg/yr	4.6 Tg/yr	0.82 Tg
Heald 2008	496 TgC/yr	24.3 TgC/yr	19.2 TgC/yr	0.59 TgC
Henze 2008	408 TgC/yr	30.3 Tg/yr	14.4 Tg/yr	0.81 Tg
Hoyle 2008 no_sul	194 TgC/yr	53.4 Tg/yr	15 Tg/yr*	0.5 Tg

*data from Hoyle et al., 2007

I assume the rates of production reported are the net rates of production (production minus evaporation). Although the SOA burden and production of SOA from isoprene predicted by Hoyle are consistent with works mentioned above, the isoprene emissions are drastically different. The authors discuss the discrepancy between their emission inventory and recent work on page 18916, but the Hoyle et al. (2008) rate of production seems high considering the fact that isoprene emissions are so low. Is there a reason for this? The lifetime in Hoyle et al. (2008) is also on the short side (about 3.4 days compared to 9.8 days in Henze et al. (2008) and 16 days in Tsigaridis and Kanakidou (2007)). The relatively high production rate of SOA predicted for the present-day deserves some discussion or clarification.

5. Figure 3: Why the positive RF near northeast Russia and in part of South America?

6. Figure 2 and Page 18920, Line 27: “The reduction in SOA at high northern latitudes was due to the lower biomass burning emissions in the 2004 inventory (see also Fig 1).” Figure 1 does not show any decrease in SOA (the scale stops at zero). Also, Table 2 indicates that POA increases from Pind_std to Pind_BBpres while the other emissions remain constant. It’s difficult to determine how the emissions change for the different scenarios, partly because Table 2 does not have consistent labels.

Also, in Figure 2, panels C and D indicate SOA decreases in the Southern hemisphere high latitudes (around 400 hPa). Why does panel A then show an increase in SOA?

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1. Page 18923, Line 18: 28 should be 26 Tg/yr according to Table 3.
2. Page 18923, Line 19: Burden increased 0.26 Tg not 26 Tg.
3. Tables 3,4: Present day SOA burden (no sulfate) is 0.52 in one table and 0.50 in the other.
4. Tables 1,2: Names of runs in these two tables are inconsistent.
5. Figure 2: Missing vertical labels on Plot A. Vertical labels on Plot B should be removed.
6. Figure 2,3: Put panels in the same location for each figure. For example, Figure 3 should be Pind_std vs Pres_std, Pind_nosul vs Pres_nosul, ... like Figure 2.

References

Heald, C. L., Henze, D. K., Horowitz, L. W., Feddema, J., Lamarque, J. F., Guenther, A., Hess, P., Vitt, F., Seinfeld, J. H., Goldstein, A. H., and Fung, I.: Predicted change in global secondary organic aerosol concentrations in response to future climate, emissions, and land-use change, J. Geophys. Res., 113, D05211, doi:10.1029/2007JD009092, 2008.

Henze, D. K., Seinfeld, J. H., Ng, N. L., Kroll, J. H., Fu, M., and Heald, C. L., Global modeling of secondary organic aerosol formation from aromatic hydrocarbons: High-vs-low-yield pathways, Atmos. Chem. Phys., 8, 2485-2421, 2008.

Hoyle, C. R., Berntsen, T., Myhre, G., and Isaksen, I. S. A.: Secondary organic aerosol in the global aerosol 8211; chemical transport model Oslo CTM2, Atmos. Chem. Phys., 7, 56758211;5694, 2007.

Tsigaridis, K. and Kanakidou, M.: Secondary organic aerosol importance in the future atmosphere, Atmos. Environ., 41, 46828211; 4692, 2007.

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