

Interactive comment on “Insights into the aging of biomass burning aerosol from satellite observations and 3D atmospheric modeling: Evolution of the aerosol optical properties in Siberian wildfire plumes” by Igor B. Kononov et al.

Anonymous Referee #1

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This is a detailed study combining satellite observations and modeling of biomass burning SOA. It provides several insights on evolution of BBOA and its optical properties based on analyses of a field dataset of a fire event.

Following are some key comments/suggestions for improvement: 1. How is plume rise included in Chimere? What is the maximum vertical height of injection?

2. A lot of model measurement evaluation is based on satellite data that have their own

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challenges as described in this study. Are there any in-situ measurements of organic aerosols at source/receptor sites? These would be valuable to constrain surface and vertical profiles of OA simulated by Chimere.

3. Biomass burning emissions inventories like GFED often severely under-predict POA emissions from biomass burning. Can the authors provide any discussions/evaluations of primary BBOA emissions used in the model? Along the same lines, if inventories are missing a large BB-POA source, one could simply increase POA by a factor of 3 to 5, turn off BB-SOA formation and just age POA. This may result in different size evolutions (e.g. SSA, scattering efficiency), AAOD and AOD evolution. Would be interesting to see how this could affect the results and interpretations of this study.

4. Page 18: Its confusing as written: " We selected only those simulations that have the same ranks as the subset of CO observations matching (as described above) the OMI AAOD data". Please elaborate. How did the authors calculate ranks? Did they consider different simulations driven by different reanalyses to minimize plume dispersion errors?

5. Table 2: In equation R3 how were coefficients 0.33 and 0.30 determined? Also in R5 and R6 85% of SOA is lost by fragmentation. Is the fragmented SOA recirculated or does it react to yield some MV-SOA/LV-SOA?

6. Figure 2: Why does Chimere have too high AOD compared to MODIS in the South-Eastern part of domain?

7. Page 22 Before section 3.2: Can the authors comment on relative importance of various processes affecting decrease of AOD to AAOD from source to receptor, e.g. fragmentation, evaporation etc.?

8. Figure 10: Seems we need another case showing BC core with absorbing OA shell and lensing effects.

9. How does particle water affect calculated optical properties, especially if water is on the shell?

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10. It would be intuitive to see a map of particle water over the domain, especially given discussion of potential importance of heterogeneous oxidation of biomass burning OA. I would think that even with hygroscopicity of 0.2 water content of BBOA will be large due to its high concentration.

11. Can the authors comment on role of photolysis of biomass burning SOA as its loss process?

12. Page 28: If SOA is glassy, it may not mix with POA. How are the authors treating absorptive gas-particle partitioning of POA-SOA mixtures. One could envision treating them as two separate solutions from Raoult's law perspective.

13. Would the increase of brown carbon with BC to OA ratio imply LV-SOA is more absorbing (brown) than MV-SOA? I recall this was implied in Saleh et al. study referenced by the authors. But this is contrary to the author's hypothesis that LV-SOA is much less absorbing than MV-SOA. This may need some discussions.

14. In Conclusions, the authors say 100h processing decreases ENRs for AOD and AAOD by 45% but not SSA. Why? One would expect SSA to change as the size distribution shifts with changes in evaporation, fragmentation etc. Would be nice to show change in size distributions simulated by Chimere with different processing times.

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