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comment**

Interactive comment on "Probing into the aging dynamics of biomass burning aerosol by using satellite measurements of aerosol optical depth and carbon monoxide" *by* Igor B. Konovalov et al.

Anonymous Referee #1

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The manuscript explores the effect of aging on the evolution of aerosol optical depth (AOD) of biomass burning smoke. The authors use a combination of satellite observations of AOD and CO column amount (with MODIS and IASI respectively) with CHIMERE model simulations of the same variables, and calculate AOD enhancement ratio (ER). Positive ER values mean that BB aerosol that has undergone the aging process is optically thicker than when originally emitted. The implication of this finding is that when aerosol models do not consider secondary aerosol processes, it results in model underestimation of total column AOD in the BB-affected locations. Introduction of aerosol aging process into CTMs could improve simulations of BB aerosol properties.

The submitted manuscript addresses an important topic within the active area of research. The reasons for discrepancy between model and satellite BB AOD are currently an area of vivid interest in the modeling and satellite observation community. Investigation of aging process as one of the factors explaining observed discrepancies is very timely. I thank the authors for a comprehensive, well-structured and thorough work. The paper is of adequate quality to be published in ACP with revisions and clarifications outlined below.

Comments on the content:

P4 lines 11-14: The sentence starting with "Konovlaov et al. (2014) optimized BB emissions..." and till the end of the paragraph is very difficult to read. I had trouble understanding if the values of the factors 2.2 and 2.9 refer to emissions or to ratios of optimal BB emissions. Please rephrase.

P9 lines 10-24: I understood from this section (specifically P9 lines16-17: "...we zeroed emissions of other types of aerosol and disabled secondary aerosol formation from anthropogenic and biogenic precursors.") that model runs including BB emissions (VBS and STN) only include BB aerosols without the other background aerosol. Does this mean that to obtain total AOD for, say, VBS run you add VBS_AOD and BGR_AOD? If so, then I can't see where this is stated explicitly (or this is what P10 lines 30-34 mean?). Please clarify.

P11 lines 14-15: Should T1 read T0? From the definition of trace species on P8 line 20, it looks like T0 is the only chemically passive species, the concentration of which will stay constant over time in the presence of OH. If I am mistaken and you insist that there should be T1 please elaborate (on P11 line 14, after the words "would be constant") on why this is so.

P12 line 23: what is BB part of the observed AOD? Is this total MODIS AOD less the background AOD? In which case, is this observed background AOD value obtained by averaging the most background-like values as described in P10 line 27 – P 11 line 2?

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Also, from here on in the text, only one kind of background values are referenced. These are all the variables with subscript b. It is not very clear to me if these background values are all from the model, or there are separate backgrounds for model and observations (e.g. in Eq. 9 are the same values subtracted from the first (obs) and the second (model) parts of the terms in the parentheses?), or it is some combined value applicable to both model and observation? I see that this is explained somewhat afterwards (P13 line 25 till the end of the section), but this still does not answer the question of using the same or different backgrounds for model and observation in the same equation.

Suggested technical changes:

P5 line 9: "ageing" should be "aging". I noticed this instance, but please check the rest of the manuscript for consistency.

P5 line 21: remove "and" between "algorithm" and "is".

P8 line 23: remove either 'is' or 'it is' between the words 'as' and 'follows'.

P16 line 9: remove "and" between "comparison" and "of the measurement".

Fig. 2b: Y-axis label contains subscript bm, which is not used anywhere else in the paper. Please make consistent or explain.

Fig.5 in the headers of the figures: dt is nowhere defined. From the text in section 3.2, I deducted that this is probably the bin width, but could be helpful of the notation was also mentioned.

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