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Atmospheric Chemistry and Physics Discussions

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 #2

Received and published: 23 November 2016

General Comments:

The manuscript on "Probing into the aging dynamics of biomass burning aerosol by using satellite measurements of aerosol optical depth and carbon monoxide", by Konovalov et al. describes the use of aerosol optical depth (AOD) and carbon monoxide (CO) retrievals from satellite observations to explain the effect of the aging process of biomass burning (BB) aerosol emissions on the enhancement of aerosol mass concentrations in smoke as it is transported downwind, with the aim of improving the representation of these BB aerosol emissions in chemistry transport models (CTMs) and climate models. "The goal of this study is to investigate the feasibility of deriving the information on BB aerosol aging from satellite measurements of AOD and CO columns."

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Discussion paper

The study found that smoke aging produces enhancement of the smoke aerosol loading (expressed in terms of column aerosol optical depth), which almost doubles within temporal scales of ∼10 hours, especially in dense smoke plume conditions (with PM2.5 concentrations exceeding 100 μg m-3). However, the enhancement was found to decrease thereafter, although with significant uncertainty, and the study was not able to resolve what happens within the first 5 hours of the BB aerosol emissions. Nevertheless, this study has provided some insight into the evolution of aerosol loading due to aging processes at timescales (> 5 hours) that have not been adequately explored hitherto, thereby contributing toward finding possible pathways for resolving one of the outstanding significant uncertainties in model simulations of BB aerosols. The authors have demonstrated thoroughness in conducting sensitivity studies to account for possible uncertainties due to their methodology and assumptions. The manuscript is well written, the methodology and results clearly described, and the illustrations of good quality. Therefore, I believe that this study merits publication and is appropriate for Atmospheric Chemistry and Physics (ACP).

However, the authors should address some (mostly minor) issues highlighted in my specific comments.

Specific Comments

In the following comments, I have highlighted a few specific issues that need to be addressed, but certainly not all of them. I suggest that the authors use the identified issues (including typos and grammatical errors) as only examples of things to look out for, as they very carefully read the manuscript to find and correct similar occurrences of such issues or others wherever they exist in the manuscript.

The authors state (Page 19, Lines 1-3) that: “the analysis presented in Fig. 5 clearly indicates that the VBS scheme enables more adequate representation of BB aerosol dynamics than the standard scheme at the first (growing) stage of BB aerosol aging.” However, only STN simulations are shown in Figure 4. It would be good to include

(later in the manuscript) a figure showing the spatial visualization (similar to Figure 4) of simulations comparing the results of incorporating the aging process in the model against those that do not consider aging. Such visuals would more readily demonstrate the benefit of this work.

At various points in the article, the authors raise an important issue that needs to be investigated, but immediately state that it is "beyond the scope of this study" (e.g. Page 8 - Line 6, Page 15 - Line 13, Page 18 - Line 5, Page 18 - Line 29). Given that the scope of a study is not set in stone anywhere, but typically determined by the authors themselves, it is unnecessary to identify an essential aspect of an investigation and turn around to say that it is beyond the cope of your study. There is no rule preventing the authors from conducting such analyses in this study. Therefore, I suggest that the authors find a better way to express why they cannot conduct such relevant analyses, make a suggestion on how to effectively approach each of such issues, or avoid raising them in the first place.

Page 4, Line 6: change "doubled" to "increased". You have "by a factor of 2" later in the sentence, which makes the use of "doubled" repetitive.

Page 5, Line 21: delete "and" from "algorithm and is".

Page 6, Line 21-22: delete one "type" from "a given type of land cover type".

Page 8, Line 22: It is not clear what is meant by: "as it is follows from ours simulations". Please rephrase and clarify.

Page 11, Lines 1-2: Unconventional sentence construct: "Only those grid cells and days were considered to be representative of background conditions, where the contribution of the fires to the simulated values of both CO columns and AOD did not exceed 10 percent." Please rephrase.

Page 12, Line 9: insert "to" after "corresponding".

Page 15, Line 5: delete "of" before "parameters".

Page 17, Line 17: replace “adequate” with “reasonable”. Since the differences between measured and modeled values are still apparently significant, these results should not be described by the term “adequate”.

Page 21, Line 31: There are no “green crosses” in Figure 7b. The crosses are black.

Page 24, Line 2: It is not clear how “absorption” can increase the surface area of aerosol particles. Please explain the physical mechanism implied here. I think you probably mean “hygroscopicity” (which involves the absorption of moisture that may cause aerosol particle to swell). However, “absorption” is not the technical term used to describe that process. “Absorption” is mostly used to refer to light absorption (as opposed to “scattering”).

Page 26, Line 23: change “then unity” to “than unity”.

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