

Interactive comment on “Chemical, physical, and optical evolution of biomass burning aerosols: a case study” by G. Adler et al.

G. Adler et al.

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Received and published: 30 January 2011

We thank the Reviewer for the thoughtful review and comments. We seriously considered each of them. Detailed replies to all issues raised are given below

General Comments . . . A major assumption apparently made during this analysis is that changes in the aerosol composition observed at the receptor site are due to chemical ageing of the particles. However, alternative explanations could be changes in the burning phases, fuel types (changing with source region) or ambient temperature (causing changes in the partitioning of semi volatiles). The authors need to discount these possibilities more thoroughly or caveat their conclusions accordingly...

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Reply: The authors have added to the discussion and to the conclusions the possibility of mixing with other aerosol types from transportation or other sources and the possible effect of the ambient temperature (causing changes in the partitioning of semi volatiles). However, it is important to note that the fuel used for all the bonfires is roughly the same (collected local wood, wood from construction sites and old wooden furniture). In addition, the transportation rush hour is between 7:00-9:00AM. The peak in the aerosol number concentration, which follows the ozone peak (figure 10), appears around noon. If the peak was transportation-emitted aerosols we would have expected it to appear at the time of the rush hour since the measurements were conducted in proximity to a main road of the city Added text: p.24385 L15 p.24384 L 7 conclusions: p.24389 L5

. . . Throughout the paper, the authors refer to the optical properties by their complex refractive indices. While this is unquestionably more fundamental to the physical properties of the aerosols, it would be very informative if they could report equivalent single scattering albedos (SSAs). . . Reply: Unfortunately, the SSA cannot be calculated because the effective refractive index retrieved is for the entire visible spectrum, not for a single wavelength.

In spite of the fact that an HR-TOF-AMS was used, the authors do not attempt to analyse any of the sub-unit mass resolution (UMR) data. Some of this could be very insightful for the study of the chemical properties of the organics, through the provision of data products such as the O:C ratio and the relative contributions of oxygenated ions to m/z channels such as 57 (see below). While this paper is still publishable with the analysis of UMR data alone, it would be greatly strengthened if the authors were to include some sub-UMR statistics as well.(Note that some of this analysis should still be possible with V (rather than W) mode data).

Reply: The relative abundances of C₄H₉ and C₃H₅O were calculated using the PIKA software. Therefore, this is not estimation. Since the V mode was used the authors are careful in the way this data is presented in the paper.

C12954

Specific comments 1. P 24372, L 26: Rather than just the IPCC report, a specific reference to inventory estimation works would be appropriate.

Reply: We added the following reference for the specific statement (About 40% of global emission of BC originates from biomass burning): A technology-based global inventory of black and organic carbon emissions from combustion., Tami C. Bond, David G. Streets, Kristen F. Yarber, Sibyl M. Nelson, Jung-Hun Woo, and Zbigniew Klimont. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 109, D14203, doi:10.1029/2003JD003697, 2004

2. P 24373, L 1: A reference for previous BC composition work would be appropriate here.

Reply: The authors added the following reference for the description of the components found in BB: Emission of trace gases and aerosols from biomass burning. M. O. Andreae and P. Merlet, GLOBAL BIOGEOCHEMICAL CYCLES, VOL. 15, NO. 4, PAGES 955–966, DECEMBER 2001

3. P 24373, L 5: Specific numbers with references should be used to back this statement up.

Reply: "Biomass burning can be a source of primary organic aerosols, which make up a large fraction (20-90%) of the submicron particulate matter. The specific numbers were added: 20-90% The authors added the following reference:

1. Murphy, D. M., Cziczo, D. J., Froyd, K. D., Hudson, P. K., Matthew, B. M., Middlebrook, A. M., Peltier, R. E., Sullivan, A., Thomson, D. S., and Weber, R. J.: Single-particle mass spectrometry of tropospheric aerosol particles, J. Geophys. Res.-Atmos., 111, D23S32, doi:10.1029/2006JD007340, 2006.

2. Zhang, Q., Jimenez, J. L., Canagaratna, M. R., Allan, J. D., Coe, H., Ulbrich, I., Alfarra, M. R., Takami, A., Middlebrook, A. M., Sun, Y. L., Dzepina, K., Dunlea, E., Docherty, K., De-Carlo, P. F., Salcedo, D., Onasch, T., Jayne, J. T., Miyoshi, T., Shi-

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mono, A., Hatakeyama, S., Takegawa, N., Kondo, Y., Schneider, J., Drewnick, F., Borrmann, S., Weimer, S., Demerjian, K., Williams, P., Bower, K., Bahreini, R., Cottrell, L., Griffin, R. J., Rautiainen,

J., Sun, J. Y., Zhang, Y. M., and Worsnop, D. R.: Ubiquity and dominance of oxygenated species in organic aerosols in anthropogenically-influenced Northern Hemisphere mid-latitudes, Geophys. Res. Lett., 34, L13801, doi:10.1029/2007GL029979, 2007.

4. P 24373, L 21: The authors give a slightly misleading (albeit common) description of the treatment of SVOOA and LV-OOA. The separation into two discrete groups is merely a product of the data model used in factorization. The SV- and LV-OOA data products are thought to be describing a continuum of various chemical states of OOA (this is described in detail in the cited Jimenez and Ng papers). Along these lines, I would reword P24383, L1 to get rid of the term 'switched'.

Reply; The sentence "It is a demonstration that the chemical character of the aerosol switched from SV-OOA to LV-OOA" was crossed out 5. P24380, L20: The RIE used for the PAHs should be given. Reply: The RIE used was 1.4. This is now added in the text .P.24380 L15

6. P24383, L17: If an HR-TOF-AMS was used in this study, can the authors not estimate the relative abundances of C4H9 and C3H5O from these data?

Reply: The relative abundances of C4H9 and C3H5O were calculated using the PIKA software. Therefore, this is not estimation. Since the V mode was used the authors were careful in the way this data is presented in the paper.

7. P24385, L10: Can the authors be sure that this is due to nucleation and is simply not coincident with a primary source (e.g. transport)? It might be expected that the ambient surface area would tend to suppress potential nucleation events.

Reply: The authors have added to the discussion and the conclusions the possibility of mixed aerosols from transportation or other sources and the possible effect of the am-

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bient temperature (causing changes in the partitioning of semi volatiles). However, we note that the transportation rush hour is between 7:00-9:00AM. The peak in the aerosol number concentration, which follows the ozone peak (figure 10), appears around noon. The peak in the transportation-emitted aerosols should have ben detected at the time of the rush hour since the measurements were conducted in proximity to a main road of the city

Technical corrections

1. P 24372, L 5: 'H-TOF-AMS' or 'HR-TOF-AMS' are the preferred acronyms for the instruments (this is used elsewhere)- Reply: The term 'Hi-RES-TOF-AMS' was changed to 'HR-TOF-AMS'

2. P 24372, L 7 (also P24379, L1): This sentence seems to contradict itself. Is BB common or not?

Reply: The sentence has been rephrased: "While these types of extensive BB events are not common in this region, burning of agriculture waste is a common practice" This was changed both in P 24372, L 7 and P24379, L1:

3. P 24372, L 25: When the authors say 'carbonaceous emissions', they should specify whether they mean particulate or total emissions. Reply: The sentence has been rephrased: "About 40% of global emission of BC is originate from biomass burning"

4. P 24373, L18: A technical reference for the HR-TOFAMS should be given here (suggest doi: 10.1021/ac061249n or 10.1002/mas.20115)

Reply: The following reference was added: DeCarlo, P. F., Kimmel, J. R., Trimborn, A., Northway, M. J., Jayne, J. T., Aiken, A. C., Gonin, M., Fuhrer, K., Horvath, T., Docherty, K. S., Worsnop, D. R., and Jimenez, J. L.: Field-deployable, high-resolution, time-of-flight aerosol mass spectrometer, *Anal. Chem.*, 78, 8281–8289,2006.

5. P24374: L 14: I would suggest referring to the direct radiative effect specifically.

Reply: The sentence has been rephrased: "The direct impact of aerosols on Earth's C12957

radiative budget is partially driven by their optical properties; specifically, the scattering and absorption components of the refractive index which is a key parameter in modeling their radiative effect"

6. P24375, L 13: Although is given elsewhere, I would give the date here. Also, is Lag BaOmer the name of the festival?

Reply: Lag BaOmer is the name of the festival (explanation added in the text). Also, the date is added.

7. P24375, L 17: Would "extinguished" be more appropriate than "turned off"? Reply: The word "extinguished" was changed to "turned off"

8. P24375, L20: Because fly ash may be contributing to the PM10 concentrations, the authors should qualify that it is submicron POA that is being characterized here

Reply: The word submicron was added ("submicron POA and secondary submicron organic aerosol (SOA)")

9. P24376, L6: The 3022's lower size cut is normally quoted as around 5 or 7nm

Reply: The 3022's lower size cut was changed to 7nm

10. P24376, L7: The material the 'conductive tubing' was made of should be specified Reply: The phrase conductive tubing was modified to "conductive silicone rubber tubing"

11. P24376, L19: The operator of the monitoring site should be given here.

Reply: The operator of the monitoring site was added: monitoring network which belongs to the ministry of environmental protection of Israel;

12. P24376, L23: The Drewnick et al. reference describes the C-TOF-AMS, not the HR (DeCarlo et al.should be used here).

Reply: The authors agree with the reviewer: Drewnick et al has been replaced with

DeCarlo et al

13. P24377, L13: Allan et al. is not an appropriate reference for RIEs. Suggest doi: 10.1016/j.atmosenv.2004.01.054

Reply: The authors agree with the reviewer: Allan et al has been replaced with Alfarra et al.2004

14. P24378, L20 (and elsewhere): It would be more conventional to place the 'i' after the numbers (as the authors do on P24389). It should also be italicised.

Reply: In all complex numbers the i is now placed after the number, in italic form.

15. P24379, L12: Recommend changing "we had" to "there were"

Reply: The phrase "we had" has been changed to "there were".

16.P24379, L14: Reword "massive amount" to something less chatty (e.g. "large number")

Reply: The phrase "massive amount" has been changed to "large number"

17. P24380, L14: Correct "updateing" to "updating"

Reply: Thank you. The spelling mistake was corrected to "updating"

P24382, L2: Replace "delta" with the corresponding Greek symbol

Reply: The word "delta" has been replaced with the Greek symbol

P24383, L16: Correct "Previews" to "Previous"

Reply: The word "Previews" have been corrected to "Previous"

18. P24387, L22: For the sake of formality, recommend changing "there's" to "there is"

Reply: The word "there's" have been corrected to "there is"

19. P24388, L13: The location should be more specific than "the Middle East"

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Reply: The location was changed to "The middle east area (in Israel)

Figures(general):

Suggest increasing the font sizes for the sake of legibility.

Reply: The font size was increased in all the figures

superscripts should be consistently used when quoting " $\mu\text{g}/\text{m}^3$ " No need –

Reply: All figures were changed accordingly

Figure 3: Suggest showing the peaks as mass fractions rather than absolute masses

Reply: Figure3 has been changed to mass fraction

Figure 11: It would be very useful to show the size-resolved SMPS data alongside the total number concentrations

Reply: Figure 11 presents the SMPS size distribution normalized to the maximum concentration. The authors choose to focus on the change in the size distribution rather than on the number concentration. This type of presentation (normalized to the max concentration) makes the change in the size distribution easier to follow.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 24371, 2010.

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