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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The contribution of wood burning and other pollution sources to wintertime organic aerosol levels in two Greek cities" *by* Kalliopi Florou et al.

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(1) *This paper presents results from high resolution time-of-flight aerosol mass spectrometer measurements made during the winter of 2012 and 2013 at two different major cities in Greece (Athens and Patras). The composition of the aerosol is presented and discussed. Positive Matrix Factorization (PMF) analysis results are provided to explore the different sources of organic aerosol in the two cities, with a specific aim at better understanding the role of residential wood burning. Biomass burning is one of the main sources of organic aerosol, but its contribution is still not well understood. In addition, the role of biomass burning as a source is becoming more and more important in many locations. This paper is presenting results from one such location. Therefore, many*

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Discussion paper

in the atmospheric community would be interested in this work. Overall, this is a good paper. The authors have done a nice job with the paper. I really appreciate seeing all parts of the PMF analysis to understand how they obtained their results.

We do appreciate the positive assessment of our work and the many suggestions by the referee that led to an improvement of our paper.

General comments:

(2) *I am mainly wondering if the authors have considered trash burning as possibly playing a role in their results and could be part of what leads to the two BBOA factors being identified in Patras.*

We have considered the possibility of the use of different fuels (including trash) resulting in two BBOA factors in Patras. To test this hypothesis we have used the results of Mohr et al. (2009) who investigated in the laboratory the organic aerosol emissions of paper and plastic burning. The trash burning AMS spectra were completely different from those of biomass burning in this study with angles exceeding 45 degrees. Based on this trash burning cannot be the main source of any of the two BBOA factors in Patras. This information has been added to the revised paper.

(3) *Otherwise, I just have a number of comments to help with the flow of the paper, like clarifying the notation for BBOA-I and BBOA-II in the figures which the authors seem to go back and forth on using. All of this is outlined below in detail and needs to be addressed before the paper can be considered for publication.*

We have followed the reviewer's suggestion and made the corresponding corrections to the notation used in the paper.

Specific Comments:

(4) *Line 96 – Suggest changing till to until.*

Done.

(5) *Line 97 – Suggest changing place at to place on.*

Done.

(6) *Line 106 – Suggest changing real time to real-time.*

Done.

(7) *Line 117 – The start of this line should be indented to match the rest of the formatting of this section.*

Done.

(8) *Line 133 – The chemical abbreviations used are not defined.*

We have added the corresponding definitions.

(9) *Lines 101-142 – If the authors were looking for a way to shorten the paper, they could remove some of the discussion in the instrument section pertaining to data they do not show in the paper. I believe that data from the SMPS, thermodenuder, some of the gas monitors, and filters are not presented or discussed in the text.*

We have removed the corresponding discussion just mentioning the other instruments that were used in the study for completeness.

(10) *Line 160 – m/z should be in Italics.*

Done.

(11) *Line 186 – Suggest changing meteorological conditions to air masses observed.*

Changed.

(12) *Lines 224-229 – In this line the authors are discussing OA being correlated with VOCs found in petrol fuel. But I am a bit unclear if it is during the same times as when OA was correlated with acetonitrile (18:30-02:30) or the remaining period they are also discussing in this paragraph.*

We have rewritten this sentence to clarify that we are referring to the periods during which biomass burning was not the dominant source.

(13) *Lines 240-244 – The authors mention that chloride has a major morning peak and an evening peak. They mention the pools located near the sampling site as a possible source. But could this also be due to trash burning? I would expect that if trash burning is occurring, it would peak in the morning before the boundary layer started to rise.*

This is an interesting suggestion. The data suggest that the chloride peaks occurred on average an hour earlier (at 7:00 LST) than the corresponding OA peaks (at 8:00 LST). This coupled with the major differences between known AMS fingerprints for trash and the estimated PMF factors suggest that trash burning was probably not a major contributor to the morning chloride peaks. This information has been added to the revised manuscript.

(14) *Line 260 – Suggest adding a the before value.*

Added.

(15) *Line 261 – Suggest adding the word peaked after OA.*

Added.

(16) *Line 266 – The chemical abbreviation used is not defined.*

We have added the definition.

(17) *Lines 276 and 278 – Suggest changing till to until.*

Done.

(18) *Line 313 – Suggest changing time-series to time series.*

Done.

(19) *Lines 367-379 – In this section the authors are discussing the difference between BBOA-I and BBOA-II. I was wondering have the authors checked to see if one of these factors is more correlated with chloride than the other? It was shown that there was an extra chloride peak in the diurnal profile and chloride can come from trash burning.*

We checked the corresponding coefficients of determination and they were both quite low. The R^2 between BBOA-II and the AMS chloride was 0.02 and that between BBOA-I and chloride was 0.16. These low correlations do not support the link between one of these factors and trash burning or chloride. These values have been added to the paper.

(20) *Lines 413-425 – In this section the authors are comparing the BBOA spectrum obtained at both sites to those from literature. Although this is interesting, the spectra the authors are comparing to include both residential burning and burning from wildfires and prescribed burning. My understanding is that the data collected from Greece should be impacted by residential burning. I am not sure if the authors have taken this into account in their comparison.*

We included for completeness all types of burning in the comparisons. We do clarify now in the revised paper the type of burning dominating in each field study (e.g., resi-

dential, agricultural, prescribed, wild fires) and that the fact that residential burning was the main BBOA source in Greece in the present study.

(21) *Line 424 – I am not sure if the correct reference is listed. I don't believe there are any AMS spectra provided in that paper.*

We have corrected the FLAME-I reference.

(22) *Line 434 – Suggest changing summertime at to summertime in.*

Done.

(23) *Line 438 – The period for the end of the sentence is missing after processes.*

Added.

(24) *Lines 449-453 – The authors mention that the diurnal concentration of OOA decreased in the morning and then increased again in the afternoon peaking at midnight. They believe this could be due to nighttime SOA production from biomass burning-related VOCs reacting with NO3 radicals. I am not sure I am completely following this discussion. For this to be true, wouldn't there have to be organonitrates present then? I believe that it was mentioned earlier that when biomass burning dominated organonitrates were low.*

This is an excellent observation that has been added to the manuscript. The increase of OOA during the night is accompanied by increases in mostly inorganic nitrate with a relatively small contribution of organic nitrate. This does not support the hypothesis that the OOA increase is due to the production of SOA from reactions of the biomass burning emissions with nitrate radicals. We have rephrased this sentence adding the above discussion.

(25) *Line 454 – Suggest removing the word reasons.*

Done.

(26) *Lines 467 and 476 – Suggest adding a the before Po.*

Done.

(27) *Line 546 – Figure 10a is being referenced, but there is no Figure 10. Should it be Figure 8?*

We have made the suggested correction.

(28) *Line 551 – Suggest adding the words had only before minor.*

Done.

(29) *Line 612 – Believe accent marks are missing on Prevot.*

We have added the accent marks.

(30) *Line 630 – Should the a before Li be capitalized?*

We have made the change.

(31) *Line 639 – Believe accent marks are missing on Prevot.*

We have added the accent marks.

(32) *Line 667 – Should the a before Herndon be capitalized?*

Changed.

(33) *Line 692 – The a after Prevot should be capitalized.*

Changed.

(34) *Line 720 – There is an added hyphen in Seinfeld.*

Removed.

(35) *Line 724 - The a after Boreave should be capitalized.*

Changed.

(36) *Lines 758 -760 – All the a initials should be capitalized.*

Done.

(37) *Line 774 - The a before Knighton should be capitalized.*

Done.

(38) *Line 775 - The a before de Foy should be capitalized.*

Done.

(39) *Lines 783-785 - All the a initials should be capitalized.*

Done.

(40) *Line 793 - Believe accent marks are missing on Prevot.*

We have added the accent marks.

(41) *Line 809 – The a after Nenes should be capitalized.*

Done.

(42) *Line 842 – The a before Alfarra should be capitalized.*

Done.

(43) *Line 843 - Believe accent marks are missing on Prevot.*

We have added the accent marks.

(44) *Line 866 – The a before Querol should be capitalized.*

Done.

(45) *Line 886 – I believe the year is listed in the wrong place.*

Done.

(46) *Line 910 – The a before Facchini should be capitalized.*

Done.

(47) *Line 925 - Believe accent marks are missing on Prevot.*

We have added the accent marks.

(48) *Line 929 – The a before Forster should be capitalized.*

Done.

(49) *Line 934 - All the a initials should be capitalized.*

Done.

(50) *Line 949 – The a after Chaloulakou should be capitalized.*

Done.

(51) *Line 953 – The a before Nitrogen should be capitalized.*

Done.

(52) *Lines 963-964 - All the a initials should be capitalized.*

Done.

(53) *Lines 973-974 - All the a initials should be capitalized.*

Done.

(54) *Table 1 -I believe that not all the chemical abbreviations used in the Table have been defined in the text, for example EVK and MBO.*

We have added all the definitions here too.

(55) *Figure 2 -I am not sure what the 124 in the OA plot is referring to. It is not mentioned in the caption.*

During the first day of the measurements the mass concentration of OA was equal to 124 μg m^{-3} and this is not shown in the plot. This information has been added to the figure caption.

(56) *Figure 6 -I believe that BBOA is actually BBOA-I and BBOA-I is BBOA-II. To stay consistent with the previous figure and the text it would be best to label them as I and II.*

We have made the corresponding correction.

(57) *Figure 7 -I am not sure what the 30 in the HOA plot is referring to. It is not mentioned in the caption.*

During the first day of the measurements the peak concentration of HOA was equal to 30 μg m^{-3} and this is not shown in the plot. This information has been added to the figure caption.

(58) *Figure S2 -Suggest adding to caption that the figure is showing the origin of the air mass every 3 h for all the sampling days.*

We have added the suggested information.

(59) *Figure S3 -In caption, suggest removing the hyphen from back trajectories.*

Done.

(60) *Figure S4 -In caption, suggest removing the hyphen from back trajectories.*

Done.

(61) *Figure S5 -Suggest adding to caption that the figure is showing the origin of the air mass every 3 h for all the sampling days.*

Done.

(62) *Figure S6 -What do the red boxes indicate? It is not mentioned in the caption.*

The boxes show the two periods with frequent precipitation. This information has been added to the figure caption.

(63) *Figure S8 -What do the dashed lines indicate? Is it the average ratio? It is not mentioned in the caption.*

The dashed values are indeed the average ratios. This is now mentioned in the figure caption together with the corresponding values.

(64) *Figure S9 -What do the dashed lines indicate? Is it the average ratio? It is not mentioned in the caption. -In caption, suggest removing the comma after Patras.*

The dashed values are the average ratios. This is now mentioned in the figure caption together with the corresponding values. The comma has been deleted.

(65) *Figure S11 -There are no letters identifying the plots as indicated in the caption.*

We have added the missing letters to the corresponding graphs.

(66) *Figure S12 -There are no letters identifying the plots as indicated in the caption.*

We have added the missing letters to the corresponding graphs.

(67) *Figure S14 -In caption, I believe there is a word missing after stable. Maybe something like solution or area -In first line of caption, fpeak is misspelled.*

The word “solution” has been added and the typo has been corrected.

(68) *Figure S15 -The label on the right-hand y-axis of plot d is missing.*

We have added the label.

(69) *Page 17 -I believe the plots shown on this page are a repeat of Figure S11 and show the data for Patras and not Athens.*

We have corrected this typo.

(70) *Figure S19 -The letters identifying the plots do not match the caption.*

We have corrected these letters.

(71) *Figure S22 -In order to match the text, I believe that the plot labeled BBOA-1 is really BBOA-II and the plot labeled BBOA is really BBOA-I.*

We have made the suggested changes.

(72) *Figure S23 -In order to match the text, I believe that for the legend labels BBOA-1 is really BBOA-II and BBOA is really BBOA-I.*

We have made the suggested changes.

(73) *Figure S24 -In order to match the text, I believe that the plot labeled BBOA-1 is really BBOA-II and the plot labeled BBOA is really BBOA-I.*

We have made the suggested changes.

(74) *Table S1 -I believe Table S1 is not referenced in the text and that it is also an exact copy of Table 1.*

We have removed Table S1.

(75) *Table S2 -I believe Table S2 is not referenced in the text.*

A reference to Table S2 has been added in the main paper.

(76) *Figure S29 -In the caption and in the graph title, it should be BBOA-II.*

Done.

(77) *Figure S34 -This figure is referenced before Figures S32 and S33.*

We have renumbered the corresponding figures.

(78) *Figure S35 -I believe there is no reference to or discussion about this figure in the text.*

A reference to Figure S35 has been added in the main paper.

(79) *Figure S36 -I believe there is no reference to or discussion about this figure in the text.*

A reference to Figure S36 has been added in the main paper.

References

Mohr, C., Huffman, J. A., Cubison, M. J., Aiken, A. C., Docherty, K. S., Kimmel, J. R., Ulbrich, I. M., Hannigan, M. and Jimenez, J. L.: Characterization of primary organic aerosol emissions from meat cooking, trash burning, and motor vehicles with High-Resolution Aerosol Mass Spectrometry and comparison with ambient and chamber observations, Environ. Sci. Technol., 43, 2443–2449, doi:10.1021/es8011518, 2009.

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