Atmos. Chem. Phys. Discuss., 14, C1745–C1750, 2014
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Source apportionment and seasonal variation of $PM_{2.5}$ in a Sub-Sahara African city: Nairobi, Kenya" *by* S. M. Gaita et al.

Anonymous Referee #1

Received and published: 24 April 2014

This manuscript describes and discusses results from long-term measurements (up to 2 years) of the mass, BC and 13 elements for PM2.5 at two sites in Nairobi, Kenya. As indicated by the authors, few long-term data sets of aerosol composition are available for urban areas of sub-Saharan Africa. This manuscript has as merit that it helps to fill some gaps in our knowledge.

Unfortunately, no measurements were made of organic carbon, which is likely a dominant aerosol component, and of nitrate and ammonium, which may also be important. It is also a pity that the major crustal elements Al and Si were not included in the elemental analysis. I presume that this was difficult or virtually impossible with Mo as secondary target in the EDXRF set-up, but it should have been possible if also EDXRF measurements had been made with, e.g., Ti as secondary target (e.g., Adams et al.,

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1983).

The manuscript is on a few occasions unclear and the data interpretation is not always convincing. There are also several problems with the grammar (subject in plural and verb in singular or vice versa) and the language and wording should be improved. Substantial revision is needed before this manuscript can be published in ACP.

Specific comments:

1. Page 9566, line 24, and further within the manuscript (e.g., page 9567, lines 8-9; page 9567, lines 24-25; page 9568, lines 5-6): References within parentheses within the text should be placed in chronological order.

2. Page 9571, lines 1-4: How was BC obtained from the reflectometer reading? Some explanation or a literature reference is needed.

3. Page 9571, lines 21 and 23: It is not specified what the index "i" indicates. Should it not be "A" instead of "i"?

4. Page 9573, lines 9-18: The average data for the PM2.5 mass, BC and some elements of the two sites are compared here, but the data for the university site apply to a 2-year period and those for the UNEP site to a period of one year only. One cannot really draw conclusions from this comparison of different periods. It would be fairer to make the comparison for the one-year period that was is common for the two sites.

5. Page 9673, lines 22-23: There is an inconsistency here; the percentages of 17 % and 14 % add up to 31 %, which is larger than the 29 % given in line 19.

6. Page 9674, lines 2-3, with regard to Fig. 2: It is unclear what the percentage data in the figure denote. Percent of what? Perhaps percent of the sum of the concentrations of the three elements, whereby the BC data were divided by ten? In any case, this should be made clear.

7. Page 9575, lines 20-27: The interpretation of the third factor is hard to follow and not

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convincing at all. The presence of K, Mn, Ni, Cu, Zn, Rb, and BC in this factor do not point to secondary formation processes. This factor looks to me like a mixed factor of biomass burning aerosol (indicated by the presence of K, Zn, Rb) with perhaps some secondary aerosol (part of the S on this factor may be derived from gaseous SO2 that is emitted by biomass burning).

8. Page 9577, line 17: It is noteworthy that the Br/Pb ratio of 0.64 in the aerosol is lower than the ratio of 0.77 expected for fresh vehicular exhaust. This could indicate that part of the Br from the leaded gasoline emissions was present in the vapor phase. In their study for the city of Butare, Rwanda, where TEL-B was also used as antiknock agent, Maenhaut and Akilimali (1987) found that the Br/Pb ratio in the aerosol was, on average, 0.68 ± 0.11 (n = 18) during the night versus 0.43 ± 0.03 (n = 16) for the day. The difference was attributed to much more Br being present in the vapor phase during the warm day than during the cool night, and it was stated that this suggests that significant exchange takes place between particulate and gaseous Br. The same is likely also the case for Nairobi.

9. Page 9579, line 3: Although contribution from soil Pb and other anthropogenic sources of Pb may have been partly responsible for the low Br/Pb ratio of 0.43 at the UNEP site, it should not be discounted that part of the automotive Br may have been in the vapor phase, as was discussed in the previous comment.

10. Technical and other minor corrections:

p. 9566, l. 22: Replace “include; an” by “include an”.

p. 9566, l. 25: Replace “high quality” by “high-quality”.

p. 9567, l. 23: Replace “come” by “comes”.

p. 9569, l. 3: Replace “include” by “including”.

p. 9569, l. 18: Replace “results” by “result”.

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p. 9569, l. 24: Replace “vary” by “varies”.

p. 9570, l. 21: Replace “comprises of” by “comprises”.

p. 9571, l. 5: Replace “analyzed” by “determined”.

p. 9571, l. 11: Replace “analyzed” by “measured”.

p. 9573, l. 21: Replace “nitrates” by “nitrates,”.

p. 9574, l. 10: Replace “hand more” by “hand, more”.

p. 9574, l. 28: Replace “as that of” by “as the”.

p. 9575, l. 10: Replace “contributes” by “contribute”.

p. 9575, l. 15: Replace “contributes” by “contribute”.

p. 9575, l. 23: Replace “implying” by “imply”.

p. 9576, l. 11: Replace “materials,” by “materials”.

p. 9576, l. 15: Replace “mineral contribute” by “mineral dust account for”.

p. 9576, l. 23: Replace “season” by “seasons”.

p. 9577, l. 4: Replace “rain” by “rainy”.

p. 9577, l. 5: Replace “being below” by “exhibiting concentrations below”.

p. 9577, l. 18: Replace “exhaust,” by “exhaust”.

p. 9577, l. 23: Replace “it is” by “is”.

p. 9579, l. 19: Replace “enjoy” by “enjoys”.

p. 9579, l. 23: Replace “impacts” by “impact”.

p. 9582, l. 4: Replace “source” by “sources”.

p. 9582, l. 5: Replace “was” by “were”.

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p. 9582, l. 6: Replace “concentration” by “concentrations”.

p. 9583, l. 5: Replace “condition” by “conditions”.

p. 9584, l. 31: Replace “BrPb” by “Br/Pb”.

p. 9586, l. 17: Replace “Vermont?” by “Vermont”.

p. 9589, l. 2: Replace “concentration” by “concentrations”.

p. 9589, l. 2: Replace “Africa and Europe” by “Africa”; there are no data for European sites in the table.

p. 9590, l. 3 from bottom: Replace “Environmental. Programme” by “Environmental Programme”.

p. 9597, l. 1: It is unclear what the “te” indicates.

p. 9597, l. 2 from bottom: Replace “originates” by “originate”.

p. 9598, l. 3 from bottom: Replace “Percentage composition of source factors from PMF analysis of” by “Percentage contribution of source factors from PMF analysis to”.

p. 9599, within Fig. 10: Replace “rain” by “rainy”. (3 times)

p. 9599, l. 3 of caption: Replace “significant of vehicular emission” by “significance of vehicular emissions”.

References

Adams, F., Van Espen, P., and Maenhaut, W.: Aerosol composition at Chacaltaya, Bolivia, as determined by size-fractionated sampling. Atmospheric Environment, 17, 1521-1536, 1983.

Maenhaut, W. and Akilimali, K.: Study of the atmospheric aerosol composition in equatorial Africa using PIXE as analytical technique, Nuclear Instruments and Methods in Physics Research, B22, 254-258, 1987.

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 9565, 2014.

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