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.

Responses to Anonymous Referee #2

We would like to thank the Anonymous Referee #2 for the insightful and in-depth review s/he has given to our manuscript.

The responses to his/her specific comments are listed herein;

1. Page 9566, line 4, "particles" should be "particulate"

   Response: The suggested change has been effected.

2. Page 9569, section 2.1 could be summarized:

   Response: The authors have shortened the section by removing the last paragraph which had explained the developmental plans for the sampling area.

3. Section 2.2 could be shortened:

   Response: The authors concur with the referee and the said section has been shortened.

4. Page 9570, line 12: 3 lpm is a very low flow, did the authors take positive artefacts for OC into account? They did not measure OC (which is a pity), but this may have affected particle mass.

   Response: The authors have noted the valid point with regard to lack of OC measurement. In order to correct for the positive artefacts for OC, concentration values from the field blank filters were subtracted from the measured samples' values.

5. Page 9570, line 16: what was the total number of valid samples collected for each location? Were they daily samples?

   Response: The number of valid sample filters collected at both sites was 780 and is indicated in page 9570, line 23.

6. Page 9572, section 3.1: does any Kenyan legislation exist? If so, what are the limit values?

   Response: There is the Draft Air Quality Regulation, 2008 which is referred to as "The Environmental Management and Coordination (Air Quality) Regulations, 2008" (NEMA, 2013).The said regulation is still in the draft form as there is no scientific

knowledge which is specific to Kenya that is available to back any suggested air quality guidelines.

7. Page 9574, line 13: shouldn't there be larger biomass burning contributions in the background area than in the city centre? If not, please clarify here why.

   Response: The background area site (UNEP) recorded lower BC concentration since it was shielded by two forests (Karura and Gigiri) which inadvertently are located in the same direction as the local wind and regional air mass back trajectories.

8. Page 9574, line 16: what sort of combustion?

   Response: The likely combustion process is the use of biomass based fuel in domestic energy generation.

9. Page 9576, lines 1-7: the profile of this source could be mistaken for traffic based on its tracers. Do the back-trajectories support this interpretation?

   Response: The back trajectories supports these observations in that their general direction lies between east and south, which is the same direction as the industrial area as well as the low income households (where biomass based fuel is used and open burning of trash is common (Karanja & Makau, 2012).

10. Page 9577, line15: what is the mean $Pb/PM_{2.5}$ ratio?

    Response: The mean $Pb/PM_{2.5}$ ratio was 0.001375

11. Page 9577, lines 26-27: please remove "due to prevailing.....(Querol et al., 2001)" and substitute with "due to the S emissions from vehicles, as described in sections above."

    Response: The referee's suggestion has been implemented.

12. Page 9579, lines 1-2: "traffic factor compared to other sources...", but this is the background site, how do the authors explain that the $Pb/PM_{2.5}$ ratio is higher at UNEP? Shouldn't this ratio be higher in the city centre?

    Response: In the view of banning lead in gasoline by the Kenyan government in 2006, it is expected that the Pb concentration in the soil dust will last for long period and somewhat be constant (Datko-Williams et al., 2014; Xu et al., 2012). In absolute values, the university site had higher concentration value (23 ± 16 ng m^{-3}) compared to the UNEP site (17 ± 14 ng m^{-3}). More so, since the university site is close to the city centre and therefore it is influenced heavily by PM sources as characterized by the reported 50% higher $PM_{2.5}$ concentration than the value reported at the UNEP site.

13. Page 9579, line 8: Does this factor correlate with the traffic one, then? They should if this interpretation is correct.

    Response: The interpretation of the third factor has high uncertainty. As highlighted by the referee (see comment 16), it has contribution from mixed sources such as biomass burning and industrial emission. Therefore, this factor will be reviewed and discussed as a mixed factor.

14. Page 9579, lines 8-9: this statement is too vague, please elaborate or remove

    Response: The said statement has been removed.

15. Page 9580, lines 2-3: But the authors stated above that they are 2 independent factors, and that road dust is included in the traffic source. Then why does the mineral source decrease on the weekends? If this is regional dust then there should be no weekly trend.

    Response: The authors see the point raised by the referee and agree that the specific anthropogenic sources should be indicated in the text to avoid confusion with road dust. The implied anthropogenic sources of mineral dust that lead to weekly trend include quarrying activities and road construction which as employment activities follow a weekly trend.

16. Page 9580, line 14: A similar situation here: it was stated that S from traffic was included in the traffic source, therefore it cannot be included again in the secondary aerosol factor. If the secondary aerosol factor is of regional (or possibly industrial) origin, then it should not have a weekly trend. The interpretation of this source should be revised

    Response: Once again the authors agree with the referee and as stated in comment 13, the said factor will be reviewed and discussed afresh.

17. A deeper analysis of back-trajectories vs. sources would be extremely helpful to further understand and confirm the nature of the sources. I would suggest adding a section on this.

    Response: The proposed discussion will be included in the results as well as in the discussion section.

18. Page 9580, line 23: "value", which value?

    Response: The referred value is the concentration value from Gatari et al. (2009).

19. Page 9582, line 12: I think "but lower" should be "and thus higher"?

    Response: The authors agree with the suggested change of phrase.

20. Page 9582, line 18: "mineral dust", what are the natural and anthropogenic sources of the mineral dust factor? This should be clarified earlier in the text.

    Response: The authors agree with the referee and will clarify the natural and anthropogenic sources of mineral dust. In this regards, the natural source of mineral dust in Kenya include windblown dust from local soil (indicated by presence of Fe, Ca and Ti). The anthropogenic sources of mineral dust include quarrying activities which have gained momentum due to increased road construction and infrastructure development in Kenya especially during the sampling period.

21. Page 9582, line 22: this is an interesting conclusion, how would it be done (reducing the lead content)?

    Response: Reducing lead content will entail strict implementation of emission control from industrial sources (Were et al., 2012).

22. Page 9583, lines 3-4: also an interesting recommendation.

    Response: Authors are grateful for the positive comment.

References

Datko-Williams, L., Wilkie, A., & Richmond-Bryant, J. (2014). Analysis of U.S. soil lead (Pb) studies from 1970 to 2012. *Science of The Total Environment, 468–469*(0), 854-863. doi: http://dx.doi.org/10.1016/j.scitotenv.2013.08.089

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