

Interactive comment on “Seasonal variation and chemical characterization of PM_{2.5} in northwestern Philippines” by Gerry Bagtasa et al.

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This manuscript presents the first seasonal analysis of the fine particulate matter and its components in Burgos, and also discussed the source attribution using the PMF model. Though for each season, the study only had 7-14 days of sample, this study provides a peak for the magnitude and seasonal distribution of the PM_{2.5} distribution in this area. In my opinion, this paper is written poorly. Sentences were sometimes not complete or, too long with comma only. The authors should spend time and effort to revisit their draft and improve the writing. Some specific comments can be seen below. Response. We appreciate and would like to thank the reviewer for the constructive comments. We will do our best in editing this manuscript to improve the writing. As to the 7-14 day sampling to represent a season, we think that the

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sampling days/periods were able to capture the climatological characteristics of each of the monsoon regimes (southwest, northeast and transition). Moreover, another year of sampling was done (not included in this present study) in slightly different months but in the same seasonal partition (i.e. mam, jja, son and djf), data shows similar seasonal wind and concentration variability. Leading us to conclude that the sampling we did for this study is representative of the seasons.

1. In the abstract, add the standard deviation for the the peak and low concentration of the PM_{2.5}. Also, keep consistent for the valid digit used in the paper. For example, in the abstract, the authors listed the highest PM_{2.5} of 21.59, but in the section 3.2, it listed 21.6. Response. Manuscript edited to keep decimal places consistent and include standard deviation in abstract.

2. The discussions of the transition of the monsoons under section 3.2 are not very appropriate, or even very redundant. I didn't see any connections between these few paragraphs with other contents. Suggest the authors remove these discussions, or put them together with the source attribution under section 3.4 to help explain the sources of PM_{2.5} over this area. Response. Since the Philippines is in the tropics, the 4 boreal seasons do not necessarily describe the local seasons. Moreover, local seasonal terminologies in the Philippines are at times contradictory to common/normal climate descriptions. For instance, the driest months in the Philippines are from March to May, and this is locally referred to as "summer". With these inconsistencies (especially for local readers) in mind, we think it is best to retain this brief discussion of boreal season – monsoon relation. Does the reviewer suggests this section be moved to 3.4 or be incorporated in 3.2?

3. In section 2.1, the authors discussed that the observation period during summer for this study was a "monsoon break", which makes all sampling periods non-rainy days. This makes me wonder how will that affect the seasonal distribution of the aerosols over this area, and how the authors' conclusion "peak in spring and low in fall" will stand out. Precipitations should have significant impact on aerosol. So please explain or add to

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the discussions. Response: Monsoon break here is meant to describe a reduction of convective activity in the region. The summer season of JJA is the time when tropical cyclones in the northwest Pacific is most active. At this time, significant rainfall along the northwest coast of the Philippines is induced when a tropical cyclone is present to the east of the Philippines (Bagtasa 2017). During the summer sampling period, a typhoon just passed by the region, and there was no synoptic scale disturbance present in the northwest Pacific region. For other seasons, on the other hand, the northwest region of the Philippines has a distinctly dry climate (Coronas 1912, page 3 line 20), the sampling days other than summer season were characteristic of dry season. In addition, our sampling protocol calls for the temporary suspension of sampling whenever there is rain, this is to prevent abnormally low aerosol concentrations that may pull down the mean 24h concentration values. Whenever sampling is suspended, we do the necessary correction on the number of sampling hours in calculating concentration. It just so happened that all sampling days in this study had non-rainy days and there was no need to suspend any sampling.

4.Explain the enrichment factor. Response: Enrichment factor is a method of characterizing the chemical composition of a metallic element determining the abundance of elements by using a reference. Enrichment factor is the is an approach established by Taylor (1964) to characterize the chemical composition of airborne particulate matter (APM) by relating the concentration of an element to that of a crustal element in the air, normalized to the ratio of the element in the average continental crust (Farooq et al., 2012). The method uses reference elements, usually those that are stable in the soil, and are least influenced by vertical shear, and/or anthropogenically altered (Ackermann, 2008). We've added the following in the manuscript: "Analysis of the enrichment factor (Taylor, 1964, Hernández-Mena et al., 2011; Lomboy et al., 2015; Rushdi et al., 2013) is done to further characterize the composition and associations of the chemical components of PM2.5. The analysis employs relating the concentration of PM2.5 components that are known anthropogenic to those that are found stable in the crust, or those that are naturally found in the local atmosphere. " Ref-

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erences: Ackermann, F. (2008). A procedure for correcting the grain size effect in heavy metal analyses of estuarine and coastal sediments A PROCEDURE FOR CORRECTING THE GRAIN SIZE EFFECT IN HEAVY METAL ANALYSES OF, (September 2013), 37–41. Farooq, H., Ahmad, M. R., Jamil, Y., Ahmad, M. R., Khan, M. A. A., Mahmood, T., . . . Khan, S. A. (2012). Lead Pollution Measurement Motorway in Punjab , Pakistan Along National Highway and. *Journal of Basic and Applied Sciences*, 8, 463–467. <http://doi.org/10.6000/1927-5129.2012.08.02.34> Hernández-Mena, L., Murillo-Tovar, M., Ramírez-Muñiz, M., Colunga-Urbina, E., De La Garza-Rodríguez, I., & Saldarriaga-Noreña, H. (2011). Enrichment factor and profiles of elemental composition of PM 2.5 in the city of Guadalajara, Mexico. *Bulletin of Environmental Contamination and Toxicology*, 87(5), 545–549. <http://doi.org/10.1007/s00128-011-0369-x> Lomboy, M. F. T. C., Quirit, L. L., Molina, V. B., Dalmacion, G. V., Schwartz, J. D., Suh, H. H., & Baja, E. S. (2015). Characterization of particulate matter 2.5 in an urban tertiary care hospital in the Philippines. *Building and Environment*, 92, 432–439. <http://doi.org/10.1016/j.buildenv.2015.05.018> Rushdi, A. I., Al-Mutlaq, K. F., Al-Otaibi, M., El-Mubarak, A. H., & Simoneit, B. R. T. (2013). Air quality and elemental enrichment factors of aerosol particulate matter in Riyadh City, Saudi Arabia. *Arabian Journal of Geosciences*, 6(2), 585–599. <http://doi.org/10.1007/s12517-011-0357-9> Taylor, S. R. (1964). Abundance of chemical elements in the continental crust: a new table. *Geochimica et Cosmochimica Acta*, 28(8), 1273–1285. [http://doi.org/10.1016/0016-7037\(64\)90129-2](http://doi.org/10.1016/0016-7037(64)90129-2) (minor) 1.Reorder all the figures. The figure number start with 1 instead of 11. Response: Edited. We apologize for this as it was a problem with latex typesetting.

2.Pg 1 line 2: This study only has 7 days of observation during summer. So please clarify. Response: Edited. “Each 24H sample ...for two weeks every season” to “Each 24H sample ...for four seasons from 2015 – 2016”. The detailed discussion of sampling period is then found in sec. 2.2.

3.Pg 1 line 16: change “but also on its effects” to “but also for their effects” Response:

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Edited.

4.Pg 1 line 17: cite the latest IPCC 2013 report. Response: citation updated.

5.Pg 1 line 20: “is transported” to “are transported” Response: Edited.

6.Pg 2 line 10: incomplete sentence. Response: Edited. From “. Its effects cover large regions of SEA.” to “..., the effects of which cover large regions of SEA.”

7.Pg 2 line 33-35: In this paragraph, the authors started to discuss the LRT on the influence of the aerosol in the county. Then they switched to discuss that this region is also source of biomass burning emissions. The authors should make a new paragraph discuss on the differences between the LRT and regional sources on local aerosol concentration. No need to capitalize Organic Carbon. Response: Edited. Study about the Philippines as source of levoglucosan moved to 2nd paragraph.

8.Pg 4 line 5-9: rewrite these sentences. Response: Edited. From “..., the filter” to “. The filter...”

9.Pg 5 line 24-26: use the seasonal mean plus STD to discuss the seasonal differences since the values showed in the manuscript are from daily values which are meaningless. Response: Edited. Reference to daily values were removed.

10.Pg 6 line 3: put the “the bold dashed line . . .” into figure 5 instead of the main contents. Response: Edited.

11.Pg 7 line 4-5: rewrite the sentence. Response: Edited. From “Seasonal mean and standard deviation of PM_{2.5} and some water soluble ionic components are shown in fig. 6. Figures 6b, 6c and 6d show NO₃⁻, SO₂⁻ and NH₄⁺, respectively” to “Figure 6 shows the seasonal mean and standard deviation of PM_{2.5} and some water soluble ionic components. It is apparent that NO₃⁻, SO₂⁻ and NH₄⁺ shown in fig. 6b, 6c and 6d, respectively,” (appropriate formatting is applied in manuscript)

12.Pg 9 line 25: delete the last half sentence or rewrite as a whole. Response: Edited.

From "...mass concentration. Providing" to "mass concentration, providing"

13.Pg 10: in the conclusion part, add the discussions of the seasonality of the total PM_{2.5}, which is the main points of this study.

14.Pg 10 line 23-27: consider to move this paragraph into the results. Response: Edited. Moved as sec 3.2.4

15.Pg 18, Figure 4: I suggest the authors make a similar plot as Fig. 3 for both OC and EC, by doing that both the temporal characteristic of OC and BC, and also their ratios can be clearly seen. Response: Figure edited to include daily OC/EC ratio.

16.Pg 18, Figure 5: choose different markers for the OC/EC ratio plots. Response: Figure marker modified, same for fig. 8.

17.Pg 21, Figure 8 (c): change Ca to "Ca²⁺" Response: Corrected.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-931>, 2017.

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