

Dear reviewer:

Thank you very much for your constructive comments. We have addressed them one by one below and incorporated your suggestions in our manuscript. Hope you find our revisions useful. Thank you again.

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Regards,

Steve

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General comments: Lots of previous studies have indicated that The transboundary air pollution (TAP) constitutes one of the major contributor to the aerosol loading in Korea and Japan. However, it remains elusive to separate out the contribution from local emission and TAP. This study examined the spatiotemporal variations of TAP and sectoral contributions from China emissions and identified the contributions of TAP to acid depositions. The TAP's impact on acid deposition was found to be larger than TAP's impact on PM2.5 concentration. These findings have implications for the decision-making policy for emission control in the upwind regions. Overall, this manuscript is well written, and the analysis methods are scientifically sound. Apparently, this study could be a significant addition to the community of transboundary transport of air pollution, provided the following concerns have been fully considered. Therefore, I recommend its acceptance for publications in ACP pending minor revision.

Specific comments:

1. L44: Too many citation followed by “impacts on people’s health, the environment, and economic costs: : :”. I strongly suggested to cite these references separately. In addition, air pollution also exert influence on clouds and precipitation (Li et al., 2011, doi: 10.1038/ngeo1313; Koren et al., 2012, doi: 10.1038/ngeo1364; Guo et al., 2016, doi: 10.1002/2015JD023257)

Response: Thanks for your suggestion. We separate the citations to different aspects, including public health, environment, climate, and economic cost.

2. L60-61: Grammar error in “much of it transboundary in nature. ”

Response: Thanks for your comments. We change this sentence to “The East Asian region has been suffering from air pollution for decades, especially transboundary air pollution.”.

3. L110: Grammar error in “describe in the next section (2) details

Response: Thanks for your comments. We change this sentence to “The method details of the source apportionment analysis are provided in Section (2).”.

4. In Fig.1, black cross representing the major cities is the same as the color of country boundary. This should be avoid.

Response: As suggested, we modified the color of major cities to be red, which is different with black country boundary.

5. L148: “, see Table 1”-> “ (see Table 1)”

Response: Modified as suggested.

6. The titles of X-axis and Y-axis in in Fig.2 are suggested to indicate the PM2.5.

Response: We changed the titles of X- and Y- axis based on your suggestion.

7. L254: “accounted for in” -> “accounted for by”

Response: We changed the term from “accounted for in” to “contributed by”.

8. L288: “Shown in Table 5”->“As shown in Table 5”

Response: We changed the term from “Shown in Table 5” to “As shown in Table 5”.

9. Table 6 caption: “kg” is a typo? Is it supposed to be “tonne” or “Tg”?

Response: Kg is a typo error and thus changed to Tg. Thanks.

10. L387: grammar error in “..enhance increase soil N availability” .

Response: Thanks for your comments. We deleted “enhance” to avoid the duplication.

11. The fonts in Fig.4 are too small to be read easily.

Response: We increase the font size of Fig.4

12. Section 4: This study revealed a significant contribution (more than 50%) of TAP from Asia on surface PM2.5 in Japan and South Korea using one-year model simulation alone. Given that a large amount of previous observational studies have been involved in the TAP, especially trans-Pacific transport of aerosols, at the very

least, the authors are suggested to discuss more on the previous results from long-term observations, e.g., what is the difference of magnitude of the ratio of TAP to total pollution, what is the role that multi-scale circulation plays in the TAP, among others. As such, the readers can get a full picture on this topic.

Response: We cite an exhaustive list of research on TAP in this region throughout the manuscript, including those that have used back-trajectory analyses (Lee et al., 2013) (Lee et al., 2011), atmospheric models (Kim et al., 2017) (Koo et al., 2008), and/or measurements with positive matrix factorization and potential source contribution functions (Heo et al., 2009) in attempts to conduct source apportionment. These studies of both short-term episodic events and long-term average concentrations generally point to similar results, e.g. between 60% and 80% of local PM in South Korea is attributable to transboundary sources.

13. The journal name is missed in the reference of Gu et al., 2016b.

Response: We noticed that reference Gu et al, 2016b duplicated with Gu et al. 2016. Gu et al. 2016b is therefore removed.

References

Heo, J.-B., Hopke, P.K., Yi, S.-M., 2009. Source apportionment of PM2.5 in Seoul, Korea. *Atmospheric Chemistry and Physics* 9, 4957–4971.

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Koo, Y.-S., Kim, S.-T., Yun, H.-Y., Han, J.-S., Lee, J.-Y., Kim, K.-H., Jeon, E.-C., 2008. The simulation of aerosol transport over East Asia region. *Atmospheric Research* 90, 264–271.

Lee, S., Ho, C.-H., Choi, Y.-S., 2011. High-PM10 concentration episodes in Seoul, Korea: Background sources and related meteorological conditions. *Atmospheric Environment* 45, 7240–7247. <https://doi.org/10.1016/j.atmosenv.2011.08.071>

Lee, S., Ho, C.-H., Lee, Y.G., Choi, H.-J., Song, C.-K., 2013. Influence of transboundary air pollutants from China on the high-PM10 episode in Seoul, Korea for the period October 16-20, 2008. *Atmospheric Environment* 77, 430–439.