

Author's Response : Anonymous Referee #2

Dear, referee

We would like to thank the referee for your valuable feedback and suggestions. Below are our responses to the comments provided.

Comment 1:

"One can regret that the root cause for the increase of the mass extinction efficiency is not found. This should be said explicitly in the abstract."

Author's Response:

Thank you for your valuable feedback. I will add the following sentence on lines 23-24: "However, due to the limitations in obtaining long-term composition data in this study, further research is needed to accurately determine the causes of the increase in PM_{2.5} MEE."

Comment 2:

"The trends for several variables are given on a per month basis. Yet, the variables show a large seasonal cycle. Therefore, I believe that the per month basis is somewhat misleading and should be converted to a per year value."

Author's Response:

Thank you for your insightful comment. We agree that the seasonal variation complicates a straightforward by-eye inspection of the trends. Nevertheless, we have opted for this version because of data availability. As month-long data gaps exist in the data sets, the use of annual means would include an unbalanced representation of the results. We have now added annual mean values to the relevant plots, i.e., Figures 2, 3, and 4. These show trends that are in line with the ones inferred from using monthly means and help guiding the eye when inspecting the plots.

Comment 3:

"The introduction contains sentences such as "several citizens still believe that PM5 pollution remains serious." This clearly implies that the citizen are wrong in their fear of atmospheric pollution. Yet, although the pollution may have decrease, the levels are farm from harmless. Thus, the citizens are right in their perception that pollution remains serious"

Author's Response:

I agree with your comment that the sentence, "several citizens still believe that PM_{2.5} pollution remains serious." could imply that citizens are wrong in their concerns about atmospheric pollution. Therefore, to prevent any unintended interpretations, I will remove this sentence from the introduction.

Comment 4:

"Abstract However, both Relative humidity and Absolute humidity are not statistically significant". The trends of these variables are not statistically significant.

Line 233 : "Figure 2 and Table 1 show the monthly changes". The figure show the monthly values, not the changes"

Author's Response:

We appreciate your careful review. We will revise the sentence in abstract and line 233.

<Abstract>

- However, both Relative humidity and Absolute humidity are not statistically significant
 - However, the trends of these variables are not statistically significant.

<Line 234>

- Figure 2 and Table 1 show the monthly changes in PM_{2.5}, PM_{2.5-10}, and PM₁₀ concentrations with the visibility across Seoul and Ulsan consistent with the findings of previous studies, the monthly PM mass concentrations in both cities are higher in winter and spring, and lower in summer and autumn
 - Figure 2 and Table 1 show the monthly values in PM_{2.5}, PM_{2.5-10}, and PM₁₀ concentrations with the visibility across Seoul and Ulsan consistent with the findings of previous studies, the monthly PM mass concentrations in both cities are higher in winter and spring, and lower in summer and autumn

We appreciate your thorough feedback and have implemented the suggested revisions to improve the clarity and accuracy of the manuscript.

Author's Response : Anonymous Referee #1

Dear, referee

We would like to thank the referee for your valuable feedback and suggestions. Below are our responses to the comments provided.

Comment 1:

""the particles become smaller each year". Clear mention smaller in size or number"

Author's Response:

Thank you for your valuable comment. We agree that the original phrasing could lead to ambiguity. To improve clarity, we have revised the sentence on line 23 to: "the size of the particles becomes smaller each year"

Comment 2:

"It is a very interesting work where the authors show how decreasing PM2.5 concentrations are not related to visibility. However, there is one confusion, the angstrom parameter values show increase in fine mode particles and the authors assumed the backscatter coefficients of fine mode are assumed to correspond to the light extinction caused by PM2.5. So when authors show increase of fine mode, does it also mean PM2.5 increases? on the contrary they also showed a decreasing trend in PM2.5."

Author's Response:

Thank you for your insightful comment and for highlighting this point of confusion. We understand the concern regarding the apparent contradiction between the increase in the fine mode particles indicated by the Ångström exponent and the decreasing trend in PM2.5 mass concentrations.

To clarify, the Ångström exponent is an indicator of the size distribution of aerosol particles, with higher values typically suggesting a dominance of fine particles. However, an increase in the Ångström exponent does not necessarily correspond to an increase in PM2.5 mass concentration. The observed decrease in PM2.5 concentration in our study reflects a reduction in the total mass of particulate matter with diameters less than 2.5 micrometers. The increase in the Ångström exponent observed in this study and the increase in the fine-mode Ångström exponent reported in previous studies suggest that the particle size within the fine mode has become smaller.

To make this point clearer, we have revised the manuscript to include the following statement on

page 16, line 390-393: "Considering the results of previous studies, the increases in the Ångström exponent and PM_{2.5} MEE observed in this study are presumed to be caused by the decrease in the size of fine-mode particles."

We hope this clarification resolves the confusion, and we appreciate your valuable feedback.

Comment 3:

"Moreover, the study would be well-rounded if composition information was added to know about hygroscopicity. The authors can look into satellite data for information about composition if ground data isn't available. Its not so straight forward to say organics are hydrophobic, one has to consider oxidised organics or SOAs"

Author's Response:

Thank you for your valuable feedback. We appreciate the suggestion to include composition information related to hygroscopicity and we agree that it is important to consider the role of composition.

Unfortunately, due to limitations in our data collection capabilities, we were unable to obtain detailed composition information for the aerosols studied. As a result, we could not directly address the hygroscopicity of specific components.

To improve clarity and avoid potential confusion, we have revised the manuscript to reflect a more accurate representation of hydrophilic and hydrophobic species. Specifically, on page 13, lines 325-326, the original text stated: "Hydrophilic species include secondary inorganic compounds (e.g., sulfate, nitrate, and ammonium) and sea salt, while hydrophobic species include organic carbon and black carbon." This has been modified to: "Hydrophilic species include secondary inorganic compounds (e.g., sulfate, nitrate, and ammonium) and sea salt, while hydrophobic species include dust and black carbon."

We hope this revision contributes to a clearer understanding of our study. We deeply appreciate your insightful comments and suggestions, which have been invaluable in enhancing the quality of our research.