

Response to reviewers for manuscript AMT-2022-74: **Average visibility that has been miscalculated**

We thank the editorial team and the reviewers for your valuable input in enhancing the quality of our manuscript. We are happy to submit our point-by-point responses to the reviewers' comments and suggestions. The reviewers' comments/suggestions are in black. Our responses are in red. All the suggested changes have been incorporated in the manuscript.

Anonymous Referee #1

General Comments:

Zhang et al. address the question of the calculation and interpretation of the average visibility and its relationship to the extinction coefficient. While the equation relating visibility and extinction is straightforward, the use of a simple arithmetic average of visibility can be misleading, producing a statistic that is disconnected from the underlying physical cause of visibility reduction, namely, atmospheric extinction. Researchers therefore need to be aware of these considerations if they use visibility datasets to investigate underlying trends in the atmospheric extinction.

This is a revised manuscript that addresses many of the deficiencies of the earlier submission. There are some weaknesses in the manuscript that should be addressed to improve its clarity. Some of these are minor textual changes while others require greater clarification. These are addressed below.

General Response: We thank the reviewer for the valuable review and encouraging comments.

L1.: Omit colon in title

Thank you for this valuable comment. We agree with the reviewer and have changed our title.

L18: "On the ONE hand"

Thank you for pointing out this error. The suggested change has been implemented in the manuscript. We have also corrected other grammatical errors in the paper.

L32: Rephrase "which greatly supports many research. " Unclear.

Thanks for pointing out this. We now state the following in Line 32 "A large amount

of gridded visibility data have been accumulated through long-term observations at dense measurement sites (Pitchford et al., 2007; Singh et al., 2017). These visibility data are widely used and greatly support many research. "

L34: Preferable: "Methodological issues in calculating the average visibility..." or similar

The suggested change has been implemented in the manuscript.

L43: Given that the paper focuses on different average statistics, these should be specified explicitly.... "The second method first calculates the arithmetic average of the extinction coefficient, ". And likewise elsewhere in the manuscript.

Suggested changes have been implemented in the manuscript; where "the average extinction coefficient" has changed to "the arithmetic average of the extinction coefficient" in this paragraph. (Line 44- Line 51)

L61: The sentence "The answer seems clear, but not yet convincing. " adds little to the argument and should be dropped.

This sentence has been removed from the manuscript.

L65: Better: "been overlooked in the past. "

The suggested change has been implemented in the manuscript.

L68: "If the difference...is also reliable". The authors have already pointed out that arithmetically the two methods are not the same, while "reliability" relates to the purpose that the data is being used for and the accuracy and precision needed. Some clarification is needed here.

We thank the reviewer for this useful comment. The sentence has been modified as follows in Line 70: "If the difference is negligible, there is no point in discussing this issue, and the arithmetic average visibility obtained from Eq. 2 can be used with small error. "

L74: It seems what the authors are doing is not developing an "intuitive understanding", but rather demonstration the divergence of the two approaches with a

given dataset.

We have revised the sentence, which now reads "To visualize the magnitude of the numerical difference between arithmetic average visibility and harmonic average visibility, ..."

Fig. 1: It is difficult to compare the short term effects and the two different methods for calculating the average visibility since they are on separate graphs. It would be helpful to have plots (e.g., monthly, yearly) on the same figure to improve comparison.

We appreciate the reviewer's suggestion. We think that Fig. 1 has achieved our intentions, and no changes have been made. The main focus of Fig. 1a and Fig. 1b is to show the average visibility data calculated by the two methods. The comparison of them is shown in Fig. 1c, which illustrates the distribution of the relative deviation of arithmetic average visibility from harmonic average visibility. Figure 1c shows that the relative deviation of the yearly average is larger than that of the monthly average, which is larger than that of the hourly average. It can be drawn from Fig. 1c that the difference between the two calculation methods cannot be ignored, especially when analyzing large-scale or long-term visibility data, and when analyzing local visibility data with large changes within a short period of time. No changes have been made. The relative deviation is not negligible, so that the difference between the two calculation methods cannot be ignored, especially when analyzing large-scale or long-term visibility data, and when analyzing local visibility data with large changes within a short period of time. No changes have been made.

L104: Correct "period CHOSEN to"

The suggested change has been implemented in the manuscript.

L143: I presume "extensive" property is what is meant?

Yes. Extensive property is a property of a component or system that is a function of the whole component, a property that changes if material is added or subtracted to the component (https://en.wiktionary.org/wiki/extensive_property). Extensive properties are proportional to the amount of matter in the system, while intensive properties do not depend on the size of the system, nor the amount present in the system.

L146: "the summation of visibility has no real physical meaning". That might be so, yet it could still be a useful statistic.

Thanks for pointing out this. We now state the following in Line 146: "Therefore, the summation of visibility data is just a useful statistic without real physical meaning. "

L147: "3.2 Physical meaning of arithmetic average visibility and harmonic average visibility" is a clearer and shorter section title.

The suggested change has been implemented in the manuscript.

L154/5: This section is confusing as M_j here relates to the average mass extinction of the SAMPLE, not individual SUBSTANCES composing the sample, which is the meaning for the same symbol in Table 1. This should be clarified in the text and the properties and symbols distinguished from one another.

We appreciate the constructive comment made by the reviewer. The word "substances" is changed to "components" in section 3.1, and the word "substances" is changed to "samples" in section 3.2.

L158: Change "substances" to "sample" as in the above.

The suggested change has been implemented in the manuscript.

L183: Perhaps "property" is better than "process".

The word "process" is changed to the word "meaning". The sentence now reads "...so that the results of the summation of visibility are just numerical values with no corresponding physical meaning" (Line 183)

L197: I think this is a statistical rather than a "mathematical" problem.

The suggested change has been implemented in the manuscript.