

Review of “Average visibility that has been miscalculated”

Zhang et al. report a reassessment of the equations used to calculate the average visibility and propose that the usual understanding of average visibility be dropped in favour of a weighted average. Their work highlights the important connection between the visibility and the underlying atmospheric extinction coefficient, which itself is connected to the composition of the atmosphere (particle concentration, composition, hygroscopicity, etc). Users of visibility data need to be alert to the differences between Eqs. (2) and (3), and that average visibility cannot be straightforwardly related to average extinction coefficient.

The authors do well to bring this to the attention of the community, but their approach has several flaws that should be addressed. I do not think that the work is publishable in its present form. It is not simply a question of the title, an issue raised by the two reviewers. The authors need to revise and clarify the argument and points made in the manuscript.

A major objection is that “average visibility” (Eq. 2) conforms to the accepted definition of arithmetic average or arithmetic mean of a given property, and this is what most scientists would understand by the term. The authors are right that Eq. (2) and (3) are not mathematically equivalent. What is needed then is for the authors to provide helpful terminology distinguishing between Eq. (2) (“average visibility”) and Eq. (3). There are presumably circumstances when researchers would find the average visibility (Eq. 2) a useful concept for describing their observations. In other cases, a weighted average or some other statistic would be more appropriate (using Eq. (3) to study the underlying extinction coefficient). The circumstances for using one or other statistic needs to be clarified.

Because it may be reasonable to use one or other equation depending on a study’s goals, the manuscript’s terminology denoting logical conclusions (“therefore”, “proves”), and correctness (“correct”, “miscalculated”, “error”) is too narrow. This paper would be much more valuable to the scientific community if it brought greater clarity and nuance to the ways in which visibility data are analysed.

More emphasis should be placed on when the values produced by the two equations differ. The values produced by Eq. (2) and (3) converge as the range of visibility values becomes increasingly narrow. As Fig. 1c shows, the variation in the results of the two approaches within the hourly dataset is small, presumably because visibility is generally changing little over this time period for most observations. Greater variation occurs when datasets are long enough to contain larger variations in the individual visibility measurements.

The manuscript’s arguments about the average value becoming infinite if any one of the measurement series is infinite are not convincing. Such contributions to the average visibility (or another physical property) do not occur in practice because individual measurements giving infinity are physically implausible (whether for visibility or another physical property) and would be removed from the data set. The formal mathematical possibility of an infinite result is not helpful.

The manuscript title is uninformative and potentially misleading. Both reviewers thoroughly disliked the title, but the authors were resistant to changing it. I think they should. Perhaps something like "Average visibility and its relationship to atmospheric extinction: a clarification" provides a better summary of their paper's content and aims.