Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-415-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Ångström exponent errors prevent accurate visibility measurement" *by* Hengnan Guo et al.

Anonymous Referee #1

Received and published: 21 December 2020

In this manuscript the authors identify an error in determining visibility conditions from "visibility meters." The main focus of the manuscript is that the WMO recommends monitoring visibility at a wavelength of 1.07 um, while visibility occurs at shorter wavelengths (550 nm is the reference assumed). The fundamental issue is that without knowledge of the Angstrom exponent, which is rarely available, it is impossible to accurately correct the measurements into the visible portion of the spectrum. The authors go on to quantify the impacts of this issue on errors in visibility measurements and ultimately suggest that the current approach be changed to deal with these problems. The results are what one might expect, but the authors do a thorough job of quantifying the errors associated with the current methods. I recommend the manuscript be published when the following comments are addressed.

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Discussion paper

Comments In several places throughout the manuscript, the authors ascribe a belief, opinion or intent to the WMO. This is not appropriate, and the language should be changed. For any large scale endeavor, assumptions and simplifications must be made, and I am guessing that is the case here as well. âĂć Lines 40-41. "Obviously, WMO believes that. . ." should be changed to, "This statement implies that. . ." or something similar. âĂć Lines 56-64. The authors are taking a simplifying assumption from the WMO and suggesting that they don't understand what the Angstrom exponent is. This paragraph should be rewritten to simply state what the implications are. For example, remove phrases like, "If the opinion of the WMO is correct. . ."; âĂć Line 65. ". . .under the premise that WMO's judgement is correct," should be changed to, "WMO's recommended approach is adequate." Or something similar.

It would be worth providing a paragraph describing the primary method(s) that are used as "visibility meters", the wavelengths used, and typical corrections (e.g. at lines 65-66). For research purposes, many current visibility measurements use multiple wavelengths and so the Angstrom exponent can be directly determined. I am not as familiar with the measurements the authors are describing, and it would benefit the reader to have more background information. On this note, where do most measurements fall in relation to the contours of Figure 1?

Section 3 and Figure 2. The authors fix the size distributions and refractive index for four expected aerosol types, and then use these data to determine the Angstrom exponent by varying N (although it is not a function of N). The authors should vary the size distributions and refractive indices within physically reasonable bounds to determine ranges of values for their calculated Angstrom exponents (Figure 2b) for the different aerosol types. This would be a useful result in and of itself.

Section 4.2. The authors note, "If it is generally believed that a definite function of q and v exists. . ." Both q and v depend on aerosol composition, size distributions, hygroscopicity, etc. There is no believing in this relationship – there are reasons the two are related, but simplifying assumptions attempt to relate them in a way that is easy

to implement.

Section 6. In addition to the schemes explored, it would be interesting to determine q from the two wavelengths used (0.87 um and 0.44 um) for every data point, and then determine AOD at a 3rd wavelength from Aeronet (not currently included) collected at the same time, to get a better idea of uncertainty in q due solely to the Aeronet measurements.

Minor Comments Line 45. A statement describing the parameters that affect the Angstrom exponent would be useful here. Line 70. You should be more specific when you state, "...errors exist in the error estimates of current visibility measurements." Research grade instruments do not suffer from these same issues. Line 96. Define what the hygroscopic growth factor is. Lines 139-141. The authors note, "The common conclusion reached during calibration of the four groups is that q is a constant variable independent of visibility. This is a different conclusion from previous studies, where q is determined by an empirical formula that uses visibility as a variable." Other work which assumes a dependence of q (a proxy for size distribution) on visibility (a proxy for aerosol loading) are based on the assumption that greater aerosol loadings typically occur following atmospheric processing (e.g. Pitchford et al., 2007 JAWMA), which results in larger aerosol sizes (and therefore a change in q). This is based on ambient measurements, not simulations where size distributions can be kept constant. Line 167. Who is "thinking" in this sentence. Please re-phrase.

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