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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Different trends between extreme and median surface aerosol extinction coefficients over China inferred from quality controlled visibility data" *by* Jing Li et al.

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Anonymous Referee #2 Received and published: 19 December 2017 GENERAL The paper presents trend analyses of aerosol extinction coefficient at numerous mea- surement sites in China. Different methods for calculating trends are compared. The analysis also compares trends in major areas of China. The paper is very interesting, I can definitely recommend publishing it in ACP. I did not find any very big errors in the paper. However, there are some points that need to be explained in more detail and some points that should be changed. The changes I am suggesting are minor, mainly clarifications.

We thank the reviewer for his/her positive and helpful comments on our paper! We have addressed the detailed comments point-by-point below, and have also revised the paper accordingly.

DETAILED COMMENTS

The most important point that should be changed is this: the Aerosol Extinction Coefficient (AEC) that is used for the analyses is not unitless like it is presented all over the paper and the supplement. AEC comes from the Koschmieder formula (visibility = 3.912/AEC) and visibility is given in units of length. So, the unit of AEC is inverse units of length, for instance inverse meters or inverse kilometers or inverse megameters. In polluted areas of China extinction coefficient is typically in the range of some hundreds of inverse megameters. Go through the paper and the supplement and present the units of AEC everywhere both in the text and the figures. This is important also since the AEC values are something that link the paper's values better to the rest of the world.

We are sorry for the confusion. Yes, AEC has unit km-1. However, because the absolute value of extreme and mean AEC can be orders of magnitude different which makes their absolute trends incomparable, we report all trends in terms of relative changes. Therefore, the trends throughout the paper are unitless. We have clarified this point in both the abstract (line 13) and the main text (lines 158-160).

There are no tables. Give the main results in 1 or 2 tables. For instance trends within each major region obtained with the different methods. Tables give you also more references because they can easily be compared with by other authors.

Thanks for this suggestion. We added a table displaying the extreme and mean trends and their differences for the major regions. We also added the same table for seasonal trends in the supplementary material.

In the figures, give units for the color bars, if they have a unit. And if they are unitless, give an explanation of the color scales in the captions. Now there are no explanations of the colorbars in any figure.

OK. We added statements in the figure captions that the trends are unitless (line 437).

L108 " ... annual or seasonal time series of the 95th percentile of the extinction coefficients ..." There is nowhere mentioned, what is time resolution of the data. So, does this mean the 95th percentile of one-minute or hourly or daily averaged AEC in any given year? How do you define each season?

Again sorry for the confusion here. We use daily averages (averaged from hourly data) and the percentiles refer to those of daily averages. We added an explanation as follows in lines 110-111: “The hourly AEC is first averaged to daily values and 95th percentile (50th percentile for the median trend) is then calculated for each year or each season for the seasonal analysis.”

The seasons are defined as: March, April and May for spring, June, July August for summer, September, October and November for autumn and December, January and February for winter, which are stated in the parenthesis of lines 260-263.

L111. In eq (1) there is Xi and Xj. They must be the AEC values at i and j. Then b has the same unit as AEC. Or is it - as I would assume - that b has the units of AEC divided by the units of time, for instance inverse meters in a year if i – j in eq. (1) means time step. Does it?

b has unit of AEC divided by units of time. We use annual percentiles of AEC so the unit of b is km-1/yr. However, b is not the final trend reported as we converted it to relative changes, which is b times the number of years divided by the AEC value of the starting year (1980). This point is clarified in lines 158-160.

The quantile regression has the formula (9). Is the beta in formula 9 the trend? If it is, write it explicitly out. If it is not, in which formula is it? And further, does it also have units? It should if it is to be compared with b of eq. (1).

Yes. The beta in (9) is the slope of the trend and its unit is also km-1/yr. The final trend

of the quantile regression model is also reported as relative changes.

Figure 2 shows the probability density functions of AEC in different regions. It is very interesting. But the same issue applies to this plot also: units. AEC has units of inverse length, e.g., inverse megameters. So, I would recommend presenting the picture so that you simply show the x-axis as inverse megameters but use a logarithmic scale. That would also help in comparing the data with the rest of the world. Another issue in this figure is the values of the pdfs. The integral of a pdf should equal 1. Now there are values larger than 1 so the integrals are definitely > 1. Explain in detail what the y axes mean. And do corrections if needed. Further in the same figure: if you calculate a pdf like that, the data are divided into bins of AEC and then you present how large a fraction of data is in each bin. What is the bin division you used?

Figure 2 shows the distribution of the absolute AEC values so they have unit km-1. We have changed the x axis to inversion megameters in logarithmic scale and added the unit in the figure caption. We have double checked that the integral of all pdf functions are indeed 1. Values greater than 1 are reasonable to appear in the pdf and this does not necessarily mean the integral is greater than 1 (for integral you have to multiply the x axis). In fact, pdf can take any non-negative values as long as the integral equals to 1. The pdf only reflects the probability density for some interval rather than the real probability. For example, in one pdf in Figure 2 the y axis is 1.35 and the x axis is 6.21. This means the probability between some very small interval around 6.21, say between 6.20 and 6.22 is 1.35*(6.22-6.20)=0.027. This number must not exceed 1. To produce Figure 2 we use 20 bins ranging from the minimum log(AEC) to the maximum log(AEC) to calculate each pdf.

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