

## ***Interactive comment on “Evaluation of climate model aerosol trends with ground-based observations over the last two decades – an AeroCom and CMIP6 analysis” by Augustin Mortier et al.***

**Anonymous Referee #1**

Received and published: 25 February 2020

The paper by Mortier et al. reports the results of an interesting study on regional trends in aerosols, focussing on properties which are sufficiently observed by global and regional observational networks. The way the results are presented is appealing, in particular figures 5 and 6. The summary is nicely presented as a series of bullets. The impact of restricted sampling at the monitoring sites on the trends is well explained. I am in favour of publication, but have a number of minor comments that should be addressed before publication.

Minor comments:

C1

Abstract: Please include a list of the models included in the study.

The introduction is too short to my opinion. There is very little information on previous aerosol model-model and model-observations intercomparisons. Activities like AeroCom, CMIP6, should be introduced.

I89: "Samples are collected every third day". Is this only for the speciated analysis or also for total PM<sub>2.5</sub> and PM<sub>10</sub>?

I102: "The data have been screened" By the authors, by Aas et al. or by the instrument teams? Please give some more details: when is a site regionally representative? Is there a link with the model grid box size? Also for PM the representativity would be good to discuss (in sec 2.1.2).

I117: Since Gliss et al. is in preparation, it would be good to provide more details on the selection/correction procedure.

Sec 2.2.1. It is a bit strange to call the CAMS reanalysis a "climate model" (line 120). Maybe it is good to explicitly refer to "climate models, aerosol models and aerosol reanalyses" in the paper or at least clearly explain the types of models/reanalyses.

I129: Please place reference to Inness et al between brackets.

I147: "ESGF nodes". Please explain the acronym and provide a web link or reference.

I154: ".. into one average time series." This may be removed from the sentence to avoid repetition.

I155: "not as easy to define when combining the trends for individual sites together." Why not? Is there a difference between the trend of a sum and the sum of individual trends?

I156: "with our aggregation method, even a station that has not provided a sufficient amount of data for computing a trend at its location can still contribute to the computation of a regional time series." This sounds a bit dangerous. Including incomplete

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time series that have an offset with respect to the mean will introduce a spurious trend. Please provide more discussion on how much this may impact the trends derived?

I160: "Seven regions". Please provide the corner locations of the regions, for instance in a small table. Is there overlap between Asia and NAfrica? Are some stations used in multiple regions?

I180: "minimum of 300 valid daily measurements". This is basically one year of data. Why are the authors not more selective, e.g. allowing only stations with measurements for 50% of the time? Why this choice?

I182: "three valid points". Please specify more explicitly. Is a valid point a daily mean observation for one station? Or something else?

I201: "Mann-Kendall test ... Theil-Sen". Please provide a reference.

I208: "residuals". Please provide a definition of the residuals. Is this computed based on the yearly-mean, regional-mean values?

I228: "model subset of data". What does this mean? Make very clear that this study is based on model data only.

I230-236: I read the description of the datasets a few times and still I am not sure I understand what is done. Please define the "Ref" and "Exp" very explicitly, maybe even using formula's.

I238:  $\sigma = 0.5$ . Why 0.5? It seems  $\sigma$  has a unit %/year?!

Eq.2: I'm struggling with the representativity and the normal distribution. A relative trend is expressed as %/year. Therefore this has a dimension. But a normal distribution takes a dimensionless quantity as argument? Therefore Eq.2 does not make sense.

Fig. 4: Why is the number of points a coloured region, and not a simple line?

Fig. 4: Which model is used for this?

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I278: Is there an explanation why PM<sub>2.5</sub> is a larger fraction of PM<sub>10</sub> in Europe compared to North America?

I305: "Collaud Coen". Provide reference.

I310: "smoother". What does this mean?

I314: "somewhat higher". Do you mean "somewhat more negative" or "less negative"?

I321: The difference with Collaud Coen deserves more discussion. Is this trend significant? Is the difference understood?

I 339: second increase: should this be "decrease"?

I394: "could be caused by increased wet scavenging". How does this match with the SO<sub>4</sub> negative trends?

I464: The large trend in Arctic? Do the authors have any idea how to explain this?

I542: "brightening Streets et al. (2006); Norris and Wild (2007)." Please place references between brackets.

References: Please provide the DOIs for all the cited papers.

Olivié, D. et al.: in preparation. Please remove or provide full author list and title. The same remark holds for a few other preprints/in preparation papers.

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-1203>, 2020.

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