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## ***Interactive comment on* “Changes in atmospheric aerosol loading retrieved from space based measurements during the past decade” by J. Yoon et al.**

### **Anonymous Referee #1**

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#### General comments

The paper focuses on an interesting topic, namely aerosol loading changes. Such changes are very interesting in many aspects of atmospheric science, including cloud properties or aerosol-radiation interactions, as aerosols have been suggested to be an important cause of solar dimming and brightening. Of course, climatically it would be more interesting to have a more extended study period, but the authors have chosen to only use post (or around) 2000 launched satellite instruments and platforms. However, this is still interesting. My main reservations are:

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(i) A good number of papers have been published in the last few years on aerosol changes and trends. What is missing in this paper is a comparison of its findings to the existing ones from other studies.

(ii) I also have some reservations regarding the methodology, which are discussed below.

(iii) Since the study period is relatively short, it is better to use the term “tendencies” instead of “trends”.

(iv) In the manuscript, explanations of obtained changes of AOT are quite often based on speculations reaching the limit of hypotheses. Often, they are based on discussions of the regime of aerosol sources and transport, for each area. However, I am afraid that this is not enough. More support is necessary and authors may search to get some in other way. For example, seasonal analyses of trends could provide some evidence and explanations, shedding more light.

## Main comments

### Abstract

1. Page 26002, lines 1-14: text is not appropriate here since it is pure theoretical and does not refer to the findings of this study

2. Based on the previous comment, the remained Abstract must be enhanced to stand up alone.

3. The studied period has to be explicitly indicated in the Abstract and not be referred as “during the past decade”.

### Introduction

4. A considerable number of studies dealing with trends of AOD have been studied so far, either at local or regional and global scale. Therefore, it should be clearly stated here what new the present study brings and adds to scientific knowledge with respect

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to the previous and existing studies. Section 2.4 (AERONET)

5. It should be reported how many AERONET stations are used in the study, making reference to Table 2. It would be also useful to show them on a map. Section 3

6. Has any care been taken with regards the continuity of AERONET data? It is stated that their minimum temporal coverage is 5 years but it is not clarified whether they cover continuous periods or they do have breaks on it.

7. It is also important to provide the number of compared satellite-AERONET AOD data pairs, for each AERONET station.

8. Page 26007, line 21, "...are caused only by the different and limited sampling": it should be clarified whether the term "sampling" refers to time or space. The entire sentence has to be re-written in a much cleared manner. Section 4

9. Page 26009, lines 2-4, "A relatively large ... cloud-free AOT retrieval (Yoon et al., 2011)": yes, but large standard deviations can also be attributed to strong temporal variability of AOT itself induced by aerosol- and not cloud- related changes. How can the authors isolate the contribution of this to their computed overall standard deviation of daily AOTs within a month? This should be important in areas, for example, undergoing aerosol transport or biomass burning.

10. sub-section 4.1: when applying the Grubbs and Gaussian tests to remove outliers in weighting factors, it is "assumed that that an approximately normal distribution is the most probable one.". This, as shown in Figure 4, indeed effectively removes outliers. Nevertheless, what happens if these outliers are meaningful? For instance, if values correspond to AOT, how/why can/should very low or high values be excluded? Authors should discuss this.

Section 5

11. Last sentence is meaningless; you should rather state whether trends are nicely correlated or not. Section 6

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12. second paragraph. The discussion of AOT trends over western and eastern Europe and especially their attribution to causes must be further supported. For example, the decreases of emissions in eastern Europe are not given any reference while hypothetical explanations and assumptions should not be presented as facts unless supported by references. Also, for both regions, the role of natural aerosols should be also assessed given its contribution to total AOD.

13. Page 26014, lines 9-11: there are available references for the megacity of Cairo (e.g. Kanakidou et al., 2011).

14. Page 26015, lines 3-4, "... with nearly about 1 billion people living in and around the Ganges valley, are ...": nevertheless, the increase of AOD is not in that region.

15. The statements concerning the increase of AOT over Korea and Japan should be supported by some evidence, literature included.

16. Page 26015, line 28 through to page 26016, line 2: is this enough to explain the increasing tendency of MODIS-Aqua afternoon AOT? For example, wildfires usually do not last for half a day but are more persisting sometimes lasting for a few days.

17. As to the discussion of AOT tendencies over China and the relevant Fig. 10, what are the changes suggested by each dataset (and applied liner regression fit)? Also, why there are more spikes in red curve, i.e. the one of AERONET?

18. Page 26016, line 29 through page 26017, line 2: a R value equal to 0.6 certainly cannot justify statements like "strong correlation".

#### Other details

1. Page 26002, line 17: replace "Whilst the aerosol optical thickness, AOT, over Western Europe decreases ..." by "While the aerosol optical thickness, AOT, decreased over Western Europe ..."