

## ***Interactive comment on “Evaluation of VIIRS, GOCI, and MODIS Collection 6 AOD retrievals against ground sunphotometer measurements over East Asia” by Q. Xiao et al.***

**Anonymous Referee #2**

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This work studies the spatial and temporal characteristics of satellite remote sensing of aerosol products against ground measurements of AERONET, the DRAGON-Asia campaign, and data from a mobile sunphotometer sampling campaign in Beijing. Five emerging satellite aerosol products from three different platforms (i.e. MODIS, VIIRS, GOCI) are evaluated over East Asia in 2012–2013.

In general, the manuscript is well written and organized in a clear and logical way. This manuscript is, as far as I know, the first to compare these five satellite AOD products in one study. Moreover, the VIIRS and GOCI products are rather new and have not yet explored in depth. As such, this study adds knowledge to the atmospheric research

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community and could be published after addressing the following comments: Major Comments:

• The authors use VIIRS products and comment in page 20712, lines 16–17 that “The VIIRS aerosol product reached validated maturity level in January 2013”. In the NASA LAADS website it is written in relation to the use of VIIRS products that “All Suomi NPP VIIRS EDRs are currently beta quality (with known problems) and are not intended for scientific use”. A clarification is therefore needed as the data sources for VIIRS and GOCI satellite products are missing.

• This work presents data from sources with very different temporal and spatial resolutions including a changing footprint (e.g. MODIS) compared to a fixed footprint (i.e. GOCI). It is not clear how these differences have been taken into account? How has data fusion to one grid been done?

• This In page 20717, line 2 the authors write that the data was “remapped”. A detailed explanation in the text of the remapping methodology is missing. I find it an important stage of the work and a detailed explanation will able the reader to understand and reproduce the methodology in a future work. Furthermore, is the remapping a daily procedure? What is the possible bias due to the remapping procedure?

• I suggest to put more emphasis in the conclusion (and abstract) and throughout the manuscript on the better performance of satellite aerosol products in tracking the day-to-day variability than in tracking/representing the spatial variability at high resolution. For example, in the Conclusion the authors claim that small scale variability and point sources can be detected. Unless point source has the size of 3–6 km I do not see how this claim is supported by the results in this manuscript. Also, individual exposure is mentioned on line 10 of p. 20729 – individual exposure estimation in urban areas may be obtained if we assume uniform exposure for all the people that live in a 3–6 km grid cells. If this is what the authors mean this needs to be clarified. Otherwise, I suggest to reduce expectations rather than increase them based on the reported MS results.

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• Sections 3.2, 3.3 – it will be very valuable to show performance metrics for the different satellite aerosol products after they were calibrated against ground measurements. Namely, once these products are calibrated it is very interesting to know which in fact performs better. Clearly, the calibration should be based on a complete leave-one-out cross validation process, such that the model parameters are “optimal” in the sense that they represent all the data but not overfitting the data. Model parameterization should be developed on a regional (spatial) scale and then applied locally on AOD measurements, such that the spatial variability is still evident.

Minor Comments:

• Figure S1 presents the spatial distribution of the stations with the different buffers. (a) The size of the ground station symbols is not proportional and I recommend to reduce the symbol size. (b) I recommend using a scale bar of 3-6-9 km, which is more relevant, instead of 5-10-20 km. (c) The different sample size boxes are not very clear: 3x3, 4x4, 6x6, 9x9? An additional table at the bottom of the figure with an explanation in the manuscript and next to each cell size can possibly make this clearer.

• Table S2- How was the number of observations (N) from each data source taken into account? Show that the results are affected/not affected by this parameter (N).

• The standard deviation within the 3x3 cells isn't reported. I think it is important to report it before averaging the cells in order to study/observe the distance between values within the 3x3 boxes is low.

• P 20720, lines 2-4. “slope is the slope of the linear regression with satellite retrievals as the dependent variable and ground AOD measurements as the independent variable;” it should be exactly the opposite. We want to predict ground PM by AOD so satellite AOD should be the independent variable and ground measurements (here ground AOD) be the dependent variable. This way the satellite AOD will be consistently used as the independent variable.

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• Page 20720, lines 10-16. Consider moving these lines to the introduction and method sections.

• p 20721 line 3. Figure 2b shows the site specific average AOD with the regional average AOD subtracted in these three cities – how was the background calculated? Also, please explain what is the meaning of 0.01 increase in AOD as represented by different colors in Figure 2(b). Moreover, the manuscript (page 20721, line 20) refers to a difference of AOD of 0.4 between stations, a value not represented in the figure.

• P 20721 lines 15-18. I assume that the higher variability in Beijing comes from the (a) poorer performance of the hand held device (e.g. instrument quality), (b) the use of daily average AOD values in DRAGON sites vs. momentarily measurements (in each site-day) in Beijing (e.g. measurement noise, un-representativeness of the measurements in Beijing), and (c) in Beijing the measurement may have been performed when the devices does not exactly face the sun due to operation errors. I suggest to discuss all these optional sources of errors.

• Page 20722, lines 4-5. Compare the availability of different satellite-based data and AOD from AERONET at 13:00. Terra overpass is at 10:30 local time, it hasn't been mentioned throughout the manuscript if the Terra data was compared to AERONET data at 10:30. One can understand from the text that the Terra observations were compared to AERONET at 13:00. Yet, later in the manuscript, in the first paragraph in page 20724, the overpass time difference of Terra is mentioned. I recommend to either make this clearer or to consider excluding the Terra dataset from this study.

• As written in page 20724, line 3, the Y-axis in Figure 4 is “relative frequency rather than the total number of retrievals”. If the frequency is relative to the number of observations (N) than it (i.e. N) should be specified in the text and/or in the figure. Moreover, as the number of satellite observations has seasonal variation (e.g. due to clouds), I suggest to add the number of observations per satellite per month, possibly in a separate figure/table.

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â€” Page 20729 top. Clearly, the conclusion that the 6 km products provide more accurate data than the 3 km products results from the spatiotemporal averaging. This may be useful in some cases but is huge disadvantage in other cases, in particular for environmental health and exposure estimation, which is one of the applications declared by the authors as their interest.

â€” Figure 6. The color scale should be the same for all figures for a clearer interpretation.

â€” Table 3. The temporal comparison section and the spatial comparison section should be separated, e.g. by a line above the spatial comparison section.

â€” Caption to Fig. 2a – what is “Loess curvy” ? Fig. 2b – what is the meaning of the green background color in non-measurement locations?

â€” Fig. 5 is too small and its details cannot be seen. There is a need to improve the presentation of this fig.

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