Atmos. Chem. Phys. Discuss., 15, C8790–C8794, 2015
www.atmos-chem-phys-discuss.net/15/C8790/2015/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Estimating ground-level $PM_{2.5}$ in Eastern China using aerosol optical depth determined from the GOCI Satellite Instrument" *by* J. Xu et al.

J. Xu et al.

Junwei.Xu@dal.ca

Received and published: 1 November 2015

Authors' Response to Comments from Referee #3

We would like to thank Referee 3 for his/her useful comments and suggestions that helped to improve the quality of this manuscript. Reponses to these comments are provided below. Specific Comments:

1) Page 17254, Introduction: Suggest have one paragraph describing why using the Korean Geostationary Ocean Color Imager (GOCI) to quantity surface PM2.5 concentrations in the eastern China. As the authors mentioned, this approach has been

applied to a number of satellite instruments: MODIS, MISR, and SeaWiFS. What are the advantages to use the GOCI instrument?

RESPONSE: Thanks for the suggestion. The advantage of GOCI instrument lies in high data density due to geostationary nature, which enables more detailed investigation on aerosol properties at regional scale. We have added the following paragraph on page 4 line 8-14 to highlight this advantage.

"The Geostationary Ocean Color Imager (GOCI) is the first geostationary satellite instrument that offers multi-spectral aerosol optical properties in Northeast Asia (Park et al., 2014). GOCI has a high observation density of 8 retrievals/day (hourly retrievals from 09:00 to 16:00 Korean Standard Time) over a location, which exceeds the retrieval density of traditional low-Earth polar-orbiting satellite instruments. Thus, GOCI is promising for more detailed investigations on aerosol properties in highly polluted and populated regions including eastern China."

2) Page 17256, Section 2.1: In the manuscript, the authors emphasized the importance of cloud filters at a number of places. How sensitive are the conclusions to the three cloud filters? For example, the first filter set a minimum number of 15 retrievals per 30km x 30km grid, how would the results change if using the number of 10 retrievals?

RESPONSE: Thanks for the suggestion. The thresholds of filters described in this manuscript actually present the best consistency between satellite data and ground-based observations. For example, changing the threshold of buddy check in our cloud filters from 15 to 10 would significantly underestimate AOD especially in northern Taiwan where the MFB would increase from -1.2% to -15.0%. Limiting the diurnal variation of GOCI AOD to the 80th percentile of diurnal variations in observations would introduce bias (rRMSE would increase by 4% in Beijing) in GOCI AOD. Decreasing the threshold of local variance check to 0.4 has little influence (< 0.1% for all statistics) on AOD, but would introduce bias to GOCI-derived PM2.5 by depressing the variation of PM2.5 concentrations. This is reflected by the underestimated GOCI-derived PM2.5 in

Beijing areas (rRMSE=16.6% and MFB=-6.8%) and Shandong areas (rRMSE=16.6% and MFB=-3.42%) where PM2.5 concentrations are higher than average (Table 1). We have added this description to page 12 line 5-12 and page 14 line 18-23 to clarify this point.

4) Page 17258, Line 5: It appears that Heald et al. (2012) has tested a few ways to correct the HNO3 overestimates over the United States. Can you describe which ones you have implemented in your study? And does the HNO3 overestimation also apply over the eastern China?

RESPONSE: In model, we reduced HNO3 concentrations at each timestep to 75% of their original values to correct the overestimation. The HNO3 overestimation is also found over eastern China by Wang et al. (2013). We have revised page 8 line 14-15 to describe the implementation of this HNO3 correction.

References: Wang, Y., Zhang, Q. Q., He, K., Zhang, Q. and Chai, L.: Sulfate-nitrate-ammonium aerosols over China: response to 2000–2015 emission changes of sulfur dioxide, nitrogen oxides, and ammonia, Atmos. Chem. Phys., 13(5), 2635–2652, doi:10.5194/acp-13-2635-2013, 2013. 5) Page 17262, Line 1-4: It would be helpful to explain the comparisons with GEOS-Chem and MODIS-derived PM2.5 concentrations. Are these your results or from previous studies?

RESPONSE: These are our results. We have revised the text to "Using the same technique, we also estimated PM2.5 from MODIS Collection 6 AOD for 2013, and found GOCI-derived PM2.5 achieves greater consistency than MODIS-derived PM2.5 when compared with ground-based measurements (slope=1.1, r2=0.61)" on page 14 line 4-7.

6) Page 17262, Section 3.3: This section discussed the chemical speciation of satellite-derived PM2.5. I suggest add a few more sentences describing how you derived the chemical composition of satellite-derived PM2.5 and a new figure showing their spatial distribution (like the panel of Figure 3). These would help to support the discussion

here.

RESPONSE: Thanks for the suggestion. We firstly used GEOS-Chem to simulate an annual mass fraction of chemical components in PM2.5, and then applied the simulated mass fraction to GOCI-derived PM2.5 concentration to estimate the mass concentrations of components in GOCI-derived PM2.5. We have modified the text to "Fig. 6 also shows the chemical composition of GOCI-derived PM2.5, as calculated by applying the GEOS-Chem simulated mass fraction of PM2.5 chemical components to GOCI-derived PM2.5 mass concentration" on page 15 line 6-8. We have also provided the spatial distribution of GOCI-derived PM2.5 chemical composition and related text in supplementary materials.

7) Page 17263, Section 3.3: Is there any difference between Organic Matter (OC) and Organic Carbon (OC)? Please clarify.

RESPONSE: Yes, organic matter (OM) is constituted of organic carbon (OC) as its major component and other element such as hydrogen, oxygen and nitrogen. We have clarified the difference by adding "OM, which includes elements such as hydrogen, oxygen and nitrogen" to page 7 line 19-20.

8) Page 17265, Line 9-14: Please tell us how you estimated the health impact. By summing up the population over areas with PM2.5 concentration above 35 ug m-3? From Figure 3, it did not seem to me that all regions of eastern China exceed 35 ug m-3 (with the color scale goes to zero).

RESPONSE: The population of eastern China in Table 1 was a simple sum of population geographically located in eastern China. As the referee implied, a more accurate way to estimate the health impact is to sum up the population over areas where PM2.5 concentration exceeds 35 ug m-3. Therefore, we have changed the "Population (million people)" row of Table 1 to "Population (million people) exposed to PM2.5 exceeding IT-1 level", and re-calculated the population. We have also changed the text on page 18 line 11-15 accordingly. Besides, we modified the colormap of Fig. 3 to provide clearer distribution when PM2.5 concentrations are below 50 ug m-3.

9) Page 17275, Table 1: Please clarify whether the concentrations of different chemical speciation are population-weighted or area-weighted.

RESPONSE: The concentrations of chemical composition are area-weighted. We modified the caption of Table 1 to specify this point.

Technical Comments:

1) Page 17253, Line 2: East China or the eastern China? Please be consistent. The term East China represents a specific geographic domain.

RESPONSE: Thanks. We have substituted all East China to eastern China in text.

2) Page 17254, Line 27: Please define the domain of the eastern China in the study, the domain of Figure 3 or by longitude and latitude?

RESPONSE: We added country borders to Fig. 3 to identify eastern China.

3) Page 17256, Line 7: Please define mathematically the coefficient of variation, probably in Section 2.5.

RESPONSE: We added the mathematical equation of coefficient of variation in Section 2.5.

4) Page 17260, Line 19: Suggest change the forecast value to the model simulated value

RESPONSE: Thanks. We have revised the “forecast value” to “satellite-derived value” and have substituted the “Fi” in equation to “Si”

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 17251, 2015.