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Atmospheric Chemistry and Physics Discussions

Interactive comment on "NASA A-Train and Terra observations of the 2010 Russian wildfires" *by* J. C. Witte et al.

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We would like to thank the reviewer for the helpful comments and suggestions. The reviewers comments are repeated in quotes.

" Sometimes it is unclear to the reader why a given grid box / domain is chosen. These domains should be consistent where possible and clear justiïňAcations should be given where this cannot or should not be done. It would be nice if the various gridbox / domain sizes were stated and justiïňAed in the introduction or in Section 2 if it was more generalized as "methods". For instance, why is the OLR and Figure 6 domain different from those used for trajectories and Figure 4. "

The goal was to facilitate mapping the spatial and temporal extent of the effect of the

wildfires. Essentially, we used the 2010 August fire data to tell us where the worst of the fires were located and for how long. Thus, we take the worst-case set of observations against which we calculate the burdens and anomalies relative to the historic data records.

We have included the following description in the first paragraph of Section 5.1 where we first introduce our domains:

Satellite observations indicate that the central region of western Russia was the most severely impacted by high levels of smoke pollution from wildfires. Figure 4 shows our region of interest (45°-63°N, 23°-63°E), which encompasses western Russia and parts of Eastern Europe and is divided into 12 smaller domains (latitude and longitude limits given in Table 1). Our region of interest was chosen based on a preliminary analysis of the location of all the MODIS fires counts during August 2010, when the count and FRP reached a maximum, and the geographic extent of the three-day back trajectories from Fig. 3. Dividing this large region into smaller domains (12 in total) facilitates mapping the spatial extent of the observations affected by the wildfires, their magnitude, as well as the temporal range. In this study, we are taking the worst-case set of observations against which we calculate the contribution of smoke pollution from the wildfires, relative to the historic satellite data records. . . .

Regarding OLR, we wanted to encompass the radiosonde locations, with a focus on western Russia. This region is also quite large, similar that in Figure We have added and modified paragraph 2 in Section 3:

We calculate the time series of AIRS OLR anomalies (2010 daily values minus the 2003–2009 daily mean) over the box region shown in Fig. 1c. that encompasses the radiosonde locations and includes regions where MODIS observed elevated fire activity. AIRS OLR anomalies over western Russia, in Figure 2, were positive during the same 60-day time period. Anomalous values ranged from 16 W/m2 to 84 W/m2 between June and mid-August and were around 2 standard deviations above the mean.

AIRS OLR values ranged from 255 W/m2 to 312 W/m2 with a mean of 292±15 W/m2, indicating clear-sky conditions associated with atmospheric subsidence.

We also added the following sentence in Figure 2 caption: This domain is shown in Fig. 1c and encompasses all the radiosonde stations in western Russia.

" The OMI SSA values reported throughout the paper seem to be rather high for what is typical of strongly absorbing aerosols, this could be due to cloud contamination from OMI's large pixels (see SpeciïňĄc comments for section 2.2). Also the modest shifts in SSA are quite close to the error range of the OMI SSA data product, the authors should mention both of these factors in the discussion. Moscow air pollution composition is likely complex and was affected by many factors due not only to the wildïňĄres, but also to the stagnation, where the typical urban pollutants would have been trapped, re-circulated along with the inïňĆux of absorbing aerosols from the ïňĄres. Unique transformation due to stagnation and extended constituent lifetimes may have also been at work here. "

The reviewer is correct that sub-pixel contamination is one of the most important sources of uncertainty in OMI AI and SSA. Also correct is the addition of local pollution to the smoke mixture, which can lead to an overestimation in SSA.

We have added the following sentence in the OMI description in Section 2.2:

Two important sources of uncertainty in OMI AI and SSA are sub-pixel cloud contamination due to the large OMI footprint and the dependence on the assumed aerosol layer height (Torres et al., 2007). The effect of sub-pixel cloud contamination is the overestimation of SSA (measure less absorption than actual). OMI AI is less affected by clouds, except that it does not provide a quantitative estimate of aerosol absorption.

We have also added the following statements to Section 5.1, paragraph 2:

Increased aerosol absorption was observed in these domains (SSA values of 0.96 – 0.97) concurrent with elevated levels AOT.55 and COTC, although it should be noted

that this enhancement in absorption is near the estimated uncertainty (±0.03). OMI SSA is likely overestimated due to sub-pixel cloud contamination. Furthermore, retrieved SSA assumes black carbon and organics are the dominant components in their smoke aerosol model, so SSA may be unexpectedly higher in domains where the composition of air is a complex mixture of urban pollution (e.g. Moscow in domain 6) and smoke tracers.

Reviewers SpeciïňĄc comments:

" p. 19118, section 2.2: Would be good to mention the problems of cloud contamination for OMI-SSA as sub-pixel cloud contamination can lead to overestimation of 0.15 (Torres, et al. 2007). This should be mentioned when the measured values of SSA are reported. "

In fact, the first reviewer had a similar comment. This is similar to the question above. To reiterate, we have added the following to Section 2.2 describing OMI AI and SSA measurements:

Two important sources of uncertainty in OMI AI and SSA are sub-pixel cloud contamination due to the large OMI footprint and the dependence on the assumed aerosol layer height (Torres et al., 2007). The effect of sub-pixel cloud contamination is the overestimation of SSA (measure less absorption than actual). OMI AI is less affected by clouds, except that it does not provide a quantitative estimate of aerosol absorption.

" p. 19118, lines 19-20: It should be mentioned that AI is dependent not only on aerosol layer height and AOT, but SSA as well and also if the aerosol layer is located above clouds or not. "

This is very true. Please see above for the statement added to Section 2.2

" p. 19119, section 3: Please give a bit more description of the radiosonde data used here, including whether this is based on daily averaged data from multiple launches and/or when the launches took place (morning, afternoon, evening?). 1-2 additional sentences should sufïňĄce here. “

We have added the following information about the radiosonde data to Section 3:

Radiosondes measure the vertical distribution of temperature, pressure, RH, and winds recorded at standard pressure levels. All stations launch radiosondes daily at 12Z (16:00 local time in Moscow) and represent mid-afternoon local weather conditions. We focus on the surface measurements.

“ p. 19121, lines 21-23: for clarity, consider moving these lines to the end of the ïňĄrst paragraph of section 4. “

We have moved this sentence up to the end of the 1st paragraph.

“ p. 19124, section 5.2: please brieïňĆy explain the domain choice used for Figure 6. “

We have made the additional description – please refer to our response to your first comment, which is link to this one.

“ p. 19124, line 23: this statement that decreased SSA is consistent with increased AI should be clariïňĄed (see comment for p. 19118, lines 19-20). “

Agreed - this sentence actually needs to be re-written! We have changed the sentence to the following:

OMI SSA showed considerable variability in August where decreases from unity occurred frequently, indicating enhanced absorption over the city.

Reveiwers Detailed comments:

We have made all the changes and corrections in the detailed comments. Thank you for the careful review of this manuscript and attention.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 19113, 2011.