

Interactive comment on “Radiative characteristics of aerosol under smoke mist conditions in Siberia during summer 2012” by Tatiana B. Zhuravleva et al.

Anonymous Referee #3

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This paper performs an analysis of aerosol properties at a Siberian site during the strong summer 2012 fire season, with additional comparison to background and smoke-laden periods during other years at this site. The main focus of this analysis is AERONET data, and some calculations of the radiative effects of the smoke are also made. This paper is topically relevant to ACP. I agree with the comments posted by the other reviewer, and have some additional comments of my own. I recommend revisions and another round of peer review. These comments are as follows:

1. I find the term ‘smoke mist’ unusual and had not encountered it before. Is this a term in common use (perhaps translated from Russian) or a new term? Perhaps I missed it. I would recommend giving a clear definition of what ‘smoke mist’ means, if it has a

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specific technical meaning. The term 'mist' to me has connotations of a liquid water fog, but I don't think that is what is being talked about here. If 'smoke mist' is not a technical term then perhaps something else can be used as shorthand for the strong burning period of summer 2012.

2. As the other reviewer also noted, the paper introduces SSMART as an alternative to the AERONET data processing. However SSMART results are barely mentioned after that (there is a little in Figure 3 but that's about all). So either SSMARTS description should be removed, or SSMART results should be added and discussed in more depth. My preference is for this second option (i.e. add the SSMART results to the analysis and discussion).

3. MODIS small mode fraction. The authors show maps of MODIS Dark Target AOD from the latest Collection 6, and MODIS aerosol small mode fraction from the older version Collection 5. Small mode fraction was deleted from Collection 6 because it was found not to have any skill, and the developers recommend not to use this product. So showing maps of this does not really support the authors' discussion about the large scale structure of the aerosol during this period because the data set is so unreliable that it was discontinued by the people who created it. The MODIS small mode fraction should therefore be removed from the paper. If the authors want to show the regional pattern of total AOD and the amount from the fine mode, there are other options. The MODIS Deep Blue product gives both AOD and Angstrom exponent over land. The MISR product also has these, and I believe also has other quantities to get more directly at fine mode contribution to AOD. MISR has a narrow swath but since this is a seasonal composite, that would probably not matter too much. Either (or both) of these would be more appropriate and more convincing to use than the MODIS Dark Target data shown here.

4. On the topic of the regional extent of smoke, there are two other AERONET sites in this region which look like they may also have sampled the summer 2012 intense smoke period (based on an examination of time series from the AERONET website).

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These are Irkutsk and Yekatarinburg. Tomsk is basically in the middle of these two. It would be instructive to see whether the AERONET inversions at these additional sites are similar to those at Tomsk or not (in terms of e.g. size distribution and SSA), as this will be another way to look at spatial/temporal variability in aerosol properties for this large-scale smoke event.

5. I am intrigued by the spectral shape of SSA seen on July 28 (Figure 11, red line) where the SSA shows the opposite spectral shape to the other sites. In fact that spectral behavior is opposite from what is seen for most types of smoke aerosol. The authors note that this is unusual and suspect that it may indicate an enhanced component of brown carbon compared to normal. However there is no specific evidence for this idea. I think it would be good to dig deeper and see if the reasons for this can be found with more confidence. Since the authors include several members of the AERONET team, perhaps they can take a closer look at this case and see whether there is any indication of a retrieval problem or if it is probably real. I went on the AERONET website and found that this unusual spectral pattern of SSA was found for about one week at the end of July, with more usual patterns before and after. Perhaps HYSPLIT back trajectories or some other method will reveal something extra about possible contributions to the aerosol observed during this week as opposed to at other times.

6. Radiation calculations and discussion: I understand, if I have read correctly here, that the calculations of the smoke aerosol radiative effects here are diurnally-averaged. But I wonder if some instantaneous calculations could also be included. This would allow comparison with for example the diurnal cycle of observed radiative fluxes shown in Figure 4. CERES data could also be used as a point of comparison, as I believe this includes various flux products. In a more general sense, I think it would be good to find some way to make this information useful for other studies (as a reader I am not sure what I would use these numbers for in my own research). Perhaps something like forcing efficiency (i.e. flux change per unit AOD) could be calculated, to provide a point of comparison with aerosols in other regions.

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7. UV AOD observations. As a minor point, I note that the Tomsk sun photometer includes UV bands. I believe that the SDA product (for AERONET fine/coarse AOD) also uses these to provide information about the spectral curvature of the Angstrom exponent. Table 1 shows that the visible Angstrom exponent for the summer 2012 cases was similar to that of normal smoke. Table 3 shows that the peak radius and spread for summer 2012, though, were somewhat larger than normal smoke. I would expect this difference to be reflected in the UV behavior of the AOD (either the curvature of the Angstrom exponent, or just in the Angstrom exponent over the 340-500 nm range). Perhaps this information could also be added to Table 1 as another comparison between the two periods. The calculated absorption Angstrom exponents could also be added here and discussed.

8. Figure 6, could the one-sided error bars be described in the caption for panels a and c? My guess is that these represent the mean and maximum values? Or is this a plotting error? Same question for panel d of Figure 11.

I am sorry for the delay in providing this review; I was invited to provide a review later on in the review process and then was away on travel until recently.

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