Response to comments of Reviewer #4

First of all, we would like to thank the Reviewer for careful reading the manuscript and for useful suggestions.

MINOR REVISIONS

I have a personal curiosity related to the paper: The authors have a lot of works on retriving aerosol microphysical properties from 3b+2a lidar measurements, even for non-spherical particles. Here, authors have the measurements for the retrieval. I would like to know why authors have decided not to do the 3b+2a inversion to retrieve aerosol refractive index. I have also follow your last papers in retrievals of aerosol microphysical properties from space-borne simulations and I would like to know if your new results can have an impact in space retrievals.

We think that consideration of variation of the imaginary part (and its spectral dependence) is important for both dust and biomass burning products and should be included in simulation of space based lidars simulation. Corresponding references are added to Conclusion.

In the discussion of changes in lidar ratios for smoke with relative humidity, please take into account that they do not only depend on refractive index. Also is important the possible changes in size distribution.

The model considers variation of PSD with RH, so it is included.

Line 51-55: Please, note that spectral dependence in lidar ratio have been demonstrate useful to estimate the range of refractive index for non-spherical particles, although assuming no spectral dependence in CRI

Yes, preliminary estimation of range of refractive index (RI) variation is important. Still we need to make next step and include spectral variation of RI in inversion.

Line 77: Please, define variables. What is Im440 and Im355.

Done

Line 110: Why measurements are acquired at 47 degrees angle to horizon?

We measured through the window in the room, so it was the largest possible angle.

Equation 1: Please, give a proper reference

We derived it ourselves. It is quite straighforward.

Line 163: I thing there is a type in 'recalculated'

We think that "recalculated" looks correct in the context used…

Line 204: ' The backcatter Angström exponent Ab, in contrast with Az is sensitive to the spectral dependence of the imaginary part of CRI'. Please clarify and provide references. Actually, Aa also depends on imaginary refractive index.

Here we paste Figure from (Veselovskii et al., 2010). Corresponding reference is added to the text.

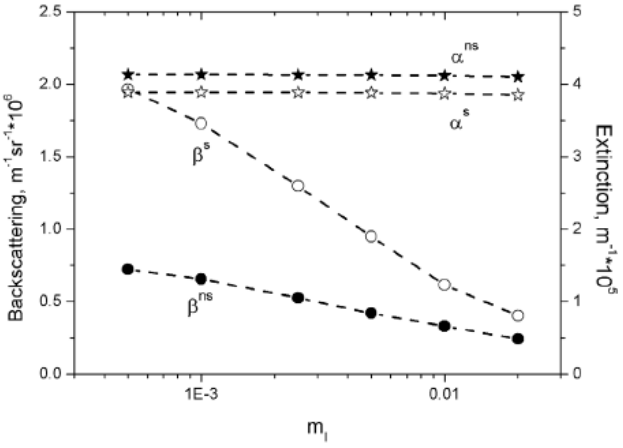

Figure 6. The particle backscattering (circles) and extinction (stars) coefficients at 355 nm wavelength as a function of the imaginary part of the refractive index. Calculations for spheres (open symbols) and spheroids (solid symbols) were performed for the PSD_{20} with $m_R = 1.55$, $N_f = 100$ cm^{-3}.

Yes, backscattering depends also on the real part (Re), but Re for dust doesn't show significant spectral dependence.

Line 245: Please explain futher why you assume 35% and 7% for dust and depolarization ratio or provide appropiate references.

35% is the highest depolarization ratio we observed for pure dust. The depolarization ratio of different types of smoke can vary significantly. 7% is the lowest value we observed in elevated smoke layers during SHADOW. We should mention, that depolarization of smoke is much lower than that of dust, thus the choice of exact value of smoke depolarization does not influence significantly the results. Corresponding comment and reference is added to manuscript.

Line 258: It is not clear why 25 sr is unrailstic lidar ratio. Please, provide references.

We added reference to Burton et al., 2012.

Line 267: Why smoke lidar ration should increase with RH ?

This is combined effect of size increasing and the real part decrease.

Line 276: the statement 'dust became less absorbing in the UV' is unclear. Are you referring to imaginary refractive index or to single scattering albedo?

Dust becomes less absorbing due to decrease of the imaginary part, which in turn leads to increase of SSA. Effective radius (as follows from AERONET) didn't change significantly during this period.

Lines 338-353: Authors give a description of the 3b+3a lidar inversion. That should come earlier becase previously in Figure 13 you show size distribution from 3b+2a inversion.

We actually don't describe the inversion, just provide the reference. It was described for many times previously.

Lines 333-337: It is not clear to me how you make the simulations.

We computed extinction and backscattering coefficients for different Im using spheroids model. From these data the lidar ratios and Angstrom exponents were obtained. To estimate influence of spectrally dependent Im, we used β and α computed for different Im at 355 and 532 nm.

Table 1: How you estimated uncertainties?

For lidar ratios we considered only statistical errors. For RH, we took upper and lower limits of lidar derived water vapor mixing ratio, basing on uncertainty of calibration. For these values RH was calsulated.

Lines 465-467: Please, note the limitations in PSD variability with relative humidity in MERRA-2.

Yes, PSD of smoke particles can vary with RH differently for different types of smoke. A single model can't describe all variability of smoke particles, so one of the goals of this work was comparison of MERRA-2 predictions with observations. We conclude that the model reproduce the general tendency of increase of the lidar ratio with RH, if the initial values of the imaginary part of dry particles are chosen correctly.

Conclusion section: 'Our study shows the impact of aerosol spectral absortion variation on the lidar-derived aerosol properties'. Do you refer to any aerosol type? I think you want to say dust and smoke aerosol.

Yes, this is for dust – smoke mixture. We corrected it in Conclusion.

Figure 7a. There is a blue line missing.

Contribution if Sea Salt is just very low and can't bee seen on a figure.