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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability of Lidar-Derived Particle Properties Over West Africa Due to Changes in Absorption: Towards an Understanding" *by* Igor Veselovskii et al.

Anonymous Referee #3

Received and published: 18 March 2020

The paper "Variability of Lidar-Derived Particle Properties Over West Africa Due to Changes in Absorption: Towards an Understanding" presents and discusses the possibility to identify the spectral dependence of dust refractive index imaginary part (form here on iDRI) using Raman lidar measurements. Goal of this analysis is to reveal the effect of dust increased absorption in the UV on lidar derived parameters. The authors use 3+2+1 lidar measurements performed during the "SHADOW-2" campaign in Senegal, as well as the available AERONET dataset for the campaign period. The analysis is performed for dust dominated cases during April 2015 and it is separated between two periods: first and second half of April, based on variations of SSA440 derived from AERONET. More specifically, during the second period SSA440 increases indicating

that dust particles become less absorbing.

The analysis is not only limited to dust dominated cases but as supplementary subject smoke lidar ratio variability is examined in relation to relative humidity variations. Furthermore, the smoke S355/S532 ratio is examined in order to provide indications of increased smoke absorption in the UV. To this end case studies during December 2015 and January 2016 are selected since during this period intense forest fires are observed in the region.

In general, I find this study very interesting and of high value and I believe it falls within the scope of ACP. The authors have done a thorough job in presenting the results, the manuscript is well-written / structured, the presentation clear and the quality of the figures high. Furthermore, the authors give credit to related work and the results support the conclusions. However, in order to help improving the manuscript, I would kindly suggest the authors to take into account the following minor comments:

Fig.8a and Page 9, Lines 283-285: "Thus, we can assume that increase of the imaginary part in UV in the first layer is more significant, than in the second one".

I noticed from this figure that the Angstrom exponent (both backscatter and extinction related) increases towards higher altitudes, which coincides with a slight decrease of depolarization ratio and a coincidence of the S355 and S532. Could these variations point towards the dominance of smaller dust particles higher in the layer? From laboratory studies we know that smaller dust particles present lower depolarization ratio values (i.e. Järvinen et al. 2016; Sakai et al., 2010), while also the larger S532 values lower in the layer could be attributed to the increased "sensitivity" this wavelength should have to the presence of larger particles. Why is the dominance of smaller dust particles should be excluded here?

Page 8, Line 245: "assuming 35% and 7% for dust and smoke depolarization ratio".

Please provide some references on choosing these values specifically. Did you use

the same values also for the dust-smoke decomposition you perform for all the cases presented?

Also Page 14, Line 429: “In principle, we can estimate S_532ˆs using Eq.5, because the ratio (β_532ˆs)/β_532 is available”. Here the β_532ˆs depends on the selected value of d_532ˆs. Can you provide an estimation of the uncertainties of this approach? What could be the effect on the resulting S_532ˆs values?

Table 1: Could you add to the table the height intervals chosen for the analysis of the smoke layers and also an estimation of their lifetime? Could any differences in the smoke properties be related to the age of smoke particles?

Page 4, Line 113: for the range resolution of particle extinction coefficient it is not clear to me which height intervals are selected. Do you mean 50 m up to 1000m and 125 m from 1000m to 7000m?

Page 7, Line 217: the authors probably mean “hydrophobic”.

Page 11, Line 344: “spectrally independent refractive index”. Please provide the selected values for this analysis.

Page 12, Line 369: “so variation of the imaginary” add “part of the refractive index”.

Section 3.2: Please provide the spatial-temporal evolution of backscatter coefficient, water vapor and particle depolarization for these cases also.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2020-98/acp-2020-98-RC1-supplement.pdf

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