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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Radiative budget in the presence of multi-layered aerosol structures in the framework of AMMA SOP-0" *by* J.-C. Raut and P. Chazette

Anonymous Referee #1

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1)General comments. The paper by Raut and Chazette presents a comprehensive study on the aerosol optical properties retrieved from surface-based and airborne measurements over Niamey during AMMA. The authors focused their analysis to days characterized by the presence of a biomass burning layer above desert dust. The complex refractive index of the different aerosol types is derived using different approaches involving the airborne as well as the columnar measurements from surface instrumentation. The description of the experiments setup and of the methodology is well described and the overall presentation is well structured. Perhaps the manuscript is too long, and some paragraphs may be synthesized. Overall, my opinion is that the paper addresses relevant scientific questions within the scope of ACP.

2)Specific comments. In paragraph 3.1 the authors highlight the coherence and the differences in the vertical profiles of the aerosol extinction profiles derived from ULA and FAAM instrumentation : while the agreement in the biomass burning layers is good, large differences are detected in the desert dust cloud. This is possibly caused by the limit in the aerosol size distribution derived from the PCASP, with a maximum radius of 1.5 μm, while the contribution of larger particles, especially over the desert, is clearly significant. This has also implications in the determination of the aerosol complex refractive index, and may explain why approaches A1 and A2, as also stated by the authors.

In the simulation of the UV and visible fluxes by means of the TUV radiative transfer model did the authors account for NO2 and SO2 column? Are there any measurements accounting for NO2 and SO2 columnar amount or surface concentrations?

In the model simulations the 2-stream Delta-Eddington approximation and the 4-stream discrete ordinate method are used (paragraph 2.2.2). While the 4-stream DOM may be appropriate to simulate the irradiances, usually 4 streams are not sufficient for the calculation of photolysis rates, which requires a larger number of streams (16). This may explain the differences found by the authors between measured and modeled J(NO2) photolysis rates (paragraph 6.1). In my opinion the comparison of the radiative fluxes calculated with the two methods may be eliminated, and only the 4-stream DOM may be used. Moreover, I would suggest to use 16 streams to model the J(NO2) and to verify whether differences arise.

In paragraph 6.2.1 it may be useful to compare the radiative forcing efficiency (radiative forcing for unit aerosol optical depth in the visible, i.e. 500 nm) instead of the radiative forcing calculated in previous studies, which strongly depends on the aerosol amount. The radiative forcing efficiency, on the contrary, depends on the aerosol optical properties.

I would recommend to shorten some paragraphs, for example 6.2.4, 6.2.5, 6.3.

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3)Technical corrections. Page 12462, line 3: indicate the year of the measurement period. Page 12462, line 14: indicate the wavelength. Page 12462, line 24: change "sensitivity" with "sensitive to". Page 12464, line 1: add "particles" after "aerosol". Page 12464, line 13: change ";" with ",". Page 12465, line 13: change "complimented" with "complemented". Page 12466, line 4: add "in" after "involved". Page 12466, line 8: add "described in the following" after "near-infrared". Page 12466, line 17: change "aerosol" with "backscattering coefficient". Page 12466, line 22: "956°" is a misprint. Page 12467, line 6: change "-" with "to". Page 12467, line 27: change "interpolated" with "extrapolated". Page 12467, line 28: change "with" with "in". Page 12468, line 3: add "during" after "30%)". Page 12468, line 18: change "from" with "of". Page 12468, line 23: the phrase "which is the probability wavelength dependent," is not clear. Page 12468, line 24: change "Interpolation" with "Extrapolation". Page 12468, line 26: change "closest hour to the flights" with "closest time of the flights". Page 12469, line 6: delete "is". Page 12469, line 7: add "." after "radiation". Page 12469, line 10: change "performed" with "determined from a comparison". Page 12469, line 19: delete "measurements of". Page 12470, line 18: delete "of NO2 molecules". Page 12472, line 20: add "flight" after "corresponding". Page 12472, line 21: add commas after "coefficient" and "exponent". Page 12473, line 7: specify the wavelengths used to calculate the Angstrom exponent. Page 12473, line 10: the expression "multiple elevated-layers" is not clear. Page 12473, line 13: change "emitted" with "present". Page 12473, line 16: add "from" after "south". Page 12474, line 14: change "explains" with "explain". Page 12479, line 3: delete "there" and change "difference" with "differences were found". Page 12479, line 26: the authors state that "In the A1 approach the extinction coefficient profiles have been determined from lidar signal profile at 355nm and Angstrom exponent between 355nm (LAUVA) and 880nm (PdRam).". Is it correct? Page 12480, line 9: change "extrapolated" with "interpolated". Page 12481, line 14: delete "than". Page 12482, line 12: change "varied" with "variable". Page 12492, line 21: add "of" after "factor". Page 12493, line 7: change "It" with "This". Page 12501, line 2: add "that" after "showed". Page 12514, Table 4 caption: change "position" with

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"positions".

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