**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Variability of aerosol vertical distribution in the Sahel" *by* O. Cavalieri et al.

Anonymous Referee #1

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General comments

The ACPD paper of Cavalieri et al., 2010 address relevant scientific questions within the scope of ACP. It presents long-term analyses of combined ground-based and satellite observations and reaches substantial conclusions. Scientific methods and assumptions are valid, however not always clearly outlined, which I specify in detail below in a Specific Comments. Results are sufficient to support the interpretations and conclusions. Presented results are traceable. Authors give proper credit to related work but do not clearly indicate their new/original contribution. The title clearly reflect the contents of the paper but the abstract is very poor and do not provide a concise and complete summary. The overall presentation quite well structured but in some places unclear. The language is generally fine. However a lot of paragraphs are used in

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the text, as the authors begin every new thought with a new paragraph. This makes manuscript difficult to read as it is breaking the flow. I made several suggestions on reducing the number of paragraphs in each section. Additionally, I suggest change in structure of the manuscript to following

Sect. 1 Introduction (as it is) Sect. 2 Optical properties calculation. (now Sect. 2.1 Optical properties) Sect. 3 Instrumentation. This section would contain three subsections (now Sect. 2.1.1 MULID lidars, 2.1.2 CALIOP lidar and 2.1.3 AERONET photometers). Note: Here I would add also one or two sentences as an introduction to the entire section mentioning what instruments were used. Sect. 4 Air mass transport analysis. Sect. 5 Seasonal variability. Note: Here I would not write specifically the year of investigation Sect. 6 Inter-annual variability. This section would contain three subsections (now Sect. 4.1, 4.2 and 4.3). Note: Here I would change all titles from 'Banizoumbou' to 'Banizoumbou region' etc. Sect. 7 Back-trajectory analysis Sect. 8 Conclusions

The mathematical formulae, symbols, abbreviations, and units are mainly correctly defined and used. Some of the Figures must be clarified (I specify this in Figures comments). References in the text and in the list must be checked carefully, as there contain several mistakes. Some references should be added as suggested below. Supplementary material should have a Introducrtory page with title of supplement material. Figures in this supplementary material should be improved as they are unreadable.

Manuscript is recommended for publication in ACP only if specific comments given below are addressed by the authors.

Specific Comments

1 Introduction

Make one paragraph out of the text starting with

1. line 7 page 17611 until end of line 13 p. 17612

2. line 14 p. 17612 until end of line 23 p. 17612

3. line 24 p. 17612 until end of line 13 p. 17613

4. line 17 p. 17613 until end of line 8 p. 17614

5. line 9 p. 17614 until end of line 3 p. 17615.

p. 17610

line 19 here and throughout manuscript change Niger to => Nigeria

p. 17611

line 12 aerosol influences => aerosols influence

line 13 Haywood and Boucher, 2001 – wrong reference

line 14 while => additionally

line 21 very little open biomass => what do you mean ?

line 24 et => and

p. 17612

line 5 shift => shifts

line 24 Recently, the African. . . => Recently in the frame of the African Monsoon Multidisciplinary Analysis (AMMA) project extensive multiannual series of observations in Sahelian Africa were performed (here add reference). In this place an introductory reference is missing, e.g. An introduction to the SCOUT-AMMA stratospheric aircraft, balloons and sondes campaign in West Africa, August 2006: rationale and roadmap by Cairo et al., Atmos. Chem. Phys., 10, 2237-2256, 2010

p. 17613

line 2, 6, 10, 11, twice in 12, and throughout the manuscript change (2001–2010) to (2001 – 2010), 15 May–30 June to 15 May – 30 June, etc. If you use LaTeX you can type sequence 2001\,–\,2010
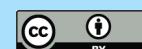
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line 13 (Redelsperger, 2006) => (Redelsperger et al., 2006)

line 16 Take out sentence: In its framework, several studies focussing on aerosol have thus been performed.

line 17 Too long sentence: Ground-based measurements... my suggestion: Ground-based measurements of aerosol mass, optical properties and vertical distribution over M'Bour, Senegal from 2006 to 2008 have been reported by Leon et al. (2009). The maximum in the dust activity was observed in summer...

p. 17614

line 5 Banizoumbou (Niger) => Banizoumbou, Nigeria.

line 7 and a layer of biomass burning aerosol from the PBL up to an altitude of 5km was frequently observed => and frequently observed layer of biomass burning aerosol in the PBL and up to an altitude of 5km

line 11 remove: present in the atmosphere and

line 15 you are mentioning MULIDs lidars for the first time here. If exists, a reference to a paper which is describing these system would be very helpful here

line 16 instead of using 'while' make two sentences

line 18 after CALIOP give reference to Winker et al. 2007

line 18 decide whether you want to use CALIOP or Caliop and use it throughout the manuscript

line 21 after AERONET give introductory reference, e.g. Holben et al. 1998, AERONET - A federated instrument network and data archive for aerosol characterization, Rem. Sens. Environ., 66, 1-16.

line 21/22 3 years => For the period of three years

line 23 satellite lidars and biomass => satellite lidars. The biomass

line 23 sources => source

line 24 can you give introductory reference after ATSR World Fire Atlas ?

p. 17615

line 1 and tries to link it to => linked to

2 Instrumentation and methods

Make one paragraph out of the text starting with

1. line 24 page 17616 until end of line 7 p. 17617

2. line 14 page 17617 until end of line 7 p. 17618

3. line 4 page 17619 until end of line 12 p. 17619

4. line 18 page 17619 until end of line 21 p. 17619

5. line 22 page 17619 until end of line 18 p. 17620

6. line 19 page 17620 until end of line 26 p. 17620

7. line 27 page 17620 until end of line 7 p. 17621

8. line 12 page 17622 until end of sentence 23 p. 17622

9. line 23 page 17622 beginning of sentence until end of line 3 p. 17623

10. line 14 page 17623 until end of line 19 p. 17623

11. line 20 page 17623 until end of line 26 p. 17623

line 6 remove 'technique'; the vertical profile => vertical profiles

line 7 references should be given accordingly to they appearance, so Gobi. . ., Di Sara. . . and Di Donfrancesco. . .

line 9, 18, and throughout the manuscript: remove ':' at the sentences before the

equations, e.g. equation is given by : => equation is given by

line 14 after molecules and aerosol add indexed m and a, respectively.

p. 17616

line 2 remove: (say how you calculate it. For instance Raman lidar can calculate it directly from lidar signal)

line 4 after the end of this paragraph you should add information on typical values of R for the clear free troposphere and different types of aerosols present in Tropical and Subtropical regions. It would be interesting to know such values for your region and compare it by values typical for the Arctic, e.g. Stachlewska et al. 2010, AMALi – the Airborne Mobile Aerosol Lidar for Arctic research, Atmos. Chem. Phys., 10, 2947-2963, 2010.

line 5 The lidar ratio is defined as : => The aerosol and molecular lidar ratios are defined as

line 7 While Lm is given by light scattering theory, => The Lm is given by light scattering theory.

line 7 The aerosol lidar ratio La can vary widely => The La vary widely

line 10 give references for the typical values of maritime, dust, and biomass burning aerosols

line 11 after Eq.(1) add 'and usually'

line 21 change index // to Œř throughout the manuscript

p. 17617

line 8 reference Heese and Wiegner, 2009 => chack the publication date

line 10 and 12 references in brackets starting with Mona et al. and later Balis et al. must be given accordingly to the publication date, so Mattis et al. 2002b should be as

a first one at line 10 and Ferrare et al. at line 12

line 10 − 13 check the publication dates of references: Tafuro et al., Immler and Schrems, Mattis et al., Balis et al.

line 18 represents => denote

line 20 so positive => so that a positive

line 25 since their wavelength dependence of the absorption properties causes => unclear, do you mean: since their wavelength depends on the absorption properties and causes

p. 17618

line 2 use consequently throughout the manuscript LIDAR or lidar

line 5 after in particular add 'takes'

line 9 remove: such as,

line 10 This => It

line 18 change throughout the manuscript Angstrom => Ångström (Although you can argue that it is possibile to use angstrom as a unit, i.e. A instead of Å, I do not agree that you can use it in the surname of Mr Anders Jonas Ångström.)

line 21 are independent from wavelength, and => are wavelength independent and

line 24/25 remove completely both Eq. (9) as these are trivial

line 23-25 p. 17618 + line 1 p. 17619 For two different wavelengths, (. . . here Eq.(9). . .) from which the Angstrom coefficient A, can be retrieved. => For two different wavelengths, defined as in Eq. (8), the Ångström coefficient Å can be retrived as follows

p. 17619

line 3 Larger values of A implies => Higher/Greater value of A implies or Higher/Greater

values of A imply

line 3 (r >0.5 μm) while when => (r >0.5 μm). When

line 7 A assumes values => assumes ?

line 9 these type of => these types of

line 13 use consequently MULID or Mulid

line 14 Three micro lidar => Three microlidars

line 14 remove: named

line 16 occur, in => occurs, namely in

line 22 out site => outside ? outdoor ?

line 23 ground while in M'Bour station it was => ground. In M'Bour lidar was

line 25 rural stations => rural station

p. 17620

line 2 lidar is installed => lidar was installed

line 2 "Station de geophysique" => Station de Geophysique // I suggest you do not use parenthesis when using the name of institution or its facility. If you must emphasize it I suggest you use italic font.

line 14 (Balis et al., 2004; Rajot, 2001) => change the order of references

line 14).A =>). A sunphotometer station AERONET

line 15 close to => nearby

line 19 Details on the => Detailed description of the

line 19 and date inversion algorithm => and the data inversion algorithms

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line 19 in O. Cavalieri => in Cavalieri

line 19 here only a brief account will be given. => and, hence, here only a brief account on theses will be given.

line 21 signal, the => signal. The

line 23 the process converged => convergence

line 28 for some periods were not covered => for periods not covered

line 29 problems with the laser heads => what problems ?

line 29 Daily backscatter => Backscatter

p. 17621

line 1 resolution are available. Two measurement sessions => resolution at two measurement sessions

line 4 after overpasses add ','

line 6 after retrieved add 'by'

line 6 after top of the add 'MULIDs'

line 9-12 I suggest to rewrite the first sentence of this section to following: The CALIPSO satellite hosts various instruments (more information at http://eosweb.larc.nasa.gov/PRODOCS/calipso/table calipso.html), among others, the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP). This elastic backscattering lidar provides information on the vertical distribution of aerosols and clouds as well as on their optical and physical properties over the globe (Winker et al., 2007).

line 12-15 I reckon that the following sentences are obvious, please remove: Linearly polarized laser pulses are transmitted at 532nm and 1064 nm. The 1064nm receiver channel is polarization insensitive, while the two 532nm channels separately measure the components of the 532nm backscatter signal polarized parallel and perpendicular
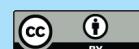
to the outgoing beam.

line 23 check date of publication for Kim et al.

line 24 add information or reference on hoe the depolarization ratio is calibrated

line 24 at 532nm and the => at 532nm. The

line 25 Eq. (5) => Eq. (6)

line 25 after 1064nm add '.'

line 27 and 28 for giving reference (4 times) to different lat-ling locations use \,–\, instead of –

p. 17622

line 1 at its centre =>in its centre

line 2 MULID => MULIDs or MULID lidars

line 7 occurs => occurred

line 9-10 Since I suggested a new first sentence of this paragraph following sentence should be removed: Further information on the Caliop (you meant CALIPSO ?) instrumentation and its products can be found at: http://eosweb.larc.nasa.gov/PRODOCS/calipso/table calipso.html.

line 14 annual => annually

line 15 at four of these wavelengths, => at four of those,

line 20 (AOD) => AOD

line 21 to 22 remove: (the ratio of the AOD at two different wavelengths)

line 25 about 07:00 => around 7:00

line 25 05:00 => 5:00

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line 27 and line 1 p. 17623 , the wavelength of lidar measurements, => (wavelength of lidar measurements)

p. 17623

line 1 by: => by

line 1, 9 BAMGOMAS uses words 'back trajectories'. You use back trajectories, back-trajectories, backtrajectories, sometimes even trajectories, and respectively for singular forms. Choose one nomenclature and use it consequently throughout the paper. I suggest 'back-trajectories'. line 9 obligatory changes: BAMGOMAS (Back trajectories, Aeronet, Modis, Gocart, Mplnet Aerosol Synergism) => Back trajectories, AERONET, MODIS, GOCART, MPLNET Aerosol Synergism (BAMGOMAS) NASA GMAO (Global Modeling Assimilation Office) => Global Modeling Assimilation Office (GMAO) at NASA NCEP (National Centers for Environmental Prediction) => National Centers for Environmental Prediction (NCEP)

line 13 I suggest rewriting the firtst paragraph as follows: Air mass back-trajectories have been used to identify main circulation patterns and their seasonal variability in the region under investigation. Trajectories calculated 7 days backward at different altitudes above three measurement sites were retrieved using the http://aeronet.gsfc.nasa.gov/cgi-bin/bamgomas interactive site. This support website for the AERONET program and for the Back trajectories, AERONET, MODIS, GO-CART, MPLNET Aerosol Synergism (BAMGOMAS) project uses trajectory calculations based on kinematic trajectories analysis utilizing assimilated gridded analysis data of the Global Modeling Assimilation Office (GMAO) at the NASA for the period of 1 January 2000–30 August 2007 and the National Centers for Environmental Prediction (NCEP) analyses from 31 August 2007 onward.

line 22 and 26 choose one nomenclature (Sect.5 or section 5 or Section 5) and use it consequently throughout the paper.

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line 23 and 25 for giving reference (4 times) to different lat-ling locations use \,–\, instead of –

line 25 (called "Ocean" in Sect. 5)=> (called further in this manuscript Atlantic Ocean

3 Seasonal Variability in 2006

Make one paragraph out of the text starting with

1. line 7 page 17624 until end of line 27 p. 17624

2. line 28 page 17624 until end of line 13 p. 17625

3. line 14 page 17625 until end of line 27 p. 17625

4. line 28 page 17625 until end of line 1 p. 17626

5. line 2 page 17626 until end of line 8 p. 17626

6. line 9 page 17626 until end of line 24 p. 17626

7. line 25 page 17626 until end of line 8 p. 17627

p. 17624

line 1 remove: 'in 2006'

line 2 If you want to discuss seasonal variability perhaps you should add one or two sentences on what you expect to see?

line 2 I suggest to rewrite the first paragraph as follows: A statistically significant number of 144 profiles of aerosol extinction coefficient were collected by MULID system from February to August 2006 at the Banizoumbou site in Nigeria and 48 profiles obtained from January to July 2006 for the Cinzana site in Mali allowes to infer aerosol seasonal evolution during this period. A much lesser number of only 19 profiles measured at the M'Bour site in Senegal limits analysis to the dry season of 2006 at this location.

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line 8 profiles function => profiles as a function

line 7 The first => First

line 10 Profiles extend up to 6 km and above => We display profiles only up to 6 km as above

line 3 to 11 From what you wrote you studied total of 211 extinction profiles, each of them up to 6 km, and you considered negligible aerosol contribution to AOD above. Are these 211 profiles all of the available observations? How did you cloud screen these data? Were you able to calculate extinction profiles for all 211 attenuated backscattering observations? That would be remarkable. You assumed negligible aerosol contribution to AOD above 6 km. Did you assume also negligible aerosol contribution in an uncompleted overlap region? At what height/range is a full overlap of MULID? From attenuated backscattering profiles you calculated the extinction profiles and from these the respective AOD values. An obligatory error calculation or at least estimation for the obtained extinction profiles and AOD values is missing!

line 12 to characterize different biomass => characterizing biomass

line 13 extinction and depolarization => aerosol extinction coefficient ïĄ ̨a and volume depolarization D

line 16 , and are not highlighted in these panels => and those are not highlighted in the panels

line 16 Do you actually mean that these cases and not highlighted, which suggests that they are drown in the pictures as the background values (black color) or you rather meant that they are not shown on the panels at all? Write it more clearly.

line 17 to 19 those with aerosols extinction coefficient values ïĄ ̨a larger than 0.2 km-1 and volume depolarization D larger than 10% => those with ïĄ ̨a ïĂ ̧ 0.2 km-1 and D ïĂ ̧ 10%

line 20 after 0.2 add missing unit 'km-1'

line 20 to 21 , which have been marked in green. => (marked in green in Fig. 1b).

line 21 to 22 by higher extinction (ïĄ ą > 0.2) and low depolarization (D < 10%) values => by ïĄ ą ïǍ ¿ 0.2 km-1 and D ïǍij 10% values

line 23 and have been marked in blue in Fig. 1b. => (marked in blue in Fig. 1b).

line 25 The red triangles shows => Each red triangle marks

p. 17625

line 1 after Biomass burning add 'aerosols'

line 2 layers => layer (0.5 – 1.5 km)

line 2 to 3 I do not see on Fig. 1 that 'in February non negligible extinction values are observed up to 4 km'(line 2), 'aerosol burden increases at the beginning of the summer'(line 3), 'AOD values reaching values as high as 2' (line 11). I reckon, you must improve the text (here or even earlier in the introduction?) by adding definition of seasons, i.e. what is it meant by dry-wet season what months you consider as summer, winter, etc.; are these seasons definitions ate same for all three regions? Later you talk about May, June but use the Julian-day in the figure. Actually, quality of Fig. 1 itself is unacceptable and must be made more readable! I added more comments about the figures issue at the end of this review.

line 4, 5, 19 and 22 change e.g. 4–5 km => 4 – 5 km (using \,-\,) etc. and also make space after > in line 19

line 14 I do not see 'A similar behaviour is observed in Cinzana' in Fig. 1, there is great difference in extinction (raw a) in middle atmosphere and in integrated AOD (raw d) values and these can be attributed to more often occurring dust events (raw b) in Cinzana.

line 5 cluster => clusters

line 6 remove: layers

line 6 displayed in Figs. => displayed (blue points) in Figs.

line 7 remove: Air mass backtrajectories have been marked by blue points.

line 11 (2–6 km) => should be: (4 – 6 km)

line 11 parcel are more => parcels are

line 12 (upper central panel) => (upper right panel)

line 13 Why this is in 'partial contrast'? Rather comment on how much and in what sense back-trajectories in Fig.2 are not representative for the Fig.1!

line 14 frequently => frequent

line 15 to 20 please rewrite this long sentence and bring out why you referee here to Kim et al. (2009)

line 25 definition of seasons must be done earlier

line 27 when talking about the regions I would use Northern Africa. This will be important later when you mention transport from Southern Africa (region) not South Africa (country).

line 28 after observations add 'discussed here'

line 28 shows => show

line 29 So, the => Hence, the

p. 17627

line 2 of the continent => of Africa

line 4 to 6 I suggest to rewrite this paragraph as follows: Back-trajectories analysis for

2006 revealed that air masses at the two upper levels originated mainly in the Northern and North-Eastern Africa. The majority of observations can be interpreted as DD, sometimes in very intense events, being well in accordance with the mentioned air mass transport pathways.

line 8 remove: probably ('could' already points it out)

line 9 Figs. 2 and 3 are qualitatively very similar. I reckon skipping Fig. 3 completely does not harm quality of the paper. Accordingly to my comment above I suggest a following change: shows a picture similar to Banizoumbou. => show strong similarity with the back-trajectories obtained for the Banizoumbou site (Fig.2) and, hence, are not presented here.

line 10 to 11 originates from Saharan desert in the North and from the Atlantic ocean => originate in the North of the Sahara Desert and at the Atlantic Ocean

line 11 panel) while between => panel). Between

line 14 If there is a 'presence of BBA between 2 and 5 km' then the panels on Fig. 3 are shifted !

line 14 Can you add comment on wet season?

4 Inter-annual variability

Make one paragraph out of the text starting with

1. line 16 page 17627 until end of line 10 p. 17628

2. line 28 page 17628 until end of line 7 p. 17629

3. line 8 page 17629 until end of line 1 p. 17630

4. line 11 page 17630 until end of line 16 p. 17630

5. line 17 page 17630 until end of sentence line 24 p. 17630

6. beginning of sentence line 24 page 17630 until end of line 2 p. 17631

7. line 4 page 17631 until end of line 12 p. 17631

8. line 5 page 17632 until end of line 12 p. 17632

9. line 23 page 17632 until end of line 5 p. 17633

p. 17627

line 16 You want to discuss inter-annual variability, perhaps you add a sentence or two on what you expect to see?

line 18 sunphotometrs in the station of Banizoumbou, Cinzana and Dakar, and => sunphotometr stations in Dakar (approximately 80 km north of M'Bour), Senegal, Cinzana and Banizoumbou, as well as through investigation of

line 19 from the CALIOP => provided by the CALIOP

line 20 we have indicated => we denote

line 22 However, when => When

line 23 it has to be borne in mind => one should bare in mind

line 26 nearest CALIOP retrievals to => CALIOP retrievals nearest to

p. 17628

line 1 to 4 I suggest to rewrite this sentence as follows: Three years of time series of attenuated aerosol backscattering profiles (row a) obtained by CALIOP lidar together with the AOD (row b) and the Ångström coefficient (row c) obtained by AERONET sunphotometers for Banizoumbou region are given in Fig. 4. Similar was done for Cinzana region in Fig. 6 and M'Bour region in Fig. 8.

line 8 As observed in all the three figures, => In the three figures

line 9 variability above all => variability, above all

line 9 season and this => season. This

line 9 imputed => accounted ?

line 11 after Banizoumbou add 'region'

line 12 in Banizoumbou, in the => for Banizoumbou region in

line 12 what do you mean here by 'total'?

line 13 (Fig. 5a) => (Fig. 5, row a)

line 14 levels – i.e. below 2km – in January, levels (below 2km) in January,

line 14 for 2007 and 2008 I cannot see aerosol 'slightly reducing in February then steadily increasing from mid February to March' as figures are too small. For the 2006 there is no CALIOP data at all.

line 16 what you mean by 'at the lowermost levels is at its highest in 2007'?

line 17 I cannot see that 'profile increases in vertical extension and intensity' as all profiles are up to 6 km.

line 18 largest => highest

line 18 values => altitudes ?

line 18 Figures are soo small to see anything 'between mid May and July'

line 22 If there is 'clear seasonal pattern' try to fit a polynomial function to these data. It would greatly help the reader to see a general trend in these data.

line 22 in Fig. 4b => in row b of Fig. 4

line 22 to 27 In 2006 and 2008 I see no 'larger values from January to September 0.5 and 2'. I hardly see 'maxima up to 2.5–3 in intense events'. It does not 'reduces to around 0.5'. Please carefully re-check your statements.

line 25 use consequently throughout manuscript interannual or inter-annual

line 28 in Fig. 4c => in row c of Fig. 4

line 28 The Angstrom coefficient is shown in Fig. 4c. It attains its higher vaules => The Ångström coefficient shown in raw c of Fig. 4 attains high values

p. 17629

line 1) during =>), during

line 2) and in =>), and in

line 2), often is =>). It is often

line 1 to 2 I see in Jan + Feb 'between 0.5 and 1' only in 2006; in Jul + Aug 'up to 1.5' only sporadically in 2006 and 2008 and a little more often in 2007; in Dec I do not see 'up to 1.5'.

line 2 I see correlation 'with low AOD values' only for 2006 and 2008 and for 2007 in summer. December 2007 is correlated with low AOD and high Å

line 9 CALIOP Depolarization and Color Index => depolarization D and color index C derived from the CALIOP measurements.

line 9 remove: which have been used to identify different kind of aerosol.

line 10 to 14 suggestion to rewrite this sentence: In Fig.5 the joint probability density function (PDF) for D and C retrievals for different seasons depicted in four consecutive columns as January-February (JF), March-April-May (MAM), June-July-August-September (JJAS), October-November-December (OND) at two atmospheric layers, lower one up to 2 km (row a) and high layer between 2 and 6 km (row b).

line 14 could you comment on why you chosen such a division of atmosphere? Is the lower layer considered a boundary layer and the higher a free troposphere?

line 22 shows => show

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line 23 D-C space showing => (C,D) space indicating

line 29 probably => probable

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line 2 Cinzana => Cinzana region

line 3 In Cinzana the seasonal pattern of the aerosol vertical distribution => The seasonal pattern of the aerosol vertical distribution obtained for the Cinzana region

line 4 I see 'presence of aerosol' as you described but only for the years 2007 and 2008!

line 8 large => higher

line 8 remove: of altitude

line 10 after 'the end of 2006' add 'with respect to other years.'

line 11 However, the => The

line 11 the same => similar

line 12 As => However,

line 13 larger => higher

line 17 greater => lower

line 17 markedly in April => with peak above 0.5 in April

line 18 exceeding 1.5 => even exceeding 1.5

line 19 not exceeding 1? In every picture from Oct to Dec I see values exceeding 1.

line 20 AOD values, suggesting the presence of BBA. => AOD values (or opposite), suggesting the presence of BBA (or DD).

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line 22 slight year-to year => weak year to year

line 23 and 24 up to 1, while in => even above 1. In

line 24 the year 2007 shows A values up to 1.5. => of 2006 and 2007 Å values reach even beyond 1.5 while in 2008 they remain below 1.

line 24 Figure 7 shows joint probability density function (PDF) for CALIOP D and Color Index => Joint probability density function for CALIOP's D and C over Cinzana region is depicted in Fig.7

p. 17630

line 1 evident. => evident at this location.

line 1 to 2 sugestion for rewriting the last sentence: In contrary to Banizoumbou and M'Bour regions at Cinzana an increased presence of DD is observed in the upper layer during winter (JF) and fall (OND).

line 3 M'Bour => M'Bour region

line 4 to 5 sugestion for rewriting sentence: Figure 9a depicts clear annual aerosol evolution over M'Bour.

line 5 I do not see that this evolution is 'analogous to Cinzana.' It would be easier to see such a seasonal cycle if a function would be fillet on top of the data.

line 6 is it really 'located around 3 km'?

line 9 'up to 2.5' but only in 2006

line 10 are below 0.5 => are most of the time below 0.5

line 10 what is 'dry season'? It is not JF + OND? If so why you say later on 'and between end of October and December

line 11 No 'AOD average values' are not 'around 1' here.

line 13 the inland sites => the two inland sites

line 14 and 15 season. Nevertheless, the intensity => season but the intensity

line 15 seems to be => is rather

line 17 are slightly variable year-to-year variation with the year 2006 => show weak variability on the year-to-year scale. However, the year 2006 is

line 19 remove: '(PDF)' it was already defined

line 20 no, not 'closely'

line 21 in Banizoumbou. The clearly discernible difference => in Banizoumbou in the sence that the difference

line 24 layers => layer

p. 17632

line 3 the number => number

line 5 reports => depicts

line 7 levels (as described in Sect. 2); in order => levels, as described in Sect. 2. In order

line 9 box while, in order to => box and to

line 9 flow Guinea => flow, Guinea

line 11 fires, as observed from AATSR, occurred.. => fires observed by AATSR occurred.

line 13 The superposition of the trajectories the BBA sources => The superposition of the back-trajectories originating at the BBA sources

line 14 region => the region

line 15 desert region, and northward transport from Equatorial Africa is inhibited by => the desert region due to a northward transport from Equatorial Africa which was inhibited by

line 16 to 17 I appreciate work done to obtain all plots which are included in the Supplement to this manuscript. However quality of the figures is such a bad one that one can hardly use these figures. My suggestions on how to improve it are given at the end of this review.

line 19 Figure 12 => Figure 11

line 22 'yellow'? It is more 'orange'.

line 22 to 23 (columns a to c) . . . (rows a to c) => (columns) . . . (rows)

line 23 origins => origin

line 25 Saharan desert => Sahara Desert (blue)

line 26 in the first and last part of the year => at the beginning and end of year

line 26 in the central part of the year => during the middle of the year

line 27 result to be => are

line 28 in land => inland

p. 17632

line 1 Biomass burning => Biomass burning (red)

line 5 There is also a decrease of the BBA similar for the three sites; from (about) Julian day 200 – 270 at Banizoumbou, 190 – 270 at Cinzana and 180 – 280 at M'Bour there is no BBA whatsoever. Could you comment on that?

line 14 years and discussed here above. => years.

line 18 kind => type

line 19 , and their sources searched for by using trajectory studies. => , as well as in terms of their sources obtained using back-trajectories.

line 21 levels => level

line 23 flow => flows

line 25 remove: 'in fact'

line 27 remove: ' , '

p. 17634

line 5 coming from the south Africa region => originating in the Southern Africa, a region

line 8 remove: 'sparse'

line 9 placed in => placed sparsely in

line 11 dust aerosols: the air => dust aerosols. The air

line 11 arrived or from => arrive from

line 12 Saharan desert => Sahara Desert

line 12 Guinea Gulf while in => Guinea Gulf. In

line 13 originated => originate

line 13 The maximum => In this period the maximum

line 14 remove: 'in this period'

line 15 transect, characterized => transect, which is characterized

line 19 Summer is in fact characterized by extensive and fast convective phenomena. Lidar profiles shows at times => Summer is characterized by extensive and fast convective phenomena and this is pronounced in the lidar profiles. They often show cases

of

line 26 kind of aerosol => types of aerosols

line 26 according => accordingly

line 27 characteristics, their => characteristics. Their

line 28 years, and => years and

line 28 searched for with the aid of trajectory studies, whose outcome => identified using back-trajectory studies, which

p.17635

line 1 with what inferred => with information inferred

line 17 Niger => Nigeria

References

p. 17635

line 24 should be Ångström, A.

p. 17636

line 24 Ferrare et al. is misplaced here

line 27 Fiebig et al. is misplaced here

p.17637

line 6 Dubovik et al 2002 is before Dubovik et al. 2000 in line 9

line 30 Haywood et al. 2000 chack the publication date in text and here

p.17638

line 19 Junge, 1963 does no appear in the text

line 20 Leon et al., 2009 where was in published

line 23 Liu and Mishchenko, 2001 does no appear in the text

p. 17639

line 1 Mattis et al. you yse two assignments 2002 (here) and 2002b (in text) choose correct one

line 20 Prospero et al., 2002 does no appear in the text

line 20 Prospero et al., 2002 and in line 24 Prospero and Carlson, 1972 should be swaped

Tables

Table 2

change title to: Parameters of the MULID lidar.

change x4 to 4 x

add parameters:

signal's upper range limit

full overlap

Figures

Commentary to Fig.1

Figure must be improved. It is too busy, panels are too small to see differences in a paper-printed version of manuscript. Units for the extinction are missing. In row b blue and black colors are not separable, change of background from black to grey could do well. Barycentre in row c denoted by red cross is not visible. Scale for AOD should be changed to 0 – 2 and the two outstanding observations for Cinzana around Julian day 140 can be mentioned in the text or in the figure's caption. I also suggest rewriting the

caption under Fig. 1 as follows:

Fig.1. MULID observations of aerosol extinction coefficient profiles (row a), type of aerosol (raw b), aerosol occurrence vertical distribution (row c), and aerosol optical depth (row d) at three sites Banizoumbou in Nigeria (left column, 144 observations), Cinzana in Mali (middle column, 48 observations) and M'Bour in Senegal (right column, 19 observations) during 2006. In row b intense dust events (DD) are assigned in red, biomass burning aerosol (BBA) in green, mix of DD and BBA aerosols in blue, and a background aerosol in black. In row c top, bottom and barycentre (red cross) of vertical distribution of maximum aerosol load are given.

Commentary to Fig.2

Please enlarge each of the subplots to make Figure more readable in a paper-printed version of manuscript. Change caption to following:

Fig.2. AERONET 7-days back-trajectories (blue dots) arriving at Banizoumbou site between 0 – 2 km (left), 2 – 4 km (middle), and 4 – 6 km (right) along with biomass burning emission map (black cross) for the period of January – February 2006 (upper row) and June – September 2006 (lower row).

Commentary to Fig.3

I suggest to skip this figure. If it is kept please shift columns (1st should be 3rd). Then follow the comments for Fig.2

Commentary to Fig.4

Please enlarge each of the subplots to make Figure more readable in a paper-printed version of manuscript. If possible fit a function over the time series to bring out the essential annual cycles. I suggest a new caption for Fig.4:

Fig.4. Total attenuated backscatter profiles (km-1 sr-1) obtained at 532nm from CALIPSO database (row a) along with time series of aerosol optical depth (row b)

Interactive Comment

and Ångström coefficient (row c) estimated at 532nm from AERONET database for year 2006 (left), 2007 (middle), and 2008 (right) at Banizoumbou site.

Commentary to Fig.5

I like this Figure very much. Colored rectangles must be drown clearly on the first subplot – now they are not visible in printer-version of manuscript. I suggest a new caption for Fig.5:

Fig.5. Joint PDF for Color Index and Depolarization retrieved from CALIOP observations for different seasons over Banizoumbou site. In column 1 we depicted JF, in column 2 MAM, in column 3 JJAS, and in column 4 OND. Upper row show results for a boundary layer $(0 - 2$ km) and lower for free troposphere $(2 - 6$ km). In the upper left subplot yellow and red rectangles identify, respectively, desert dust and biomass burning aerosols classified using criteria specified in Table1. Colored rectangles are shown only in one subplot for brevity.

Commentary to Figs. 6, 7, 8, and 9 => follow instructions for Figs. 4 and 5

Commentary to Fig.10

I like this figure very much. In caption of this figure change:

1. if their number is larger than 10 => if their number of occurrence was beyond 10 times

2. skip parentheses in "Desert" and "Ocean"

3. add ' , ' before respectively

4. if possible swap coloration to more natural, i.e. Desert = yellow and Ocean = blue

Commentary to Fig.11

I would just correct the caption as follows:

Fig.11. Time-height evolution for airmasses originating in the Desert region (blue) and

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Discussion Paper

the Ocean region (orange) as well as the airmasses encountering Forest fires observed by AATSR (red). Number of trajectories is averaged over 10 days. Units are arbitrary.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 17609, 2010.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper