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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Transport and vertical structure of aerosols and water vapor over West Africa during the African monsoon dry season" *by* S.-W. Kim et al.

Anonymous Referee #2

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General comments:

In the present paper, valuable observations are presented and a proper analysis using model-derived meteorological fields would be very profitable. However, major revisions are needed in many aspects in order to make the paper publishable. A thorough improvement of the paper is needed, particularly to clearly present the originality of the paper, to properly justify the occurrence of the cited dynamical mechanisms and to include proper background information and references.

Major remarks:

1)The main objective and new findings of the paper should be clarified. The two-layer structure (a dust layer below a biomass burning aerosol layer) was already the object of several papers (Chazette et al., 2007, Osborne et al., 2008, Johnson et al., 2008, Raut and Chazette, 2008, etc). The main transport pattern during the SOP-0 was explained by Haywood et al. (2008). Considering this, what is the new point regarded by the paper?

2)The description of the involved dynamical mechanisms is not clear. What is the actual origin of lifting in the 10°N fringe? Is it dry convection or deep convection? No justification is given for an increase in surface heating. In my opinion, if "transport" is included in the title, a thorough explanation of the circulation patterns and the involved dynamical mechanisms should be given. This aspect should be significantly expanded and properly justified.

3)The background information and references cited in the paper are fairly poor, particularly when it comes to West African meteorology. Many basic notions concerning the meteorology and atmospheric circulation in the region are omitted. Among other, the Inter-tropical discontinuity, the Saharan air layer and the African easterly jet are fundamental actors in the circulation patterns in the analyzed cases, but they are not mentioned. The difference between the ITCZ and the inter-tropical discontinuity should be explained.

Other important points:

4)The indication of many geographic locations is mainly vague and very difficult to follow when referring to the figures. The Sahara and the Sahel are very vast regions covering thousands of kilometres and more precise locations should be given.

5)Backtrajectories are an important support of the paper. The uncertainties involved should be clearly discussed and mentioned in the analysis. Some information is given by Knippertz et al., 2008.

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Knippertz P, Ansmann A, Althausen D, Muller D, Tesche M, Bierwirth E, Dinter T, Muller T, von Hoyningen-Huene W, Schepanski K, Wendisch M, Heinold B, Kandler K, Petzold A, Schultz L, Tegen I. 2008. Dust mobilization and transport in the northern Sahara during SAMUM ; A meteorological overview. Tellus B. DOI:10.1111/j.1600-0889.2008.00380.x.

6)It is not clear whether the paper analyses a complete period covering a season or a series of study cases. Only punctual observations are given and their significance is not analyzed.

7)English language should be improved in general. More precision should be given for example for wind directions. Winds are either easterly or westward when they come from the east. Easterly, east and westward should be precisely used. Repeating of statements should be avoided when possible. To benefit from a clearer and more direct reading, the point of each section should be suggested at the beginning.

Particular remarks:

8)Please, rewrite the sentence in lines 21-23 of page 3

9)Equation (1) is not correct. Please, rewrite, properly define the variables and indicate a reference.

10)What are the values of the lidar ratio used in the inversion of the ULA lidar signals? Please, give them and justify.

11)Why the ULA lidar signals are inversed and only attenuated backscatter CALIOP profiles are given? I recommend providing inversed signals in all cases, particularly to avoid ambiguities induced by atmospheric transmission. With the optical depth of the layers involved, it may be possible that the lidar return of a lower layer may be attenuated by a higher one.

12)In line 5 of page 7, is it "derived" or simply supplied by a data provider service. Please, cite the website or the origin of CALIOP datasets.

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13)Page 9, lines 6-9 are not clear. Please, explain again.

14)Page 9, lines 17-20. Please, be more specific with locations. What indicates the type of aerosols?

15)Page 10, lines 1-2. It is not true. The monsoon is a low level flow up to 2 km of altitude, well below the 700 hPa level. Please, clarify.

16)Page 10, line 7 and 19. Locations are vague and the point is not clear to understand. Where are the winds described? Which latitude and longitude?

17)Page 10, line 18. North or south? Please replace convective by convection.

18)Page 11, line 3. Turbid imply that they are mainly opaque. Scattering layers is a better term.

19)Page 11, line 11. Indicate closed or open marks.

20)Page 11, line 15. Some fires are closed to the trajectory. Some mixing may occur.

21)Page 11, lines 18-21. Please, rephrase.

22)Page 12, line 6. It was not updraft motion prevailing in the region in Fig.2?

23)Page 12, line 10. What is the importance of the clean air layer?

24)Page 12, lines 11-18. Please, explain the importance of the fact that one layer is more humid than the other (4 and 5.5 g/kg of water vapour mixing ratio).

25)Page 13, line 11. Please rephrase, it is not clear to which layer it refers.

26)Page 14, line 21. Why there is no mixing? In some of the cases of the figure, there is no clear air layer between the two aerosol layers. Some partial mixing could occur at the boundary between the two layers.

27)Page 15, line 9. Please, avoid back and forth comments.

28)Page 15, lines 15-21. Please rephrase. Justifications are not clear. What is the

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relationship between surface heating and deep convection? Why the large scale ascent is higher at 850 hPa than at 925 hPa (fig. 2)? An additional figure showing the location of mesoscale convective systems in the period would be very important in the discussion.

29)Page 16, lines 10-14. These references are not exhaustive. Please expand or omit the comment.

30)Page 17, lines 4-7 for example. Please include technical details in section 2 and mainly use the body of this section to make the scientific statements.

31)Page 18, lines 1-2 for example. Please compare the color ratio values to the ones shown in other publications (e.g. Cattral et al., 2005). More references on typical depolarization ratio values and variability is desired.

Cattrall, C., J. Reagan, K. Thome, and O. Dubovik (2005), Variability of aerosol and spectral lidar and backscatter and extinction ratios of key aerosol types derived from selected Aerosol Robotic Network locations, J. Geophys. Res., 110, D10S11, doi:10.1029/2004JD005124.

32)Page 18, lines 3-4. In order to make this statement, inversion of the CALIOP profiles would be needed.

33)Page 18, line 11. Could it be the natural variability of biomass burning aerosols? Please refer to works as Cattrall et al. (2005).

34)Page 19, lines 12-15. Please rephrase. Doesn't it mean that it is simply stratified?

35)Page 21, lines 23-24. What complex interactions?? The radiative budget is product of the various aerosols layers.

36)Page 22, lines 1-3. What is the sense of this last sentence?

37)Figure 1: The location of the ITCZ and the inter-tropical discontinuity should be given in each case. The criterion of identification should be explained. Only impor-

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tant panels should be kept. Arrows should be bigger and I would recommend using streamlines.

38)Figure 2: The location of the ITCZ and the inter-tropical discontinuity should be given in each case. Vertical speeds for a pressure level which is below the ground level should not be displayed. Important locations as Niamey should be indicated.

39)Figures 3. What is the abscissa variable in panel a? 32?

40)Figure 6. Please, reduce the number of panels or show a synthesis figure. This extends to some other figures when applicable.

41)Figure 9. It is desirable that panels a and b show the same latitude sector.

42)Figure 9b. Latitude (N)?

43)Please indicate the line numbers in the new version of the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 1831, 2009.

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