

Interactive comment on “Mineral dust effects on clouds and rainfall in the West African Sahel” by L. Klüser and T. Holzer-Popp

Anonymous Referee #2

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The authors present a statistical study on dust-cloud effects using cloud and aerosol data from Aqua-MODIS. The study is based on 5 years (2004–2008) satellite observations and tries to relate cloud properties to dust optical thickness, both retrieved from MODIS measurements. In addition, SEVIRI BMDI brightness temperature differences are used to identify dust events and categorise them qualitatively into 'no', 'moderate', and 'high' aerosol loading cases.

The presented results are qualitative and based on statistical indications, mainly presented as histograms. Although the authors address an interesting topic, the discussion seems to remain superficial in some points.

C2239

Specific comments:

1. Title: There is no discussion on dust effects on rainfall. I suggest to change the title.
2. Abstract: You mention 3 satellites to be used for statistical analysis on the influence of mineral dust on clouds, but finally only one, MODIS on Aqua, are used for analysis. The two others are used for data selection. This should be pointed out.
3. The introductory parts (section 'Data and methods') on the 'Deep Blue' algorithm and algorithm for cloud property retrieval are rather short. More detailed background information are desirable as the analysis mainly bases on this data.
4. The role of dust particles for ice particle formation is described in the introductory part, but the analysis considers warm clouds. The authors should introduced the role of dust particles for liquid clouds and give a background on warm clouds.
5. The authors mainly draw their results on histograms representing observation densities for the whole area. It would be interesting to see some spatial relation between aerosol and cloud parameters.
The defined area is affected by disturbances related to e.g. African Easterly Waves. Ridges and troughs along the disturbance are related to monsoon and harmattan flow as discussed by the authors and shown in their Fig. 4. However, the meteorological presentation and discussion on this part is quite short. But as the authors mention the possible impact of atmospheric conditions such as

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temperature, humidity and stability, a spatial investigation of the aerosol-cloud relations should be added.

6. A prerequisite for the presented study is that dust and clouds are existing beside each other and not above each other. E.g. dust plumes covered by clouds like arcus clouds ahead a haboob are not considered. Thus the study might under-represent dust events caused by cold-pool outflows. Over the considered area transported dust plumes from dust sources far upwind and upward mixed dust layers are more likely to observe due to the distance towards frequent source areas.
A short discussion on the limits and prerequisites of the study should be added.
7. The difference between cloud cover and ice phase fraction for 'no aerosol', 'moderate aerosol' and 'high aerosol' class are relatively low (e.g. Fig. 3). Why should we trust in such small differences? Is it possible that the differences are related to e.g. artefacts due to the retrieval methods?
8. Harmattan and monsoon flow are identified by WVC. Does this method agree with the commonly used criteria of wind and relative humidity?
9. Is there any evidence, that precipitation rate (i.e. afternoon/night precipitation rate, Fig. 1) is reduced in case of present dust?
10. The reference list has to be checked concerning completeness and layout!

C2241

Minor comments, technical corrections:

mixing upper and lower case for 'harmattan' and 'Harmattan'

P6168 L20 although both, desert and tropical air masses are warm, desert air is warmer than tropical. To make the difference clearer, e.g. "[...] separates the warm and dry Saharan air mass from the cooler and wet [...]"

P6168 add some words defining the meaning of ITCZ

P6169 add some information on effects of dust particles on warm clouds as this is discussed later

P6170 L12 three different satellites

P6170 L22 give time at which time Aqua pass over the area of interest

P6172 definition of 'Harmattan'

P6172 L10 add geographical coordinates of box. Also, add some words on the characteristics of the here defined extension of the Sahel zone (e.g. precipitation, reference) and the motivation for defining the Sahel zone as given.

P6172 L27 why 'e.g.'? Which months are classified/identified as monsoon season?

P6173 L13 what do you mean by 'fine mode fraction' here?

Fig. 1: (left) You show the mean annual rainfall in colours. As the Sahel zone is often defined by annual precipitation, a plot showing the isohets would makes it easier to identify the 'borders' of the Sahel zone.

Fig. 3-6 There are too many tick marks on the bottom x-axis!

Fig. 4 monsoon season in blue and dry season in red would be a more intuitive colouring