

## ***Interactive comment on “Comparing two years of Saharan dust source activation obtained by regional modeling and satellite observations” by I. Tegen et al.***

**Anonymous Referee #1**

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The paper investigates dust emission events in the Sahara for two years. It is mostly based on a comparison of dust source activation (DSA) between MSG observations and a regional model. The paper underlines the role of the low-level jet (LLJ) in the emission of dust. The paper is clear, but the comparisons are too qualitative. The annual average of aerosol optical depth (AOD) from the model is too low compared to AOD obtained from AERONET and MODIS retrievals (see Fig. 1 of this review). Last but not least, DSA in MSG observation occurs almost always in the morning hours, which make results too suspicious.

### **General comments**

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The areas where dust emission is allowed in the model correspond to dust source activation found in the MSG observation. Moreover, the threshold used to identify the dust events in the model was based on the MSG observation. However, no dust emission can be detected from MSG observations in presence of thick cloud cover or high water vapor loading. These strong limitations in the dust source activation obtained from MSG observations lead to constraints in the model that should be discussed.

The dust source activation occurs almost exclusively between 06:00 and 12:00 UTC according to the MSG analysis (Fig. 1, top row). However there is a significant literature discussing about dust source activation during other hours because of Sharav cyclones and mesoscale convective systems (as cited page 27675). As the later are associated with cloud cover, their associated emission should lack in the observations and in the model. This point should be discussed.

### **Specific comments**

#### **Abstract**

Page 27668, line 7. "Considerable number", please give a number

Page 27668, lines 11-17. Observations at AERONET stations are not necessarily representative of dust variability. So an agreement between the model and AERONET observation does not imply that the model reproduces the aerosol optical depth well everywhere. Thus the deficiency of the model to reproduce the interannual variability might be of importance.

#### **Section 3.1 Dust source activation frequencies**

Page 27674, line 8. "Cloud cover higher than 50%", please justify the choice of such an arbitrary threshold. The total water vapor content that masks the dust signal in the MSG observation should be taken into account as well. Why do you not consider it?

Page 27674, line 25. Dust emission due to LLJ is just an important (not dominant) mechanism as it accounts for 40% of events only (Table 1 and page 27675, line 19).

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Page 27674, line 27. Please indicate some reasons explaining the DSA observations are biased towards the morning. The quasi-totality of emission in the morning is too surprising to be right.

Page 27676, line 7. You stated that "the passages of Sharav cyclones are the cause of major dust emission events in Northern Sahara". Because the Sharav cyclones do not shown any diurnal cycle and DSA occurs exclusively in the morning hours in October to January, this more than suggests that the MSG observations underestimate DSA.

Page 27676, line 8. Similarly to the Sharav cyclones, mesoscale convective systems would mask dust emissions leading to another underestimation of DSA in the observations.

Page 27676, line 13. "The agreement between modeled and observed dust emission events is very good". This statement is subjective. Few lines below, you write "missed emissions are most evident for the annual average in the Sudan and the mountainous region along the border between Algeria, Mali and Niger". So the agreement is not so good. Please prefer numbers to subjective statements.

Page 27677, line 1. Why is an overprediction of the morning wind peaks due to the LLJ breakdown unlikely?

Page 27676, line 8. "Potential deficits in the model capability to reproduce moist convection may be also obscured in favor of the model". It would be worth mentioning here that the model does show some emissions in the afternoon while MSG does not. This discrepancy in hours of emission has to be discussed.

Page 27677, line 9. "...to cloud-free conditions" and high water vapor loading as well. This should be noted.

Page 27677, line 25. "...a close agreement is achieved between the model and observations". As the number of DSA in the model was constrained to equal the number of DSA in the observation, adding number of days with LLJ occurrences but without dust

C10322

emissions increases by 30% the number of DSA in the model. In that case, there is no more a close agreement between the model and observations. It would be worth to remark it. Furthermore, the location of these additional numbers of days should be shown in a new figure to verify the suggested close agreement.

### **Section 3.2 Dust optical thickness**

Figure 4. For an easier comparison, the model outputs should be shown using the same projection than the one used for the observation. Also, it would be preferable to plot the observation in the top row (as in Figures 1 and 3). Why do you use OMI index and not MODIS Deep Blue aerosol optical depth? This would render the evaluation more quantitative. Apparently, the aerosol optical depths from the model fro 2007 and 2008 are much lower than those retrieved from MODIS Deep Blue (see Fig. 1 of this review).

Page 27678, line 23. Please justify the choice to compare optical thickness observations at 440nm with model results of dust optical thickness at 500nm wavelength. An accurate comparison would use optical thickness observations at 500nm.

Page 27679, line 4. Dakar and Agoufou are not in the Saharan desert.

Page 27679, line 14. Please quantify "the good agreement at the station Saada" and "the notable discrepancies" at the other stations (e.g., bias, rmse, correlation). It appears that the AOD is strongly underpredicted in the simulation at Dakar.

Page 27679, line 19. Agoufou is in the Sahel (not close to the Sahel).

Figure 5, the black dots are too small to be read

### **Conclusions**

Page 27681, line 1. This paragraph on the observation uncertainties is very welcome. It should be emphasized that observed dust events occurred quasi-exclusively in the morning, which is very suspicious.

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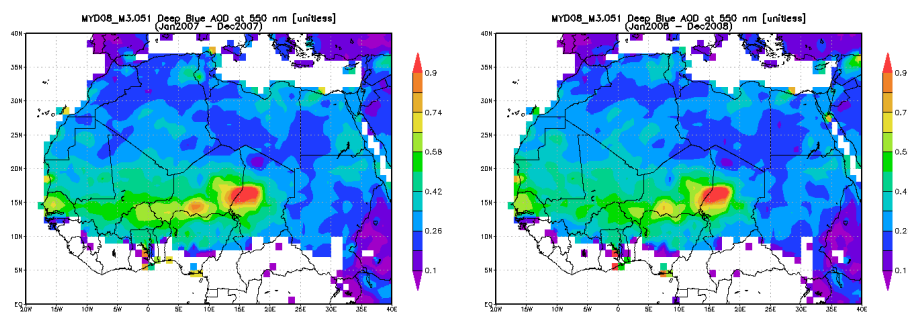
Page 27681, line 8. "The model results agree generally well with the AERONET optical thickness data". This sentence is not correct as many discrepancies were noted.

### Typos

"Ehile" (27679/14), "the their" (27680/20), "overpredicing" (27686)

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C10324



**Fig. 1.** MODIS Deep Blue aerosol optical depths in 2007 (left) and 2008 (right)

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