Response to anonymous referee #1

This manuscript presents an analysis of the simulation of density currents giving rise to dust emissions using the RAMS/CLAMS model. The work is well written and the topic is relevant in the context of dust modeling in desert areas.

We would like to thank the reviewer for the useful comments. We address each comment below and most of these considerations are clarified in the revised manuscript. The reviewer's comments are in bold and followed by our response.

My main concerns are:

1) The analysis presented in this work heavily focuses on the model results and no explicit comparison is made with observations. The authors only mention at the end of page 21590 the meteorological observations presented in Knippertz et al 2007. However, a comparison of the observed variables at the stations mentioned in the paper need to be included. In addition, I would recommend the incorporation of a new section describing the observations. Moreover, based only on model results the authors make quantitative assessments of the system behavior that cannot be contrasted with any ground truth.

The main objective of the manuscript is to describe the physical processes related to the mobilization of dust particles from convectively driven density currents. Unfortunately there are no available observations inside the density current head during the system development that would be used for comparison. Comparison with satellite images (Figures 2,3) and ground measurements (Figure 12) is used as an indication of the model ability to reproduce the main atmospheric properties during the haboob event. In the revised manuscript we have added the surface observations from Tinfou station and the relevant section has been extended.

2) Only one case is analyzed. The in-depth description of the case study is interesting but it raises the question on how representative is this case when compared with the eight density current systems observed during SAMUM.

As stated also in Knippertz et al. (2007) this particular case is a typical example for illustrating the dust production mechanism mainly due to the weak background flow, the isolated nature of the density current and the availability of observations. Modeling simulations of other events resulted in similar frontal structures and dust elevation. The corresponding section has been rephrased in the revised manuscript.

3) Are you explicitly considering the effect of the rain that is produced by these storms on the soil properties, so inhibition of dust emissions might occur right after the passage of the leading edge of the storm? If not, you are over predicting the dust emissions. This issue needs to be explicitly addressed in the manuscript.

The increase in ground wetness due to rainfall is explicitly treated in the model. Reduction of dust production due to increased soil moisture is addressed with the parameterization of Fecan et al. (1999). The relevant section (page 21584, lines 9-11)

has been included in the manuscript for clarity. Rainfall was evident only in the area of Atlas Mountains during the thunderstorm. The cool downdraft generated a density current that propagated southwards and covered a distance of several hundred kilometers towards Algeria. The movement of the density current was not associated with rainfall.