

*Reply to reviewer 2 by Bernhard Vogel, Heike Vogel, Tanja Stanelle, and Christoph Kottmeier*

We thank the reviewer for his valuable comments.

*MAJOR COMMENT:*

*The major result of the study is an increase of the surface temperature and connected positive feedback in the regions of the largest concentration over Sahara. This result contradicts to decrease of temperature and negative feedback effect obtained by all (according to my knowledge) published similar studies; most of them the authors reference in the manuscript. At least one of the previously published experiments is based on use of the same atmospheric driver implemented in the current study.*

This difference is indeed an interesting outcome of our study.

Our findings can be summarized in the following way:

1. When the dust layer is elevated the scattering and the absorption of radiation leads to a) a temperature decrease directly at the surface and a decrease of air temperature below the dust cloud and b) to an increase of air temperature inside the dust cloud due to absorption.
2. When the dust layer is attached to the surface we have to distinguish two cases. We found a decrease of surface temperature and a decrease of air temperature when dust particles are freshly emitted and the area is not influenced by an advected near surface air layer which was heated by dust particles (see Fig. 10, 5 March 2006, 15 UTC and 6 March 2006, 15 UTC north of 32° N) . We found an increase of air temperature within the dust layer when the dust stays in an area for several days or the area is influenced by an advected heated layer. The temperature increase in the dust layer is caused by absorption during day and night of long wave and short wave radiation and by increased downward long wave radiation at the surface. This leads to a reduction of nocturnal cooling and by that to a reduction of the daily temperature range. The latter is in agreement with observations. In addition to the three dimensional model runs we carried out 1-dimensional model runs that are documented in Stanelle (2008) that also showed a warming in the boundary layer when mineral dust is attached to the surface.

Unfortunately, based on the published results and on our own work we can only speculate why especially the group (IFT) that uses the same meteorological driver as we do always finds a cooling when the dust is attached to the surface. One clear difference is the used procedures of the model simulations. We are simulating 144 hours without any restart of the model that means that we are integrating the radiative effects of mineral over that time span. We are currently performing a model inter comparison with IFT that might help to elucidate the reasons of the difference in the temperature signal. This model inter comparison will give a more conclusive insight in the differences probably caused by refractive indices, surface albedo, dust size distributions, integration procedure etc. than a 3 month model run.

*A common feature of the current study and several other similar works are that all are based on selected dust storm cases. So, lack of longer-term model experiments in all current studies could explain the existence of divergent conclusions from different studies.*

*See comment above.*

*Taking into account the importance of the subject of this study and necessity to clarify the way how dust affects the radiation balance, I strongly propose to authors to perform additional model experiment performed over a selected 3-month season, and to evaluate the model results with respect to the surface temperatures for available SYNOP stations over northern Africa. Although indirectly, the proposed sensitivity experiment can indicate the features of the dust direct effects on the radiation balance.*

See comment above.