We thank Drs. Marsham, Knippertz and Parker, hereafter referred to as "Authors", for their insightful comments and suggestions. Our responses appear in italics, below.

The conclusions are based on trajectories derived from ECMWF fields. In the discussion of the limitations of this approach, although deep moist convection is mentioned, deep dry convection is hardly discussed. Deep dry convection is of particular importance in many dust source regions.

We agree on the importance of deep dry convection over many dust source regions, described succinctly for the Sahara in the reference pointed out by the Authors [i.e., Cuesta et al., 2009.]

The atmosphere of the Sahara exhibits the deepest dry convection on Earth – dust is routinely observed to be mixed by dry convection to 5 or even 6 km (~500 hPa, e.g. Cuesta et al 2009, Knippertz et al. 2009 and references therein). The dust in the Saharan boundary layer is then exported out over neighbouring cooler boundary layers in the Saharan Air Layer (e.g. Cuesta et al 2009, as you say "the Saharan Air Layer is confined to 5 to 6 km altitude"). Since it does not account for dry convection, Figure 3 only shows air ascending to these heights after it has travelled westwards away from the African continent.

Indeed, Figure 3a shows air originating from 700 hPa over West Africa and ascending to 5-6 km (~500 hPa) only after it has travelled westwards over the Atlantic and northwards toward the Atlantic and Mediterranean coasts of North Africa. We recognize that had trajectories been started at all heights in the Saharan Atmospheric Boundary Layer (SABL), transport at ~500 hPa would have been evident immediately in the African trajectories. [Dust reaching ~500 hPa is shown in many, if not most CALIPSO transects of summer time Saharan dust plumes that we examined.] As you point out below, we state briefly in section 4.3, that "While the mixed boundary-layer depth above the hotter African continent routinely reaches 5 km, the melting level and the tropopause altitude above this low-latitude desert are correspondingly higher than in Asia." We have added these points to the discussion of Figure 3 (Section 2.2), which up to now was used only to make the point that "if African dust ascends to the ***upper troposphere*** *(Figure 3a), this occurs near deep convective systems over or near the Atlantic, while dust from the Taklimakan desert (in the Tarim basin) seems at least partly influenced by the local topography." [Additionally, Figure 3 was used to illustrate regional transport pattern differences between Africa and Asia, as stated.]*

Other deserts also have deep dry convective boundary layers. Therefore, for this study it would be more realistic to start the trajectories from all heights between the surface and the expected top of the boundary layer (as done and discussed in Knippertz et al. 2009), rather than simply from 770 hPa. (or 700 hPa on line 7 page 4052?).

We will comment on starting trajectories at different heights further down. We fixed 700 to 770 on line 7 (p 4052) as well as in the caption of Figure 13. All non-case study trajectories were started from 770 hPa, while only the two case studies (performed earlier) were started from 700 hPa.

Boundary-layer top is a parameter analyzed by the ECMWF routinely and could be used in this study (although we have not evaluated these values for the Sahara). Care must be taken to account for the strong diurnal cycle in the boundary layer over deserts that creates differential advection during the night and deep vertical mixing during the day (see Knippertz et al. 2009 for a discussion of this matter).

Knippertz et al. [2009] discuss the limited use of 2-day backward trajectory calculations in pin-pointing the exact dust source regions for three observation-based case studies in light of the complex and vigorous sub-grid scale mixing processes over the Sahara, wherein a lower convective boundary layer erodes a higher residual layer during the day (the two taken together comprise the complete Saharan boundary layer). We reiterate that our study is not based on particular transport events, but rather on trajectories launched from the same locations year-round at 00Z, 06Z, 12Z and 18Z, with the goal of highlighting different large-scale three-dimensional dispersion patterns from African and Asian source regions. Furthermore, we chose the rather low starting point of 770 mb to ensure that our trajectories, although statistical in nature, remained safely within the atmospheric boundary layer throughout the diurnal cycle. [While this is certain over the Sahara, it may sometimes be arguable over Asian deserts, where 770 hPa corresponds to an altitude of ~ 1-1.5 km above the surface; nonetheless, we settled on 770 hPa in order to avoid too many trajectories "crashing into the ground" over Asia.] Finally, the lower boundary layer is more likely to contain dust during peak dust emission seasons, better justifying our assumption that long-range transport of dust indeed occurs in our trajectories. Nevertheless, we agree with the Authors that an analysis of trajectories launched from higher altitudes in the boundary layer would be interesting to examine. These trajectory calculations were not performed because, as the Authors point out, defining the top of the boundary layer requires much care. In particular, although boundary layer height is a parameter routinely analyzed by ECMWF, its accuracy is not at all straight forward to evaluate at this time given the notorious lack of observations in the remote (and vast!) dust source regions of the world. Having considered these challenges and uncertainties, we chose to limit the scope of our study at this stage to more reliably dusty lower regions of the boundary layer.

If this is not done, we recommend that this limitation of the method should be stated in Section 3.2, the conclusions and the abstract. Currently this limitation is only referred to briefly in section 4.3,
"While the mixed boundary-layer depth above the hotter African continent routinely reaches 5 km, the melting level and the tropopause altitude above this low-latitude desert are correspondingly higher than in Asia."
"Our analysis may underestimate both the ascent of bare mineral dust by clear-air turbulent processes and the ascent of cloud-processed mineral dust via convective systems."

We recognize that our focus on the upper troposphere (> 7 km, <300 hPa) stems from the original goal of our study having been to assess the possible interaction of dust with upper tropospheric ice clouds. Having expanded our work to mixed-phase and water clouds, we acknowledge that a more complete picture of transport and condensation would emerge if trajectories were also started at the top and perhaps even in the middle of the boundary layer. We have acknowledged this limitation in section 3.2, the conclusions and the abstract.

The role of dry convection in the vertical transport of dust in arid regions also means that very limited conclusions can be drawn from Figure 2, which shows zonally and annually averaged potential temperatures. The longitudinal, seasonal and diurnal variations in this field are so large that this does not give a realistic picture of dust transport; in the tropics the vertical gradient in potential temperature is sufficiently small that in some regions (eg the Sahara where the atmosphere is often dry adiabatic to almost 6 km), as discussed, dry convection routinely results in significant vertical transport of dust over the source regions and their surrounds.

We revised the discussion of Figure 2 in Section 2.2 to caution against over-interpreting the figure with respect to realistic dust transport in light of the limitations discussed above. We believe the figure is nonetheless valuable in highlighting tropical vs. mid-latitude synoptic uplift *features, which, as you point out, are the only transport feature faithfully represented by 3-D ECMWF wind field-based trajectories used in our study.*

Given the more mid-latitude and less tropical locations of the Asian dust sources compared with the African sources it is unsurprising that the ECMWF trajectories show greater vertical transport for the Asian sources. Only synoptic scale ascent will be captured by the trajectories and this is comparatively more important in the mid-latitudes compared with the tropics, where convection is expected to play a larger role.

We have clarified this point in our discussion of limitations with respect to deep tropical convection in Section 3.2.