

Review of “Snow-darkening versus direct radiative effects of mineral dust aerosol on the Indian summer monsoon onset: role of dust source temperature changes” by Shi et al.

In previous version of manuscript, the authors emphasized the role of the Tibetan Plateau in dust aerosol effects on Indian summer monsoon (ISM) onset, which is inconsistent with the findings of previous studies. The authors provided exactly new explanations in the revised manuscript, and the role of dust source temperature changes is emphasized. However, the revised manuscript is still not convincing enough to published on Atmospheric Chemistry and Physics. Please see the details in the major comments.

Major comments:

A new concept “dust source temperature” was proposed in the revised manuscript, but its meaning is not clear. I guess it means the surface temperature change in dust source regions. Please provide detailed explanations and make it clear in the manuscript.

The dust SDE could induce a warming in both TP and Central Asia, while the warming due to BC SDE is constrained over TP regions. Such difference in warming distributions could produce different ISM responses, as proposed by the authors. However, both the snow fraction (Figure 2a) and surface radiative forcing (Figure 9e) due to dust SDE is small and insignificant over central Asia, which could not explain the warming there. Thus, the response of ISM to dust SDE could not be simply attributed to the warming in dust source regions. The authors should provide solid evidences to show that dust SDE could induce a significant warming over Central Asia.

Moreover, in observation, strong ISM is found associated with the surface warming in Central Asia (Wang et al. 2000, their Figure 7b), which also does not support the conclusions of the manuscript. It is noticed that BC DRE also produces a warming in both Central Asia and TP (Figure S2a), but the ISM (Figure S2c) response is quite different. All evidences suggest that the weakening of ISM induced by dust SDE could not be simply explained by the warming in dust source regions. The authors should provide convincing explanations and supportive references to prove that a warming in Central Asia and western TP can weaken ISM.

For dust DRE, the authors emphasize the role of surface warming in Arabian Peninsula, which is also difficult to understand. The absorbing aerosols (BC and dust) always reduce the solar flux to surface, cool the surface, but warm troposphere (Vinoj et al., 2014). The net surface radiative effect is very small over Arabian Peninsula (Figure 10f), which could not explain the surface warming there. The authors should provide detailed explanations why dust DRE could induce significantly warming Arabian Peninsula at surface.

The authors said what they found in dust DRE effects also gains strong support from previous researches (Vinoj et al., 2014; Jin et al., 2014; Solomon et al., 2015). Although

previous studies show that dust DRE could intensify ISM, the mechanism is totally different. According to previous studies, the dust DRE could intensify ISM through heating the atmosphere, other than inducing a warming at surface. The authors should carefully check the model results, and make a comparison with previous studies.

The authors proposed that, due to the dust DRE, branch of Indian monsoon westerly over Arabian Sea becomes strong and intensifies the water vapor transport from ocean, which is not true. The stronger westerly is constrained over the coastal regions of Arabian Peninsula (Figure 6b), which may not intensify the water vapor transport to Indian. In summary, how dust DRE intensify ISM is still not clear and needed further analysis.

Overall, the main conclusions of this manuscript are still unclear and inconsistent with previous studies. Thus, the manuscript needs further revisions and resubmitted.

Other comments:

Line 34: Duplicated periods.

References:

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