

Interactive comment on “Direct radiative effects of dust aerosols emitted from the Tibetan Plateau on the East Asian summer monsoon – a regional climate model simulation” by Hui Sun et al.

Anonymous Referee #1

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This is an interesting study which investigates the direct radiative effects of dust aerosols emitted from the Tibetan Plateau on the East Asian summer monsoon with a regional aerosol-climate model. In general, it is well written and structured and there are original model results presented and discussed. However there are a number of major comments that have to be taken into consideration before acceptance of the manuscript for publication.

Comments 1) Please discuss briefly what is the added value of using a regional climate model instead of global climate model to study the impact of aerosols on climate. 2) In the discussion section the authors should also comment on the limitations of using a regional climate model to study the impact of aerosols on climate. For example, could

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the authors comment if an RCM which is actually forced by lateral boundary conditions of a GCM or reanalysis can be able to provide the adequate spatial coverage for the development of atmospheric circulation feedbacks over a limited area. 3) An issue that it is not discussed at all is if the aerosol induced signal on the meteorological fields is higher than the model's internal variability. Did the authors carried out some sensitivity experiments to investigate this important issue? I think at least a few comments on this issue are necessary. This is also a part of the limitations in these simulations. 4) Page 3, lines 4-7: There are a number of other recent published studies that have looked the effect of aerosols on climate using RegCM e.g. Das et al., Clim. Dyn., 2015 and Das et al., TAC, 2016 for Asia, Zanis et al., Clim.Res. 2012 for Europe, Ji et al., Clim. Dyn., 2015 and Komkoua et al., Int. J. Clim., 2017 for Africa. 5) There is a recent study by Tsikerdekis et al., ACP (2017) testing a newly implemented 12-bin approach for RegCM which is also compared with the default RegCM4 4-bin approach used in the RegCM simulations of this work. 6) Please clarify if the RegCM simulations in this work use only dust aerosols or other aerosols as well (such as anthropogenic or marine aerosols). To my understanding the simulations include only dust particles. Hence the comparison of modelled dust AOD with AOD from satellite (MISR) and ground based (AERONET) measurements is not one to one comparison since these observations include all types of aerosols. Mind though that there are available pure dust satellite products from CALIPSO (see e.g. Amiridis et al., ACP, 2013 and Marinou et al., ACP, 2017). 7) The authors mention that in order to eliminate the dust emission in the Tibetan Plateau they replaced the land cover types of these areas with the nearby vegetated types. This change could stop the dust emission but will also change the surface albedo which itself could have an impact on radiation budget, temperature and circulation. In other words if it is like this the results do not show simply the effect of eliminating the emission of dust particles but also the effect of land cover type and albedo change. Please comment on this important issue. 8) The authors mention in Section 3.2 that "the dust aerosol increases and decreases over the TP as the EASM index weakens and enhances, respectively". Please could provide some discussion on the physical explanation for

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this anti-correlation. Also provide some short description for the EASM index used. 9) The authors point in Section 3.4.1 that the effect of TP aerosols on surface temperature are not limited to the areas that the dust aerosols are locally emitted. So the effect on temperature is not solely due to local radiation imbalance from the presence of dust aerosols but also due to aerosol induced circulation changes. Similar results have been pointed for Asia by Das et al., 2015 as well as in earlier studies by Zanis, 2009 and Zanis et al., (2012) for Europe. 10) It would be helpful if the authors could also add in Figure 10 the Geopotential Height anomalies with colors to point spatially the anticyclonic circulation anomaly. 11) The discussion in Section 3.4.3 for the dust particle effect on precipitation in heavy and light dust years needs more elaboration. Maybe the authors could include a figure for precipitation similar to Figure 9 for temperature. 12) The conclusion that Figure 12 shows that the dust aerosols emitted over the TP delay the onset of the EASM is really weak since no uncertainty analysis is implemented and the differences between control and sensitivity experiments are small. I think this statement needs more elaboration and justification. 13) Since the work is focusing on summer monsoon season I think that Figure 2 (a, b, c and d) should also refer to the summer season for consistency reasons, similarly to Figures 2e and 2f.

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