Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-431-RC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling dust sources, transport, and radiative effects at different altitudes over the Tibetan Plateau" *by* Zhiyuan Hu et al.

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Received and published: 29 August 2019

General comments: In this work, the authors conduct a quasi-global WRF-Chem simulation and implement a tracer-tagging method to investigate dust source, intercontinental transport and radiative forcing at the different altitudes over the Tibetan Plateau (TP) for the period of 2010–2015. The main conclusions summarized briefly below are reasonable. (1) The model has a reliable representation of spatial distribution of dust AOD (DOD) at different altitudes compared with the CAIPSO retrievals. (2) The East Asia contributes more dust mass over the northern slope, and the Middle East contributes more dust mass over the southern slope. In the higher altitude (above 6 km) over the TP, the major contributor is Middle East with a value of 60%. (3) The East Asia dust number over the TP is mainly in 2∼8 km, while North African and Middle East dust

number is broader, even reaches to 12 km. (4) For the radiative forcing, dust produces the annual mean SW, LW and NET (SW + LW) radiation forcing is –1.40, 0.13, and –1.27 W/m2 at the TOA, 0.67, –0.26 and 0.41 W/m2 in the atmosphere, and –2.08, 0.39 and –1.69 W/m2 at the surface over the TP, respectively. As stated by the authors in Section 6. This study provides a climatological view about the intercontinental transport characteristics of dust from different source regions over the TP, and these results are important to understand the source contribution of the dust over TP and the dust belt formation over the Northern Hemisphere. Overall, the model, method, and data utilized are suitable for this topic, and the context is basically well organized. However, the scientific importance need be further clarified because the dust number accounts for smaller contribution for total aerosols number compared with sulfate, OM and other aerosols in the column over TP. People might be more interested in to what a degree the mineral dust can affect the in situ and surrounding precipitation, diabatic heating, and cloud.

Specific comments: 1. The references in the text should not be limited in the aerosol community, especially for the climate effect of the TP in terms of dynamical and thermal effects. 2. Abstract. "The East Asian dust trasnports southward and is lifted up to the TP". This statement seems to be misleading because East Asia area defined here, i.e., (25° N – 50° N and 75° E – 150° E) covers a large domain with the TP itself included. According the context, it might mainly be Gobi and Taklamakan. A more specific description is needed. 3. Introduction. "As the highest (about 4000 m) and largest plateau in the world, the Tibetan Plateau (TP)...", the largest plateau is not true. 4. Introduction. The conception of "elevated heat pump" can be traced to some earlier literatures. 5. Caption of Fig. 1. It should be climate mean spatial distribution. 6. Section 4. Evaluation of AOD and DOD simulated by WRF-Chem. "Between 6–9 km and 9–12 km, the modeled DOD are higher than CALIPSO. The reason would be that the CALIPSO nighttime retrievals in cloud-free condition are used, which have higher accuracy than daytime observations (Winker et al., 2009). Besides, the model results are averaged in all day." This explanation for model bias seems to be questionable, is

it possible related to circulation condition? How about the nighttime results for model? Also, it's better to put CALIPSO results in the left panels of Fig. 3. 7. The TP domain plotted in Fig. 4 is too large, with many surrounding plains included such as north Indian subcontinent and north Indo-China Peninsula. 8. Fig. 5. The annual mean horizontal and vertical wind field may neglect the remarkable seasonality of TP and adjacent monsoon regions. Particularly for the ascending at 3-6 km but descending above it in the south fringe of the TP. 9. Section 5.4 Dust radiative forcing over the TP. "the dust LW radiative forcing at TOA is waring with a positive value of 0.5 W/m2". Waring is a typo. 10. Fig. 9. The average altitude of TP is 4 Km, how can get the results at 0-3 Km? 11. Fig. 10 and 12 can be merged in one. 12. Section 6 Conclusions and Discussion. "the dust particle can reach upper-troposphere (above 8 km) and even stratosphere, which can provide a pathway for dust into the upper-troposphere (above 9 km)." This expression is strange and hard to follow. 13. Caption of Fig. 13. "Spatial distribution of seasonal mean. . .". For which season the authors mentioned here.

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