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Interactive comment on "East Asian dust storm in May 2017: observations, modelling and its influence on Asia-Pacific region" *by* Xiao-Xiao Zhang et al.

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We sincerely thank anonymous referee #2 for his/her supportive and thoughtful remarks.

Anonymous Referee #2

Comments

Question 1: Page 2, Line 3, "This dust storm originated from the deserts of Central and East Asia, namely the Mongolian Gobi Desert, Taklimakan Desert, Hexi Corridor, and Alxa Desert (Fig. 1)". Therefore, it is recommended that you mark the Mongolian Gobi

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Desert, Taklimakan Desert, Hexi Corridor, and Alxa Desert position in Figure 1.

Reply: Since Figure 1 includes all of East Asia, marking these locations in the figure would be rather difficult to see. We have instead marked the locations in Figure 2 and have revised the text to include Figure 2 at the end of the sentence "This dust storm originated from the deserts of Central and East Asia, namely the Mongolian Gobi Desert, Taklimakan Desert, Hexi Corridor, and Alxa Desert (Fig. 1 and Fig. 2)" (see Page 2, Line 3).

Question 2: Page 2, Line 15, "Dust aerosols can be transported long distances, even on a global scale". Therefore, I suggest you should explain in detail the path of dust aerosols transport.

Reply: This sentence has been revised as "Dust aerosols can be transported long distances, even on a global scale from Africa to the Americas or from Asia to North America" (Page 2, Line 15-16).

Question 3: Page 5, Line 31, "In this study, we selected the dust emission scheme of Shao et al.". Please explain the difference between this scheme and other programs, and further obtain the advantages of this scheme.

Reply: Due to the lack of cohesive wind erosion data sets, in particular dust flux data sets, none of the dust emission schemes has been rigorously tested and validated (Shao et al., 2011b). The parametrization schemes such as dust emission scheme of Shao et al. (2011b) used in this study was developed following the Shao (2001) and Shao (2004) schemes. This size-resolved dust emission scheme has been rigorously examined and validated with field measurements. The major difference between the Shao et al. (2011b) dust emission scheme and other schemes is that the dust emission formula was based on implicit physical mechanism and adjusted key parameters after field validation. It is not our intent to rank the performance of dust emission schemes. Although most of the dust emission schemes have been tested in a wind tunnel, the advantage of Shao et al. (2011b) is that it has been tested with success in East Asian

arid and semi-arid regions. Notwithstanding, some dust emission schemes other than Shao et al. (2011b) are widely used in global dust studies. For consideration of East Asia dust, we selected Shao's dust emission scheme due to above reasons. In addition, Kang et al. (2011) and Wu and Lin (2014) tested several dust emission schemes in East Asia during a severe dust event, which suggested a similar viewpoint. We've added further explanation in Section 2.2 (see Page 5, Line 21-25). New references have been included in this section as follows:

Kang, J.-Y., Yoon, S.-C., Shao, Y., and Kim S.-W.: Comparison of vertical dust flux by implementing three dust emission schemes in WRF/Chem, Journal of Geophysical Research, 116, D09202, doi:10.1029/2010JD014649, 2011.

Wu, C., and Lin, Z.: Impact of Two Different Dust Emission Schemes on the Simulation of a Severe Dust Storm in East Asia Using the WRF/Chem Model, Climatic and Environmental Research, 19(4), 419-436, doi:10.3878/j.issn.1006-9585.2013.13041, 2014.

Question 4: Page 6, Line 26, "Aeolian dust migrated eastward to the Central China Plain in the lower reaches of the Yellow River and degraded air quality". It is recommended to quantify the extent of the decline in air quality by specific numerical values.

Reply: We've added more details on the impact of dust transport on air quality in Section 3.1. (Page 6, Line 30 to Page 7, Line 4).

Question 5: Page 6, Line 27, "Dense dust clouds continued to move east to southeast China where high PM10 concentrations were observed on the Shandong Peninsula on 5 May, 2017.". Please specify the value of PM10 at this time.

Reply: We have added the requested information (Section 3.1, Page 7, Line 5-6).

Question 6: Page 7, Line 10, you have mentioned the quality assurance confidence, please specify the calculation method of quality assurance confidence.

Reply: The calculation method of quality assurance confidence is according to doc-

uments from the Goddard Space Flight Center, NASA, which used a MODIS-specific compositing method based on product quality assurance metrics to remove low quality pixels. These are level-2 single pixel AOD (550 nm) measurements with a QAC flag of 3 and >0 over land and Sea, respectively. The white color in Figure 5 is for missing values. We have further revised this section (see Page 7, Line 22-23). New references have been included in this section as follows:

Masuoka, E., Roy, D., Wolfe, R., Morisette, J., Sinno, S., Teague, M., Saleous, N., Devadiga, S., Justice, C., and Nickeson, J.: MODIS Land Data Products: Generation, Quality Assurance and Validation. In: Ramachandran B., Justice C., Abrams M. (eds) Land Remote Sensing and Global Environmental Change. Remote Sensing and Digital Image Processing, vol 11, Springer: New York (NY), p509-531, doi:10.1007/978-1-4419-6749-7_22, 2010.

Question 7: Page 8, Line 29, you have mentioned "However, the dust deposition rate over Chinese deserts has been reported to be 70 times larger than over the North Pacific Ocean". Please explain how this result was obtained.

Reply: This information is from Shao (2000). We have included this reference in this section (Section 3.4, Page 9, Line 10).

Question 8: Page 10, Line 17, "In general, long-range transport Asian dust originated from the Gobi Desert or other sources can significantly elevate ambient particulate matter concentration and affect air quality in major cities of China, Mongolia, Korea, Japan, and far beyond.". Please explain how to get this result, if you get it from other articles, please list the documents that you refer to. I think the following two articles will help you: (1) Chen S., J. Huang, J. Li, R. Jia, N. Jiang, L. Kang, X. Ma, and T. Xie, 2017: Comparison of dust emissions, transport, and deposition between the Taklimakan Desert and Gobi Desert from 2007 to 2011. Science China Earth Sciences, doi: 10.1007/s11430-016-9051-0. (2) Uno, I.; Wang, Z.; Chiba, M.; Chun, Y.; Gong, S.; Hara, Y.; Jung, E.; Lee, S.; Liu, M.; Mikami, M.; Music, S.; Nickovic, S.; Satake, S.;

Shao, Y.; Song, Z.; Sugimoto, N.; Tanaka, T.; Westphal, D. Dust model intercomparison (DMIP) study over Asia: Overview. Geophys Res. 2006, 111(D12), 2503-2511, DOI: 10.1029/2005JD006575.

Reply: The result was concluded from an integrated analysis of both Sections 3.3 and 3.4 as well as from previous literature. We have added an explanation and extended the analysis in this section (Section 3.5, Page 10-11). New references have been included in this section as follows:

Uno, I., Wang, Z., Chiba, M., Chun, Y.S., Gong, S.L., Hara, Y., Jung, E., Lee, S.-S., Liu, M., Mikami, M., Music, S., Nickovic, S., Satake, S., Shao, Y., Song, Z., Sugimoto, N., Tanaka, T., Westphal, D.: Dust model intercomparison (DMIP) study over Asia: Overview, Journal of Geophysical Research, 111(D12), 2503-2511, doi:10.1029/2005JD006575, 2006.

Chen, S., Huang, J., Li, J., Jia, R., Jiang, N., Kang, L., Ma, X., and Xie, T.: Comparison of dust emissions, transport, and deposition between the Taklimakan Desert and Gobi Desert from 2007 to 2011, Science China Earth Sciences, 60(7), 1338-1355, doi: 10.1007/s11430-016-9051-0, 2017.

Huang, J., Li, Y., Fu, C., Chen, F., Fu, Q., Dai, A., Shinoda, M., Ma, Z., Guo, W., Li, Z., Zhang, L., Liu, Y., Yu, H., He, Y., Xie, Y., Guan, X., Li, M., Lin, L., Wang, S., Yan, H., and Wang, G.: Dryland climate change: Recent progress and challenges, Reviews of Geophysics, 55, 719-778, doi:10.1002/2016RG000550, 2017.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-205/acp-2018-205-AC2-supplement.pdf

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