

Response to Referee #3: We would like to thank the referee for the careful review and the insightful comments, especially the reference source concerning the dust emission over Horqin desert, which help us to further improve the quality of the manuscript.

Our response follows (*the reviewer's comments are in italics and blue*)

General comments

The authors need to explore published papers on dust sources and dust modeling that cover domain of northeast China, and include related findings – to emphasize the significance of the work presented in this manuscript and the necessity of upgrading dust source information in numerical models in order to reduce dust forecast uncertainties in this area. Few suggestions for such references are listed bellow

Some of the references that recognized dust emission activity in this region are: UNEP, WMO, UNCCD: Global Assessment of Sand and Dust Storms, United Nations Environment Programme, 2016., which includes already discussed: Ginoux, P., Prospero, M.J. Gill, T.E., Hsu, C. and Zhao, M.: Global scale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS Deep Blue aerosol products. Reviews of Geophysics, 50, RG3005, doi: 10.1029/2012RG000388, 2012., and DTF: Integrated Desert Terrain Forecasting for Military Operations, Earth and Ecosystem Sciences, 2013.

Reference about need for updating dust source masks in numerical dust forecast model: Kim, D., M. Chin, H. Bian, Q. Tan, M. E. Brown, T. Zheng, R. You, T. Diehl, P. Ginoux, and T. Kucsera, The effect of the dynamic surface bareness on dust source function, emission, and distribution, J. Geophys. Res., 118, doi: 10.1029/2012JD017907, 2013.

Reference that describe dust model simulation for this region, but with special intervention to include Horquin source: Zhang, DF, et al., Effects of climate changes on dust aerosol over East Asia from RegCM3, Advances in Climate Change Research, Volume 7, Issue 3, pp. 145-153, <https://doi.org/10.1016/j.accre.2016.07.001>

Reply: Thanks for providing the rich reference source concerning the Horin desert dust emission. Discussion about the dust emission over the Horqin desert in the northeast China is supplemented in page 4, line 18-23. “*Horqin desert which is also named as Horqin sandy land is mixed with sparse vegetation, agriculture lands in northeastern China. Though it is recognized as one potential emission source*”

in several dust models but is also considered of far less importance compared to other major ones, e.g., Gobi and Mongolia desert, and Taklamakan desert (Zhang et al., 2003; Ginoux et al., 2012; UNEP. Et al., 2016). Kim et al. (2013) suggested a dynamic vegetation index is essential for representing the seasonal bareness variation that regulates dust emissions over this region. Zhang et al. (2016) predicted a declining trend in dust emission from this sandy land due to the climate change.”

Technical comments:

Page 7, line 21: Rephrase the sentence: “Note that the dust emission model computes hourly emissions per grid cell, which may vary strongly from hour to hour.” to “Note that the dust emission model output data are on every hour per grid cell, and results may vary strongly from hour to hour. Also, dust concentration extremes that last less than one hour, can be missed in model output data. ” explanation (if I have understood well meaning of these data in the manuscript): numerical dust atmospheric model can calculate in time steps much lesser than one hour (depending on spatial resolution and setup of model for physics time steps), but model output data are what matters in presenting forecast and perform model verification. As is understood from the text, this sentence refers to the frequency of model output data.

Reply: Accepted.

Page 17, line 22-23: At the end of paragraph, add the comment with reference (it considers the detection of high latitude sources): These emissions may originate from high-latitude sources, as one discussed in Bullard et al. (2016). (or rephrase it as you wish) Bullard, J. E. et al. High-latitude dust in the Earth system. Rev. Geophys. 54, 447–485, 2016.

Reply: Yes, potential dust source from the high-latitude is now mentioned in page 18, line 27-28 “**Earlier emissions are traced northwards from regions in Siberia or other high-latitude regions as discussed in Bullard et al. (2016) that are still not identified as active source in dust emission models.**”