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Atmospheric Chemistry and Physics
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Interactive comment on "Transport, mixing, and feedback of dust, biomass burning and anthropogenic pollutants in eastern Asia: A case study" *by* Derong Zhou et al.

Anonymous Referee #3

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The study by Zhou et al. reported very interesting events with a vertical mixture of dust, biomass burning and anthropogenic pollutants in eastern Asia (i.e., Nanjing-Shanghai, Yantze-River-Delta region in China). The transport, mixing and feedback to the regional meteorological conditions have been comprehensively discussed with the support of different modelling tools and observational data. This study contributes to the current understanding of the air pollution formation in YRD and highlights the need of comprehensive vertical observations in the polluted city clusters in east China. Since previous studies in this region were mostly based on ground-based measurements, the inclusion of vertical structure analysis provided further insight of the distinct pollution regimes. Thus, I recommend publication of this study after the following issues have

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Discussion paper

been addressed.

P5 L10: How about the chemical initial and boundary conditions? Please specify the configurations.

P5 L10-15: Which dust scheme has been used here? How was the performance compared to observations? I suggest to split the statistics in Table 1 into anthropogenic dominated period and dust dominated period, and a time series of model vs observation would be helpful.

P6 L10-15: Please clarify during the dust event if the 'secondary inorganic compositions NO3-, SO42- and NH4+ did not show an obvious synchronous change (with the increasing concentration of Ca2+)' or 'a synchronous small peak of SO42- . . . could be observed as the dust plume approached'. These two statements sound contradictory. Also, I would suggest the author to mark the 'synchronous' peak of SO42- and Ca2+ in Fig. 2.

P6 L15-20: How was the relative humidity during the studied period? If it is wet chemistry, was it similar 'foggy' conditions like in Xie, Ding et al. (2015) or an aerosol water/haze mediated chemistry as in Cheng, Zheng et al. (2016)? Otherwise, was it more of a heterogenous uptake and oxidation on the dry particles or a new particle formation enhanced by the dust events, e.g., Nie, Ding et al. (2014), which may not be coated-sulfate on dust particles then?

P10 L25: What is the refractive index of dust treated in WRF-Chem simulation?

P11 L5-P12 L5: How frequent does such kind of vertical mixture of dust, anthropogenic pollution and biomass burning occur in YRD? What is the effect of vertical mixed structure? Here the two examples, one demonstrates the effect of elevated polluted aerosols (Anqing) and the other one is for the effect of biomass burning aerosols (Shantou). Will the meteorological feedback effect (per unit of mass) increase when all three pollutants mixed together? Here the authors show that the warming and dimming effects can change the vertical temperature profile at Anqing and Shantou. I am wondering after including the direct radiative forcing of aerosols in the WRF-Chem simulation (EXP_WF) whether the model simulated pollutant fields (e.g., PM2.5, PM2.5-10, inorganic ions, CO, or organic etc.) agreed better with observations than the EXP_WoF case?

P11 L5: Here the authors mainly referred to the previous studies about the effect of the reduced ground surface temperature and heating in the upper air. I would suggest to have more evidences and discussion here or later (P11 L20-30) with the difference of cross-section of averaged pollutant from FF, BB and dust with or without aerosol direct radiative effect as the air temperature change diagnosed by EXP_WF and EXP_WoF in Fig. 13.

P11 L15: It is interesting that the warming peak (red shaded between 800-900 hPa) at Shantou does not co-located with the peaks of PM2.5-10 and BC at around 700 hPa (Fig. 12b). It would be great if the authors could further comment on it.

P11 L20: I agree with the other referee that the author should demonstrate here if it is appropriate to use CO, BC and PM2.5-10 as surrogates of FF, BB and dust, respectively. I would suggest the authors to analyze the difference between the base case EXP1 and the scenario simulations EXP2 (no anthropogenic CO emission in eastern China), EXP3 (no dust emission) and EXP4 (no BB emission from Indochina) and show the contributions to CO, BC and PM2.5-10 in these two cross-sections (in percentage) from the three types of emissions (i.e., anthropogenic CO emission in eastern China, dust emission, BB emission from Indochina).

P19 Fig. 2: The label of x-axis should be ‘Date’ (maybe indicate that ‘hourly’ data are showing here in the figure caption). I suggest to tick the full date range from 3/18 to 3/25 on the x-axis.

P24 Fig. 11: It should be ‘(a)(d)’ in figure caption.

References

Cheng, Y., et al. (2016). "Reactive nitrogen chemistry in aerosol water as a source of sulfate during haze events in China." Science Advances 2(12).

Nie, W., et al. (2014). "Polluted dust promotes new particle formation and growth." Scientific Reports 4: 6634.

Xie, Y., et al. (2015). "Enhanced sulfate formation by nitrogen dioxide: Implications from in situ observations at the SORPES station." Journal of Geophysical Research: Atmospheres 120(24): 12679-12694.

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