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Comment on acp-2022-557

Anonymous Referee #1

Referee comment on "Composited analyses of the chemical and physical characteristics of co-polluted days by ozone and $PM_{2.5}$ over 2013–2020 in the Beijing–Tianjin–Hebei region" by Huibin Dai et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-557-RC1, 2022

In this manuscript the chemical and physical characteristics of O3 (O3SPD), PM2.5 (PM2.5SPD) polluted days and O3 and PM2.5 (O3&PM2.5PD) co-polluted days over BTH are investigated by using the 3-D global chemical transport model (GEOS-Chem). This manuscript is clearly written and well organized, and its conclusions are interesting.

- The simulated PM2.5 components including NO3 - , NH4 +, SO4 2- , BC, and OC are compared against observed PM2.5 concentrations, and the comparison shows that the simulated PM2.5 had a NMB of -26.9%. Even with the adjusted thresholds, percentages of observed polluted days for PM2.5SPD shown in Figure c are lower than for O3SPD and O3&PM2.5PD. Is the underestimation attributable to some missing primary aerosols?
- In the analysis two oxidation indicators (sulfur oxidation ratio and nitrogen oxidation ratio) are used, but not assessed. As observed SO2 and NO2 concentrations are available at CNEMC, model performance for SO2 and NO2 is suggested to be evaluated.
- Figure S5a shows the hourly variations of PBLH (m) averaged in all model-captured O3SPD (blue), PM2.5SPD (yellow), and O3&PM2.5PD (purple). Average PBLH at noon time for O3SPD and O3&PM2.5PD is over 2000m, why are they so high? Figure S5b shows the daily anomaly of PBLH for O3SPD and O3&PM2.5PD at night time exceeds -500m, while at noon time over 1000m. How does PBLH usually change over BTH?
- Figure S6 shows the vertical profile of SO4 2- chemical production. Why is SO4 2- chemical production larger at high levels than at low levels? Is it associated with cloud or high relative humidity? How is SO2 concentration distributed vertically? How to understand the difference between O3SPD and PM2.5SPD?
- It is interesting to see Figure 8a that O3 levels for O3SPD are lower than for O3&PM2.5PD. Does it mean high PM2.5 leads to in crease in O3? Figure 8b also shows BC is well mixed vertically up to ~819h Pa. Is it an average for all selected days?