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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid increase in summer surface ozone over the North China Plain during 2013–2019: a side effect of particulate matters reduction control?" *by* Xiaodan Ma et al.

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This manuscript uses observations (including in situ and remote sensing data) and box model simulations to examine the trend of O3 over North China Plains during 2013-2019 and its impacting factors including emissions, AOD, SSA, temperature and boundary layer height (PBLH). The contribution to O3 formation from each impacting factor is quantified and found that reduction of emissions and aerosol radiative effects are the dominant factors that contribute to O3 increase from 2013 to 2019. Such analysis help understand O3 chemistry over NCP and help develop effective control strategies on reduction of ambient O3. The manuscript is written well and clearly. This

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Discussion paper

reviewer would recommend publication after addressing the following comments.

Specific comments:

1. The assumptions made in box model simulations need to be described more clearly. According to LN161, "This model computes time-dependent chemical evolution of an air parcel initialized with a known composition, assuming no additional emissions, no dilution and no heterogeneous processes", the model only takes initial concentration of chemical species, radiation and temperature and compute evolution of concentrations. It cannot directly quantify "the relative contributions of anthropogenic emissions and aerosol optical and radiative properties to the change in surface O3" stated on LN151. A few assumptions must have been made. How does the model account for different NOx and VOCs emissions, and PBLH?

LN187, Using meteorological data at a 4-hour interval appears too coarse/crude to reproduce diurnal variation of O3. Why not use hourly values?

2. The diurnal variation of O3 depends on the nighttime O3 depletion due to NO titration and dry deposition and daytime O3 formation after rush hour emissions. The box model does not account for dry deposition and additional rush hour emissions, it is a little surprising the box model can still capture the full diurnal variation of O3 in Fig. 7.

3. What is the purpose of sensitivity of jNO2 to different solar zenith angle in Figs. 8 and 9? which should not vary from 2013 to 2019. In another word, solar zenith angle is not a factor for O3 variation from 2013-2019.

LN59, TCNO2 was reported to be increased by 307% in Beijing from 1996-2011, but it decreased from 2013-2019 in Fig. 2. Are they consistent?

LN115 what is "ppb a-1"? ppb/year ?

Fig. 7b needs to be improved, different lines are hard to read.

LN97, " reducing heterogeneous uptake of reactive gases (mainly HO2 and O3), of

which the latter is more important". Box model appears more suitable to investigate such an impact.

Fig. 5g may be misleading. The positive correlation between PBLH and O3 may be simply because on those high PBLH cases, radiation and temperature are much higher, thus O3 formation is stronger. Many papers report that shallower PBL suppresses dispersion of pollutants and leads to higher O3, suggesting a negative correlation between PBLH and O3.

Sensitivity simulations summarized in Table 1 appears to attribute radiation uncertainties to aerosols (AOD and SSA). Cloud may also play critical roles, which might be the reason to explain the poor correlation between radiation and aerosol concentrations in Fig. 6b.

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