

The manuscript titled “Rapid assimilations of O<sub>3</sub> observations – Part 2: tropospheric O<sub>3</sub> changes in the United States and Europe in 2005-2020” assesses the impact of synoptic patterns on O<sub>3</sub> pollution and crop yield in China. This study shows the different trends between surface O<sub>3</sub> and tropospheric O<sub>3</sub> column, and attempt to explore the underlying driver of trends. The article is well organized. It can be accepted after considering the following suggestions.

Major comments:

The manuscript lacks of the description of methods. This makes it hard for reader to follow the section of results and discussion. I suggest to provide a clear picture of the methods. Also, I did not find the citation of Part 1, Zhu et al. (2023) in Atmos Chem Phys, and it seems that it is under review in Geosci Model Dev.

Some key terms should be explained clearly, such as priori simulations and posteriori simulations and how to assimilate surface O<sub>3</sub> and OMI O<sub>3</sub> column. In addition, it is important to clarify the difference between assimilation of surface O<sub>3</sub> and assimilation of OMI O<sub>3</sub> column, and which represents the real O<sub>3</sub> column. Otherwise, readers cannot understand clearly.

I suggest to add an analysis about the uncertainties in simulations of O<sub>3</sub>, observations of OMI O<sub>3</sub> column, assimilations of O<sub>3</sub> column and O<sub>3</sub> trends. It is important to know if the trend of O<sub>3</sub> is statistically significant.

Other comments:

Lines 130-133: Another reason for the inverse relationships between surface O<sub>3</sub> concentrations and local anthropogenic NO<sub>x</sub> emissions is the titration of NO on O<sub>3</sub>. How do you consider the titration effect of NO?

Line 182-185: How do you draw this conclusion since you did not show the trend of local anthropogenic emissions (NO<sub>x</sub> and VOC emissions) for different seasons?

Line 209-211: Why does the posteriori simulations of O<sub>3</sub> column decreased far faster than the OMI observations? If the OMI observations represent a real O<sub>3</sub> column trend, this results exactly suggest that the posteriori simulations of O<sub>3</sub> column overestimates the decrease in O<sub>3</sub> column. The trends of posteriori simulations of O<sub>3</sub> column here (-0.16 DU yr<sup>-1</sup>) differs from that in Section 2.4 (-0.29 DU yr<sup>-1</sup>). Please explains these differences.

Line 26-30: Here you show distinct O3 column trends derived from two methods. You need to clarify which is the real trend, and what we learn from the comparison of two distinct trends.