The manuscript titled “Rapid assimilations of O3 observations – Part 2: tropospheric O3 changes in the United States and Europe in 2005-2020” assesses the impact of synoptic patterns on O3 pollution and crop yield in China. This study shows the different trends between surface O3 and tropospheric O3 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 O3 and OMI O3 column. In addition, it is important to clarify the difference between assimilation of surface O3 and assimilation of OMI O3 column, and which represents the real O3 column. Otherwise, readers cannot understand clearly.

I suggest to add an analysis about the uncertainties in simulations of O3, observations of OMI O3 column, assimilations of O3 column and O3 trends. It is important to know if the trend of O3 is statistically significant.

Other comments:

Lines 130-133: Another reason for the inverse relationships between surface O3 concentrations and local anthropogenic NOx emissions is the titration of NO on O3. 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 (NOx and VOC emissions) for different seasons?

Line 209-211: Why does the posteriori simulations of O3 column decreased far faster than the OMI observations? If the OMI observations represent a real O3 column trend, this results exactly suggest that the posteriori simulations of O3 column overestimates the decrease in O3 column. The trends of posteriori simulations of O3 column here (-0.16 DU yr\(^{-1}\)) differs from that in Section 2.4 (-0.29 DU yr\(^{-1}\)). 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.