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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of stratospheric ozone recovery on tropospheric chemistry and air quality" *by* H. Zhang et al.

Anonymous Referee #2

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This manuscript provides an interesting study on investigating the effects of stratospheric ozone recovery on tropospheric key chemicals by using a chemical transport model (GEOS-Chem). The topic is applicable for Atmospheric Chemistry and Physics. Authors study the troposphere ozone and OH changes based on the modification to radiation transfer. Basically, the method sounds and result is well stated. It is potentially an important work. Although there is no major problems, I would suggest some more comprehensive examinations that would significantly improve the value of this article and provide more substantial results to the science community. Suggestions for addressing certain details necessary for the revised manuscript are listed below.

1. Climate change would be an important factor for stratospheric ozone recovery. If the stratospheric ozone recovered, there are definitely corresponding changes in environ-

mental (climate and emission) conditions. Therefore, without considering it, the results would be less persuasive and contain more uncertainties. For example, (1) Climate change would sensitively affect the cloud coverage, which further affect the radiation transfer. (2) Climate change resulted temperature profile would affect the stratosphere and troposphere ozone chemistry. etc. A conclusion based on certain climate change scenarios or estimated uncertainty in climate change would show more meaningful results.

2. Radiation distribution change resulted change in water vapor profile (so is the climate change) directly affect the concentrations of OH in the atmosphere. How does it affect the result?

3. In page 21430, more clear expression on the method is needed. In the sensitivity run, the stratospheric ozone is assumed to recover to 1980 levels. Is it a modification to initial value ? or hold it as a constant field? If using the Linoz stratospheric ozone package, how the current emissions and environment (climate) adjust the 1980 stratospheric ozone field with time in simulations?

4. Surface ozone is sensitive to changes in VOC concentrations too. How the radiation change affect the photosynthesis rate and further affect the biogenic VOC emissions? Does it will affect the conclusion that the largest changes in surface ozone appear to be over the oceans?

5. A comprehensive study on the ozone transport from stratosphere to troposphere is valuable to enhance this study. Previous studies [Barré et al., 2012; Hsu et al., 2005] have shown that this stratosphere-troposphere ozone exchange is frequent, which would be significant for the tropospheric ozone change after the stratosphere ozone recovery. A simple method [e.g. Hsu et al., 2005] would be enough to examine this issue.

Articles suggested to use:

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Barré, J., Peuch, V.-H., Attié, J.-L., El Amraoui, L., Lahoz, W. A., Josse, B., Claeyman, M., and Nédélec, P.: Stratosphere-troposphere ozone exchange from high resolution MLS ozone analyses, Atmos. Chem. Phys. Discuss., 11, 33419-33463, doi:10.5194/acpd-11-33419-2011, 2011.

Hsu, J., M. J. Prather, and O. Wild (2005), Diagnosing the stratosphere-to-troposphere flux of ozone in a chemistry transport model, J. Geophys. Res., 110, D19305, doi:10.1029/2005JD006045.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21427, 2013.