Comment on acp-2020-1297
Anonymous Referee #2

Referee comment on "An Arctic Ozone Hole in 2020 If Not For the Montreal Protocol" by Catherine Wilka et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1297-RC2, 2021

ACP-2020_1297

Comment on ‘An Arctic Ozone Hole in 2020 If Not For the Montreal Protocol’, by Wilka et al.

The paper by Wilka et al. examines the significant Arctic ozone depletion that occurred during spring 2020 using the Specified Dynamics version of WACCM and observations from various satellite and ground based platforms. The study compares a simulation forced with observed “real world” boundary conditions of the major ozone depleting substances (ODS), with that forced with a “world avoided” scenario in which ODSs increase 3.5%/year after 1985. The paper demonstrates that under the extreme meteorological conditions of spring 2020, significantly greater Arctic ozone depletion would have occurred were it not for the Montreal Protocol. The paper also performs several sensitivity simulations to assess the model denitrification compared with MLS data, and refines the assumptions of the model NAT aerosol density.

This is a well written paper that presents some important results concerning the stratospheric ozone impacts as a result of the Montreal Protocol. It follows other recent “world avoided” studies, focusing on the very cold Arctic conditions during spring 2020. I found the analysis to be mostly clear and the figures well presented. I have only a few minor comments and a suggestion (listed below) which should be mostly straightforward to address, but otherwise recommend publication of the manuscript.

Comments/corrections:

1) Figure 2a: This is a nice figure, but please try to enlarge the map in the lower left corner, or at least make the lettering significantly larger. The location names are unreadable as is (at least in the version I have).
2) L91-92: "... assumes a 3.5% per year increase ..." – Please provide a little more explanation on how this increase was determined.

3) L162: "Although temperature histories can also be important ...." – "temperature histories" should be briefly defined/explained. I assume the authors are referring to how much the back trajectories of parcels encounter (or not) temperatures cold enough for PSC formation and ozone loss.

4) L167: should read: "... the Microwave Limb Sounder (MLS) instrument onboard the Aura satellite ...”

5) L175: “Figure 3 shows the progression of six increasingly denitrified ....” – only four model panels (a-d) are shown (not six). This is also referred to on L181-182.

6) L188: “daily minimum” – separate into two words.

7) L298, citation should read: “Langematz, U. and M., Tully (Lead Authors), Calvo, N., Dameris, M., .....”

8) Given that the WA vs. RW ozone difference in spring 2020 is especially large (e.g., Fig. 4 shows ~100DU difference persisting into late April 2020), and larger than the 2010-2020 SH spring (late Oct - Dec in Fig. S4), it would be useful to show the WA vs. RW UV index, or at least the ratio in surface UV flux (WA/RW) vs. wavelength for the Arctic late spring or early summer 2020 (e.g., 70N - 90N avg).

The change in surface UV was shown in the previous WA studies (e.g., Newman et al., 2009, Garcia et al., 2012) as an important end result of ozone depletion. The authors briefly mention this point in the Conclusions, but showing a figure and briefly quantifying the resulting change in surface UV in the Arctic late spring/summer would be useful to include in the present paper. However, I’ll leave it to the authors whether or not to pursue this depending on the logistical and time constraints involved (e.g., re-running the model to get the needed output, etc.).