Response to the Reviewer #1

This manuscript provides a very nice and well-written presentation of a valuable data set of marine boundary layer ozone and CO observations, spanning the full latitudinal range of the North and South Pacific Oceans. As demonstrated in the paper, the data are valuable for understanding pollutant outflow from Asia and ozone destruction in the tropics. The data are also very useful for global atmospheric chemistry model evaluation. I recommend that the paper be published after a minor revision, as described below.

We appreciate the reviewer's careful reading and positive comments on our manuscript. Detailed point-by-point responses are given below.

1) P1, line 21 Here the authors use the term "chemical transport models" as a general term to refer to all types of models that quantify atmospheric chemistry processes. As explained in the recent TOAR paper by Young et al. [2018], the general term should be "global atmospheric chemistry models".

The term "chemical transport models" is replaced with "global atmospheric chemistry models" to generally cover all types of model frameworks.

2) P5, line 9 Here it says that the TCR-2 chemical reanalysis relies on assimilation of TES ozone values. TES provided relatively dense global coverage from 2004 to 2010, but after 2010 the instrument slowly lost power and its observational range was steadily reduced from global coverage to just a few urban areas. How did this reduction in coverage affect the TCR-2 ozone values?

The following sentences will be added to clarify this point (page 5, lines 21-25):
"Because the number of assimilated TES O_3 retrievals decreased substantially after 2010, the data assimilation performance became worse after 2010 in the previous version TCR-1 (Miyazaki et al., 2015), and it can be expected that TCR-2 has similar increases in O_3 analysis errors after 2010. Nevertheless, the multi-constituent data assimilation framework provides comprehensive constraints on the chemical system and entire tropospheric O_3 profiles through corrections made to precursors' emissions and stratospheric concentrations, as demonstrated by Miyazaki et al. (2015, 2019). "

3) When reviewing previous studies of ocean surveys, the following paper should be referenced. This early study reported increasing ozone across the Atlantic Ocean, using ship-borne observations: Lelieveld, J., Van Aardenne, J., Fischer, H., De Reus, M., Williams, J. and Winkler, P., 2004. Increasing ozone over the Atlantic Ocean. Science, 304(5676), pp.1483-1487.

In the revised manuscript, we will cite the paper as "a large collection from multiple cruises (e.g., Lelieveld

et al., 2004)" (page 2, line 31)

4) In addition to the TOAR paper by Schultz et al. [2017], reference should also be made to Gaudel et al. [2018], as this is the TOAR paper that describes ozone observations at remote locations in order to understand the trends of ozone that are important for climate studies.
Gaudel, A., et al. (2018), Tropospheric Ozone Assessment Report: Present day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation. Elem Sci Anth, 6(1), p.39. DOI: http://doi.org/10.1525/elementa.291

We will mention Gaudel et al. (2018), together with Schultz et al. (2017), in the revised manuscript (page 2, line 22).

5) P2, line 11 The radiative forcing of ozone needs to be stated with its uncertainty: 0.4+/- 0.2 W m−2

We will include the uncertainty range as suggested (page 2, line 13).

6) Figure 1 It's difficult to see the magenta dots that indicate the TOAR observations. Please make the dots a little larger. Also panel (a) is presented below panel (b). This is confusing and the order should be reversed.

The size of the magenta dots is increased. Panel (a) will be put on top in the revised manuscript.

7) Figure 2 The color scale runs from 0 to 600 which leaves most data points in the blue range of colors. This provides very little contrast and makes it difficult to see concentration gradients. Please try lowering the maximum value on the color scale from 600 to 400 or 300. This should provide greater contrast.

After revision, the scale will be from 40 to 340 ppbv for CO mixing ratio to have better contrast.

8) Figure 3 It's difficult to distinguish between the red and magenta trajectories. Please try using different colors.

The red thin lines in Figure 3 will be dark-red, thicker lines in the revised manuscript.

9) Throughout the paper there are many instances in which an ozone or CO mixing ratio is described as a concentration. Technically, this is not correct as a concentration has units of mass/volume. To be consistent with SI metrology, any value in units of ppbv needs to be described as a mixing ratio. Furthermore, ppb needs to be listed as ppbv.

As suggested, "mixing ratio" and ppbv are used, in the revised manuscript.

Finally, we added a co-author Takashi Sekiya, who contributed significantly to development of data assimilation system and TCR-2.

We thank the reviewer again for the productive comments.

References

Gaudel, A., Cooper, O. R., Ancellet, G., Barret, B., Boynard, A., Burrows, J. P., Clerbaux, C., Coheur, P.-F., Cuesta, J., Cuevas, E., Doniki, S., Dufour, G., Ebojie, F., Foret, G., Garcia, O., Granados-Muñoz, M. J., Hannigan, J. W., Hase, F., Hassler, B., Huang, G., Hurtmans, D., Jaffe, D., Jones, N., Kalabokas, P., Kerridge, B., Kulawik, S., Latter, B., Leblanc, T., Le Flochmoën, E., Lin, W., Liu, J., Liu, X., Mahieu, E., McClure-Begley, A., Neu, J. L., Osman, M., Palm, M., Petetin, H., Petropavlovskikh, I., Querel, R., Rahpoe, N., Rozanov, A., Shultz, M. G., Schwab, J., Siddans, R., Smale, D., Steinbacher, M., Tanimoto, H., Tarasick, D. W., Thouret, V., Thompson, A. M., Trickl, T., Weatherhead, E., Wespes, C., Worden, H. M., Vigouroux, C., Xu, X., Zeng, G., and Ziemke, J.: Tropospheric Ozone Assessment Report: Present day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation. Elem Sci Anth, 6(1), p.39. DOI: http://doi.org/10.1525/elementa.291, 2018.

Lelieveld, J., Van Aardenne, J., Fischer, H., De Reus, M., Williams, J. and Winkler, P., 2004. Increasing ozone over the Atlantic Ocean. Science, 304(5676), 1483-1487.