

## Anonymous Referee #2

This manuscript by Wenfu Tang et al presented a comparison of the latest MOPITT CO V8 retrievals with aircraft measurements from DISCOVER-AQ, SEAC4RS, ARIAs, A-FORCE, and KORUS-AQ campaigns conducted over the US or East Asia. In addition, the sensitivities of validation results to assumptions and data filters applied during the comparisons of MOPITT retrievals and in-situ profiles were also performed and analyzed. The comparison between the MOPITT CO product with various version and the coincident observations has been previously performed by many scientists in many groups around the world. This study is an extension of previous study and the strategy for comparison has been used extensively in previous MOPITT evaluation and validation studies. However, this study is one of few studies that focus on comparison over around urban regions, this is interesting. Overall, this paper is well written and fits well within the scope of AMT. I recommend for publication though I rate the novelty of this paper as moderate. Since referee # 1 has listed numerous technical comments which are mostly overlapped with my comments. Here I don't present the repeated correction request.

Response: Thank you for your time and effort in reviewing our manuscript. We have addressed the comments accordingly. Please see below for details.

Extra minor revisions or comments are:

1. The Base map and color bar in Fig. 1 can be improved. It is hard to distinguish one from another. In latitude and longitude axis, the number like 30 should be 30°.

Response: We have changed colormap, color scale, and increased marker size. We also added the symbol for degree (°) in the latitude and longitude. See the updated Figure 1 in the manuscript for details.

2. What does the dashed line in Figs. 4 and 5 mean? The one to one line should be stated in the caption.

Response: The dashed lines are one-to-one ratio lines. We added this information in the captions of Figures 4 and 5.

3. If you only compare the results at surface, 800 hPa, and 600 hPa. Then the expression should be the concentrations at surface, 800 hPa, and 600 hPa rather than the profiles at surface, 800 hPa, and 600 hPa.

Response: As described in the Section 2.3, we did compare the 10-level MOPITT profiles to 10-level in-situ profiles. Due to the lack of observations above 600 hPa, we only showed and discussed the results of comparisons below 600 hPa. The surface layer, 800-hPa layer, and the 600-hPa layer are selected to represent different conditions of the profiles below 600 hPa. Please also see the response to the comment # S20 from the reviewer 1. Nevertheless, we thank the reviewer for bringing this up, and changed the term “profile” to “concentration”/“value” when discussing a single layer. For example, we changed “*the overall agreements between values of MOPITT and in-situ profiles at the 800-hPa layer*” to “*the overall agreements between MOPITT and in-situ profiles at the 800-hPa layer*” in the section 4.1 to emphasize this statement is only for one layer.

4. Another confusing thing is that the MOPITT could have a very low DOFS at a given level with a limited range (Fig. 3). Thus, the retrieval should come more from a priori information rather than

the measurement. In other words, I guess, the good agreement between the MOPITT and aircraft at a given level is largely attributed to the a priori information and the smoothing effect in equation 2.

Response: The MOPITT V8N product does have a lower degree of freedom for signal compared to the MOPITT V8T and V8J products. Note that this manuscript mainly focuses on the V8T and V8J products (see the reply to the comment S4 of the reviewer 1). It is true that applying MOPITT AK and a priori (the smoothing effect in equation 2) to in-situ profile would reduce the difference between MOPITT profile and the in-situ profiles. However, this is the only correct way to perform such comparison. As stated by the MOPITT Version 8 Product User's Guide (available online at [https://www2.acom.ucar.edu/sites/default/files/mopitt/v8\\_users\\_guide\\_201812.pdf](https://www2.acom.ucar.edu/sites/default/files/mopitt/v8_users_guide_201812.pdf)), because of the dependence of MOPITT on the a priori information, users must transform these comparison datasets using the equation 2, so that the comparison data exhibit the same degree of smoothing and a priori dependence as the MOPITT product. We are aware of the impact of the a priori information in the retrievals. However, as described in Section 3.1, we explicitly removed the a priori information in the validation process following the method described in Deeter et al. (2017). Therefore, the good agreement between the MOPITT and aircraft at a given level is not largely attributed to the a priori information. In fact, the agreement would be much better than it is now if we did not remove the a priori information in the validation process.