

## ***Interactive comment on “A Climate-scale Satellite Record for Carbon Monoxide: The MOPITT Version 7 Product” by Merritt N. Deeter et al.***

### **Anonymous Referee #1**

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This is a nice paper that provides interesting and useful information on the latest version of the widely used, highly regarded, and long (~17-year) record of CO profile measurements from the spaceborne MOPITT instrument. The work is directly aligned with the AMT journal. A few of the points made could be expanded upon as I describe below, and some minor rewordings and clarifications are also suggested herein. Once these are addressed, I'd be very happy to recommend the paper for publication in AMT. The standard of writing and graphics etc. is very good.

The main area where I feel this paper could include more information is a greater analysis and breakdown of the relative contribution of each V6/V7 algorithm/software modification to the changes seen in the results. For example, it would be nice to have some quantification of the degree to which the inclusion of time-varying N<sub>2</sub>O in the retrieval affects the trends shown in figures 10-15. Given the discussion at the end of

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section 2.1, this specific example should be easily answerable (at least approximately) with information the team have on hand. In cases, like this, where the team already have sufficient information to make such assessments (e.g., from some test run during development that only changed one of the factors), I'd encourage them to include them in the discussion. I'm not pushing for additional test runs here (though if they'd be easy enough, I guess there's no harm in doing them).

Also, I feel that, in many cases, the discussion would benefit from inclusion of an estimate of the statistical significance of the correlations found (I think it's the t-test for the correlation coefficient isn't it? Though some cases might need autocorrelation to be factored in).

==== More specific comments

Section 1: I feel just a little more background information on CO would be good. Just a few sentences talking about sources and sinks, the role of CO in air quality, use as a marker of more complex pollutants etc. As it is the introduction leaps fairly rapidly into MOPITT specifics. I recognize this is AMT and not, for example, ACP. However, such information never hurts.

Line 13: Are the air quality forecasts mentioned here operational ones (e.g., EPA? Europe?)? In any case, a citation would be good.

Section 2.3: I felt some of this discussion was a little unclear to those (like me) uninitiated into the details of the MOPITT products. For example, on line 93, you use the term "discarded". Does this mean that such profiles get labeled with one of the diagnostic index values (1-5) that means something like "We didn't attempt a retrieval for this profile", or is the profile simply absent from the record entirely? Now they are "retained", what does that mean exactly? Are they now given a different index value (perhaps that's what's described in the sentences that follow, but it's not clear)? Then, on line 99, how is "clear sky" defined? I presume from the thermal channel radiances, but is it also/instead reflected in or given by the diagnostic index values? It feels odd to

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specifically define index value 6, but not tell us what values 1 to 5 mean (a table would be good here). Fundamentally, something more in the way of a "MOPITT screening rules 101" discussion might be good to fold in here.

Line 107/108: I don't think you need to enumerate (1) and (2) here as you don't refer to them again. Actually, they initially confused me as I was expecting each of (1) and (2) to contain a comparison, rather than the comparison being of (1) and (2).

Line 113: A bit more detail on the minimizing here might be good (though perhaps it's in the papers cited). Not how the minimization was performed specifically, more about how shallow the minimum was? Was there a clear answer or was (as I suspect) there just a rather incremental improvement in some chi-squared like statistic. This kind of goes back to my main point above related to how big a contribution each change made.

Line 120: "the NOAA aircraft profile set". This dataset hasn't been properly introduced yet, so "a NOAA..." (or something a little more verbose) might be a better introduction.

Line 135: Perhaps this more than a minor point, and clearly goes beyond the scope of this paper. If factoring in the "future" calibrations makes a 20% difference, then to me MOPITT needs to spend more time doing the hot calibrations. 20% is a big number! Are the calibration changes monotonic? How confident are you that the current (14 month?) calibration cycle is frequent enough? Do you have any insights into stability on shorter timescales? I recognize the value, particularly for a sustained record of this duration, of changing observation patterns as little as possible, but I come back to 20% being big.

Lines 200-205: I heartily approve of this approach of looking for correlations in differences from a priori rather than in the "raw" measurements. However, this discussion feels like it's in the wrong place. It applies not only to the NOAA comparisons in this section, but to all the comparisons doesn't it? Perhaps move it into the parent section.

Line 200: There is potential confusion for the uninitiated reader in that the term  $x_{sim}$

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does not appear in equation 1. Might be good to clarify.

Lines 243-249: I think this discussion would be clearer if you swapped the order/sense of the second sentence. "However, because of the sparseness of aircraft in-situ measurements at high altitudes (e.g., pressures less than 350 hPa), particularly for the NOAA dataset, statistical comparisons of V6 and V7 upper-tropospheric CO products are less significant than comparisons of results for the lower troposphere. For example, for retrievals of CO at 200 hPa, the sections of the NOAA validation profiles in the upper troposphere and lower stratosphere are heavily based on the CAM-chem climatology (as described in Section 3.1), and validation results will likely be less reliable than for lower levels."

Line 253: I think it would be better to write this specifically along the lines of "Figures 2 and 3 show ...". Otherwise those figures are not introduced anywhere. You mention them in passing on lines 196 and 201, but with a "don't look at the figures now, just bear these points in mind when it's time to do so" message. Without a formal introduction here (line 253), the reader may think that this mention is like those others, rather than an indication that it's time to pay attention to them.

Line 257: I'm not sure "substantially" is justified here. These changes are small compared to the -4.7% to -0.9% improvement you've just told us about. Perhaps soften the tone.

Line 296: Perhaps remind the reader of exactly how long it is, add "(17 years to date)" or something like that.

Lines 329-332: Back to my main point at the top, if you have to hand test runs that quantify the relative contributions of these terms, it would be good to summarize them.

Captions for Figures 3-9: Reword as "As for Figure 2 except ...", that way you get quasi-complete caption that includes description of the dashed lines etc.

Caption for Figure 16: Would be good to define black diamond here in the caption as

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well as in body text.

Caption for Figure 17: Either include definition of black diamond here too, or use the same "As figure Figure 16 except..." construct advocated previously. (Don't see the need to advocate similar for Figures 11-15 as their captions are complete as they are).

Table 2 caption: Infinite loop reference to Table 2 caption. Did you mean Table 1?

Table 3 caption: Presumably should point to Table 1 caption here too?

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