Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-370

Anonymous Referee #1

Referee comment on "The MOPITT Version 9 CO product: sampling enhancements and validation" by Merritt Deeter et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-370-RC1, 2021

In this paper the authors present new changes implemented in the MOPITT V9 algorithm and how the results before and after the changes compare with aircraft measurements. The latest algorithm uses a calibration method that produces more negligible discontinuities and processes more scenes, especially those previously assumed to be too cloudy or polluted. Overall I found the paper to be well written, insightful, and clear. The improved coverage mentioned in Section 4 looks like a very nice result for the community.

I recommend publication with minor revisions. My biggest overall comment is often a sentence or two of additional detail is needed for the rest of the community. Sixteen of the thirty-one references were led by authors on this paper, which to me highlights the immense combined expertise of the authors which those in the rest of the scientific community do not necessarily have.

I wish the authors a safe and happy holiday season.

Specific comments

S1 - P2, L24: Is the top level 100 hPa or 50 hPa? Please clarify. If the retrieval algorithm does not go to the top of the atmosphere, please specify what is used for the top layer up to the TOA.

S2 - P2, L30: To save the reader from looking up other papers, could you provide an extra sentence or two describing the prior? E.g., spatiotemporal resolution and are there inter as well as intra annual trends?

S3 - P2, L38: Does low SNR preclude use of 7A? It would be helpful to mention the cooler failure and other bands not being designed to quantify CO so those new to MOPITT don't wonder why the numbering starts at 5.

S4 - P2, L38: "J" often shows up in figures for the TIR-NIR retrievals, please define here. I think it means "joint" but I am not finding that word in this paper.

S5 - P3, L66: Why March every year? Is this the only time that works for Terra, or is it just arbitrary? It seems like this could cause sampling errors.

S6 - P5, L99-102: I don't fully understand how these 2 sentences relate. Were p and T calculated but not used to update optical depth before?

S7 - P5, L104: From Deeter et al., 2014 it seems these are scalar factors for 5A, 5D, and 7D, correct? If so, could you add the values to this paragraph? Or do these factors get rolled up with R_0 already listed in Table 1?

S8 - P6, L131: Why does the radiative transfer model only use clear-sky conditions? Is it to save on computational expense? While computational power has increased over the past 21-years, I presume the model has also become more complex which precludes just trying to process all soundings and filtering later?

S9 - P7, L174: Marey et al., 2021 (https://amt.copernicus.org/preprints/amt-2021-112/) have also looked into the MOPITT cloud filtering method and recommended reconsideration of processing land scenes with low clouds. For completeness that study should also be referenced, even if the suggestion was unused.

S10 - P8, L208: Consider changing "retrieval error" to just "error" to make it more generic and account for all the various sources of error/noise (e.g., Rodgers, 2000 eq. 3.16). E.g., there is uncertainty on the in-situ measurements.

S11 - P8, Eq2: I prefer to see an explicit generic error term, like in Rodgers and Connor 2003 (Eq. 3 therein) and then a statement afterwards saying the error term is neglected rather than just neglecting the error term from the beginning. Given that the error

actually seems to be the major focus of Section 3, it makes more sense to explicitly include it. As written, Eq. 2 is only correct in the context of the accompanying sentence, not as a stand-alone.

S12 - P9, L230: Is this 50 km from the center, the nearest edge, or the furthest edge of the MOPITT sounding? If the soundings are about 22 km wide this could make a difference.

S13 - P9, L233: I'm trying to understand how this is not circular since the CAM-chem model is also used for the a priori. Have you tried looking only at results for where measurements are available?

S14 - P10, Fig 2: I'd like to see estimates of uncertainty. Maybe error bars for all 6 profiles would be too cluttery, but a representative 1 standard error of the mean region (on TIR V9?) could perhaps be used since standard deviations are too large.

S15 - P10, Fig 2 (and 3 and A1-A3): Should these points be shifted up 50 hPa? For example, if the 900 hPa points really represent the layer average from 900-800 hPa then 850 hPa would be a more appropriate place to put the marker. If the values are just being plotted as representative indices then it does not make sense to show on a log-scale.

S16 - P10, Sec 3.1: Are there any correction factors or attempts to correct for these biases and drifts in the products delivered through Earthportal or ASDC? If not, please comment in the paper on whether you recommend end users should attempt to include their own corrections based on these results or if data can be used as-is. Same comment for Sec 3.3.

S17 - Fig. 4: (Comment) These y-values appear to be in the correct locations. Gridlines could help the reader.

S18 - P19, Data availability: Please include how other datasets can be accessed as well including the various in situ profiles, and CAM-chem model results.

S19 - Tables 2 and throughout: Please explicitly state the range for the levels. Presumably 800hPa is actually 800-700hPa (rather than say 900-800 hPa or 850-750 hPa). If there is not enough space in the column headers a short description and example could be added to the table caption of e.g., Table 2.

Technical comments

T1 - P2, L19: "continuously" – "continually" may be a better word choice

T2 - P4, Fig 1: mean -> daily-mean

T3 - P5, L99: Is MOPFAS an acronym? If so please add it here.

T4 - P6, L133: the MODIS -> the Terra MODIS… (to indicate they are on the same spacecraft)

T5 - P7, L176: MOPITT observed to modeled radiance ratio…

T6 - P11, L292: "below" -> "herein"

T7 - Hyphens used in ranges should be en dashes throughout (presumably will be corrected anyways during copy editing)

Optional

O1 - P8, Section 3: I personally dislike the use of the word "validation" in this context, as it has the connotation of confirming something already presumed to be correct. However, there will almost certainly be a V10 product at some point, which I anticipate will have smaller errors and be more correct. Then V9 will be less-valid, though perhaps not invalid…I personally prefer terms like "comparison" or "intercomparison" (as in Rodgers and Connor, 2003), but can go either way as I realize much of the literature has unfortunately gone down the "validation" route in recent years.

O2 - P10, Fig. 2: The authors may just consider turning on the grid in the plotting tool rather than the dashed vertical line at 0% which I temporarily thought was a profile. X ticks on the upper axis may also enhance clarity.

O3 - P10, Fig 2, 3, 4, A1-A3: More of just a note, but the connected lines are not representative of error profiles because values are bin averages and thus layer averages are not preserved on interpolation (e.g., Delhez 2002, doi: 10.1016/S0893-9659(02)00139-8). I am assuming their purpose is just to guide the eye, which is okay and to me preferred over unconnected dots.