

Atmos. Meas. Tech. Discuss., referee comment RC1  
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## Comment on amt-2022-90

Anonymous Referee #1

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Referee comment on "Differences in MOPITT surface level CO retrievals and trends from Level 2 and Level 3 products in coastal grid boxes" by Ian Ashpole and Aldona Wiacek, Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-90-RC1>, 2022

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### ***23 These L3L L3W differences are clearly linked to retrieval sensitivity differences***

While reading the abstract it was unclear if the authors were taking into consideration the fact that CO emissions over water are negligible and whether that affects the difference between L3L and L3W.

*421 As expected from the previous analysis, the land-water sensitivity contrast is greater when mean VMRs are significantly different than when not.*

It's as if they assume that all land-water contrast is a processing artifact. See line 446

*446 An underlying assumption is that the temporal trend in "true" VMRs should not vary much across a 10 x 10 L3 grid box.*

This was revisited in line 399. It seems as if the authors neglect to account for wind direction. If the prevailing wind is blowing from the ocean inland (e.g. the coast of California) then the CO concentration could be much higher over the land than the water in the same gridbox. Whereas if the wind was blowing out to sea, one would expect far less difference between L3L and L3W. Yet it appears that the authors are not accounting for this.

*110 It cannot be overlooked that working with L3 data thus requires fewer computing resources and less technical proficiency*

Agreed. Furthermore gridded products are accessible by many more tools that users are familiar with such as Panoply.

*177 Validation results are comparable to V8. It is expected that the main conclusions of this paper to hold for V9, since the land-water sensitivity contrast remains and L3 processing method appears to be unchanged.*

Actually, V9 discards far fewer L2 pixels due to cloudiness than V8 which may affect the results. I suggest the authors repeat some experiments with V9 to confirm their assumption. Yes, they are correct that the L2  $\square$  L3 processing method is unchanged.

*193 which at the time of writing, is the most recent data quality summary*

More recent data quality statements are available now. See [https://asdc.larc.nasa.gov/documents/mopitt/mopitt\\_quality\\_statements.html](https://asdc.larc.nasa.gov/documents/mopitt/mopitt_quality_statements.html)

*483 However, the results presented do imply a general tendency for trend*

*484 underestimation in retrievals over water within coastal grid boxes compared to retrievals over land in the*

*485 same grid boxes obtained at the same times, which appears to be linked to differences in retrieval sensitivity.*

This feels like the most important point of the paper. Perhaps more effort to demonstrate and quantify would be helpful.

The discussion in the paragraph starting on line 417 is very important however it would have even more impact if it included the consideration of one more bit of information.

The skill of MOPITT retrievals of CO (VMR) is not random. It is dependent on conditions such as thermal contrast between the surface and the air, which is what the authors are describing when they see discontinuities between L3L and L3W. However another factor is that MOPITT sees CO better when there's a lot of it. The uncertainty (as measured by DFS) decreases when the CO signal is large. So if there's less CO over the ocean due to fewer sources, that will also affect the results of this analysis.

451 – The word “gradient” appears but I’m having trouble understanding its definition here. Is it just the difference between temporal trends of L3L and L3W? Or is it spatial?

Table 1 – It took me several attempts to understand what the “d” column was.

*483 However, the results presented do imply a general tendency for trend*

*484 underestimation in retrievals over water within coastal grid boxes compared to retrievals over land in the*

*485 same grid boxes obtained at the same times, which appears to be linked to differences in retrieval sensitivity.*

This seems like a valid conclusion based on the analysis performed. There are a lot of details about the methodology to arrive at this conclusion that confused me more than served as support for clear statements such as this.

*613 In these instances, L3O would therefore seem to be misclassified.*

This is a valuable insight.

*820 there is enough*

*821 evidence to support the suggestion from Ashpole and Wiacek (2020) that an additional L3 "land-only"*

*822 product, created only from averaging bounded L2 retrievals performed over land – the L3L dataset that has*

*823 been analysed in this paper – would be beneficial to the research community.*

This recommendation will be brought to the attention of the MOPITT science team. It will hopefully be incorporated in the archival processing version.

#### General Comments:

These researchers took a very close look at how the MOPITT L3 product is created and have identified a flaw in the way the MOPITT team processes pixels into coastal grid cells by mixing retrievals of uneven quality. This distorts the values reported for a non-insignificant number of gridcells. Their conclusions appear valid and robust. However, I had a difficult time following the arguments and methodology of the paper. I didn't understand why they were focused on surface level retrievals instead of higher in the atmosphere where MOPITT is considerably more sensitive. I was curious if they would have come to the same conclusion if they looked at MOP03M (monthly mean) products which have far less random noise and greater coverage than the daily L30 products. In several places, the authors were making a clear distinction between two situations and I had trouble understanding the meaning of this distinctions. For example: "For other datasets, whether the marker is filled or not, and whether the lines are solid or dash/dot, depends on the outcome of an independent, 2-tailed t-test assuming unequal variance (aka "Welch's test") against L3L: filled markers and solid lines indicate the mean is significantly different to L3L ( $p < 0.1$ ); open markers and dash/dot lines indicate there is no significant difference to L3L." This distinction was too difficult for me to understand its significance.

I believe the researchers can transform this paper into a valuable analysis by having a more clarified statement of their conclusions and focusing the readers' attention on the evidence that supports that point.