Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2022-90

Anonymous Referee #2

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-RC2, 2022

The manuscript describes a study of MOPITT V8 TIR-NIR surface CO retrievals over 33 coastal cities. Daily L3 data (data gridded to 1^{o}x1^{o}, 111x111 km^2 per pixel) and daily L2 data (22x22km^2 per pixel at nadir) are analyzed. This study's main findings are that statistics of coastal cities obtained from L3 and L2 products differ, that "mixed" L3 pixels (L3 pixels averaging both water and land L2 pixels) are not suitable to study coastal cities, and that a L3 land only product for coastal pixels is needed. In order to demonstrate these points, several comparisons and statistical analyses between land and water L3 TIR-NIR pixels (original and re-created from L2 data) are performed. The manuscript is well written.

Two major issues are described below.

1. Use of TIR-NIR data in land/water comparisons

As described in Deeter et al., 2013, among others, TIR-NIR retrievals over land and over water are fundamentally different, since NIR radiances cannot be used in the latter. The authors acknowledge the fact that retrievals over water are limited to the TIR band due to the lack of NIR signal, but don't acknowledge the implications, which are key. Using the TIR-NIR product for this study is not appropriate, since there are two effects causing land/water differences in the averaging kernels: thermal contrast effects and the lack of NIR radiances in retrievals over water. The two effects cannot be separated.

2. Use of L3 data to study coastal cities

L3 products (either TIR-NIR or TIR) are not suited for the analysis of the coastal cities listed, given the horizontal extent of the targets. A cursory search (please see Table 1 attached) shows that 30 of the 33 cities in Fig. 9 correspond to a very small fraction of a single L3 pixel footprint. Only 3 of the 33 cities are close to covering or barely cover one L3 pixel footprint. Basing such analysis on L2 data could be an adequate choice, at least for some of these cities. About half of the 33 cities would not even fill the footprint of a single L2 retrieval. Only 10 of the 33 cities would fill 4 or more L2 retrieval footprints.

According to the manuscript, "L3 data are better suited to long timeseries analysis than L2 data owing to their smaller size". That statement is wrong. Some tools are easier and more convenient to use than others, but that does not mean that they are better suited for a given task. Analyzing long time series with L3 data may be easier, more convenient. However, easy and convenient generally comes at a cost, in this case the quality of the analysis. The manuscript continues "working with L3 data [...] requires fewer computing resources and less technical proficiency […] L3 products thus make the MOPITT data more easily accessible, especially to less-expert users, who may lack the expertise required to scrutinize the data for potential a priori bias." Again, a tool may be easy/convenient to use but unfit for certain tasks.

Time series are at the center of this work and are the justification provided for using L3 data in the first place. The manuscript, however, does not include a single time series. It's hard to imagine that meaningful information/trends can be identified in L3 time series covering a ~6400 days range (from 25 Aug 2001 to 28 Feb 2019) but having only a few hundreds of even a few tens of days with a L3 value at all (and that L3 value coming in all cases from a single L3 pixel). This is the case for most of the cities analyzed (Fig. 9).

Are those few hundreds of even few tens of L3 data points representative of the 1^{o}x1^{o} areas they stand for? L3 pixels (land, water, or mixed) may be produced by averaging as little as 2 L2 pixels. As an example: more than 25% of the total number of daytime pixels in a randomly selected L3 file resulted from averaging either 2 or 3 L2 measurements. These L3 pixels may not be representative of the 1^{o}x1^{o} area they stand for and, thus, should be filtered out so as not to corrupt the statistical results. It is unclear if such filtering was applied.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2022-90/amt-2022-90-RC2-supplement.pdf