Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-218-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "Full-physics carbon dioxide retrievals from the OCO-2 satellite by only using the 2.06 µm band" *by* Lianghai Wu et al.

Robert Roland Nelson (Referee)

robert.r.nelson@jpl.nasa.gov

Received and published: 23 July 2019

General comments:

The manuscript entitled, "Full-physics carbon dioxide retrievals from the OCO-2 satellite by only using the 2.06 μm band" presents a discussion on a non-traditional method of retrieving the column-averaged dry-air mole fraction of carbon dioxide (XCO2) from OCO-2. The authors extend the simulated work of Butz et al. (2009) to real OCO-2 measurements with the goal of improving the precision and accuracy of OCO-2 measurements and thus it is scientifically relevant, as current XCO2 retrieval biases are likely still too large to satisfy the demands of the carbon flux model community. Additionally, the implication that perhaps only a single-band instrument may be needed

to make high-quality XCO2 measurements from space has significant implications for potential future GHG missions. The manuscript, although brief, is presented well and I recommend publication in AMT after the authors address a few minor and technical issues.

Specific comments:

- Regarding not using a bias correction, you mention wanting to evaluate the "true" retrieval capability but, as you stated, a bias correction is always employed operationally. Did you look at implementing a bias correction for the one-band retrieval and how it impacted the final σ values relative to the three-band retrieval?

- What do the aerosol results (AOD, size parameter, height) look like for the one-band retrieval? Are they similar to the three-band retrieval or does the lack of spectral information at 0.76 and 1.61 um cause the one-band retrieval to behave in interesting ways? In Butz et al. (2009) the size parameter is not retrieved so it would be informative to see the DFS for the three aerosol parameters retrieved in your one-band setup. In the end, it's only the XCO2 that matters but this is an important topic that at least deserves a discussion.

- The only spatial results shown are limited to four fall/winter months in 2014 over EMEA (Fig. 5). However, multiple studies have highlighted temporal patterns in OCO-2 errors (e.g. O'Dell et al., 2018). Did you look at other regions (could you show a global map?) and would it be possible to examine at least one full year of data to ensure that the one-band retrieval has no significant seasonal/regional biases relative to the three-band retrieval? Examining more regions with better coverage could reveal places where the one-band retrieval performs better or worse than the three-band, e.g. snow/ice or tropical forests.

- P3 L33: What percent of soundings are removed by comparing the non-scattering 2.06 um CO2 retrieval to CarbonTracker and filtering the ratio between 0.96 and 1.04? And how were the 0.96 and 1.04 thresholds determined? While this range is several

ppm of XCO2, potentially real signals (e.g. large power plants) might be filtered out.

- P3 L34: Could you include a physical explanation of how pre-filtering on CO2 and H2O ratios derived at 2.08 and 2.05 um works?

- Regarding Fig. 3, do you have a hypothesis as to why the one-band retrieval does poorly over Lauder and Ascension?

Technical comments:

Overall: define acronyms and technical terms before use. E.g. OCO-2, SD, "full-physics", DFS

P1 L3: change to "A-band", and on P5 L7

P1 L6: change to "ground-based"

P1 L9: remove "region"

P1 L10: Last sentence doesn't make sense

P1 L13: change to "Over the past decade"

P2 L8: change to "simpler"

P4 L7: change to "cloud filter"

P5 L17: change to "has a much"

P5 L22: change to "hundreds of thousands"

P5 L25: "and"

Figure 4: third panel, what do the aerosol layers at approximately -10000 meters represent?

Figure 5: I would recommend using a perceptually uniform colormap for plotting XCO2 (like you did for the third panel in this figure) and reducing the range so that differences

are more visible. Please put a label and units on the colorbars as well.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-218, 2019.