

Atmos. Meas. Tech. Discuss., referee comment RC2 https://doi.org/10.5194/amt-2022-106-RC2, 2022 © Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.

## Comment on amt-2022-106

Anonymous Referee #2

Referee comment on "Evaluation of the High Altitude Lidar Observatory (HALO) methane retrievals during the summer 2019 ACT-America campaign" by Rory A. Barton-Grimley et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-106-RC2, 2022

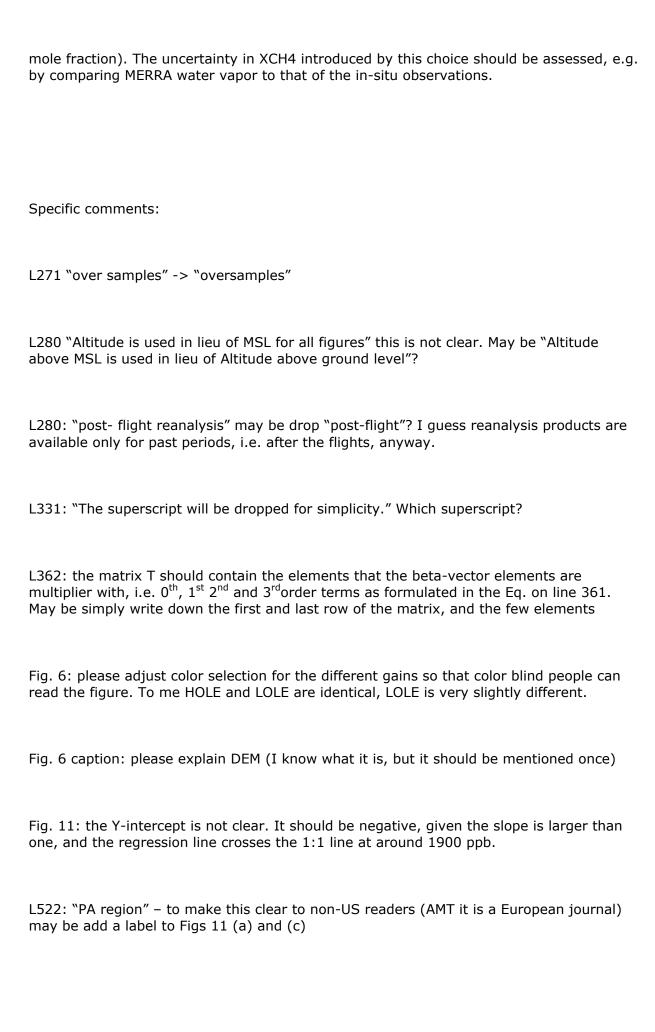
This paper describes the first results from a lidar system deployed onboard a research aircraft measuring atmospheric methane. The paper is well-written, and fits well within the scope of AMT. However, a few issues listed below should be addressed before the paper can be recommended for publication.

## General comments:

Note that the term "mole fraction" is recommended rather than "mixing ratio", see e.g. https://www.empa.ch/web/s503/gaw\_glossary#recommendations. I suggest simply replacing throughout the text. Also I would recommend to consistently use ppb for dry air mole fractions of CH4. Using both ppb and ppm (e.g. Fig. 10 (b) ) is confusing to the reader.

Comparison to in-situ measurements: The deployment of the different aircraft sampling different altitude regimes really has potential, as indicated e.g. by Figs. 12 and 13 and the associated discussion. I suggest a simple combination of the in-situ measurements within the free troposphere from the C-130 aircraft, the boundary layer in-situ measurements from the B200 aircraft, and the estimate of the boundary layer height derived from the HSRL measurements onboard the C-130, to calculate a partial column XCH4 based on in-situ observations that can directly be compared to HALO XCH4. The assumption is that CH4 is well mixed within the PBL and also within the free troposphere. Any advection of air masses with enhanced CH4 above the PBL would clearly stick out as differences between HALO XCH4 and the aircraft derived XCH4.

Dry air mole fraction - impact from H2O: In the in-situ measurement community there is much discussion on drying/conditioning samples before measurement vs. correcting based on simultaneous H2O measurement within the exact same sample. As the authors describe, MERRA humidity is used in the retrieval of XCH4 (the column average dry air



L571: I don't see any cross-hatched area in Fig. 14, may be I am misunderstanding something

L612 "spatial" -> "spatially" or drop

L659: the dial DAOD estimated at SSE shown in the inset of Fig. 17 (b) (magenta symbol) is around 0.2875, not at 0.9243 as given in the text. Please clarify.

L661: "un-bias-corrected" may be use non-bias-corrected

L736 "PBL fluxes" use PBL mole fractions or concentrations