Thank you to RC1 for putting time and effort to read and review our manuscript. The reviews were helpful and insightful and have made the paper stronger. Below are the comments from RC1 and the responses by the authors are in blue.

RC1: 'Comment on egusphere-2023-1420', Anonymous Referee #1

In the manuscript "Performance and sensitivity of column-wise and pixel-wise methane retrieval for imaging spectrometers", Alana K. Ayasse and colleagues investigate the performance of two different types of algorithms for the retrieval of atmospheric concentration columns of CH4 from spectra acquired by imaging spectrometers. As basis, they not only use observations from the Global Airborne Observatory (GAO), which were collected during two controlled release experiments in 2021 and 2022, but also observations from previous field campaigns. While one of the algorithm (pixel-wise) retrieves CH4 columns for every single spatial pixel by iteratively fitting a simulated spectrum to the measured spectrum (IMAP-DOAS), the second algorithm (column-wise) uses statistics from observed spectra in a flight column (along track) to retrieve CH4 column anomalies (column matched filter, CMF).

The two algorithms compared have their distinct advantages and disadvantages, one being independent from other observations within one flight leg but slow (IMAP-DOAS); the other one depending on a sufficient number of additional observations from the same flight leg but fast (CMF). One key finding of the study is the minimum length of a flight leg required for the fast CMF approach to perform equally well as the slower pixel-wise approach IMAP-DOAS. The authors perform extensive tests and comparisons to find well-suited lengths for different flight legs for the CMF approach. For the comparisons, the retrieved CH4 columns/anomalies are additionally inverted to fluxes/emissions and they are also compared to the "true" metered emissions. In principle, those findings can be transferred to other imaging instruments and/or similar retrieval approaches. Overall, the manuscript is well-written and conclusive. The manuscript fits well in the scope of AMT and I recommend publication after some minor modifications along the line of the comments below.

Specific comments:
P2L40: Could you provide already here some references for Carbon Mapper and the Global Airborne Observatory (GAO)? Does GAO only consist of an imaging spectrometer or does it comprise an entire suite dedicated to atmospheric measurements? It is also not entirely clear to me how Carbon Mapper and GAO are connected.

Line 44 has been edited to read. 'Carbon Mapper, a non-profit that provides facility scale methane emission data via remote sensing, participated in both experiments. Carbon Mapper contracted the Global Airborne Observatory (GAO) imaging spectrometer, which has the same design as AVIRIS-NG, to collect the raw radiance data which Carbon Mapper then processed to emission estimates.'

To clarify further, GAO is an airborne platform, The main instrument on it is the imaging spectrometer, it is also equipped with a high-resolution camera and a lidar, however neither of those were used for the research conducted in this paper. Carbon Mapper is a non-profit research

group that has expertise in using imaging spectrometer data to detect and quantify methane plumes. We contract 2 airborne imaging spectrometers that are essentially identical. One is AVIRIS-NG operated by NASA JPL the other is GAO operated by ASU. For these experiments we contracted GAO.

P3L83f: Are there references describing your standard procedures and the assumption you are putting in more detail (Especially for the definitions of unstable plume morphology and unstable wind conditions)?

A section has been added to the supplement section that describes what we looked for when we say unstable wind or plume morphology.

P4L100: The factor of 7: Has this originated from your long term experience with AVIRIS-ng data or is this based on another study?

This is based on our experience.

P6L175: What is the reasoning behind the two different percentiles for the 2021 and 2022 plumes?

Quantifying a concentration background is a core challenge for total column retrieval methods. Continuing work is needed to quantify backgrounds dynamically given a diverse set of observing conditions. We have edited the document to make this more clear. P11L335: However, continuing work is needed to robustly quantify background concentrations over a diverse set of observing conditions.

Fig1: Could you add already in the first Figure that error bars represent 1-sigma uncertainties?

The figure 1 caption has been edited to say the error bars represent 1 sigma uncertainties.

Fig2: I would appreciate a little bit more information for the shown graph (Whisker plot?) in the caption in terms of what is 'meant' by the different circles, dots, bars, and lines like the percentiles.

For figure 2 the caption has been edited to include " The data is displayed as a box plot with the blue box representing the inter quartile range, the gray bar is the median, the dashed lines are the min and max, and the black circles are outliers"

Fig3: Would it be possible to add the fitted line and OLS equation as done for Fig. 1?
Fig4: Same as for Fig. 3. Would it be possible to add fitted lines to left and right panel and the OLS equations?

Fit lines have been added to both figure 3 and 4.

Fig5: Could you add that the retrieval used for Fig. 5 is CMF in the caption? Additionally, I assume the panels are mixed up. See P8L254 and P9L 259. In the right panel, it appears that the IME levels-off for larger values. Would you have an explanation for this or is it not significant at all and just a coincidence?

The figure caption has been edited to include retrieval and the panels listed in the text were indeed mixed up. The leveling off at higher line length is expected and then explanation for this is discussed in P7 L 250-255.

Fig6: What happened to the 1-sigma uncertainties for the metered emissions (x-axis)?

1-sigma uncertainties are added for the x-axis, they are just so small it is hard to see them.

SuppFigS1L26: What is meant by "… both figues...".

This has been edited.

Technical corrections:
P1L11 and L15: Could you add that GAO stands for Global Airborne Observatory?

The acronym has been removed from the abstract and it is defined in the introduction on L47.

P1L23, P2L44, P3L87, P4L96L107L110L124, …: Could you subscript numbers in chemical formulae: CH4 CH4?

We will reformat according to AMT guidelines if accepted for publication.

P4L97-98: There seems to be a formatting issue regarding new line P4L124: Please remove one "optical depths for".

One has been removed.

P9L259, P9L285L287, …: Please capitalize "figure" throughout the manuscript.

Figure has been capitalized throughout the manuscript.

P9L263: "… to require minimum flight…" to "…to required minimum flight…"?

Edited to make better grammatical sense.

SuppP2L33: Typo: Covid CA 202

Changed in text.

SuppFigS1L25: Typo: Duren e al 2019 responses

Changed in text.