Dear Editor,

The authors should be commended for extensive revisions and improvements to this manuscript, having responded to all reviewer comments. I have a few minor comments and suggestions which I trust that the authors can adequately address without need for a further round of review.

Specific comments

Line 2: "UAS-based systems"

- It's not too clear what a UAV-based system is; it is not well-defined. This translates to "uncrewed aircraft systems-based systems". Perhaps this is fine but it is something for the authors to consider.

Line 19: "applied"

- It may be worth stating that a bespoke water correction was both derived as well as applied. This emphasises the additional work of the authors. Otherwise, it may seem like a generic water correction was used.

Line 29: "Overall, our results demonstrate that a cost-effective sensor can provide reliable CH_4 mass emission rate estimates with uncertainties comparable to those of established UAS-based systems."

- This sentence is confusing as it compares a "cost-effective sensor" to a "UAV-based system" which is not the same thing.
- It is not too clear what a "UAS-based system" is, as it has not been defined. Is it a UAV with an integrated methane sensor? Does the "UAS-based system" include the flux quantification methodology?

Line 23: "global warming to below 2 °C"

- Perhaps clarify that this is compared to pre-industrial levels.

Line 66: "altitudes"

- Consider replacing this with "heights" as altitude conventionally refers to the height above mean-sea level.

Line 117: "Water vapour experiments were performed to determine the effect of water vapour on sensor readings."

- I also assume that this water effect test was used to correct raw Axetris measurements. It should probably be stated here that as well as determining the water effect, this water characterisation was used to correct all field sampling data.

Line 140: "critical functions"

- What sort of functions?

Line 164: "optical cavity operating at standard conditions of 40 kPa"

- This is a bit confusing as "standard conditions" is usually defined as 1 bar (or 1 atmosphere). It would be better to state that the LI-7810 uses "a pressure-controlled optical cavity operating at standard pressure of 40 kPa".

Line 164: "V_{eff}"

- What does this mean?

Line 179: "The LI-7810 system linearity was confirmed by extensive laboratory tests (ICOS, 2020)."

- I still think it is important to state here explicitly that the linearity characteristics of a different LI-7810 are assumed to hold here for the LI-7810 used in this work. I appreciate that the authors added some text about generalising in the previous paragraph, but it is important to additionally state this here explicitly for full clarity. From my point of view, there is nothing wrong with this approach, but it should be clear to avoid ambiguity.

Line 187: "CH_{4_Ax}"

- Has this term been defined?

Line 187: "CH_{4_LIC}"

- Has this term been defined?

Line 187: "120"

- Consider including the units here. I appreciate that they are given below, but there is no harm in including them here as well.

Line 221: "In practice, water vapour concentrations were either measured directly or taken from model simulations."

- I am not sure what it means to take water mole fraction from model simulations. I would assume that any water mole fraction needs to be based on some sort of measurement.
- In any case, if the Axetris water correction is based on LI-7810 water mole fraction measurements, it should only be applied in the field using LI-7810 water measurements (which are empirical and have not otherwise been calibrated). Otherwise potential errors in empirical LI-7810 water measurements would not automatically be eliminated.

Line 222: "With this, we assume that the non-dilution part of the water vapour correction remains the same at ambient levels as at high concentrations."

- I am very pleased that the authors have included this statement, which does a great deal to clarify the rationale for the approach. I am not totally convinced that spectroscopic effects remain the same across the methane mole fraction range. I would expect a lot of spectral overlap at 1 650 nm between methane and water. If would be a real added bonus if the authors could provide some justification for this assumption, but it is fine as it is and a major improvement.

Line 236: "more turbulent conditions"

- The conditions on a UAS are turbulent in what way?
- I do not think atmospheric turbulence should effect temperature-controlled Axetris measurements sampling from a controlled reference calibration bag. The poorer precision could be due to UAS vibrations.
- But I think some brief discussion is required here on what turbulence means in this context and why the authors believe it can effect sensor measurements.

Line 258: "show that turbulent conditions"

- Following the previous comment, I do not think this statement can be made unless the authors are absolutely sure of the cause of poorer precision when sampling on-board the UAS. As a minimum, this should be replaced with "show that turbulent conditions may reduce its precision", with addition of the word "may" to indicate that this is a hypothesis. But some brief discussion is really required on what turbulence means here and why it effects the measurements.

Line 312: "The dairy cow farm quantified"

- Strictly speaking, it is emissions from the dairy cow farm and not the farm itself that is quantified in this work.

Line 332: "possible mildly convective"

- I do not see any details on convection in Table 1.

Line 403: "compensation for water vapour dilution"

- Which water mole fraction measurements were used to correct Axetris methane mole fraction measurements? Was the LI-7810 used? If this is the case, then this entire methodology relies on both an Axetris and a LI-7810, which is no longer a cheap solution.
- In a future solution, water mole fraction can perhaps be derived from relative humidity and pressure measurements. However, the derived water correction presented in this work would no longer be valid, as empirical (non-calibrated) LI-7810 water mole fraction have been used to derive the water correction coefficients. The authors may wish to discuss this.

Line 435: "CH_4 mole fraction enhancement"

- It would be nice to remind the reader that this is a dry mole fraction enhancement above a dry background here.
- The laboratory-derived water correction is applied to this data.

Line 442: "Additionally, the ambient H_2O mole fractions were obtained using the LI-7810 analyser."

- Were these same LI-7810 water mole fractions used to derive dry methane mole fractions? Please make this totally clear.
- Water mole fraction is required twice in this methodology. It is used to calculate both dry molar value and dry methane mole fraction. Both parameters require a water mole fraction value in their calculation. Make it clear where both water mole fractions come from (or if the same value is used for both parameters).

Line 485: "We use only the raw signal in subsequent analyses."

- This is not strictly true, as a water correction is also applied to the data. Perhaps "raw" is not the best word here.

Line 654: "uncertainties"

- Replace this with "uncertainty".

Line 699: "drift"

- Is sensor drift evaluated in this analysis? I can see that noise is evaluated, but a drift test doe not seem to be described.

Line 709: "Table 3"

- Is "Everything 0" the best term? The standard scenario is to have a single flight, not zero flights.

Line 717: "flight repeats"

- Perhaps "repeats" is not the best word here. I understand what this means. But a single flight is not a repeat. And six consecutive flights are five repeats of a single flight.
- The same issue arises in Table 3.
- Maybe it is better to count the repeats from zero to five. Then, the previous comment (about "Everything 0") is easier to resolve.
- The same applies to Figure 4a. It may be better to plot it from zero repeats (*i.e.* a single flight) up to five repeats (*i.e.* six consecutive flights).

Line 812: "quantitative assessment of the sensors' performance"

- Consider ending this sentence with "in mass emission flux quantification".

Line 827: "Active AirCore technique"

- It would be good to say here that the AirCore was used in conjunction with a high-precision gas analyser to measure its contents.

Line 835: "sufficiently large"

- Perhaps this should be replaced with "sufficiently intense". The word "large" infers that this refers to the physical size of the source.

Line 838: "since errors in background estimation can account for more than 100% of the total uncertainty for a mass emission rate of 10 kgCH_4/hr"

- Please specify here that this 100% value is specific to simulating the UAS sampling in this particular study. This 100% uncertainty contribution may not apply to a different UAS sampling in a different way downwind of a different source, with a different set of environmental conditions.

Line 1009: "Table A1"

- Please change "UAV" to "UAS". Consider replacing "Licor" with "LI-7810".

Line 1026: “28°”

- Replace this with 28° C.

Line 1051: “Figure D2”

- Please indicate here (either in the figure or the caption) that the water mole fraction measurements come from the LI-7810.