## 3 Response to Community Comments 1 (CC1)

Link to Original Submission: A New Technique for Airborne Measurements to Quantify Methane Emissions Over a Wide Range: Implementation and Validation – Dooley et al. (2024)

**(RC 301)** Line 150: Authors are neglecting the effect of the pitch and roll angles on the wind measurement of Trisonica mini which is not a bad estimation if the copter does not pitch and roll during flight (i.e., maybe only during hovering at a certain altitude). However, in line 211, the flight speed was given as between 2-5 $\mathrm{m/s}$ which I think will force the copter to roll or pitch at about 10-15 $\mathrm{degrees}$.

**(AC 301)** ***L186-199. Figure A1.*** The average pitch and roll of the UAS is on the order of 1-3 $\mathrm{degrees}$ during steady, level flights through the plume (see Figure A1). The pitch and roll increases when the UAS accelerates (e.g., at the ends of each transect) but these samples are filtered out during processing, prior to flux estimation.

**(RC 302)** Considering the placement of the anemometer (~$0.8\,\mathrm{m}$ over the propeller plane), the angular momentum might become non-negligible I think. Therefore, there might be a bias in the wind speed measurements during the flight. I think this should be clarified, if there is a small effect this needs to be shown by the authors. I think checking Donnel et al. (2018) paper might help with this (https://doi.org/10.2514/6.2018-2986).

**(AC 302)** ***L186-199.*** Samples collected during maneuvers causing large pitch and roll are filtered out during processing, prior to any flux calculations. The measured pitch and roll for the entirety of each flight shown in Figure 12 and Table B1 are plotted in figure A1.

**(RC 303)** Figure 3, from the figure it looks like the widths of each spike are not similar. If the flight characteristics are the same for each repeated crosswind flight why then the width of these spikes are different? Is this because of the environmental conditions?

**(AC 303)** ***L215-217.*** Each 'spike' in figure 3 is a plume concentration measurement from an individual transect. Variability in spike magnitude and duration is due to different transect altitude and downwind locations relative to the target source.

**(RC 304)** Additionally, why does the background $CH_4$ increase over time? $CH_4$ concentrations are between 2.2-2.3 $\mathrm{ppm}$ before $800\,\mathrm{s}$, and it increases at about $2.5\,\mathrm{ppm}$ at the end of the measurement. I would expect that the background signal will be more or less similar during the flight and when the drone sees the plume the spikes will occur. Maybe this figure (3) needs more explanation.

**(AC 304)** ***Figure 7. L213-238.*** The steady increase in $CH_4$ was due to changes in local environmental conditions during collection.

**(RC 305)** Line 259: Why was the flight conducted 130 m away from the source? Why not closer, were there any restrictions?

**(AC 305)** ***Section 2.5. Section 4. L480-490.*** Distance is a function of local topography and environmental conditions, in the case of figure 7 there was a $60\,\mathrm{m}$ perimeter around the source (controlled release stack) and a further 60-70 $\mathrm{m}$ south to allow more growth.

**(RC 306)** Line 265: This is a bit cryptic. How did the authors find the lower quantification threshold here? What are the standard flight conditions?

**(AC 306)** ***L366-369.*** We define standard flight conditions as periods of high solar insolation and steady windspeed between 2-6 $\mathrm{m/s}$. This is discussed on lines L366-369 in the context of calculating the Limit of Detection (LOD) for the system. The plume evolution is dependent on multiple environmental conditions, but a cross-sectional area of 100 m2is used in the LOD calculation.

**(RC 307)** Also, in Table 1, how did the authors come up with the Mira Pico uncertainties? When I check the manual, the only information given about the instrument is the sensitivity which is $< 1\,\mathrm{ppb/s}$ and the drift which is given as $30\,\mathrm{ppb}$. Maybe adding a bit more explanation for Figure 7 might help here.

**(AC 307)** ***Section 2.7. Table 1. L342-350.*** The MIRA Pico used in this study (circa 2019) is stated as having sensitivity of $1\,\mathrm{ppb\,s^{-1}}$ $CH_4$ and $0.5\,\mathrm{ppb\,s^{-1}}$ $C_2H_6$. This is an excellent sensitivity level on the raw concentration measurements ($\chi$) and the quasi-periodic drift is removed using the background estimation and removal ($\chi_0$) as described in section 2.3. The later processes introduce a $3\sigma$ error of ~$16\,\mathrm{ppb}$ $CH_4$, ~$2.5\,\mathrm{ppb}$ $C_2H_6$.