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Technical note: Isolating methane emissions from animal feeding operations in an interfering location

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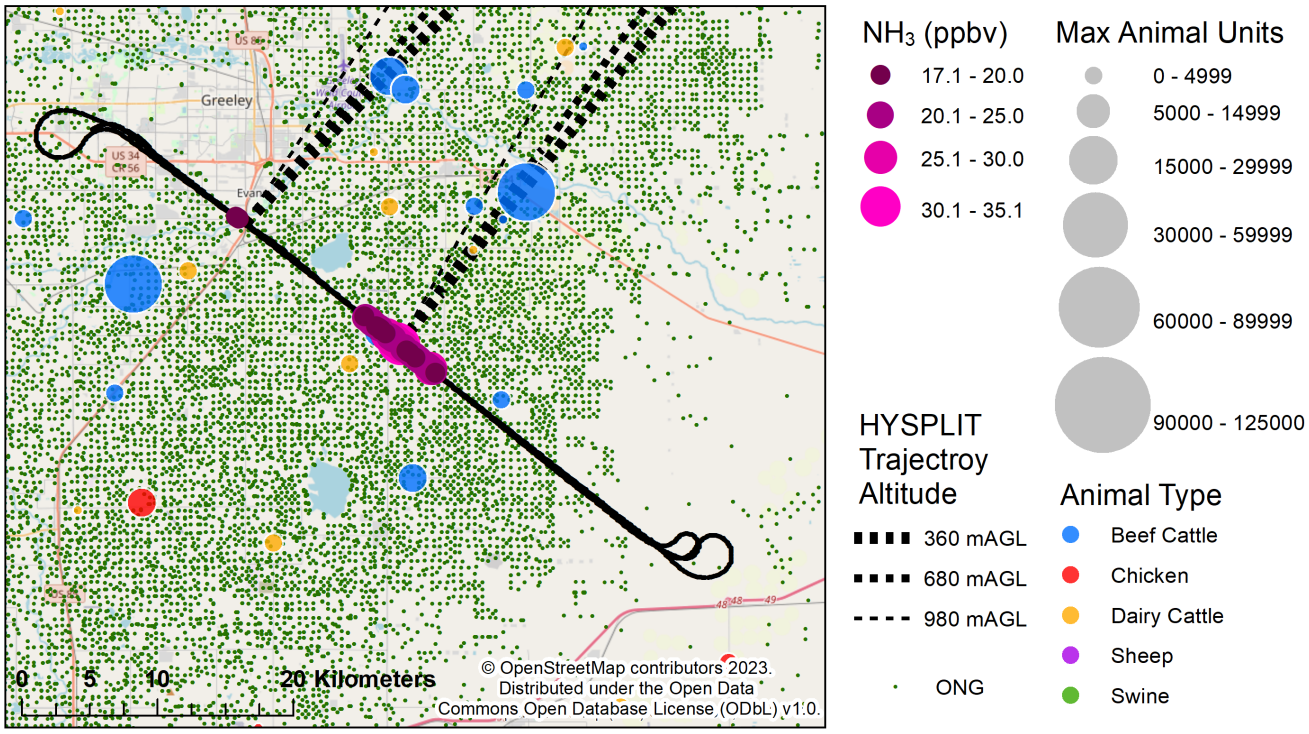

Figure S1. Back trajectory plot for flight F2, on November 13, 2019. The flight track is colored in black, with the largest 4% of NH_3 observations colored in pink to show the two separate plumes. HYSPLIT back trajectories are shown originating from the center of each NH_3 plume for three altitudes. Animal operations are indicated by the different colored circles as in Figure 1. Green dots represent ONG wells, data of ONG as of 2015 (Colorado Department of Natural Resources Oil & Gas Conservation Commission, 2016).

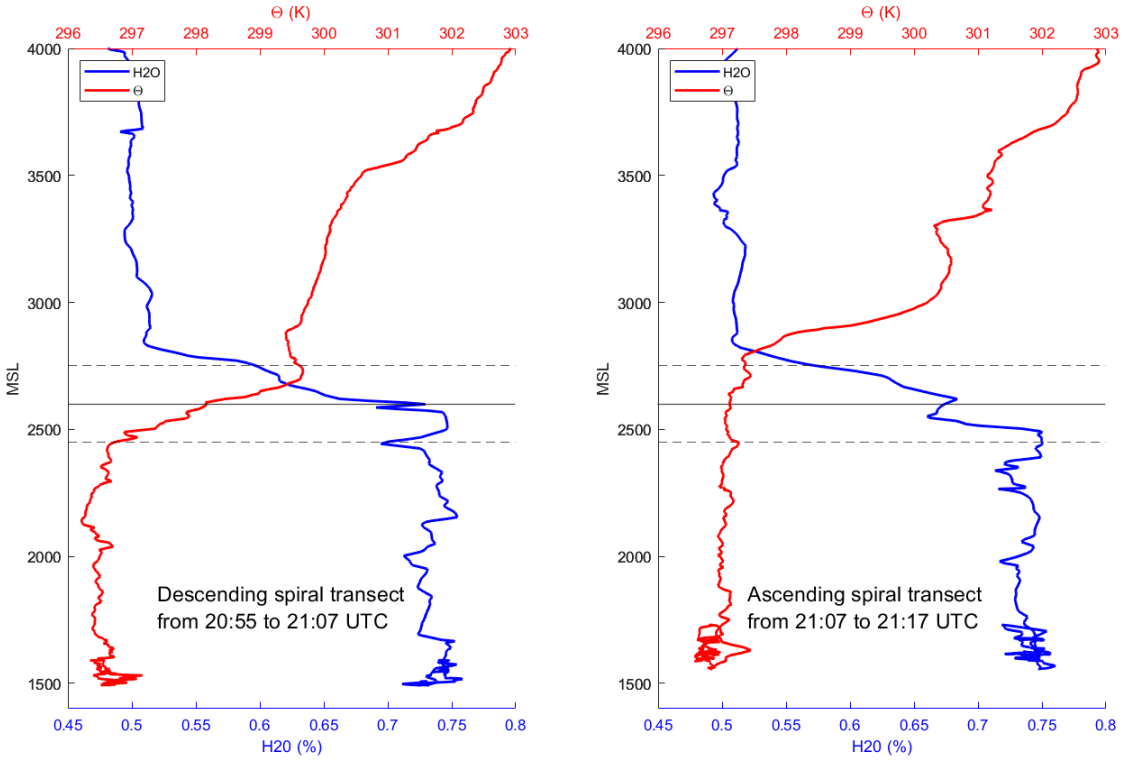

Figure S2. Descending spiral transect (left) followed by an ascending spiral (right) transect to show the MLB during flight 2 (F2) conducted on November 13, 2019. Potential temperature (θ, red) and water vapor (H_2O, blue) were used to determine the mixed MBL. The dotted line represents the selected MBL used in calculations.

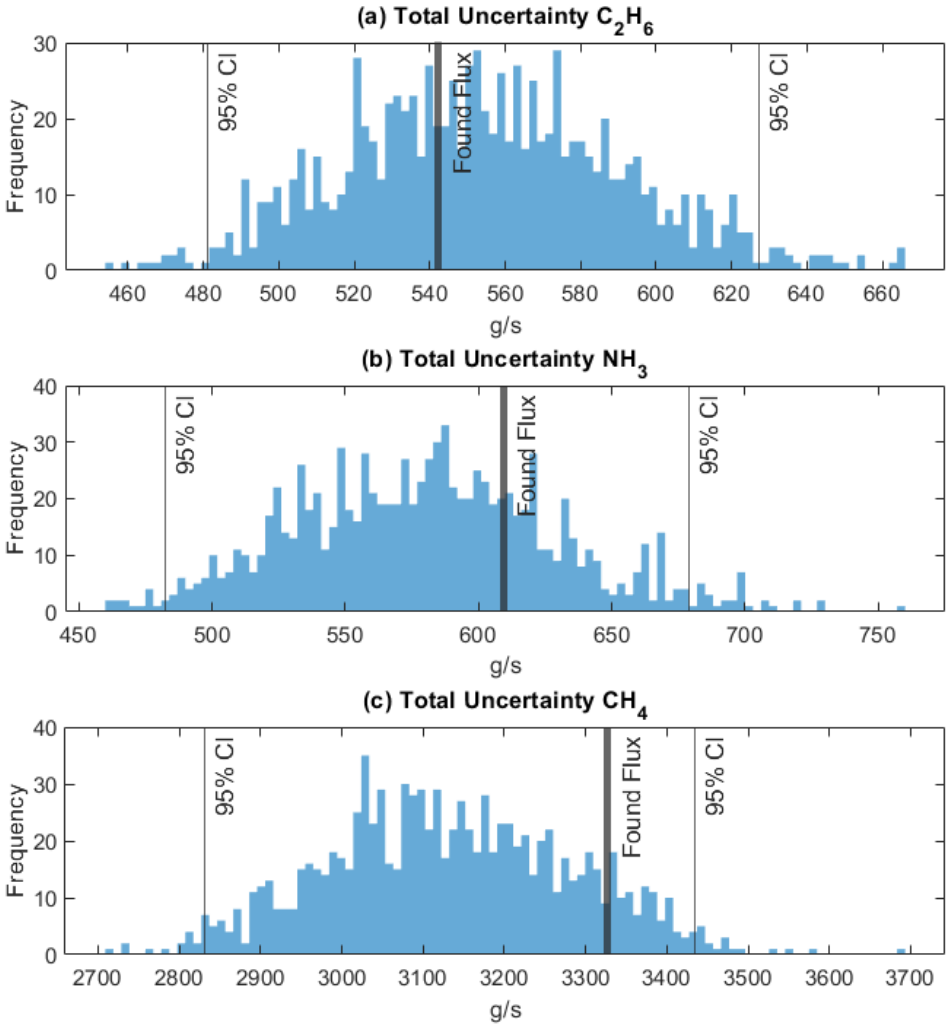

Figure S3. Total uncertainty based on Monte Carlo. (a) Total uncertainty C_2H_6. (b) Total uncertainty of NH_3. (c) Total uncertainty of total CH_4.

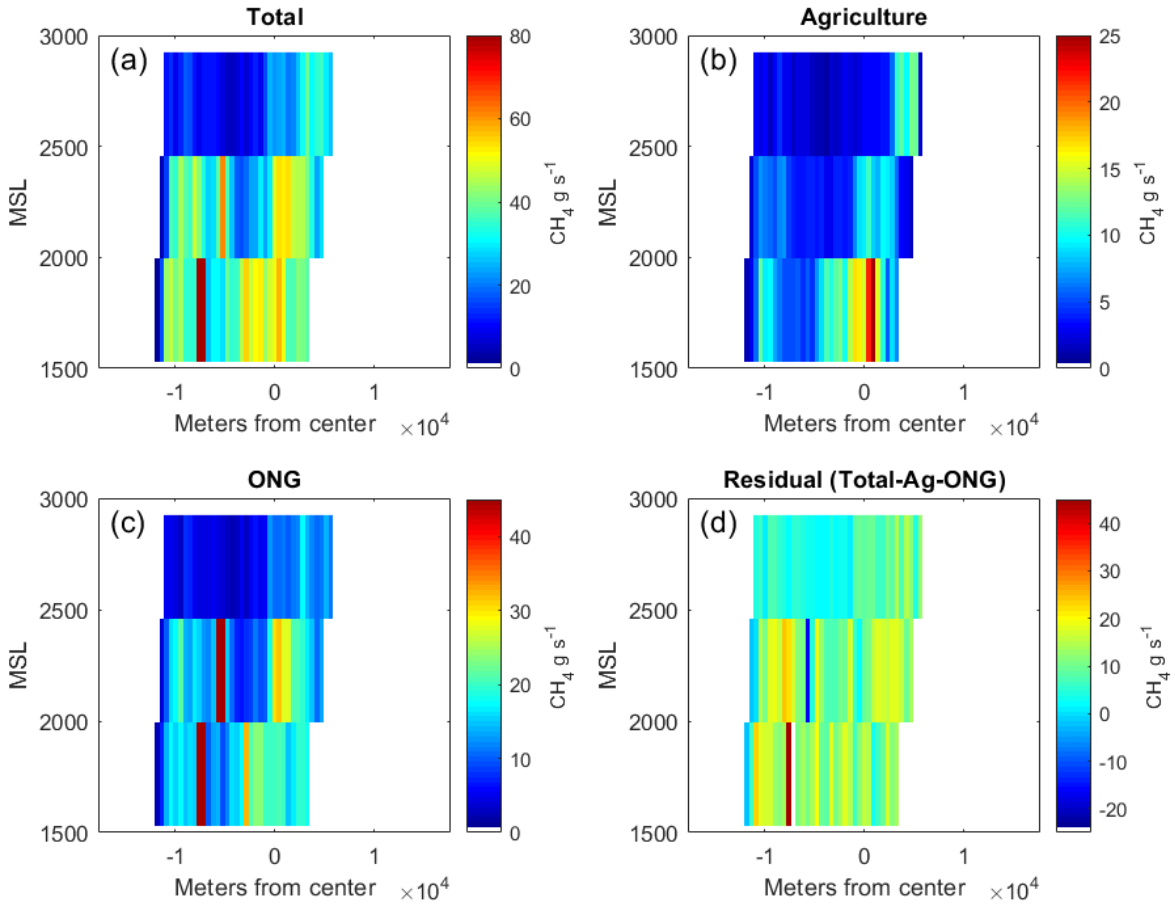

Figure S4. Curtain plots of CH_4 emission by point. (a) Total emissions by point. (b) Agriculture emissions. (c) ONG emissions. (d) Any remaining emissions that are not accounted for in ONG and agriculture.

Table S1. Sensitivity of the MVR fit for Transect data.

Transect MVR Approaches	a	b	c	R^2
Raw CH_4	1933.2±0.6	1.090±0.072	5.73±0.10	0.74
Background subtracted CH_4	0.6±0.6 (1933.2)	1.090±0.072	5.73±0.10	0.74
Background subtracted C_2H_6 & NH_3	1945.9±0.4	1.090±0.072	5.73±0.10	0.74
Background subtracted CH_4, C_2H_6 & NH_3	13.3±0.4 (1945.9)	1.090±0.072	5.73±0.10	0.74

Background subtracted CH_4 - 1932.6 (found from around the transects.)

Table S2. Sensitivity of the MVR fit for F2 data.

F2 MVR Approaches	a	b	c	R^2
Raw CH_4	1933.2±0.2	0.638±0.010	6.329±0.051	0.78
Background subtracted CH_4	0.6±0.2 (1933.2)	0.638±0.010	6.329±0.051	0.78
Background subtracted C_2H_6 & NH_3	1945.2±0.2	0.638±0.010	6.329±0.051	0.78
Background subtracted CH_4, C_2H_6 & NH_3	12.6±0.2 (1945.2)	0.638±0.010	6.329±0.051	0.78

Background subtracted CH_4 - 1932.6 (found from around the transects).

Table S3. Attribution method fit statistics.

Approach	Data	a	b	c	R^{2a}	Average Residual	Normalized Sum of Residual^2 [b]
SM	$F2^2$	1932.6 ± 33	1.2	9.1	0.20	-14	3.02
SM	Transect	1932.6 ± 33	2.22	6.8	0.47	-11	2.04
MVR	F2	1933.2±0.6	0.638±0.010	6.329±0.051	0.72	-9	1.87
MVR	Transect	1933.2±0.2	1.090±0.072	5.729 ±0.095	0.74	1	1.0

[a] Calculated R^2 on the transect data at 1 Hz. [b] The normalized Sum of Residual^2 is calculated by dividing each approach's Sum of Residual^2 by the minimum value (i.e., the value from the MVR Transect approach).

Table S4. RF13 Subtraction Method Results

Transect Number	Distance from Feedlot (km)	CAFO CH_4 (g s^{-1})	Uncertainty (g $s^{-1)}$	Relative Uncertainty (%)
1	2.8	181	130	72
2	5.5	583	184	32
3	11.1	489	206	42
4	12.9	627	367	58
5	16.8	701	170	24
Average	9.8	516	208	40

References

Colorado Department of Natural Resources Oil & Gas Conservation Commission: Colorado Oil and Gas Information System (COGIS), www.colorado.gov/pacific/cdphe/animal-and-livestock-feeding-operations, accessed: April, 2016, 2016.