1.0 Effects of chamber seal

We performed an additional single controlled release test of the static chamber method in June 2019 to investigate the impacts of a chamber seal on measurement accuracy. One controlled release was performed outdoors of the MacDonald Engineering Building at McGill University (Canada) using the rectangular 2,265 L chamber with fans present in the interior. The chamber was installed over soft ground for this experiment. One single controlled release of methane (2.5% methane with a balance of air) at a rate of 160 mg/hour of methane. The controlled release test lasted 20 minutes in total. For the first 10 minutes, the chamber was sealed to the ground using metal collars to press the chamber material to the ground. For the second 10 minutes of the release, the metal collars were removed and the chamber material was allowed to rest over the ground. Wind speeds were low (i.e., <5 kph) for this experiment. The measured methane flowrate during the first 5 minutes of the experiment was 133 mg/hour (R^2 = 0.9758), and for the second 5 minutes the measured flowrate was 91 mg/hour (R^2 = 0.9587), meaning that the change in the chamber seal led to a decrease in accuracy from -17% for the proper chamber seal to -43% from the improper chamber seal.

Table S1: IPCC Emission factor database – summary of assumptions used for component level methane emission factor calculations.

Category	Assumption	Reasoning (if applicable)
Waste	Component level = 1 person	
Waste	5.12 L of wastewater per capita per hour	- 8,000,000,000 people globally - 359,000,000,000 m^3/yr wastewater generation globally[1]
Waste	0.019 kg of waste per capita per hour	- 8,000,000,000 people globally - 1,300,000,000 tons/yr solid waste generation globally[2]
Energy	1.12 hours per liquid unloading	- Average duration of liquid manual unloading[3]
Energy	9301 km driven per year per capita	-Population based average from 12 countries[4]

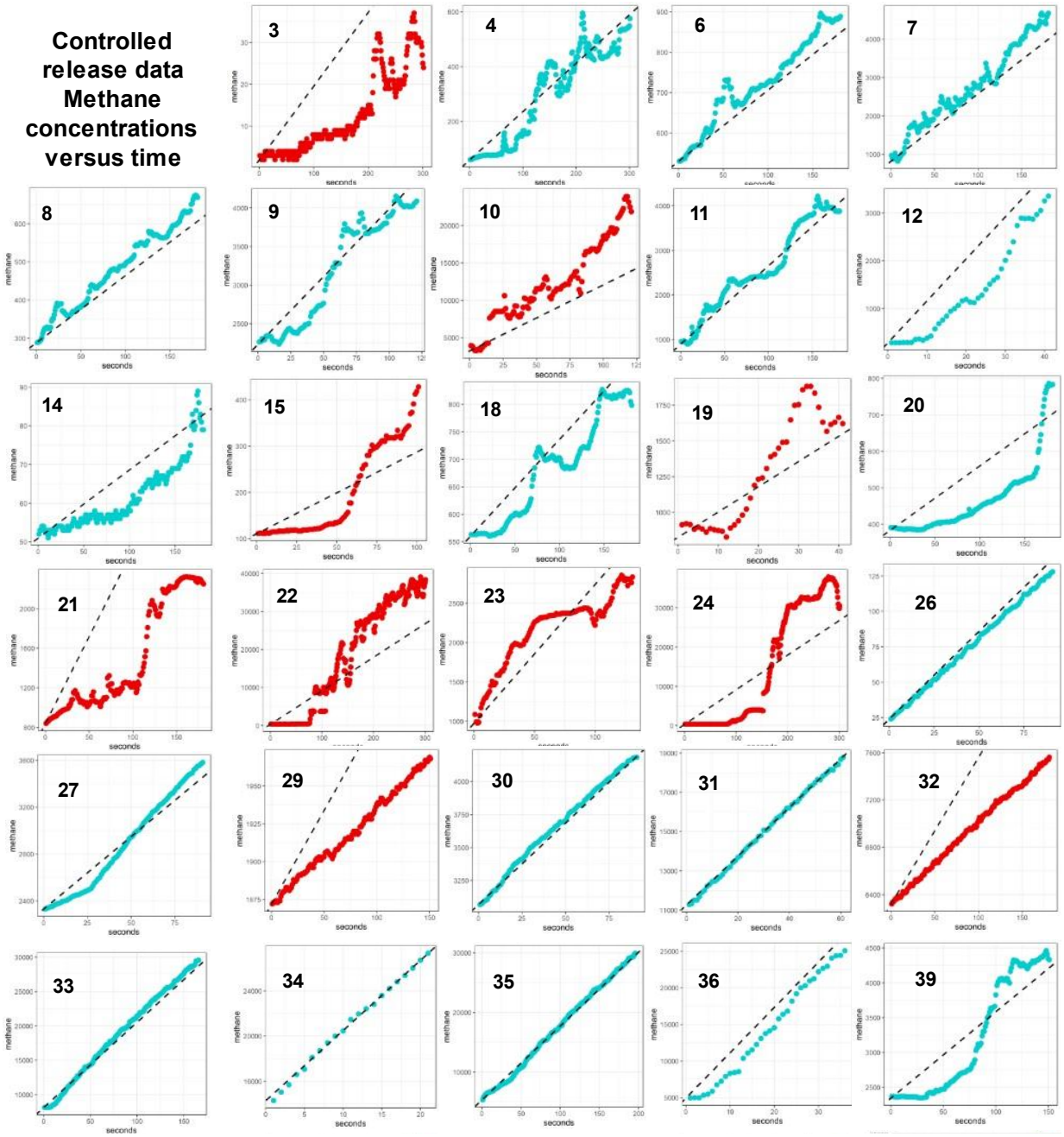
Energy	19.1 g of methane per ft^3	
Energy	80.5 hours	- Average flowback duration[3]
AFOLU	Component level = 1 head of cattle	
Other	16.04 grams per mol of methane	
Other	GWP of methane = 24	

Table S2: Physical chamber factors and leak properties of all 64 controlled release tests.

Leak ID	Mass flowrate (g/hour)	Methane percentage of leak (%)	Volumetric flowrate of leak (slpm)	Volume (L)	Shape*	Fans present
3	1.02	5	0.476	2,265	Rec.	Yes
4	10.2	5	4.76	2,265	Rec.	Yes
6	10.2	10	2.38	2,265	Rec.	Yes
7	102	10	23.8	2,265	Rec.	Yes
8	10.2	50	0.476	2,265	Rec.	Yes
9	102	50	4.76	2,265	Rec.	Yes
10	512	50	23.8	2,265	Rec.	Yes
11	102	100	2.38	2,265	Rec.	Yes
12	512	100	11.9	2,265	Rec.	Yes
14	1.02	5	0.476	2,265	Rec.	No
15	10.2	5	4.76	2,265	Rec.	No
18	10.2	10	2.38	2,265	Rec.	No
19	102	10	23.8	2,265	Rec.	No
20	10.2	50	0.476	2,265	Rec.	No
21	102	50	4.76	2,265	Rec.	No
22	512	50	23.8	2,265	Rec.	No
23	102	100	2.38	2,265	Rec.	No
24	512	100	11.9	2,265	Rec.	No
26	1.02	5	0.476	322	Cyl.	Yes
27	10.2	5	4.76	322	Cyl.	Yes
29	1.02	10	0.238	322	Cyl.	Yes
30	10.2	10	2.38	322	Cyl.	Yes
31	102	10	23.8	322	Cyl.	Yes
32	10.2	50	0.476	322	Cyl.	Yes
33	102	50	4.76	322	Cyl.	Yes
34	512	50	23.8	322	Cyl.	Yes
35	102	100	2.38	322	Cyl.	Yes
36	512	100	11.9	322	Cyl.	Yes
39	10.2	5	4.76	322	Cyl.	No
42	10.2	10	2.38	322	Cyl.	No

43	102	10	23.8	322	Cyl.	No
45	102	50	4.76	322	Cyl.	No
46	512	50	23.8	322	Cyl.	No
47	102	100	2.38	322	Cyl.	No
48	512	100	11.9	322	Cyl.	No
50	1.02	5	0.476	14	Rec.	Yes
51	10.2	5	4.76	14	Rec.	Yes
53	1.02	10	0.238	14	Rec.	Yes
54	10.2	10	2.38	14	Rec.	Yes
55	10.2	50	0.476	14	Rec.	Yes
57	1.02	5	0.476	14	Rec.	No
58	10.2	5	4.76	14	Rec.	No
60	1.02	10	0.238	14	Rec.	No
61	10.2	10	2.38	14	Rec.	No
62	102	10	23.8	14	Rec.	No
63	10.2	50	0.476	14	Rec.	No
64	102	50	4.76	14	Rec.	No
65	512	50	23.8	14	Rec.	No
66	102	100	2.38	14	Rec.	No
67	512	100	11.9	14	Rec.	No
69	1.02	5	0.476	18	Cyl.	Yes
70	10.2	5	4.76	18	Cyl.	Yes
72	1.02	10	0.238	18	Cyl.	Yes
73	10.2	10	2.38	18	Cyl.	Yes
74	10.2	50	0.476	18	Cyl.	Yes
77	10.2	5	4.76	18	Cyl.	No
79	1.02	10	0.238	18	Cyl.	No
80	10.2	10	2.38	18	Cyl.	No
81	102	10	23.8	18	Cyl.	No
82	10.2	50	0.476	18	Cyl.	No
83	102	50	4.76	18	Cyl.	No
84	512	50	23.8	18	Cyl.	No
85	102	100	2.38	18	Cyl.	No
86	512	100	11.9	18	Cyl.	No

*Rec. = Rectangular chamber shape, Cyl. = Cylindrical chamber shape


Controlled release data Methane concentrations versus time
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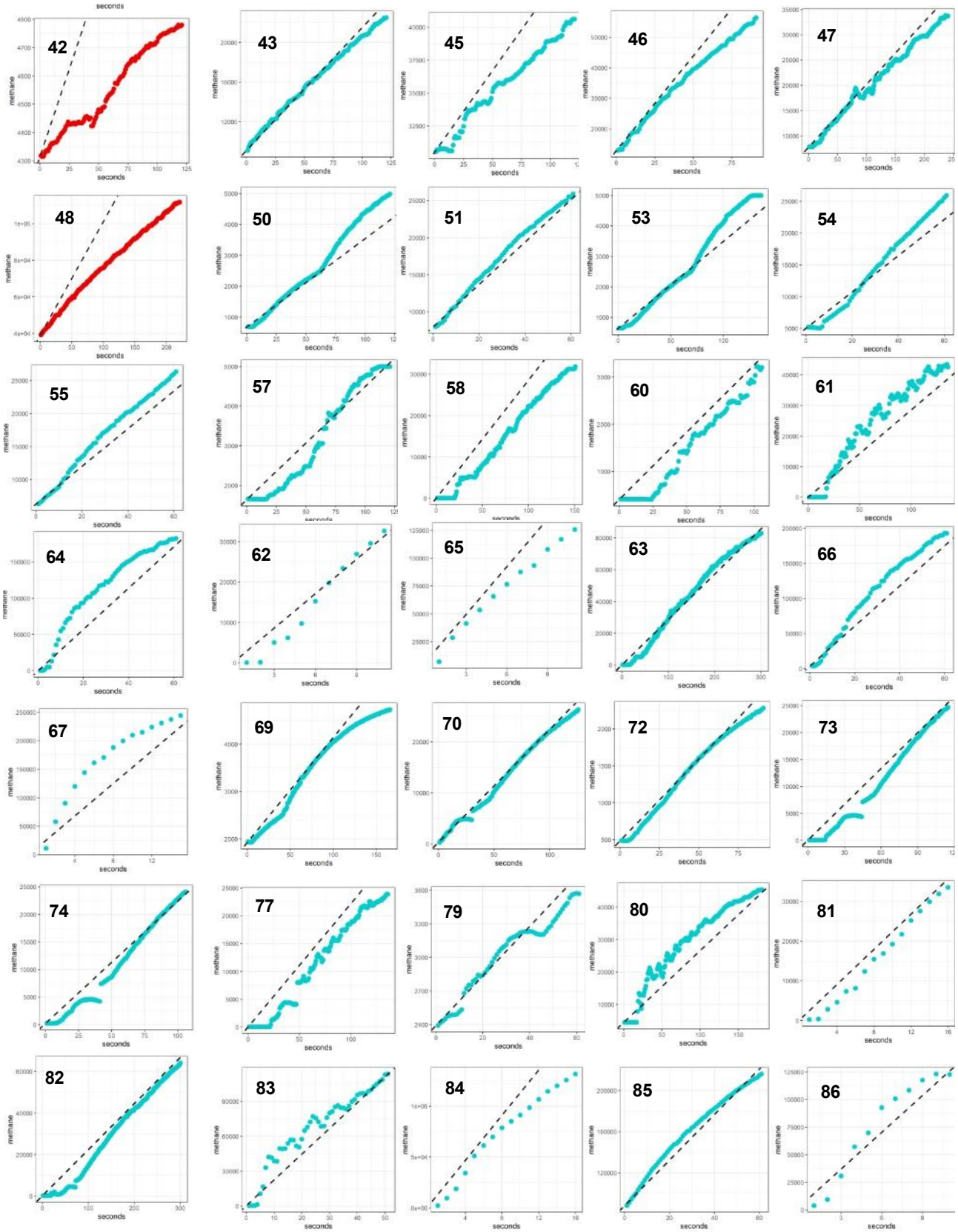
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Figure S1: Scatter-plots of methane concentration over time for all 64 controlled release tests. Points coloured blue indicate a measurement accuracy of 40% or better. Points coloured red indicate a measurement accuracy of 40% or worse.

References

[1] Jones, Edward R., et al. "Country-level and gridded estimates of wastewater production, collection, treatment and reuse." *Earth System Science Data* 13.2 (2021): 237-254.

[2] Kawai, Kosuke, and Tomohiro Tasaki. "Revisiting estimates of municipal solid waste generation per capita and their reliability." *Journal of Material Cycles and Waste Management* 18.1 (2016): 1-13.

[3]Allen, David T., et al. "Measurements of methane emissions at natural gas production sites in the United States." Proceedings of the National Academy of Sciences 110.44 (2013): 17768-17773.

[4]Internation Comparisons – Transportation. Accessed: 2023-02-09. Available: https://internationalcomparisons.org/environmental/transportation/