atmosphere

Supplementary Material

Table S1. Conditions during mobile measurements.

.	Date (Start)	Time start (CET)	Time end (CET)	Temp. (°C)*	Wind speed (m s^{-1})*	Wind direction*	Stability conditions	Height of the stable boundary layer (m)***
1	08 Jan. 2021	22:29	01:29	0.6 – 1.3	1.5 – 2.8	WNW – NW	stable – very stable	152
2	10 Jan. 2021	09:53	12:52	1.1 – 2.5	1.7 – 2.9	SSW – SW	very unstable	0
3	16 Jan. 2021	06:58	09:17	−0.5 – −0.1	0.8 – 2.4	SSW – SW	neutral	0
4	23 Jan. 2021	00:48	03:02	1.4 – 2.3	1.5 – 3.2	S – SSW	extremely stable	140
5	30 Jan. 2021	23:28	01:37	−2.1 – −1.4	2.4 – 3.3	ENE	very stable	41
6	23 Feb. 2021	00:02	02:43	12.7 – 13.0	2.1 – 3.4	SSW – SW	extremely stable	263
7	27 Feb. 2021	22:05	00:19	6.3 – 6.7	0.4 – 1.8	NNW – N	stable – very stable	0
8	01 Mar. 2021	23:01	01:06	3.5 – 4.0	1.4 – 2.4	ENE	extremely stable	194
9	03 Mar. 2021	21:43	23:47	6.0 – 8.2	0.8 – 2.1	WNW – NNW	extremely stable	26
10	06 Mar. 2021	23:05	01:10	2.4 – 3.5	1.1 – 2.5	N	extremely stable	103

* MS21; ** derived from vertical temperature gradient; *** radiosonde ascent of DWD Essen [1] at the nearest time point.

Table S2. Locations with occurrence of elevated mixing ratios (EMR), measured maximum mixing ratio (MR) and estimated mean emission rate according to Weller et al. [2].

Location	Max. EMR at trip # (DMR (ppm))										Max. MR (ppm)	Reported	Leakage on gas network confirmed (date)	Mean emission rate (g h^{-1})
	1	**2**	3	4	5	6	**7**	**8**	**9**	**10**				
E05_1								1.26			3.40	X		
F04_1									0.45		2.81			
F06_1				0.42							2.68			
F06_3				3.24		0.85			1.28		5.43	X		215
F06_5	1.16			3.80				4.37	9.84	6.05	12.25	X		926
G04_1								0.54			2.68			
G09_1									0.50		2.86			
H05_1					0.53						2.55			
I08_1										2.71	4.76	X		
I11_5			1.17			1.21	1.89		0.45	1.09	4.01	X		102
J07_1				0.45							2.68			
J07_10	10.21	12.93	45.44	15.98	19.98	19.29	3.59	3.74	0.90	2.85	47.63	X	15 Mar. 2021	5,530 / 400*
J10_1				0.46							2.69			
K05_2			0.47	0.97							3.20	X		36
K05_3	0.77	0.59				1.00					3.04	X		43
K06_6	0.44		1.30				0.56	0.58	1.19	1.84	4.01	X	24 Aug. 2021**	77
K06_7	1.00				19.98	0.42	0.59	1.74	0.97	5.74	21.99	X	24 Aug. 2021	929
K07_1									0.43		2.73			
K08_3		2.32			1.10		0.51				4.78	X		131
L07a_2					2.14				1.03		4.14	X		170
L07b_2						4.06				1.04	6.10	X		367
L07c_2								2.31	2.00		4.52	X	21 Sep. 2021	267
L07_1				0.86							3.10			
L08_1				0.70							2.93			
L08_4							0.69	1.40	0.82	0.47	3.61	X		54

* determined from elevated mixing ratios before and after the leakage was repaired on 25 February 2021 (trip 1 – 6 / trip 7 – 10); ** two leakages at the location.

Table S3. Estimation of the source strength in the period of seven trips; time of start and time of end limit the period of stable stratification conditions.

Date (Start)	Time start (CET)	Time end (CET)	Trip #	Mean temp. (°C)*	Mean pressure (hPa)*	Height of the stable boundary layer (m)**	Slope CH_4 mixing ration per h (ppm h^{-1}) ***	Source strength (g h^{-1})	Source strength (g m^{-2} a^{-1})
08 Jan. 2021	15:50	06:30	1	1.1	1,007.2	152	0.037	63,297	34.9
22 Jan. 2021	18:10	03:10	4	2.9	984.8	140	0.033	50,509	27.9
30 Jan. 2021	17:00	09:10	5	−1.9	992.7	41	0.008	3,679	2.0
22 Feb. 2021	16:20	07:20	6	14.1	1,012.7	263	0.011	31,256	17.2
01 Mar. 2021	17:10	09:20	8	4.4	1,020.3	194	0.039	85,236	47.0
03 Mar. 2021	16:50	01:00	9	9.3	1,012.5	26	0.033	9,426	5.2
06 Mar. 2021	17:40	08:30	10	2.8	1,016.8	103	0.059	68,622	37.8

* at MS21; ** radiosonde ascent of DWD Essen [1]; *** averaged value from B_{MS21} and $B_{MS4.9}$

References

1. University of Wyoming. College of Engineering. Department of Atmospheric Science. Available online: http://weather.uwyo.edu/upperair/sounding.html (accessed on 25 August 2021).
2. Weller, Z.D.; Yang, D.K.; von Fischer, J.C. An open source algorithm to detect natural gas leaks from mobile methane survey data. *PLoS ONE* **2019**, *14*, e0212287. https://doi.org/10.1371/journal.pone.0212287.