Supplement to:

The ASK-16 Motorized Glider: An Airborne Eddy Covariance Platform to measure Turbulence, Energy and Matter Fluxes

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The aim of this supplementary material is to provide transparent and detailed background information
10 about the ASK 16 measurement platform. In supplement A more details are provided about the flight maneuvers that have been used to calibrate the wind measurements. This includes detailed tables, that present measurement conditions during the calibration maneuvers. In Supplement B more information about atmospheric boundary layer height conditions is given for two specific flight dates (29.08.2018 and 21.09.2019).

Supplement A: Flight Maneuver Information

Flight maneuvers were performed during several calibration and measurement flights to obtain calibration parameters for the angle of attack, the sideslip angle, the static pressure and the dynamic pressure. Tables S1 – S5 provide information about flight itself (e.g. height, flight time etc.) and the meteorological conditions that were prone during the flight maneuvers. Additionally, all tables provide information about the optimized parameterization of the individual flight maneuvers.

Table S1: General information about the speed maneuvers, including general flight information (date, time, mean height, and mean groundspeed), meteorological conditions (median windspeed, wind directions, and wind vector information). The table also includes the range in measured static pressure (P_s) and static pressure defect (err P_s). Wind conditions were calculated with the median calibration parameters for 2017/2018 and 2019/2022 from Table 3 (and not with the obtained calibration parameters for each individual maneuver – a_1 and a_2 Eq. 2). Symbology: M = median, lon = longitude; lat = latitude; alt = altitude; $m.a.g.l.$ = meters above ground level; T = temperature; $wspd$ = windspeed; $wdir$ = wind direction, v_{gs}= groundspeed, r^2 = coefficient of determination representing fit for parameters a_1 and a_2 (fit for parameter a_3 is provided in Table S2).

no	flight date	flight time	M(lon)	M(lat)	M(alt)	M(T)	M(wspd)	M(wdir)	M(w)	range v_{gs}	a_1 Eq. 2	$a2$ Eq. 2	r^2 fit Eq .2
	-	start - end	deg	deg	m.a.g.l.	°K	m/s	°	m/s	m/s	-	-	-
1	8/9/2017	17:09:54 - 17:12:46	12.516	52.1	2557	278	11.8	230	0.48	12.1 - 32.96	0.045	-2.04	0.97
2	9/21/2019	10:51:22 - 10:53:02	12.507	52.08	1052	287	2.1	318	0.05	27.28 - 48.19	0.045	-1.72	0.99
3	5/4/2022	12:28:44 - 12:29:45	12.56	52.12	779	284	2.7	135	0.49	20.93 - 48.75	0.056	-1.62	0.98
4	6/7/2018	18:12:33 - 18:18:46	12.671	52.12	631	295	7.0	112	0.05	30.19 - 57.67	0.048	-1.98	0.98
5	4/17/2019	11:08:58 - 11:20:28	12.756	51.98	1631	276	8.5	126	-0.06	18.26 - 41.51	0.047	-2.24	0.92
6	9/21/2019	10:02:39 - 10:08:56	12.406	52.01	1080	287	1.5	299	0	27.21 - 48.48	0.049	-2.09	0.94
7	9/21/2019	10:47:46 - 10:53:02	12.484	52.05	1039	287	2.0	303	0.06	27.28 -50.1	0.046	-2.12	0.91
8	9/21/2019	10:07:11 - 10:09:56	12.345	51.98	1102	287	1.1	306	-0.05	27.73 - 47.86	0.058	-1.94	1.00
9	9/21/2019	10:09:56 - 10:13:28	12.251	51.95	1124	287	1.8	337	0.05	27.88 - 47.79	0.040	-2.42	0.99
10	9/21/2019	10:11:26 - 10:13:28	12.231	51.94	1126	287	2.0	338	-0.01	28.99 - 47- 79	0.040	-2.44	0.99
11	9/21/2019	10:47:46 - 10:49:33	12.457	52.01	1047	287	1.9	294	-0.04	27.41 - 47.97	0.040	-2.15	0.99
12	9/21/2019	10:49:33 - 10:51:22	12.485	52.05	1027	287	2.1	292	0.12	27.57 - 50.1	0.053	-1.72	0.99

Table S2: General information about the performed yawing maneuvers, including general flight information (date, time height, groundspeed), meteorological conditions (windspeed, wind directions, and wind vector information) and the obtained calibration parameters – Par a_3 for Eq. 2. and C_β for Eq. 6. All wind parameters were calculated after calibration (using median calibration values for 2017/2018 and 2019/2022 from Table 3 - and not with the parameters in the last column). Symbology: M = median; lat = latitude; lon = longitude; alt = altitude; $m.a.g.l.$ = meters above ground level; T = temperature; μ = average conditions; $wspd$ = windspeed; $wdir$ = wind direction; v_{gs}= groundspeed; θ = Pitch angle; Ψ = heading, r^2 = coefficient of determination representing fit for parameter a_3 in Eq. 2 (fit for other parameters is provided in Table S1). The second part of this table is positioned on the next page.

Table S2 part A

no	flight date	flight time	M(lon)	M(lat)	M(alt)	M(T)	M(wspd)	M(wdir)	M(u)	σ(u)	σ(v)
	yyyy-mm-dd	hh:mm:ss	deg	deg	m.a.g.l.	°K	m/s	°	m/s	m/s	m/s
1	2017-08-09	17:07:31 - 17:07:52	12.572	52.137	2602	278.8	13.26	228.7	9.98	0.21	0.18
2	2022-06-14	10:04:40 - 10:05:25	13.462	53.351	2364	273.5	13.29	315.7	9.28	0.1	0.15
3	2018-07-16	14:44:18 - 14:44:33	13.254	52.235	606	294.2	3.04	39.2	-1.76	0.55	0.43
4	2018-07-18	10:41:46 - 10:42:48	12.462	52.188	2357	280	8.37	300.6	7.19	0.39	0.28
5	2018-07-18	10:45:19 - 10:45:46	12.521	52.207	2415	279.4	7.87	305.4	6.4	0.25	0.26
6	2018-06-07	18:26:47 - 18:27:55	12.712	52.079	630	295.2	6.12	114.5	-5.56	0.23	0.25
7	2019-04-17	11:27:58 - 11:28:40	12.666	52.03	1822	274.2	7.44	143.5	-4.28	0.38	0.55
8	2019-09-21	10:19:35 - 10:20:00	12.342	51.963	1119	286.8	1.69	300.4	1.44	0.2	0.16
9	2019-09-21	10:56:30 - 10:57:22	12.554	52.172	1038	286.8	1.83	297.5	1.59	0.37	0.25

Table S2 part B

no	flight_date	min(g_s)	max(g_s)	σ(θ)	σ(Ψ)	a_3 Eq. 2	r^2 Eq. 2	Cβ	Period	M(w)	M(v)
	yyyy-mm-dd	m/s	m/s	°	°	-		-	s	m/s	m/s
1	2017-08-09	28.11	33.09	0.13	0.32	-1.02	0.71	0.072	3.01	1	8.78
2	2022-06-14	27.17	31.82	0.09	0.59	-1.50	0.94	0.070	4.10	0.32	-9.51
3	2018-07-16	43.84	46.68	0.1	0.57	-1.25	0.97	0.071	3.76	-1.2	-2.33
4	2018-07-18	25.07	31.41	0.17	0.6	-1.40	0.98	0.070	5.17	0.26	-4.29
5	2018-07-18	36.56	40.61	0.15	0.61	-1.49	0.98	0.070	5.41	0.15	-4.53
6	2018-06-07	34.47	39.92	0.09	0.45	-1.23	0.86	0.072	7.56	-0.1	2.53
7	2019-04-17	40.68	46.76	0.11	0.68	-1.72	0.97	0.069	6.01	0.53	5.94
8	2019-09-21	34.95	40.97	0.19	0.53	-1.64	0.97	0.071	4.17	0.19	-0.85
9	2019-09-21	36.3	41.44	0.1	0.61	-1.52	0.97	0.072	5.78	0.01	-0.78

Table S3: General information about the unbound and return flights (legs), including general flight information (date, flight time, height, groundspeed, true airspeed), meteorological conditions (windspeed, wind directions, and wind vector information), and information about the position of the aircraft (true track, heading and drift angle). All wind parameters were calculated after calibration (using median calibration values for 2017/2018 and 2019/2022). Symbology: lon = longitude, lat = latitude; T = temperature; M = median; $wspd$ = windspeed; $wdir$ = wind direction; v_{gs}= groundspeed; v_{tas} = true airspeed; θ = Pitch angle; Ψ = Heading,

	flight date	flight leg	flight time	dist	M(lon)	M(lat)	M(alt)	M(T)	M (wspd)	M(wdir)	M(χ)	M(w)	M(gs)	α0
	d/m/y	-	h:m:s	km	deg	deg	m.a.g.l.	°K	m/s	°	°	m/s	m/s	-
1	8/14/2017	Leg1	11:28:20 - 11:37:40	24.11	12.897	53.888	197	290.8	2.2	195.1	33.0	-0.33	39.6	5.20
2	8/14/2017	Leg10	16:07:00 - 16:16:00	20.34	12.899	53.91	2094	277	6.1	208.5	213.3	0.03	26.2	5.51
3	8/14/2017	Leg10	16:07:00 - 16:16:00	20.34	12.899	53.91	2094	277	6.1	208.5	213.3	0.03	26.2	5.51
4	8/14/2017	Leg1	11:28:20 - 11:37:40	24.11	12.897	53.888	197	290.8	2.2	195.1	33.0	-0.33	39.6	5.20
5	8/14/2017	Leg2	11:39:50 - 11:50:00	23.91	12.897	53.888	221	291.4	1.8	196.2	213.5	-0.26	34.15	5.36
6	8/14/2017	Leg3	11:51:00 - 12:00:10	23.95	12.897	53.89	197	291.9	2.1	202.7	33.2	-0.24	38.67	5.45
7	8/14/2017	Leg4	12:01:45 - 12:12:12	23.68	12.897	53.89	210	292	1.9	203.7	213.1	-0.18	29.52	5.48
8	8/14/2017	Leg5	10:53:00 - 11:02:05	24.26	12.913	53.894	2256	278.8	5.7	211.6	33.2	-0.04	40.24	5.46
9	8/14/2017	Leg6	11:03:05 - 11:14:00	24.22	12.892	53.899	2272	278.6	5.1	217.1	213.4	0.03	34.05	5.49
10	8/14/2017	Leg7	16:37:30 - 16:46:30	22.65	12.902	53.897	222	292.4	2.7	119.5	32.9	-0.07	37.26	5.45
11	8/14/2017	Leg8	16:48:45 - 16:57:45	23.07	12.901	53.894	229	293	2.8	83.3	213.1	0.03	39.85	5.63
12	8/14/2017	Leg9	15:57:30 - 16:05:20	22.66	12.91	53.889	1916	278.2	6.1	201.5	32.9	0.07	45.25	5.57
13	8/15/2017	Leg1	06:09:20 - 06:17:40	23.45	12.903	53.897	240	290.8	14.3	159.4	32.8	0.12	42.09	5.68
14	8/15/2017	Leg10	09:24:35 - 09:34:30	20.8	12.864	53.981	227	294	8.3	136.9	113.5	-0.11	27.79	5.45
15	8/15/2017	Leg11	10:41:30 - 10:48:15	22.54	12.91	53.89	2008	283.2	8.0	224.6	32.9	0.02	52.01	5.47
16	8/15/2017	Leg12	10:49:40 - 10:58:50	22.16	12.888	53.894	2019	283	8.3	226.4	212.8	-0.02	36.12	5.47

	flight date	flight leg	flight time	dist	M(lon)	M(lat)	M(alt)	M(T)	M (wspd)	M(wdir)	M(χ)	M(w)	M(gs)	α_0
	d/m/y	-	h:m:s	km	deg	deg	m.a.g.l.	°K	m/s	°	°	m/s	m/s	-
17	8/15/2017	Leg2	06:20:00 - 06:32:10	23.33	12.903	53.898	249	291	12.7	155.6	213.0	-0.11	27.83	5.36
18	8/15/2017	Leg3	05:31:00 - 05:39:10	23.41	12.914	53.895	2133	281.5	3.9	231.2	33.2	-0.05	45.48	5.41
19	8/15/2017	Leg4	05:42:00 - 05:50:55	23.03	12.891	53.898	2167	281	3.2	238.9	212.9	0	40.08	5.46
20	8/15/2017	Leg5	08:36:45 - 08:45:40	23.47	12.901	53.894	217	293.2	8.1	139.1	33.2	-0.11	39.38	5.44
21	8/15/2017	Leg6	08:47:30 - 08:57:50	23.25	12.901	53.895	218	293.5	7.9	133.6	213.2	-0.08	32.12	5.45
22	8/15/2017	Leg7	09:36:45 - 09:43:30	20.14	12.868	53.979	262	294	9.0	137.8	293.5	-0.14	46.77	5.39
23	8/15/2017	Leg8	09:46:20 - 09:56:00	20.11	12.866	53.98	222	294.6	8.3	138.4	113.5	0	29.87	5.55
24	8/15/2017	Leg9	09:15:00 - 09:21:50	20.55	12.862	53.982	216	293.8	9.2	134.2	294.3	-0.08	45.47	5.42
25	8/29/2018	Leg1	12:22:58 - 12:32:46	22.55	12.904	53.899	208	294.8	6.4	139.4	213.3	-0.04	35.42	5.40
26	8/29/2018	Leg2	12:34:35 - 12:42:50	22.37	12.904	53.899	178	295.2	7.3	139.5	33.2	-0.27	41.31	5.22
27	8/29/2018	Leg3	12:45:56 - 12:55:40	23	12.905	53.9	199	295.2	6.9	133.2	213.1	-0.08	36.17	5.47
28	8/29/2018	Leg4	12:57:40 - 13:06:10	22.86	12.905	53.9	206	295.2	7.3	134.6	33.1	0.03	39.77	5.59
29	8/29/2018	Leg6	13:36:00 - 13:42:50	21.63	12.915	53.901	2081	283.6	7.9	205.2	32.1	-0.02	49.39	5.47
30	8/29/2018	Leg7	13:44:10 - 13:53:00	20.46	12.905	53.917	2061	283.6	7.2	208.1	213.1	-0.04	35.18	5.44
31	8/1/2019	Leg1	10:59:30 - 11:03:30	9.42	12.897	53.208	187	291.8	2.5	318.5	94.0	-0.07	36.11	5.57
32	8/1/2019	Leg2	11:06:25 - 11:10:55	9.63	12.89	53.206	206	291.8	2.0	311.8	274.1	-0.02	33.47	5.61
33	8/21/2019	Leg1	11:52:00 - 11:58:30	12.85	12.905	53.202	270	291.2	6.0	275.7	274.6	-0.27	29.55	5.40
34	8/21/2019	Leg2	12:02:00 - 12:07:30	14.55	12.888	53.206	263	291.2	6.2	272.7	92.9	-0.01	39.95	5.62
35	9/4/2019	Leg1	11:03:00 - 11:16:45	29.44	12.462	50.143	352	291.2	5.6	213.5	158.7	0.07	28.91	5.92
36	9/4/2019	Leg10	12:58:35 - 13:05:00	13.96	12.473	50.136	359	292.4	5.5	213	252.0	-0.46	31.17	5.25

	flight date	flight leg	flight time	dist	M(lon)	M(lat)	M(alt)	M(T)	M(wspd)	M(wdir)	M(χ)	M(w)	M(gs)	α₀
	d/m/y	-	h:m:s	km	deg	deg	m.a.g.l.	°K	m/s	°	°	m/s	m/s	-
37	9/4/2019	Leg11	13:06:35 - 13:12:00	14.53	12.472	50.136	345	292.6	6.3	219.9	72.1	-0.09	37.79	5.77
38	9/4/2019	Leg12	13:13:35 - 13:20:10	14.51	12.475	50.137	460	292	5.7	209.2	252.2	-0.21	30.84	5.76
39	9/4/2019	Leg13	13:22:30 - 13:26:50	12.43	12.461	50.16	408	292	6.1	214.3	72.1	-0.06	43.01	5.90
40	9/4/2019	Leg14	13:28:45 - 13:34:30	12.42	12.461	50.16	358	292.5	5.8	209.1	252.0	-0.51	32.48	5.39
41	9/4/2019	Leg15	13:36:20 - 13:41:10	13.36	12.462	50.16	412	292.2	6.4	212.1	72.3	-0.36	42.66	5.50
42	9/4/2019	Leg16	13:42:32 - 13:48:40	13.44	12.462	50.16	301	293.2	5.7	207.7	252.4	-0.52	32.79	5.11
43	9/4/2019	Leg2	11:19:00 - 11:30:15	29.4	12.457	50.154	407	290.6	6.1	199.1	339.6	-0.33	38.52	5.36
44	9/4/2019	Leg3	11:32:23 - 11:45:50	29.87	12.461	50.143	391	290.8	5.4	204.8	158.7	-0.32	31.27	5.44
45	9/4/2019	Leg4	11:47:55 - 11:59:40	29.78	12.456	50.156	391	291	6.3	200.3	338.7	-0.46	36.49	5.23
46	9/4/2019	Leg5	12:02:50 - 12:11:10	18.13	12.405	50.168	457	291	5.6	205.5	158.8	-0.08	30.59	5.77
47	9/4/2019	Leg6	12:13:20 - 12:20:30	18.07	12.404	50.169	395	291.4	6.3	202.5	338.4	-0.26	38.21	5.60
48	9/4/2019	Leg7	12:23:00 - 12:32:45	20	12.404	50.171	345	291.8	5.6	201.1	158.7	-0.31	30.26	5.41
49	9/4/2019	Leg8	12:34:05 - 12:41:34	19.8	12.406	50.165	443	291.2	6.4	197.4	338.0	-0.05	38.89	5.72
50	9/4/2019	Leg9	12:51:40 - 12:56:50	13.77	12.47	50.135	461	291.4	6.3	214	72.0	0.1	38.86	6.22
51	9/5/2019	Leg1	09:29:00 - 09:40:00	28.33	12.464	50.144	566	286	7.2	287.4	158.6	0.13	39	6.01
52	9/5/2019	Leg10	11:26:36 - 11:34:30	14.41	12.472	50.134	460	287.8	6.8	281.3	252.3	-0.23	27.92	5.60
53	9/5/2019	Leg11	11:36:20 - 11:41:20	14.09	12.482	50.137	490	287.8	7.4	277.7	72.3	-0.16	42.01	5.92
54	9/5/2019	Leg12	11:43:10 - 11:50:20	14.11	12.479	50.136	441	288.2	7.3	277.9	252.1	-0.23	30.21	5.69
55	9/5/2019	Leg13	11:52:40 - 11:57:30	12.91	12.468	50.156	448	288	8.2	273.4	72.2	-0.49	41.28	5.34
56	9/5/2019	Leg14	11:59:05 - 12:05:40	12.98	12.468	50.156	377	288.6	6.7	275.2	252.4	-0.35	29.26	5.56
57	9/5/2019	Leg15	12:07:35 - 12:12:40	13.16	12.46	50.153	382	288.6	7.2	278.2	72.1	-0.52	39.85	5.11
58	9/5/2019	Leg16	12:14:15 - 12:20:40	13.05	12.462	50.154	289	289.4	6.2	279.6	252.0	-0.24	31.42	5.51

	flight date	flight leg	flight time	dist	M(lon)	M(lat)	M(alt)	M(T)	M (wspd)	M(wdir)	M(χ)	M(w)	M(gs)	α_0
	d/m/y	-	h:m:s	km	deg	deg	m.a.g.l.	°K	m/s	°	°	m/s	m/s	-
59	9/5/2019	Leg2	09:42:08 - 09:55:05	28.66	12.463	50.146	556	286	7.0	277	338.6	-0.11	32.13	5.83
60	9/5/2019	Leg3	09:57:10 - 10:09:00	29.34	12.465	50.142	533	286.5	6.5	278	158.7	-0.16	36.7	5.80
61	9/5/2019	Leg4	10:11:23 - 10:24:55	29.48	12.461	50.152	498	287	6.9	274.8	338.5	-0.1	31.55	5.86
62	9/5/2019	Leg5	10:29:00 - 10:37:10	20.36	12.409	50.164	477	287	7.7	282.4	158.4	-0.22	36.82	5.73
63	9/5/2019	Leg6	10:38:35 - 10:48:30	20.32	12.408	50.169	489	287	7.1	279.1	338.2	-0.33	27.54	5.57
64	9/5/2019	Leg7	10:49:40 - 10:57:37	19.48	12.406	50.173	540	286.8	6.7	280.3	158.4	-0.01	37.24	6.19
65	9/5/2019	Leg8	11:00:15 - 11:09:20	19.51	12.408	50.169	525	286.8	6.2	280.9	338.7	-0.14	27.64	5.92
66	9/5/2019	Leg9	11:18:30 - 11:23:50	14.2	12.469	50.133	543	287	7.6	280.2	72.1	-0.07	36.02	5.91
67	5/4/2022	Leg1	12:23:15 - 12:25:00	4.04	12.504	52.11	760	284.6	3.9	148.1	74.7	0.67	36.24	7.01
68	5/4/2022	Leg2	12:26:00 - 12:27:10	2.86	12.522	52.122	804	283.6	3.8	139.3	265.3	-0.17	39.07	5.32
69	6/14/2022	Leg1	10:05:23 - 10:06:45	3.02	13.483	53.364	2384	273.2	13.5	315.1	57.5	0.04	30.72	5.57
70	6/14/2022	Leg2	10:07:05 - 10:08:20	3.12	13.479	53.366	2418	273.2	13.2	321.5	237.3	0.15	39.89	5.71
71	6/15/2022	Leg1	10:11:00 - 10:21:30	23	12.901	53.892	174	289.5	4.0	277.7	213.2	0.06	32.09	5.72
72	6/15/2022	Leg2	10:24:00 - 10:33:30	21.58	12.887	53.874	170	289.5	2.6	263.1	33.3	-0.05	31.46	5.42
73	6/15/2022	Leg3	13:48:10 - 13:58:00	23.13	13.284	53.882	244	290.6	3.5	318.8	197.3	0.07	33.28	5.74
74	6/15/2022	Leg4	14:00:40 - 14:10:30	22.67	13.281	53.874	247	290.6	2.3	280.2	17.4	0.2	34.87	5.90
75	6/15/2022	Leg5	14:22:15 - 14:32:30	25.22	12.916	53.884	249	290.6	3.1	337.7	213.0	0.26	34.78	6.05
76	6/15/2022	Leg6	14:35:00 - 14:46:30	23.33	12.913	53.88	239	290.8	2.3	327.9	33.3	-0.08	26.76	5.39

80 Table S4: General information about the difference in flight conditions between the outbound and return flights (legs). Δ values in this table indicate the absolute difference in median conditions between the unbound and the return flight. Symbology: lon = longitude, lat = latitude; T = temperature, M = median; $wspd$ = windspeed; alt = altitude; $wdir$ = wind direction, ψ = heading.

	leg 1	leg 2	flight_date	Δ(time)	Δ(alt)	Δ(T)	Δ(wspd)	Δ(wdir)	Δ(Ψ)
	-	-	m/d/yyyy	s	m.a.g.l.	°K	m/s	°	°
0	Leg1	Leg2	8/14/2017	50	27.56	0.6	0.3	1.1	-0.2
1	Leg3	Leg4	8/14/2017	77	18.79	0.06	0.2	1	0.1
2	Leg5	Leg6	8/14/2017	110	14.67	0.1	0.6	5.5	-3.1
3	Leg7	Leg8	8/14/2017	0	7.46	0.6	0.2	36.2	5.4
4	Leg9	Leg10	8/14/2017	70	171.62	1.3	0.0	7	-0.6
5	Leg1	Leg2	8/15/2017	230	18.27	0.24	1.6	3.8	22.0
6	Leg3	Leg4	8/15/2017	45	48.99	0.6	0.6	7.7	-5.4
7	Leg5	Leg6	8/15/2017	85	3.29	0.3	0.2	5.5	19.5
8	Leg7	Leg8	8/15/2017	175	40.4	0.7	0.7	0.6	4.8
9	Leg9	Leg10	8/15/2017	185	9.84	0.2	1.0	2.7	3.0
10	Leg11	Leg12	8/15/2017	145	13.8	0.1	0.2	1.8	-8.6
11	Leg1	Leg2	8/29/2018	93	27.3	0.4	0.9	0.1	17.6
12	Leg3	Leg4	8/29/2018	74	2.92	0	0.3	1.4	16.1
13	Leg6	Leg7	8/29/2018	120	8.76	0	0.7	2.9	-2.4
14	Leg1	Leg2	8/1/2019	30	12.94	0	0.5	6.7	-2.8
15	Leg1	Leg2	8/21/2019	60	8.97	0.1	0.1	3	2.7
16	Leg1	Leg2	9/4/2019	150	61.25	0.5	0.5	14.4	7.6
17	Leg3	Leg4	9/4/2019	102	18.64	0.2	0.8	4.5	8.1
18	Leg5	Leg6	9/4/2019	70	59.68	0.4	0.7	3	9.9
19	Leg7	Leg8	9/4/2019	136	120.79	0.7	0.9	3.7	9.8
20	Leg9	Leg10	9/4/2019	75	116.71	1	0.8	1	7.2
21	Leg11	Leg12	9/4/2019	70	111.05	0.7	0.6	10.7	6.0
22	Leg13	Leg14	9/4/2019	85	52.29	0.5	0.4	5.2	5.2
23	Leg15	Leg16	9/4/2019	78	122.64	0.9	0.7	4.4	6.8
24	Leg1	Leg2	9/5/2019	117	19.62	0.1	0.3	10.4	17.0
25	Leg3	Leg4	9/5/2019	102	46.7	0.4	0.4	3.2	16.7
26	Leg5	Leg6	9/5/2019	105	19.36	0.1	0.7	3.3	20.0
27	Leg7	Leg8	9/5/2019	68	12.41	0.1	0.5	0.6	16.4
28	Leg9	Leg10	9/5/2019	154	75.39	0.7	0.8	1.1	-13.8
29	Leg11	Leg12	9/5/2019	130	45.45	0.4	0.1	0.2	-11.8

	leg 1	leg 2	flight_date	Δ(time)	Δ(alt)	Δ(T)	Δ(wspd)	Δ(wdir)	Δ(Ψ)
	-	-	m/d/yyyy	s	m.a.g.l.	°K	m/s	°	°
30	Leg13	Leg14	9/5/2019	105	69.86	0.7	1.4	1.8	-12.1
31	Leg15	Leg16	9/5/2019	80	96.55	0.8	1.0	1.4	-10.5
32	Leg1	Leg2	5/4/2022	35	46.8	1	0.1	8.8	-5.7
33	Leg1	Leg2	6/14/2022	7	26.56	0	0.3	6.4	-36.9
34	Leg1	Leg2	6/15/2022	60	1.87	0	1.4	14.6	9.3
35	Leg3	Leg4	6/15/2022	0	1.64	0	1.2	38.6	4.9
36	Leg5	Leg6	6/15/2022	75	17.73	0.2	0.8	9.8	3.5

85

Table S5: General information about the performed pitching maneuvers, including general flight information (date, time height, groundspeed, true airspeed), meteorological conditions (windspeed, wind directions, and wind vector information) and the obtained calibration parameters for C_α. All wind parameters were calculated after calibration (using average calibration values for 2017/2018 and 2019 - and not with the parameters in the last column). Symbology: lon = longitude, lat = latitude; T = temperature; M = median; $wspd$ = windspeed; $wdir$ = wind direction; v_{gs}= groundspeed; v_{tas} = true airspeed; θ = Pitch angle; C_α = calibration value for alpha angle.

Table S5 part A

	Flight Date	Flight Time	time	distance	M(lon)	M(lat)	M(height)	M(T)	M(wspd)	M(wdir)
	-	hh:mm:ss	s	km	deg	deg	m.a.s.l.	°K	m/s	m/s
1	8/9/2017	17:08:06 - 17:09:08	62	1.73	12.559	52.125	2595.3	279.4	14.39	227.5
2	7/18/2018	10:40:15 - 10:41:37	82	2.36	12.48	52.171	2274.4	280.4	8.8	297.1
3	7/18/2018	10:43:31 - 10:44:33	62	2.74	12.474	52.191	2363.8	279.8	8.66	301.3
4	6/7/2018	18:24:50 - 18:26:17	87	2.58	12.665	52.081	650	295	6.26	114.6
5	9/21/2019	10:15:16 - 10:17:39	143	5.56	12.24	51.948	1036	286.8	0.92	308.4
6	9/21/2019	10:54:32 - 10:55:40	68	2.33	12.543	52.136	1034.9	287	1.49	309.3
7	6/14/2022	10:01:30 - 10:03:20	110	3.07	13.439	53.314	2224.4	274.4	12.24	319.2

Table S5 part B

	Flight Date	M(u)	M(v)	period	M(w)	σ(w)	M(gs)	min(θ)	max(θ)	Cα
	-	m/s	m/s	-	m/s	m/s		°	°	-
1	8/9/2017	10.51	9.7	8.9	1.15	0.25	28.3	-20.1	8.39	0.090
2	7/18/2018	7.93	-4.1	16.4	0.02	0.24	28.2	-27.3	17.08	0.105
3	7/18/2018	7.37	-4.5	12.4	0.38	0.17	43.5	-28	20.3	0.091
4	6/7/2018	-5.73	2.6	14.5	0.11	0.27	29.0	-21.5	12.83	0.093
5	9/21/2019	0.72	-0.6	11.0	0.12	0.15	38.9	-28.6	17.18	0.093
6	9/21/2019	1.13	-0.8	13.6	0.14	0.19	32.9	-30.5	23.57	0.090
7	6/14/2022	7.98	-9.3	18.3	0.25	0.23	27.7	-20.6	15.55	0.131

Supplement B: Vertical Flight Profiles

During several flights, vertical flight profiles were flown to determine the height of the atmospheric boundary layer. Here, we show four vertical profiles flown during two flights over Northeast Germany (flight dates: 29th of August 2018 and 21st of August 2019). Abrupt changes in atmospheric chemistry and potential temperature indicate the border of the atmospheric boundary layer.

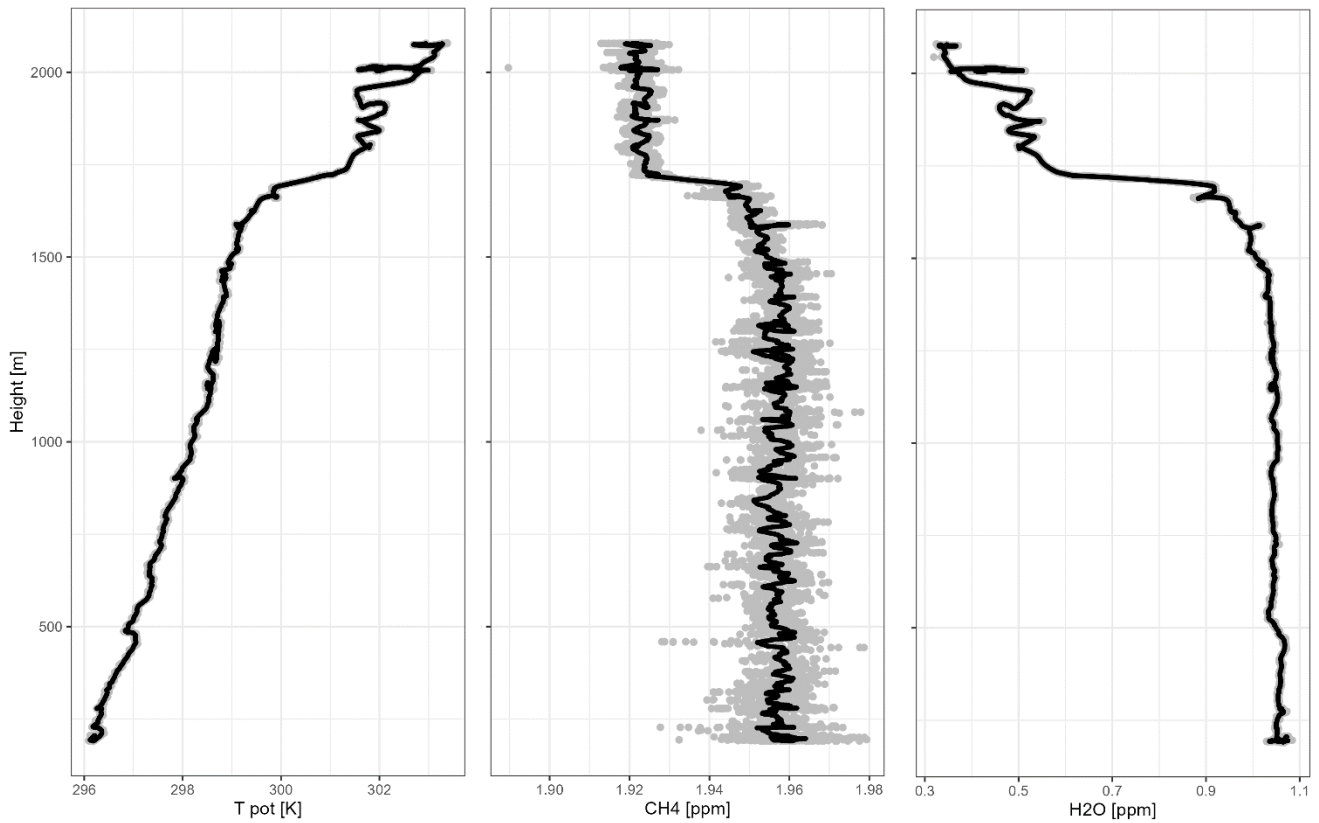



Figure S1: First vertical flight profile flown on the 29th of August 2018, close to Demmin, Germany (Mecklenburg-Vorpommern). This profile was flown to determine the height of the atmospheric boundary layer, which is defined by abrupt changes in CH_4, H_2O and potential Temperature. Grey dots indicate measured variability in concentrations/ temperature at a specific height whereas black lines indicate height averaged concentrations/ temperature. The y-axis represents the measurement height (altitude) above ground level.

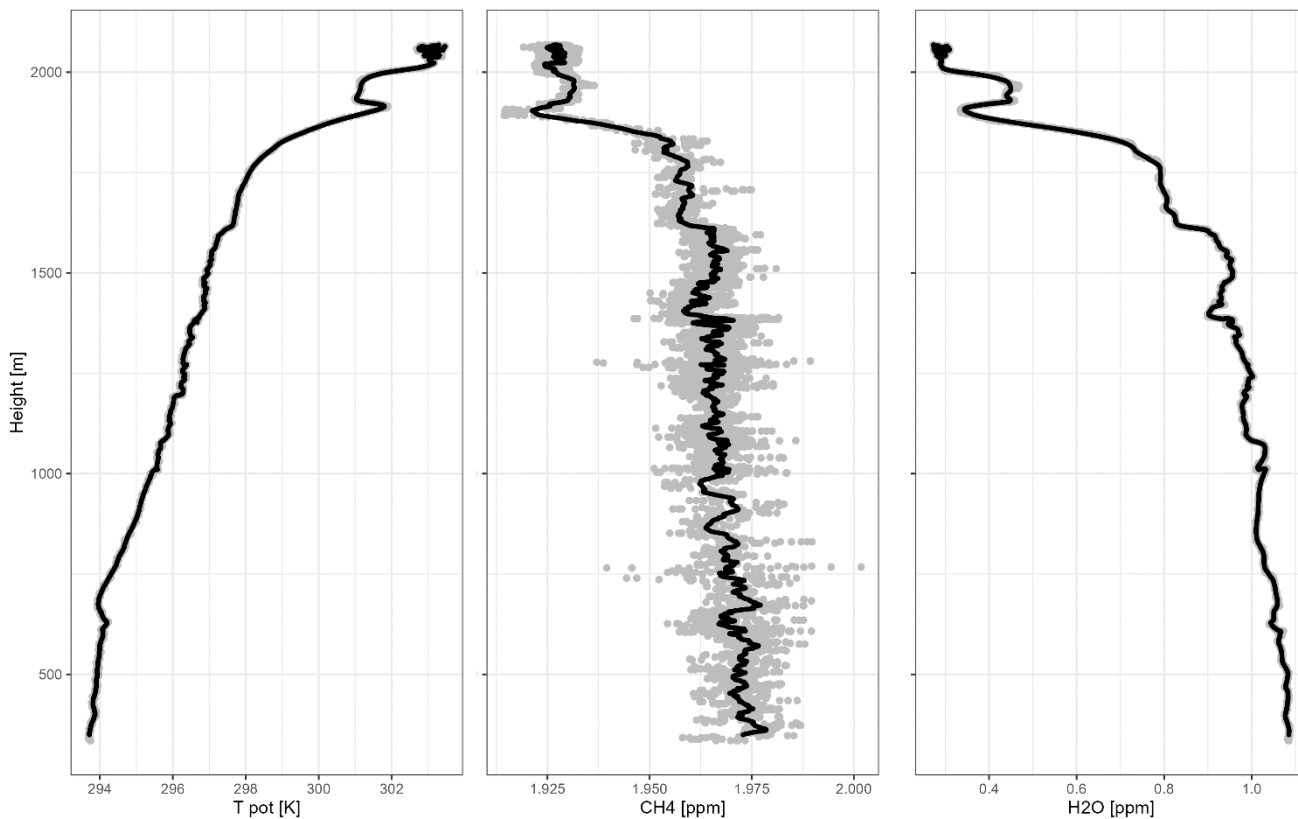
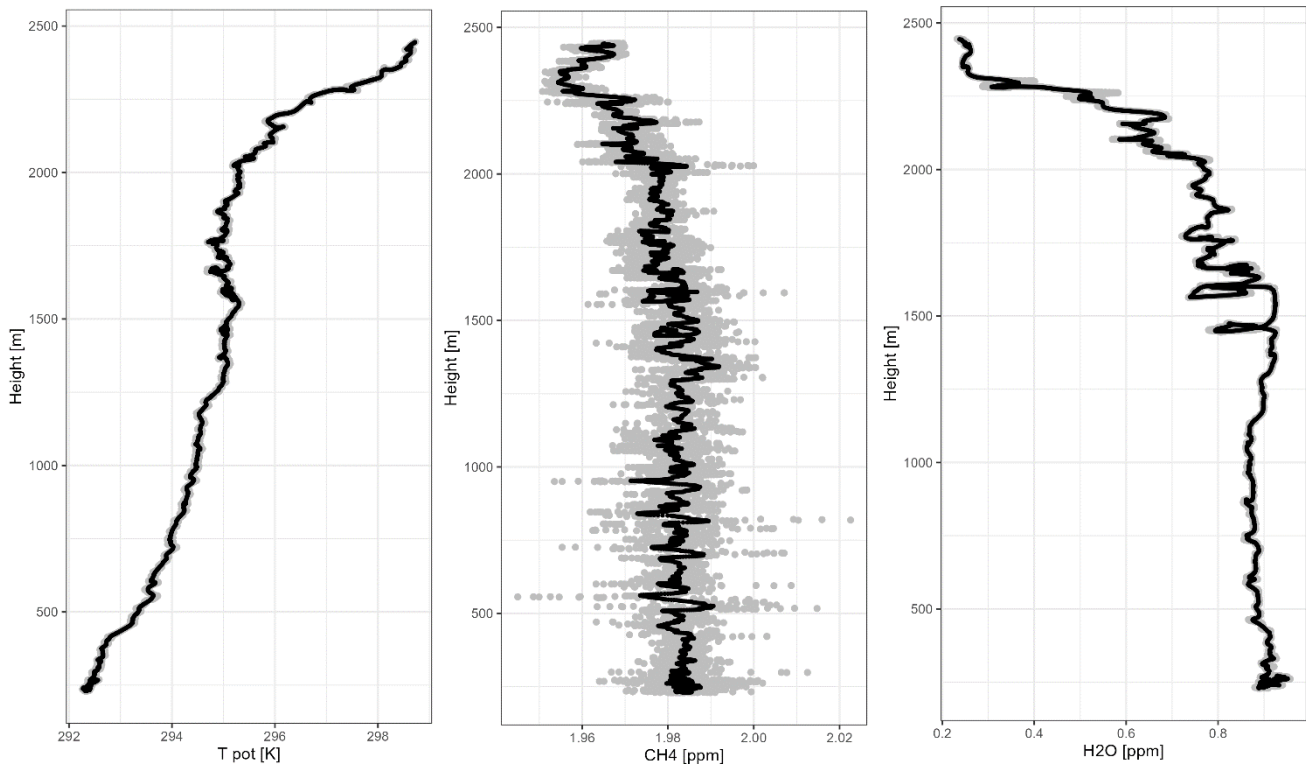



Figure S2: Second vertical flight profile flown on the 29th of August 2018, close to Demmin, Germany. This profile was flown to determine the height of the atmospheric boundary layer, which is defined by abrupt changes in CH_4, H_2O and potential Temperature. Grey dots indicate measured variability in concentrations/ temperature at a specific height whereas black lines indicate height averaged concentrations/ temperature. The y-axis represents the measurement height (altitude) above ground level.

135 **Figure S3:** First vertical flight profile flown on the 21st of August 2019, close to the Müritz national park in Germany. This profile was flown to determine the height of the atmospheric boundary layer, which is defined by abrupt changes in CH_4, H_2O and potential Temperature. Grey dots indicate measured variability in concentrations/ temperature at a specific height whereas black lines indicate height averaged concentrations/ temperature. The y-axis represents the measurement height (altitude) above ground level.

140

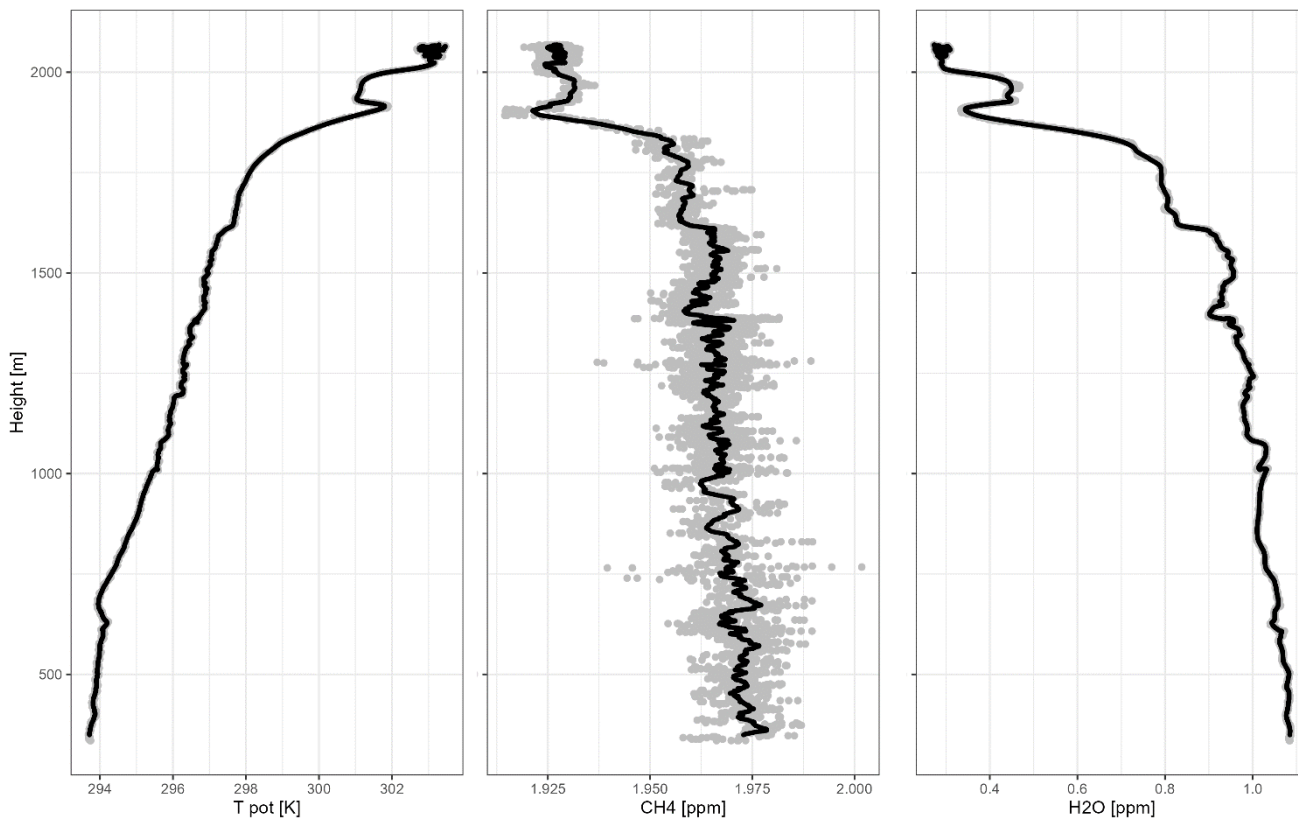



Figure S4: Second vertical flight profile flown on the 21st of August 2019, close to the Müritz national park in Germany. This profile was flown to determine the height of the atmospheric boundary layer, which is defined by abrupt changes in CH_4, H_2O and potential Temperature. Grey dots indicate measured variability in concentrations/ temperature at a specific height whereas black lines indicate height averaged concentrations/ temperature. The y-axis represents the measurement height (altitude) above ground level.

150