Supplement of Atmos. Meas. Tech., 17, 5731–5746, 2024
https://doi.org/10.5194/amt-17-5731-2024-supplement

Atmospheric Measurement Techniques
Open Access
EGU

Supplement of

Intercomparison of fast airborne ozone instruments to measure eddy covariance fluxes: spatial variability in deposition at the ocean surface and evidence for cloud processing

Randall Chiu et al.

Correspondence to: Randall Chiu (randall.chiu@colorado.edu) and Rainer Volkamer (rainer.volkamer@colorado.edu)

Date	RF	Subsection Number	Start Time UTC	End Time UTC	starting latitude	starting longitude
413	3-A	1	2022-04-13 19:16:43	2022-04-13 19:20:13	20.1280	-156.831
413		2	2022-04-13 19:24:56	2022-04-13 19:31:06	20.2879	-156.971
413	3-B	1	2022-04-13 20:45:33	2022-04-13 20:52:08	19.9928	-156.711
413		2	2022-04-13 20:57:53	2022-04-13 21:04:06	20.2338	-156.923
413		3	2022-04-13 21:14:01	2022-04-13 21:16:16	20.2172	-156.853
413		4	2022-04-13 21:17:20	2022-04-13 21:18:41	20.0569	-156.75
413	3-C	1	2022-04-13 22:29:35	2022-04-13 22:32:36	19.9831	-156.737
413		2	2022-04-13 22:38:15	2022-04-13 22:44:51	20.2377	-156.926
413		3	2022-04-13 22:46:02	2022-04-13 22:54:15	19.9664	-156.653
415	4-A	1	2022-04-15 21:16:20	2022-04-15 21:21:46	25.9755	-155.00
415		2	2022-04-15 21:22:12	2022-04-15 21:25:50	26.3548	-155.00
416	4-B	1	2022-04-16 00:51:13	2022-04-16 00:53:35	20.2486	-152.33
420	5-A	1	2022-04-20 20:56:06	2022-04-20 21:06:01	36.6096	-155.343
421	6-A	1	2022-04-21 19:39:47	2022-04-21 19:44:44	59.3743	-152.177
422	6-B	1	2022-04-22 02:28:59	2022-04-22 02:32:01	22.2292	-155.530
423	7-A	1	2022-04-23 21:43:30	2022-04-23 21:49:20	19.9951	-156.754
423		2	2022-04-23 21:52:40	2022-04-23 21:57:58	20.0846	-157.041
423		3	2022-04-23 22:04:07	2022-04-23 22:06:45	20.0292	-156.864
423		4	2022-04-23 22:11:24	2022-04-23 22:16:08	19.9505	-156.595

Table S1. Meterological conditions during flux legs.

alt (m)	air speed (m/s)	Ambient T (C)	MBL height (m)	wind (m/s)	qualitative cloudiness	JNO2 (1/s)	JO3 (1/s)	SNPP chlor-a (mg/m^3)	SST (C)	NO2 (pptv)	NO (pptv)	CO TDL (ppbv)
312	125	21.2	800	12.0	moderate low clouds	0.00918	2.12E-05	0.035	21.4	55.0	24.8	94.5
98.6	103	23.1	800	12.0	moderate low clouds	0.00918	2.25E-05	0.035	21.4	42.0	21.7	94.4
101	107	23.3	1500	11.2	light clouds	0.0101	3.72E-05	0.035	21.4	26.3	6.1	95
256	104	21.8	1500	12.3	light clouds	0.0102	3.88E-05	0.035	21.4	18.7	0	94.9
315	103	21.1	1500	13.9	light clouds	0.0111	4.42E-05	0.035	21.4	20.3	1.9	93.1
98	104	23.2	1500	12.8	light clouds	0.0109	4.26E-05	0.035	21.4	25.2	8.5	95
107	106	23.1	1000	12.3	mostly cloudy	0.0103	4.23E-05	0.035	21.4	21.4	15.4	96.3
889	106	17.7	1000	6.8	mostly cloudy	0.011	4.74E-05	0.035	21.4	23.6	16.7	90
476	107	20.9	1000	3.5	partly cloudy	0.011	4.88E-05	0.025	24.7	25.2	18.4	93.5
93.3	116	21.5	1000	9.4	partly cloudy	0.0101	3.30E-05	0.048	18.3	30.5	7.98	117.2
101	120	21.4	1000	8.0	partly cloudy	0.0104	3.49E-05	0.048	18.3	20.3	6.11	116.5
98.5	115	21.7	2400	10.7	partly cloudy	0.0077	2.18E-15	0.042	24.1	NA	NA	106.7
110	117	11.9	800	8.3	mostly clear	0.00996	2.81E-05	0.112	13.4	68.1	17.60	160
58	108	1.5	3000	5.7	mostly cloudy	0.005	3.52E-06	1.26	4.9	28.1	9.42	135.3
116	127	21.2	700	9.2	overcast	0.004367	5.14E-06	0.039	22.2	50.5	12.9	121.4
116	136	23.4	1700	11.7	mostly sunny	0.0107	4.76E-05	0.0468	18.3	9.91	10.10	100.1
464	119	20.3	1700	11.1	mostly sunny	0.011	5.11E-05	0.0468	18.3	12.9	4.25	99.8
778	136	17.9	1700	8.0	mostly sunny	0.0113	5.38E-05	0.0468	24.1	27.4	2.24	133.3
472	126	23.4	1000	3.0	mostly sunny	0.0107	4.86E-05	0.04765	25.7	13	0	101.6

	Fast O3				FAIRO 1				FAIRO 2			
leg	avg. (ppb)	range (ppb)	st. dev. (ppb)	% RSD	avg. (ppb)	range (ppb)	st. dev. (ppb)	% RSD	avg. (ppb)	range (ppb)	st. dev. (ppb)	% RSD
RF03-B-4	36.6	0.9	0.40	1.1	34.4	0.7	0.35	1.0	34.5	0.8	0.38	1.1
RF04-B-1	24.0	1.0	0.36	1.5	21.5	0.6	0.26	1.2	21.2	1.1	0.30	1.4
RF07-A-3	24.6	1.0	0.34	1.4	23.5	0.7	0.29	1.2	23.9	0.8	0.23	1.0
RF03-C-1	35.8	1.2	0.43	1.2	35.1	1.1	0.38	1.1	35.0	1.6	0.45	1.3
RF05-A-1	53.5	3.3	0.86	1.6	53.9	1.8	0.52	1.0	53.9	2.1	0.57	1.1
RF04-A-2	30.0	1.0	0.37	1.2	28.0	1.0	0.35	1.3	28.2	1.3	0.39	1.4
RF07-A-4	24.0	1.6	0.42	1.8	22.8	0.9	0.30	1.3	23.1	0.9	0.22	1.0
RF07-A-2	23.9	1.2	0.37	1.6	23.5	1.0	0.33	1.4	23.8	0.8	0.22	0.9
RF03-A-1	35.6	1.6	0.48	1.5	35.0	1.6	0.41	1.2	34.6	1.1	0.38	1.1
RF03-B-3	37.0	1.7	0.44	1.2	34.7	1.6	0.44	1.3	35.0	1.8	0.44	1.3
average				1.4				1.2				1.1

Table S2. Summary of instrument precision estimates from low-variability flux legs.

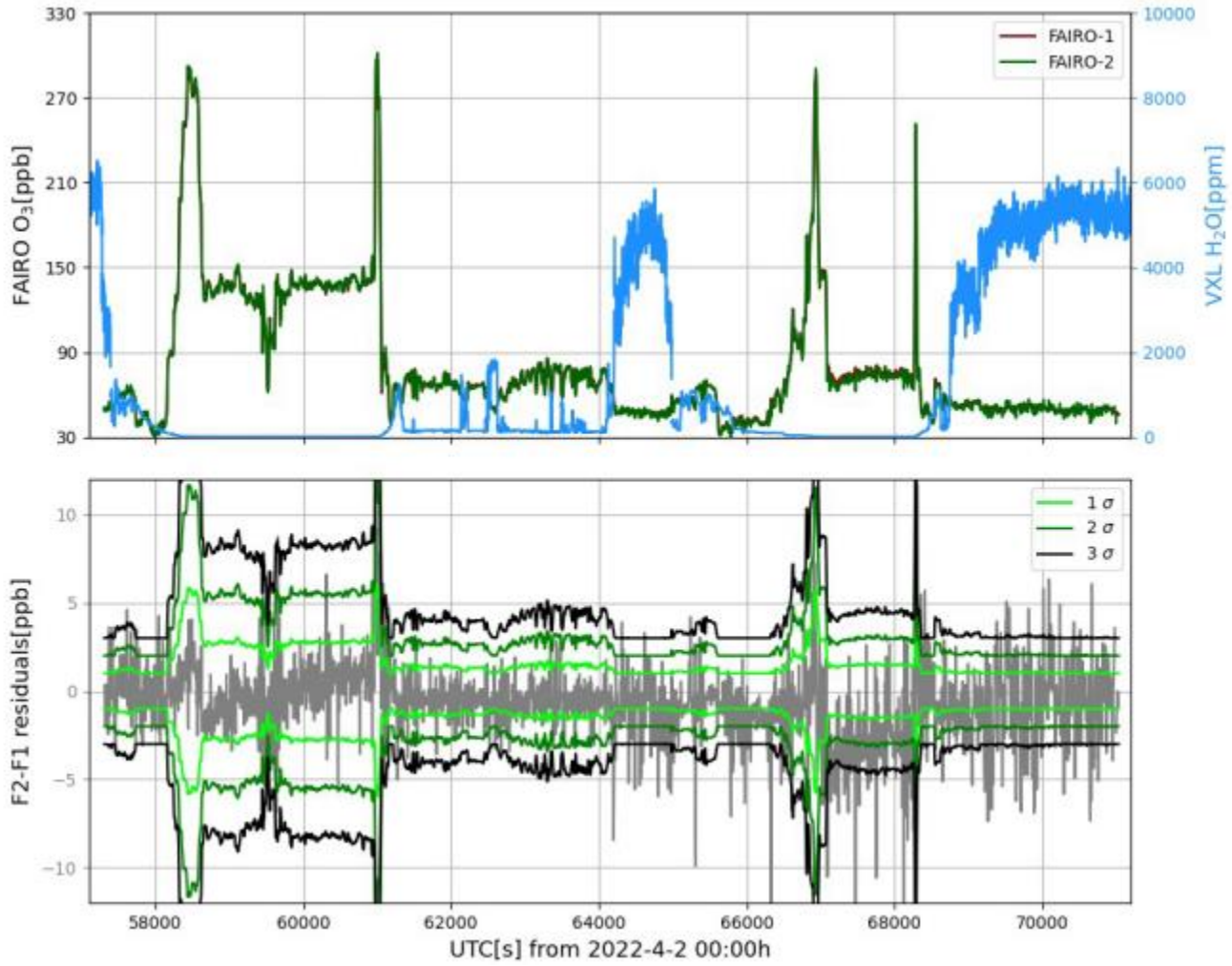

Figure S1: Potential for a small humidity interference of FAIRO uv photometers. At high H_2O VMR, when considerable RH variability occurs (top panel), a larger variability/noise is observed for O_3 in the difference "FAIRO-1 minus FAIRO-2" (bottom panel), e.g. for RF-01 at 64.000 – 65.000 s or after 69.000 s. This may be due to a (small) H_2O dependence of the dielectrical constant of air that influences Rayleigh scattering: a rapid increase of humidity leads to a higher H_2O VMR in the ambient air, corresponding to additional scattering and the retrieved O_3 concentration may be too high; the opposite happens when suddenly dry air is intersected.

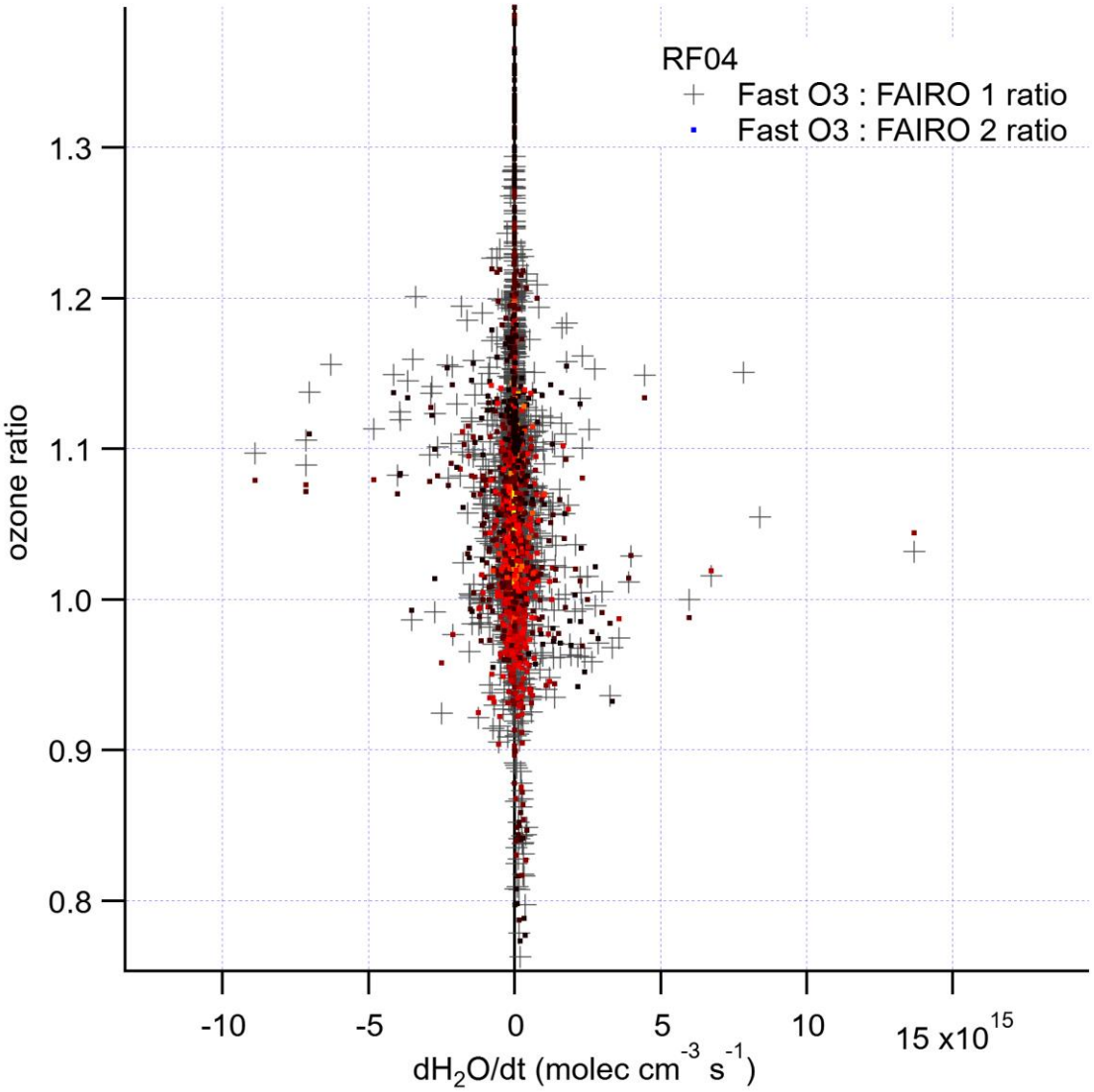

Figure S2: Effect of water vapor changes on Fast O3/FAIRO intercomparison. Ratio of Fast O3 to FAIRO 1 is shown as gray crosses. Ratio of Fast O3 to FAIRO 2 is shown as color-coded dots, with black dots indicating low ozone and hotter colors indicating higher ozone (color scale ends at 100 ppbv, yellow). Comparisons are calculated from data averaged over 10 s. No systematic behavior is observed.

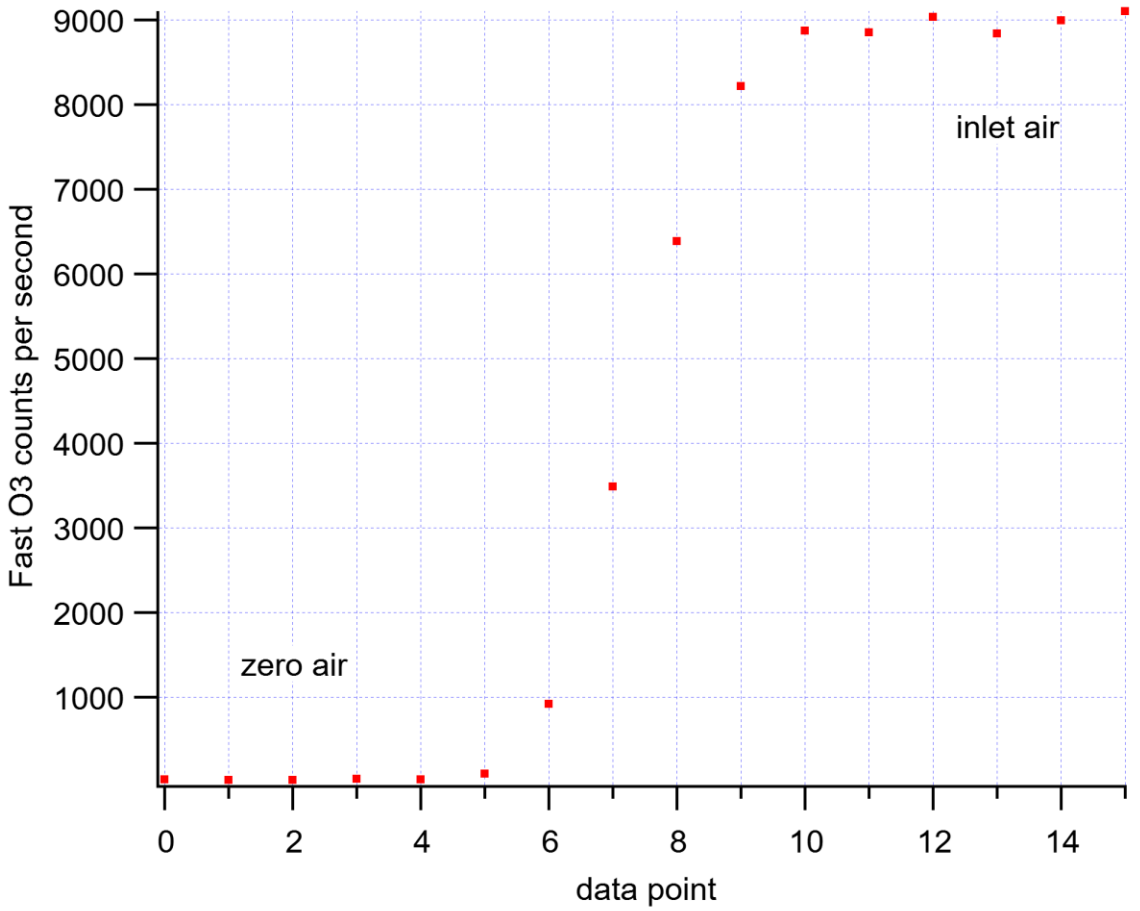

Figure S3: Fast O3 photon counts during valve-switching from zero air back to sampling outside air from the inlet. Data points are collected at 10 Hz.

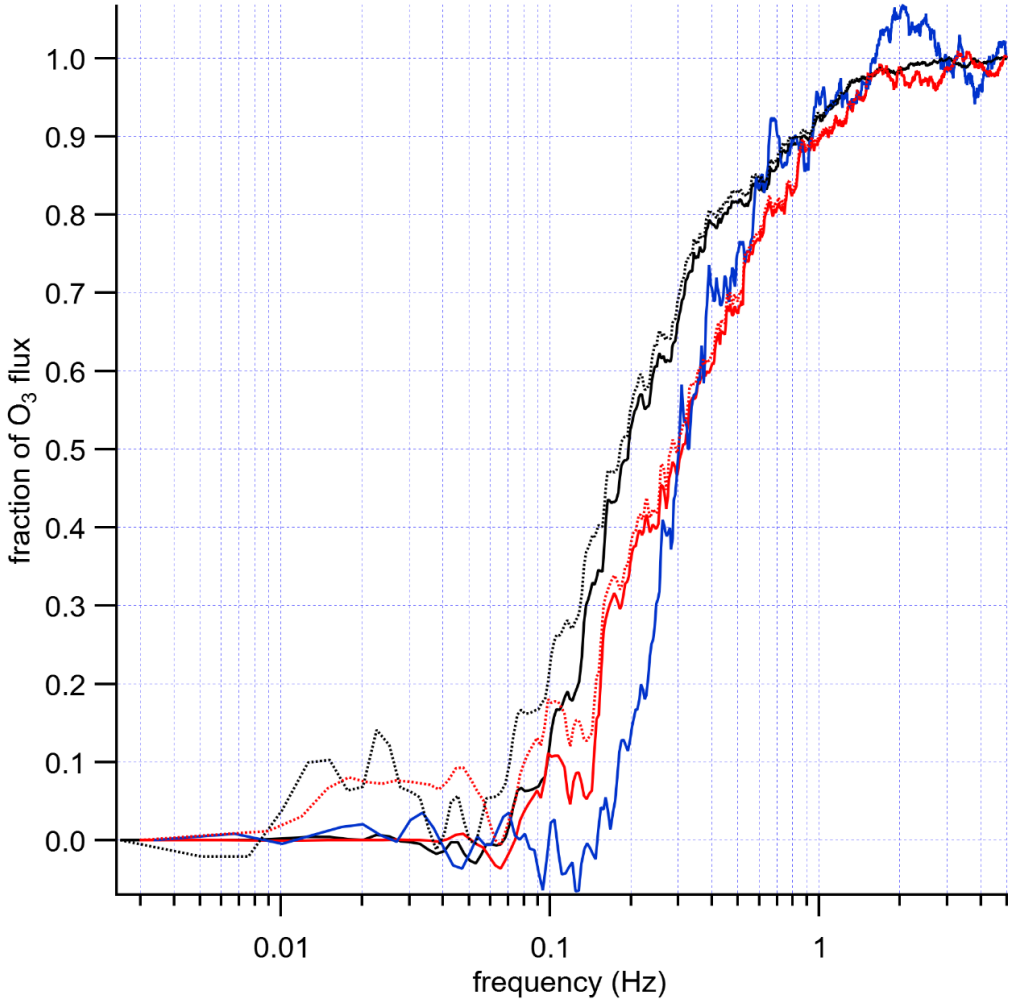

Figure S4: Cumulative frequency graphs (ogives) for RF03-C-2 (black), RF04-A-1 (red), and RF06-A-1 (blue) of the ozone fluxes from the Fast O3 instrument. Solid lines: detrended to 10 s; dotted lines: no detrending. Detrending eliminates fluxes over >10s time frames. Fluxes at frequencies >1 Hz account for ~10% of total flux. WA flux calculation for RF06-A-1 did not agree with EC flux without detrending, so detrended ogive for RF06-A-1 is not included.