

### **Supplemental Information 1. Calculation of bulk formula (BF) fluxes**

The location of the measurements and measured values of the water  $f\text{CO}_2$  are shown in Table S1. On each measurement day, the BF  $\text{CO}_2$  flux was determined as the weighted-average of the BF measurements (Schuepp et al., 1990), except for the data in October, in which the comparable EC measurement was excluded. In May, the direction of the footprint (measurement area) was toward the mouth of the Fukido River. The water  $f\text{CO}_2$  increased from the platform to the river mouth. The water  $f\text{CO}_2$  decreased at the platform from morning (366  $\mu\text{atm}$ ) to noon (46  $\mu\text{atm}$ ) and increased at the river mouth (1066  $\mu\text{atm}$  to 2067  $\mu\text{atm}$ , respectively). This temporal variation was attributable to photosynthesis and the increase in the inflow of river water associated with tidal exchange. The  $p\text{CO}_{2\text{water}}$  indicated that the lagoon was both a source and a sink of atmospheric  $\text{CO}_2$ , depending on the location within the lagoon and the time of day. In July, the wind direction changed abruptly, and the footprint changed from the river mouth to east of the platform. The value of  $f\text{CO}_2$  was extremely high (874–4810  $\mu\text{atm}$ ) compared to other seasons; thus, the measured BF  $\text{CO}_2$  flux indicated that the lagoon was a source of atmospheric  $\text{CO}_2$  in July. This result was probably related to flushing events, which increased the inflow of river water with high  $f\text{CO}_2$  and reduced water transparency and the photosynthetic rates of seagrass and phytoplankton (Nejrup and Pedersen, 2008). In September, in contrast, photosynthesis seemed to be active because  $f\text{CO}_2$  was low (<225  $\mu\text{atm}$ ). However, the wind speed was low during the day (<2  $\text{ms}^{-1}$ ); thus, the estimated BF  $\text{CO}_2$  flux was almost zero.



	Location data		Data on-site			Data at platform			
	Distance from EC (m)	Direction from the platform	Water temp. (°C)	Salinity	Water-fCO2 (µatm)	U10 (m/s)	Current speed (cm/s)	Water depth (m)	Air-fCO2 (µatm)
2014/5/29	6:15	100 210°	12.35	11.82	366.03	4.20	1.11	1.07	548.74
2014/5/29	6:55	500 ↓	11.55	7.72	1006.13	4.46	0.93	0.98	544.47
2014/5/29	7:31	1000 ↓	11.12	3.53	1065.77	3.92	1.64	0.81	500.54
2014/5/29	7:58	100 190°	11.85	9.29	752.57	3.92	1.64	0.81	500.54
2014/5/29	8:33	500 ↓	11.21	2.74	1399.77	4.25	2.92	0.63	448.09
2014/5/29	9:12	850 ↓	11.67	1.91	1115.98	4.00	4.67	0.55	429.94
2014/5/29	9:44	100 190°	12.36	5.20	728.38	3.87	5.08	0.47	421.51
2014/5/29	10:19	500 ↓	13.40	5.77	990.83	4.13	4.66	0.38	428.67
2014/5/29	10:55	650 ↓	13.78	0.48	1733.52	4.79	3.47	0.31	414.08
2014/5/29	11:24	50 190°	14.36	7.52	164.03	5.70	7.25	0.24	401.99
2014/5/29	11:56	100 ↓	15.03	9.17	258.39	6.19	6.23	0.17	398.31
2014/5/29	12:33	200 ↓	16.21	4.45	267.38	7.97	3.34	0.11	402.12
2014/5/29	12:53	400 ↓	16.86	1.92	2067.22	7.97	3.34	0.11	402.12
2014/5/29	12:53	400 190°	16.86	1.92	2067.22	7.97	3.34	0.11	402.12
2014/5/29	13:14	300 ↓	15.92	0.65	2116.47	8.28	0.77	0.15	401.43
2014/5/29	13:53	200 ↓	17.91	8.01	98.92	8.67	1.90	0.24	401.68
2014/5/29	14:11	100 ↓	16.55	9.65	46.10	9.04	1.12	0.34	402.46
2014/5/29	14:31	50 ↓	15.91	10.01	52.29	9.17	2.29	0.44	402.40
2014/7/15	6:40	1000 210°	17.98	1.01	3824.24	3.84	1.13	1.36	395.66
2014/7/15	7:07	500 ↓	18.61	1.93	3863.25	3.94	1.48	1.30	394.58
2014/7/15	7:30	100 ↓	18.14	3.01	3017.96	3.81	1.77	1.23	394.33
2014/7/15	7:53	50 ↓	18.74	5.32	3231.69	3.81	1.77	1.23	394.33
2014/7/15	8:22	1000 220°	17.15	0.26	3610.88	4.05	2.26	1.16	395.30
2014/7/15	8:49	500 ↓	17.33	0.42	3398.24	4.65	2.75	1.08	395.48
2014/7/15	9:15	100 ↓	18.22	2.68	3814.27	4.46	2.80	1.00	393.95
2014/7/15	9:45	50 ↓	18.51	2.56	3765.98	3.27	3.06	0.91	387.94
2014/7/15	10:11	1000 220°	17.60	0.05	4451.21	1.86	3.21	0.83	381.81
2014/7/15	10:36	500 ↓	18.57	0.17	4035.30	1.25	3.49	0.75	379.17
2014/7/15	11:05	1000 110°	16.45	3.11	2420.70	1.58	3.84	0.66	374.46
2014/7/15	11:29	500 ↓	19.31	2.10	3222.06	1.58	3.84	0.66	374.46
2014/7/15	11:55	100 ↓	19.44	3.32	2497.84	1.52	3.77	0.59	369.33
2014/7/15	12:18	50 ↓	20.12	3.65	2340.14	4.36	6.02	0.51	325.52
2014/7/15	13:26	500 180°	19.25	0.06	4808.75	1.72	6.53	0.00	336.01
2014/7/15	13:40	300 ↓	19.96	0.10	4130.18	2.92	6.53	0.00	336.86
2014/7/15	13:57	100 ↓	21.02	1.59	1426.57	2.92	6.53	0.00	336.86
2014/7/15	14:11	50 ↓	21.03	2.62	873.59	3.03	6.53	0.00	337.70
2014/9/21	9:47	100 ↓	17.77	18.23	182.30	2.04	10.98	0.41	384.56
2014/9/21	10:14	50 ↓	18.06	17.23	175.38	1.90	4.09	0.39	386.92
2014/9/21	10:57	1000 280°	18.53	18.45	224.57	1.56	2.50	0.40	386.70
2014/9/21	11:27	500 ↓	18.40	18.77	169.95	0.73	11.39	0.45	384.12
2014/9/21	11:54	100 ↓	18.60	17.23	124.71	0.15	11.18	0.52	383.09
2014/9/21	12:19	50 ↓	18.61	16.89	95.14	1.17	15.14	0.59	385.44
2014/9/21	13:39	1000 210°	19.74	14.10	32.51	0.45	11.28	0.81	376.87
2014/9/21	14:05	500 ↓	18.40	22.41	90.54	0.62	12.77	0.89	387.68
2014/9/21	14:29	100 ↓	18.11	23.08	128.94	0.62	12.77	0.89	387.68
2014/9/21	14:53	50 ↓	17.96	23.49	138.32	2.03	10.51	0.95	376.61

		Location data		Gas transfer velocity (cm/h)			Flux on-site ( $\mu$ mol/m <sup>2</sup> /s)			NF (%)	Weighted average of flux ( $\mu$ mol/m <sup>2</sup> /s)				
		Distance from EC (m)	Direction from the platform	W92	B04	M14	W92	B04	M14		W92	B04	M14		
2014/5/29	6:15	100	210°		6.87	13.58	10.82	-0.14	-0.26	-0.21		0.30%	-0.04	-0.09	-0.06
2014/5/29	6:55	500	↓		7.77	14.19	12.62	0.40	0.70	0.62		0.05%			
2014/5/29	7:31	1000	↓		5.99	13.56	9.12	0.39	0.84	0.57		0.02%			
2014/5/29	7:58	100	190°		5.99	13.56	9.12	0.17	0.36	0.24		0.29%			
2014/5/29	8:33	500	↓		7.05	15.66	11.18	0.78	1.65	1.18		0.07%	0.30	0.64	0.44
2014/5/29	9:12	850	↓		6.25	16.34	9.61	0.50	1.24	0.73		0.02%			
2014/5/29	9:44	100	190°		5.85	16.67	8.86	0.20	0.55	0.29		0.26%	0.36	0.87	0.55
2014/5/29	10:19	500	↓		6.65	17.65	10.39	0.42	1.07	0.63		0.07%			
2014/5/29	10:55	650	↓		8.97	19.13	15.10	1.38	2.80	2.21		0.04%			
2014/5/29	11:24	50	190°		12.67	25.18	23.26	-0.33	-0.63	-0.59		0.12%	0.33	0.30	0.72
2014/5/29	11:56	100	↓		14.93	27.38	28.57	-0.23	-0.40	-0.42		0.25%			
2014/5/29	12:33	200	↓		24.75	31.17	53.74	-0.37	-0.45	-0.78		0.18%			
2014/5/29	12:53	400	↓		24.75	31.17	53.74	4.69	5.64	9.72		0.08%			
2014/5/29	12:53	400	190°		24.75	31.17	53.74	4.69	5.64	9.72		0.08%	0.52	0.70	1.02
2014/5/29	13:14	300	↓		25.72	26.20	59.13	5.28	4.94	11.14		0.12%			
2014/5/29	13:53	200	↓		29.32	28.22	66.41	-0.97	-0.89	-2.09		0.18%			
2014/5/29	14:11	100	↓		31.84	27.44	73.63	-1.23	-1.01	-2.72		0.26%			
2014/5/29	14:31	50	↓		32.80	28.59	76.41	-1.25	-1.04	-2.77		0.09%			
2014/7/15	6:40	1000	210°		5.74	12.47	8.66	2.24	4.64	3.22		0.02%	1.79	3.85	2.56
2014/7/15	7:07	500	↓		6.05	12.99	9.24	2.37	4.86	3.45		0.05%			
2014/7/15	7:30	100	↓		5.66	12.89	8.51	1.67	3.63	2.39		0.29%			
2014/7/15	7:53	50	↓		5.66	12.89	8.51	1.78	3.86	2.54		0.17%			
2014/7/15	8:22	1000	220°		6.38	13.84	9.87	2.36	4.88	3.48		0.01%	2.53	5.23	3.81
2014/7/15	8:49	500	↓		8.42	15.73	13.96	2.90	5.17	4.58		0.06%			
2014/7/15	9:15	100	↓		7.75	15.38	12.59	2.99	5.65	4.63		0.23%			
2014/7/15	9:45	50	↓		4.18	12.99	5.82	1.59	4.57	2.11		0.13%			
2014/7/15	10:11	1000	220°		1.34	9.17	1.41	0.63	4.09	0.63		0.01%	0.33	3.25	0.30
2014/7/15	10:36	500	↓		0.61	7.95	0.53	0.26	3.16	0.21		0.04%			
2014/7/15	11:05	1000	110°		0.98	9.21	0.94	0.20	1.82	0.19		0.01%			
2014/7/15	11:29	500	↓		0.98	9.21	0.94	0.31	2.81	0.29		0.04%	0.78	2.84	1.11
2014/7/15	11:55	100	↓		0.90	9.27	0.85	0.21	2.10	0.19		0.24%			
2014/7/15	12:18	50	↓		7.42	18.17	11.91	1.66	3.87	2.54		0.18%			
2014/7/15	13:26	500	180°		1.16	nd	1.17	0.59	nd	0.57		0.02%	0.40	nd	0.54
2014/7/15	13:40	300	↓		3.33	nd	4.37	1.43	nd	1.80		0.09%			
2014/7/15	13:57	100	↓		3.33	nd	4.37	0.41	nd	0.51		0.35%			
2014/7/15	14:11	50	↓		3.57	nd	4.78	0.21	nd	0.27		0.42%			
2014/9/21	9:47	100	↓		1.62	15.14	1.78	-0.03	-0.30	-0.04		0.34%	-0.03	-0.26	-0.03
2014/9/21	10:14	50	↓		1.41	11.46	1.50	-0.03	-0.24	-0.03		0.51%			
2014/9/21	10:57	1000	280°		0.95	9.31	0.92	-0.02	-0.15	-0.01		0.01%	-0.01	-0.34	-0.01
2014/9/21	11:27	500	↓		0.21	11.53	0.14	0.00	-0.24	0.00		0.02%			
2014/9/21	11:54	100	↓		0.01	9.38	0.00	0.00	-0.24	0.00		0.16%			
2014/9/21	12:19	50	↓		0.53	12.73	0.44	-0.02	-0.36	-0.01		0.71%			
2014/9/21	13:39	1000	210°		0.08	8.58	0.04	0.00	-0.29	0.00		0.00%	-0.02	-0.25	-0.02
2014/9/21	14:05	500	↓		0.15	9.12	0.09	0.00	-0.26	0.00		0.01%			
2014/9/21	14:29	100	↓		0.15	9.12	0.09	0.00	-0.22	0.00		0.14%			
2014/9/21	14:53	50	↓		1.61	11.96	1.76	-0.04	-0.27	-0.04		0.21%			

## References of Supplemental Information

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