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Supplementary Table S1. Overall annual, seasonal, and daily medians of pH, total alkalinity (TA), salinity (sal) and temperature as well as calculated salinity normalized total alkalinity (nTA), aragonite saturation (Ω_{arg}), calcite saturation (Ω_{cal}), pCO_2 and dissolved inorganic carbon (DIC) for seawater samples collected daily over three months (March – May 2013) and weekly over the course of one year (May 2012 – May 2013) from Arthur Harbor, adjacent to Palmer Station, Antarctica.

		pH_T	TA (µmol kg^{-1} SW)	nTA (µmol kg^{-1} SW)	In situ temp. (°C)	Sal. (ppt)	Ω_{cal}	Ω_{arg}	pCO_2 (µatm)	DIC (µmol kg^{-1} SW)
Annual (May 2012–May 2013)	median	8.09	2295	2295	-0.06	35.0	2.51	1.58	334	2149
	max	8.62	2333	2333	2.38	36.2	7.23	4.55	418	2292
	min	8.00	2221	2221	-1.54	33.8	2.08	1.31	79	1874
Fall/winter (Mar–May/ Jun–Oct)	median	8.09	2295	2295	-0.85	35.0	2.42	1.52	340	2169
	max	8.16	2333	2374	2.24	36.2	2.93	1.85	418	2292
	min	8.00	2221	2151	-1.54	33.8	2.08	1.31	273	2046
Spring/summer (Nov–Dec/ Jan–Feb)	median	8.22	2291	2291	1.90	35.0	3.48	2.19	240	2076
	max	8.62	2329	2329	2.38	35.6	7.23	4.55	281	2148
	min	8.15	2239	2201	-0.70	35.0	2.91	1.83	79	1874
Daily (Mar–May 2013)	median	8.09	2282	2241	0.90	35.6	2.60	1.64	334	2137
	max	8.20	2352	2370	3.07	36.5	3.28	2.07	371	2277
	min	8.06	2207	2151	-0.43	34.0	2.42	1.52	256	2030

Supplementary Table S2. The median and minimum/maximum values for temporally overlapping data sets with 2 degrees of measurement resolution for measured pH, total alkalinity (TA) , salinity (sal) and temperature and for calculated salinity normalized total alkalinity (nTA), aragonite (Ω_{arg}), calcite (Ω_{cal}, pCO_2) and dissolved inorganic carbon (DIC) for seawater samples collected from Arthur Harbor, adjacent to Palmer Station, Antarctica, from May 2012 – May 2013. Absolute semidiurnal variation was recorded over the course of 24 h to quantify potential variation during the day and night experienced by marine organisms inhabiting the near-shore benthos on the western Antarctic Peninsula. Also shown is the percentage of days for which we calculated an overall increase (or decrease) in each parameter (day or night) between semidiurnal seawater sample collections.

		pH	TA (µmol kg^{-1} SW)	nTA (µmol kg^{-1} SW)	In situ temp. (°C)	Sal (ppt)	Ω_{cal}	Ω_{arg}	*p*CO2 (µatm)	DIC (µmol kg^{-1} SW)
Semidiurnal variation: day (Δ_{day})	median	0.02	17	29	0.25	0.3	0.12	0.08	14	13
	max	0.13	99	97	1.29	1.3	1.42	0.90	112	164
	min	0.00	2.1	0.4	0.00	0.0	0.00	0.00	0.0	0.0
Semidiurnal variation: night (Δ_{night})	median	0.02	21	37	0.36	0.3	0.16	0.10	14.7	25.4
	max	0.11	79	86	2.68	1.3	0.72	0.45	146	99
	min	0.00	0.4	5.2	0.00	0.00	0.00	0.00	0.7	0.7
Day (% incidence)	increase	26	56	59	29	47	34	34	53	55
	decrease	42	44	38	66	42	63	63	39	42
	no net change	32	0	3	5	11	3	3	8	3
Night (% incidence)	increase	29	56	63	62	37	26	26	60	66
	decrease	66	41	38	35	60	71	71	40	34
	no net change	6	3	0	3	3	3	3	0	0

Supplementary Table S3. Calculated monthly median variations (± 1 SD of measurement accuracy and propagated uncertainties) in salinity normalized dissolved inorganic carbon (ΔDIC_{obs}) at each sampling frequency due to air–sea CO_2 flux (ΔDIC_{as}) and biological activity (ΔDIC_{bio}). For the determination of these controls on the observed variations in dissolved inorganic carbon, see Eqns. 2-3. The monthly median variations are organized by sampling frequency and listed by month-year of sampling. For seawater samples collected semidiurnally, the variations calculated for daylight hours (d) and nighttime hours (n) are reported.

	Month	ΔDIC_{obs}	ΔDIC_{as}	ΔDIC_{bio}
Weekly (mmol C m^{-2} d^{-1})	May 2012	-0.003 ± 0.047	-2.7 ± 1.5	2.73 ± 0.01
	Jun 2012	0.001 ± 0.009	-8.1 ± 5.8	8.08 ± 0.03
	Jul 2012	0.000 ± 0.012	-5.0 ± 6.2	5.02 ± 0.03
	Aug 2012	0.001 ± 0.007	-9.0 ± 8.2	8.95 ± 0.01
	Sep 2012	-0.003 ± 0.058	-1.1 ± 3.5	1.06 ± 0.00
	Oct 2012	-0.003 ± 0.010	-0.4 ± 2.6	0.38 ± 0.01
	Nov 2012	-0.005 ± 0.232	-3.8 ± 6.7	3.81 ± 0.04
	Dec 2012	-0.004 ± 0.250	-3.2 ± 1.2	3.19 ± 0.02
	Jan 2013	-0.001 ± 0.014	-4.7 ± 3.7	4.73 ± 0.04
	Feb 2013	0.002 ± 0.029	-5.5 ± 3.8	5.47 ± 0.22
	Mar 2013	0.003 ± 0.032	-4.4 ± 4.5	4.37 ± 0.22
	Apr 2013	0.002 ± 0.009	-6.2 ± 4.4	6.19 ± 0.02
	May 2013	-0.001 ± 0.008	-4.8 ± 5.4	4.80 ± 0.03
Daily (mmol C m^{-2} d^{-1})	Mar 2013	-0.005 ± 0.035	0.2 ± 11.2	-0.23 ± 10.0
	Apr 2013	0.002 ± 0.025	1.3 ± 8.9	-1.24 ± 8.32
	May 2013	0.002 ± 0.019	2.6 ± 6.9	-2.60 ± 6.93
Diurnal (mmol C m^{-2} h^{-1})	Mar 2013 day	-0.006 ± 0.033	-0.3 ± 4.3	0.34 ± 0.03
	Mar 2013 night	0.022 ± 0.062	14.4 ± 44.6	-0.01 ± 0.02