

Auxiliary material for Arzeno et al., "Ocean variability contributing to basal melt rate near the ice front of the Ross Ice Shelf, Antarctica"

Extended tidal analyses and comparisons with regional tide model

In Tables T1 and T2, we present tidal coefficients for surface elevation and depth-averaged currents at M-1 and M-2, based on the regional inverse barotropic tide model CATS2008, the Circum-Antarctic Tidal Simulation, version 2008.

In Tables T3-T4, we provide tidal coefficients for analyses of GPS surface elevation records and individual current meters at the two ANDRILL mooring sites, M-1 (77°29.3' S, 171°34.3' E) and M-2 (77°34.9' S, 171°30.4' E). Tidal analyses were performed using the Matlab software package T_TIDE with linear trend removal [Pawlowicz *et al.*, 2002], which is based on Foreman [1977]. The typical record lengths of ~60 days are too short to explicitly resolve all major tidal constituents; therefore, we estimated the P1 and K2 tidal components using inference from K1 and S2 respectively, with amplitude-ratio and phase-offset parameters obtained from the ~238-day record of tidal elevation from the GPS station at M-2 (Table 4).

Table T1. Tidal elevation amplitude and phase predicted by CATS2008 at M-1 and M-2. Phase is given relative to Greenwich.

	<i>M-1</i>	<i>M-2</i>	<i>M-1</i>	<i>M-2</i>
<i>Const.</i>	<i>Amp (cm)</i>	<i>Amp (cm)</i>	<i>Phase (°)</i>	<i>Phase (°)</i>
<i>K1</i>	24.0	24.4	196	196
<i>O1</i>	22.3	22.6	181	181
<i>P1</i>	8.8	8.9	196	196
<i>Q1</i>	5.0	5.0	173	173
<i>M2</i>	2.9	2.8	17	16
<i>S2</i>	2.0	2.0	319	317

Table T2. Tidal ellipse parameters predicted by CATS2008 at M-1 and M-2. Inclination angle is measured counterclockwise from east. Phase is given in degrees relative to Greenwich.

<i>M-1</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	4.6	-0.9	105	283
<i>O1</i>	3.3	-0.9	104	259
<i>P1</i>	1.3	-0.3	101	279
<i>Q1</i>	0.7	-0.3	105	66
<i>M2</i>	0.9	-0.1	111	293
<i>S2</i>	0.8	0.0	107	67
<i>M-2</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	4.8	+0.0	100	289
<i>O1</i>	3.4	-0.2	98	266
<i>P1</i>	1.4	-0.1	95	284
<i>Q1</i>	0.7	-0.1	98	74
<i>M2</i>	0.9	0.0	104	297
<i>S2</i>	0.8	+0.1	101	69

Table T3. M-1 tidal ellipse parameters and 95% confidence limits for the five current meters listed in Table 3. The instruments are numbered by increasing depth: M-1.1 (226.4 m); M-1.2 (343.4 m); M-1.3 (457.4 m); M-1.4 (612.4 m); M-1.5 (777.4 m). Phase is given relative to Greenwich.

M-1.1	Major (cm s⁻¹)	Minor (cm s⁻¹)	Inclination (°)	Phase (°)
K1	6.0±0.5	1.2±0.7	85.1±7.7	309.0±5.6
O1	4.0±0.5	0.1±0.8	86.5±11.4	285.9±7.7
P1	1.9±0.5	0.4±0.9	85.1±23.8	305.2±16.7
Q1	1.0±0.5	0.8±0.5	157.1±82.3	354.0±92.4
M2	1.1±0.5	-0.2±0.5	12.5±32.7	26.8±26.3
S2	1.1±0.5	-0.2±0.6	23.5±32.5	343.6±28.7
M-1.2	Major (cm s⁻¹)	Minor (cm s⁻¹)	Inclination (°)	Phase (°)
K1	5.7±0.5	0.8±0.5	95.0±5.2	302.3±4.9
O1	4.1±0.5	-0.0±0.4	96.4±6.7	272.0±7.0
P1	1.8±0.5	0.3±0.5	95.0±14.5	298.6±14.7
Q1	0.7±0.5	0.2±0.4	97.7±53.3	262.6±47.2
M2	0.8±0.4	-0.3±0.3	76.3±26.7	330.6±32.7
S2	1.4±0.4	0.1±0.3	97.7±12.9	267.6±15.3
M-1.3	Major (cm s⁻¹)	Minor (cm s⁻¹)	Inclination (°)	Phase (°)
K1	5.1±0.7	0.5±0.6	111.2±6.6	301.1±7.4
O1	3.7±0.5	-0.5±0.6	108.6±9.1	275.2±9.4
P1	1.7±0.7	0.2±0.5	111.2±19.7	297.3±20.2
Q1	0.8±0.6	-0.1±0.6	120.9±39.5	242.2±50.4
M2	1.0±0.3	0.2±0.4	108.8±21.3	296.7±21.6
S2	1.0±0.4	-0.1±0.4	105.1±17.8	251.4±19.5
M-1.4	Major (cm s⁻¹)	Minor (cm s⁻¹)	Inclination (°)	Phase (°)
K1	5.7±0.5	0.4±0.4	94.8±3.7	299.5±5.6
O1	3.8±0.5	-0.2±0.4	94.9±5.9	269.9±6.8
P1	1.9±0.5	0.1±0.3	94.8±11.4	295.8±15.5
Q1	0.8±0.5	-0.0±0.4	103.6±23.2	256.9±34.9
M2	1.0±0.3	0.2±0.4	102.1±22.3	307.3±23.8
S2	1.1±0.3	0.4±0.4	92.5±23.3	254.5±20.4
M-1.5	Major (cm s⁻¹)	Minor (cm s⁻¹)	Inclination (°)	Phase (°)
K1	6.1±0.5	0.5±0.3	91.5±2.9	303.1±4.8
O1	4.2±0.5	-0.3±0.3	91.5±4.5	274.2±6.6
P1	2.0±0.5	0.2±0.3	91.6±10.0	299.4±15.5
Q1	0.8±0.5	-0.2±0.3	91.8±24.7	277.1±42.1
M2	0.7±0.3	-0.1±0.4	80.4±31.6	322.7±26.7
S2	1.1±0.3	0.2±0.4	103.0±19.4	234.9±15.8

Table T4. M-2 tidal ellipse parameters and the 95% confidence limits for the five current meters listed in Table 3. The instruments are numbered by increasing depth: M-2.1 (236 m); M-2.2 (390 m); M-2.3 (543 m); M-2.4 (691 m); M-2.5 (851.5 m). Phase is given relative to Greenwich.

<i>M-2.1</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	5.2±0.5	0.3±0.5	91.5±5.1	299.1±5.8
<i>O1</i>	3.9±0.5	-0.4±0.5	98.6±7.7	273.5±8.5
<i>P1</i>	1.7±0.6	0.1±0.5	91.5±16.4	295.4±18.2
<i>Q1</i>	0.9±0.4	-0.3±0.5	71.1±38.9	271.1±45.1
<i>M2</i>	0.7±0.5	-0.1±0.6	89.3±59.2	320.5±45.3
<i>S2</i>	0.5±0.4	-0.3±0.4	67.7±92.4	276.7±78.2
<i>M-2.2</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	4.5±0.4	0.3±0.6	96.6±6.5	298.4±5.8
<i>O1</i>	3.6±0.4	0.0±0.6	103.3±9.5	270.4±6.8
<i>P1</i>	1.5±0.5	0.1±0.6	96.6±23.4	294.7±16.8
<i>Q1</i>	0.9±0.4	-0.8±0.4	126.8±97.7	238.5±93.9
<i>M2</i>	0.8±0.3	-0.2±0.4	112.0±28.2	292.5±25.5
<i>S2</i>	1.0±0.3	0.0±0.3	85.8±24.6	288.1±19.5
<i>M-2.3</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	5.2±0.4	0.3±0.3	96.4±3.8	298.7±5.2
<i>O1</i>	4.0±0.4	-0.4±0.4	98.4±5.2	270.8±6.6
<i>P1</i>	1.7±0.5	0.1±0.3	96.4±12.1	295.0±18.0
<i>Q1</i>	0.9±0.5	-0.2±0.3	92.6±25.4	273.3±28.9
<i>M2</i>	0.7±0.2	-0.4±0.3	98.6±28.3	301.6±26.3
<i>S2</i>	1.2±0.2	-0.1±0.2	102.7±13.5	254.7±9.8
<i>M-2.4</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	5.4±0.7	0.1±0.6	93.7±5.4	297.7±6.0
<i>O1</i>	4.3±0.5	-0.3±0.5	95.8±7.8	270.9±8.4
<i>P1</i>	1.8±0.6	0.0±0.6	93.7±18.0	294.0±19.1
<i>Q1</i>	1.0±0.5	-0.4±0.5	84.2±35.4	266.2±41.9
<i>M2</i>	0.9±0.3	-0.1±0.3	96.5±17.8	306.7±17.4
<i>S2</i>	1.3±0.3	0.2±0.3	105.0±12.0	238.6±12.1
<i>M-2.5</i>	<i>Major (cm s⁻¹)</i>	<i>Major (cm s⁻¹)</i>	<i>Inclination (°)</i>	<i>Phase (°)</i>
<i>K1</i>	4.2±0.5	0.0±0.4	81.3±4.4	303.7±5.7
<i>O1</i>	3.6±0.4	-0.6±0.4	81.2±5.4	270.9±7.9
<i>P1</i>	1.4±0.4	0.0±0.3	81.3±15.2	299.9±17.3
<i>Q1</i>	0.9±0.3	-0.3±0.4	41.9±33.1	279.7±32.4
<i>M2</i>	0.3±0.1	0.1±0.2	87.5±38.8	282.6±33.4
<i>S2</i>	0.8±0.2	-0.0±0.2	82.2±14.1	224.2±12.0