

Supplement to “New determinations of tides on the northwest Ross Ice Shelf”

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This supplement assembles tables of tidal harmonic constants determined at the two tide-gauge stations Cape Roberts and Scott Base, and at a number of GPS stations located on the floating Ross Ice Shelf. Descriptions of the sea-level measurements and the methods for tidal analysis are given in the main paper. For most of the analyses, more coefficients were estimated than are given in these tables; constituents not included are of either small amplitudes—generally less than 1.5 mm, with occasional exceptions—or of amplitudes smaller than three times the estimated standard error. No long-period constituents are included for any of the GPS stations, since experience has shown many years of data are generally required to obtain reliable constants.

Ascii text files of these constants are available from the first author upon request.

The following tables make use of an ‘extended Doodson number,’ with the final digit indicating a multiplicative factor of 90° to be added to the argument. This allows an unambiguous definition of the tidal arguments. They should agree with those of Doodson & Warbug (1941).

The two tables for Cape Roberts and Scott Base are more comprehensive than those from the GPS analyses, since the time series are far longer. They include three constituents—one diurnal and two semidiurnal—arising from third-degree terms in the tidal potential; they are denoted here by prime symbols: M'_1 , N'_2 and L'_2 (in the main paper they are denoted with a leading superscript of 3). Another unusual item to mention is the terdiurnal S_3 , which here is most certainly of radiational origin and is accompanied by two large seasonal sidelines—dubbed T_3 and R_3 —that are larger than the central S_3 line, a common feature of the terdiurnal atmospheric tide (Ray & Poulouze, *J. Phys. Oceanogr.*, 2003).

Table S1: Harmonic constants for Cape Roberts.

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
Sa	056.5550	0.041069	21.0	60.0	5.1
Mm	065.4550	0.544375	16.8	176.2	2.7
Mf	075.5550	1.098033	30.4	191.5	2.2
Mt	085.4550	1.642408	6.2	199.8	1.5
α_1	117.6553	12.382765	2.5	177.1	0.3
2Q ₁	125.7553	12.854286	6.6	181.3	0.3
σ_1	127.5553	12.927140	8.6	184.2	0.3
Q ₁	135.6553	13.398661	47.0	190.2	0.3
ρ_1	137.4553	13.471515	9.1	191.2	0.3
O ₁	145.5553	13.943036	209.1	201.6	0.3
τ_1	147.5551	14.025173	2.8	208.1	0.2
M' ₁	155.5552	14.492052	3.5	173.1	0.3
M ₁	155.6551	14.496694	13.2	210.7	0.3
χ_1	157.4551	14.569548	2.4	213.4	0.3
π_1	162.5563	14.917865	2.9	230.9	0.4
P ₁	163.5553	14.958931	67.4	214.1	0.4
S ₁	164.5552	15.000000	2.2	268.9	0.4
K ₁	165.5551	15.041069	205.0	215.7	0.4
ϕ_1	167.5551	15.123206	2.1	230.0	0.4
J ₁	175.4551	15.585443	9.4	219.1	0.3
OO ₁	185.5551	16.139102	4.2	215.9	0.2
ϵ_2	227.6550	27.423834	4.1	199.1	0.1
2N ₂	235.7550	27.895355	8.9	211.8	0.2
μ_2	237.5550	27.968208	12.6	238.0	0.2
N' ₂	245.5551	28.435088	4.6	338.3	0.2
N ₂	245.6550	28.439730	38.3	263.0	0.1
ν_2	247.4550	28.512583	6.2	268.8	0.1
MA ₂	254.5550	28.943036	2.8	188.0	0.3
M ₂	255.5550	28.984104	54.1	6.8	0.3
MB ₂	256.5550	29.025173	1.6	159.3	0.3
L ₂	265.4552	29.528479	2.4	180.3	0.2
L' ₂	265.5553	29.533121	2.8	127.0	0.2
T ₂	272.5560	29.958933	4.6	263.9	0.2
S ₂	273.5550	30.000000	48.3	310.0	0.3
K ₂	275.5550	30.082137	18.0	314.0	0.3
η_2	285.4550	30.626512	3.1	36.9	0.2
MO ₃	345.5553	42.927140	4.1	17.6	0.1
M ₃	355.5552	43.476156	5.2	13.8	0.1
MK ₃	365.5551	44.025173	4.1	94.3	0.1
T ₃	381.5552	44.958931	13.1	92.7	0.2
S ₃	382.5552	45.000000	7.6	189.7	0.2
R ₃	383.5552	45.041069	13.2	295.6	0.2
MN ₄	445.6550	57.423834	3.0	146.5	0.1
M ₄	455.5550	57.968208	5.9	193.3	0.1
MS ₄	473.5550	58.984104	6.3	246.1	0.1
MK ₄	475.5550	59.066242	2.2	235.2	0.1
T ₄	490.5550	59.958931	2.0	304.8	0.1
R ₄	492.5550	60.041069	3.0	83.6	0.1

Table S2: Harmonic constants for Scott Base.

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
Sa	056.5550	0.041069	14.7	0.6	7.1
Mm	065.4550	0.544375	17.7	187.8	4.6
Mf	075.5550	1.098033	30.7	197.6	4.8
Mt	085.4550	1.642408	5.7	203.3	2.9
α_1	117.6553	12.382765	2.8	170.5	0.4
2Q ₁	125.7553	12.854286	7.2	171.7	0.4
σ_1	127.5553	12.927140	8.9	178.8	0.3
Q ₁	135.6553	13.398661	50.6	183.7	0.4
ρ_1	137.4553	13.471515	8.9	184.8	0.4
O ₁	145.5553	13.943036	227.0	193.5	0.3
τ_1	147.5551	14.025173	2.9	208.3	0.3
M' ₁	155.5552	14.492052	3.5	160.4	0.4
M ₁	155.6551	14.496694	15.5	201.9	0.3
χ_1	157.4551	14.569548	2.8	208.0	0.4
π_1	162.5563	14.917865	4.6	217.7	0.5
P ₁	163.5553	14.958931	79.4	205.5	0.5
S ₁	164.5552	15.000000	2.6	215.6	0.5
K ₁	165.5551	15.041069	245.6	207.5	0.5
ϕ_1	166.5541	15.082135	1.7	147.9	0.4
J ₁	167.5551	15.123206	3.1	207.4	0.4
θ_1	173.6551	15.512590	2.4	215.5	0.3
J ₁	175.4551	15.585443	10.9	213.7	0.3
OO ₁	185.5551	16.139102	4.4	209.3	0.2
ϵ_2	227.6550	27.423834	3.5	176.4	0.2
2N ₂	235.7550	27.895355	6.9	190.3	0.2
μ_2	237.5550	27.968208	9.8	215.5	0.2
N' ₂	245.5551	28.435088	3.7	316.2	0.2
N ₂	245.6550	28.439730	29.4	242.4	0.2
ν_2	247.4550	28.512583	4.9	246.1	0.2
MA ₂	254.5550	28.943036	2.3	156.3	0.4
M ₂	255.5550	28.984104	38.1	357.2	0.4
MB ₂	256.5550	29.025173	1.0	156.1	0.4
L ₂	265.4552	29.528479	1.9	155.1	0.2
L' ₂	265.5553	29.533121	2.1	114.2	0.2
T ₂	272.5560	29.958933	3.3	257.9	0.3
S ₂	273.5550	30.000000	34.9	293.6	0.3
K ₂	275.5550	30.082137	13.8	301.2	0.3
η_2	285.4550	30.626512	2.9	31.1	0.1
MO ₃	345.5553	42.927140	3.1	10.3	0.1
M ₃	355.5552	43.476156	4.1	9.6	0.1
MK ₃	365.5551	44.025173	3.4	90.8	0.1
T ₃	381.5552	44.958931	11.5	89.5	0.3
S ₃	382.5552	45.000000	6.7	184.6	0.3
R ₃	383.5552	45.041069	11.9	288.9	0.3
MN ₄	445.6550	57.423834	1.6	137.7	0.1
M ₄	455.5550	57.968208	3.3	187.5	0.1
MS ₄	473.5550	58.984104	3.5	240.6	0.1
R ₄	492.5550	60.041069	1.7	76.5	0.1

Table S3: Harmonic constants for Station WLLY

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	7.8	174.0	0.9
σ_1	127.5553	12.927140	9.0	172.2	0.9
Q ₁	135.6553	13.398661	48.1	183.9	0.9
ρ_1	137.4553	13.471515	9.1	194.8	0.9
O ₁	145.5553	13.943036	227.0	193.7	0.9
τ_1	147.5551	14.025173	2.8	213.0	0.7
M ₁	155.6551	14.496694	18.9	204.5	0.9
χ_1	157.4551	14.569548	3.5	228.3	0.9
π_1	162.5563	14.917865	5.2	211.0	0.8
P ₁	163.5553	14.958931	79.9	205.1	0.9
S ₁	164.5552	15.000000	3.0	254.6	0.9
K ₁	165.5551	15.041069	247.3	209.6	0.9
ϕ_1	167.5551	15.123206	3.3	208.4	1.0
J ₁	175.4551	15.585443	10.7	217.7	0.9
OO ₁	185.5551	16.139102	5.3	201.8	1.1
ϵ_2	227.6550	27.423834	3.4	175.0	0.4
2N ₂	235.7550	27.895355	6.6	192.3	0.4
μ_2	237.5550	27.968208	9.9	215.7	0.4
N ₂	245.6550	28.439730	28.7	246.5	0.4
ν_2	247.4550	28.512583	4.6	251.8	0.4
M ₂	255.5550	28.984104	38.0	349.3	0.6
L ₂	265.4552	29.528479	2.7	210.3	0.5
T ₂	272.5560	29.958933	3.7	253.9	0.5
S ₂	273.5550	30.000000	37.4	292.1	0.5
K ₂	275.5550	30.082137	11.4	280.4	0.5
MO ₃	345.5553	42.927140	2.7	347.4	0.4
M ₃	355.5552	43.476156	5.0	352.9	0.4
MK ₃	365.5551	44.025173	2.6	83.8	0.4
T ₃	381.5552	44.958931	12.2	83.4	0.5
S ₃	382.5552	45.000000	7.1	186.2	0.6
R ₃	383.5552	45.041069	11.4	284.6	0.6
M ₄	455.5550	57.968208	3.2	172.1	0.4

Table S4: Harmonic constants for Station WLLZ

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	8.1	173.3	1.3
σ_1	127.5553	12.927140	8.7	171.4	1.8
Q ₁	135.6553	13.398661	48.5	184.1	1.5
ρ_1	137.4553	13.471515	8.8	194.0	0.7
O ₁	145.5553	13.943036	227.2	193.7	0.9
τ_1	147.5551	14.025173	3.1	213.7	0.7
M ₁	155.6551	14.496694	18.4	204.7	0.7
χ_1	157.4551	14.569548	3.4	224.3	0.7
π_1	162.5563	14.917865	5.0	226.3	0.7
P ₁	163.5553	14.958931	79.6	205.2	0.7
S ₁	164.5552	15.000000	2.8	250.9	0.8
K ₁	165.5551	15.041069	244.7	208.4	0.8
ϕ_1	167.5551	15.123206	3.4	218.1	0.7
θ_1	173.6551	15.512590	2.8	228.3	0.7
J ₁	175.4551	15.585443	10.3	214.0	0.7
OO ₁	185.5551	16.139102	4.9	204.6	0.9
ϵ_2	227.6550	27.423834	3.3	169.6	0.5
2N ₂	235.7550	27.895355	6.8	189.8	0.7
μ_2	237.5550	27.968208	10.1	215.1	0.7
N ₂	245.6550	28.439730	28.5	245.3	0.5
ν_2	247.4550	28.512583	5.3	251.1	0.5
M ₂	255.5550	28.984104	37.2	348.7	0.5
L ₂	265.4552	29.528479	2.4	214.2	0.5
T ₂	272.5560	29.958933	2.3	261.2	0.5
S ₂	273.5550	30.000000	38.0	292.6	0.5
K ₂	275.5550	30.082137	14.4	300.9	0.7
MO ₃	345.5553	42.927140	3.0	351.0	0.5
M ₃	355.5552	43.476156	4.4	353.3	0.3
MK ₃	365.5551	44.025173	2.2	74.8	0.4
T ₃	381.5552	44.958931	12.1	83.6	0.3
S ₃	382.5552	45.000000	6.8	186.7	0.3
R ₃	383.5552	45.041069	11.1	284.0	0.4
M ₄	455.5550	57.968208	3.4	172.3	0.4

Table S5: Harmonic constants for Station LORG

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
α_1	117.6553	12.382765	5.2	127.2	1.3
2Q ₁	125.7553	12.854286	10.1	150.7	1.6
σ_1	127.5553	12.927140	9.1	176.9	1.6
Q ₁	135.6553	13.398661	51.7	179.5	1.4
ρ_1	137.4553	13.471515	10.6	186.8	1.4
O ₁	145.5553	13.943036	244.9	188.4	1.3
M ₁	155.6551	14.496694	19.4	202.7	1.1
π_1	162.5563	14.917865	6.0	186.1	1.3
P ₁	163.5553	14.958931	87.7	199.8	1.4
K ₁	165.5551	15.041069	265.0	202.4	1.5
J ₁	175.4551	15.585443	11.5	212.0	1.3
OO ₁	185.5551	16.139102	4.6	200.3	1.5
ϵ_2	227.6550	27.423834	3.2	154.3	0.7
2N ₂	235.7550	27.895355	5.5	182.1	0.7
μ_2	237.5550	27.968208	8.6	205.3	0.7
N ₂	245.6550	28.439730	23.3	234.2	0.7
ν_2	247.4550	28.512583	4.7	234.0	0.7
M ₂	255.5550	28.984104	28.0	343.7	0.7
L ₂	265.4552	29.528479	2.8	194.0	0.8
S ₂	273.5550	30.000000	29.8	288.2	0.8
R ₂	274.5542	30.041067	2.6	57.5	0.8
K ₂	275.5550	30.082137	17.0	238.9	0.9
MO ₃	345.5553	42.927140	3.1	346.3	0.6
M ₃	355.5552	43.476156	4.3	355.6	0.6
MK ₃	365.5551	44.025173	2.9	77.8	0.6
T ₃	381.5552	44.958931	11.4	77.0	0.9
S ₃	382.5552	45.000000	5.1	199.9	0.9
R ₃	383.5552	45.041069	11.4	274.4	0.9
M ₄	455.5550	57.968208	2.0	189.6	0.5

Table S6: Harmonic constants for Station PHNX

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
α_1	117.6553	12.382765	2.8	163.7	0.9
2Q ₁	125.7553	12.854286	8.0	176.9	0.9
σ_1	127.5553	12.927140	9.0	174.9	0.9
Q ₁	135.6553	13.398661	48.6	184.8	0.8
ρ_1	137.4553	13.471515	9.0	191.6	0.8
O ₁	145.5553	13.943036	226.9	194.9	0.8
τ_1	147.5551	14.025173	2.7	209.4	0.6
M ₁	155.6551	14.496694	18.7	206.8	0.8
χ_1	157.4551	14.569548	3.4	218.8	0.8
π_1	162.5563	14.917865	5.1	218.3	0.7
P ₁	163.5553	14.958931	78.7	206.4	0.8
S ₁	164.5552	15.000000	3.1	228.7	0.8
K ₁	165.5551	15.041069	241.9	209.1	0.8
ϕ_1	167.5551	15.123206	3.7	216.5	0.7
J ₁	175.4551	15.585443	11.0	217.9	0.8
OO ₁	185.5551	16.139102	5.2	205.9	1.0
ϵ_2	227.6550	27.423834	3.1	176.8	0.4
2N ₂	235.7550	27.895355	7.1	194.7	0.4
μ_2	237.5550	27.968208	10.4	215.8	0.4
N ₂	245.6550	28.439730	29.8	247.5	0.4
ν_2	247.4550	28.512583	5.1	253.1	0.4
M ₂	255.5550	28.984104	39.6	348.6	0.6
L ₂	265.4552	29.528479	2.3	215.6	0.6
T ₂	272.5560	29.958933	3.2	265.2	0.5
S ₂	273.5550	30.000000	39.1	291.7	0.5
K ₂	275.5550	30.082137	19.3	272.8	0.6
MO ₃	345.5553	42.927140	3.1	350.5	0.5
M ₃	355.5552	43.476156	5.0	355.5	0.5
MK ₃	365.5551	44.025173	2.7	87.8	0.5
T ₃	381.5552	44.958931	12.2	82.1	0.5
S ₃	382.5552	45.000000	7.2	183.0	0.5
R ₃	383.5552	45.041069	11.7	283.1	0.5
M ₄	455.5550	57.968208	3.4	169.8	0.4

Table S7: Harmonic constants for Station BATG

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
α_1	117.6553	12.382765	3.4	153.0	1.1
2Q ₁	125.7553	12.854286	10.4	167.2	1.1
σ_1	127.5553	12.927140	10.8	170.6	1.0
Q ₁	135.6553	13.398661	56.0	176.7	1.0
ρ_1	137.4553	13.471515	11.7	185.1	1.0
O ₁	145.5553	13.943036	262.5	186.8	1.0
τ_1	147.5551	14.025173	3.5	200.4	0.8
M ₁	155.6551	14.496694	21.9	187.8	1.3
χ_1	157.4551	14.569548	3.6	199.1	1.0
π_1	162.5563	14.917865	5.3	212.1	0.9
P ₁	163.5553	14.958931	96.0	200.3	0.9
K ₁	165.5551	15.041069	298.5	201.3	1.0
ϕ_1	167.5551	15.123206	5.5	196.9	0.9
θ_1	173.6551	15.512590	3.6	227.6	1.0
J ₁	175.4551	15.585443	13.7	209.2	1.0
ϵ_2	227.6550	27.423834	2.2	132.5	0.4
2N ₂	235.7550	27.895355	4.9	152.6	0.3
μ_2	237.5550	27.968208	7.9	174.3	0.3
N ₂	245.6550	28.439730	21.9	205.2	0.3
ν_2	247.4550	28.512583	3.1	211.8	0.3
MA ₂	254.5550	28.943036	2.0	139.9	0.5
M ₂	255.5550	28.984104	18.6	321.9	0.5
MB ₂	256.5550	29.025173	1.1	91.1	0.5
S ₂	273.5550	30.000000	21.3	254.3	0.4
K ₂	275.5550	30.082137	4.4	265.9	0.4
MO ₃	345.5553	42.927140	2.1	353.5	0.3
M ₃	355.5552	43.476156	3.0	339.8	0.3
MK ₃	365.5551	44.025173	2.1	83.2	0.4
T ₃	381.5552	44.958931	9.1	74.9	0.3
S ₃	382.5552	45.000000	6.1	175.2	0.3
R ₃	383.5552	45.041069	9.6	277.1	0.5

Table S8: Harmonic constants for Station DRIL

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	7.8	161.8	0.5
σ_1	127.5553	12.927140	9.0	166.1	0.5
Q ₁	135.6553	13.398661	49.3	173.8	0.5
ρ_1	137.4553	13.471515	8.9	185.6	0.5
O ₁	145.5553	13.943036	220.8	184.1	0.5
τ_1	147.5551	14.025173	2.6	189.3	0.5
M ₁	155.6551	14.496694	16.1	198.9	0.6
χ_1	157.4551	14.569548	3.0	180.5	0.6
π_1	162.5563	14.917865	5.6	172.1	0.7
P ₁	163.5553	14.958931	79.9	196.8	0.6
K ₁	165.5551	15.041069	247.9	196.2	0.7
ψ_1	166.5541	15.082135	2.2	55.6	0.6
ϕ_1	167.5551	15.123206	3.0	154.9	0.6
θ_1	173.6551	15.512590	2.9	183.1	0.7
J ₁	175.4551	15.585443	11.7	198.1	0.7
OO ₁	185.5551	16.139102	4.8	221.6	0.6
2N ₂	235.7550	27.895355	5.1	190.6	0.6
μ_2	237.5550	27.968208	7.6	214.8	0.6
N ₂	245.6550	28.439730	20.7	247.2	0.4
ν_2	247.4550	28.512583	4.6	256.7	0.4
MA ₂	254.5550	28.943036	1.5	172.8	0.5
M ₂	255.5550	28.984104	35.2	5.2	0.4
L ₂	265.4552	29.528479	3.1	157.8	0.4
T ₂	272.5560	29.958933	3.5	270.7	0.4
S ₂	273.5550	30.000000	31.3	300.5	0.4
K ₂	275.5550	30.082137	13.1	310.5	0.5
η_2	285.4550	30.626512	2.0	77.2	0.5
MO ₃	345.5553	42.927140	2.6	20.6	0.5
M ₃	355.5552	43.476156	3.6	3.1	0.5
MK ₃	365.5551	44.025173	3.5	86.5	0.5
T ₃	381.5552	44.958931	11.3	89.8	0.8
S ₃	382.5552	45.000000	6.0	180.2	0.8
R ₃	383.5552	45.041069	10.6	288.1	0.8
M ₄	455.5550	57.968208	3.3	196.2	0.3

Table S9: Harmonic constants for Station NASC

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	9	103	4
Q ₁	135.6553	13.398661	61	117	10
O ₁	145.5553	13.943036	284	134	14
M ₁	155.6551	14.496694	20	153	2
P ₁	163.5553	14.958931	114	167	5
K ₁	165.5551	15.041069	342	170	14
J ₁	175.4551	15.585443	17	181	5
M ₂	255.5550	28.984104	25	17	15

Table S10: Harmonic constants for Station NASS

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	9	96	2
Q ₁	135.6553	13.398661	60	114	8
O ₁	145.5553	13.943036	282	135	10
M ₁	155.6551	14.496694	20	155	1
P ₁	163.5553	14.958931	112	169	3
K ₁	165.5551	15.041069	334	171	10
J ₁	175.4551	15.585443	15	181	3
M ₂	255.5550	28.984104	25	27	10

Table S11: Harmonic constants for Station R13A

Tide	Doodson number	Frequency (°/h)	Amp (mm)	Phase (deg)	σ (mm)
2Q ₁	125.7553	12.854286	8	102	2
Q ₁	135.6553	13.398661	57	120	8
O ₁	145.5553	13.943036	273	139	10
M ₁	155.6551	14.496694	20	159	1
P ₁	163.5553	14.958931	108	175	4
K ₁	165.5551	15.041069	320	177	10
J ₁	175.4551	15.585443	15	191	4
M ₂	255.5550	28.984104	22	29	10