

CHAPTER 10 TIDAL VARIATIONS IN THE EARTH'S ROTATION

Periodic variations in UT1 due to tidal deformation of the polar moment of inertia have been derived (Yoder, et al., 1981) including the tidal deformation of the Earth with a decoupled core. This model leads to effective Love numbers that differ from the bulk value of 0.301 because of the oceans and the fluid core giving rise to different theoretical values of the ratio k/C for the fortnightly and monthly terms. However, Yoder, et al., recommend the value of 0.94 for k/C for both cases.

Oceanic tides also cause variations in UT1 represented by models given by Brosche, et al., (1991, 1989) and Dickman (1991a, 1991b, 1990, 1989). The contribution of the oceanic tides is split into a part which is in phase with the solid Earth tides and an out-of-phase part. The oceanic tides also cause variations in the rotation of the Earth at diurnal and semi-diurnal frequencies.

Table 10.2, below, is composed of the tidal coefficients derived from Yoder, et al., (1981) modified by the ocean effects derived from Dickman (1991b). To avoid possible confusion with corrections recommended previously in IERS Technical Note 3, it is recommended that the terms $UT1S$, ΔS , ωS , be used to denote the use of the tide series contained in Table 10.2. In this way then, the term $UT1R$ refers to the use of Table 11.1 in IERS Technical Note 3 which is reproduced below as Table 10.1.

Table 10.1. Zonal Tide Terms With Periods Up to 35 Days. UT1R, ΔR , and ωR represent the regularized forms of UT1, the duration of the day Δ , and the angular velocity of the Earth, ω . The units are 10^4 s for UT, 10^3 s for Δ , and 10^{-14} rad/s for ω .

ARGUMENT*					PERIOD	UT1-UT1R	$\Delta-\Delta R$	$\omega-\omega R$
l	l'	F	D	Ω	Days	Coefficient of Sin (Argument)	Coefficient of Cos (Argument)	
1	0	2	2	2	5.64	-0.02	0.3	-0.2
2	0	2	0	1	6.85	-0.04	0.4	-0.3
2	0	2	0	2	6.86	-0.10	0.9	-0.8
0	0	2	2	1	7.09	-0.05	0.4	-0.4
0	0	2	2	2	7.10	-0.12	1.1	-0.9
1	0	2	0	0	9.11	-0.04	0.3	-0.2
1	0	2	0	1	9.12	-0.41	2.8	-2.4
1	0	2	0	2	9.13	-0.99	6.8	-5.8
3	0	0	0	0	9.18	-0.02	0.1	-0.1
-1	0	2	2	1	9.54	-0.08	0.5	-0.5
-1	0	2	2	2	9.56	-0.20	1.3	-1.1
1	0	0	2	0	9.61	-0.08	0.5	-0.4
2	0	2	-2	2	12.81	0.02	-0.1	0.1
0	1	2	0	2	13.17	0.03	-0.1	0.1
0	0	2	0	0	13.61	-0.30	1.4	-1.2
0	0	2	0	1	13.63	-3.21	14.8	-12.5
0	0	2	0	2	13.66	-7.76	35.7	-30.1
2	0	0	0	-1	13.75	0.02	-0.1	0.1
2	0	0	0	0	13.78	-0.34	1.5	-1.3
2	0	0	0	1	13.81	0.02	-0.1	0.1
0	-1	2	0	2	14.19	-0.02	0.1	-0.1
0	0	0	2	-1	14.73	0.05	-0.2	0.2
0	0	0	2	0	14.77	-0.73	3.1	-2.6
0	0	0	2	1	14.80	-0.05	0.2	-0.2
0	-1	0	2	0	15.39	-0.05	0.2	-0.2
1	0	2	-2	1	23.86	0.05	-0.1	0.1
1	0	2	-2	2	23.94	0.10	-0.3	0.2
1	1	0	0	0	25.62	0.04	-0.1	0.1
-1	0	2	0	0	26.88	0.05	-0.1	0.1
-1	0	2	0	1	26.98	0.18	-0.4	0.3
-1	0	2	0	2	27.09	0.44	-1.0	0.9
1	0	0	0	-1	27.44	0.53	-1.2	1.0
1	0	0	0	0	27.56	-8.26	18.8	-15.9
1	0	0	0	1	27.67	0.54	-1.2	1.0
0	0	0	1	0	29.53	0.05	-0.1	0.1
1	-1	0	0	0	29.80	-0.06	0.1	-0.1
-1	0	0	2	-1	31.66	0.12	-0.2	0.2
-1	0	0	2	0	31.81	-1.82	3.6	-3.0
-1	0	0	2	1	31.96	0.13	-0.3	0.2
1	0	-2	2	-1	32.61	0.02	0.0	0.0
-1	-1	0	2	0	34.85	-0.09	0.2	-0.1

* l = $134^{\circ}96 + 13^{\circ}064993$ (MJD-51544.5) Mean Anomaly of the Moon
l' = $357^{\circ}53 + 0^{\circ}985600$ (MJD-51544.5) Mean Anomaly of the Sun
F = $93^{\circ}27 + 13^{\circ}229350$ (MJD-51544.5) L- Ω : L: Mean Longitude of the Moon
D = $297^{\circ}85 + 12^{\circ}190749$ (MJD-51544.5) Mean Elongation of the Moon from the Sun
 Ω = $125^{\circ}04 - 0^{\circ}052954$ (MJD-51544.5) Mean Longitude of the Ascending Node of the Moon

Table 10.2. Zonal Tide Terms. UT1S, ΔS , and ωS represent the regularized forms of UT1, the duration of the day Δ , and the angular velocity of the Earth, ω . The units are 10^{-4} s for UT, 10^5 s for Δ , and 10^{-4} rad/s for ω .

ARGUMENT*					PERIOD	UT1-UT1S		Δ - ΔS		ω - ωS	
l	l'	F	D	Ω	Days	Sin	Cos	Coefficient of			
								Cos	Sin	Cos	Sin
1	0	2	2	2	5.64	-0.02		0.3		-0.2	
2	0	2	0	1	6.85	-0.04		0.4		-0.3	
2	0	2	0	2	6.86	-0.10		0.9		-0.8	
0	0	2	2	1	7.09	-0.05		0.4		-0.4	
0	0	2	2	2	7.10	-0.12		1.1		-0.9	
1	0	2	0	0	9.11	-0.04		0.3		-0.2	
1	0	2	0	1	9.12	-0.40	0.01	2.7	0.1	-2.3	-0.1
1	0	2	0	2	9.13	-0.98	0.03	6.7	0.2	-5.7	-0.2
3	0	0	0	0	9.18	-0.02		0.1		-0.1	
-1	0	2	2	1	9.54	-0.08		0.5		-0.5	
-1	0	2	2	2	9.56	-0.20		1.3		-1.1	
1	0	0	2	0	9.61	-0.08		0.5		-0.4	
2	0	2	-2	2	12.81	0.02		-0.1		0.1	
0	1	2	0	2	13.17	0.03		-0.1		0.1	
0	0	2	0	0	13.61	-0.30		1.4		-1.2	
0	0	2	0	1	13.63	-3.20	0.09	14.7	0.4	-12.4	-0.4
0	0	2	0	2	13.66	-7.73	0.21	35.6	1.0	-30.0	-0.8
2	0	0	0	-1	13.75	0.02		-0.1		0.1	
2	0	0	0	0	13.78	-0.34		1.5		-1.3	
2	0	0	0	1	13.81	0.02		-0.1		0.1	
0	-1	2	0	2	14.19	-0.02		0.1		-0.1	
0	0	0	2	-1	14.73	0.05		-0.2		0.2	
0	0	0	2	0	14.77	-0.72	0.02	3.1	0.1	-2.6	-0.1
0	0	0	2	1	14.80	-0.05		0.2		-0.2	
0	-1	0	2	0	15.39	-0.05		0.2		-0.2	
1	0	2	-2	1	23.86	0.05		-0.1		0.1	
1	0	2	-2	2	23.94	0.10		-0.3		0.2	
1	1	0	0	0	25.62	0.04		-0.1		0.1	
-1	0	2	0	0	26.88	0.05		-0.1		0.1	
-1	0	2	0	1	26.98	0.18		-0.4		0.3	
-1	0	2	0	2	27.09	0.44		-1.0		0.9	
1	0	0	0	-1	27.44	0.53		-1.2		1.0	
1	0	0	0	0	27.56	-8.33	0.12	19.0	0.3	-16.0	-0.2
1	0	0	0	1	27.67	0.54		-1.2		1.0	
0	0	0	1	0	29.53	0.05		-0.1		0.1	
1	-1	0	0	0	29.80	-0.06		0.1		-0.1	
-1	0	0	2	-1	31.66	0.12		-0.2		0.2	
-1	0	0	2	0	31.81	-1.84	0.02	3.6	0.0	-3.0	0.0
-1	0	0	2	1	31.96	0.13		-0.3		0.2	
1	0	-2	2	-1	32.61	0.02		0.0		0.0	
-1	-1	0	2	0	34.85	-0.09		0.2		-0.1	
0	2	2	-2	2	91.31	-0.06		0.0		0.0	
0	1	2	-2	1	119.61	0.03		0.0		0.0	
0	1	2	-2	2	121.75	-1.88		1.0		-0.8	
0	0	2	-2	0	173.31	0.25		-0.1		0.1	
0	0	2	-2	1	177.84	1.17		-0.4		0.3	
0	0	2	-2	2	182.62	-48.84	0.11	16.8	0.0	-14.2	0.0
0	2	0	0	0	182.63	-0.19		0.1		-0.1	
2	0	0	-2	-1	199.84	0.05		0.0		0.0	
2	0	0	-2	0	205.89	-0.55		0.2		-0.1	
2	0	0	-2	1	212.32	0.04		0.0		0.0	
0	-1	2	-2	1	346.60	-0.05		0.0		0.0	
0	1	0	0	-1	346.64	0.09		0.0		0.0	

Table 10.1 (continued)

ARGUMENT*					PERIOD	UT1-UT1S		Δ -AS		ω - ω S	
l	l'	F	D	Ω	Days	Sin	Cos	Coefficient of		Cos	Sin
0	-1	2	-2	2	365.22	0.83		-0.1			0.1
0	1	0	0	0	365.26	-15.55	0.02	2.6	0.0	-2.2	0.0
0	1	0	0	1	386.00	-0.14		0.0		0.0	
1	0	0	-1	0	411.78	0.03		0.0		0.0	
2	0	-2	0	0	1095.17	-0.14		0.0		0.0	
-2	0	2	0	1	1305.47	0.42		0.0		0.0	
-1	1	0	1	0	3232.85	0.04		0.0		0.0	
0	0	0	0	2	3399.18	7.90		0.1		-0.1	
0	0	0	0	1	6790.36	-1637.68	0.10	-10.4	0.0	8.8	0.0

* l = 134°96 + 13°064993(MJD-51544.5) Mean Anomaly of the Moon

l' = 357°53 + 0°985600(MJD-51544.5) Mean Anomaly of the Sun

F = 93°27 + 13°229350(MJD-51544.5) L- Ω : L: Mean Longitude of the Moon

D = 297°85 + 12°190749(MJD-51544.5) Mean Elongation of the Moon from the Sun

Ω = 125°04 - 0°052954(MJD-51544.5) Mean Longitude of the Ascending Node of the Moon

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