Lunar Partial Tides in H at Alibag

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Winch (1970) gave a numerical procedure with the relevant theory for the determination of phase law tides and partial tides of geomagnetic lunar variations. The lunar fortnightly tide also can be estimated by this procedure. The phase law tides are those terms whose phase angle relative to solar time decreases by 4π per synodic month and these are generally estimated by the statistical method of *Chapman* and *Miller* (1940); the partial tides are those whose phase angle relative to solar time increases by 4π per synodic month.

In the present note lunar phase law and partial tides in H are determined by the numerical procedure of *Winch* (1970) for d-season for the period 1958–61, for a low latitude station, Alibag (dip N 24° 38.5′). The sequence of 24 mean hourly values of the day and the first hourly mean value of the following day used in the analysis are the absolute values, obtained by adding the tabular base of the corresponding days to the tabular values. Amplitudes and phases of phase law and partial tides upto four harmonics ($n=1$ to 4) along with the probable errors (p.e.) are given in Table 1. The lunar semimonthly (fortnightly) tide is also given against $n=0$ in Table 1 under phase law tides.

The amplitudes and phases of phase law tides ($n=1$ to 4) in Table 1 are comparable with the corresponding parameters of lunar variations calculated by *Rao* (1971) for the same period by Chapman-Miller method. As expected the amplitudes and phases of phase law tides, when calculated with the initial values before iteration for the final convergence, are almost identical with the corresponding values by Chapman-Miller method. Iteration procedure smoothens the amplitudes and phases and the semidiurnal amplitude is thus now more prominent in the lunar daily variations.

The amplitudes of first three harmonics of lunar partial tides at Alibag are smaller than the corresponding amplitudes of phase law tides. The order of the partial tide values for Alibag are comparable with the southern summer values of H at Toolangi (Table 6 of *Winch* (1970)). Lunar semimonthly tides at Alibag and Toolangi are, however, widely different in magnitude. The amplitude of semimonthly tide at Alibag is 0.53 and is insignificant with a p.e. of 1.56γ. At Toolangi, for southern summer, it is $54.50\pm17.44\gamma$ for quiet, $20.41\pm20.12\gamma$ for medium and $17.91\pm6.94\gamma$ for disturbed periods. *Winch* (1970) explained these extraordinarily large amplitudes in H as due to the manifestation of the second harmonic of the 27-day recurrence tendency for magnetic disturbance. The question immediately arises as to why the 13.5 day recurrence does not vitiate the semimonthly tide at Alibag.

The amplitude and phase of the semimonthly tide for Alibag H is also estimated by the method of *Bartels* and *Johnston* (1940). The daily means of H, *i.e.*, averages of the 24 hourly values, for the d-season of 1958–61 are arranged in 12 groups for μ or

Table 1. Amplitudes and phases of Lunar Phase Law and partial tides.

Harmonic	Phase Law Tides		Partial Tides		± p.e.
	Amplitude	Phase	Amplitude	Phase	
(n)	(γ)	(°)	(γ)	(°)	(γ)
0	0.53	312			1.56
1	1.48	1	1.01	160	0.55
2	1.57	164	0.61	234	0.37
3	0.51	356	0.21	281	0.20
4	0.18	52	0.26	48	0.16

$\mu - 12$, where μ is the lunar phase (the hour angle of the mean moon at the time of Greenwich mean noon). The average values of the 12 groups are harmonically analysed to obtain the semimonthly wave. The amplitude and phase of the semimonthly wave are 1.08γ and 94°, respectively, and those calculated by *Winch*'s method (1970) using the initial values before iteration, are 0.98γ and 137°. The amplitudes are obviously of the same order. The amplitude of the semimonthly tide in H at Alibag, for d-season, is therefore insignificant.

A detailed investigation on the geomagnetic lunar phase law, partial and semimonthly tides in the Indian Region is in progress.

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References

Bartels, J. and H.F. Johnston: Geomagnetic tides in horizontal intensity at Huancayo—Part I. *Terr. Magn. Atmos. Elect.*, **45**, 269-308, 1940.

Chapman, S. and J.C.P. Miller: The statistical determination of lunar daily variations in geomagnetic and meteorological elements, *Monthly Not. of R.A.S. Geophysical Supplement*, **4**, 649-669, 1940.

Rao, D.R.K.: Lunar and luni-solar variations of the geomagnetic field in the Indian region, *Pure and Applied Geophysics*, 1971 (in press).

Winch D.E.: Geomagnetic lunar partial tides, *J. Geomag. Geoelect.*, **22**, 291-318, 1970.

D.R.K. Rao and N.S. Sastri

Indian Institute of Geomagnetism,
Colaba, Bombay-5, India