TIDAL VARIATIONS FROM LOCAL ASTROMETRIC EOP SETS

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In this paper the material of Pulkovo database was used for the investigation of tidal variations in different regions. The part of this data (1899.7-1992.0) was used for recalculation EOP in international work (Vondrak et al., 1998). Since 1) nearly ten years of observations were added, in some of these sets new systematic (refraction reductions) were included, 2) the new precession-nutation model IAU2000A (Convention, 2000) was taken into consideration, 3) the new model of diurnal tidal oceanic perturbations of EOP and sub-diurnal geopotential perturbations of polar coordinates was appeared, 4) tidal variations of the Earth rotation in frequency region from 5 days to 18.6 years were improved.

The above-mentioned models were used by IERS software tools (Bizouard, 2002). The ICRS (HiC) was used for processing all observational sets.

The combination of Love's numbers $\Lambda = 1 + k - l$ was estimated by diurnal and semi-diurnal variations of vertical (generally by O_1 and M_2 waves) and k was estimated by the tidal variations of the Earth rotation (M_m and M_f waves). The model equation is

$$r(t) = kv(t) + \Lambda w(t) + \epsilon(t). \quad (1)$$

The polyharmonic functions of tidal irregularity of the Earth rotation $v(t)$ and variation of vertical $w(t)$ were taken from (Vondrak et.al., 1998), $\epsilon(t)$ is the noise component, $r(t)$ is observed residuals from EOP(IERS)C01 and C04 (UT1R-UTC, X,Y). The using (UT1R-UTC) suggests the including of 41 short-periodic terms of tidal variations of the Earth rotation up to 35 days. The M_m (27.53 day) and M_f (13.66 day) waves were excluded from (UT1R-UTC) to be evaluated from the observations by the model (1). The influence of the above-mentioned sub-diurnal oceanic loads (71 terms) and luni-solar perturbations (10 terms) on EOP was taken into account.

Table 1: Love's number.

Ins.	PUF	PUG	PUH	RIG	NIK	IRK	PUZ1	PUZ2
ϕ_0	59.8°	59.8°	59.8°	56.9°	47.0°	52.3°	59.8°	59.8°
λ_0	30.3°	30.3°	30.3°	24.0°	32.3°	104.3°	30.3°	30.3°
Span	62.0-71.4	71.2-85.4	71.9-03.5	79.4-87.0	74.0-92.4	79.0-99.9	04.8-41.5	48.8-95.0
k	0.28±.16	0.20±.14	0.18±.12	0.30±.18	0.20±.10	0.16±.11	-	-
Λ	1.14±.49	1.10±.44	1.06±.35	1.31±.64	1.24±.36	1.20±.36	1.25±.61	0.89±.34

The tools for calculation of Λ and k were least-squares method (LSM) solution of conventional equations (1) for each instrument, spectrum analysis (FFT) and singular spectrum analysis (SSA) in soft realization from (Goliandina et al., 2001). SSA was used together with FFT for low frequency filtration. The main usage of two-dimensional (2D) realization of SSA was in joint analysis of $r(t)$-sets with chosen tidal harmonic component. This approach permits to investigate the dynamics of the probable instability of this component in sets.

The principal results evalueted by LSM are given in the table. The heterogeneity of sets has some influence on the SSA results, so any conclusions about dynamics of regional elastic properties of the Earth by astrooptical EOP sets could not be done.

Irregular 5-7 years variations of the Earth rotation velocity (LOD)were revealed as a by-product of this research. The most significant errors in UT0-UTC (catalog, instrumental and refraction origin) cannot excite systematic errors of 5-7 years variations. But in the astrometric EOP data by the best instruments (Vondrak et al.,1998) these variations are presented with amplitude about 100 msec from 1984 (when astrometric tools have stopped participation in the EOP determination) up to the end of the realization (1992). It may be only if global EOP sets are not uniform or/and if new observational means cannot register the reaction of some geophysical process on LOD.

Two sets of LOD in disposal of IERS database were investigated by SSA (C04(IERS)EOP and LOD from 1832 to 1997 (Gross, http://hpiers.obspm.fr/)). The residuals of LOD variations after the reconstruction by the first main components (99.3% of set power) show the presence of quasi-periodical variations with amplitude about 0.15 msec in both sets (fig. 1a).

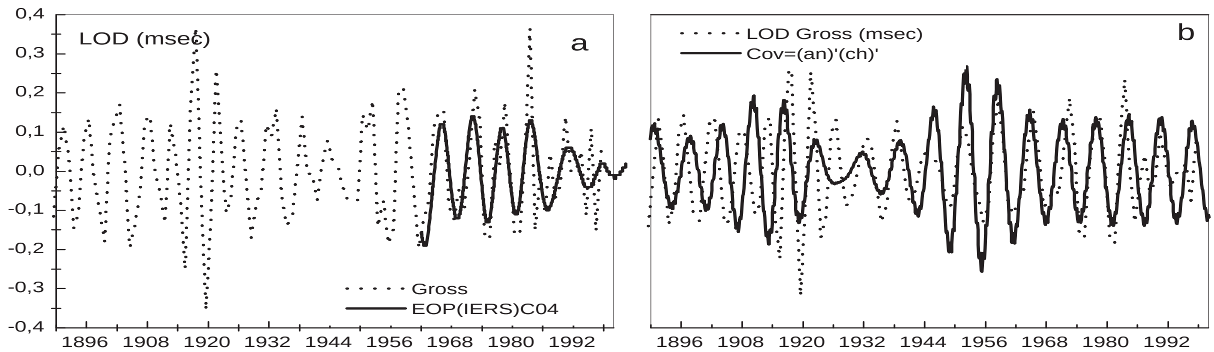

Figure 1: a) The residuals of LOD sets after subtraction of reconstructed decadal variation. b) The residuals of LOD and function COV describing phase relation of annual and chandler pole oscillation.

There is more important fact of significant correlation of LOD and phase relation of annual and chandler polar motion. When these oscillations are in phase - the LOD is increasing (fig. 1b) and vice versa. This correlation is especially evident after the attenuation of chandler wobble in 1920. The character of the LOD variations as a whole (the damping of amplitude and the phase change) are similar to polar motion dynamics. This can be consequence of geophysical linking of these processes (Gorshkov et al.,2002) or presence of mutual reason of modulation.

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