VARIATIONS OF THE SECOND ORDER HARMONICS OF GEOPOTENTIAL FROM THE ANALYSIS OF THE ETALON SLR DATA FOR 1992–2001

T.V. IVANOVA, N.V. SHUYGINA
Institute of Applied Astronomy of RAS
10, Kutuzov quay, 191187 St.Petersburg, Russia
e-mail: itv@quasar.ipa.nw.ru, nvf@quasar.ipa.nw.ru

The paper is devoted to study of the second order harmonics of the geopotential from analysis of satellite laser ranging to Etalon 1&2. All available observations for 1992–2001 are taken from the Crustal Dynamics Data Informational System (CDDIS) and the European Data Center (EDC). Each measurement represents a normal point produced from two-way ranges averaged on 2-minute interval. A total number of approximately 10-year period of Etalon1&2 observations is about 46000 for each satellite. These observational data were analysed by means of the problem-oriented programming system for ephemeris astronomy ERA (Ephemeris Research in Astronomy) (Krasinsky and Vasilyev 1996), which is basically follows the IERS Conventions. Initial site positions were taken from ITRF2000 solution. Transformation from the Terrestrial Reference Frame to Celestial Reference Frame is carried out using IAU (1976) precession, IAU (1980) nutation, celestial pole offsets and Earth rotation parameters taken from EOP (IERS) C04 series.

The main aim is to estimate the in-phase amplitude of K_1 tidal wave in the tesseral harmonics C_{21}, S_{21} which manifest themselves as sinusoidal oscillations $\Delta C_{21}, \Delta S_{21}$ with the period of one sidereal day, given in IERS Conventions 2003 (McCarthy 2003) for the normalized coefficients $\overline{C}_{21}, \overline{S}_{21}$ in the form

$$\left(\Delta\overline{C}_{21}\right)_{K_1} = K_1 \sin(S+\pi)\,, \qquad \left(\Delta\overline{S}_{21}\right)_{K_1} = K_1 \cos(S+\pi)\,, \tag{1}$$

where

$$K_1 = 471.8 \times 10^{-12}, \tag{2}$$

S being the Greenwich Mean Siderial Time. This wave is caused by the differential rotation of the Earth's fluid core and so is very informative for geophysics.

The data analysis has been performed into two steps. The whole time span was divided into 21-day arcs. It turned out that 21-day interval is the optimal period of time for which there are sufficient number of normal points. At the first step six coordinates and velocities, along-track acceleration and reflectance coefficients were adjusted by the least-squares data fitting (Ivanova and Shuygina 2002). At the second step simultaneously with these parameters the K_1 amplitude and the correction to C_{20} have been estimated. The last values are regarded as global parameters for the time interval of one year, while the orbital parameters are considered as the local ones on each arc.

Corrections to C_{20} were determined over 10 intervals of a year. Averaging all the corrections we have obtained:

$$\Delta C_{20} = (-4.0 \pm 2.2) \times 10^{-10}. \tag{3}$$

Estimating K_1 a smoothing procedure was applied. We separated the whole time span of 10 years into 1-year intervals with subsequent displacement of each interval on a 21-day arc. The obtained 155 estimates are shown in Figure 1, where the error bars are 3.5σ values determined by the least-squares solutions.

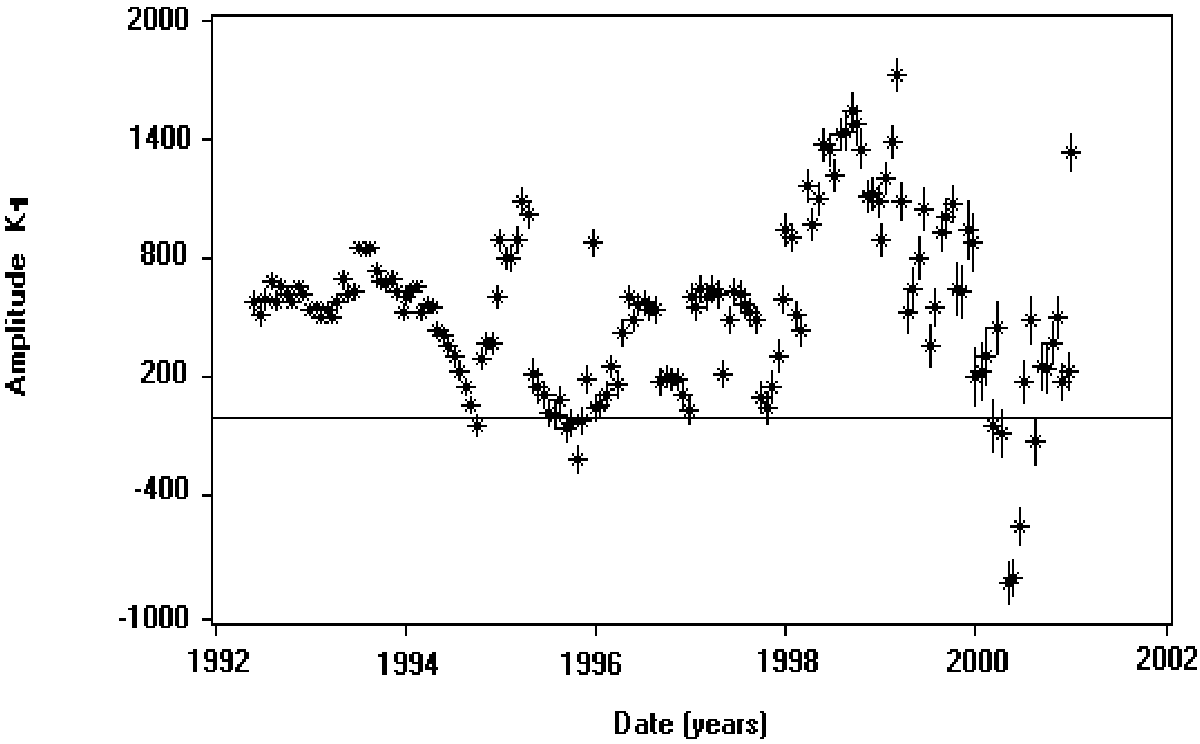

Figure 1: $K_1 \times 10^{12}$ amplitude estimated for 1992 - 2001 years.

It should be paid attention to the increase of the error bars to the end of the time span interval. The most likely cause of that is the deterioration of technical and physical characteristics of satellites with time.

After averaging we have obtained the following estimate of the K_1 amplitude:

$$K_1 = (557.9 \pm 25.1) \times 10^{-12} \quad (4)$$

which has to be compared with IERS value (2). One can see that the estimated K_1 amplitude is slightly different from that recommended by IERS Conventions. More precise determination of this difference is the problem of further investigation.

REFERENCES

Krasinsky G. A., Vasilyev M. V., 1996, ERA: knowledge base for ephemeris and dynamical astronomy, *In: Proceedings of IAU Colloquium 165*, 239.

McCarthy D. D., 2003, IERS Conventions 2003, *IERS Technical Note*, **32**.

Ivanova T. V., Shuygina N. V., 2002, Analysis of SLR observations of the Etalon geodetic satellites, *IAA Transactions*, **8**, 90.