IAA Transactions, No. 8, "Celestial Mechanics", 2002

Analysis of SLR observations of the Etalon geodetic satellites

T. V. Ivanova, N. V. Shuygina

Institute of Applied Astronomy, St.Petersburg, Russia

This paper is devoted to the results of an analysis of satellite laser range observations of two Russian Etalon geodetic satellites. They were launched in 1989 (in January and May, respectively). They have near–circular orbits (eccentricities are equal to 0.0007) with semi–major axis of about 25000 km and inclination of 65° with respect to the Earth's equator, each orbit lying in one of the orbital planes used by the Glonass Navigation System. Etalon1&2 laser range observations are available since June 1, 1992. All range measurements were taken from the Crustal Dynamics Data Informational System (CDDIS) and European Data Center (EDS). Each measurement represents a normal point produced from two–way ranges averaged over 2-minutes interval. A number of Etalon1&2 observations is much less than that of Lageos satellites because the height of the Etalon orbit is three times more than the height of the Lageos orbit. A total number of an approximately 10 years period of observation is about 46000 for each satellite.

These observational data were analyzed by means of the problem–oriented programming system for ephemeris astronomy ERA (Ephemeris Research in Astronomy) [1], which follows basically the IERS Conventions [2]. 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 a priori accuracy varies within considerably wide ranges: from a few millimeters to about 1 meter. Moreover, there are many misprints in source data which cannot be corrected automatically. That is why the observations were weighted anew according to the special procedure depending on the real quality of station.

The data analysis is performed in several steps. The whole time span of about 10 years was divided into 21 days arcs. It turned out that 21–day interval is the optimal period of time with sufficient number of normal points. At the first

step six coordinates and velocities and along–track accelerations, and reflection coefficients were adjusted. The data fitting was produced using the least squares method. Usually it was sufficient to perform two or three iterations to achieve the convergence. The average value of the post–fit residuals is about 7 cm.

At the next step the global improvement was done over the whole time span. At this stage the improved satellite orbits were used to obtain both corrections to the station coordinates and Earth orientation parameters.

The next step of the investigation is to obtain the lowest order harmonics of geopotential by means of Etalon1&2 SLR observations. Meanwhile there appeared some difficulties in taking into account the accurate radius correction and its dependence on the system of observing laser station. The corrections to the station coordinates prove to be in agreement with that received from the processing of Lageos measurements.

References

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

2. Mc. Carthy, IERS Conventions (1996), IERS Technical Note 21, Obs. de Paris, 1996.