

Quality of orbit predictions for satellites tracked by SLR stations

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Abstract

Satellite Laser Ranging (SLR) measurements need high-quality predictions of satellite orbits, which are fundamental for obtaining and increasing the number of the returns from the retroreflectors installed onboard various satellites. If the orbit predictions are very imprecise, SLR stations must spend more time to correct the telescope orientation, and thus the number of collected observations is small or, in an extreme case, there are none of them at all. Currently, there are about 140 satellites equipped with laser retroreflectors orbiting the Earth. Hence, the necessity of the quality assessment of predictions provided by various analysis centers appears, in the context of the increasing number of satellites to be observed.

The aim of this study is to evaluate and analyze the orbit predictions of selected geodetic, GNSS, and scientific low-orbiting satellites, which are tracked by laser stations. We compare the orbit predictions to final GNSS orbits, precise orbits of geodetic satellites based on SLR measurements and post-processing, and kinematic orbits of low-orbiting satellites based on GPS data. We assess the degradation of the quality of the orbit predictions over time depending on the type of the orbit and satellite being analyzed, estimate the time of usefulness of prediction files, and indicate those centers which publish most accurate predictions of the satellites' trajectories. The best-quality predictions for geodetic satellites and Galileo reach the mean error of 0.5-1 m for the whole 5-day prediction file, while the worst ones can reach values of up to several thousand meters during the first day of the prediction.