Geophysical Research Abstracts
Vol. 13, EGU2011-11130, 2011
EGU General Assembly 2011

Further Improvements in Understanding Subtle Systematic Effects in Laser Ranging Observations

Graham Appleby (1), Toshimichi Otsubo (2), and Vincenza Luceri (3)

(1) NERC Space Geodesy Facility, Herstmonceux, United Kingdom (gapp@nerc.ac.uk, +44 (0)1323 833929), (2) (2) Geoscience Laboratory, Hitotsubashi University, Kunitachi, Japan, (3) (3) e-GEOS S.p.A., CGS, Matera, Italy

The laser ranging technique has the potential to make extremely precise measurements to retro-reflector clusters on orbiting satellites, with normal-point range precision at a level of 1mm for the best tracking stations of the International Laser Ranging Service (ILRS). To realise a similar level of measurement accuracy to the mass-centres of the satellites and ultimately, through orbital analyses, in the determination of the origin and scale of the ITRF, requires accurate models for two key elements of the technique; referring the range measurements to the centres of mass of the geodetic satellites and accurate determination of potential non-linearity in the time-of-flight measurements. Errors in these key elements will of course directly contaminate the determination of the origin and scale of the ITRF. Otsubo and Appleby previously published tracking-system-dependent centres-of-mass (CoM) corrections for the LAGEOS and ETALON satellites, which they found to vary across the ILRS network by up to 1 cm and 5 cm respectively. This work has been extended here to develop tables of CoM corrections, with reasonable error bounds, for each of the ILRS tracking stations and which take account of any hardware and operational changes as the individual stations seek to improve their measurement precision. As a result of this work, new system-dependent CoM values are now available for evaluation prior to re-analysis work towards the next realization of the ITRF. Work carried out previously into measurement and mitigation of non-linearity present in some time-of-flight devices highlighted both the magnitude of the effect which can reach 20mm and the potential of using newer, highly-accurate devices to post-calibrate historical laser data. We discuss case studies from a number of ILRS stations and highlight the improvements that can be achieved. However, earlier expectations that this work could be applied to carry out similar absolute calibration of the ten or so ILRS systems that have used similar electronic devices proved to be too optimistic, but the work nonetheless does serve as an indication of the magnitude and epochs of applicability of this source of potential systematic effects. We finally discuss mitigation of these two effects, which ultimately will involve modeling as well as empirical determination during the orbital analyses.