3.6.2.7 GeoForschungsZentrum Potsdam (GFZ)

Reference Frame Solutions Including Low Degree Gravity Field Coefficients

The objective of the IERS CRC at GFZ is to determine, apart from station positions and Earth Orientation Parameters (EOPs) accurate low degree, long wavelengths gravity field parameters with a high temporal resolution. Dense and continuous GPS observations from the CHAMP and GRACE satellite missions set the basis for a high resolution of the solved for parameters. The quality and type of the data lead to high accuracy, and the low altitude of the considered satellites (Low Earth Orbiters, LEOs) assures high sensitivity.

For the processing of the CHAMP and GRACE measurements we follow the strategy of the so-called “integrated” approach, i.e., the combination of multiple satellites with various kinds of tracking observations and of space geodetic data, respectively, at the observation level. The EPOS software at GFZ is well-suited to handle this variety of data and sensors types. Using this “integrated” approach, the homogeneity and consistency of the combined solutions can be maximized. In the case of CHAMP and GRACE we integrate ground and space-borne GPS receiver observations, SLR observations, accelerometer measurements, K-band data and mission-specific data to solve for the orbits of all the satellites, including the GPS constellation, with dynamical models, the ground station coordinates, the EOPs and the low degree spherical harmonic coefficients of the Earth gravity field. Results have been published by König et al. (2005a) and Hu et al. (2005).

In parallel to the “integrated” approach, the standard strategy of processing Satellite Laser Ranging (SLR) data to the geodetic-type satellites LAGEOS-1 and -2 delivers comparable ensembles of parameters with less time resolution though, but with the confidence of a well-established technique. This opens up the possibility to compare the two types of results in detail. In the reporting period, time series of C20 parameters were computed and compared to published results in order to validate the procedures. Also combinations with GRACE monthly gravity field solutions were generated to verify GRACE C20 variations. Results and comparisons to the integrated approach were presented in König et al. (2005b).

Our third approach is the so-called “on-board co-location”, where the conventional co-location of instruments at ground stations is reversed: local ties are replaced by the centre of mass offsets of the instrument locations on the satellites. We used the combined GPS/CHAMP/GRACE constellation to compare SLR and GPS-based reference frames. For this, GPS and LEO orbits were determined from GPS observations only. Then, by freezing the orbits and therefore the GPS reference frame, ground station coordinates were determined for the SLR sites, solely based on SLR observa-

tions to GPS-35, GPS-36, CHAMP and GRACE. Systematic differences of the derived coordinates to the purely SLR-based coordinates in the ITRF2000 were not found. Results were presented in Neumayer et al. (2005).

References

Hu XG, Shi C, Flechtner F, Koenig R, Schwintzer P, Schmidt R, Meyer U, Massmann FH, Reigber C, Zhu SY (2005): High Frequency Temporal Earth Gravity Variations Detected by GRACE Satellites. In: Flury J, Rummel R, Reigber C, Rothacher M, Boedecker G, Schreiber U (Eds.) Observation of the Earth System from Space. Springer, Berlin, Heidelberg, pp. 165–174

König R, Reigber C, Zhu SY (2005a): Dynamic model orbits and Earth system parameters from combined GPS and LEO data. Advances in Space Research, 36, doi 10.1016/j.asr.2005.03.064, pp. 431–437

König R, Reigber C, Rothacher M, Schmidt R, Zhu SY (2005b): Low Degree Harmonics of the Earth's Gravity Field from GPS and LEO and SLR Observations. EGU General Assembly, Geophysical Research Abstracts, Vol. 7, Abstract No. EGU05-A-07804

Neumayer KH, Rothacher M, Flechtner F, Koenig R, Massmann FH, Zhu SY (2005) Comparison of the ITRF reference frame with SLR station coordinates established via LEO on-board collocation. EGU General Assembly, Geophysical Research Abstracts, Vol. 7, Abstract No. EGU05-A-06235

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