VII. Solutions not included in ITRF96

VII.1. Description of the solutions

VII.1.1. Summary of the VLBI solutions

VII.1.1.1. SSC(IAA) 97 R 01

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The VLBI group at the Institute of Applied Astronomy (IAA) have analyzed 192 VLBI sessions from NEOS-A network from 05-May-1993 till 30-December-1996. The SSC(IAA)97R01 solution includes terrestial reference frame: SSC (positions
of 8 stations) and SSV (velocities of 6 stations). Reference frame is established by ICRF 94 and coordinates of Wettzell from ITRF 94. The orientation of the TRF and CRF is defined by one-day EOP (IERS) C 04 values. The EOP(IAA)97R01 solution includes EOP estimates with 7-day intervals. CRF is established by ICRF 94. TRF is close to ITRF 94 exception KAUAI, NRAO20 and MIAMI20 coordinates which have been taken from IAA 97 R01.

VII.1.1.2. SSC(GAOUA) 97 R 01

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The GAOUA 97 R 01 solution is based on the VLBI data acquired on various networks during 6 years since 02 January 91 till 28 January 97. The solution consist of RSC (129 radio sources), SSC (39 stations), SSV (26 stations) and EOP. The radio sources coordinates have been constarined by requiring the sum of right ascension of 46 sources equals the corresponding sum from the solution RSC(IERS)95C02. The same no-translation constraint have been applied to fix the origin (coordinates of 17 stations linked to the ITRF94) and the rotation (velocities of 15 stations linked to NNR-NUVEL1A) of the terrestrial reference frame. The orientation between celestial and terrestrial reference frames is defined by the EOP(IERS)97C04 values for the date 13 November 1995.

VII.1.2. Summary of the LLR solutions

VII.1.2.1. SSC(FSG) 97 M 01

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The solution is based on the LLR data acquired since the beginning of the observations (1970) until February, 1997. The station coordinates of five sites are estimated using the NNR-Nuvel1 plate motion model. The ephemeris of the major solar system bodies are computed with the FSG ephemeris programm; the lunar librations were integrated simultaneously. The initial values for the integration are taken from the ephemeris DE200. But the geocentric position and velocity of the Moon and the barycentric position and velocity of the Earth for a certain epoch are estimated during the fit. Corrections to precession and some nutation terms are applied or estimated. Input Earth rotation values are taken

from a solution from R. Gross (JPL). This solution is called COMB96 and is aligned with the IERS system. The estimated EOP result in time series of UT0-UTC and in time series of the variation of latitude (VOL) for the various stations. 1098 values for UT0-UTC and VOL have been computed. The intervals between the EOP values depend on the observations; the intervals are irregular (from less than 1 day up to several months).

VII.1.2.2. SSC(JPL) 97 M 01

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Lunar Laser Ranging (LLR) data between April 1970 and November 1996 have been analyzed to produce earth rotation values and station locations. There are 11218 ranges from McDonald (three sites), Grasse (OCA/CERGA), and Haleakala Observatories to four retroreflectors on the moon. These data have been analyzed in a global solution to estimate station locations, precession, 18.6 yr nutation and other parameters. After the global solution, values of UT0-UTC and variation of latitude (VOL) are generated for individual stations on individual days which have sufficient data. These 1670 UT0 and VOL values are irregularly spaced over a 26 year span. Solutions were made using the ephemeris DE330. The station location solution is designated SSC(JPL) 97 M 01 and the UT0/VOL values are called EOP(JPL) 97 M 01. DE330 is nominally on the IERS celestial reference frame.

VII.1.2.3. SSC(SHA) 97 M 01

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Lunar Laser Ranging (LLR) data have been analyzed during JD 2447187.0 - JD 2450435.0. These data from McDonald (71111, 71112), Grasse (1910) and Haleakala(56610) contain 6209 normal points reflected from four reflectors during Jan. 1988 - Dec. 1996. The 750 value of UT1 and the coordinates of the observing station 71112, 1910, 56610(the velocities of stations are fixed on the NNR-NUVEL1A model) and the lunar retro-reflectors are solved and submitted to IERS.

VII.1.3. Summary of the SLR solutions

VII.1.3.1. SSC(SHA) 97 L 01

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The solution EOP(SHA) 96 L 01 and were derived from Lageos quicklook normal point data of laser ranging from Jan.1,1995 to Dec.20,1996. The interval between the values in EOP(SHA) 96 l 01 is about 5 days. The SSC(SHA) 96 L 01 are from ITRF94 at epoch 93.0. There are 26 sites in the terrestrial frame. The most station coordinates of SSC(SHA) 96 L 01 were fixed except for 1884,1953,7295,7810,7811,7835,7838. But 7837 station coordinates are fixed at the values which are different from the values of 7837 in ITRF94. Because 7837 station coordinates in ITRF94 include about a system error about 10 cm.

VII.1.3.2. SSC(CGS) 97 L 01

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The CGS 97 L 01 solution is derived from a combination of Lageos -I observations acquired from January 1985 to December 1996, and Lageos-II obse rvations from November 1992 to the same end date. The gravity model used is JGM-3. Station coordinates at epoch January 1993 have been adjusted for the global network of mobile and fixed SLR sites, keeping the orientation of the terrestrial system by constraining the cartesian coordinates of Herstmonceux (7840) and Washington (7105) to the a-priori values. The time evolution of the terrestrial system is constrained to the ITRF94 velocity field for all the sites. The main objective of this solution is the estimation of daily values for Earth orientation parameters (x, y and UT1R-UTC, EOP(CGS 97 L 01)), keeping UT1R fixed to IERS bulletin B values at the epochs when satellites node have been estimated (every 30 days).

VII.1.3.3. SSC(GAOUA) 97 L 01

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The solution GAOUA 97 L 01 is based on the SLR global network data of Lageos-1 since September 1, 1983 through December 28, 1996 and Lageos-2 since October 24, 1992 through December 30, 1996. Totally 1,065,896 normal points have been processed using Kiev-Geodynamics-5.2 software. The solution consists of ERP (Xp, Yp, UT1-UTC) sets at three-day intervals from MJD 45583 till MJD 50440, coordinates of 98 stations at epoch January 1, 1993 (MJD 48898) and velocities of 43 sites (58 stations) with good observing histories. Terrestrial reference frame is attached to ITRF94 by fixing the latitude of station 7105 (Greenbelt) and 7210 (Haleakala) and longitude of station 7105. The station velocities are linked to NNR-NUVEL1A by fixing the rate of these parameters to the values given by the NNR-NUVEL1A model. Transformation from the Celestial Reference Frame to the Terrestrial Reference Frame is modelled using IAU (1976) precession model, IAU (1980) nutation model, a priori values of celestial pole offsets and ERP from EOP(IERS97)97C04 series.

VII.1.3.4. SSC(GZ) 97 L 01 & 02

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The GeoZUP solutions GZ97101 and GZ97101 are based on QL-NP data for both Lageoses from the end of 92 to the end of 96. Both solutions are monotechnique/multisattelite and estimate laser network simultaneously with 6-days SV and some biases. The first was done for Russian Mission Control Center specially to adjust laser network and EOP(IERS)C04 serie and finally to improve accuracy of operational PM and LOD values calculated in MCC. It is used in MCC computations of PM and length of day from May 1997. The second one is primary solution with 3-days interval between PM parameters. 50 stations and 30 site velocities were computed in both solutions. Orientation and time evolution are in agreement with latitude and longitude of 7105 and latitude 7840 and their rates from ITRF94. Weighted RMS of residuals in solutions are equal 2cm and 1.9cm respectively.

VII.1.3.5. SSC(IFAG) 97 L 01

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Earth orientation parameters and station positions were derived from the analysis of Lageos-1 SLR data with UTOPIA software. Observation data from January to December 1996 was used. The EOPs have been determined for 3-day intervals. The number of observation sites is 37. Coordinates have been estimated for 35 stations. The terrestrial reference frame is oriented to agree with ITRF93 by fixing the latitude and longitude of the site

Maui (7210) and the latitude of the site Greenbelt (7105). The time evolution of the system is modelled by NNR-NUVEL1A. The UT1 results are constrained to follow the EOP(IERS) 97 C 04 series at intervals of 30 days.

VII.1.3.6. SSC(DUT) 97 L 01

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The solution EOP(DUT) 97L01 consists of a coherent set of Earth Orientation Parameters (EOPs), determined from SLR observations of LAGEOS-1 taken in the period September 1983 to December 1993 and of LAGEOS-2 in the period October 1992 to December 1993. The solutions are obtained for 3-day intervals. Essential for this computation was the development of the model representing the instantaneous positions for the observing stations. This model, SSC(DUT) 97C01, was derived in a combined analysis of the SLR data mentioned above, and GPS data taken during the EUREF89 campaign (May 1989), the WEGENER/GPS92 and WEGENER/GPS94 campaigns (August 1992 and 1994, respectively), and the European component of the IGS network (January 1993 to December 1996). The ground segment includes a total of 101 stations. The reference epoch is January 1, 1993. The kinematic component of SSC(DUT) 97C01 basically follows the NUVEL-1A NNR model, which is effectuated by constraining the motion solutions for 15 globally distributed stations in a Bayesian way to the corresponding geophysical values.

VII.2. Analysis of the solutions

The solutions submitted in 1997 and not included in ITRF96 combination were a posteriori compared to the ITRF96, using diagonal variances only. Tables T10 and T11 of the appendix give respectively the transformation parameters and global residuals with respect to ITRF96.

The causes of rejection of these solutions from the ITRF96 combination are mainly due to:

- structure and format SINEX problems for some solutions
- some other solutions did not estimate velocities.