II. Selected data for ITRF97

II.1. Solutions submitted by the IERS analysis centers

The selected solutions for the ITRF97 combination are coming from those received in 1998 as well as some past data. These solutions, summarized in Table 1, are 4 VLBI , 5 SLR , 6 GPS, 3 DORIS and one multi-technique (SLR + DORIS) solution. For each individual solution, a summary description is given in the next section, as provided by the analyis centers.

Table 1. Selected Solutions for the ITRF97 analysis

Solution	Data Span yy-yy	Station nb.	Ref. Epoch y:doy
VLBI			
SSC(GSFC) 98 R 01	79-98	129	97:001
SSC(GIUB) 98 R 01	85-97	49	93:001
SSC(USNO) 98 R 01	79-98	110	97:001
SSC(NOAA) 95 R 01	79-94	107	93:001
SLR			
SSC(CSR) 98 L 01	76-98	129	93:001
SSC(DUT) 98 L 01	83-97	72	93:001
SSC(GZ) 98 L 01	93-98	51	93:001
SSC(GSFC) 98 L 01	80-97	38	86:182
SSC(CGS) 98 L 01	86-98	76	93:001
GPS			
SSC(CODE) 98 P 01	93-98	139	95:314
SSC(EMR) 98 P 01	94-97	40	98:001
SSC(EUR) 98 P 01	96-98	67	97:074
SSC(GFZ) 98 P 01	93-97	76	97:001
SSC(JPL) 98 P 02	91-98	84	96:001
SSC(NRCAN)98 P 01	95-98	145	98:001
DORIS			
SSC(GRGS) 98 D 01	93-98	63	93:001
SSC(IGN) 98 D 04	90-97	69	94:001
SSC(CSR) 96 D 01	93-96	54	93:001
Multi-technique			
SSC(GRIM) 98 C 01	85-96	143	

II.1.1. Summary of the VLBI solutions

II.1.1.1. SSC(GSFC) 98 R 01

C. Ma and K. D. Baver (RITSS), Code 926, Goddard Space Flight Center, Greenbelt, MD 20771, USA, cma@virgo.gsfc.nasa.gov

Mark III VLBI delay observations between Aug 1979 and Jul 1998 acquired by the NASA Crustal Dynamics Project, POLARIS/IRIS organized by NOAA, the Communications Research Laboratory (Japan), the Geographical Survey Institute (Japan), the University of Bonn Geodetic Institute, the National Astronomical Observatory (Japan), the Naval Research Laboratory Reference Frame Program, the USNO NAVNET/NAVEX, the NASA Space Geodesy Program-GSFC, and the National Earth Orientation Service (USA) have been analyzed for TRF. There are 128 points in the TRF and the CRF includes 630 radio sources. The origin and orientation of the TRF are connected to ITRF96 at 1997.0 by applying no-net-horizontal- translation and no-net-rotation constraints to the position adjustments of twelve stations with uniform station weighting for both constraints. The evolution of the TRF is connected to NNR-NUVEL1A by applying no-net-horizontal-translation and no-net-rotation constraints to the velocity adjustments of five stations with uniform station weighting for both constraints. The right ascension origin and orientation of the CRF are connected to ICRF95 by applying a no-net-rotation constraint to the position adjustments of the 212 ICRF95 defining sources with weighting proportional to the precision of the source positions. Three-dimensional velocities are adjusted for all sites with constraints for those sites with insufficient data. The velocities of some groups of stations are constrained to be equal. Some stations are allowed a single discontinuous jump. The solution is done in two steps with EOP information derived from the first step used as a priori information in the second step.

Note: This solution is different from the one submitted for EOP.

II.1.1.2. SSC(GIUB) 97 R 01

A. Nothnagel, K. Boerger, J. Campbell, R. Haas, A. Mueskens Geodetic Institute of the University of Bonn (GIUB) Nussallee 17, D-53115 Bonn, Germany E-mail: nothnagel@uni-bonn.de
V. Thorandt, D. Ullrich Institute for Applied Geodesy (IfAG) Karl-Rothe-Strasse 10-14 D-04105 Leipzig, Germany E-mail: vt@leipzig.ifag.de
Observing technique: VLBI, group delay observables Data span: January 1985 - December 1997 (1894 sessions), worldwide set of VLBI observations Number of sites: 50, number of radio sources: 637 Type of results: EOP, RSC, SSC - station coordinates and velocities - right ascension and declination of radio sources - earth orientation parameters (X,Y,UT1-UTC,dpsi,deps) with short periodic variations according to Gipson (1996) included - reference epochs for UT1-UTC and polar motion: midnight epochs - reference epochs for nutation offsets: beginning of each session Connection between systems: - The orientation of CRF is defined by fixing the ICRF (1995) WGRF R.A. of 2145+067 and 0552+398 and Dec. of 2145+067. - Definition of initial translation of the TRF: Condition that the sum of adjustments of 6 sites with respect to ITRF94 is zero. - The initial and long term orientation of the terrestrial frame with respect to the axis of rotation is established by constraining the EOP of the data in the years 1985 and 1997 to their IERS Rapid Service values with uncertainties of 3 mas (xp), 3 mas (yp) and 0.2 ms (UT1). - The evolution of the velocity field is defined by introducing the condition that the sum of adjustments of the velocities of four sites with respect to NUVEL-1A is zero.

II.1.1.3. SSC(NOAA) 95 R 01

J.R. Ray, M.D. Abell, W.E. Carter, W.H. Dillinger, and M.L. Morrison, Geosciences Laboratory, NOAA N/OES13, SSMC-4, 1305 East-West Highway, Silver Spring, Maryland 20910-3281, USA

Two solutions are submitted using most of the available Mark III VLBI data from 1980 September through 1994, including 1216103 group delay observations from 1774 24-hour

sessions. NOAA 95 R 01 includes estimated values for radio source coordinates, terrestrial site coordinates and velocities, and a time series of Earth orientation parameter values. A separate series of quasi-daily UT1 values is provided in NOAA 95 R 02, referred to the NOAA 94 R 01 reference frames.

The geocentric origin of the SSC(NOAA)95R01 terrestrial reference frame is specified for the epoch 1988.0 by constraining the vector sum of the adjusted coordinates for 20 VLBI sites to equal the corresponding sum for ITRF92. The net translational and rotation motions of the frame are specified by constraints on the vector sums of the respective adjusted velocity components for 10 VLBI sites using the NNR-NUVEL-1A model as the reference. Coordinates and velocity estimates are reported for 111 sites at epoch 1993.0; coordinates for 30 sites with insufficient data are projected using NNR-NUVEL-1A velocities. The full covariance matrix is also provided.

The right ascension origin of the RSC(NOAA)95R01 celestial reference frame at epoch J2000.0 is specified by constraining the sum of the adjusted RA values for 71 radio sources (weighted by cosine of declination) to equal the sum from RSC(IERS)93R01. Coordinates for 249 radio sources are reported.

EOP(NOAA)95R01 gives the adjusted EOP values for 1772 epochs; EOP values for the reference epoch 1991 August 12 19:49:50 have been held fixed at the interpolated values from the EOP(IERS) 90 C04 series. UT1 estimates are reported for 2397 epochs in EOP (NOAA) 95 R02. All tidal effects are included, including diurnal and semi-diurnal variations.

II.1.1.4. SSC(USNO) 98 R 06

T.M. Eubanks, B.A. Archinal, F.J. Josties, and J.R. Ray, U.S. Naval Observatory, Washington, D.C., 20392-5100

As part of its participation in the National Earth Orientation Service (NEOS) the U.S. Naval Observatory (USNO) operates a program in Very Long Baseline Interferometry (VLBI) data acquisition and analysis to monitor changes in the orientation of the Earth on a regular basis. This report describes the VLBI observations conducted by the USNO, the methods of data reduction and analysis, and the Navy 1998-6 reference frame created for use in operational VLBI data reduction for Earth orientation. The major differences between the Navy 1998-6 and the Navy 1997-8 system used in the last annual report, besides the accumulation of new data, are that the 1998-6 celestial and terrestrial reference frame reference frame and Earth orientation parameters are now aligned using No-Net Rotation and No-Net Translation constraints to the ITRF-96 and the new ICRF.

The USNO VLBI group is in the process of retrieving and introducing all of the previously ignored archival mobile VLBI data, in order to complete the USNO VLBI data archives. The USNO SINEX submission for the Terrestrial Reference Frame (TRF) includes substantially more mobile data, and has been designated Navy 1998-10. This frame is in all respects except for the amount of data used the same as the 1998-6 frame.

II.1.2. Summary of the SLR solutions

II.1.2.1. SSC(CGS) 98 L 01

R. Devoti1, V. Luceri2, P. Rutigliano2, C. Sciarretta1
1 Telespazio SpA, Via Tiburtina 965, Rome, Italy
2 Telespazio SpA, ASI Space Geodesy Center, Matera, Italy
G. Bianco
Italian Space Agency (ASI), Space Geodesy Center (CGS), Matera, Italy

The global solution CGS 98 L01 provides SSC/SSV at epoch 930101 and 3-day EOP derived from Lageos I (jan 86 - dec 97) and Lageos II (nov 92 - dec 97) data compressed in normal points. The general analysis strategy goes along the lines of previous solutions submitted to IERS and is based on two steps of data reduction: a) an arc reduction procedure in which satellite parameters (state vectors, residual accelerations) and measurement biases are estimated at a proper time frequency for each 30-day arc spanning the

whole data set and the normal equation matrices are produced; b) a global reduction procedure in which all the 30-day normal matrices and residuals are combined into a multi-year estimation in which SSC/SSV and EOP are derived. The CGS98L01 follows the IERS 1996 conventions for the majority of aspects. The gravity model is JGM-3. The solution is solved at the same time for SSC/SSV and EOP, with proper costraints for the reference system. The realization of the terrestrial kinematic reference frame is obtained by fixing the position of two sites, Washington (7105) and Greenwich(7840), and their velocities at the ITRF94 values.

II.1.2.2. SSC(CSR) 98 L 01

Description not available

II.1.2.3. SSC(DUT) 98 L 01

R. Noomen, B. Kampes
Delft University of Technology, Faculty of Aerospace Engineering,
Kluyverweg 1, 2629 HS Delft, The Netherlands
The solution SSC(DUT) 98L01 consists of a coherent set of station positions and velocities. This solution has been determined from SLR observations of LAGEOS-1 (September 1983 - December 1997) and of LAGEOS-2 (October 1992 - December 1997). In total, SSC(DUT) 98L01 includes 74 stations. The reference epoch is January 1, 1993. The kinematic component of SSC(DUT) 98L01 basically follows the NUVEL-1A NNR model, which is effectuated by constraining the motion solutions for 12 globally distributed stations in a Bayesian way to the corresponding geophysical values.

II.1.2.4. SSC(GSFC) 98 L 01

D.E.Smith and R.Kolenkiewicz, NASA/Goddard Space Flight Center, Greenbelt MD 20771
P.J.Dunn and M.H.Torrence, Raytheon STX Corp.,Greenbelt, MD 20770 E.C.Pavlis, Joint Center for Earth Systems Technology, Univ. of Maryland, Baltimore, and NASA/GSFC, Greenbelt, MD 20771

The GSFC 98L01 solution was obtained by fitting data from LAGEOS I between January 1980 and December 1997, and LAGEOS II between January 1993, and December 1997, in 30 day arcs, and once per year (in July) in 35 day arcs, using normal points from the global SLR tracking network. The monthly arcs were combined to derive a set of station positions and station velocities. Earth Orientation Parameters were estimated as independent values of time and polar motion at 5 day intervals from January 1980 through December 1982, and daily intervals since January 1983. The LOD values given are for an epoch midway between the Xp Yp values and the next Xp Yp values. Non-conservative drag-like forces for the LAGEOS satellites were modeled by adjusting a constant and once-per-revolution along track acclerations at 15 day intervals through January 1990, and at 5 day intervals thereafter. The IERS 1992 standards were followed except that the JGM3 gravity field with expanded ocean tidal terms, and a value of GM 398600.4415 km3/s2 were adopted.

II.1.2.5. SSC(GZ) 98 L 01

V. V. Mitrikas
GEOZUP Company , Koroliov of Moscow region , The Russian Federation
The GEOZUP solutions GZ98L01 and GZ98L01 are based on QL-NP data for both Lageoses since 13/01/93 until 28/02/98. 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)97C04 serie and finally to improve accuracy of operational PM and LOD values calculated in MCC. It is already used in MCC computations of PM and LOD since 20 Apr 1998. The

second one is primary solution with 3-days interval between PM parameters. 51 stations and 29 site velocities were computed in both solutions. Total dimension of the solutions is 4781 for GZ98L01 and 6009 for GZ98L02. Orientation and time evolution of GZ98L02 are in agreement with latitude and longitude of 7105 and latitude 7840 and their rates from ITRF94. Orientation and time evolution of GZ98L01 conform longitude and its rate of 7105 from ITRF94 and Earth orientation parameters from EOP(IERS)97C04 serie.

II.1.3. Summary of the GPS solutions

II.1.3.1. SSC(CODE) 97 P 02

M. Rothacher, G. Beutler, T.A. Springer, S. Schaer
Astronomical Institute, University of Berne.

The solution made available to the IERS by the CODE Analysis Center of the IGS for the 1997 submission was produced using as observations the GPS data of the global IGS network. The solution is based on observation over the time interval from GPS week 0961 (April 1993) to GPS week 0963 (June 1998). The number of global IGS stations processed daily at CODE grew from about 35 (in 1993) to more than 100 in 1998.

II.1.3.2. SSC(EMR) 98 P 01

R. Ferland, P. Tetreault, C. Huot, J. Kouba, D. Hutchison.

The 1994-1997 daily solutions were rigorously combined using unconstrained variance-covariance matrices to derive consistent sets of SSC(EMR) 98 P 01 (epoch 1998.0), and EOP(EMR) 98 P 01. The new EOP(EMR) 98 P 01 solution contains daily PM x, y and UT1-UTC, LOD, apriori PM x,y rates and apriori CP(IERS Bull A) corrections from Jan. 01/96 (MJD 50083.5), from June 30/96 (MJD 50264.5) to Dec. 31/97 estimated PM x,y rates and sigmas. Additionaly, from June 30/96 as recommended by IGS, the IERS subdaily EOP model is employed in EMR analysis. However, the reported EOP, as it is now required by IERS, do not include the subdaily EOP effects. The terrestrial reference frame origin and orientation are determined by the ITRF96 coordinates and velocities of 22 fiducial stations. The time evolution is constrained by the ITRF96 station velocities for the 22 stations. The EOP orientation and time evolution is thus consistent with the ITRF96 station coordinates/velocities and the SSC(EMR) 98 P 01. EOP(EMR) 98 P 01 serie provided cover from 95/01/01 to 97/12/31. Although complete variance- covariance matrices between SSC/SSV and EOP were evaluated and are available, only a fully populated SSC/SSV covariance matrix was submitted for the SSC(EMR) 98 P 01. The SSC(EMR) 98 P 01 includes the daily solutions between 94/01/02 and 97/12/31.

II.1.3.3. SSC(EUR) 98 P 01

T.A. Springer (1), D. Ineichen (1), C. Bruyninx (2)
(1) Astronomical Institute, University of Berne.
(2) Royal Observatory Belgium.
The solution made available to the IERS by the EUREF combination center for the 1998 submission was produced based on all available weekly EUREF solutions from GPS week 0834 to GPS week 0960 (126 weeks). It contains the estimated site coordinates and velocities in the SINEX format for all 64 official EUREF sites. All results are based on GPS observations only!

The EUREF weekly combinations are based on the results produced by the following EUREF Analysis Centers:

Contributing Solutions:

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Group Description
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ASI - Nuova Telespazio S.p.A., Space Geodesy Center
BEK - International Commission for Global Geodesy of
      the Bavarian Academy of Sciences (BEK)
COE - European solution created at CODE
      (Center for Orbit Determination in Europe)
GOP - Geodetic Observatory Pecny, Czech Republic
IFG - Institute for Applied Geodesy in Germany (IfAG)
LPT - Bundesamt fuer Landestopographie (L+T),
      Switzerland
NKG - Nordic Geodetic Commision (NKG)
OLG - Observatory Lustbuehel Graz (OLG)
ROB - Royal Observatory of Belgium (ROB)
WUT - Warsaw University of Technology (WUT)
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Each of the EUREF Analysis Centers provides a weekly SINEX file containing their coordinate estimates. These individual solutions are combined to give the official EUREF solution which is submitted to the IGS to be included in the IGS densification project. These weekly EUREF results have been combined to produce this EUREF contribution to the IERS. The EUREF combinations are performed officially since gpsweek 0860 (June 30, 1996) but have been available since gpsweek 0834.

II.1.3.4. SSC(GFZ) 98 P 01

G. Gendt, G. Dick,W. Soehne, W. Sommerfeld, Th. Nischan, G. Beeskow GeoForschungsZentrum (GFZ) Potsdam

A global Set of Station Coordinates (SSC(GFZ)98P01) and Earth Rotation Parameters (ERP(GFZ)98P01) have been computed using the global GPS data spanning 5 years from January 1, 1993, to December 31, 1997, and the GFZ analysis software package EPOS.P.V2.

Site velocities are adjusted for all sites which were analyzed for more than one year (65 sites). The velocity in height is loosely constrained. The orientation of the system is defined by applying no-net-rotation constraints both for the site coordinates and the site velocities, as a reference the ITRF96 (ITRF96_IGS_RS47.SNX) reference frame including velocities is used.

The daily ERP results (ERP(GFZ)98P01 with x, y, LODR) are consistent with this coordinate set. Since June, 30 1996 the daily and sub-daily polar motion and UT1 are modelled according IERS 1996 Standards.

II.1.3.5. SSC(JPL) 98 P 02

M. B. Heflin, M. M. Watkins, D. C. Jefferson, F. H. Webb, and J. F. Zumberge Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA

The most recent velocity and position solution from JPL is based on more than seven years of data from 91jan22 through 98may02. Only sites with three years or more of data are included. Daily estimation was carried out with JPL's GIPSY software using strategies which generally adhered to IERS/IGS standards as described by Zumberge and Jefferson (1992), Heflin et al. (1992, 1994), Blewitt et al. (1992), Vigue et al. (1994), Zumberge et al. (1995), Bar-Sever et al. (1995), and most recently Zumberge et al. (1996). Antenna height corrections were applied using information from the standard IGS log files. Each daily coordinate and eop solution was transformed into ITRF96 with a 7-parameter Helmert transformation. Positions, velocities, coordinate time series, polar motion, length of day, geocenter, and scale time series are all available at URL:
http://sideshow.jpl.nas.gov/mbh/series.html.

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II.1.3.6. SSC(NRCAN)98 P 01

R.Ferland
NRCan combination of GNAACs

This file contains a combined solution of the weekly GNAAC solutions from JPL (Jet Propulsion Laboratory) , MIT (Massachusetts Institute of Technology) and NCL (Univ of Newcastle upon Tyne). The combination includes weekly GNAAC SINEX files between weeks 837 to 977 inclusively. All the weekly solution were unconstrained whenever appropriate. Corrections were applied whenever necessary. Inconsistencies in the station names were for the most part corrected. The implicit geocenter was extracted from each weekly GNAAC solution and 1m uncertainty was applied to avoid singularities. The explicit geocenter was removed before generating the final solution. At each station, the velocity was estimated. Stations with weekly solutions spanning only short intervals have in general poor velocity estimate. Those stations were removed from the solution. Each weekly GNAACs variance- covariance information was rescaled by an estimated variance factor before the final combination. The final solution variance-covariance matrix was not scaled. The solution was aligned to ITRF96 using a 14-parameters transformation. The solution was not constrained to ITRF96.

II.1.4. Summary of the DORIS solutions

II.1.4.1. SSC(GRGS) 98 D 01

L. Soudarin, J.F. Cretaux and A. Cazenave Groupe de Recherche de Geodesie Spatiale, Toulouse, France

The solution gives the station coordinates and velocities of 63 DORIS stations with good observing histories. The DORIS data of 5 years of SPOT2, SPOT3 and TOPEX / POSEIDON (january 1993 to december 1997) were treated for this solution. The data were computed on a dayly basis for the SPOT2 and SPOT3 satelites and on a 3-days basis for the TOPEX/POSEIDON satellites. The computations were made by a semi-dynamical approach in which the satellite orbits, station positions and velocities, and Earth orientation parameters are determined in a single inversion, together with selected parameters required to improve the force model and the measurement corrections. This method uses the GINS/DYNAMO software developped for precise orbit computation and geopotential modelling. For the SSC solutions, the EOP parameters are being fixed to the IERS EOPC04 values. The gravity field model is JGM3 and the ocean tide model is FE95. The stations parameters (positions and velocities) were all estimated, to make the frame entirely free and connected to the IERS only by the EOP.

II.1.4.2. SSC(CSR) 96 D 01

M. M. Watkins Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA
J. C. Ries Center for Space Research, The University of Texas at Austin, Austin, USA

Positions and velocities have been computed for 47 separate DORIS beacons. The data set used consisted of 125 cycles (3.4 years) of tracking data to the Topex/Poseidon satellite. Although a total of over 60 beacons have tracked the Topex/Poseidon, SPOT-2, and SPOT-3 spacecraft, only 54 have sufficient data to estimate a reasonable velocity. The solution was performed without fiducial constraints on any site. Rotational constraints were applied to the network as a whole to remove the rotational singularity, and the network was aligned in rotation and rotation rate to the ITRF94 solution. Translation (geocenter) and scale are left as estimated from the DORIS data. The force and measurement models generally adhered to the IERS standards. Earth rotation parameters were held fixed to the operational values from the University of Texas Center for Space Research CSR95L02 series.

II.1.4.3. SSC(IGN) 98 D 04

Pascal Willis, Institut Geographique National ENSG/LAREG, 6-8, Avenue Blaise Pascal 77455 Marne-la-Vallee, France

1)presentation of the solution

The Position/Velocity Parameters were estimated using all the available DORIS /IERS data for the January 1990-December 1997 period, which is the period including at most 3 satellites (SPOT-2, SPOT-3 and TOPEX/POSEIDON).

Data were processed daily using the GIPSY/OASIS II software at IGN in a free-network approach (a priori constraints of 100 m on, station position for daily solutions)..

Solutions (daily positions including full covariance information) were combined (using stamrg) into monthly solutions (position/velocity). These monthly solutions (including full covariance information) were then combined (using stamrg) and then projected (in rotation, scale and translation) and transformed (in rotation only). The scale and geocenter information comes only from DORIS.

At the final step (after transformation) local tie information on velocity (only) was used to constrain points due to relocation of antennas.

II.1.5. Summary of the Multi-technique solutions

II.1.5.1. SSC(GRIM) 98 C 01

COMBINED SLR AND DORIS SITE COORDINATES AND VELOCITIES SOLUTION SSC(GRIM)98C01

COMPUTED BY GRGS/CNES/GTP (Toulouse), GRGS/CERGA (Grasse), GFZ (Potsdam) and EOPGS (Strasbourg).
R. Biancale, J-M. Lemoine, J-C. Marty, G. Balmino, B. Moynot
P. Exertier, Y. Boudon, O. Laurain, F. Barlier
P. Schwintzer, Ch. Reigber, A. Bode, F.-H. Massmann, H. Meixner, J.C. Raimondo, S. Zhu
P. Gegout

A solution of coordinates and velocities has been computed using :

- SLR data of 11.5 years of tracking on Lageos (Mai 1985 to October 1996)
- SLR data of 4 years of tracking on Lageos2 (November 1992 to October 1996)
- DORIS data of three 4-month periods for SPOT2, SPOT3 (between November 1993 and October 1996)
- SLR and DORIS data of three 4-month periods for TOPEX/Poseidon (between November 1993 and October 1996)

This solution concerns 147 SLR and DORIS stations in position and 120 sites in velocity.

Data analysis

The tracking data are analysed through a dynamical orbit computation in which the satellite orbit, station positions and velocities are determined in a single inversion, together with selected parameters required to improve the force models and the measurement corrections.
Orbits are computed by 10-day-arcs for the Lageos satellites, by 2 to 4 day arcs for the SPOT satellites, and by 3 to 5 day arcs for the TOPEX/Poseidon satellite.
Normal equations are then formed for orbit parameters, force parameters, station coordinates and velocity vectors.
Individual normal equations are accumulated to form a combined matrix. The inversion of this matrix yields the solution for the geodetic parameters.
The connection between the SLR and DORIS networks in that combined station solution is obtained through the simultaneous use of both techniques on a single satellite (TOPEX/Poseidon), and not through the use of ground survey ties between stations.
The gravity field model used in the orbit computation is a preliminary version of GRIM5.

Estimated parameters

The position of 147 SLR and DORIS stations was estimated, using a no-rotation constraint:
The weighted sum of the longitudes of 44 stations is kept close to the ITRF96 longitude reference, with a constraint of 8.2e-12 rd (equivalent to 5.e-5 m on the equator).
The weighting is done according to the a-priori uncertainties of the stations positions.

The velocity of 120 sites was estimated. The solution was stabilized by constraining it to the a-priori model with a sigma of 8.2e-3 m/y.
The a-priori model is a combination of a GRIM5-step1 solution, ITRF96, NNR-NUVEL1A and ICE4G-VM2.

II.2. Local surveys

As an improvement of the use of the local ties, all the eccentricities of colocated sites were converted into a complete set of positions for each site, provided in SINEX format. Each SINEX file reflects correlations between the cartesian components of the points within each site. This has been achieved by solving for the following system of observation equations (II.1):

$$\begin{pmatrix} \Delta x_s^{i,j} \\ \Delta y_s^{i,j} \\ \Delta z_s^{i,j} \end{pmatrix} = \begin{pmatrix} x^j - x^i \\ y^j - y^i \\ z^j - z^i \end{pmatrix} \tag{II.1}$$

Where ($\Delta x_s^{i,j}$, $\Delta y_s^{i,j}$, $\Delta z_s^{i,j}$) are the geocentric components of the tie vector linking two points i and j, of a given data set s. The standard deviations (SD) ($\sigma\Delta x_s^{i,j}$, $\sigma\Delta y_s^{i,j}$, $\sigma\Delta z_s^{i,j}$) for each local tie vector are used to compute a diagonal variance matrix. If these SD are not available, they are computed by :

$$\sigma_{computed} = \sqrt{\sigma_1^2 + \sigma_2^2} \tag{II.2}$$

where,

$$\sigma_1 = 3 \text{ mm} \quad \text{et} \quad \sigma_2 = 10^{-6} \times \sqrt{(\Delta x_s^{i,j})^2 + (\Delta y_s^{i,j})^2 + (\Delta z_s^{i,j})^2}$$

The equation system (II.1) needs of course initial coordinates for one point per tie vector set s, which are taken from ITRF solutions with 1 meter as standard deviation.

Table T3 of the appendix lists the local ties vectors used in the ITRF97 combination.