SATELLITE LASER RANGING

EARTH ORIENTATION AND SITE COORDINATES FROM THE CENTER FOR SPACE RESEARCH SOLUTION CSR 92 L 01

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Earth orientation parameters were derived from a combination of Lageos full rate and quick look data. Full rate data was used from 1976 until the end of June, 1991, and quicklook data used for July 1991 through December 1991. A summary of the 1991 data used in the solution is provided in Table 1. The column titled RBTB RMS refers to the root mean square of the residuals after removing an estimated range bias and time bias. The column titled PREC EST refers to the residual rms after removing a second order polynomial, yielding an estimate of the internal precision of the data.

Mean positions for all sites were adjusted and horizontal site velocities were adjusted for 42 sites with good observing histories. For all other sites, velocities were held fixed to those predicted by the NUVEL-1 NNR model.

The force and measurement models used for this solution conform generally to the IERS Standards, with the following exceptions:

1) The mean gravity field was TEG-2, a state of the art gravity field computed at the University of Texas Center for Space Research.
2) The ocean tide model was an enhanced version of the Schwiderski model extrapolated to include 80 consituents complete through degree and order 20, assuming admittances which vary linearly with frequency.
3) The solid tide model has been expanded to include third degree and fourth degree terms.
4) The geogravitational constant, GM, was 398600.4415 km3/s2.
5) The nominal plate motion model was NUVEL-1 NNR.
6) The free core nutation period has been changed from 460 to 430 days.

The data was weighted in a piecewise continuous, linearly interpolated model to reflect the improvement in laser hardware over the data span. The weighting curve had the following node points:

MJD 42905.0 : 700 mm
MJD 44162.0 : 400 mm
MJD 45578.0 : 200 mm
MJD 47000.0 : 100 mm

The weights are larger than the true random component of the laser ranges in order to reflect unmodelled systematic errors, and are thus scaled so that the formal uncertainties on the Earth orientation parameters are consistent with their internal precision.

The solutions for orbit elements and Earth orientation parameters were computed using residuals from a long arc fit spanning the period from 7 May 1976 through 13 February 1992, a period of 15.8 years. The short arc adjustments were made at 3 day intervals subject to the constraint that the posteriori uncertainties were less than specified values, to allow for the change in data quantity over time. Thus if the solution for a given 3 day interval yielded unacceptably large uncertainties on the adjusted parameters, the interval was extended by another 3 day interval and the solution repeated. Thus each final interval is a multiple of 3 days. For each interval, regardless of length, 6 Keplerian mean elements and xp and yp were solved. The UT1 estimates are obtained from the Lageos node residuals, with the constraint that they follow the JPL SPACE91 series at periods longer than about 60 days (Gross, 1992).

References

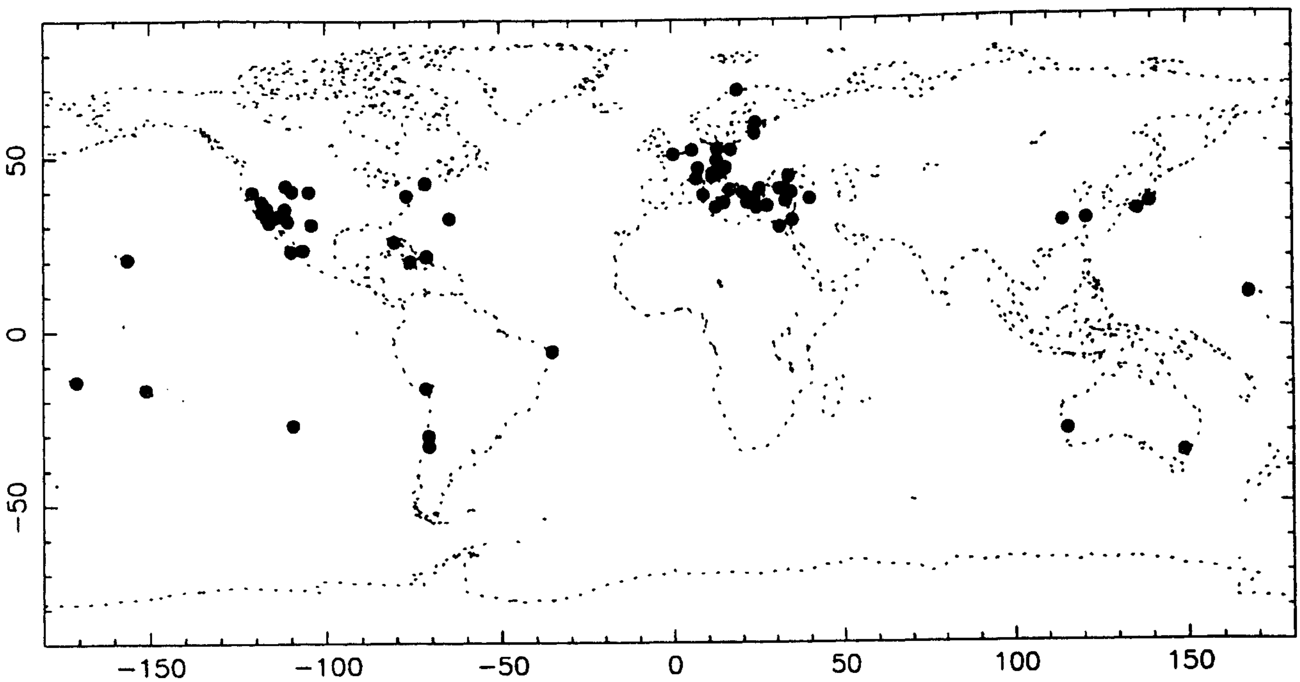
Gross, R.S., 1992: A Combination of Earth Orientation Data: SPACE91, *IERS Technical Note 11*, Observatoire de Paris, p. 113.

Table 1. Summary of 1991 Lageos Residual Analysis, B Ver NP Jan-Jun, QL Jul-Dec

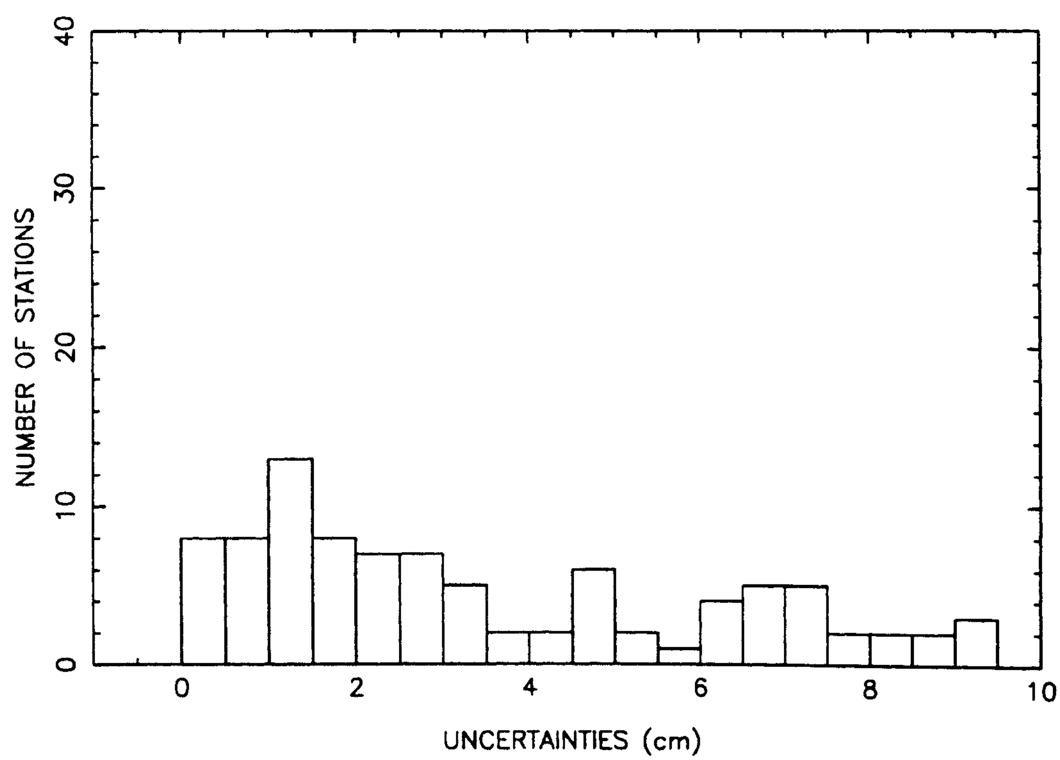
Station	# of Passes	# of 2-min np	number edited	percent edited	number kept	Raw RMS (cm)	RBTB RMS (cm)	PREC. EST. (cm)
1181 POTSDM	29	246	71	28.9	175	9.4	6.0	4.7
1873 SIMEIZ	27	193	27	14.0	166	8.6	5.4	3.9
1884 RIGA	58	627	88	14.0	539	8.6	3.8	3.4
1953 SANCUB	27	184	105	57.1	79	9.9	6.1	5.3
7046 BRLAK2	60	844	10	1.2	834	2.3	0.6	0.5
7080 MCDON4	217	2403	32	1.3	2371	2.5	0.8	0.6
7090 YARAG	226	3875	54	1.4	3821	2.7	0.3	0.2
7097 EASTR2	43	512	1	0.2	511	3.1	1.1	1.0
7105 GRF105	175	2393	31	1.3	2362	2.5	0.5	0.4
7109 QUINC2	145	1754	23	1.3	1731	2.6	0.5	0.4
7110 MNPEAK	337	4932	52	1.1	4880	2.9	0.4	0.2
7112 PLATVL	28	345	6	1.7	339	4.2	0.8	0.7
7122 MAZTLN	70	1078	6	0.6	1072	2.4	0.4	0.2
7123 HUAHI2	48	558	8	1.4	550	3.6	1.2	1.1
7210 HOLLAS	288	4081	56	1.4	4025	2.9	1.0	0.7
7236 WUHAN	48	546	8	1.5	538	7.4	3.2	2.2
7288 MOJAV2	21	355	10	2.8	345	4.2	0.4	0.3
7295 RICHMO	53	777	18	2.3	759	4.2	0.6	0.5
7401 CERTOL	68	1019	12	1.2	1007	2.7	0.6	0.3
7403 ARELA2	126	1579	23	1.5	1556	3.4	0.9	0.7
7542 MONVEN	63	484	17	3.5	467	4.6	1.6	1.4
7560 RIGA2	12	84	1	1.2	83	2.5	1.0	0.8
7561 SIMEI2	34	493	6	1.2	487	3.7	0.6	0.5
7597 WET597	12	117	1	0.9	116	5.0	0.9	0.5
7810 ZIMMER	140	1835	11	0.6	1824	4.1	2.2	2.0
7811 BOROWC	12	71	5	7.0	66	7.7	4.0	3.6
7831 HELWAN	118	1167	5	0.4	1162	4.3	2.4	2.0
7834 WETZEL	17	187	4	2.1	183	2.7	1.2	1.1
7835 GRASSE	414	5762	100	1.7	5662	3.8	1.4	1.0
7837 SHAHAI	105	1053	123	11.7	930	8.0	4.3	3.6
7838 SHO	77	1081	21	1.9	1060	5.3	2.8	2.1
7839 GRAZ	153	2377	12	0.5	2365	2.8	0.7	0.5
7840 RGO	450	5201	38	0.7	5163	2.6	0.9	0.7
7843 ORRLLR	38	458	5	1.1	453	4.1	1.3	1.0
7883 ENSENA	25	360	4	1.1	356	3.2	0.7	0.6
7907 ARELAS	24	293	60	20.5	233	8.3	6.4	5.8
7918 GRF918	4	47	0	0.0	47	1.7	0.8	0.8
7920 GRF920	4	49	0	0.0	49	2.6	0.9	0.8
7939 MATERA	163	2004	102	5.1	1902	6.6	4.8	4.2
8834 WETZL2	307	3155	92	2.9	3063	5.1	1.5	1.2

Summary description of the terrestrial system attached to the set of station coordinates SSC(CSR) 92 L 01

1 - Technique :	SLR
2 - Analysis Center :	CSR
3 - Solution Identifier :	SSC(CSR) 92 L 01
4 - Software Used :	UTOPIA
5 - Relativity Scale :	Geocentric (LE)
6 - Permanent Tidal Correction on station :	Tidal correction has nonzero mean. Positions do not reflect true mean.
7 - Tectonic Plate model :	NUVEL-1 NNR
8 - Velocity of light :	299792458 m/sec
9 - Geogravitational constant (GM) :	398600.4415 km3/s2
10 - Reference Epoch :	1988.0
11 - Adjusted Parameters:	
Coordinates :	Epoch 1988.0 position for all sites in cartesian coordinates solved one time for entire data span. Horizontal velocities adjusted for 42 selected sites
Site dependent biases :	Adjusted where necessary.
Orbit :	6 Keplerian mean element corrections to long arc orbit solved every 3 days throughout span subject to constraint that posteriori uncertainties were less than specified values. If not satisfied, interval was extended in multiples of 3 days until solution was acceptable.
EOP :	x, y and UT1 (UT1 constrained by JPL SPACE91) solved at same intervals as orbit
12 - Definition of the origin :	Geocentric, C10 = C11 = S11 = 0.0
13 - Definition of the orientation :	System oriented to agree with IERS combined in a mean sense over period 1984-1990, maintained through fixing the latitude and longitude of site 7210 (HOLLAS) and the latitude of site 7105 (GRF105).
14 - Constraint for time evolution :	Latitude and longitude rate of site 7210 (HOLLAS) and latitude rate of site 7105 (GRF105) fixed to NUVEL-1 NNR velocities. Horizontal site velocities adjusted with a priori covariance of 100 mm/yr for 41 other sites with sufficient data.



Distribution of the 68 sites of the terrestrial frame SSC(CSR) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 110 stations of the terrestrial frame SSC(CSR) 92 L 01. 18 stations with uncertainties larger than 10 cm are not shown.

EOP(CSR) 92 L 01 From May 1976 to Dec 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for UT1

YEAR	X		Y		UT1	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1976	33	11.30	33	11.03	33	6.55
1977	82	11.29	82	9.53	82	6.22
1978	77	10.44	77	7.81	77	5.85
1979	82	8.07	82	7.53	82	4.88
1980	118	4.74	118	3.07	118	2.59
1981	112	4.70	112	2.86	112	2.32
1982	114	3.26	114	2.64	114	2.05
1983	118	2.49	118	2.57	118	1.48
1984	121	1.16	121	1.06	121	0.90
1985	121	0.99	121	0.85	121	0.70
1986	122	0.85	122	0.78	122	0.67
1987	122	0.58	122	0.55	122	0.45
1988	122	0.48	122	0.51	122	0.39
1989	121	0.52	121	0.51	121	0.42
1990	122	0.48	122	0.52	122	0.39
1991	122	0.61	122	0.62	122	0.46

EARTH ORIENTATION AT 1-DAY INTERVALS FROM THE CENTER FOR SPACE RESEARCH CSR 92 L 02

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Solutions for orbital elements and Earth orientation parameters were computed using residuals from a long arc fit to Lagoes SLR data from November 1987 through January 1992, a period of just over 5 years. Observation equations for Earth orientation parameters and orbital elements were produced from the data during 1-day intervals centered on midnight UT. This information was combined with UT1 estimates from the JPL SPACE91 (Gross 1992) series in a Kalman smoother to produce the reported series. The forward and backward filters used in the smoother had 18 states consisting of 6 orbital parameters with their 6 excitations and 3 Earth orientation parameters with their 3 excitations.

The 9 excitation parameters were modelled as first order Gauss-Markov processes with specified time constants and steady-state variances. The EOP excitation parameters correspond to Chi1 and Chi2 for wobble and LOD for UT1. The colored noise process for Chi1 and Chi2 used 3 days for the time constant and 50 milliarcsec for the steady-state standard deviation. A full discussion of the model used for the orbital parameters is beyond the scope of this brief summary. The most important aspect of the orbit model for this report is that the stochastic process for the excitation of the longitude of the ascending node used a time constant of 3 days and a steady-state standard deviation of 200 milliarcsec per year. Use of this process noise model results in UT1 estimates that are highly correlated with the UT1 observations from the SPACE91 series, even down to periods of less than 10 days.

The terrestrial reference frame used for this solution was fixed to that of the CSR 92 L 01 series (Eanes and Watkins 1992).

References

Gross, R.S., 1992: A Combination of Earth Orientation Data: SPACE91, *IERS Technical Note 11*, Observatoire de Paris, p. 113.
Eanes, R.J., Watkins, M.M.,1992: Earth Orientation and Site Coordinates from the Center for Space Research Solution CSR 92 L 01, *IERS Technical Note 11*, Observatoire de Paris, p. 75.

EOP(CSR) 92 L 02 From Jan 1987 to Jan 1992

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for UT1

YEAR	X		Y		UT1	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1987	365	0.48	365	0.45	365	0.14
1988	366	0.42	366	0.44	366	0.14
1989	365	0.45	365	0.43	365	0.13
1990	365	0.42	365	0.44	365	0.13
1991	365	0.49	365	0.49	365	0.15
1992	1	0.64	1	0.65	1	0.15

EARTH ORIENTATION AND STATION COORDINATES COMPUTED FROM 11.75 YEARS OF LAGEOS OBSERVATIONS DGFII 92 L 01

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The solution (DGFII) 92 L 01 is an earth orientation, station position and station velocity solution derived by DGFI from all laser tracking data acquired in the period January 1980 to September 1991 from LAGEOS by fixed and mobile SLR systems of the international SLR network. The difference to the previous DGFI earth orientation and station position solution (DGFII) 91 L 01 is the extension of the LAGEOS analysis interval from 10.3 to 11.75 years.

The derived pole positions are referred to the position of the mean pole averaged over the period 1/1980 to 10/1986. This DGFI fixed origin of the pole departs from the CIO position by .045" in x and .286" in y.

The station coordinates are given for the reference epoch 1988.0.

1) COMPUTATION MODEL:

The models and constants underlying the (DGFII)92L01 solution and used for parameter estimation within the DGFI Orbit and Geodetic Parameter Estimation System (DOGS) are given in the following:

Reference Frame

CIS :	mean equator and equinox of J2000.0
Precession :	IAU 1976
Nutation :	IAU 1980 + DGFI correction(*) (Zhu and Reigber 1991)
Planetary Ephemerides :	JPL DE200/LE200 ephemerides
Initial Earth Rotation :	BIH87C02S homog. series, IERS Bulletin B (pole position transf. to zero mean pole: 1/1980 - 10/1986)(*)
Initial Station Coordinates :	GRIM4-S1 (Schwintzer *et al.* 1991)
Initial Station Velocities :	zero
Orientation of CTS :	stations 7086, 7090, 7105, 7109, 7122, 7210, 7834, 7835, 7840, 7907 (c.f. Bender and Goad 1979)
Time Evolution of Orientation :	common rotation with respect to AM0-2 plate motion model fixed to zero (same stations as above)

Dynamical Model

GM :	3.98600440 E+14 m**3 s**-2, C(0,0) solved
Semi Major Axis of Earth :	6378136 m
Flattening 1/f :	298.257810
Angular Velocity of Earth :	0.7292115 E-4 rad/s
Gravity Model of Earth :	GRIM4-S1 (truncated at l,m=25) (*) (Schwintzer *et al.* 1991)
C(2,1), S(2,1) :	applied, computed with respect to zero mean pole

Gravity Model of Moon :	Ferrari 77 (4*4)
Third Body :	Sun, Moon, Jupiter, Venus, Saturn, Mars, Mercury
Along Track Acceleration :	empirical (adjusted)
Albedo and Infrared :	Stephens model
Ocean Tides :	Schwiderski + GRIM4-S1(*)
Solid Earth Tides :	Wahr (2,2) model, k2=0.3, d=0, with permanent tide not removed
Relativistic Motion Equation :	harmonic isotropic

Measurement Model

Marini-Murray Refraction Model :	IERS standards
Solid Earth Tides Displacement :	IERS standards (Wahr model)
Ocean Loading Site Displacement :	based on Schwiderski model
Pole Tide :	IERS 1989
Normal point elimin. criterion :	eliminated when created by 3 or less single ranges

* - departures of IERS Standards

2) DATA

Two minute normal points are used for the solution (DGFII)92L01: 470,000 normal points generated by DGFII for the period January 1980 to April 1990, and 93,000 normal points generated by the Bendix Field Engineering Cooporation for the period May 1990 to Sept. 1991.

3) ANALYSIS PROCESS

The analysis was performed with the DGFI Orbit and Geodetic Parameter Estimation System (DOGS). DOGS consists of several macro modules. Those being used for the described analysis are the orbit computation module (DOGS-OC) and the reduction, accumulation and solution module (DOGS-CS). The processing sequence is as follows:

```
              --------------------
              ! Archived NP-Data !
              --------------------
                        !------<-----------+
                   ==========    ------------------
                   ! DOGS-OC !   ! fine screening !    Orbit
                   ==========    ------------------    computation
                        !------>-----------+
          ----------------------------
          ! monthly normal equations !
          ----------------------------
                        !                              Reduction,
                   ==========                          accumulation,
                   ! DOGS-CS !                         solution
                   ==========                          of normal
                        !                              equations
  ---------------------------------------------
  !             multi-year solution           !
  ---------------------------------------------
```

DOGS-OC is used for orbit computation, fine screening of data, and for the creation of monthly arc normal equations. DOGS-CS is firstly providing the reduced normal equations, secondly accumulating several reduced normal equations including datum constraints and eccentricity conditions, and thirdly solving the 11.75 years combined normal equation system simultaneously for all parameters listed below.

4) GEODETIC DATUM

The solution is minimum constrained. Since the origin of the reference system is the geocentre by setting the first degree and order terms of the gravity model to zero and the scale being defined by the velocity of light, the orientation remains to be defined. This is done by forcing the common rotation between the initial and the adjusted coordinates of a selected set of stations to become zero (Bender and Goad 1979).

In the same way the drift in orientation about the three coordinate axes is forced to be the same as derived from a given set of horizontal station velocities inferred by a geophysical plate motion model, presently being the AM0-2 model (Minster and Jordan 1978).

5) ECCENTRICITY CONDITIONS

In order to achieve reasonable drift rates on stations successively occupied by different systems some conditions have to be applied: coordinate rates referring to the same site are set equal and eccentricity values (survey ties) between two occupations are introduced as external observations if available and proved to be correct. In contrary, some occupations had to be divided into separate occupations, because a discontinuity appeared somewhere in the data.

6) ADJUSTED PARAMETERS

The adjusted parameters are listed in the following table:

Gravity Field Parameters	: C(0,0)
Direct Solar Radiation Pressure	: CR (per 15 days)
Along Track Acceleration	: CA (per 15 days)
Orbital State Vector	: 6 parameters per 30 days
Polar Motion	: one x and y parameter per 5 days
LOD	: one parameter per 5 days
Station Coordinates	: geocentric coordinates X, Y, Z
Velocity of Stations	: north and east direction (phidot, lambdadot*cos(phi))

Some of these parameters have been reduced in the monthly normal equations before combining the equations to a multi-year system in order to reduce the size of the system. The solution has 198 sets of X-, Y- ,Z- station coordinate parameters. Only horizontal station velocities were solved for. For stations with a time span of the observations shorter than one year no station velocities were solved for. There are North and East velocity parameters solved for 46 observation sites.

7) RESULTS

The results consist of Earth orientation parameters for the 11.75 years interval, station coordinates and velocities. They are available on request from the Central Bureau of IERS.

References

Bender, P., Goad, C., 1979: Probable LAGEOS Contributions to a Worldwide Geodynamics Control Network. *The Use of Artificial Satellites for Geodesy and Geodynamics*, Eds. G. Veis and E. Livieratos, Athens (Greece), Publication of the National Technical University, Vol. II, pp 145-161.

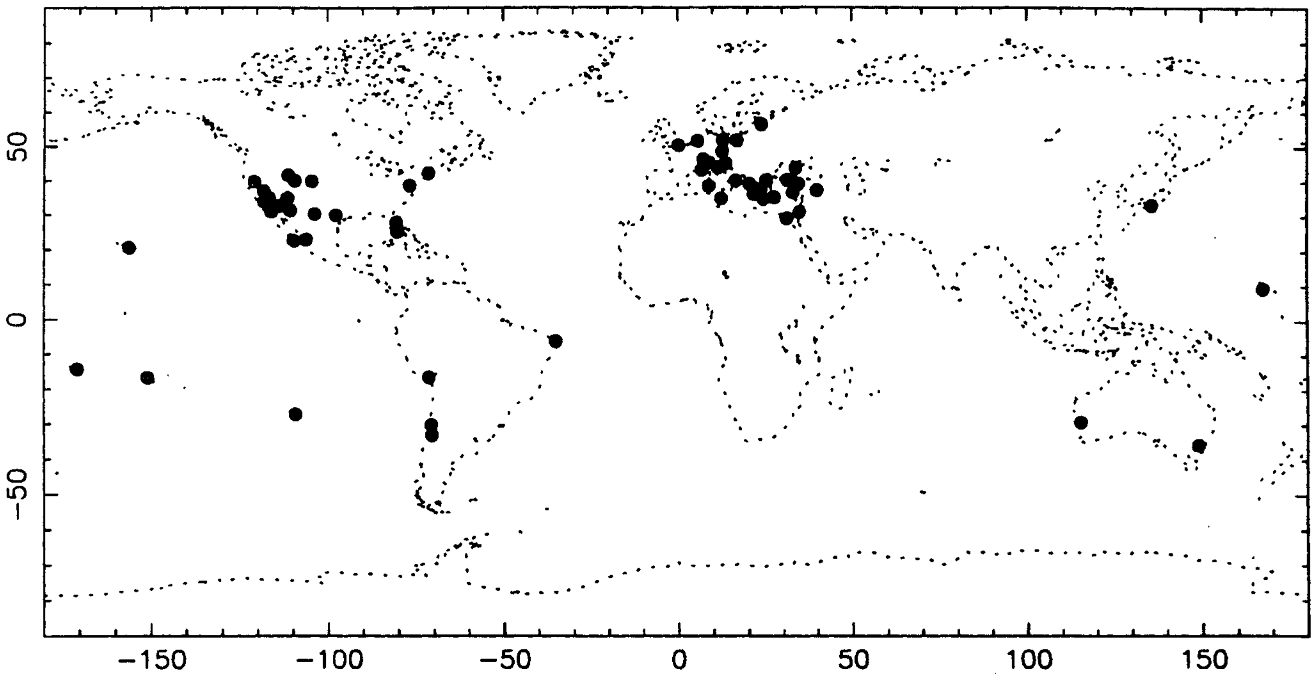
Minster, J.B., Jordan, T.H., 1978: Present-Day Plate Motions, *J. Geophys. Res.*, **83**, B11, pp 5331-5354.

Schwintzer, P., Reigber, Ch., Massmann, F.H., Barth, W., Raimondo, J.C., Gerstl, M., Li, H., Biancale, R., Balmino, G., Moynot, B., Lemoine, J.M., Boudon, J., Barlier, F. 1991: A New Earth Gravity Field Model in Support of ERS-1 and SPOT2: GRIM4-S1/C1, *Technical Report to the German Space Agency (DARA) and the French Space Agency (CNES)*, DGFI/GRGS, Muenchen/Toulouse.

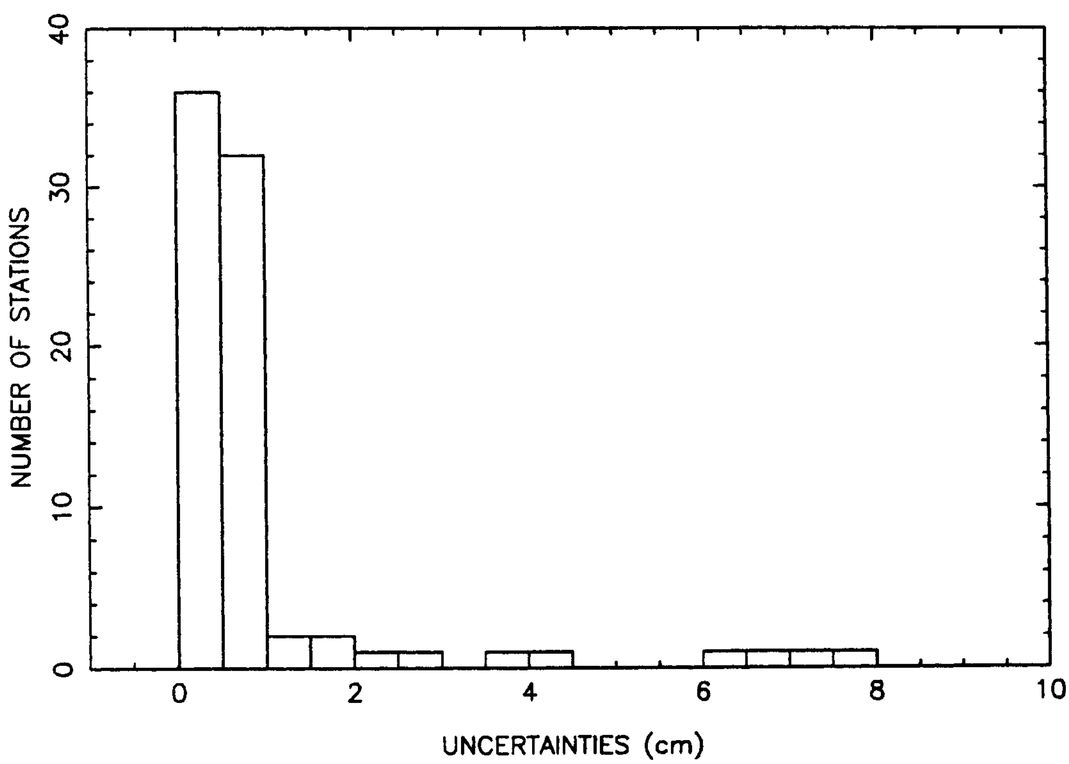
Zhu, S.Y., Reigber, Ch., 1991: The German PAF for ERS-1: ERS-1 Standards used at D-PAF, *D-PAF Document ERS-D-STD-31101*, Muenchen.

Summary description of the terrestrial system attached to the set of station coordinates SSC(DGFII) 92 L 01

1 - Technique :	SLR
2 - Analysis Center :	DGFI, Dept.I, Munich
3 - Solution identifier :	SSC(DGFII) 92 L 01
4 - Software used :	D O G S (DGFI Orbit and Geod. Parameter Estimation System)
5 - Relativity scale :	LE
6 - Permanent tidal correction on station :	not included
7 - Tectonic plate model :	no a priori model
8 - Velocity of light :	299792458 m/sec
9 - Gravit. const. * Earth mass (GM) :	3.986004396E+14 m*3/s**2 (adjusted)
10 - Reference epoch :	1988.0 (MJD 47161.0)
11 - Adjusted parameters :	C00, X,Y,Z, Lamdadot*cos(phi),phidot (for 11.75 years) LAGEOS state vector at epoch (at monthly intervals) CR, CA (at 15 day intervals) PX, PY, LODR (at 5 day intervals)
12 - Definition of origin :	geocentre
13 - Definition of the orientation :	common rotation angle between initial and adjusted coordinates of 10 stations forced to be zero
14 - Constraint for time evolution :	drift in orientation around the three coordinate axes is forced to be the same as derived from a given set of AM0-2 horizontal station position velocities.



Distribution of the 60 sites of the terrestrial frame SSC(DGFII) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 81 stations of the terrestrial frame SSC(DGFII) 92 L 01. 1 station with uncertainty larger than 10 cm is not shown.

EOP(DGFII) 92 L 01 From Jan 1980 to Sep 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1980	73	0.70	73	0.40	73	0.07
1981	73	0.70	73	0.40	73	0.07
1982	73	0.50	73	0.40	73	0.06
1983	73	0.50	73	0.40	73	0.05
1984	73	0.30	73	0.30	73	0.04
1985	73	0.30	73	0.20	73	0.03
1986	73	0.30	73	0.30	73	0.03
1987	73	0.30	73	0.30	73	0.03
1988	73	0.30	73	0.30	73	0.03
1989	73	0.30	73	0.30	73	0.04
1990	73	0.30	73	0.30	73	0.03
1991	55	0.30	55	0.30	55	0.04

EARTH ROTATION AND STATION COORDINATES COMPUTED FROM SLR OBSERVATIONS ON LAGEOS

DUT 92 L 01

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The solution ERP/SSC(DUT) 92 L 01 consists of a coherent set of Earth Rotation Parameters (ERPs), determined at 5-day intervals, and coordinates of a global laser station network. The solution was computed from laser range observations on the geodetic satellite LAGEOS, taken during the period January 1986 through December 1990.

For the analysis, the 5-year data interval was divided into a total of 21 sub-periods, with a length of 13 weeks on average. The actual analysis was performed in a 2-step approach.

First, a continuous but mutually independent series of 21 global network and ERP solutions was computed by analyzing each batch of observations. The parameter estimation was based on a least-squares fit of the satellite orbit to the SLR observations. To limit the effect of potential dynamic model errors, the analysis programs GEODYN-2 and SOLVE-2 were executed in a so-called multi-arc mode, where each sub-period was further divided into a series of 7-day data arcs and satellite parameters (state-vector at epoch, solar reflectivity and along-track acceleration parameter) were estimated for each individual data arc.

To prevent computational singularities, the parameters were constrained in a Bayesian way.

The a priori standard deviation of the pole position and UT1 were assigned values of 0.1 arcsec and 0.01 s, respectively, with a priori values taken from the monthly IERS Bulletins B. The initial station coordinates, computed during a preliminary data screening run, were given an a priori uncertainty of 1 m. The ascending nodes of the satellite state-vectors were kept fixed at the values determined in the data screening.

The computation model is summarized in Table 1. The model closely follows the IERS Standards, with few exceptions: (i) the GEM-T2 solution, both for the gravity field and for the ocean tides, was used instead of the advised GEM-T1 and Schwiderski models; (ii) the effect of ocean loading on station coordinates was not applied; and (iii) no plate motion was applied during each "13-week" sub-period. Details of the terrestrial system are given in Table 2.

The second step was primarily aimed at bringing coherency into the series of parameter solutions. This was done by fitting a model for tectonic deformations to the series of individual station coordinates, while eliminating systematic differences. This model consists of initial station coordinates at a reference epoch and the time-derivatives of these coordinates. A priori values for these time-derivatives were taken from the NUVEL-1 No Net Rotation model, and either kept fixed for a sub-set of 12 SLR stations, which are known to follow the motions described by this model, or estimated for the remainder of the stations.

Next, the resulting model for instantaneous station positions was back-substituted into the GEODYN/SOLVE data reduction programs. Finally, new solutions for the ERPs were computed without application of any constraint, and keeping the station positions (and the ascending nodes) fixed. The computation model is identical to the one for step 1, already listed in Table 1.

The resulting series of ERP solutions and the station coordinates solution are available on request from the Central Bureau of IERS. The solution for each station consists of the cartesian monument coordinates at epoch, the corresponding standard deviations (both in m), the apparent motions and the standard deviations of the latter (in m/yr). The reference epoch of the solution is January 1, 1988. In UT1, the effect of short-term perturbations, caused by zonal tides, has been removed.

Table 1: Models and constants.

DYNAMIC MODEL:

Gravity field :	NASA/GSFC GEM-T2 model, truncated at 20x20; C(2,1) and S(2,1) according to IERS Standards (1989)
GM :	398600.4360 km**3/s**2
c :	299792.458 km/s
ae :	6378.1370 km
1/f :	298.257
Solar and lunar attraction :	JPL DE200 ephemeris
Solid earth tides :	Wahr model
Ocean tides :	NASA/GSFC GEM-T2 model
Solar radiation :	CR adjusted; occultation by Earth and Moon; umbra and penumbra
Along-track acceleration :	AT adjusted
Third body attraction :	Sun, Moon, Venus, Mars, Jupiter, Saturn; positions from JPL DE200/LE200 ephemeris
Pole tide (dynamic part) :	applied

REFERENCE FRAME:

Station coordinates :	adjusted (step 1); modelled with NUVEL-1 NNR (step 2)
Earth rotation :	adjusted at 5-day intervals; a priori values from IERS Bulletin B
CIS :	mean equator and equinox of J2000.0
Precession :	IAU 1976 (Lieske model)
Nutation :	IAU 1980 (Wahr model) plus Herring correction
Plate motion :	not applied
Tidal uplift :	h2 = 0.609, l2 = 0.0852
Pole tide (geometric part) :	applied
Ocean loading :	not applied

MEASUREMENT MODEL:

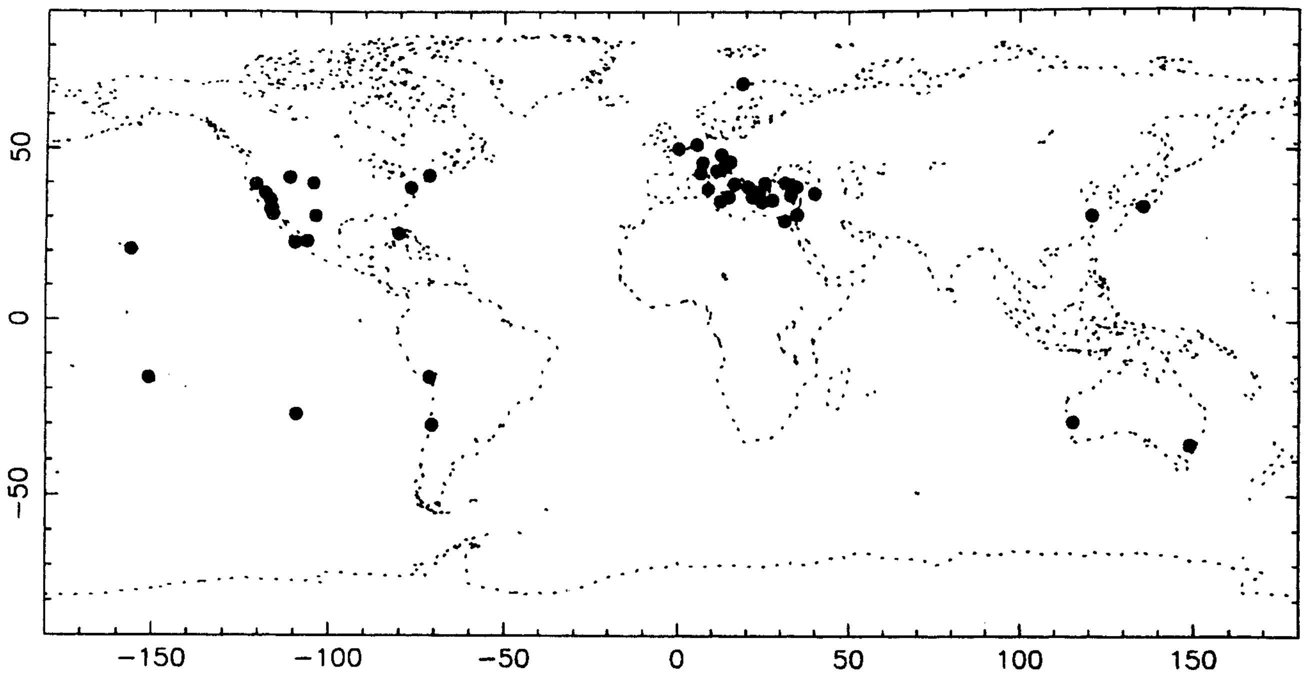
Observations :	Release B normal points, computed at DGFI (January - October 1986, 1987), DUT (November, December 1986) and Bendix (1988 - 1990)
Data weighting :	determined from overall model accuracy and system characteristics
Tropospheric refraction:	Marini-Murray model

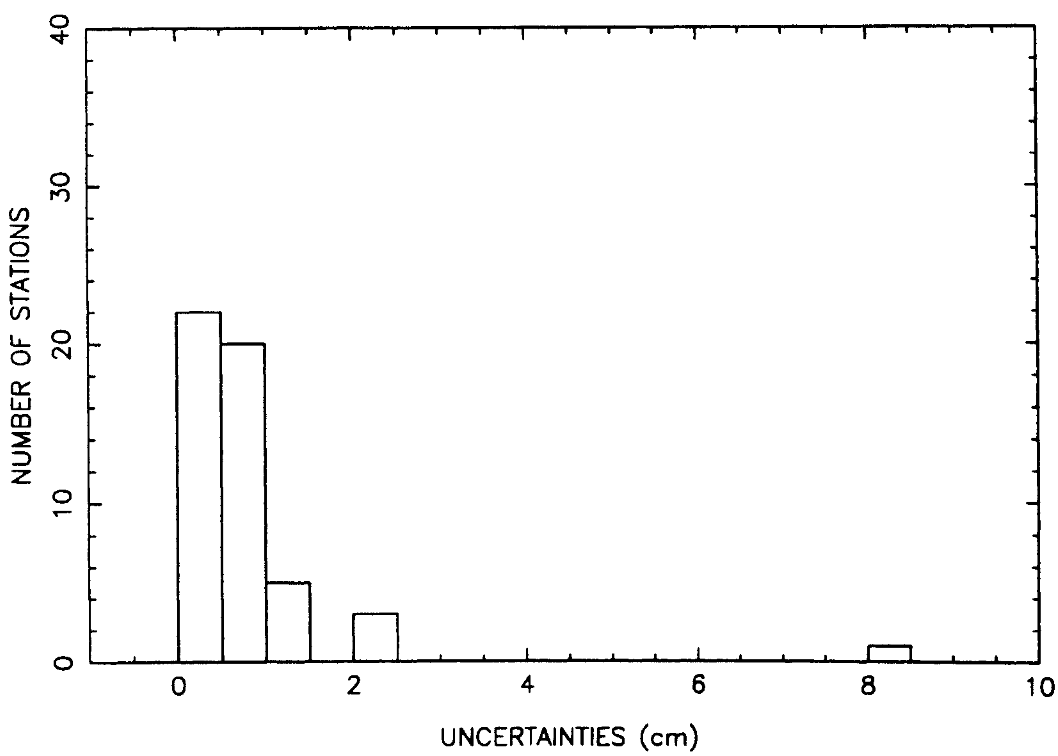
Table 2.

Summary description of the terrestrial system attached to the set of station coordinates SSC (DUT) 92 L 01

1- Technique :	SLR
2- Analysis center :	DUT
3- Solution identifier :	SSC(DUT) 92 L 01
4- Software used :	GEODYN-2/SOLVE-2
5- Relativity scale :	local Earth
6- Tidal uplift :	yes
7- Tectonic plate model :	NUVEL-1 NNR for selected sites (Yarragadee, Easter Island, Greenbelt, Platteville, Huahine, Mazatlan, Maui, Wettzell, Graz, RGO, Orroral Valley, Kootwijk); DUT solutions derived for the remainder of the stations, determined w.r.t. a reference frame moving according to NUVEL-1 NNR
8- Velocity of light :	299792.458 km/s
9- Gravitational constant :	398600.4360 km**3/s**2
10- Reference epoch :	January 1, 1988
11- Adjusted parameters :	X0, Y0, Z0 (for selected stations); X0, Y0, Z0, Xdot, Ydot, Zdot (remainder)
12- Origin definition :	C(1,0) = C(1,1) = S(1,1) = 0
13- Orientation definition :	initial coordinates at reference epoch
14- Evolution constraint :	NUVEL-1 NNR (for selected stations); DUT apparent motions (remainder)

Distribution of the 48 sites of the terrestrial frame SSC(DUT) 92 L 01





Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 52 stations of the terrestrial frame SSC(DUT) 92 L 01. 1 station with uncertainty larger than 10 cm is not shown.

EOP(DUT) 92 L 01 From Jan 1986 to Dec 1990

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for UT1

YEAR	X		Y		UT1	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1986	72	0.23	72	0.19	72	0.17
1987	72	0.19	72	0.17	72	0.15
1988	73	0.18	73	0.18	73	0.14
1989	73	0.18	73	0.17	73	0.15
1990	73	0.16	73	0.16	73	0.14

EARTH ROTATION AND STATION COORDINATES FROM 1983 - 1991 LAGEOS OBSERVATIONS ANALYSIS GAOUA 92 L 01

A.I. Emets, V.N. Salyamov, V.K. Tarady

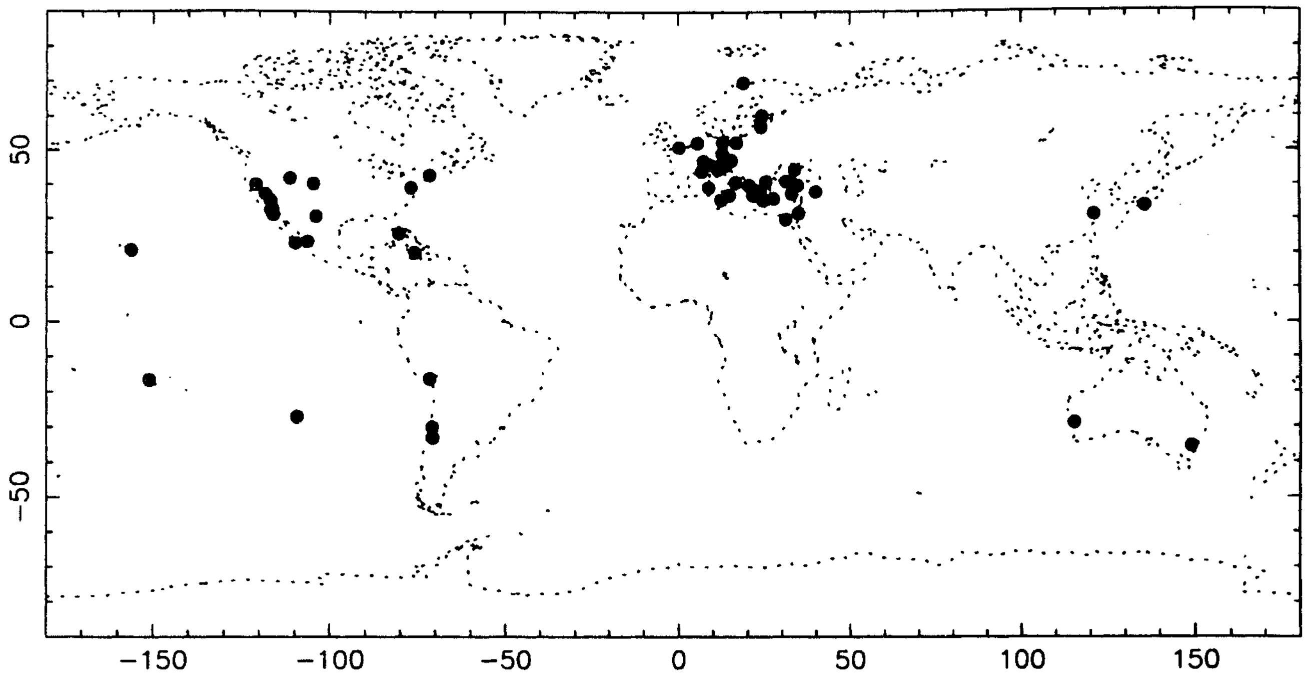
A set of 72 station cartesian coordinates and a EOP series have been determined from 468415 Lageos normal points involving the period of 8 years from september 1983 through sepember 1991. Kiev-Geodynamics-4 software based on numerical Adams method with a variable step and integration order and on the most of IERS recommendation has been used for data analysis. The differences from IERS Standards are the same as described in previous solution GAOUA 91 L 01.

Data processing consists of two stages. First 15-day arcs were used to determine 6 orbit elements. Second station coordinates as global parameters, were estimated simultaneously with orbit elements (excluding ascending node longitude), EOP and their rates of change on 5-day subarcs, the coefficients of reflectivity and along-track acceleration on 15-day arcs as the local ones. Computer capabilities entail two passes through the data at this stage. The global parameters are known after the first pass, and other parameters after the second one.

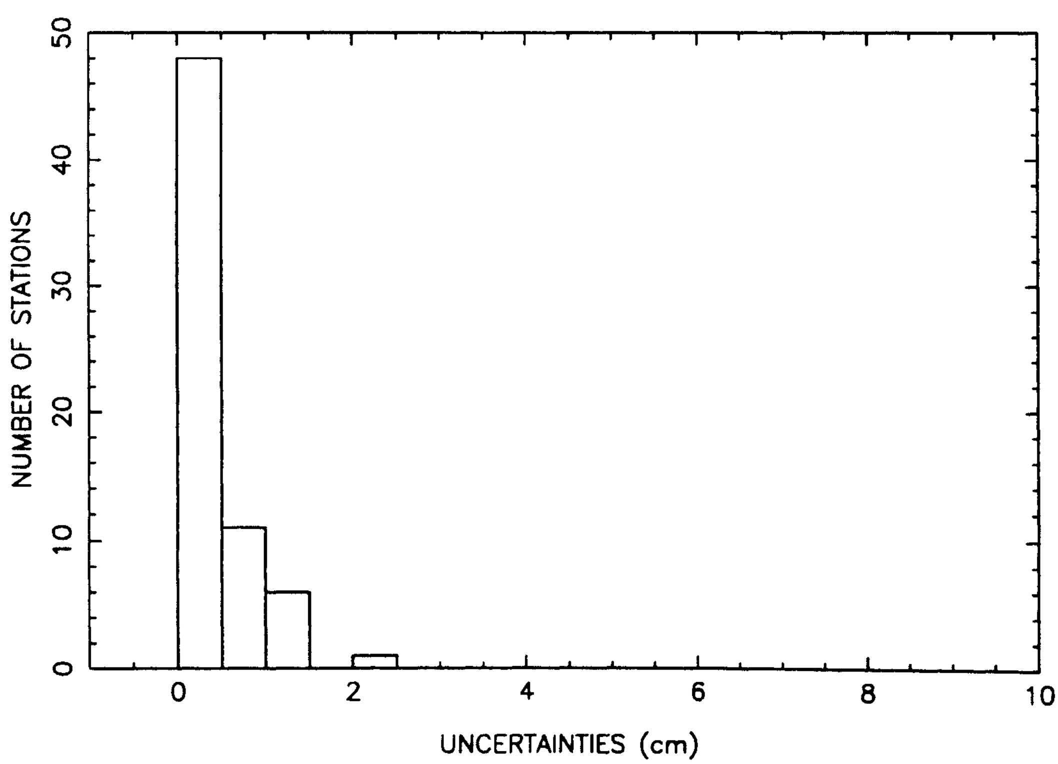
In order to provide the connection of SSC(GAOUA) 92 L 01 to ITRF88 reference system Grasse station (7835) longitude and Herstmontceux station (7840) longitude and latitude were held fixed. The station motions were constrained by Minster and Jordan AM0-2 model with reference epoch MJD 47161. A priori values for EOP were taken from BIH Annual Reports and IERS Bulletin B. UT1R values in each first subarc were held fixed.

Summary description of the terrestrial system attached to the set of station coordinates SSC (GAOUA) 92 L 01

1 - Technique :	SLR
2 - Analysis Center :	GAOUA
3 - Solution identifier :	SSC(GAOUA) 92 L 01
4 - Software used :	KIEV-GEODYNAMICS - 4
5 - Relativity scale :	LE
6 - Permanent tidal correction on station :	NO
7 - Tectonic plate model :	AM0-2
8 - Velocity of light :	299 792 458
9 - Geogravitational constant (GM) :	3.9860 0440*10**14
10 - Reference epoch :	MJD 47161
11 - Adjusted parameters :	X,Y,Z
12 - Definition of the origin :	C10=0, C11=0, S11=0
13 - Definition of the orientation :	ERP values from IERS Bulletin B
14 - Constraint for time evolution :	fixed plate motion model



Distribution of the 57 sites of the terrestrial frame SSC(GAOUA) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 67 stations of the terrestrial frame SSC(GAOUA) 92 L 01. 1 station with uncertainty larger than 10 cm is not shown.

EOP(GAOUA)92 L 01 From Sep 1983 to Oct 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for UT1

YEAR	X		Y		UT1	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1983	24	0.40	24	0.30	16	0.30
1984	73	0.30	73	0.20	48	0.25
1985	73	0.20	73	0.10	49	0.20
1986	73	0.20	73	0.20	49	0.20
1987	73	0.20	73	0.10	48	0.20
1988	73	0.20	73	0.10	49	0.20
1989	73	0.20	73	0.20	49	0.20
1990	73	0.20	73	0.10	48	0.20
1991	56	0.30	56	0.20	38	0.20

EARTH ORIENTATION AND STATION COORDINATES BY LAGEOS LASER RANGING DATA FROM 1980 TO SEPTEMBER 1991

GFZ 92 L 01
GFZ 92 L 02
GFZ 92 L 03
GFZ 92 L 04

H. Montag, G. Gendt, G. Dick, Th. Nischan, W. Sommerfeld
GeoForschungsZentrum (GFZ), Potsdam

SOFTWARE AND DATA

Altogether two Sets of Station Coordinates (SSC(GFZ) L 01, L 02) and four sets of Earth Rotation Parameters (EOP(GFZ) L 01 ... L 04) were derived from Satellite Laser Ranging (SLR) data to LAGEOS using the improved POTSDAM-5 software package. These solutions were based on normal points of the IERS stations from the beginning of 1980 (MJD 44238) until September 1991 (MJD 48519), in total 38711 passes from 100 stations. A statistical summary (station fits for 5-day orbit adjustment together with number of passes and observations) for 1990 and 1991 is given in Table 1.

The constants and model parameters used for these solutions conform to the IERS Standards (draft 1992) with the following differences:

- tidal variations in UT1 caused by zonal tides with periods bigger than 35 days not considered
- LAGEOS center of mass correction 0.251 m
- nutation-corrections by VLBI for
  46799-47519 from ANNUAL REPORT 1988 p. II-68
  47529-48519 from IERS BULLETIN B.

In a multistage-multiarc procedure different parameters were solved for as given in the summary sheet. Here also details on the adopted model for the terrestrial system are listed.

STATION COORDINATES AND VELOCITIES

For the main solution SSC(GFZ) 92 L 01 the coordinates of all sites were adjusted simultaneously with site velocities using data from the whole time interval. For 74 stations the data distribution was good enough to determine site velocities, whereas the velocities of the other stations were held fixed to that of the NUVEL-1 model. In a second variant (additional solution SSC(GFZ) 92 L 02) all site velocities were fixed to that predicted by NUVEL-1 rigid plate model (de Mets *et al.*, 1990). In the adjustment some constraints were incorporated :

- marker eccentricity parameters according to NASA CDP
- colocated markers must have the same velocity
- colocated markers should have the given differences (*IERS Technical Note* 5 ,1989 and *NASA CDP, Catalogue of Site Informations,* 1989):
  7035 to 7062; 7080 to 7885; 7105 to 7063, 7103, 7125, 7899, 7918 and 7920; 7109 to 7886; 7288 to 7265; 7834 to 7596; 7853 to 7114, 7939 to 7540 and 7541.

For the stations Wettzell (7834) and Grasse (7835) significantly different positions were adjusted in 1980 to 1982, not understood up to now; thus fictive occupations were assigned to these stations (783599 from 1980 to 1982, 783497 in 1980, 783498 in 1981, 783499 in 1982).

The site positions were refered to epoch 1988.0.

The origin of the reference system was defined by C10=C11=S11=0. The orientation was constrained by fixing the latitude and longtitude of the station 7840 and the latitude of the station 7105. Additionally, no common net rotation was permitted in relation to the reference coordinate set ITRF89. Corrections due to the permanent tidal deformation of the Earth were applied.

The station coordinates and the adjusted velocities for the 74 sites mentioned above are available on request from the Central Bureau of IERS. The given errors have been scaled with a factor 5, because the calculated errors seem to be too optimistic.

EARTH ROTATION PARAMETERS

For the EOP (pole coordinates and length of day - LOD) two sets with 5-day time resolution were computed. The main solution EOP(GFZ) 92 L 01 refers to the SSC(GFZ) 92 L 01 with adjusted site velocities and the EOP(GFZ) 92 L 04 is based on SSC(GFZ) 92 L 02 with motion fixed to NUVEL-1. Starting from the MERIT-Campaign (September 1983) thanks to the better data distribution two additional sets (EOP(GFZ) 92 L 02, L 03) with a higher resolution of 3 and 2 days, respectively, were determined. For these series the station coordinates SSC(GFZ) 92 L 01 were introduced.

The results show a good agreement with the previously reported series of ZIPE (for time intervals 1984 -1989) and with IERS results. The differences between EOP results obtained on the basis of adjusted site velocities and those derived by fixed to NUVEL-1 site velocities are not significant.

Whereas in the 5-day solutions the LOD values were estimated directly, in the L02 and L03 solutions UT1 values were solved for instead of LOD. These UT1 results were converted into LOD. That means that the time scales (col.1) for the EOP(GFZ) 92 L 02 and L 03 have to be transferred for the LOD values by -1.5 d and -1.0 d, respectively.

Generally, the SLR data were weighted according to their estimated accuracy. In addition, several non-permanent stations were provided with smaller weights in order to reduce the influence of the change of the station distribution. No post-adjustment smoothing or filtering procedure was applied to the EOP series.

The standard deviations of the EOP series are about ±0.1 to ±0.2 mas for the pole coordinates and ±0.001 to ±0.003 ms for LOD if there are enough relevant data submitted. Mainly because of this data effect the precision was significantly increased in the course of the last ten years. The accuracy was estimated to be about ±1 mas and ±0.1 ms, respectively. In cases of poor data distribution the errors can be several times lager. Therefore, several single results showing large deviations caused by a too small number of data (only about two to four relevant passes) were omitted.

References

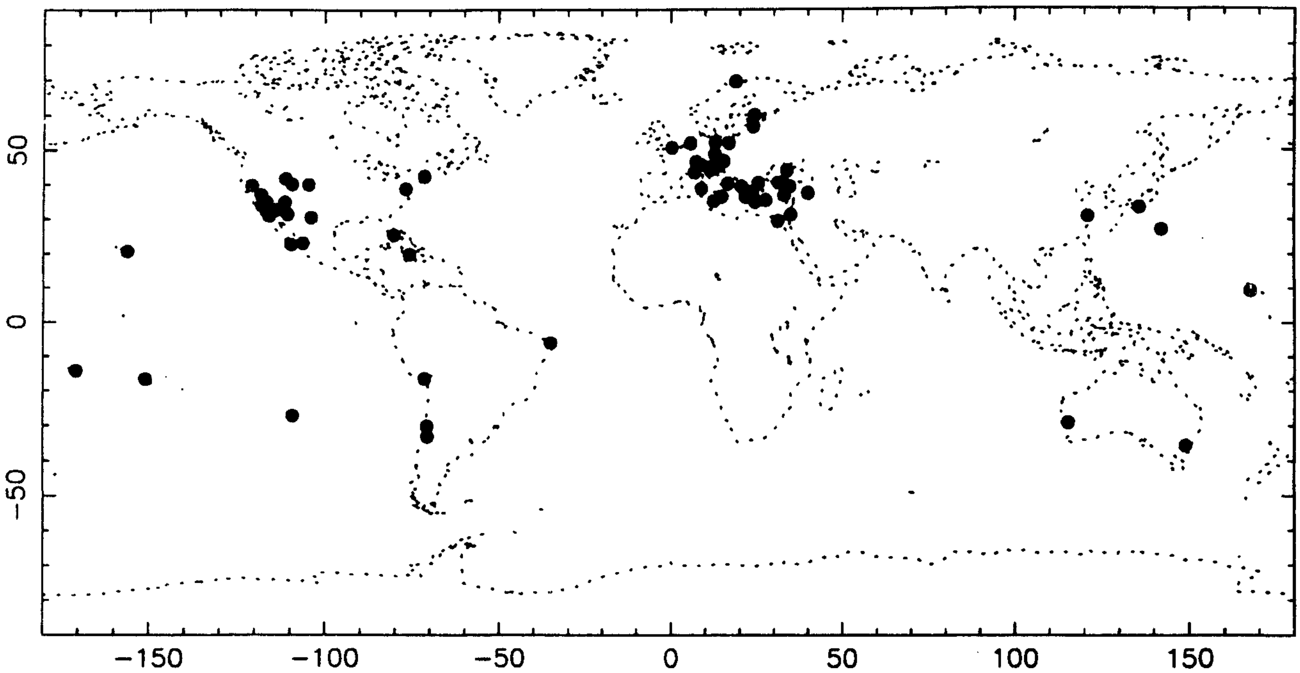
DeMets, C., Cordan, R.G., Argus, D.F., and Stein S., 1990: Current plate motions, *Geophys. J. Int.*, **101**, 425-478.

Table 1. Summary of statistical information for 1990-1991

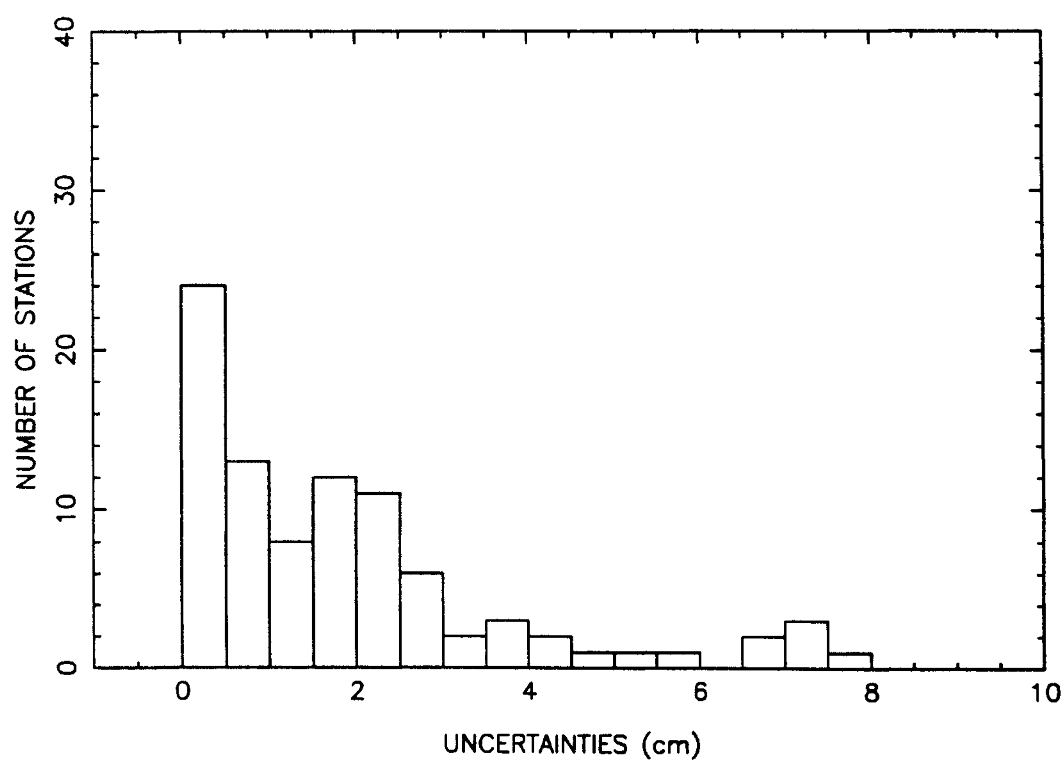
station	Number of passes	Number of obs.	mean rms (m)	station	Number of passes	Number of obs.	mean rms (m)
118101	136	1071	0.164	7542	6	50	0.030
187301	85	639	0.130	7543	47	530	0.036
188401	90	889	0.160	7545	36	436	0.044
189301	20	177	0.106	7602	45	444	0.027
195301	33	148	0.189	7805	6	29	0.428
7046	62	920	0.031	7810	315	3954	0.040
7080	309	3079	0.043	781102	72	627	0.121
7090	409	6891	0.025	7831	120	1063	0.046
7091	50	747	0.032	7834	191	1920	0.038
7097	82	914	0.042	7835	892	14182	0.036
7105	195	2815	0.026	7837	136	1468	0.089
7109	303	4105	0.021	7838	111	1415	0.045
7110	607	9427	0.025	7839	238	3132	0.031
7112	51	688	0.039	7840	677	7295	0.034
7122	203	2877	0.030	7843	290	3628	0.029
7123	76	936	0.035	7853	40	529	0.054
7210	53	4668	0.029	7907	163	2274	0.082
7288	47	720	0.028	7918	77	986	0.028
7295	51	681	0.028	7920	13	143	0.090
7401	143	2158	0.042	7939	461	6656	0.064
7403	186	2644	0.031	8833	30	289	0.031
7515	42	519	0.040	883401	124	1236	0.058
7525	28	361	0.039				

Summary description of the terrestrial systems attached to the sets of station coordinates SSC(GFZ) 92 L 01 and 92 L 02.

1 - Technique : SLR
2 - Analysis Center : GFZ
3 - Solution Identifier : SSC(GFZ) 92 L 01 and SSC(GFZ) 92 L 02
4 - Software Used : POTSDAM-5
5 - Relativity Scale : Geocentric (LE)
6 - Permanent Tidal Correction on station : Yes
7 - Tectonic Plate model : adjusted (L01) resp. NUVEL-1 (L02)
8 - Velocity of light : 299792458 m/sec
9 - Geogravitational constant (GM): adjusted to 398600.4420 km3/s2
10 - Reference Epoch : 1988.0 (MJD 47160.)
11 - Adjusted Parameters :
Coordinates: radius, longitude and latitude for all sites plus velocities in each of the coordinates, all solved one time for the whole data span (L02: velocities are fixed to NUVEL-1)
Orbit: 6 Keplerian mean elements for intervals of 5 days
EOP: x, y and LOD, solved at 5-day intervals (the same as orbit)
x, y and UT1, solved at 2- and 3-day intervals (were the orbit is solved for 6 days)
12 - Definition of the origin : Geocentric, C10=C11=S11=0
13 - Definition of the orientation : System oriented by fixing:
- the latitude of 7105 ,7840
- the longitude of 7840
14 - Constraint for time evolution : L 01 - constraints on net rotation by fixing the velocities of:
- the latitude of 7105, 7840
- the longtitude of 7840



Distribution of the 66 sites of the terrestrial frame SSC(GFZ) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 94 stations of the terrestrial frame SSC(GFZ) 92 L 01. 4 stations with uncertainties larger than 10 cm are not shown.

EOP(GFZ) 92 L 01 From Jan 1980 to Sep 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X, Y, 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1980	66	0.46	66	0.25	66	0.04
1981	65	0.40	65	0.22	65	0.03
1982	70	0.34	70	0.19	70	0.03
1983	70	0.23	70	0.20	70	0.02
1984	73	0.14	73	0.11	73	0.01
1985	73	0.10	73	0.08	73	0.01
1986	73	0.11	73	0.09	73	0.01
1987	73	0.10	73	0.08	73	0.01
1988	73	0.10	73	0.09	73	0.01
1989	73	0.10	73	0.09	73	0.01
1990	73	0.08	73	0.09	73	0.01
1991	52	0.10	52	0.09	52	0.01

EOP(GFZ) 92 L 02 From Jul 1983 to Sep 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X, Y ; 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1983	56	0.24	56	0.22	56	0.17
1984	121	0.19	121	0.16	122	0.14
1985	122	0.14	122	0.11	121	0.10
1986	121	0.14	121	0.12	122	0.11
1987	122	0.13	122	0.12	121	0.11
1988	121	0.13	121	0.12	122	0.10
1989	122	0.14	122	0.13	121	0.11
1990	120	0.11	120	0.12	121	0.10
1991	88	0.13	88	0.13	87	0.10

EOP(GFZ) 92 L 03 From Jul 1983 to Sep 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X, Y ; 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1983	78	0.30	78	0.26	78	0.21
1984	178	0.23	178	0.19	178	0.17
1985	176	0.17	176	0.14	177	0.13
1986	177	0.17	177	0.14	176	0.13
1987	180	0.16	180	0.15	180	0.14
1988	175	0.16	175	0.14	175	0.13
1989	177	0.17	177	0.16	177	0.14
1990	180	0.13	180	0.15	181	0.12
1991	128	0.15	128	0.15	127	0.12

EOP(GFZ) 92 L 04 From Jan 1980 to Sep 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X, Y ; 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1980	66	0.47	66	0.25	66	0.04
1981	65	0.41	65	0.23	65	0.03
1982	70	0.36	70	0.21	70	0.03
1983	70	0.26	70	0.21	70	0.02
1984	73	0.14	73	0.11	73	0.01
1985	73	0.11	73	0.09	73	0.01
1986	73	0.11	73	0.09	73	0.01
1987	73	0.10	73	0.08	73	0.01
1988	73	0.10	73	0.09	73	0.01
1989	73	0.11	73	0.10	73	0.01
1990	73	0.09	73	0.10	73	0.01
1991	52	0.11	52	0.10	52	0.01

EARTH ORIENTATION PARAMETERS FROM GSFC SOLUTION SL8.1 GSFC 92 L 01

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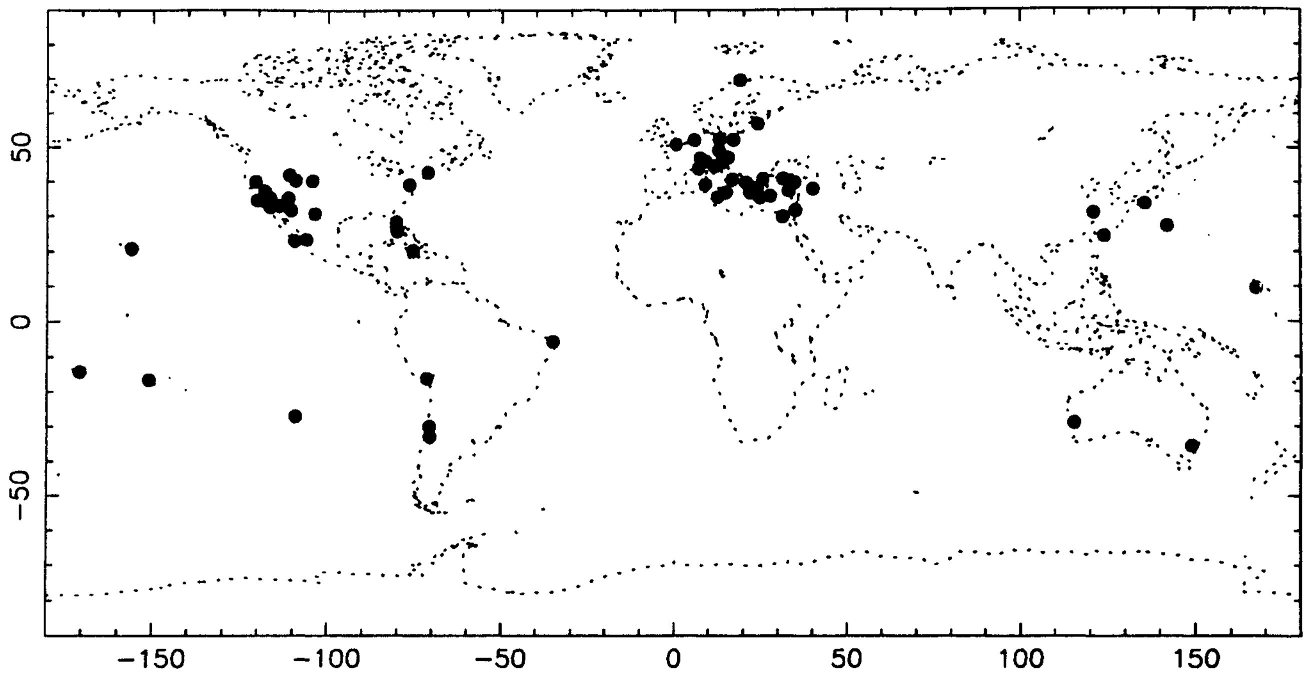
The SL8 solution was obtained by fitting the orbit of LAGEOS in 30 day (and occasionally 35 day) arcs using normal points generated from full rate data collected between January 1980 and December 1991. The monthly arcs were combined to form a solution for a set of station positions at epoch 860701, moving according to the SL7 station velocity model when there were significant differences from NUVEL-1. Orbit and force model parameters were adjusted at the intervals listed below. Earth Orientation Parameters were estimated as independent values of time and polar motion at daily intervals since January 1983, and at 5 day intervals up to December 1982. The IERS standards were followed with the exception that the GEM-T3 gravity field with expanded ocean tidal terms was adopted and the value of the geogravitational constant was employed as listed below.

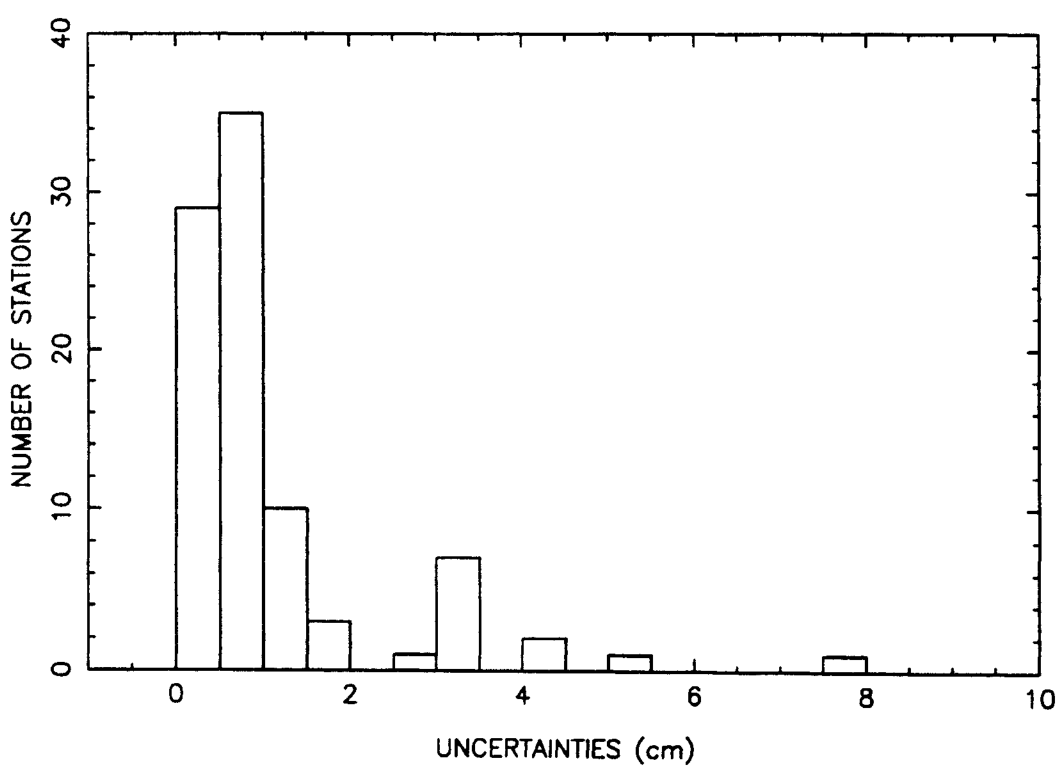
The EOP series that are attached to this submission were "Vondrak"smoothed using an epsilon value of 0.1 . The reason for the smoothing was the elimination of some spurious values due to lack of observations during the averaging interval. This only occured at a few instances, about 4% of the data have been edited in this fashion. The smoothing replaces these aberrant values with interpolated values based on those before and after the spurious point. The LODR series were obtained from the forward differencing of the UT1R series with IERS-nodes at arc-length intervals. The differencing was performed on the weakly smoothed UT1R series to minimize the noise amplification. Examination of the rms differences between the raw and the smoothed series indicates that given the accuracy of the series, the smoothing has not compromised its signal content.

Summary description of the terrestrial system attached to the set of station coordinates SSC(GSFC) 92 L 01

1 - Technique :	SLR to LAGEOS
2 - Analysis Center :	NASA/GSFC
3 - Solution Identifier :	GSFC SL8.1
4 - Software Used :	GEODYN II and SOLVE II
5 - Relativity Scale :	Local Earth
6 - Station Tidal Correction :	Earth tides and Ocean loading (Scherneck)
7 - Tectonic plate model :	SL7.1 and NUVEL-1NNR
8 - Velocity of light :	299792458 m/s
9 - GM :	398600.4415 km3/s2
10- Reference epoch :	86 07 01
11- Adjusted Parameters - Orbit:	6 elements every 30(35) days along track accel. every 15 days once per rev. accel. every 15 days
Stations:	estimated in three dimensions except lat., long. 7105 and lat. 7210
EOP:	X,Y,UT1 every 5 days from 80 01 01 to 82 12 28 every day from 82 12 29 to 91 12 31 one UT1 value fixed at IERS each month
12- Definition of Origin :	Geocentric
13- Definition of Orientation :	a priori ERP from IERS 90 C 04 and fixed station components
14- Constraint for time evolution :	SL7.1 and NUVEL-1NNR plate motion models the EOP values



Distribution of the 65 sites of the terrestrial frame SSC(GFSC) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 90 stations of the terrestrial frame SSC(GFSC) 92 L 01. 1 station with uncertainty larger than 10 cm is not shown.

EOP(GSFC) 92 L 01 From Jan 1980 to Dec 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y; 0.0001s for UT1.

YEAR	X		Y		UT1	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1980	74	0.37	74	0.22	61	0.30
1981	73	0.37	73	0.22	61	0.30
1982	75	0.31	75	0.22	63	0.30
1983	365	0.54	365	0.45	338	0.60
1984	366	0.37	366	0.32	354	0.50
1985	365	0.35	365	0.30	349	0.40
1986	365	0.37	365	0.31	349	0.40
1987	365	0.31	365	0.29	350	0.50
1988	366	0.32	366	0.31	355	0.40
1989	365	0.33	365	0.31	347	0.40
1990	365	0.34	365	0.38	342	0.60
1991	364	0.42	364	0.42	339	0.50

A 7.8-YEAR EARTH ROTATION FROM LAGEOS LASER RANGING NAL 92 L 01

M. Murata, National Aerospace Laboratory, Tokyo

The set of solution for earth orientation parameters and station coordinates was derived by fitting 30-day arcs of LAGEOS normal points for the period of September 1983 through May 1991. Models and constants adopted adhere to the IERS Standards. The 94 30-day arcs were combined to form a unique solution for the six cartesian orbital elements at every arc epoch, two coefficients of along-track accerelation (every 15 days), three coefficients of solar radiation pressure (every 10 days), earth orientation parameters (every 5 days), and station coordinates (over the whole interval). The overall post RMS fit of the laser normal points to the orbits in 30-day arcs ranged 6 to 13 cm.

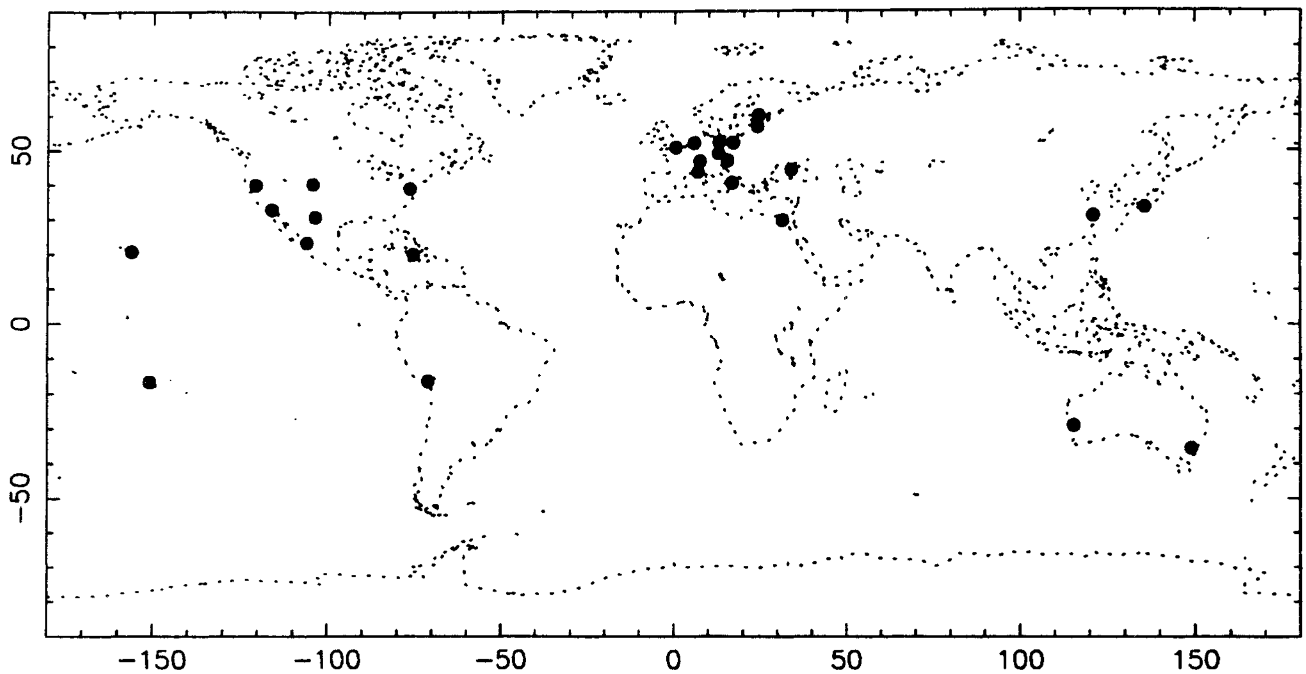
The station coordinate SSC(NAL) 92 L 01 includes solutions for the selected 30 stations which tracked LAGEOS with longer data coverage over the 7.8-year interval, and it has the reference epoch on 1990 January 1 0h UTC assuming the Minster-Jordan plate motion model AM0-2. The origin of the reference system was defined by fixing the longitude and latitude of station 7105 (Greenbelt) and the latitude of station 7909 (Arequipa). Corrections due to the permanent tidal deformation of the earth were applied.

The estimation strategy of earth orientation parameters is that pole coordinates are assumed constant over each 5-day subarc and UT1R-TAI is assumed to be continuous and piecewise linear over each subarc so that only values at subarc nodes, except for the epochal value which is kept fixed at that taken from the IERS Bulletin B, need to be estimated. The excess length of day is derived straightforwards using this model.

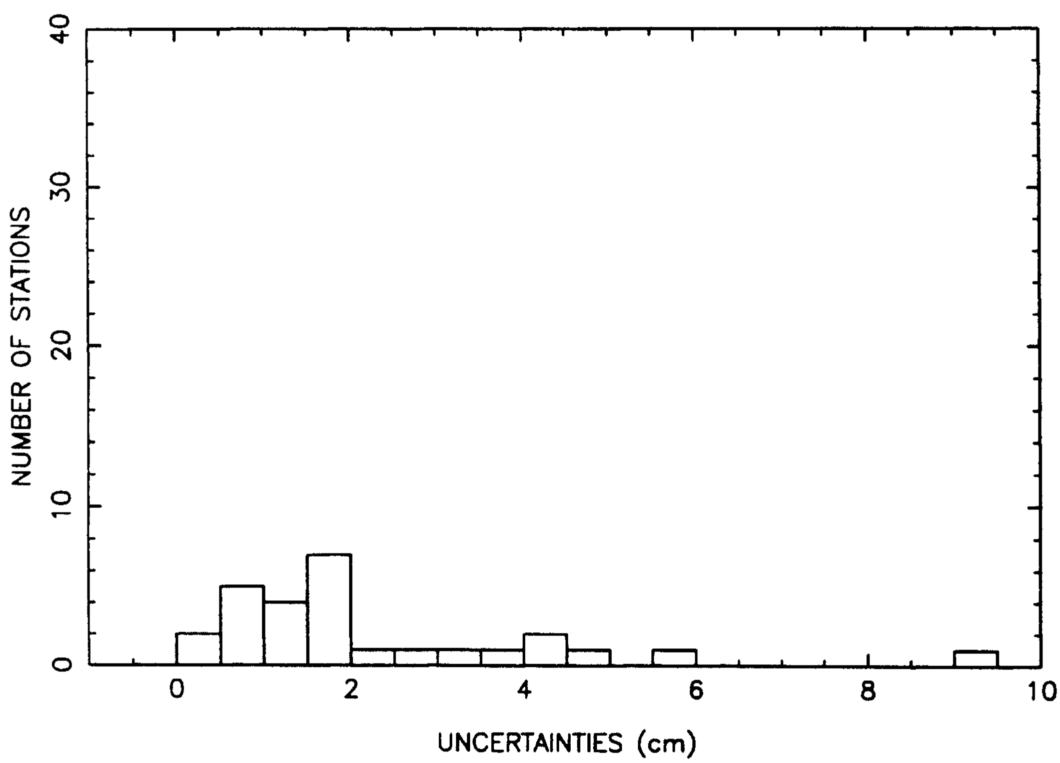
The earth orientation parameter series for the 7.8-year interval, designated as EOP(NAL)92 L 01, and the station coordinates at the reference epoch (January 1, 1990) are available on request from the Central Bureau of IERS. The coordinates refer to the optical axis of the laser ranging system.

Summary description of the terrestrial system attached to the set of station coordinates SSC(NAL) 92 L 01

1 - Technique :	SLR
2 - Analysis Center:	NAL
3 - Solution identifier :	SSC(NAL) 92 L 01
4 - Software used :	COSMOS
5 - Relativity Scale :	LE
6 - Permanent tidal correction on station :	NO
7 - Tectonic plate model:	AM0-2
8 - Velocity of light :	299792458 m/sec
9 - Geogravitational constant (GM0) :	398600.4415 km3/s2 (fixed)
10 - Reference epoch :	1 January 1991 (MJD 48257.0)
11 - Adjusted parameters :	6 Cartesian elements (for each 30-day arc) ; CR (for 10 days); CA (for 15 days) ; PX, PY, UT1R (for 5 days) ; Station coordinates (globally adjusted)
12 - Definition of the origin :	C10=C11=S11=0
13 - Definition of the orientation :	Two latitudes and one longitude
14 - Constraint for time evolution :	Fixed plate motion model



Distribution of the 27 sites of the terrestrial frame SSC(NAL) 92 L 01.



Distribution of the uncertainties (quadratic mean of σ_x, σ_y, σ_z) for the 28 stations of the terrestrial frame SSC(NAL) 92 L 01. 1 station with uncertainty larger than 10 cm is not shown.

EOP(NAL) 92 L 01 From Sep 1983 to May 1991

Number of measurements per year and median uncertainties
Units : 0.001" for X,Y ; 0.0001s for D

YEAR	X		Y		D	
	Nb	Sigma	Nb	Sigma	Nb	Sigma
1983	25	0.80	25	0.40	25	0.22
1984	73	0.80	73	0.40	73	0.19
1985	73	0.80	73	0.40	73	0.16
1986	73	0.80	73	0.40	73	0.18
1987	73	0.80	73	0.40	73	0.18
1988	73	0.80	73	0.40	73	0.17
1989	73	0.80	73	0.40	73	0.23
1990	73	0.80	73	0.40	73	0.21
1991	28	0.90	28	0.50	28	0.28