IERS TECHNICAL NOTE 10

The IERS GPS Terrestrial Reference Frame

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IERS Technical Notes

This series of publications gives technical information related to the IERS activities, e.g. reference frames, excitation of the Earth rotation, computational or analysis aspects, models, etc. It also contains the description and results of the analyses performed by the IERS Analysis Centres for the Annual Report global analysis.

Back issues

No 1 : C. Boucher and Z.Altamimi. The initial IERS Terrestrial Reference Frame.

No 2 : Earth orientation and reference frame determinations, atmospheric excitation functions, up to 1988 (Annex to the IERS Annual Report for 1988). *[No longer available, superseded by N.T. No 5].*

No 3 : D.D. McCarthy (ed). IERS Standards (1989)

No 4 : C. Boucher and Z. Altamimi. Evaluation of the realizations of the Terrestrial Reference System done by the BIH and IERS (1984-1988).

No 5: Earth orientation and reference frame determinations, atmospheric excitation functions, up to 1989 (Annex to the IERS Annual Report for 1989). *[Superseded by N.T. No 8].*

No 6 : C. Boucher and Z. Altamimi. ITRF89 and other realizations of the IERS Terrestrial Reference System for 1989.

No 7 : E.F. Arias, M. Feissel and J.-F. Lestrade. The IERS extragalactic Celestial Reference Frame and its tie with HIPPARCOS.

No 8: Earth orientation and reference frame determinations, atmospheric excitation functions, up to 1990 (Annex to the IERS Annual Report for 1990).

No 9 : C. Boucher and Z. Altamimi. ITRF90 and other realizations of the IERS Terrestrial Reference System for 1990.

No 10: C. Boucher and Z. Altamimi. The IERS GPS Terrestrial Reference Frame.

Future issues

D.D. McCarthy (ed.). IERS Standards (1992).

CONTENTS

1) INTRODUCTION

The Global Positioning System (GPS) becomes more and more an important technique used for geodetic and geodynamic purposes at a local as well as global scale. In the same way as SLR, LLR and VLBI, GPS has to play its role as part of the IERS activities. Conversely, the IERS has to supply to GPS analysis centers relevant materials in terms of Earth rotation and reference frame, in order to ensure the complete integration of the GPS within IERS. In this direction, this Technical Note intends to produce a global GPS Terrestrial Reference Frame expressed in the IERS Terrestrial Reference System (ITRS) to be used for GPS analysis. This product is based on a combination of the ITRF90 solution which is the up to date realization of the ITRS and local tie vectors between GPS tracking points and SLR or VLBI points.

2) INPUT DATA

2.1) Sites included

The sites considered here are those which are already IERS sites (SLR or/and VLBI sites) and where GPS antennas have been installed, temporarily or permanently. These sites belong to CIGNET network, GIG91 campaign, DMA and OCS tracking network. They are included in Table 1 which lists all the IERS sites known till now.

More details about points and marks within these sites are listed and described in Table 2.

The points located in these sites for which we provide coordinates are GPS L1 phase centers of the antennas as well as GPS monuments or marks in the case where the local ties between these GPS points and SLR or VLBI points are available.

2.2) The ITRF90 set

The ITRF90 station coordinates included in this computation are those corresponding to the sites described above. Two reference epochs were selected: 1991.0 and 1992.0. Since no velocity field has been adjusted in the ITRF90 solution, the AM0-2 model was used in order to estimate the ITRF90 positions (whose reference epoch is 1988.0) for the two selected epochs.

2.3) Eccentricities

40 local tie vectors between GPS points and SLR or VLBI points have been identified and listed in Table 3. These values were used with a proper a priori variances which are listed in Table 3 on the second line of each local tie vector.

3) DATA ANALYSIS

The general procedure adopted for the ITRF computation is largely described in the IERS Technical Notes 4, 6 and 9 as well as in (Altamimi and Boucher, 1991).

The realization of this IERS GPS Terrestrial Reference Frame consists of least square estimation of the cartesian coordinates of the selected stations. This has been done by combination of the ITRF90 set and the local tie values with their a priori variances. In this adjustment, the 7 transformation parameters of the ITRF90 have been held fixed to zero in order to express the resulting station coordinates in the IERS Terrestrial Reference System.

4) RESULTS

The coordinates of 40 GPS tracking points located in 17 sites (see Figure 1) have been adjusted and listed in Tables 4 and 5 for the two epochs 1991.0 and 1992.0 respectively. The quality of these coordinates depends obviously on both the ITRF90 coordinates and the local ties values.

The errors given for these coordinates are the combination of those of the ITRF90 as well as of the locale ties. Unfortunately, possible errors in local tie values could not be detected in this computation.

On the other hand, these errors do not take into account the propagation of uncertainties due to the use of AM0-2 model to estimate coordinates for the two selected epochs.

REFERENCES

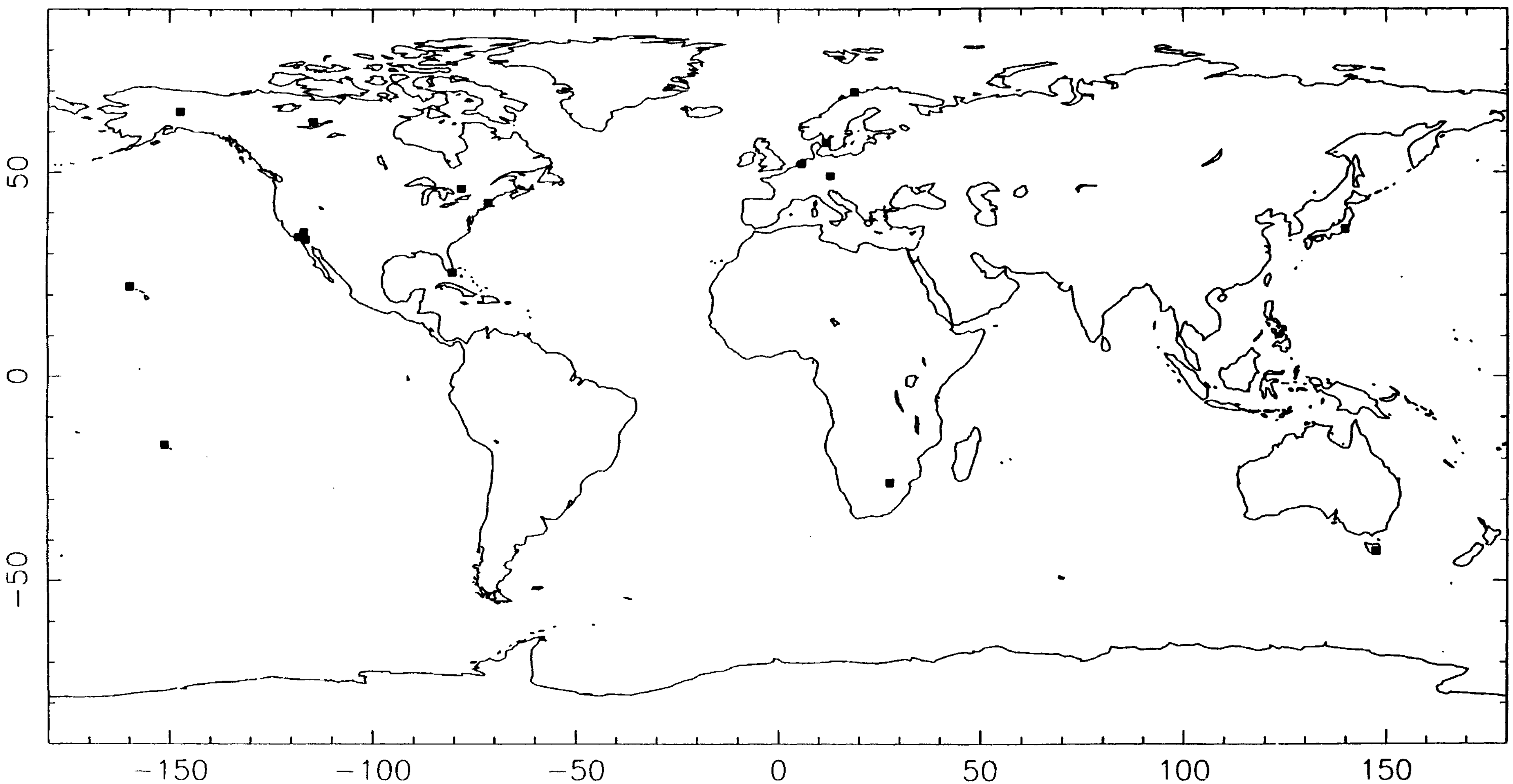
ALTAMIMI, Z., BOUCHER, C. ,1991, Realization of the IERS Terrestrial Reference System, Presented at the XX General Assembly of the IUGG, 11-24 August 1991 Vienna, Austria

BOUCHER, C. , ALTAMIMI, Z., 1990, Evolution of the realizations of the Terrestrial Reference System done by BIH and IERS (1984-1988), IERS Technical Note 4, Observatoire de Paris 1990.

BOUCHER, C. , ALTAMIMI, Z., 1991a, ITRF89 and other realizations of the IERS Terrestrial Reference System for 1989. IERS Technical Note 6, Observatoire de Paris 1991.

BOUCHER, C. , ALTAMIMI, Z., 1991b, ITRF90 and other realizations of the IERS Terrestrial Reference System for 1990. IERS Technical Note 9, Observatoire de Paris 1991.

IERS GPS TERRESTRIAL REFERENCE FRAME



STATUS 20-DEC-1991

Table 1 List of IERS sites

DOMES Number	Name	Country	Long. d	Long. m	Lat. d	Lat. m	Plate	(*)
10002	GRASSE	France	6	55	43	45	EURA	PC
10004	BREST	France	355	30	48	24	EURA	S
10302	TROMSO	Norway	18	56	69	40	EURA	SC
10317	NY-ALESUND	Norway	11	56	78	55	EURA	S
10325	HONEFOS	Norway	10	15	60	36	EURA	S
10402	ONSALA	Sweden	11	55	57	24	EURA	P
10405	MARTSBO	Sweden	17	16	60	36	EURA	S
10503	METSAHOVI	Finland	24	23	60	13	EURA	SC
11001	GRAZ	Austria	15	30	47	04	EURA	P
12205	BOROWIEC	Poland	17	04	52	17	EURA	S
12302	RIGA	URSS	24	04	56	57	EURA	S
12337	SIMEIS-KATZIVELY	URSS	33	58	44	24	EURA	S
12602	DIONYSOS	Greece	23	56	38	05	EURA	S
12612	ASKITES	Greece	25	34	40	56	EURA	S
12613	ROUMELLI	Greece	24	42	35	24	EURA	P
12614	KARITSA	Greece	20	40	39	44	EURA	S
12615	KATAVIA	Greece	27	47	35	57	EURA	S
12616	XRISOKALARIA	Greece	21	53	36	47	EURA	S
12706	LAMPEDUSA	Italy	12	34	35	31	EURA	S
12711	BOLOGNA	Italy	11	21	44	29	EURA	PC
12717	NOTO	Italy	14	59	36	53	EURA	SC
12718	TRIESTE	Italy	13	53	45	39	EURA	P
12725	CAGLIARI	Italy	9	00	39	08	EURA	S
12734	MATERA	Italy	16	37	40	42	EURA	PC
13201	CHILBOLTON	UK	358	37	51	11	EURA	S
13212	HERSTMONCEUX	UK		21	50	52	EURA	P
13296	CARNUTSY	UK	357	13	56	29	EURA	S
13407	MADRID-ROBLEDO	Spain	355	44	40	26	EURA	P
13411	MADRID-FACULTAD	Spain	356	16	40	27	EURA	S
13504	KOOTWIJK	Netherlands	5	49	52	11	EURA	S
13506	WESTERBORK	Netherlands	6	36	52	55	EURA	S
14001	ZIMMERWALD	Switzerland	7	28	46	53	EURA	P
14005	MONTE GENEROSO	Switzerland	9	01	45	56	EURA	S
14106	POTSDAM	Germany	13	04	52	23	EURA	P
14201	WETTZELL	Germany	12	53	49	09	EURA	PC
14202	HOHENBUNSTORF	Germany	10	29	53	03	EURA	S
14209	EFFELSBERG	Germany	6	53	50	32	EURA	S
20702	BAR GIYYORA	Israel	35	05	31	43	AFRC	P
20801	DIYARBAKIR	Turkey	40	12	37	55	EURA	S
20802	YOZGAT	Turkey	34	49	39	48	EURA	S
20803	MELENGICLICK	Turkey	33	11	37	23	EURA	S
20804	YIGILCA	Turkey	31	26	40	56	EURA	S
21602	WUHAN	China	114	20	30	32	EURA	S
21605	SHANGHAI	China	121	26	31	01	EURA	PC
21701	KASHIMA	Japan	140	40	35	57	NOAM	P
21709	OKINAWA	Japan	127	43	26	08	EURA	S
21718	MIYAZAKI	Japan	131	29	32	05	EURA	S
21725	NOBEYAMA	Japan	138	28	35	56	EURA	S
21726	SIMOSATO	Japan	135	56	33	34	EURA	P
21729	USUDA	Japan	138	29	36	12	EURA	S
21730	TSUKUBA	Japan	140	05	36	06	EURA	S
21732	CHICHIJIMA	Japan	142	13	27	06	EURA	SC
21733	MINAMI TORI SHIMA	Japan	153	59	24	17	PCFC	SC
21735	TSUSHIMA	Japan	129	25	34	24	EURA	S
21736	ISHIGAKI SHIMA	Japan	124	10	24	21	EURA	S
23902	DAEJEON	Korea	127	23	36	24	EURA	S
24901	BAHREIN (JUFFAR)	Bahrein	50	36	26	13	ARAB	S

30101	HELWAN	Egypt	31	21	29	52	AFRC	S
30302	JOHANNESBURG	S. Africa	27	42	-25	53	AFRC	P
30601	ASCENSION		345	40	-7	57	AFRC	S
30802	DIEGO GARCIA		72	22	-7	15	AFRC	S
32809	LIBREVILLE	Gabon	9	24	0	24	AFRC	S
40104	ALGONQUIN	Canada	281	56	45	57	NOAM	S
40105	PENTICTON	Canada	240	23	49	19	NOAM	S
40118	WHITEHORSE	Canada	224	55	60	44	NOAM	S
40127	YELLOWKNIFE	Canada	245	32	62	29	NOAM	S
40129	VICTORIA	Canada	236	31	48	23	NOAM	S
40400	PASADENA	USA	241	50	34	12	PCFC	PC
40403	PALOS VERDES	USA	241	36	33	45	PCFC	P
40404	PEARBLOSSOM	USA	242	05	34	31	PCFC	S
40405	GOLDSTONE	USA	243	06	35	20	NOAM	PC
40406	SAN FRANCISCO	USA	237	33	37	48	NOAM	P
40407	PINYON FLATS	USA	243	33	33	26	PCFC	S
40408	FAIRBANKS	USA	212	29	64	58	NOAM	P
40409	KAENA POINT (HAWAII)	USA	201	44	21	35	PCFC	S
40410	POINT REYES	USA	237	04	38	06	PCFC	P
40412	AUSTIN	USA	262	20	30	25	NOAM	S
40416	YAKATAGA	USA	217	31	60	05	NOAM	P
40417	PATRICK AFB	USA	279	24	28	14	NOAM	S
40419	KODIAK	USA	207	30	57	44	NOAM	P
40420	VANDENBERG AFB	USA	239	26	34	35	PCFC	PC
40421	NOME	USA	194	38	64	34	NOAM	S
40423	SANDPOINT	USA	343	31	55	21	NOAM	P
40424	KAUAI	USA	200	20	22	08	PCFC	P
40425	SOURDOUGH	USA	214	31	62	40	NOAM	S
40427	FORT ORD	USA	238	14	36	29	PCFC	P
40428	SANTA PAOLA	USA	241	00	34	12	PCFC	P
40430	BLACK BUTTE	USA	244	17	33	40	NOAM	P
40431	DEADMAN LAKE	USA	243	43	34	15	NOAM	P
40432	ELY	USA	244	55	39	19	NOAM	S
40433	QUINCY	USA	239	04	39	58	NOAM	PC
40434	MOUNT HOPKINS	USA	249	07	31	41	NOAM	S
40436	SAN DIEGO	USA	243	10	32	36	PCFC	S
40437	MAMMOTH LAKES	USA	241	04	37	38	NOAM	S
40438	BEAR LAKE	USA	248	35	41	56	NOAM	S
40439	OWENS VALLEY	USA	241	22	37	14	NOAM	PC
40440	WESTFORD	USA	288	31	42	37	NOAM	PC
40441	GREENBANK	USA	280	10	38	26	NOAM	S
40442	FORT DAVIS	USA	255	59	30	40	NOAM	PC
40445	MAUI	USA	203	44	20	43	PCFC	PC
40449	OCOTILLO	USA	244	12	32	47	PCFC	S
40451	WASHINGTON	USA	282	56	38	55	NOAM	PC
40452	BLOOMINGTON	USA	273	30	39	11	NOAM	S
40453	CARROLLTON	USA	274	53	33	34	NOAM	S
40454	LEONARD	USA	264	12	35	55	NOAM	S
40455	MILES CITY	USA	254	08	46	24	NOAM	S
40456	PIETON	USA	251	53	34	18	NOAM	S
40457	SEATLE	USA	237	45	47	41	NOAM	S
40460	LA JOLLA	USA	242	45	32	52	NOAM	S
40472	COLORADO SPRINGS	USA	255	07	39	00	NOAM	S
40489	HAT CREEK	USA	238	32	40	49	NOAM	P
40490	MARYLAND POINT	USA	282	46	38	22	NOAM	P
40491	FLAGSTAFF	USA	258	22	35	13	NOAM	PC
40492	VERNAL	USA	250	26	40	20	NOAM	SC
40493	YUMA	USA	245	48	32	56	NOAM	PC
40496	PLATTEVILLE	USA	255	16	40	11	NOAM	PC
40497	MONUMENT PEAK	USA	243	35	32	54	PCFC	PC
40499	RICHMOND	USA	279	37	25	37	NOAM	PC
40504	MAZATLAN	Mexico	253	33	23	14	NOAM	P
40505	CABO SAN LUCAS	Mexico	250	08	22	55	PCFC	S

40506	ENSENADA	Mexico	243	50	31	15	PCFC	S
40701	SANTIAGO DE CUBA	Cuba	284	14	20	01	NOAM	S
41505	BUENOS AIRES	Argentina	301	29	-34	34	SOAM	S
41604	NATAL	Brazil	324	40	-5	56	SOAM	S
41703	EASTER ISLAND	Chile	250	34	-27	11	NAZC	P
41705	SANTIAGO	Chile	289	20	-33	09	SOAM	S
41706	CERRO TOLOLO	Chile	289	12	-30	10	SOAM	S
41709	SEST	Chile	289	16	-29	16	SOAM	S
42001	QUITO	Equador	281	25	-0	37	SOAM	S
42202	AREQUIPA	Peru	288	30	-16	28	SOAM	P
42501	BERMUDA	UK	295	21	32	21	NOAM	SC
43602	GRAND TURK	Bahama Is.	288	42	21	28	SOAM	S
50103	CANBERRA	Australia	148	59	-35	35	INDI	PC
50106	SMITHFIELD	Australia	138	39	-34	41	INDI	S
50107	YARRAGADEE	Australia	115	25	-29	05	INDI	P
50116	HOBART	Australia	147	26	-42	48	INDI	S
50126	TOWNSVILLE	Australia	146	46	-19	17	INDI	S
50208	WELLINGTON	N. Zealand	174	47	-41	17	INDI	S
50503	AMERICAN SAMOA	USA	189	17	-14	20	PCFC	S
50505	KWAJALEIN ATOLL	USA	167	29	9	24	PCFC	SC
92201	PAPEETE	France	210	26	-17	34	PCFC	S
92202	HUAHINE	France	208	58	-16	44	PCFC	P
97101	LE MOULE	France	298	40	16	20	CARB	S
97301	KOUROU	France	307	21	5	07	SOAM	S

(*) P: Primary S: Secondary C: Colocation

Table 2 Directory of IERS stations

DOMES Number	Site	CDP Number	DESIGNATION
10002	Grasse		
M001			Mark Caussols 3 (F 2)
M003		7605	Mobile VLBI mark 1989
S001		7835	SLR IAR
S002		7845	LLR IAR
10004	Brest		
M002		7604	Mobile VLBI mark 1989
10302	Tromso		
M001			Trig. point (N 5481)
M002		7602	Mobile VLBI and SLR mark
M003			GPS marker TSS GPSM
M004			Mark TSS III
M005			Mark WMC2
S001			TI4100/L1 20-DEC-87 - 26-OCT-88
S002			TI4100/L1 28-OCT-88 - 07-NOV-88
S003			TI4100/L1 07-NOV-88 - 21-SEP-89
S004			TI4100/L1 21-SEP-89 - 17-JUL-90
S006			TI4100/L1 17-JUL-90 - 22-AUG-90
S007			ROGUE SNR-8/L1 28-MAY-90 - 30-JUN-90
S008			ROGUE SNR-8/L1 01-JUL-90 - 18-JUL-90
S009			ROGUE SNR-8/L1 18-JUL-90 -
10317	Ny-Alesund		
M001			Mark GPS
S001			ROGUE / L1 17-JAN-91
10325	Honefoss		
M001			SK Tower GPS mark
S001			ROGUE / L1 14-JAN-91
10402	Onsala		
M003			NLS Mark 761331 (S7331)
M004			Mark 3-1 GPSM
M005			Mark 401
S001		7212	VLBI ref. pt. ONSALA85
S002		7213	VLBI ref. pt. ONSALA60
S011			TI4100/L1 18-DEC-87 -
S012			ASHTECH/L1 27-JAN-91 -
10405	Martsbo		
S005			ASHTECH/L1 22-JAN-91 - 13-FEB-91
10503	Metsahovi		
M001			Mark (SF 348)
M002		7601	Mobile VLBI mark 1989
S001		7805	SLR IAR
11001	Graz		
M001			Mark (A171)
S002		7839	SLR IAR
12205	Borowiec		
S001		7811	SLR IAR

12302	Riga		
S002		1884	SLR IAR
12337	Simeis - Katzively		
S003		1873	Simeis fixed SLR IAR
S006		1893	Katzively Crimea fixed SLR IAR
12602	Dionysos		
M001			Central Pillar
M002		7515	Mark SLR Standard WEGENER disk
S001		7940	SLR IAR
12612	Askites		
M001		7510	Mark SLR 7510
12613	Roumelli		
M001		7517	Mark SLR 7517
12614	Karitsa		
M001		7520	Mark SLR 7520
12615	Katavia		
M001		7512	Mark SLR 7512
12616	Xrisokalaria		
M001		7525	Mark SLR 7525
12706	Lampedusa		
M001		7544	Mark SLR 7544
12711	Bologna		
M001			Pillar
M002		7546	Mark SLR 7546
S001		7230	Radiotelescope ref. pt.
12717	Noto		
S001		7547	Radiotelescope ref. pt.
M001		7543	Mark SLR
12718	Trieste		
M001			Mark (I 400130)
M002		7550	Mark SLR 7550
12725	Cagliari		
M001			ILS Mark (I 234165)
M002		7545	Mark SLR 7545
12734	Matera		
M001			Mark (I 201130)
M004		7541	Mark SLR 7541 "C"
M005		7540	Mark SLR 7540 "B"
M007			Roof GPS Mark
S001		7939	SLR IAR
S005		7243	Fixed VLBI antenna
S006			ROGUE/L1 22-JAN-91
13201	Chilbolton		
S002		7215	25m radiotelescope ref. pt.
S301			Hermitage / GPS DMA TI4100 / L1
13212	Herstmonceux		

M002			Primary pillar (GB 481)	
S001		7840	SLR IAR	
13296	Carnusty			
M001		7603	Mobile VLBI mark 1989	
13407	Madrid-Robledo			
S001		1563	64m antenna	DSS63
S003		1561	26(34) antenna	DSS61
S010		1565	34m antenna	DSS65
S011			ROGUE/L1	21-MAR-90
13411	Madrid-Facultad			
S001			TRIMBLE 4000SLD/L1	22-JAN-91 - 13-FEB-91
13504	Kootwijk			
M001			Perm. mark 1980	
M002		8833	Monument MTLRS 1984	
M003			GPS mark (ROGUE Antenna)	
S001		7833	SLR IAR (NL 233)	
S013			ROGUE/L1	20-JAN-91
14001	Zimmerwald			
M001			Mark (CH 99)	
S001		7810	SLR IAR	
14005	Monte Generoso			
M001			Mark (CH 65)	
M002		7590	Mark SLR	
14106	Potsdam			
M001			Pillar tour Helmert	
S001		1181	SLR IAR	
14201	Wettzell			
M001			Astro. Pillar	
M002			Trig. Point (D6843)	
M003		7595	SLR and GPS mark	
M004		7596	SLR mark	
M005		7597	SLR mark	
M006		7598	SLR and GPS (ROGUE) mark	
M007		7599	SLR mark	
M008			Mark 1000 (bottom of the TI4100 antenna 12-NOV-90 - 27-JUL-89)	
S004		7224	VLBI Ref. Point	
S002		7834	SLR IAR	
S013			TI4100/L1	12-NOV-87 - 27-JUL-89
S016			MINI MAC/L1	23-MAY-89 -
S017			ROGUE/L1	20-DEC-90
14202	Hohenbunstorf			
M002		7600	Mobile VLBI mark 1989	
14209	Effelsberg			
M001			Control network mark	
S001		7203	100m radiotelescope ref. pt.	
20702	Bar Giyyora			
M001		7530	SLR mark 7530	
S001		7530	MOBLAS-2	
20801	Diyarbakir			
M001		7575	Mark SLR	

20802	Yozgat		
M001		7585	Mark SLR
20803	Melengiclick		
M001		7580	Mark SLR
20804	Yigilca		
M001		7587	Mark SLR
21602	Wuhan		
S003		7236	Wuhan fixed laser
21605	Shanghai		
M001			Mark connect with bedrock
S001		7837	SLR IAR
S008		7226	VLBI 6m radiotelescope ref. pt.
S009		7227	VLBI 25m antenna ref. pt.
21701	Kashima		
M001			Metal station mark (Denken 1)
S001		1856	26m VLBI antenna
S004		1857	34m VLBI antenna
21709	Okinawa		
S001		7301	SLR IAR HTLRS-1
21718	Miyazaki		
S001		7312	5m mobile VLBI
21725	Nobeyama		
S001		7244	6m VLBI antenna ref. pt.
21726	Simosato		
M001			Stone marker
M002		7838	SLR mark (center of the ring of the base pier)
S001		7838	SLR IAR fixed
21729	Usuda		
M001			GPS mark Control RM roof
S001			ROGUE/L1 29-JAN-91
21730	Tsukuba		
S001		7311	5m mobile VLBI
S002			MINI MAC/L1 10-JUL-88 -
21732	Chichijima		
S001		7844	mobile VLBI
S002		7844	SLR IAR HTLRS-1
21733	Minami Tori sima (Marcus)		
S001		7300	SLR IAR HTLRS-1
S002		7310	mobile VLBI
21735	Tsushima		
S001		7302	SLR IAR HTLRS-1
21736	Ishigaki-shima		
S001		7307	SLR IAR HTLRS-1
23902	Daejeon		
S001			TRIMBLE 4000SDT/L1

24901	Bahrein		
S001			GPS DMA TI4100 / L1
30101	Helwan		
S001		7831	SLR IAR fixed
30302	Johannesburg		
M001			GPS mark below ROGUE antenna
S001		7232	26m VLBI antenna ref. pt.
S014			ROGUE/L1 15-JAN-91
30602	Ascension		
S003			GPS OCS monitor station
30802	Diego Garcia		
S002			GPS OCS monitor station
32809	Libreville		
M001			N'Koltang / Borne 1988
S001			TRIMBLE SLD/L1 22-JAN-91 - 13-FEB-91
40104	Algonquin		
M002			883160 GPS ARO N. pier
S001		7282	46m VLBI antenna ref. pt.
S003			ROGUE/L1 16-JAN-91 -
40105	Penticton		
M001		7283	Mobile VLBI mark 7283
S002			TI4100/L1
40118	Whitehorse		
M001		7284	Mobile VLBI mark 7284
40127	Yellowknife		
M001		7285	Mobile VLBI mark
M002			Mark 869211
M003			Mark 889201
S003			TI4100/L1 01-JAN-87 - 02-JUL-89
S004			TI4100/L1 07-JUL-89 - 21-JAN-91
S005			ROGUE SNR-8/L1 21-JAN-91 -
40129	Victoria		
M001		7289	Mobile VLBI mark
M002			PGC1 867001
S001			ROGUE/L1 16-JAN-91 -
40400	Pasadena		
M001		7896	Mark SLR (JPL aries 2 1975)
M003		7263	Mobile VLBI Mark
M005		7265	Mobile VLBI MARK
M006		7272	Mobile VLBI mark (JPL MV3 1983)
S004			ROGUE/L1 6-NOV-90 -
40403	Palos Verdes		
M001		7268	Mobile VLBI mark
40404	Pearblossom		
M001		7254	Mobile VLBI mark (NCMN 1983)
M002		7253	Mobile VLBI mark
40405	Goldstone		
M001		7085	MOBLAS 7085 Goldstone val

M002		7115	MOBLAS 7115-1979 standard NASA disk
M006		7265	Mojave NCMN 1983 NGS station disk
M010		7287	Mojave TLRS 1984 standard NASA disk
M011			Mojave NCMN 1 1983
M013		7288	Mojave mobile VLBI and TLRS mark (Punchmark on sheared surface of 7287 mark)
S009		7222	Mojave fixed 12m VLBI ref. point
S001		1514	Mars 64m fixed VLBI ref. point (DSS14)
S014		1513	Venus 26m fixed VLBI ref. point (DSS13)
S019		7231	Mars 34m fixed VLBI ref. ponit (DSS15)
S020			TI4100/L1 11-NOV-86 - 18-JUL-88
S024			TI4100 FRPA-2/L1/L2 19-JUL-88
S025			MINI MAC 2816AT/L1 05-FEB-89 -
S026			ROGUE/L1 14-DEC-89
40406	San Francisco (presidio)		
M001		7252	Mobile VLBI mark
40407	Pinyon Flats		
M001		7256	Mobile VLBI mark (NCMN 1981)
M002			Pinyon 1
S001			ROGUE/L1 6-NOV-90 -
40408	Fairbanks		
M001			GPS pillar
S001			26m antenna ref. pt.
S002		7225	26m VLBI ref. point (GILMORE CREEK)
S003			ROGUE/L1 17-JAN-91
40409	Kaena Point (HAWAII)		
S001			GPS OCS monitor station
40410	Point Reyes		
M001		7251	Mobile VLBI mark
40412	Austin		
M001		7890	Mark SLR 7890
M002			Austin monument
M003		7271	Mobile VLBI mark
40416	Yakataga		
M001		7277	Mobile VLBI mark
40417	Patrick AFB		
M001		7081	Mark SLR
M002		7069	Mark SLR
40419	Kodiak		
M001		7278	Mobile VLBI mark
40420	Vandenberg		
M001		7111	DMA disk MOBLAS 7111 (1981)
M002		7223	DMA disk VLBI 7223 (1983)
M003		7880	DMA disk TLRS 7880 (1983)
M004		7887	DMA disk TLRS 7887 (1983)
40421	Nome		
M001		7279	Mobile VLBI mark
40423	Sandpoint		
M001		7280	Mobile VLBI mark

40424	Kauai		
M004			VERLOT radar building JPL GPS mark 3028-S
M005			CIGNET-GPS survey marker
S001		1311	9m VLBI ref. point
S002			TI4100/L1 - -86 -
S003			TI4100 FRPA-2/L1 -APR-88 - 02-JUL-90
S004			TRIMBLE 4000SST/L1 02-JUL-90 -
S006			ROGUE/L1 21-NOV-90 -
40425	Sourdough		
M001		7281	Mobile VLBI mark
40427	Fort Ord		
M001		7266	Mobile VLBI mark (NCMN 1981)
M002		7241	Mobile VLBI mark
40428	Santa Paola		
M001		7255	Mobile VLBI mark
40430	Black Butte		
M001		7269	Mobile VLBI mark (NCMN 1982)
40431	Deadman Lake		
M001		7267	Mobile VLBI mark
40432	Ely		
M001		7286	Mobile VLBI mark R.M. 2 1954
M002		7257	Mobile VLBI mark
40433	Quincy		
M001		7051	Steel plate MOBLAS 7051
M002		7109	MOBLAS 7109 (1981) Standard NASA disk
M006		7260	Quincy ARIES 1979
M005		7886	TLRS 7886 (1982) standard NASA disk
M004		7221	TLRS and VLBI standard NASA disk
40434	Mount Hopkins		
M002		7888	Mark SLR
S001		7921	SLR IAR (SAO)
40436	San Diego Otay Mountain		
M002		7062	Mark SLR Circular 5" steel plate
M003		7035	Mark SLR 7035 1988
40437	Mammoth Lakes		
M001		7259	Mobile VLBI mark
40438	Bear Lake		
M001		7082	Mark SLR (4" x 4" Steel plate)
M002		7046	SLR mark
40439	Owens Valley		
M001		7114	MOBLAS 7114 (1979) standard NASA disk
M003		7084	MOBLAS, TLRS 7084 standard NASA disk
M004		7853	Mobile VLBI Jul 87 standard NASA disk
S002		7207	40m VLBI ref. point
40440	Haystack/Westford		
M001		7091	MOBLAS Haystack Inter Comp 1977
M004			Monument MICRO
S002		7205	Haystack / 37m VLBI ref. point

S003		7209	Westford / 18m VLBI ref. point
S014			TI4100/L1 -OCT-86 - 04-AUG-88
S016			TI4100 FRPA-2/L1/L2 05-AUG-88 - 14-FEB-89
S017			MINI MAC 2816AT/L1 29-JAN-89 -
40441	Greenbank		
S001		7204	43m radiotelescope ref. pt.
S004		7214	85-foot antenna ref. pt.
40442	Fort Davis		
M004			McDonald RM4 1977
M001		7086	MLRS, MOBLAS, TLRS-1 standard NASA disk
M005		7885	MLRS, MOBLAS, TLRS-1 standard NASA disk
M006		7080	MLRS mark 7080 1988
M008		7850	Mobile VLBI and SLR mark 7850 1988
M009		7900	Mobile VLBI mark (Havard RM 5 1977)
M010		7897	Mark SLR
S002		7206	LLR McDonald 2
S001		7086	LLR MLRS
S003		7216	85-foot VLBI ref. point (HRAS 085)
40445	Maui		
M001		7210	HOLLAS fixed carriage bolt
M002		7120	MOBLAS 7120 (1980)
S005			LLR Haleakala transmitter
40449	Ocotillo		
M001		7270	Mobile VLBI mark (NCMN 1982)
40451	Washington		
M110			Greenbelt north GEOS(GSFC) GORF
M107		7064	Mobile SLR 7064 standard NASA disk
M108		7065	Mobile SLR 7065 standard NASA disk
M101		7101	MOBLAS 7101-1977 standard NASA disk
M102		7102	Mobile SLR 7102-1978 standard NASA disk
M103		7103	Mobile SLR 7103-1978 standard NASA disk
M104		7104	Mobile SLR 7104-1978 standard NASA disk
M105		7105	MOBLAS -7 7105-1981 standard NASA disk
M106		7100	Mobile SLR 7100-1977 standard NASA disk
M111		7899	TLRS 7899-1980 standars NASA disk
M112		7063	STALAS fixed Laser standard NASA disk
M113		7106	Mark SLR
M114		7125	Mark SLR 7125 1985 standard NASA disk
M115		8213	Mark SLR
M116		7130	Mark SLR 7130 1985 standard NASA disk
M117		7920	Mark SLR 7125-B standard NASA disk
M118		7889	Mark SLR 7889 1981 standard NASA disk
M119		7917	Mark SLR 7917 Steel plate SAO-3
M120		7918	Mark SLR standard NASA disk
M121		7919	Mark SLR standard NASA disk
M122		7083	Mark SLR standard NASA disk
40452	Bloomington		
M001		7291	Mobile VLBI mark
40453	Carrollton		
M001		7228	Mobile VLBI mark
40454	Leonard		
M001		7292	Mobile VLBI mark
40455	Miles City		

M001		7038	Mobile VLBI mark
40456	Pietown		
S001		7234	VLBA antenna
40457	Seattle		
M001		7229	Mobile VLBI mark
40460	La Jolla		
M001			SCRIPPS 1
S001			ROGUE/L1 5-NOV-90 -
40489	Hat Creek		
M001			Mark NCMN B
S001		7218	26m VLBI ref. point of radio telescope
40472	Colorado Springs		
S001			GPS OCS monitor station
40490	Maryland Point		
S001		7217	(26m) 85-foot radiotelescope
40491	Flagstaff		
M002		7891	Mark SLR (RMT N 4 1981)
M003		7261	Mobile VLBI mark
40492	Vernal		
M001		7892	Mobile SLR and VLBI mark (NCMN 1981)
M002		7290	Mobile SLR and VLBI mark (NCMN 1985)
40493	Yuma		
M001		7894	Mobile SLR and VLBI mark
40496	Platteville		
M002		7258	NCMN 1981 mobile VLBI NGS station disk
M001		7112	Moblas 7112-1980 standard NASA disk
40497	Monument Peak		
M001		7110	ORT station 7110-1981 standard NASA disk
M002		7220	ARIES ORION STA 7220-1981
M003		7274	NCMN 1983 mobile VLBI NGS disk
40499	Richmond		
M001			Timer 1962
M002		7295	Mark SLR
S001		7219	65 foot VLBI antenna
S009			TI4100 FRPA-2/L1/L2 09-FEB-88 - 24-FEB-89
S011			MINI MAC 2816AT/L1 05-FEB-89 -
40504	Mazatlan		
M001		7122	MOBLAS 7122-1983 standard NASA disk
40505	Cabo San Lucas		
M001		7882	Mark SLR 7882 1983
40506	Ensenada		
M001		7883	SLR mark 7883
40701	Santiago de Cuba		
S001		1953	SLR IAR
41505	Buenos Aires		
S006			GPS DMA TI4100 / L1

41604	Natal			
S001		7929	SLR IAR	
41703	Easter Island			
M001		7061	TLRS-2 7061-1983 NASA-GSFC station disk	
M002		7097	TLRS-2 7097-1986 NASA brass disk	
41705	Santiago			
M001		7400	Mark SLR	
M002			Mark GPS	
S004			ROGUE/L1	15-JAN-91 -
41706	Cerro Tololo			
M001		7401	Mark SLR	
41709	Sest			
S001		7239	VLBI antenna	
42003	Quito			
S001			GPS DMA TI4100 / L1	
42202	Arequipa			
M002			Satellite mark 1961	
M003		7403	Mark SLR	
S001		7907	SAO-2 fixed laser	
42501	Bermuda			
M001		7067	Mark SLR	
M002		7294	Mobile VLBI mark	
43602	Grand Turk			
M001			Mark SKI 1952	
M002		7068	Mark SLR	
50103	Canberra-orroral			
M103			Stromlo PZT4	
M106		7843	Orroral center ground mark 7843	
S003		7943	SAO-3 fixed laser	
S007		7843	NLRS (coude mirror 7)	
S001		1543	DSS43 Antenna	
S005		1542	DSS42 Antenna	
S006		1544	DSS44 Antenna	
S010		1545	DSS45 Antenna	
S012			Canberra/ROGUE/L1 20-MAR-90	
S013			Orroral/TRIMBLE SST /L1	
50106	Smithfield			
S005			GPS DMA TI4100 / L1	
50107	Yarragadee			
M001		7090	MOBLAS 7090 brass disk	
M004			Mark RM-4	
S005			ROGUE/L1	15-DEC-90 -
50116	Hobart			
M001			West pillar	
M002			North pillar	
S002		7242	VLBI antenna ref. pt.	
S003			MINIMAC 2816AT/L1	21-JAN-90 -
50126	Townsville			
M001			Pillar on the office building roof	

S001			TRIMBLE 4000SST/L1 25-JUL-90 -
50208	Wellington		
M001			Pillar on the DOSLI building roof
S001			TRIMBLE 4000SST/L1 15-FEB-90 -
50503	American Samoa		
M001		7096	Mark SLR
50505	Kwajalein Atoll		
M001		7092	Mark SLR
S003		4968	Tardex 26m antenna ref. pt.
S004			GPS OCS monitor station
92201	Papeete (Pamatai)		
M002			Point IGN 1984
S003			ASHTECH/L1 22-JAN-91 - 13-FEB-91
92202	Huahine (Motu Hiumoo)		
M001			Tube Huahine no. 5
M002		7121	MOBLAS-1 7121-1982 standard NASA disk
M003		7123	TLRS-2 7123 CSR reference
M004		7123	TLRS-2 7123 standard NASA disk
M005			Mark RM-1
S008			ASHTECH/L1 22-JAN-91 - 13-FEB-91
97101	Le Moule (Guadeloupe)		
M001			RBGM / Borne
S001			ASHTECH/L1 22-JAN-91 - 13-FEB-91
97301	Kourou		
M201			Pillar Diane I (84)
S001			ASHTECH/L1 22-JAN-91 - 13-FEB-91

Table 3 Local eccentricities for IERS/GPS colocation sites

40104 Algonquin

S001	M002	94.763	61.017	6.666	Ref: (5)
		0.003	0.003	0.003	

40408 Fairbanks

S002	M001	-74.149	49.271	-31.235	Ref: (6)
		0.100	0.100	0.100	

40405 Goldstone

S009	M011	-253.471	142.251	-8.373	Ref: (1)
		0.003	0.003	0.003	
	S024	-43.6890	21.8376	-10.1977	Ref: (1)
		0.003	0.003	0.003	
	S025	-44.8701	19.3721	-14.3939	Ref: (1)
		0.003	0.003	0.003	

30302 Hartebeesthoek

S001	M002	-817.371	2103.044	203.124	Ref: (6)
		0.100	0.100	0.100	

40440 Haystack-Westford

S003	M004	111.191	84.088	43.334	Ref: (1)
		0.003	0.003	0.003	
	S016	26.3007	38.8085	30.4234	Ref: (1)
		0.003	0.003	0.003	
	S017	26.3732	42.0914	32.4902	Ref: (1)
		0.003	0.003	0.003	

50116 Hobart

S002	S003	52.453	17.009	-25.846	Ref: (2)
		0.003	0.003	0.003	

92202 Huahine

M004	M005	-18.477	5.317	26.307	Ref: (6)
		0.003	0.003	0.003	

13504 Kootwijk

M002	M003	-12.461	-37.503	23.024	Ref: (5)
		0.003	0.003	0.003	

40445/40424 Maui/Kokee Park(Kauai)

/S001	/M004	7.9413	-23.6167	-4.4070	Ref: (5),(6)
		0.003	0.003	0.003	
	/M005	28.0809	-18.9910	44.3985	Ref: (3)
		0.003	0.003	0.003	
	/S003	27.8182	-19.0942	44.4951	Ref: (3)
		0.003	0.003	0.003	
	/S004	27.6899	-19.1360	44.5681	Ref: (3)
		0.003	0.003	0.003	

10402 Onsala

S002	M004	52.631	-40.464	-43.865	Ref: (3)
		0.003	0.003	0.003	
	M005	96.352	-112.282	-66.615	Ref: (3)
		0.003	0.003	0.003	
	S011	53.500	-40.273	-42.465	Ref: (3)
		0.003	0.003	0.003	
	S012	97.185	-112.106	-65.284	Ref: (3)
		0.003	0.003	0.003	

40400 Pasadena

M003	M006	1.987	-18.063	-22.052	Ref: (5)
		0.003	0.003	0.003	

40407 Pinyon

M001	M002	125.588	117.655	279.910	Ref: (5)
		0.003	0.003	0.003	

40499 Richmond

S001	M001	59.722	35.212	29.920	Ref: (1)
		0.003	0.003	0.003	
	S009	60.2703	31.9700	31.4954	Ref: (1)
		0.003	0.003	0.003	
	S011	51.3171	14.3605	5.1997	Ref: (1)
		0.003	0.003	0.003	

10302 Tromso

M002	M003	36.287	-33.115	-9.219	Ref: (2)
		0.003	0.003	0.003	
	M004	47.186	64.101	-21.450	Ref: (2)
		0.003	0.003	0.003	
	M005	1.483	10.615	-1.314	Ref: (2)
		0.003	0.003	0.003	
	S007	47.744	64.293	-19.858	Ref: (2)
		0.003	0.003	0.003	
	S008	47.719	64.284	-19.930	Ref: (2)
		0.003	0.003	0.003	
	S009	37.125	-32.827	-6.829	Ref: (2)
		0.003	0.003	0.003	
	Rogue/L2	37.132	-32.825	-6.809	Ref: (2)

21730 Tsukuba

S001	S002	-20.826	-46.729	24.241	Ref: (1)
		0.003	0.003	0.003	

14201 Wettzell

S004	M003	11.340	90.279	-41.506	Ref: (4)
		0.003	0.003	0.003	
	M006	39.385	71.980	-58.364	Ref: (4)
		0.003	0.003	0.003	
	M008	6.054	90.492	-30.019	Ref: (4)
		0.003	0.003	0.003	
	S013	6.199	90.526	-29.847	Ref: (4)
	S016	12.449	90.533	-40.190	Ref: (4)
		0.003	0.003	0.003	

40127 Yellowknife

M001	M003	-327.848	314.599	82.882	Ref: (3)
		0.003	0.003	0.003	
	S004	-327.892	314.503	83.083	Ref: (3)
		0.003	0.003	0.003	
	S005	-327.869	314.552	82.980	Ref: (3)
		0.003	0.003	0.003	

References

(1) GPS Bulletin Vol. 2 No. 4, May-June, 1989, pages 24,26,29,31

(2) GPS Bulletin Vol. 3 No. 3, Sept-Oct, 1990, pages 20,23

(3) GPS Bulletin Vol. 4 No. 2, March-April, 1991, pages 8,10,11

(4) SGMS Newsletter April 1991, page 60

(5) GIG'91, Rogue GPS Network, Status Report: Analysis Support Package, Daily Logs and Site Specific Information, April 18, 1991

(6) IGN data base

Table 4 IERS GPS Terrestrial Reference Frame for epoch 1991.0

DOMES NUMBER	NAME	X m	Y m	Z m	SX m	SY m	SZ m
40104M002	ALGONQUIN	918129.630	-4346071.221	4561977.794	0.008	0.009	0.010
40408M001	FAIRBANKS	-2281621.301	-1453595.768	5756961.958	0.100	0.100	0.100
40405M011	GOLDSTONE	-2356424.422	-4646613.643	3668462.207	0.005	0.006	0.006
40405S024	GOLDSTONE	-2356214.640	-4646734.056	3668460.382	0.005	0.006	0.006
40405S025	GOLDSTONE	-2356215.821	-4646736.522	3668456.186	0.005	0.006	0.006
30302M002	HARTEBEESTHOEK	5084625.416	2670366.463	-2768494.056	0.102	0.102	0.101
50116S003	HOBART	-3950184.043	2522364.554	-4311588.685	0.024	0.022	0.021
92202M005	HUAHINE	-5345885.376	-2958241.958	-1824597.903	0.013	0.015	0.014
40424S004	KAUAI	-5543818.316	-2054583.115	2387858.475	0.008	0.007	0.007
40424M005	KAUAI	-5543817.925	-2054582.970	2387858.306	0.008	0.007	0.007
40424S003	KAUAI	-5543818.188	-2054583.073	2387858.402	0.008	0.007	0.007
40424M004	KAUAI	-5543838.065	-2054587.596	2387809.500	0.008	0.007	0.007
13504M003	KOOTWIJK	3899225.381	396731.752	5015078.289	0.018	0.019	0.017
10402M005	ONSALA	3370702.488	711805.147	5349764.035	0.011	0.010	0.012
10402M004	ONSALA	3370658.767	711876.965	5349786.785	0.011	0.010	0.012
10402S012	ONSALA	3370703.321	711805.323	5349765.366	0.011	0.010	0.012
10402S011	ONSALA	3370659.636	711877.156	5349788.185	0.011	0.010	0.012
40400M006	PASADENA	-2493304.025	-4655215.554	3565497.388	0.010	0.013	0.010
40407M002	PINYON FLATS	-2369510.375	-4761207.167	3511396.133	0.011	0.015	0.013
40499M001	RICHMOND	961317.853	-5674054.825	2740563.678	0.006	0.006	0.007
40499S011	RICHMOND	961309.448	-5674075.676	2740538.958	0.006	0.006	0.007
40499S009	RICHMOND	961318.401	-5674058.067	2740565.253	0.006	0.006	0.007
10302M005	TROMSO	2102905.665	721613.088	5958199.948	0.014	0.012	0.021
10302S007	TROMSO	2102951.926	721666.766	5958181.404	0.014	0.012	0.021
10302S009	TROMSO	2102941.307	721569.646	5958194.433	0.014	0.012	0.021
10302M004	TROMSO	2102951.368	721666.574	5958179.812	0.014	0.012	0.021
10302M003	TROMSO	2102940.469	721569.358	5958192.043	0.014	0.012	0.021
10302S008	TROMSO	2102951.901	721666.757	5958181.332	0.014	0.012	0.021
21730S002	TSUKUBA	-3957193.776	3310191.165	3737733.203	0.025	0.021	0.028
40440S017	WESTFORD	1492233.087	-4458088.406	4296047.989	0.005	0.006	0.006
40440S016	WESTFORD	1492233.015	-4458091.688	4296045.922	0.005	0.006	0.006
40440M004	WESTFORD	1492317.905	-4458046.409	4296058.833	0.005	0.006	0.006
14201S016	WETTZELL	4075552.467	931825.719	4801589.108	0.006	0.006	0.006
14201M003	WETTZELL	4075551.358	931825.465	4801587.792	0.006	0.006	0.006
14201M006	WETTZELL	4075579.403	931807.166	4801570.934	0.006	0.006	0.006
14201M008	WETTZELL	4075546.072	931825.678	4801599.279	0.006	0.006	0.006
14201S013	WETTZELL	4075546.217	931825.712	4801599.451	0.006	0.006	0.006
40127S005	YELLOWKNIFE	-1224452.361	-2689216.073	5633638.257	0.015	0.026	0.053
40127M003	YELLOWKNIFE	-1224452.340	-2689216.026	5633638.159	0.015	0.026	0.053
40127S004	YELLOWKNIFE	-1224452.384	-2689216.122	5633638.360	0.015	0.026	0.053

Table 5 IERS GPS Terrestrial Reference Frame for epoch 1992.0

DOMES NUMBER	NAME	X m	Y m	Z m	SX m	SY m	SZ m
40104M002	ALGONQUIN	918129.611	-4346071.223	4561977.796	0.008	0.009	0.010
40408M001	FAIRBANKS	-2281621.324	-1453595.771	5756961.948	0.100	0.100	0.100
40405M011	GOLDSTONE	-2356424.438	-4646613.644	3668462.195	0.005	0.006	0.006
40405S024	GOLDSTONE	-2356214.656	-4646734.057	3668460.370	0.005	0.006	0.006
40405S025	GOLDSTONE	-2356215.837	-4646736.523	3668456.174	0.005	0.006	0.006
30302M002	HARTEBEESTHOEK	5084625.414	2670366.487	-2768494.036	0.102	0.102	0.101
50116S003	HOBART	-3950184.081	2522364.561	-4311588.647	0.024	0.022	0.021
92202M005	HUAHINE	-5345885.420	-2958241.901	-1824597.867	0.013	0.015	0.014
40424S004	KAUAI	-5543818.327	-2054583.047	2387858.509	0.008	0.007	0.007

40424M005	KAUAI	-5543817.936	-2054582.902	2387858.340	0.008	0.007	0.007
40424S003	KAUAI	-5543818.199	-2054583.005	2387858.436	0.008	0.007	0.007
40424M004	KAUAI	-5543838.076	-2054587.528	2387809.534	0.008	0.007	0.007
13504M003	KOOTWIJK	3899225.366	396731.768	5015078.299	0.018	0.019	0.017
10402M005	ONSALA	3370702.471	711805.162	5349764.044	0.011	0.010	0.012
10402M004	ONSALA	3370658.750	711876.980	5349786.794	0.011	0.010	0.012
10402S012	ONSALA	3370703.304	711805.338	5349765.375	0.011	0.010	0.012
10402S011	ONSALA	3370659.619	711877.171	5349788.194	0.011	0.010	0.012
40400M006	PASADENA	-2493304.058	-4655215.518	3565497.410	0.010	0.013	0.010
40407M002	PINYON FLATS	-2369510.410	-4761207.132	3511396.156	0.011	0.015	0.013
40499M001	RICHMOND	961317.841	-5674054.827	2740563.678	0.006	0.007	0.007
40499S011	RICHMOND	961309.436	-5674075.678	2740538.958	0.006	0.007	0.007
40499S009	RICHMOND	961318.389	-5674058.069	2740565.253	0.006	0.007	0.007
10302M005	TROMSO	2102905.646	721613.099	5958199.954	0.014	0.012	0.021
10302S007	TROMSO	2102951.907	721666.777	5958181.410	0.014	0.012	0.021
10302S009	TROMSO	2102941.288	721569.657	5958194.439	0.014	0.012	0.021
10302M004	TROMSO	2102951.349	721666.585	5958179.818	0.014	0.012	0.021
10302M003	TROMSO	2102940.450	721569.369	5958192.049	0.014	0.012	0.021
10302S008	TROMSO	2102951.882	721666.768	5958181.338	0.014	0.012	0.021
21730S002	TSUKUBA	-3957193.798	3310191.154	3737733.190	0.025	0.021	0.028
40440S017	WESTFORD	1492233.069	-4458088.408	4296047.993	0.005	0.006	0.006
40440S016	WESTFORD	1492232.997	-4458091.690	4296045.926	0.005	0.006	0.006
40440M004	WESTFORD	1492317.887	-4458046.411	4296058.837	0.005	0.006	0.006
14201S016	WETTZELL	4075552.450	931825.735	4801589.119	0.006	0.006	0.006
14201M003	WETTZELL	4075551.341	931825.481	4801587.803	0.006	0.006	0.006
14201M006	WETTZELL	4075579.386	931807.182	4801570.945	0.006	0.006	0.006
14201M008	WETTZELL	4075546.055	931825.694	4801599.290	0.006	0.006	0.006
14201S013	WETTZELL	4075546.200	931825.728	4801599.462	0.006	0.006	0.006
40127S005	YELLOWKNIFE	-1224452.384	-2689216.076	5633638.250	0.015	0.026	0.053
40127M003	YELLOWKNIFE	-1224452.363	-2689216.029	5633638.152	0.015	0.026	0.053
40127S004	YELLOWKNIFE	-1224452.407	-2689216.125	5633638.353	0.015	0.026	0.053