

**THE INTERNATIONAL EARTH ROTATION SERVICE
1995 TO 1999**

**REPORT TO THE INTERNATIONAL ASSOCIATION OF GEODESY
SECTION V**



BUREAU CENTRAL DE L'IERS
OBSERVATOIRE DE PARIS
61 Av. de l'Observatoire
75014 PARIS (France)

Tél. : 33 (0) 1 40 51 22 26
FAX : 33 (0) 1 40 51 22 91
Internet : iers@obspm.fr

ACTIVITIES OF THE IERS

The IERS was created in 1987 by the IAU and the IUGG, replacing the Bureau International de l'Heure (BIH) and the International Polar Motion Service (IPMS), as a result of the ten-year international MERIT Campaign. The IERS started its activities in January 1988.

IERS was given the missions to define and maintain a terrestrial reference system based on the most precise space geodesy techniques at this time, to define and maintain a celestial reference system based on the directions of extragalactic radio sources and its tie to other celestial reference frames, and to monitor the Earth's orientation, i.e. the parameters that connect the terrestrial and the celestial reference systems as a function of time.

When operation began, the observational techniques available for these tasks were Very Long Baseline radio Interferometry (VLBI), Lunar Laser Ranging (LLR) and Satellite Laser Ranging (SLR). The Directing Board included representatives of the Coordinating Centres for these observing techniques, of the Central Bureau, and of IUGG, IAU and FAGS (Federation of Astronomical and Geophysical Data Analysis Services).

According to the Terms of Reference of the service, "the Directing Board exercises general control over the activities of the service, including modifications to the organisation and participation that would be appropriate to maintain efficiency and reliability, while taking full advantage of the advances in technology and in theory". The main decisions of the Directing Board in the first eight years of activity were the setting up of permanent monitoring of global atmospheric dynamical parameters in 1989, the adoption of the Global Positioning System (GPS) as an additional observing technique in 1989-93 and of DORIS (Doppler Orbitography by radio positioning integrated on satellite) in 1994-96, and the redefinition of the VLBI contributions in 1995-96.

In 1995, the IERS had achieved its primary missions, by providing globally distributed terrestrial and celestial references and the Earth's orientation with an accuracy equivalent to about one centimeter on the surface of the Earth.

After the initial IERS observing techniques reached maturity, new and powerful techniques were introduced. The environment in Earth sciences - including funding aspects - evolves rapidly. The consideration of expectations and frustrations as well as the recognition of achievements led the Directing Board to organize a general public evaluation of the service, that would encompass a review of current operation, and advice on possible extensions to better meet new and future needs for global references. In December 1995 they decided that the 1996 IERS Workshop would be dedicated to this review, after a period of preliminary discussion. The discussion was organized under six topics, each analyzed by Topic Coordinators helped by a small group. The Topics were as follows.

- 1: Assessment of current missions
- 2: Astronomical reference frames
- 3: Vertical references, incl. geoid, sea level, etc.
- 4: Topography and crustal deformations
- 5: Unification of regional reference systems
- 6: Earth rotation dynamics and geophysical fluids

The Topic Coordinators prepared draft reports with recommendations and distributed them in advance to the IERS Workshop. The latter took place at Paris Observatory, 14-16 October 1996, with program and participants as given at the end of this volume. The draft reports and recommendations were discussed in detail during the workshop and then finalized by the Topic Coordinators, taking into account the results of the discussions. The final texts are those published in this volume.

The lively discussions that took place in this context were extremely productive in that a number of important aspects were put forward or given increased emphasis. While some extensions of activities in the fields of astronomy, geodesy and geophysics were recommended, the Workshop also recognized the success of IERS in providing timely and accurate data on Earth rotation, and in the establishment and maintenance of accurate terrestrial and celestial reference frames.

The IERS Directing Board started to work on the implementation of the recommendations, at and between the two DB meetings already held in October and in December 1996. The major aspects of the foreseen evolution are as follows.

Maintaining the International Celestial Reference Frame (ICRF) based on VLBI-derived directions of extragalactic radio sources, and of the tie of the Hipparcos galactic reference frame, as will be recommended by the IAU Working Group on Reference Frames to the 1997 IAU General Assembly. This activity will be performed in concertation with an IAU Working Group on reference frames.

Coordinating the use of astronomical observations for tying the Solar System reference frames to the ICRF.

Monitoring the global geophysical fluids that influence both the ground measurements and the Earth's rotation, an extension of the current activity on atmospheric data.

Monitoring the motion of the Earth's centre of gravity.

Fostering the provision of global vertical terrestrial references and of global horizontal references for the monitoring crustal deformations, in close cooperation with the International Association of Geodesy.

Enhancing the role of Coordinators and extending their field of responsibility to general themes of importance to IERS.

Getting organized to interact with the Working Groups set up by IAU, IAG and IUGG on topics relevant to IERS missions.

Strengthening the development and maintenance of the IERS Conventions.

Developing or improving technical abilities for the global combination of products from analyses of the various observing techniques, and fostering internal competition within IERS on this aspect.

Extending formally the Directing Board membership to better represent all components of IERS activities.

Polling the IERS distribution lists to check the various types of users and their specific requirements.

The whole endeavour of reviewing IERS and making it evolve owes much to the dedication of the scientists that accepted to work on the requested evaluations and then took account of the input of the Workshop participants to finalize the documents in this volume. The IERS Directing Board is most thankful to these colleagues for their strong contributions.

IERS DIRECTING BOARD

Chairman and IUGG representative	C. Reigber, Germany
IAU representative	B. Kolaczek, Poland
FAGS representative (until September 1998)	O.B Andersen, Denmark
FAGS representative (since October 1998)	H.G. Wenzel
Central Bureau representative	
(until December 1997)	M. Feissel, France
(since January 1998)	D. Gambis, France
VLBI Coordinating Centre representative	C. Ma, USA

LLR Coordinating Centre representative	P.J. Shelus, USA
GPS Coordinating Centre representative	W.G. Melbourne, USA.
SLR Coordinating Centre representative	B.E. Schutz, USA.
DORIS Coordinating Centre representative	P. Willis, France.
SBBAM representative (until December 1997)	D. Salstein, USA
MGGF Coordinating Centre representative (since 1 January 1998)	B.F. Chao, USA.
Central Bureau, TRF representative	C. Boucher, France
Central Bureau, CRF representative	F.E. Arias, Argentina
Sub-bureau for rapid service and predictions	D.D. McCarthy, USA

PUBLICATIONS

All global IERS results are available under anonymous ftp and World Wide Web (see the back cover of this volume). IERS also maintains a series of publications, with Bulletins devoted to the Earth's rotation, Reports and Technical Notes for general results.

• Sub-Bureau for Rapid Service

- Twice weekly Bulletin A Earth orientation parameters (x,y,UT1,d₁,d₂): Rapid Service, prediction.
Available electronically only.

• Central Bureau of IERS

- Monthly Bulletin B Earth orientation parameters (x,y,UT1,d₁,d₂) combined solution and individual series. Information on UTC time scale.
First issue in January 1988.
- EOP(IERS) C 04 Earth orientation parameters (x,y,UT1,d₁,d₂) combined solution.
Updated twice weekly.
Available electronically only.
- Annual Report Activities of the coordinating centres and bureaus. Results and analyses concerning the Earth orientation and the terrestrial and celestial frames of the IERS reference system.
First issue, Report for 1988.
- Special Bulletin C Announcement of the leap seconds in UTC.
- Special Bulletin D Announcement of the value of DUT1 to be transmitted with time signals.
- Technical Notes Reports and complementary information of relevance to the work of IERS.
- IERS Gazette General information on IERS.
Available electronically only.

IER 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. The technical Notes published over the period 1995-1999 are:

No 21: D.D. McCarthy (ed.). IERS Conventions (1996)

No 22: C. Reigber and M. Feissel (eds.). IERS missions, present and future. Report on the 1996 IERS Workshop

No 23: C. Ma and M. Feissel (eds.). Definition and realization of the International Celestial Reference System by VLBI Astrometry of Extragalactic Objects

No 24: C. Boucher, Z. Altamimi, P. Sillard (eds.). Results and Analysis of the ITRF96

- No 25: J. Ray (ed.). Analysis Campaign to Investigate Motions of the Geocenter
- No 26: D. Salstein, B. Kolaczek, D. Gambis (eds.). The impact of El Niño and other low-frequency signals on Earth rotation and global Earth system parameters
- No 27: C. Boucher, Z. Altamimi, P. Sillard (eds.). The 1997 International Terrestrial Reference Frame (ITRF97)

POLL PERFORMED IN 1996

A polling of IERS users needs was done in 1996. The tables hereafter summarize some preliminary results about the domain of application of IERS results, the type of use and the importance in the users work.

Domains		IERS results		
Astronomy	32%	Celestial	Terrestrial	Earth
Space Geodesy	49%	Reference	Reference	Orientation
Navigation	22%	Frame	Frame	Parameters
Geodesy	32%	Type of use(%)		
Earth Sciences	23%	Comparison	20	45
Time	21%	Conventional refer	28	43
		Accurate reference	54	66
		Research	35	43
		Information	30	30
		Importance of results for the user(%)		
		Marginal	8	2
		Useful	24	14
		Very useful	27	31
		Indispensible	41	53

The sum of percentages and in the domain are larger than 100%, as most users have a multidisciplinary activity. It is also the case for the type of use: in the mean, the users need two types results, which is a clear confirmation of the relevance of the main mission of IERS which is to provide global references.

IERS CORRESPONDING MEMBERS

B. Ambrosius	M. Eubanks	R.W. King
B. Archinal	A.M. Finkelstein	B. Kolaczek
M. Baltuck	D.M. Fubara	J. Kouba
G. Beutler	T. Fukushima	J. LaBrecque
J. Bosworth	I. Georgiev	R.B. Langley
G. Blewitt	V. Glotov	J.L. Le Mouel
Y. Bock	C. Goad	J.-F. Lestrade
A. Brzezinski	R. Gross	B. Luzum
P. Brosche	E. Groten	P. McCulloch
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J.O. Dickey	K. Kaminuma	S. Manabe
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R. Eanes	N. Kawano	J.B. Minster

H. Montag
L.V. Morrison
I.I. Mueller
J. Müller
M. Murata
A. Nothnagel
R. Neilan
P. Pâquet
E. Pavlis
W.R. Peltier
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H. Schuh
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A. Sengoku
O. Sovers
A. Sprent
A. Steppe
A. Stolz
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V. Taradij
S. Tatevian
C. de Vegt
R.O. Vicente
J. Vondrak

K.F. Wakker
M. Watkins
I. Wenjing
A.L. Whipple
A. Whitney
J. Williams
G.A. Wilkins
C.R. Wilson
P. Wilson
W.H. Wooden
P. Woodworth
Y. Yatskiv
K. Yokoyama
T. Yoshino
T. Yunc
Zhu.
J.F. Zumberge

ELECTRONIC ACCESS TO IERS BUREAUS AND PUBLICATIONS

CENTRAL BUREAU

e-mail address:	iers@obspm.fr
World Wide Web:	http://hpiers.obspm.fr

EARTH ROTATION AND CELESTIAL FRAME

e-mail addresses	Earth rotation:	gambis@obspm.fr	
	Celestial frame:	iers@obspm.fr	
Anonymous ftp:	hpiers.obspm.fr		145.238.100.28
World Wide Web:	http://hpiers.obspm.fr		

TERRESTRIAL FRAME

e-mail address	boucher@ensg.ign.fr	
Anonymous ftp:	lareg.ensg.ign.fr	192.33.147.230
World Wide Web:	http://lareg.ensg.ign.fr/ITRF	

IERS CONVENTIONS

e-mail address	dmc@maia.usno.navy.mil	
Anonymous ftp:	maia.usno.navy.mil	192.5.41.22
	cd conventions	

SUB-BUREAU FOR RAPID SERVICE AND PREDICTIONS

e-mail address:	ser7@maia.usno.navy.mil	
Anonymous ftp:	maia.usno.navy.mil	192.5.41.22
World Wide Web:	http://maia.usno.navy.mil	

SUB-BUREAU FOR ATMOSPHERIC ANGULAR MOMENTUM (until December 1997)

e-mail address:	salstein@aer.com
Anonymous ftp:	nic.fb4.noaa.gov
	ftp.aer.com
World Wide Web:	http://www.aer.com

COORDINATING CENTER FOR MONITORING GLOBAL GEOPHYSICAL FLUID

e-mail address:	chao@denali.gsfc.nasa.gov
World Wide Web:	http://cddisa.gsfc.nasa.gov/926/mggf