



INTERNATIONAL EARTH ROTATION SERVICE (IERS)
SERVICE INTERNATIONAL DE LA ROTATION TERRESTRE
WWW: <ftp://hpvlbi.obspm.fr/iers/ierscb.html>

REPORT ON THE IERS DIRECTING BOARD MEETING No 19

Monday 14 October 1996, 9:00 - 12:30 and Friday 18 October 1996, 14:15 - 18:40
at Paris Observatory
in conjunction with the 1996 IERS Workshop

Attendance:

IERS extended Directing Board: C. Reigber (Chairman), B. Kolaczek, C. Ma, B. Melbourne, B. Schutz, P. Willis, M. Feissel, D. McCarthy, F. Arias, C. Boucher, D. Gambis.

IERS Workshop Topic Coordinators: G. Beutler, I. Mueller, J. Kovalevsky, M. Standish, B. Engen, W. Augath, J. Manning, V. Dehant, C. Wilson.

Invitees: R. Gross (Monday), J. Ray (Friday), P. Shelus (Monday, Friday)

INTRODUCTION

An IERS devoted to the review of the service, with consideration of possible extensions of its activities, was decided upon by the Directing Board at the end of 1995, organized during the following months (see reports on DB meetings Nos 17, December 1995, and 18, May 1996), and announced in April 1996.

A major aspect of the Workshop was the dedication of the scientists who acted as Topic Coordinators, providing written reports in advance, organizing the discussions at the Workshop (see Annex 1), finalizing Recommendations to the Directing Board on the basis of the opinions expressed by the participants (see Annex 2), and preparing the final reports on their topics, published as IERS Technical Note No 22 in January 1997. They are sincerely thanked for their important contribution.

FIRST PART: 14 OCTOBER, BEFORE THE IERS WORKSHOP

Three open working meetings were held at Paris Observatory in the week preceding the IERS Workshop, on topics of primary interest to IERS: meeting of the IAU Working Group on Reference Frames (convener: L. Morrison), the International Terrestrial Reference Frame (convener: C. Boucher), and technical aspects of the Earth's orientation time series (conveners: D. Gambis, D. McCarthy). Their results and conclusions were reported to the Directing Board.

IAU Working Group on Reference Frames (Chairman: L. Morrison, report: F. Arias).

The one and a half day meeting was attended by about 30 persons. It summarized the work done, the results obtained and the recommendations to be presented for adoption at the IAU General Assembly in August 1997. The main impact on the IERS is the proposed adoption of the Celestial Reference System that was defined by the IERS, under the name of International Celestial Reference System (ICRS) and the proposal that the IERS be charged with the maintenance of the International Celestial Reference Frame (ICRF) and with its tie with celestial reference frames at other wavelengths. It is also recommended that this task be performed in cooperation with an advisory group appointed by the IAU.

The background information on the related work is contained in the following publications.

- F. Arias, P. Charlot, J.-F. Lestrade, 1995: The extragalactic reference system of the International Earth Rotation Service, *ICRS. Astron. Astrophys.*, **303**, 604-608.
- C. Ma, F. Arias, M. Eubanks, A. Fey, A.-M. Gontier, C. Jacobs, O. Sovers, 1997. Article in preparation, describing the implementation of the ICRF by the IAU Working Group on Reference Frames. To be published in a major scientific journal.
- C. Ma and M. Feissel (eds.), 1997: Definition and realization of the International Celestial Reference Frame. IERS Technical Note No 23 to be issued in April 1997 and widely distributed.

ITRF Workshop (C. Boucher)

The one and a half day meeting was attended by about 35 persons. The discussions dealt with problems in the combination of individual terrestrial reference frame solutions and definition of the datum.

Data were collected in 1996 to prepare a conventional terrestrial reference frame, ITRF-C1, based on the combination of solutions with their associated full variance-covariance matrices for station positions and velocities. The detailed screening of the contributed data showed that altogether they were not sufficient to insure the robustness of a derived ITRF-C1. The main reasons were that less than three solutions were available for some of the techniques, preventing intra-technique validations, and that not all constraints imbedded in the individual solutions could be clarified.

In parallel, the WG on ITRF Datum (Chair: J. Ray) was very active in discussing the specifications for the origin, scale and orientation of ITRF, but has not yet reached a final conclusion.

EOP Technical Discussion (D. McCarthy)

The one-day meeting was attended by about 30 persons. The discussions and conclusions can be summarized as follows.

- The change in EOP on 1 January 1997 should be announced rapidly (done on 29 October 1996, IERS Gazette No 8). This will put the EOP in accordance with the ITRF and ICRF in bias and rate, but the rate correction has a relatively large uncertainty, and the EOP are likely to diverge again from ITRF. A specific study of the ways to improve the consistency is needed.
- The publication of the precession-nutation angles should be done under the complete form, i. e. not only as differences with respect to the IAU conventional models.
- The time tags for the EOP results should be given in UTC. It is not always the case.
- The electronic distribution of EOP series has become the major part of IERS distribution.
- Software for Earth rotation (e. g. nutation, tidal variations) should be made available electronically.

Decision of the Directing Board:

The EOP results published by IERS will contain no diurnal and semi-diurnal variations of tidal origin. Guidelines for recovering the instantaneous values of the EOP will be distributed (done on 30 January 1997, IERS Gazette No 13).

Lunar Laser Ranging

C. Veillet, Head of the LLR Coordinating Centre (at OCA/CERGA, France) left CERGA to take other responsibilities. The observations are continuing at the LLR station. After consultation with the CERGA Director (F. Mignard), it is decided that P. Shelus (University of Texas at Austin) will represent the Coordinating Centre at the Directing Board. The Directing Board considers it of extreme importance that LLR has a strong representation in IERS to face ongoing changes, particularly in the USA.

VLBI (C. Ma)

The NASA/GSFC VLBI group has developed a project for Continuous Observations of the Rotation of the Earth (CORE) that would provide new and improved data for the understanding of the Earth's integrated response to geophysical and astronomical excitations. CORE would also require worldwide cooperation for the upgrade of acquisition systems to Mark IV, the improvement of colocations and the organization of observations. NASA is currently examining the proposal.

The Directing Board considers that the setting up of such a program would be extremely beneficial to IERS. A letter expressing this support will be sent to NASA Headquarters.

Distribution of IERS results and information

The Sub-bureau for Rapid Service and Predictions wants to move to electronic-only distribution of Bulletin A, leaving the possibility of printed forms for those interested. The Directing Board agrees on this new organisation.

The Central Bureau (Paris Observatory group and Terrestrial Reference Frame Section at IGN) have reorganized their ftp distribution and set up Web sites. All results are available electronically. The Central Bureau Web site has one part devoted to the general description of IERS activities. Two months after its reorganisation, the ftp/Web site is consulted by 30 different users daily, and 400 different users monthly.

The Directing Board confirms that the IERS Annual Report is a key publication for the service's visibility.

The Central Bureau has revised all its mailing lists (air mail and electronic mail) by explicit confirmation of the subscribers. The resulting numbers are given in the table hereafter.

Distribution of IERS publications in 1996 [and 1988] (1)

Publication	Interval	Contents	Airmail		e-mail		ftp/www	
			1996	1988	1996	1988	1996	1988
Bulletin B	monthly	Earth orient.	120	[360]	170	[0]	Yes	[No]
Bulletin C(2)	6 months	UTC time steps	80	[250]	220 (2)	[0]	Yes	[No]
Bulletin D	8/year	UT1-UTC (0.1s)	50	[140]	150	[0]	Yes	[No]
Annual Rep.	yearly	Global anal.	400	[500]			part	[No]
Tech. Notes	2-3/year	Add. analyses	300	[200]			part	[No]
IERS Conv.	3-4 years	Models, ...	1300 (3)	[1000]			Yes	[No]
Gazette	20/year	News			600	[0]	Yes	[No]

- Notes
1. The distribution lists were revised in 1988 and 1996
 2. Bulletin C is widely reproduced in national publications on Time
 3. Number of copies printed

Preparation of the Workshop

The Topic Coordinators explained how they intended to run their sessions. As the six draft position papers have been provided well in advance, the discussions were expected to bring forward the proper contribution of the Workshop participants. It was agreed that the final version of the position papers will take into account the input of the Workshop.

SECOND PART: 18 OCTOBER 1996, AFTER THE WORKSHOP

Consequences of the Workshop

The Workshop sessions were very lively and in some cases brought significant contribution to the evaluation of IERS future missions. The Topic Coordinators agree to amend their position papers prior to their publications (IERS Technical Note No 22, January 1997, C. Reigber and M. Feissel, eds). The final Recommendations (see Annex 3) will be sent to the Corresponding Members and put on ftp.

The Directing Board declare that they accept all the Recommendations of the Workshop. They will study the ways to put them into action. The following table summarizes the planned responses. Some actions can be taken immediately, some others require preliminary studies. As the list of possible responses is too long to be seriously treated at this meeting, another meeting is planned for December 1996, in conjunction with the Fall AGU Meeting.

Recommendations	IERS Responses
Enhancement of current activity	
1.1, 6.4	Redefine Coordinating Centres missions
1.7	Poll the IERS distribution lists
2a, 2b	Organize the maintenance of ICRF
4.2, 4.3	Move to station position time series
4.1	Work on colocations and local surveys
5.1, 5.2, 5.3	Foster unification of national datums
Re-organisation or Pilot projects	
1.6, 2f	Set up an Editorial Board for the IERS Conventions
1.4	Establish a Committee on IERS Network Design and Implementation (CINDI)
3.1, 3.4	Organize an analysis Campaign on motions of the Geocenter
New Coordinating Centres (Prepare Call for Proposal)	
1.2, 3.4, 6.1, 6.2, 6.5, 6.6	Monitoring of global geophysical fluids
2c, 2d + LLR	Tie of dynamical solar system CRF to ICRF
Interaction with Consultative Groups	
1.6	IAU/WGAS, IAG/SCGC
2e	IAU/WGRF
3.1	IAG-IAPSO WG on geodetic heights (proposed)
3.2	IAPSO/IAG WG on Geodetic fixing of tide gauges
3.3	IAG/CSTG WG on combinations
	IERS WG on ITRF datum
Modified Terms of Reference	
1.3	Structure: Analysis Centres
1.5	Structure: Central Bureau, Special Bureaus, Coordinating Centres
1.5	Membership of Directing Board

Other matters

SLR: the Directing Board wishes that the SLR contributions to IERS be redefined, as was done for VLBI. The exact time to issue a new Call for Participations should take into account the calendar of the current program review at NASA.

EOP: Chopo Ma will organize a cooperative study with a selection of Analysis Centres and the Central Bureau to clarify the connections of EOP series with the ITRF.

Bulletin A: the Directing Board agrees with the proposal of the sub-bureau for Rapid Service and Predictions to issue EOP results twice per week.

SBAAM: The SBAAM personnel are currently reorganizing their activities. New support for the role of AER in this regard is being actively pursued for the period after 1997.

Next meeting

18 December 1996 in San Francisco

Annexes

1. Program of the 1996 IERS Workshop
2. Attendance
3. Recommendations on the six topics:
 - Missions
 - Astronomical reference frames
 - Vertical References
 - Crustal Deformations
 - Unification of national datums
 - Global geophysical fluids

**IERS Workshop at Paris Observatory,
14-18 October 1996**

PROGRAM

Monday 14 October

9:00-10:30 IERS extended Directing Board
Conveners: C. Reigber, M. Feissel

11:00-12:30 IERS extended Directing Board + Topic Coordinators
Conveners: C. Reigber, M. Feissel

----- START OF 1996 IERS WORKSHOP -----

13:00-14:00 **Registration.**

14:00-15:30 Topic 1(a): Assessment of current missions
Conveners: G. Beutler, I. Mueller

16:00-17:30 Topic 2: Astronomical reference frames
Conveners: J. Kovalevsky, M. Standish

Tuesday 15 October

9:00-10:30 Topic 3: Vertical references, incl. geoid, sea level, etc.
Conveners: C. Boucher, B. Carter

11:00-12:00 Topic 4: Topography and crustal deformations
Conveners: B. Engen, B. Minster

12:00-12:30 Topic 5: Unification of regional reference systems
Conveners: W. Augath, J. Manning

14:00-15:30 Topic 6: Earth rotation dynamics and geophysical fluids
Conveners: V. Dehant, C. Wilson

16:00-17:30 Topic 1(b): IERS missions, present and future
Conveners: G. Beutler, I. Mueller

Wednesday 16 October

9:00-12:00 Group discussions

14:00-16:30 General discussion and conclusions
Convener: C. Reigber

----- END OF IERS WORKSHOP -----

Friday 18 October

14:00-15:30 IERS extended Directing Board + Topic Coordinator
Conveners: C. Reigber, M. Feissel

16:00-17:30 IERS extended Directing Board
Conveners: C. Reigber, M. Feissel

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1996 IERS Workshop - Recommendations to the Directing Board

Topic 1 - Missions

Recommendation 1: Each Coordinating Center (CC) should strengthen overall control of observations, quality control, and data processing for products of interest to the IERS (coordinates, EOP series, etc) in accordance with the IERS Terms of Reference. Combinations of individual solutions into technique specific products are strongly encouraged.

Recommendation 2: Coordinating Centers should be formed to promote the collection of other types of information relevant to EOPs such as atmospheric excitation functions, information on ocean circulation, global water level changes, etc.

Recommendation 3: Combination of products from the various CCs shall be performed by at least two IERS components such as Sub-Bureaus, specialized Analysis Centers, Central Bureau Sections. The Central Bureau should disseminate the state-of-the-art combined solutions and provide the official IERS products. The criteria for the selection or production of this official solution will be determined by the IERS Directing Board.

Recommendation 4: It is desirable to form a Network Coordination Group to consider issues of Network Design, Colocation, local ties, Site Quality, etc. as previously recognized and accepted by the IERS Directing Board.

Recommendation 5: Members of the Directing Board should include representatives of CCs, Sub-Bureaus, sections of the Central Bureau, selected combination centers (see Rec. 3), the Director of the Central Bureau, and representatives of IAU, IAG/IUGG, and FAGS.

Recommendation 6: The IERS Conventions should be updated periodically at reasonable intervals. They should reflect the state-of-the-art at the time of publication. In all cases, they should be consistent with the IAU and IUGG resolutions on reference systems (at present, the resolutions adopted in 1991). The IERS Conventions should be considered one of the IERS products for the use of the internal and external researchers. An IERS unit such a Sub-Bureau shall be formed to maintain the IERS Conventions.

Recommendation 7: The IERS Central Bureau should continue its excellent work necessary to develop and make available information on the ITRF, the ICRF and the transformation parameters between them. The Central Bureau should poll its distribution list to identify the various types of users and their specific requirements.

Recommendation 8: The above Recommendations are intended to further enhance and improve the widely acknowledged excellent work performed by the IERS.

Topic 2 - Astronomical reference frames

Executive summary of recommendations

IERS tasks

To monitor the evolution in time of the instantaneous positions and motions of the equinox and ecliptic and, in particular, to provide for planetary ephemerides, the mean ecliptic and equinox in the ICRS system.

- a - To provide the maintenance of ICRF; this includes promoting and coordinating observations, monitoring source structures and updating the catalogue.
- b - To assess the accuracy with which the main astrometric catalogues in various wavelengths represent ICRS and monitor the evolution of the links. This task is primarily to be performed on the Hipparcos Catalogue as the primary optical reference frame.
- c - To monitor the evolution in time of the instantaneous positions and motions of the equinox and ecliptic and, in particular, to provide for planetary ephemerides, the mean ecliptic and equinox in the ICRS system.
- d - To assist in the collection and distribution of observations of millisecond pulsars.
- e - For these tasks, IERS will be assisted by a Consultative Group appointed by the IAU.

In addition, Topic 2 supports recommendation 6 of Topic 1 stating that the IERS Conventions should be consistent with the IAU resolutions on reference systems (at present, the IAU and IUGG resolutions adopted in 1991).

Topic 3 - Vertical References

Recommendation 1: Considering the critical contribution of IERS for vertical reference issues by defining and realizing primarily the International Terrestrial Reference System (ITRS), we recommend IERS

- to propose IAG to establish a joint working group between its Commission X (networks) and its Commission XII (geoid) on the consistent utilization of space geodetic heights, geoid models and leveling to obtain a unified vertical datum;
- to appoint an IERS representative in this WG;
- to suggest IAG to invite also a IAPSO representative for tide gauge issues.

Recommendation 2: Considering the various problems related to the realization of a proper geodetic fixing of tide gauges and the necessity to fully exploit the improving quality of the vertical component of the ITRF and its densifications, such as the IGS one, we recommend

- that the IAPSO/IAG Working group on Geodetic fixing of tide gauges be asked to prepare technical specifications on these issues;
- that this WG would ensure that these specifications be prepared with the contribution of several geodetic experts in this field.

Recommendation 3: We recommend that an IAG CSTG group deal with various topics with potential impact on IERS in a near future. We have specifically identified two subjects of this kind:

- a) the use of ground based atomic clocks as sensors of the geopotential and consequently ask the FRCN group to include a representative of this community;
- b) the definition and realization of a pilot experiment to detect some geophysical signals from a specific subnetwork of ITRF stations. IERS should draft such a proposal and submit it to the group. This experiment should include:
 - a global design of this subnet taking into account the individual quality of sites and the structure of expected signals,
 - a small group of scientifically interested persons who would take part to this design and to the analysis of results (we can mention postglacial rebound, tidal effects...),
 - a procedure to guarantee that the participating stations will accept to apply the established specifications, in particular concerning some monitoring issues to be defined in more details (local surveys, evaluation of the stability of the instruments and monuments...).

Recommendation 4: Considering the present day capability of several IERS techniques to monitor the motion of the geocenter, we recommend

- a) to support strongly the proposal to launch a pilot experiment on this issue as announced by the WG on ITRF datum;
- b) to obtain as soon as possible geophysical estimated of this motion for the following contributions:
 - atmosphere,
 - tides,
 - oceanic circulation.

The existing or new relevant IERS Sub-bureaux should take this action

Topic 4 - Crustal Deformations

Recommendation 1: The IERS should make a strong effort to promote the collocation of observations, accurate local survey and continued (re)observations at the TRF sites in order to strengthen the ITRF.

Recommendation 2: The IERS should encourage the analysis centres to provide time series of ITRF site positions and make this information available through the IERS Web site.

Recommendation 3: The IERS should encourage the Analysis Centers to report deviating behavior of ITRF sites at the 5 sigma level or above, and to attempt to identify the cause of such behavior. IERS should make such information available on the IERS Web site.

Topic 5 - Unification of national datums

Recommendation 1: Provide a consistent global reference frame, and transformations between ITRF solutions, based on a homogeneously distributed network of stations at the highest possible level of accuracy.

Recommendation 2 : Maintain the coordinates and velocities of a homogeneously distributed global network of accurate permanent stations, and parameters, so that any agency can undertake a national ITRF based datum.

Recommendation 2 : Encourage national agencies to establish their precise national datums within ITRF so that these datums can be linked into regional or continental solutions.

Topic 6 - Global geophysical fluids

Recommendation 1 : We recommend that the IERS DB strengthen the present Sub-bureau for AAM. The IERS should be aware that this Sub-bureau could be enlarged sometime in the future.

Recommendation 2 : We recommend that the IERS DB start the procedure for creating a WG to evaluate the existing ocean tide models, working towards recommending an IERS standard which includes parameters related to Earth orientation, gravity, geocenter motion, and other parameters of interest to IERS.

Recommendation 3 : We recommend that the IERS DB request that the IAG SSG5.173 investigate the status of global ocean models related to Earth orientation, gravity, geocenter motion, and other parameters of interest to IERS. We recommend that the IERS DB asks this SSG to investigate the possibility to introduce a specific algorithm within the existing ocean models to compute EOP, gravity and geocenter motion.

Recommendation 4 : We recommend that the IERS DB encourages the CC for space geodesy techniques to archive and make available water vapour estimates.

Recommendation 5: The IERS DB should expect that, in the long term, the global hydrological cycles will be part of the global climate models.

Recommendation 6: We recommend that the IERS DB encourages the establishment of contact with the SEDI community for getting core parameters relevant to Earth's rotation.

Recommendation 7: After the IERS DB accepts these recommendations, they should be publicized in the literature such as a paper in EOS.