



INTERNATIONAL EARTH ROTATION SERVICE (IERS)
SERVICE INTERNATIONAL DE LA ROTATION TERRESTRE
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REPORT ON THE IERS DIRECTING BOARD MEETING No 23

Wednesday 10 December 1997, 14:00 - 18:30
at San Francisco Moscone Center
in conjunction with the 1997 AGU Fall meeting

Attendance: C. Reigber (Chairman), C. Boucher, M. Feissel, D. Gambis, B. Kolaczek, C. Ma, D. McCarthy, B. Melbourne, D. Salstein, B. Schutz, P. Shelus, P. Willis.

Invitee: J. Ray.

CHANGE OF DIRECTOR OF THE CENTRAL BUREAU

The President of the French National Scientific Council of the IERS Central Bureau, François Barlier, informed the Chairman of the IERS Directing Board that the director of the Central Bureau since the creation of IERS (1 Jan 1988), Martine Feissel, is resigning from this function on 31 December 1997. As of 1 January 1998 she will be replaced by Daniel Gambis, also an Astronomer at Paris Observatory. The former and new directors have committed themselves to ensure a smooth transition of tasks and services.

C. Reigber regretted that the announcement was made late. He remarked that indeed a service cannot be dependent on an individual. However, he will write to Paris Observatory to request that M. Feissel ensure an overlap of the Secretariat of the Directing Board by remaining in this function until the 1998 IERS Workshop (September-October 1998). He recommended that the transition for the Central Bureau directorship should be quick and smooth.

M. Feissel described the current institutional and scientific environment of the Central Bureau. It is operated by Institut Géographique National (IGN) for the ITRF Section, and by Paris Observatory (OPA) for the Coordination of the Central Bureau activities, the Earth Orientation Section and the ICRS Section, with additional support of Centre National d'Études Spatiales (CNES) and Centre National de la Recherche Scientifique (CNRS). The Central Bureau is also a project of the Groupe de Recherches de Géodésie Spatiale (GRGS). Its activities are examined yearly by a National Scientific Council set up by the GRGS. In the last ten years the Central Bureau got four new positions (scientific and technical), and during 1997 four experienced scientists volunteered to start a participation in the Central Bureau activities. When M. Feissel announced she would resign at the end of 1997, discussions took place at different levels: the Central Bureau Sections, the Paris Observatory and the National Scientific Council. D. Gambis decided to be candidate for the position of director of the Central Bureau, after consultation of the Central Bureau staff and researchers willing to cooperate. He met with strong willingness of these individuals to continue the tasks of the service. The Paris Observatory stated again its intent to support this activity.

D. Gambis presented his plans for the Central Bureau. In the program he presented to the french national Council, he expressed his commitment to ensure the continuity of the activities of the Service: publications, technical notes, annual reports and the various Bulletins linked to the Earth Rotation activity. It is still obvious that the activities of the Central Bureau should not be restricted to a mere center for administration and publication but should keep and develop a high scientific activity. The present structure of the Central Bureau under the three sections, terrestrial, celestial and Earth Orientation seems so far adequate according to the discussions he had with C. Boucher and F. Arias.

The study and the improvement of the consistency between the terrestrial and the celestial reference frames through the Earth Orientation system remains a specific task of the Central Bureau in the continuation of the efforts of M. Feissel since the beginning of IERS in 1988. G. Petit of BIPM is interested to cooperate.

The Earth Orientation Section should be slightly reorganized with the involvement of an engineer, C. Mercuri in charge of different aspects linked to development. There are good prospects to obtain C. Bizouard in a permanent position. He completed his PhD with N. Capitaine and is now in a post-doc position in the Center for Space Research in Warsaw. He expects to join this section and act as the liaison member with the MGGF Coordinating Centre at the Central Bureau.

In order to face the new activities linked to the maintenance of the ICRF, there will be a re-organization; F. Arias has reaffirmed her willingness to continue her work in the Celestial System section. J. Souchay will progressively be involved in the section with the objective to take more responsibility in the future.

Other activities include monitoring radio sources structures with the cooperation of P. Charlot who recently moved to Bordeaux Observatory, contributions to the nutation models giving the mean celestial pole with respect to the ICRS by N. Capitaine and J. Souchay, and study of the link of the dynamical system to ICRF by J. and M. Chapront.

The ICRS was adopted as the reference celestial system at the last IAU meeting in Kyoto. It was recommended that IERS should be responsible of the maintenance of the VLBI realization of this system: the ICRF. An IAU working group was created at the IAU meeting to study the implications of the adoption of the ICRS. It is chaired by F. Mignard. The Celestial System Section of the Central Bureau that has been working on these aspects for several years wishes to continue this activity.

C. Boucher confirmed his willingness to continue, with his group, the ITRF work with the Central Bureau. He mentioned that the current organisation of the Central Bureau might be questioned and suggested that the supporting institutions be asked to redefine their implication.

After some exchange of information on the national support to the Central Bureau and a discussion of the need for continuity and the quality of results as well as long term commitment, it was decided that the Chairman of the IERS would visit the French supporting institutions to discuss these aspects.

ACTIONS SINCE LAST MEETING (September 1997)

UT nomenclature. With the increasing role of satellite geodetic determinations of Earth spin angles or angle rates that are related to universal time, such as length of day (LOD) or orientation angle referred to the satellite orbit, the Directing Board decided to recall some basic characteristics of these UT-like arguments and to recommend a non-ambiguous nomenclature. These are to be published in IERS Gazette No 27 and reproduced in the appropriate IERS publications.

The IERS recommendations are as follows.

- The designation "UT1" is to be reserved exclusively for those measurements which are referred to a celestial reference system that has no rotational speed relative to the ICRS, in particular VLBI observations of extragalactic compact radio sources.
- The UT-like quantity derived by satellite techniques, directly or from the integration of length of day measurements should be referred to generically as "UT ", but not as "UT1".

- When using time series of satellite-derived determinations of UT in conjunction with series of UT1, one should take proper account of the fact that their errors are highly correlated in time and therefore the measurements should not be modelled as temporally independent.
- In all IERS publications, tables which display UT1 and/or UT quantities will have appropriate column headings. Tables which display UT results will be accompanied by a notation which briefly explains the distinction from UT1.

El Niño analysis campaign. D. Salstein has issued a call for investigations of interactions between El Niño/Southern Oscillation and Earth rotation variations (IERS Gazette No 21, 30 Sept 1997), asking that observers of geophysical fluids (atmosphere and ocean) and of the various techniques for Earth rotation/polar motion consider the details of their products keeping in mind the analysis and possible forecast of the geodetic impacts of El Niño, especially for the recent and current El Niño events. Discussions of this topic will be included at the 1998 AGU Spring Meeting and at the 1998 IERS Workshop.

Relationship with CSTG. The activities of IAG Commission VIII, Coordination of Space Techniques for Geodesy (CSTG) have a natural interaction with those of IERS. This is particularly illustrated by two current projects on space geodesy sites and on the reorganization of the laser ranging activities. In such projects, be they joint or parallel, the IERS Directing Board is responsible for evaluating the state of fulfillment of the IERS missions. Until now, the coordination between CSTG and IERS has been satisfactorily ensured for the two above-mentioned projects, although no formal relationship has existed. Concerning the third program, the Combination of Space Geodetic Analysis Sub-commission activities, the coordination is not as yet necessary. Considering the importance of an efficient and unambiguous relationship between the two bodies, the IERS Directing Board at its meeting of 4 September 1997 in Rio decided to request that an IERS representative be invited for the CSTG Executive Committee meetings in the future. In response to a letter sent by C. Reigber, G. Beutler, the President of CSTG, agreed that C. Boucher be considered as the IERS representative to the CSTG Executive Committee from now as an immediate measure. A more formal relationship could be established at the 1999 IAG General Assembly. As a reciprocal measure, the Directing Board agreed that a CSTG representative be invited to their meetings whenever necessary.

STATUS OF ITRF96

ITRF96 is released. It provides positions for over 500 stations in 290 sites and velocities for all sites. Its datum is that of ITRF94 (14-parameter null transformation between ITRF94 and ITRF96). The combination of techniques is based on 55 colocation sites (33 with two techniques, 20 with three and 5 with four). The best level reached in positional 3-D precision is better than 1 cm for VLBI and GPS, around 1 cm for SLR and 3 cm for DORIS. The best velocity 3-D precision are 2mm/year for SLR and VLBI, 4 mm/year for GPS and 8 mm/year for DORIS. The largest discrepancies (excepting two outliers) between the origins and scales of the individual terrestrial reference frames are respectively 4 cm and $4 \cdot 10^{-9}$. ITRF96 is made available via WWW and ftp under several forms to meet the various users' needs.

The annual series of ITRF will be continued. Improved specifications for the submissions will be prepared with the help of the WG on ITRF Datum and based on discussions with the Analysis Centres. The collection of individual solutions is planned to take place before June 1998.

In cooperation with the CSTG sub-commission on space geodesy sites (J. Bosworth), it is planned to collect local surveys at colocation sites in the SINEX format, i. e. with their full variance-covariance matrices. In parallel, the analysis of time series of terrestrial reference frames that started at the ITRF Section during the geocenter motion campaign will be continued in a research mode, in cooperation with some analysis centres.

GEOCENTER MOTION CAMPAIGN

C. Boucher and J. Ray chaired the AGU sessions on "Investigations of Geocenter Motions" with oral papers Tuesday morning (9 Dec.) and posters on Wednesday, both of which were well attended and well received. The overall impression of the work presented is that the net motion of the terrestrial reference frame relative to the Earth's center of mass is detectable but small, probably no more than about 1 cm in any component. The diurnal and semidiurnal tidal variations appear to be well determined and in agreement with modern ocean tidal models. There seems to be some general agreement among the techniques in detecting seasonal variations, although more work remains to be done in this area. Geophysical computations of the expected motions based on global fluid motions are only roughly consistent with the observations.

The IERS Working Group on the ITRF Datum, which has sponsored the Geocenter Campaign, met over lunch following the Tuesday session. It was agreed that a tidal model for the diurnal and semidiurnal geocenter motions should be attainable based on recently developed ocean tide models. A model should be adopted and recommended in the IERS Conventions. For most users this could be accomplished with no additional effort by including the effect with the ocean loading model, as suggested by H-G. Scherneck (Onsala Obs.). Since the satellite techniques do not yet seem capable of measuring higher frequency variations reliably, an empirical seasonal model for these will be developed based on the data analyses now available. It is likely that a weighted combination, similar to that presented by H. Montag (Dessau), will be used for this. The combination will be performed by the TRF section at IGN. The ITRF WG also agreed to collect contributions from the campaign for an IERS Technical Note, to be completed by the 1998 IERS Workshop.

Future geocenter monitoring can be continued in two ways. The new IERS Coordinating Centre for Monitoring Global Geodynamical Fluids (MGGF) will have a special bureau devoted to computing offsets of the ITRF origin from the geocenter due to large-scale fluid motions. Also, the ITRF section will soon begin to compute monthly realizations of the terrestrial frame which can be used to assess the usefulness of the space geodetic data for this task. When higher frequency geocenter motions appear feasible the situation can be reassessed.

DECISION ON PARTICIPATION IN MONITORING OF GLOBAL GEOPHYSICAL FLUIDS (MGGF)

The review of the proposals received for the various functions was prepared by C. Reigber and M. Feissel, who consulted the following referees: G. Balmino, P. Brosche, V. Dehant, M. Eubanks, H. Jochmann, C. Le Provost, J. Wuensch. C. Reigber visited the groups at JPL and GSFC and received detailed information on the plans of the two groups. As was anticipated, the ocean centre topic proved to be the most difficult one to resolve. Both the JPL and the AER-NCAR proposals have strong merits with respect to the IERS needs. The hope was expressed that the two groups could establish a strong cooperation. The new MGGF coordinator will be requested to help in this process.

The Directing Board decided on the organisation of MGGF activities as listed below. The MGGF Coordinating Centre representative is a member of the Directing Board starting with 1 January 1998. The selected groups will be requested to prepare for the 1998 IERS Workshop (28 Sep-2 Oct 1998) a presentation of their way of organisation, methods, plans and first achievements.

Coordinating Centre

GSFC Laboratory for Terrestrial Physics (LTP)

Head: B. Chao
Contact: chao@denali.gsfc.nasa.gov

Special Bureaus

Atmosphere

Head: D. Salstein
Contact: salstein@aer.com

Atmospheric and Environmental Research (AER: D. Salstein)
National Centers for Environmental Prediction (NCEP: A.J. Miller)

Ocean

Cooperation between the following groups, to be established

- a) Jet Propulsion Laboratory (JPL: R. Gross)
- b) Atmospheric and Environmental Research (AER: R. Ponte)
National Center for Atmospheric Research (NCAR: F.O. Bryan)

Ocean tides

Head: B. Chao

GSFC Laboratory for Terrestrial Physics (LTP)

Continental Hydrology

Head: B. Chao

GSFC Laboratory for Terrestrial Physics (LTP)

Mantle Fluid Variations

Head: B. Chao

GSFC Laboratory for Terrestrial Physics (LTP)

Core

Head: V. Dehant
Contact: veronique.dehant@oma.be

Royal Observatory of Belgium (ROB: V. Dehant)
Institut de Physique du Globe de Paris (IPGP: M. Lefftz-Greff)
Ecole et Observatoire de Physique du Globe de Strasbourg (EOPGS: H. Legros)
Laboratoire de Geophysique Interne et Tectonophysique (LGIT: D. Jault)

Geocenter and Gravitational Field

Head: M. Watkins
Contact: mmw@cobra.jpl.nasa.gov

Jet Propulsion Laboratory (JPL: M. Watkins)
Center for Space Research (CSR: R. Eanes)

PLANS OF THE VLBI COORDINATOR (C. Ma)

The VLBI coordinating centre (NEOS) has prepared a proposal for the maintenance of the ICRF. Since the IAU has adopted the VLBI realization of the celestial reference frame at the Kyoto General Assembly and since the IERS has been given the responsibility to maintain the frame, it is necessary to take some formal and practical steps to perform this task. The maintenance of the ICRF includes several aspects, for which NEOS makes the following proposals (summary of the document distributed). Comments of the DB members to C. Ma are due by 28 February 1998.

Observations. NEOS has obtained VLBA data, and will continue to propose future observations, for at least six sessions annually using the VLBA and northern Mark IV stations to support maintenance of the ICRF down to the southern limit of the network (about -40 degrees declination), with a schedule aimed at monitoring the current defining and candidate sources and the extension to several thousand new radio sources. NEOS will also schedule astrometric sessions using northern and southern stations to observe sources in the southern hemisphere.

Refinement of non-defining source positions. NEOS will continue to analyze all available dual-frequency VLBI data and will encourage other VLBI analysis centres to continue similar work. Recommendations for any future revisions of the ICRF will be coordinated with the IAU Working Group of the International Celestial Reference System.

Extension to new sources. The existing ICRF solution will be incremented with data containing new sources to produce positions consistent with the ICRF, similar to solutions to refine non-defining source positions.

Maps and images. NEOS will continue conducting a program to image the structure of ICRF radio sources. In addition to their intrinsic scientific value, these data will, over time, track source structure changes allowing an assessment of the stability of the ICRF sources and, more importantly, allow us to alert users to potential problem sources.

Analysis improvements. Notwithstanding the deliberately slow pace of formal changes in the ICRF, NEOS will investigate improvements in data analysis including better troposphere modeling, data weighting, treatment of anomalous position variation, selection criteria, application of source structure corrections, and other effects. NEOS will cooperate closely with other analysis centres in its R&D efforts. Continued annual CRF solutions will be encouraged for analysis and comparison by the ICRS section of the IERS Central Bureau as well as other comparisons among interested parties, such as the IAU Working Group, in order to identify peculiarities and to improve the overall quality of the ICRF. A series of electronic newsletter will be initiated.

Distribution of results. For distribution of the ICRF catalogue and extensions to users, NEOS will maintain a Web site devoted to the ICRF.

PLANS OF THE ICRS SECTION OF THE CENTRAL BUREAU

As stated by D. Gambis, to better fulfill the needs expressed by the 1997 IAU Resolutions and the 1996 IERS Workshop Recommendations for the maintenance of the ICRF, a reorganization of the ICRS Section of the Central Bureau was decided and its plans were redefined. The ICRS Section intends to concentrate on the astrometric and statistic monitoring of the source coordinates in ICRS, by continuing analyses done in the past and initiating new studies. The main planned activities are:

- checking the stability of radio sources coordinates, either by comparing individual celestial reference frames produced by the VLBI Analysis Centres or by internal analysis using the Gloria software,
- updating the status of sources in ICRF, increasing the density of sources in the frame whenever new sources appear in the various VLBI observing programmes,
- monitoring radio-source structures and evaluating the structure indices,
- promoting observations and participating in analyses to increase the quality of the link between the ICRF and Hipparcos as well as the other optical catalogues. Extending this work to catalogues at other wavelengths (IRAS ...)
- studying the tie between the ICRS and the dynamical system, particularly the dynamical ecliptic and equinox. The use of millisecond pulsar observations (timing and differential VLBI) in addition to LLR observations to monitor the orientation of the planetary system in the ICRS is planned,
- monitoring the time evolution of the mean pole at J2000.0 in the ICRS,
- contributing to the computation of future issues of the ICRF, keeping the direction of ICRS axes.

NEW ORGANISATION IN LASER RANGING: IMPACT FOR IERS

The CSTG SLR/LLR Subcommittee has prepared Terms of Reference and a Working Group Charter for an International Laser Ranging Service (ILRS) following the IGS example. A joint IERS/CSTG Call for Proposals was prepared. It was presented by the SLR Coordinator (B. Schutz) for discussion by the Directing Board. Comments of the DB members to B. Schutz are due by 25 december 1997.

The primary objective of the ILRS is to provide a service to support, through Satellite and Lunar Laser tracking data and related products, geodetic and geophysical research activities. The ILRS collects, merges, archives and distributes SLR/LLR observation data sets to generate the following data products:

- Earth rotation parameters,
- coordinates and velocities of the ILRS tracking stations,
- geocentre coordinates,
- parameters of the Earth's gravity field,
- high accuracy satellite ephemerides,
- the determination of fundamental physical constants.

The ILRS accomplishes its mission through the following components:

Networks of Tracking Stations. ILRS Tracking Stations provide ranging data to a constellation of approved satellites (including the Moon). The stations must meet specified requirements.

Operational Centres. Their tasks include the collection and merging of data from the subnetworks, data quality checks, data reformatting, compression of data files if requested, maintenance of a local archive of the tracking data, and electronic transmission of data.

Data Centres and Archives. The Regional Data Centres collect reformatted tracking data from Operational Data Centres and/or individual tracking stations, maintain a local archive of the data received and transmit these data to the Global Data Centres.

Analysis Centres and Associate Analysis Centres. The Analysis Centres receive and process tracking data from the data centres for the purpose of producing ILRS products. The Analysis Centres are committed to produce the products, without interruption. The products are delivered to the Global Data Centres, to the IERS (as per bilateral agreements), and to other bodies, using designated standards. Associate Analysis Centres produce special products, such as satellite predictions, time bias information, precise orbits for special-purpose satellites, station coordinates and velocities within a certain geographic region, or scientific data products of a mission-specific nature.

Analysis and Lunar Coordinators. The Analysis and Lunar Coordinators serve as the respective technique Coordinators to the IERS. The Analysis Coordinator ensures that the ILRS products produced by the ILRS Analysis and Associate Analysis Centres conform with IERS requirements and standards.

Central Bureau. The Central Bureau (CB) is responsible for the general management of the ILRS consistent with the directives and policies set by the Governing Board. The primary functions of the CB are to facilitate communications between the ILRS and the external scientific community, coordinate ILRS activities, maintain a list of satellites approved for tracking support, establish and promote compliance to ILRS network standards, monitor network operations and quality assurance of data, maintain ILRS documentation, produce reports as required, and organize meetings and workshops.

Working Groups. Standing Working Groups carry out continuously evolving business of the ILRS. Ad-Hoc Working Groups carry out special investigations or tasks of a temporary nature. Currently, the Standing Working Groups are: Missions, Data Standards and Processing, Networks and Engineering, and Analysis.

IER S CONVENTIONS EDITORIAL BOARD

The mission of the IERS Conventions Editorial Board were defined at the Rio meeting (see the Report on meeting # 22, 4 September 1997). D. McCarthy has invited the following individuals to be members of the Board: Nicole Capitaine, Véronique Dehant, Toshio Fukushima, Chris Jacobs, Chopo Ma, François Mignard, Gérard Petit, Pascal Willis. All of them have accepted. In addition, a group of contributors for the IERS Conventions (2000) is being set up, starting from those of the previous issues.

The Directing Board adopts the proposed composition of the Editorial Board, to be chaired by D. McCarthy.

ORGANIZATIONAL MATTERS

IER S flyer. The structure and organisation of the draft flyer prepared by M. Feissel are adopted. Updates of the contents should be provided quickly and the flyer printed.

1998 IERS Workshop. The IERS Directing Board has decided that the 1998 IERS Workshop will take place Monday 28 September 1998 through Friday 2 October 1998 at the GeoForschungsZentrum Potsdam (GFZ), Germany. It will have three parts, with separate conveners:

- Monday pm, Tuesday: Implementation of the ITRF.
- Wednesday: Combinations of data for IERS products.
- Thursday, Friday am: Monitoring Global Geophysical Fluids.

The program will be discussed at the April Directing Board meeting.

IER S organization. D. McCarthy presented briefly a plan for an IERS reorganisation for consideration by the DB members. The plan provides for a "bureau" to be associated with each of the main products of the service. Furthermore it provides for two coordinators (one for analysis and one for operations) to be associated with each of the contributing observational techniques. Finally it allows for special research projects which may or may not be temporary to be represented by a non-voting research coordinator. The IAU and IUGG representatives would complete the Directing Board. It was decided that D. McCarthy would circulate his plan for e-mail discussion.

Next meetings

- 19 or 20 April 1998 in Paris or Nice (EGS General Assembly)
- 2 October 1998 at GFZ Potsdam