



INTERNATIONAL EARTH ROTATION SERVICE (IERS)
SERVICE INTERNATIONAL DE LA ROTATION TERRESTRE

REPORT ON THE IERS DIRECTING BOARD MEETING No 18

Thursday 23 May 1996, 18:00 - 21:30 in Baltimore (USA)
in conjunction with the AGU Spring meeting

Attendance:

G. Beutler, C. Boucher, R. Eanes (for B. Schutz), B. Engen, M. Feissel (secretary), B. Kolaczek, C. Ma, D. McCarthy, C. Reigber (Chairman), D. Salstein, M. Watkins (for W. Melbourne), P. Willis, C. Wilson.

Note: as the attendance to the meeting included only three formal members of the Directing Board, the adoption of DORIS and VLBI participations mentioned in the report was decided after the meeting by the members in a vote by correspondence.

CENTRAL BUREAU REPORT ON ANNUAL ANALYSES

Following the invitation to submit results for the 1995 IERS Annual Report, 30 Analysis Centres from 12 countries submitted solutions in VLBI (seven centres), LLR four centres), GPS (four centres), SLR (nine centres), DORIS (three centres) and combination (three centres). The data sets received include 11 celestial reference frames, 27 terrestrial reference frames and 38 EOP series. Three new Analysis Centres contributed solutions: the Institute of Applied Astronomy, St Petersburg (VLBI), Centro di Geodesia Spaziale, Rome (SLR) and Institute for Applied Geodesy, Potsdam (SLR).

The analyses of both the terrestrial and celestial reference frames to be published in the 1995 Annual Report will refer to reference frames compiled in 1994: ITRF94 and RSC(WGRF) 95 R 01, which were presented at the DB No 17 meeting in December 1995. No new combined reference frame will be compiled for the Annual Report.

The Terrestrial Frame Section will prepare a conventional TRF (ITRFC1) based on the combination of a selection of monoteknique solutions provided under the SINEX format. The interactions with the analysis centres will take place by e-mail and will converge at the ITRF Workshop (9-10 September 1996 at Paris Observatory, see Annex). The working group on the ITRF datum definition will be reactivated, under the chairmanship of J. Ray.

The Celestial Frame Section works in close cooperation with the IAU Working Group on Reference Frames (WGRF). Its contribution to the IERS Annual Report will include the publication of the Celestial frame that was used to tie Hipparcos to the International Celestial Reference System, and analyses of the differences of the submitted individual reference frames with it.

The Earth Orientation Section will update the four basic EOP series on the basis of selected individual series and analyse the differences of all submitted series to the reference EOP series.

CONSISTENCY OF IERS EOP WITH ITRF

As a result of the independent maintenance of the IERS Terrestrial and Celestial Reference Frames and of the continuity of the EOP series that was recommended by the Directing Board in 1990 and 1995, the IERS EOP series provide the rotation angles between the ITRF and the ICRF with a small inconsistency. Based on the 1994 IERS Annual Report analyses, this inconsistency reaches 0.4 mas in x and UT1 and 1.2 mas in y in 1996, with a degradation rate of the order of 0.1 mas/year. The data used to predict these discrepancies are long term analyses by VLBI and SLR. GPS series of polar motion are still not long enough to contribute.

These quantities may create problems if ignored by users of EOP. To restore the consistency it is necessary to change the IERS EOP series. To minimize the inconvenience to users, one should

1. make a single change of bias and rate, and
2. re-publish all the past.

In addition, one should try to control better the rate of degradation with time. The differences in the time evolution of EOP and TRF solutions are not known to better than $\pm 0.1\text{-}2$ mas/year. Making progress on this effect would necessitate involvement of analysts from the various techniques.

Recall that the more complete relationship between GMST and GAST has to be adopted at the beginning of 1997. The difference in UT1 is an 18 year and a 9 year term, with a total amplitude of about 3 mas. This difference is negligible on 1997 January 1.

The Directing Board decides that both changes be made by IERS on 1997 January 1st, and that the complete past series of IERS EOP be recomputed and distributed. The final values of the change will be derived from the 1995 IERS Annual Report analyses, and widely advertised as soon as possible.

ADOPTION OF DORIS AS AN IERS TECHNIQUE

P. Willis reports on the probationary phase of DORIS operation in IERS that took place from 1 October 1994 through 30 November 1995.

The permanent tracking network is managed by the Institut Géographique National (IGN) and the Centre National d'Etudes Spatiales (CNES). It includes 51 stations evenly distributed over the globe, with 17 being colocated with at least one of the other IERS techniques. The network has a stable configuration. The data flow for IERS activities has been organized; two data centres, at NASA/CDDIS and IGN, give permanent access to the DORIS data of Spot-2, Spot-3 and Topex/Poseidon. The data archives are complete, except for some early Spot-2 ones which are planned to be retrieved from CNES. A total of 13.7 millions of observations are available. Complementary data and information are also made available (manoeuvres, station coordinates,...). About 30 users regularly extract observations from the data bases, for IERS and other uses. The distribution of an electronic newsletter was established in the spring of 1996, with already 35 subscribers. It includes reports on the life of the network, the data bases and the analyses.

The analyses for terrestrial frames applications showed repeatabilities of 7 cm for daily positions, 3 cm weekly and 1 cm monthly. Three analysis centres, CSR, GRGS and IGN, submitted global terrestrial frames for the ITRF94 computation. The global agreement of their results with the other techniques is at the 1-2 cm level. GRGS and IGN will in addition participate in the establishment of monthly time series of coordinates at the Terrestrial Frame Section of the Central Bureau. The first determinations of station velocities show a 0.98 correlation with NNR-NUVEL1A. Polar motion time series at one-day intervals based on the three satellites have an rms agreement of about 1.5 mas with the IERS series.

Planned future developments include some densification of the network to extend the number of IERS colocations, and in the equatorial region for ionospheric studies, and the decision of CNES to embark DORIS on Spot-4 (1998), Envisat (1999), Topex/Poseidon Follow On (1999) and Spot-5 (2001). Hardware improvements under study include multichannel receivers that would enhance the tracking capability, improved receivers and additional types of measurements (e.g. pseudo-ranges).

The Directing Board considers that the capability of the DORIS technique to provide useful data for IERS missions is now established, in particular for maintaining the stability of the ITRF. It decides to adopt it as an IERS technique, with IGN in charge of the Coordinating Centre (representative: Pascal Willis), and the following laboratories as participants.

Institute	Country	Data Centre	Operational/Scientific Analysis Centre		Coordinating Centre
CNES/SOD	France		x	x	
CSR	USA			x	
DUT	The Netherlands			x	
GRGS/CNES	France			x	
IGN	France	x		x	x
MCC	Russia			x	
NASA/CDDIS	USA	x			

VLBI PARTICIPATIONS IN IERS

The Call for Proposals for VLBI participations in IERS was sent to 68 addresses in 15 countries. 14 proposals were received, involving 15 countries, for technical development centres, stations, network centres, operational and scientific analysis centres, and for three Coordinating Centre. They are summarized hereafter

1. VLBI Coordinating Centre: National Earth Orientation Service (NEOS), USA. NEOS is a joint effort of NASA, NOAA and USNO
2. VLBI observations
The following institutes proposed to participate in the VLBI radio observations:
 - a) Onsala Space Observatory, Sweden
 - b) Geographical Survey Institute, Japan
incl. Kashima VLBI station
two transportable systems plus 3 additional (under construction)
 - c) JPL, USA (Deep Space Network)
 - d) Ny-Alesund, Space Geodetic Observatory
 - e) Geodetic Institute, Norwegian Mapping Authority
 - f) Paris Observatory, France (with European VLBI Network)
 - g) Forschungsgruppen Satellitengeodäsie (FGS), Germany
 - h) Shanghai Observatory (plus Urumqi)
 - i) Italian Space Agency (ASI/CGS), Matera, Italy

- j) USA
 - 1) Richmond, Hawaii, Alaska, Greenbank, Westford, Goddard
 - 2) Fortaleza, Hartebeesthoek, Hobart
- k) Geodetic Survey of Canada and ISIS, Canada
Stations Algonquin, Yellowknife
- l) IAA St. Petersburg
Svethoe, Zelenchuk in 1996, Badary in 1997
- m) Simeiz VLBI station, Ukraine

3. VLBI Network Operation Centres

- a) JPL
- b) National Astronomical Observatory, Japan
- c) FGS, Germany
- d) Shanghai Observatory, China
- e) NEOS, USA (Network Maintenance Centre)
- f) Geodetic Survey of Canada and ISIS, Canada
- g) IAA St. Petersburg (QUASAR Network)

4. VLBI Operational Analysis Centres

- a) JPL
- b) Paris Observatory
- c) NEOS, USA
- d) Geodetic Survey of Canada, ISIS + IAA St. Petersburg
- e) IAA St. Petersburg

5. VLBI Scientific Analysis Centres

- a) JPL
- b) Norwegian Defense Research Establishment
- c) National Astronomical Observatory, Japan
- d) Paris Observatory
- e) FGS, Germany
- f) Shanghai Observatory, China
- g) ASI/CGS, Matera, Italy
- h) NEOS, USA
- i) IAA, St. Petersburg
- j) MAO, Ukraine

6. VLBI Technical development Centres

- a) JPL
- b) Norwegian Defense Research Establishment
- c) Communications Research Laboratory, Japan
- d) NEOS, USA
- e) Geodetic Survey of Canada and ISIS, Canada
- f) Onsala Space Observatory, Sweden
- g) IAA, St. Petersburg

7. Correlator Facilities

- a) NEOS, USA
- b) FGS, Germany
- c) NAO, Japan
- d) GSC, ISIS, Canada

The Directing Board is pleased to note that the NEOS proposal is quite complete with respect to the fulfillment of the IERS goals. In addition, a number of proposals were received from groups and observing systems that are independent from the NEOS effort, some of which were not previously associated with the IERS use of VLBI. From the analysis of the proposals it is clear that, due to technical and national constraints, the coordination of some of these activities may require special adaptation actions.

The Directing Board considers that the proposed participations will allow the IERS to face its responsibilities for the maintenance of reference frames and monitoring of the Earth's orientation. It is pleased to accept NEOS as the IERS VLBI Coordinating Centre, with Chopo Ma as representative in the Directing Board, as well as the other proposals. The Chairman will send letters of acceptance to all proposers, asking them to develop a true international cooperation through the coordination by NEOS.

PREPARATION OF THE 1996 IERS WORKSHOP

The IERS Directing Board decided to review the service missions and organisation in order to enhance its provision of global references to space- and ground -based scientific projects. The 1996 IERS Workshop, to be held in Paris on 14-18 October, will be devoted to this review. The months between now and the Fall will be used for a careful preparation of the decisions, with the hope that some actions may be started following the Workshop. This may lead to the proposal of modifications to the organisation of IERS that would be discussed in August 1997 at the IAU General Assembly in Kyoto, and in September 1997 at the IAG General Meeting in Rio de Janeiro.

The future of IERS will be discussed under the following topics.

- 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

It is important that when considering possible new activities for IERS, that consideration be given to the coordination with neighbour projects or services, in particular the FAGS ones. One should identify needs of global references that are not presently met by existing organisations but that would benefit from the support of IERS.

The study prior to the Workshop should be based on the widest possible consultation, and on the other hand the Workshop attendance should be limited so that progress can be made from the discussions. For efficiency of discussions the position papers and recommendations should be available to the participants in advance of the meeting.

The Directing Board adopts the following schedule for the next year and a half.

- .1996 June 10. The Topic Coordinators send to C. Reigber a list of up to about three names of colleagues that they will ask to help them in the preparation of their report, and of up to five names of people to be invited to the Workshop.
- .1996 June 25. The invitations to attend the Workshop are sent out.
- .1996 June 30. General announcement that the study is started, giving list of topics and inviting everybody to send comments to the Topic Coordinators.
- .1996 Sept 15. The Topic Coordinators distribute their position papers, with recommendations for the evolution of IERS, to the list of Workshop attendants.
- .1996 Oct 14-16. IERS Workshop at Paris Observatory (see schedule in Appendix)
- .1996 Oct 18. The IERS/DB decides on new directions of service, to be started in test mode for a period of 6-8 months. These decisions will be based on the recommendations and the conclusions of the Workshop.
- .1996 Fall - 1997 Spring. Test period for new service activities.

- .1996 December. The six Topic position papers finalized on the basis of the Workshop, and the IERS/DB conclusions are published as an IERS Technical Note.
- .1997 June. The IERS/DB prepares a report on the new directions and the test period, to be presented at the IAU General Assembly in August 1997 in Kyoto (Japan) and at the General Meeting of IAG in September 1997 in Rio de Janeiro (Brasil).

ORGANISATIONAL MATTERS

C. Boucher replaces M. Feissel as the IERS representative on the IGS Governing Board, to reflect the major role of terrestrial frame issues in the cooperation of the two services.

A series of e-mailed IERS Gazette was started by the Central Bureau, open to IERS bodies, Corresponding members and other interested individuals, for dissemination of information concerning Terrestrial and Celestial reference frames, Earth orientation, related models and Conventions, etc. Contact: iers@obspm.fr. Editor: M. Feissel

Appendix. Topics and schedule of the 1996 IERS Workshop

TOPICS

1: Assessment of current missions. Topic Coordinators: G. Beutler, I. Mueller

Questions asked:

- Users of, requirements for, and access to the International Terrestrial Reference System.
- Users of, requirements for, and access to the International Celestial Reference System.
- Users of, requirements for, and access to Earth orientation information (universal time, polar motion, precession-nutation).
- Conventions: How often should conventions be updated? Does IERS want to produce and maintain software for users?
- How did the IERS structure (Directing Board, Coordinating Centres, Bureaux) work? How can it be improved? How to use it in the case when the IERS missions would be extended?

2: Astronomical reference frames. Topic Coordinators: J. Kovalevsky, M. Standish

Question asked:

- What should be the role of IERS in the future maintenance of the International Celestial Reference Frame, changes in radio source structure, dynamical reference frames, frames for other wavelengths, links between frames?

3: Vertical references, incl. geoid, sea level, etc. Topic Coordinators: C. Boucher, B. Carter

Questions asked:

- Should IERS make an effort to put tide gauges in the International Terrestrial Reference System?
- Does IERS want to maintain a geoid?
- Issues related to the geopotential
- Tidal variations and surface loadings
- Should IERS monitor the motion of the geocentre?

4: Topography and crustal deformations. Topic Coordinators: B. Engen, J.B. Minster

Questions asked:

- Does IERS want to coordinate the monitoring of crustal motion?
- Does IERS want to produce bulletins of abnormal station motions?

5: Unification of regional reference systems. Topic Coordinators: W. Augath, J. Manning

Question asked:

- What should be the role of IERS in unifying the national datums into the International Terrestrial Reference System?

6: Earth rotation dynamics and geophysical fluids. Topic Coordinators: V. Dehant, C. Wilson

Questions asked:

- Assessment of current mission: users of, requirements for, and access to the Atmospheric Angular Momentum.
- Possible mission extension: should IERS take some part in the coordination of the monitoring of global fluids (underground waters, ocean currents, core currents)?
- Geophysical monitoring pertaining to nutations.

Meetings - all at Paris Observatory:

1996 OCTOBER 7-11	Morning	Afternoon
Monday	free	IAU WGRF Meeting
Tuesday	IAU WGRF Meeting	IAU WGRF Meeting
Wednesday	free	ITRF Workshop
Thursday	ITRF Workshop	ITRF Workshop
Friday	EOP Techn. disc.	EOP Techn. disc.

1996 OCTOBER 14-18	Morning		Afternoon	
Monday	DB mtg	DB+Topic Coord.	Topic 1	Topic 2
Tuesday	Topic 3	Topic 4	Topic 5	Topic 6
Wednesday	--- group discussions ---		Gen. discus.	Conclusion
Thursday	CSTG(1)	CSTG(2)	CSTG(3)	CSTG(4)
Friday	CSTG(5)	CSTG(6)	DB+Topic Coord.	DB mtg