

COMMISSION 19: EARTH ROTATION (ROTATION DE LE TERRE)

President: B. Kolaczek
Vice-president: J. Vondrak

Organizing Committee:

N. Capitaine	Jin Wen-Jing	L. Morrison
J.O. Dickey	D.D. McCarthy	D. Robertson
S. Dickman	W.G. Melbourne	T. Sasao
M. Feissel	N.T. Mironov	P. Wilson

INTRODUCTION

In agreement with the adopted by the IAU rules the IAU Commission 19 had no scientific sessions at the XXII IAU GA and its activities during the XXII IAU GA dealt with:

1. The JD 19 Nutation (V. Dehant) organized by the IAU Commission 19 and supported by the Commissions 4,7,24,31.
2. The JD 8 Time Scales: State of the art (B. Guinot) organized by the IAU Commission 31 supported by the Commissions 4,7,8,19,40.
3. The JD 14 Towards the Establishment of the Astronomical Standards (T. Fukushima) organized by the Working Group: "Astronomical Standards" supported by Commissions 4,5,8,19,24,31.
4. The Symposium S166 Astronomical and Astrophysical Objectives of Sub-milliarsecond Optical Astrometry (J. Kovalevsky) organized by the Commission 24 supported by the Commissions 4,8,9,19,26,27,35,42, 44,45.
5. Discussions on the restructuring of the IAU organized by the IAU Executive Committee.
6. Business Session 1, August 19, Friday - 9.00 am
 - Report of the IAU Commission 19 (B. Kolaczek)
 - Report of the IERS (M. Feissel, Ya. Yatskiv)
 - Report of the IGS (G. Beutler)
 - Business matters of the Commission (Election of the new members of the Organizing Committee and of the Commission resolutions, IAU restructuring, Working Groups etc.).
7. Business Session 2, August 24, Wednesday - 11.00 am
 - Report of the IERS Sub-bureau for Rapid Earth Service and Prediction (D.D. McCarthy)
 - Report of the IERS Sub-bureau for Atmospheric Angular Momentum (D. Salstein (read by M. Feissel))
 - Report of the IAG SSG 5.143 on "Rapid Earth Orientation Variations" (J.O. Dickey)
 - Report of the IAU Commission 19 Working Group on "Earth Rotation in the Hipparcos Frames" (J. Vondrak)
 - Report of the Working Group on "Astronomical Standards" (T. Fukushima)
 - Report of the IERS Standards (D.D. McCarthy)
 - Business matters and discussions.

8. IERS Analyses Centers presented their reports on posters

The reviews of the JD's and the mentioned IAU Symposium No S166 are given in other parts of this volume.

In the results of the Business meetings of the IAU Commission 19 devoted to the business matters of our Commission, the new members of the Organizing Committee were elected, new members of the Commission were accepted, prolongation of works of the Working Groups of the Commission or supported by our Commission for the new term were supported. The list of the Organizing Committee, new members and Working Groups of the IAU Commission 19 in the new term 1994-1997 as well as two resolutions prepared by the IAU Commission 19 together with the JD 19 on Nutation are given at the end of this report.

Highlights of reports of the IAU Commission 19, the IERS with its sub-bureaus, the IGS, and Working Groups presented at the Business Sessions of our Commission were published in the Report of the IAU Commission 19 in the XXII IAU GA Astronomy Reports, 1994. It is worth to remind here the most important facts. In the last IAU term GPS technique was introduced to the routine practice of ERP determinations. Diurnal and semidiurnal oscillations of ERP were determined and deeply studied. The theoretical tidal model and the nutation theory for the rigid Earth were improved.

IGS. On the January 1, 1994 the official activity of the International GPS Service for Geodynamics (IGS) started, although the IGS Campaign Oversight Committee has been worked since 1991. The IGS cooperates closely with the IERS in determinations of ERP from the GPS data with resolution of 1 day and with accuracy of 0.3 mas and 0.03 mas for pole motion and LOD respectively. This cooperation deals with improvements of the IERS ITRF through determinations of coordinates of stations participating in the IGS solutions too. Accuracies of station coordinates are of the order of 3.5 mm in horizontal coordinates and about 10 mm in heights.

IERS. Ya. Yatskiv, the Chairman of the IERS Directing Board, outlined the activity of the IERS as the successor of the ILS/IPMS, and the BIH in determinations of Earth orientation but with almost two orders of magnitude higher accuracy. He said that the IERS for the first time established a worldwide centimeter terrestrial reference frame, a milliarcsecond extragalactic reference frame and a time series of Earth orientation parameters EOP of the submilliarcsecond accuracy. In these five EOP parameters determined by the IERS, two of them are terrestrial coordinates of the CEP (Celestial Ephemeris Pole), other two are celestial coordinates of the CEP and UT1-TAI. These EOP are those angles which transform ITRF into ICRF. In practice, the estimated inconsistency in the IERS results amounts 1-2 mas in 1993. The IERS DB decided that a reset of the IERS results be made in order to ensure an initial consistency better than 0.2 mas with a rate of a divergence smaller than 0.1 mas/year. In 1994, the IERS DB did not accept the method of this reset. The IERS DB decided that the concept expression of Greenwich Sidereal Time be adopted in 1997, when the 18.6 and 9.3 periodic terms in the expression are zero.

Ya. Yatskiv said that the interpretation of variations in the Earth orientation in terms of energetic processes and angular momentum transfer within the Earth-Moon system is a multidisciplinary scientific problem. The Earth is large mechanical system, which consists of four main constituents: solid mantle, atmosphere, oceans and core. In the last decade these EOP parameters have been applied to studies of atmospheric excitations of Earth rotation. The next decade is likely to offer increased applications of Earth rotation data to the study of ocean dynamics. The major research areas for the present decade is the subdaily

measurements of EOP, atmospheric excitation function and their interpretation. The introduction of GPS and in due time the DORIS techniques open the possibility of constructing combined sub-daily series of EOP.

M. Feissel, Chair of the IERS Central Bureau, summarizing the activities of the IERS CB showed a constant increase of the contribution of Analysis Centers. In 1994 there are 47 sets from 28 Analysis Centers. This increase is mainly due to the introduction of GPS to the IERS starting in 1992.

M. Feissel stated that the IERS Terrestrial Reference Frame includes in 1994 about 300 stations (VLBI, GPS, SLR) in 180 sites, with coordinates given in the IERS System within $\pm 1-3$ cm and velocities given within $\pm 0.1-5$ mm/year. The IERS Celestial Reference Frame includes 531 extragalactic objects, 250 of which have positions known within ± 0.25 mas in the IERS System. The direction of the axes of the conventional IAU Celestial System in the IERS System have been determined, using LLR and VLBI for the origin of right ascensions (in cooperation with JPL), and VLBI celestial pole offsets for the mean pole at J2000.0. These directions are known within ± 3 mas.

M. Feissel informed that the Earth Rotation Parameters are provided with various time resolutions (0.05 year, 5 days, 1 day) to fulfill various needs. The polar motion time series starts in 1846, UT1 in 1962 (its extension in the past is under study), celestial pole offsets in 1984. Their current precision is 0.3 mas. The series of EOP are consistent with the IERS reference frames within ± 0.1 mas at 1993.0, degrading by less than ± 0.1 mas/year.

D.D. McCarthy in his report on activities of the IERS Sub-bureau for Rapid Services and Predictions stressed the important role of GPS data in the improvement of the rapid service in the last period of time. Corrections of the main zonal tide components were derived and applied in practice.

D. Salstein in his report on activity of the Sub-bureau for Atmospheric Angular Momentum (read by M. Feissel) pointed out an increase of a global activity of the Sub-bureau, determination of the AAM data with a higher resolution (6 hours) and analyzing AAM data from 1959.

Working Groups. J.O. Dickey reporting activity of the IAG/IAU Special Study Group on Rapid Earth Orientation Variations stressed large activity of the Working Group in organizations of observational campaigns (GIG 91, SEARCH 92 and others) and analysis of their data. In these campaigns SLR, VLBI and GPS techniques participated and AAM data were computed with the 6 hours resolution. In the results of analyses of these observational data diurnal and semidiurnal oscillations of ERP were determined for a first time what allows to improve of theoretical tidal models.

J. Vondrak in the frame of his report of the activity of the Working Group on Earth Rotation in the Hipparcos Reference Frame informed about the collection of observational data of about 30 stations chosen for the astrometric ERP solution in the Hipparcos Reference Frame. He described the algorithms and showed the EOP determination results from this data in the system of the Hipparcos Input Catalog. Accuracies of determinations of x , y and UT1 are of the order of 10 mas and 1 ms after 1970 respectively. The accuracy of $\delta\psi$, $\delta\epsilon$ are smaller than 10 mas in this time.

The activities of the IAU Working Group on Astronomical Standards, chaired by T. Fukushima are described in details in the reports of JD 14 on Towards the Establishment of the Astronomical Standards.

LIST OF THE MEMBERS OF THE ORGANIZING COMMITTEE FOR 1994-1997

President	J. Vondrak
Vice President	D.D. McCarthy
Past President	B. Kolaczek
The representative of the IAG/IA WG 5.143	J.O. Dickey
The representative of the IERS	M. Feissel

Members:

F. Arias ¹	S. Yang Fumin ¹	D. Robertson ²
N. Capitaine ²	S. Manabe ¹	L. Rykhlova ¹
V. Dehant ¹	W. Melbourne ²	V. Tarady ¹
S. Dickman ²	L. Morrison ²	C. Veillet ¹
P. Wilson ²		

¹ First term, ² Second term

LIST OF NEW MEMBERS ADOPTED AT THE XXII IAU GENERAL ASSEMBLY

R.S. Gross	(USA)
J. Wunsch	(Germany)
M. Stavinschi	(Romania)
R.R. James	(USA)
I. Pesek	(Czech Republic)
J. Souchay	(France)

The list of consultants of the IAU Commission 19 was not changed.

LIST OF SERVICES AND WORKING GROUPS OF THE IAU COMMISSION 19 OR SUPPORTED BY IT

1. The International Earth Rotation Service - IERS
2. IAU/ IUGG Intercommission Working Group on Non-rigid Earth nutation theory (Commissions 4,7), (chairman: V. Dehant, Observatoire Royal de Belgique, Belgium) - new
3. IAG/IAU - Special Study Group on Rapid Earth Orientation Variations (chairman: J.O. Dickey, JPL, Pasadena, USA) - continuation
4. IAU Commission 19 Working Group on Earth rotation in Hipparcos Reference Frame (chairman: J. Vondrak, Astronomical Institute, Prague, Czech Republic) - continuation
5. IAU Intercommission Working Group on Astronomical Standards (Commissions 4,8,19,24,31), (chairman: T. Fukushima, National Astronomical Observatory, Tokyo, Japan) - continuation
6. IAU Intercommission Working Group on Reference Frames (Commissions 4,8,19,24,31 and IERS) (chairman: L.V. Morrison, Royal Greenwich Observatory, Cambridge U.K.) - continuation

RESOLUTIONS

The IAU Commission 19 initiated the following resolutions:

Resolution No B8 on a Joint WG of IAU and IUGG on Nonrigid Earth Nutation

proposed by JD No 19 and Commissions 4, 7 and 19

The XXIIInd General Assembly of the International Astronomical Union

Recognizing

1. that an accepted geophysical nutation theory for the non-rigid Earth with oceans and atmosphere, including all known effects at the one tenth milliarcsecond level, is not yet available and requires further study,
2. that the Earth's nutation observations provide useful information about the physics of the Earth's interior,

Establishes

an inter-commission Working Group on the non-rigid Earth Nutation Theory to be organized by the Presidents of Commissions 4,7,19, under the leadership of V.Dehaut and

Invites

the IUGG to the IAU in sponsoring this Working Group in order to form IAU/IUGG Joint Working Group on this topic.

Resolution C1 on Observations of the Offset of the Celestial Pole and on Empirical Nutation Model for Practical Use

The participants in JD No 19 between Commissions 4, 7, 19, 24 and 31 of the IAU

Recognizing

1. that there are requirements to relate the J2000-celestial ephemeris pole (CEP) as defined by the 1980 IAU Theory of Nutation to the International Earth Rotation Service (IERS) CEP at J2000,
2. that the IERS provides accurate estimates of the offsets between these two poles,
3. that Very Long Baseline Interferometry (VLBI) and Lunar Laser Ranging (LLR) observations used by the IERS provide the most accurate data;

and considering

1. that a long series of observational data is required to separate long-period nutations in longitude from precession, and long-period nutations in obliquity from obliquity rate, and to provide an improved estimate of precession, but
2. that there is an urgent need for an improved nutation numerical series for practical purposes;

urges

that observations of the offset of the celestial pole with respect to the pole defined by the 1980 IAU Theory of Nutation be made with the most precise techniques available including laser ranging to the Moon and very long baseline interferometry;

and asks

the International Earth Rotation Service to provide, an empirical model for corrections to the 1980 IAU Theory of Nutation to be used for a priori estimates of the celestial ephemeris pole offsets.

The Commission 19 supported the following resolutions:

Resolution No B11 on the continuation and extantion of the activities of the Working Group on Astronomical Standards (WGAS)

Resolution No C6 on the use of the 1976 System of Astronomical Constants

Resolution No C7 on the definition of J 2000.0 and Time Scales