COMMISSION 19: EARTH ROTATION (ROTATION DE LA TERRE)

1. INTRODUCTION

The work of Commission 19 in the period 1993.5–1996.5 was concentrated both on observational and theoretical aspects of Earth rotation, namely on the mutual interaction of the rotating non-rigid Earth with other Solar System bodies as well as with the atmosphere and fluids (oceans, underground water). The activities were closely tied with the work of the following bodies, supported or co-supported by the Commission:

- the International Earth Rotation Service (director of the Central Bureau: M. Feissel),
- the Commission 19 Working Group on Earth Rotation in the Hipparcos reference frame (chairperson: J. Vondrák),
- the intercommission Working Group on Astronomical Standards (chairperson: T. Fukushima),
- the intercommission Working Group on Reference Frames (chairperson: L. Morrison),
- the IAU/IUGG Working Group on the non-rigid Earth nutation theory (chairperson: V. Dehant),

individual observatories and members of the Commission. The description of all these activities follows.

2. REPORT OF THE INTERNATIONAL EARTH ROTATION SERVICE (IERS)

2.1. MISSIONS OF IERS

The International Earth Rotation Service (IERS) is a member of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS), created in 1988 by the IUGG and the IAU. It is in charge of providing basic reference frames to the international scientific community; it maintains a terrestrial and celestial reference frame, and monitors the Earth Orientation Parameters (EOP) which relate the two frames as a function of time.

The celestial reference system established by the IERS is in the process of being recommended by the IAU as the International Celestial Reference System (ICRS), replacing of the FK5 star catalogue. It is realized by the coordinates of extragalactic radio-sources included in the International Celestial Reference Frame (ICRF). IERS is in charge of its maintenance and of the link to other celestial reference frames. The Hipparcos catalogue and the Jet Propulsion Laboratory ephemerides are referred to the ICRS.

The terrestrial reference system established by the IERS is recommended by the IAG and the IUGG as the International Terrestrial Reference System (ITRS). It is realized by sets of station coordinates and velocities of sites included in the International Terrestrial Reference Frame (ITRF). IERS is in charge of its maintenance.

The Earth rotation and reference frame results compiled and distributed by IERS are accurate and precise at the level of ± 0.3 mas, corresponding to ± 1 cm on the surface of the Earth.

The irregular fluctuations in the rotation of the Earth on sub-decadal time scales are driven mostly by changes in the angular momentum of the atmosphere. Thus, knowledge of the state of the atmosphere is fundamental to understanding signals in Earth orientation. Consequently the IERS extends its activity to the monitoring of the atmospheric winds and pressures, through linkage with meteorological agencies.

IERS is involved in international time service activity. It is in charge of deciding the time of introducing leap seconds in UTC (Coordinated Universal Time) that will keep it within ± 0.9 seconds of UT1.

I. Appenzeller (ed.), Reports on Astronomy, Vol. XXIIIA, 81–96.

The scientific and operational work and the evolution of the IERS are controlled by its Directing Board. The latter met seven times in 1994–1996 and organized three Workshops in Paris, the 1994 one being joint with the International GPS Service for Geodynamics (IGS). 70–80 scientists who are experts in the various fields of activity of IERS are appointed as Corresponding Members; they participate in the permanent evaluation of the service.

2.2. OBSERVATIONS FOR IERS

The study of the Earth's rotation and the maintenance of the ICRF and ITRF is based on the coordinated use of the modern observational techniques. The observing effort involves Very Long Baseline radio Interferometry (VLBI), Lunar Laser Ranging (LLR), Global Positioning System (GPS), Satellite Laser Ranging (SLR) and DORIS (Doppler Orbit determination and Radiopositioning Integrated on Satellite), all based on worldwide networks totalling over 300 stations in 1996. The close cooperation with the IGS, a FAGS service created in 1994 by the IUGG, is of special importance. While the IERS expertise in reference frames and Earth rotation is fully available to IGS, the permanent IGS orbit determination activity provides, as a by-product, daily monitoring of a part of Earth orientation information (polar motion and high frequency variations of universal time), while its regional positioning activity provides results of high consistency for the densification of, and access to, the ITRF. The atmospheric data related to Earth-orientation variations from four major meteorological centres are collected, validated and made available by the Sub-Bureau for Atmospheric Angular Momentum.

2.3. STATUS OF IERS RESULTS IN 1996

The current IERS results can be summarized as follows:

- Celestial frame: 610 extragalactic objects observed by VLBI, including 212 definition sources that materialize the ICRS. About 2/3 of these objects have position accuracies smaller than 0.5 mas.
- Terrestrial frame: 240 sites with rms position uncertainties between 5 and 15 mm and velocity uncertainties of the order of 1 mm/year, determined by one or several of the five IERS techniques.
- Earth rotation: daily polar motion and UT1–UTC, correction to nutation and precession, all with an uncertainty of 0.2 mas.
- Accuracy of the tie of Earth rotation parameters with the celestial reference system (±0.03 mas) and the terrestrial reference system (±0.13 mas at 1993.0; ±0.05 mas/year).

2.3.1. *Celestial References for Astrophysics and Geodynamics*

The ICRS (Arias et al. 1996) has its origin at the barycentre of the solar system. The directions of its axes are fixed with respect to the quasars to better than ±10 microarcseconds; they are aligned with those of the FK5 within the uncertainty of the latter (±80 mas). It is realized by estimates of the coordinates of a set of quasars in the ICRF.

A Working Group on Reference Frames (WGRF), with the participation of IERS, was appointed by the IAU to accomplish the task of constructing the ICRF. The WGRF elaborated a celestial reference frame that contains J2000.0 VLBI equatorial coordinates of 610 extragalactic radio sources, based on radio

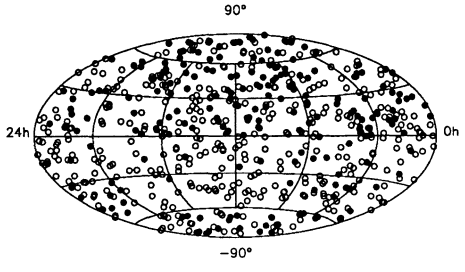

Figure 1. Sky distribution of the 610 sources in RSC(WGRF) 95 R 01. Filled circles represent the 212 defining sources.

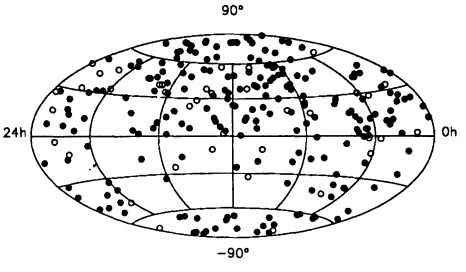

Figure 2. Sky distribution of the 253 sources in RSC(WGRF) 95 R 02. Filled circles represent the 195 defining-only sources, asterisks represent the 17 defining/link sources, circles represent the 41 link sources.