

## **International Earth Rotation and Reference Systems Service (IERS)**

<http://www.iers.org>

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### **Overview**

The International Earth Rotation and Reference Systems Service continued its operation as in previous years. It provided Earth orientation data, terrestrial and celestial reference frames, as well as geophysical fluids data to the scientific and other communities.

Earth orientation data have been issued on a daily, weekly, and monthly basis, and new global geophysical fluids data were added. Work on the next realization of the International Terrestrial Reference System and the work towards the Second International Celestial Reference Frame have nearly been finished. The IERS Conventions (i.e. standards etc.) have been updated regularly. A new edition of the Conventions is expected at the end of 2009.

The IERS continued to issue Annual Reports, Bulletins, and Newsletters. It held a Workshop on Conventions (September 2007) and organized a GGOS Unified Analysis Workshop and its follow-up meeting (December 2007 and April 2008).

The IERS Data and Information System (DIS) at the web site [www.iers.org](http://www.iers.org), maintained by the Central Bureau, has been updated, improved and enlarged continually. It presents information related to the IERS and the topics of Earth rotation and reference systems. As the central access point to all IERS products it provides tools for searching within the products (data and publications), to work with the products and to download them. The DIS provides also links to other servers, among these to about 20 web sites run by other IERS components.

### **Activities**

#### **Publications**

The following IERS publications and newsletters appeared between mid-2007 and 2009:

- IERS Annual Reports 2005 and 2006
- IERS Bulletin A, B, C, and D (weekly to half-yearly)
- IERS Messages Nos. 115 to 147

#### **Workshops**

The IERS organized the following Workshops:

- *Workshop on Conventions (Sèvres, France, September 20–21, 2007)*. The main conclusions of the workshop were among others the classification of models, the criteria for choosing models for conventional station displacements, the treatment of non-tidal loading effects, existing and proposed new models for S1/S2 atmospheric loading, the troposphere, a conventional model for the effect of ocean tides on geo-

potential, a model for diurnal and semidiurnal EOP variations, and recommendations for handling technique-dependent effects.

- *GGOS Unified Analysis Workshops (Monterey, CA, USA, December 5–7, 2007)*. It was intended to be a forum to exchange information and results and thus increase the common understanding of all the technique representatives for each of the individual techniques as they contribute to GGOS. The participants decided the following action items and recommendations: extension of the SINEX format for other parameter types and representations; tests on atmospheric loading: application on the observation or solution level?; generation of daily SINEX files (IVS Intensives and IGS Rapids); parameterisation and modelling for the next ITRF; benchmark tests for models common to several techniques; documentation of AC modelling standards and parameterisation; definition of meta data standards (e.g. SINEX meta data block).
- *GGOS Unified Analysis Workshop, Follow-Up Meeting (Vienna, Austria, April 15, 2008)*. The status of the action items from the previous workshop, SINEX issues, a proposal for reference pressure, and a common analysis description form were discussed.

Abstracts and presentations of these workshops are available at the IERS web site.

## Activities of the IERS components

### *Central components*

The *IERS Directing Board* (DB) met twice each year to decide on important matters of the Service like structural changes, overall strategy, creating working groups, launching projects, changing Terms of Reference, etc:

- Meeting No. 45 in San Francisco, December 11, 2007;
- No. 46 in Vienna, April 13, 2008;
- No. 47 in Washington D.C., October 27–28, 2008;
- No. 48 in Vienna, April 19, 2009;

Among the most important decisions made by the DB in 2007–2009 were the following:

- Terminate the present CRCs at the end of 2008.
- Revitalise the present GGFC Special Bureaus by new calls.
- Add a new Special Bureau for Propagation Delays.
- IERS will work for membership in the newly structured ICSU World Data System.

The *Central Bureau* coordinated the work of the Directing Board and the IERS in general, organized meetings and issued publications. It further developed the IERS Data and Information System based on modern technologies for internet-based exchange of data and information like the application of the extensible Markup Language (XML) and the generation and administration of ISO standardised meta data. The system provides general information on the structure and the components of the IERS and gives access to all products. A plot tool was developed and installed which allows visualizing some of the Earth orientation data provided by the IERS. The data include pole coordinates, UT1–UTC, LOD, and celestial pole offsets. For most IERS products, meta data according to ISO 19115 were produced as well as a pro-

posal for SINEX file meta data. The move to a new Content Management System is under construction.

The work of the *Analysis Coordinator* focused on coordinating the Combination Pilot Project, to prepare the GGOS Unified Analysis Workshop, and to propose a new version of the SINEX data format.

### *Technique Centres*

The Technique Centres are autonomous independent services, which cooperate with the IERS:

- *International GNSS Service (IGS)*
- *International Laser Ranging Service (ILRS)*
- *International VLBI Service for Geodesy and Astrometry (IVS)*
- *International DORIS Service (IDS)*

For the work of the Technique Centres, see their individual reports to IAG.

### *Product Centres*

The *Earth Orientation Centre* is responsible for monitoring of long-term earth orientation parameters, publications for time dissemination and leap second announcements. It issues IERS Bulletins B, C, and D and corresponding data files. An extended EOP Web Service was developed that offers the Earth orientation parameters and the Earth orientation matrix at a given date. The tool allows the computation of the excitation function of the Earth rotation and the comparison with the geophysical excitation functions. Since June 2007 a new IERS EOP reference series, IERS 05 C 04 consistent with ITRF2005 is available. A Technical Note to describe this series is being prepared. In May 2009, Bulletin B was revised following a survey which was made among the community.

The *Rapid Service/Prediction Centre* is responsible for providing Earth orientation parameters on a rapid turnaround basis, primarily for real-time-users and others needing the highest quality EOP information before the IERS final values are available. It issues IERS Bulletin A and corresponding data files. Further work has been dedicated to improvement of the centre's products. The system of the Bulletin A was changed to match the system of the new IERS 05 C 04 series. In January 2009, the centre moved its web site to a new address and changed its style considerably.

The *Convention Centre* prepared a large number of updates to the IERS Conventions (2003). A Conventions Workshop was held in September 2007 (see above) in preparation for a new registered edition, which is expected to be produced in 2009. The Centre maintains a web site including pages for the Conventions updates.

Involvement by *ICRS Centre* personnel in the celestial reference frame VLBI program has continued, increasing the number of observations of ICRF quasars in the southern celestial hemisphere and continuing an extensive observing program in the northern hemisphere. This observing program will eventually result in a new realization of the ICRS, tentatively called ICRF 2. A "Resolution on the Second Realization of the International Celestial Reference Frame" has been prepared for the IAU General Assembly in August 2009.

The *ITRS Centre* participated in complete surveys of some co-location sites, contributed to specifications for ITRF densification, developed the tools and methodology for generating the

ITRF from SINEX inputs from the various space geodesy techniques, and maintained the IERS network. The ITRS Centre, together with the ITRS Combination Centres, is planning to generate a new ITRF solution (ITRF2008, release Sept. 2009) and issued a Call for Participation in November 2008.

The *Global Geophysical Fluids Centre* (GGFC) currently consists of eight Special Bureaus (SB) for Atmosphere, Core, Gravity/Geocentre, Hydrology, Loading, Mantle, Oceans, and Tides. These provide data related to global geophysical fluids such as co-seismic excitation of Earth rotational and gravitational changes, glacial isostatic adjustment, core angular momentum changes, geocentre variations, oceanic tidal angular momentum, oceanic tidal variations in earth rotation, low-degree spherical harmonics of ocean and atmospheric tides, models for global oceanic angular momentum, models for oceanic centre-of-mass, a model for ocean bottom pressure, measurements of ocean bottom pressure, continental water storage and water flux, effective atmospheric angular momentum functions, spherical harmonic coefficients of surface pressure, global friction torque and global mountain torque, and Earth surface deformation due to surface mass loading. In May 2009 the IERS released a Call for Proposals, whose purpose is to restructure the GGFC. The structural changes are being instituted to 1) allow for the establishment of operational products, i.e., those products, which are provided with regularity and which have been evaluated as being reliable and precise; and to 2) allow for inclusion of new operational products.

#### *Combination Centres and Working Groups*

Nine *Combination Research Centres* (CRC) have been working on the development of methods and software for the combination of data and products from different techniques. The CRCs were terminated by December 31, 2008. They will be replaced by *Research Centres* which will be responsible for carrying out research on a specific subject, related to a corresponding Product Centre and limited to a term of 4–5 years. Three *ITRS Combination Centres* are responsible for providing ITRF products by combining ITRF inputs.

Areas of work of the *Working Group on Site Survey and Co-location* are standards and documentation (guidelines, survey reports, possibly store reports and data), coordination (share know-how and join efforts btw. survey teams), research (investigate discrepancies btw. space geodesy and tie vectors, alignment of tie vectors into a global frame), and cooperation. In 2009 the working group updated its Charter, changed the list of its members and presented a new schedule for work. The major task of the *Working Group on Combination* was the coordination of the IERS Combination Pilot Project. The working group was terminated by December 31, 2008. A new *Working Group on Combination at the Observation Level* is currently being established. The *Working Group on Prediction* was designed to build upon the foundation laid by the Prediction Comparison Campaign (PCC) and also investigate the new data sets from the Combination Pilot Project. The objectives of the PCC were the comparison of the various methods, models, techniques and strategies, which can be applied for EOP prediction with equal rules. In total 12 scientists participated with 20 prediction techniques in four categories: ultra short-term (10 days), short-term (30 days), medium term (500 days) and long term (20 years). The purpose of the *IERS/IVS Working Group on the Second Realization of the ICRF* is to generate the second realization of the ICRF from VLBI observations of extragalactic radio sources, consistent with the current realization of the ITRF and EOP data products.