


Recommended concepts and terminology related to Terrestrial Reference Systems.

Implication of IAU, IUGG, IAG and IERS

Claude Boucher
IAG Commission 1

IERS Convention Workshop,
Sevres 2007



Background

- New IAU activities and resolutions
- Recent IAG progresses
 - ⊙ IUGG resolution on ITRS at Perugia 2007
 - ⊙ WG on terminology in IAG Commission 1
- International GNSS Committee (IGC): establishment of a WG on geodetic references, proposed by IGS and BIPM



General comments on IERS Conventions

- Terms of reference (introduction ed 2003)
- Content of IERS Conventions
- Community involved
- Implementation of international resolutions

Terms of reference

- “to define standard reference systems realized by the International Earth Rotation Service (IERS) and the models and procedures used for this purpose”
- “All of the products of the IERS may be considered to be consistent with the description of this document. If contributors of the IERS do not fully comply with these guidelines, they will carefully identify the exceptions...”
- “The reference systems and procedures of the IERS are based on the resolutions of the international scientific unions.”

IERS Convention Workshop,
Sevres 2007



Current content of IERS Conventions

Description of :

- ⊙ **reference systems realized by IERS**
 - ⊙ **Correctly described**
- ⊙ **models used for this purpose**
 - ⊙ **Correctly described**
- ⊙ **procedures used for this purpose**
 - ⊙ **Poorly described**

Community involved

- IERS components
 - ⊙ *Fully implied*
- Technique centers
 - ⊙ IERS submission
 - ⊙ *Fully implied*
 - ⊙ Other activities :POD, specific missions (Jason, GRACE...)
 - ⊙ *Partially implied*
- Other geodetic activities (vertical, gravity...)
 - ⊙ *Not or marginally implied*



Implementation of international resolutions

- IAU resolutions

- IUGG/IAG resolutions

 - Perugia 2007: IUGG resolution on ITRS



IUGG resolution on ITRS (Perugia 2007)

The International Union of Geodesy and Geophysics

- Considering the increasing importance of geodetic reference systems in Geosciences, and more generally in numerous scientific or technical activities, such as satellite navigation systems or geo-information,
- Noting the IUGG Resolution 2 and IAG Resolution 1, both adopted in 1991 at the Vienna General Assembly, defining the Conventional Terrestrial Reference System (CTRS)
- Recognizing the quality of the work done by several IAG services (IERS, IGS, ILRS, IVS, IDS,...) to actually realize these systems and provide regular access for numerous users within and beyond the geoscience community,
- Endorses the definition of a **Geocentric Terrestrial Reference System (GTRS)** as a “System of geocentric space-time coordinates within the framework of General Relativity, co-rotating with the Earth and related to Geocentric Celestial Reference System by a spatial rotation which takes into account the Earth orientation Parameters”, in agreement with the IAU resolution B1.3 2000,
- Endorses the definition of the **International Terrestrial Reference System (ITRS)** as the specific GTRS for which the orientation is operationally maintained in continuity with past international agreements (so-called BIH orientation)
- Furthermore adopts the ITRS as preferred system for any scientific application and urges other communities such as geo-information, or navigation to do the same.

IERS Convention Workshop,

Sevres 2007



Need of a reorganization

- Need of general standards: IAG level
 - ◎ Role of GGOS?
 - ◎ Basic concepts and terminology related to Geodetic references (TRS, vertical, gravity, astronomic issues)
 - ◎ proposed WG in Commission 1
 - ◎ Publication in the JoG
 - ◎ Leading role of the IC community
- Confirmation or redefinition of the general content of the IC

Physical vs numerical levels

● Physical level

- ⊙ Physical models
- ⊙ Derived from accepted physical theories (Newtonian mechanics, General Relativity..)
- ⊙ Intrinsic equations and (local) coordinate systems

● Numerical level

- ⊙ Equations (eg observation equation relating measurements and input data to parameters of interest)
- ⊙ Estimation strategy (values and uncertainties)
- ⊙ Numerical models

Terrestrial Reference Systems

- TRS defined at the physical level
- Usual definition as affine frame or spatial part of relativistic coordinate system (see IAU and IUGG resolutions)
- Often called « frame » in litterature
 - ⊙ Either ignorance of the recommended term or use of the mathematical term
 - ⊙ Possibly a regrettable choice
 - ⊙ But used since 20 years!
- ITRS is at this level (IUGG resolution)

Terrestrial Reference Frames

- A definition at the physical level
 - ◎ Two usual types
 - ◎ Satellite ephemerides
 - ◎ Crust-based networks
 - ◎ For crust-based TRF, additional concepts
 - ◎ Regularized positions as instantaneous positions minus adopted model corrections
 - ◎ Definition of « datum » quantities (origin, scale and orientation)
- Parallel definitions at the numerical model

Conventions

- The IC should provide complete basic informations at the numerical model
 - ⊙ Needed for data analysis by technique and combination centers
 - ⊙ IERS products are numerical
 - ⊙ Needed by users to understand the products and how to use them
 - ⊙ ITRF is at this level
 - ⊙ Position papers by Jim Ray and Gerard Petit give details for this level
- What should be given in IC for the physical level?
 - ⊙ ITRS is at this level
 - ⊙ ITRF can be also considered at this level
 - ⊙ Need for some background understanding



Conclusions

- The IC Chapter 4 should be rewritten along these lines
- Definition of the amount of informations related to the physical level
 - ⊙ Ex: regularized position
- Expression of interest of the community to the WG on concepts and terminology: volunteers welcome!