GGOS Working Group on an ITRS ISO Standard

Activity Report (july 2009)

Claude Boucher
Chairman

The Working group was established by the GGOS SC14 (San Francisco december 2008) to investigate on interest and feasibility of an ISO standardization document related to ITRS.

Work Plan

The WG Work Plan is summarized by three main steps :

A) to identify and get all useful informations about existing standardization activities under the ISO umbrella which are somewhat linked to ITRS. One can also investigate, to some extend, standardization beyond ISO, either international bodies or even national agencies

B) to define various options to get an ISO document refering to ITRS

C) To write a report to GGOS, including recommendations

Members

Z Altamimi, F Arias, C Boucher, M Craymer, L Hothem, J Ihde, S Kenyon, H P Plag, B Richter

Web page

http ://www.iag-ggos.org/wgs/itrsstandard/

Activity Report

A) survey of existing standards

Up to now, three types of standardization documents has been identified:

- documents of the **ISO TC 211 "Geographical information-Geomatics"**

ISO TC 211

- Geographical information.Spatial referencing by coordinates (ISO 19111)

- documents of the **ISO TC 20 "Aircraft and Space Vehicles"**

ISO TC 20/SC 14

- Space systems. Reference coordinate systems
- Space systems. Orbit determination and estimation. Process for describing techniques

- documents related to the European **INSPIRE directive**

- INSPIRE Data specifications

B) options for a standard on ITRS

Considering the presently identified situations, the following options can be defined:

- to establish a new ISO Technical Committee on the topic

This option give full visibility to the topic but is probably hard to succeed, considering that most ISO members will consider this as too specific to be raised as a full independent committee

- to establish a new standard as a part of onr existing TC

This is a viable option but need to select the specific TC. Presently two potential candidates exist: TC 211 or TC 20. They are pro and contra for each, the first involving mostly national mapping agencies and GIS community, the second space agencies and navigation communities

- to establish a WG common to both ISO TC 211 and TC20

This is the preferred option which guarantees the widest support , potentially expandable to any community of practice (represented in a specific TC) which may be concerned by adopting a TRS. The horizontality of the subject is to be compared with units in metrology, and some contact has to be considered, considering in addition the recent recommendations of CIPM related to ITRS.

The French standardization agency (AFNOR) is performing a feasibility study of this option.

C) content of the standard

An other important issue is the overall description of the desired content of the standardization document related to ITRS. The main target is to include gereral informations on terminology, a definition of ITRS and an overview of the multiple realizations, including the primary one (ITRF), the regional densifications such as EUREF and the links with GNSS providers.

It is important the the content be approved by IAG and its main concerned services (IERS and IGS for instance). GGOS is therefore the natural forum to give this approbation to ISO.

Appendix : Background of the topic

The International Terrestrial Reference System (ITRS) is presently the recommended Terrestrial Reference System (TRS) for the whole geoscience community, through a resolution adopted by the International Union of Geodesy and Geophysics (IUGG) during its General Assembly of Perugia in 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.

Note:

This resolution upgrades the content of the IUGG Resolution 2 of 1991, by adopting the designation of GTRS in preference to the term of Conventional Terrestrial Reference System and by explicitly endorsing the ITRS as the unique preferred GTRS."

The ITRS is also recognized by the International Astronomical Union (IAU).

The fundamental realizations and access of ITRS are provided by several scientific services under the umbrella of the International Association of Geodesy (IAG), one of the member associations of IUGG.

The International Earth Rotation and Reference Systems Service (IERS) is, since its establishment in 1988, in charge of the primary realization of ITRS, by an optimal combined use

of space geodetic techniques. Several successive solutions were computed and released to the international community, labelled International Terrestrial Reference Frames: ITRFyy (ITRF88, up to the current ITRF2005).

Furthermore, each primary space geodetic technique is now organized in the frame of an international scientific service, also under the IAG : IVS for VLBI, ILRS for laser ranging, IDS for DORIS and IGS for GNSS (GPS, GLONASS and soon Galileo). Each of these services not only contributes to the IERS activities by providing input data, but also uses the IERS products to compute and release their own operational products. In particular, they use the ITRF solutions to express their products in the ITRS. This is true in particular for satellite orbits (expressed in the rotating terrestrial system). Such products are widely used by the geodetic and geophysical community, mostly for GPS, as provided by IGS.

These primary realizations are also densified and disseminated through regional, national and local terrestrial geodetic networks (permanent markers or active stations, such as GPS stations providing differential corrections). A wide coordination is ensured regionally by ad hoc committees, also under the IAG umbrella: EUREF for Europe, SNARF and CORS for North America, SIRGAS for South America…

Another community also provides realizations and accesses to ITRS, with a rapidly growing importance, namely the Satellite Navigation community (GPS, GLONASS, EGNOS, Galileo, …) commonly designated by GNSS. An upper lever coordination of this community (providers as well as users) is now existing through the International Committee for GNSS (ICG), linked to UN through the UN Office for Outer Space Afairs (UNOOSA), which provides the secretariat for ICG (see http://www.unoosa.org/oosa/SAP/gnss/icg.html).

Concerning the GNSS community, it is important to notice that USA and EU have formally recognized in their agreement about GPS and Galileo interoperability that the individual reference frame of each navigation system should be as close as possible realize the ITRS.

Although for instance, aerial navigation with ICAO, cartography with ICA, meteorological station coordinates with WMO, or hydrography with IHO have formally recognized and adopted WGS84. More precisely, it means that each of these organizations has adopted resolutions recommending the use of WGS84.

At this point, one must realize that the issue is only a wording issue: the WGS84 system designates a full set of geodetic standards, in which successive realizations of a unique TRS has been provided. The very initial one was based on Transit Doppler measurements, and used to be referred to the international TRS currently accepted in 1984, as defined by the Bureau International de l'Heure (BIH). This system is exactly the one which received the name of ITRS in 1988. Later the main WGS84 realizations were based on GPS, and the most recent solutions are in agreement with ITRF at a few centimetre level. To summarize, WGS84 products (as concerning TRS issues) must be considered as various realizations of ITRS. To name it WGS84, in place of ITRS, is confusing, and even wrong. It is satisfactory to see that the USA/EU document about GNSS used the word ITRS. Organizations such as ICAO, IHO or ICA should do the same, by modifying their past resolutions.

On the other hand, in Europe, the European Commission and EuroGeographics are adopting ETRS89, following the EUREF recommendations. Here, the issue is different: ETRS89 is a TRS which is not identical to ITRS but is defined exactly from ITRS by a mathematical formula. A clear understanding of these points is important, regarding in particular the adoption of the INSPIRE directive.