

3.4 Technique Centres

3.4.1 International GNSS Service (IGS)

The International Global Navigation Satellite System Service (IGS) is a federation of more than 200 organizations from around the world that operate a cooperative global infrastructure to provide the highest quality Global Navigation Satellite System (GNSS) data products for scientific users. The IGS is a service of the International Association of Geodesy (IAG), one of the associations of the International Union of Geodesy and Geophysics (IUGG). It is also a service of the World Data System of the International Council for Science (ICSU/WDS).

The IGS data products are openly available to all users. They include GNSS satellite ephemerides, Earth rotation parameters, global tracking station coordinates and velocities, satellite and tracking station clock information, zenith troposphere path delay estimates, and global ionosphere information. These products contribute to IERS objectives of realizing the International Terrestrial Reference Frame (ITRF) and monitoring Earth orientation parameters.

IGS Tracking Network Status

At the end of 2010, there were 424 GNSS tracking stations within the IGS network (Figure 1). Approximately 85% of these provide data on a weekly or more frequent basis and are included in IGS weekly combination solution.

The number of IGS stations co-located with other geodetic techniques has remained unchanged since 2009; 25 stations are collocated with VLBI, 37 with SLR, and 55 with DORIS. 221 IGS stations were used to compute the IGS08 reference frame. 179 were considered core stations because they exhibit long-term stable time series'.

Many IGS stations have multiple capabilities to support a range of applications. At the end of 2010, 121 stations deliver GLONASS data to support the generation of the IGS GLONASS orbit product. 134 stations are co-located with external high-precision frequency standards and are used in production of the IGS clock products. A subset of the network provides meteorological data used in the generation of the IGS troposphere product. Many IGS stations stream data in real-time to support the IGS Real-time Working Group activities, which is developing procedures and methodologies for delivering the IGS products on Real-time.

IGS Products Quality

The Analysis Centers have implemented a number of advancements in 2010 that have improved the quality of the IGS products. Table 1 gives an overview of the estimated quality of the IGS core products at the end of 2010.

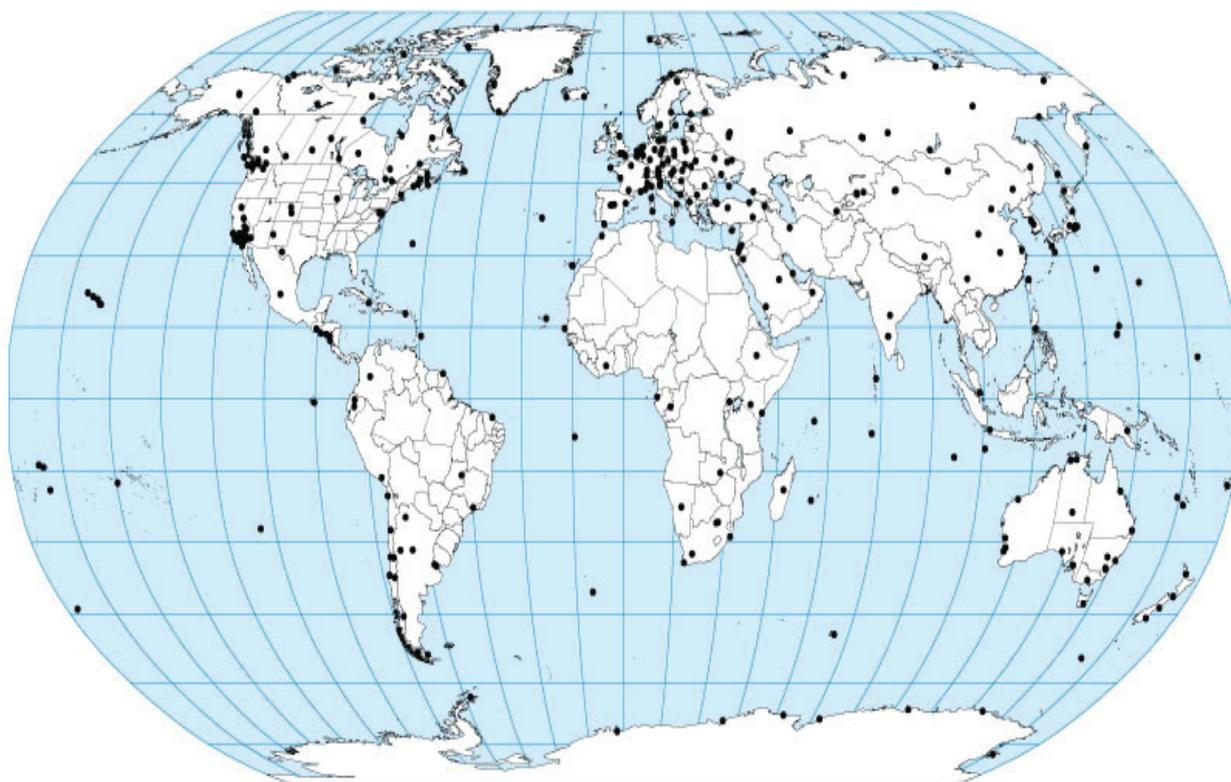


Fig. 1: IGS Global Tracking Network consisting of 424 GNSS stations as of December 2010.

Details related to the IGS products and enhancements implemented in 2010 are available on the IGS web site at <http://igs.org/components/compindex.html>. Various evaluations of the IGS product quality can be found in the Analysis Coordinator section of the IGS website at <http://acc.igs.org/>.

2010 Activity Summary

Repro1 Campaign

Details relating to the reprocessing campaign (Repro1, covering the period 1994–2007) are available online at <http://acc.igs.org/reprocess.html>. The combined SINEX orbit/clock solution was completed and posted for user access at the CDDIS Global Data

Table 1: Quality of the IGS core products at end of 2010.

Product	IGS Final	IGS Rapid	IGS Ultra Rapid	
			Adjusted	Predicted
Updates	Weekly	Daily	Every 6 h	Every 6 h
Delay	~13 days	17 hours	3 hours	Real-time
GPS Orbits	2.5 cm	3 cm	3 cm	5 cm
GPS Satellite Clocks	0.05 ns	0.1 ns	~0.2 ns	~3 ns
Station Clocks	0.05 ns	0.15 ns		
Polar Motion	0.03 mas	<0.04mas	0.2 mas	
LOD	0.02 ms/day	0.03 ms/day	0.03 ms/day	
Station Coordinates (h/v)	3 mm/6 mm			
GLONASS Orbits	~5 cm			

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Center. Long-term GNSS station stability, uncalibrated radome effects and site tie errors were identified as factors limiting the IGS reference frame products accuracy that should be urgently addressed. A number of analysis improvements identified in Re-pro1 are being carried forward as planning for Re-pro2 commences.

IGS08 Adoption The IGS08 definition was finalized, including the updated ground antenna model (igs08.atx), and circulated to Analysis Centers for their final comments. At year-end, preparations were in progress to implement IGS08 in early 2011.

Working Group Activities The IGS Working Groups responsible for the various IGS products have progressed in 2010:

- The TIGA Pilot Project has transitioned into the TIGA Working Group with introduction of an official IGS tide gauge product.
- A new Space Vehicle Orbit Dynamics Working Group has been formed to develop an advanced GNSS satellite force model for use within IGS.
- The Multi-GNSS Working Group activities are increasing in response to the Newcastle workshop recommendations. The WG is cooperating with the CONGO Network and JAXA/QZSS Demonstration Experiment to assemble a multi-GNSS data set for experimental use within IGS.
- The Real-time Working Group began producing a combined real-time orbit and clock product on an experimental basis. The RT WG is also pursuing establishment of standards for real-time GNSS messages in cooperation with the Radio Technical Commission for Maritime Services, Subcommittee on Differential GNSS (RTCM/SC104), which is the principal international standards organization for real-time GNSS services.
- The Antenna Working Group has compiled igs08.atx, updated the ANTEX format, and coordinated with calibration centers and GNSS manufacturers to include new calibrations within the IGS equipment definition files.
- The Ionosphere Working Group introduced a new predicted ionosphere product.
- The Data Center Working Group began implementation of daily data status summary files at all the Global Data Centers. The file summarizes the daily data holdings and extracts key metadata and data quality information from all files.

International Coordination and Outreach The IGS coordinates extensively with many external organizations to promote the IGS and develop relations with stakeholders around the world. 2010 was highlighted by coordination with projects involving multiple GNSS to develop cooperation in implementing new

GNSS signals within IGS. Also in 2010, IGS involvement in the International Committee on GNSS (ICG) was elevated to co-chair (along with the International Federation of Surveyors) of a newly formed task force on Reference Frames, Timing and Applications (formerly Working Group D).

- Governance** Significant governance items in 2010 include:
- Urs Hugentobler of TU Munich was elected Chairman of the Governing Board to replace John Dow whose term ended at the end of 2010.
 - The IGS Terms of Reference were fully reviewed and updated by the Governing Board to better reflect the current organization.
 - A new IGS Associates Committee was formed to review the Associate Membership.

Meetings IGS conducted the following meetings in 2010:

36 th Governing Board (GB)	Newcastle-upon-Tyne	27 June 2010
IGS Newcastle Workshop 2010	Newcastle-upon-Tyne	28 June – 2 July 2010
Closing 36 th GB	Newcastle-upon-Tyne	2 July 2010
37 th GB	San Francisco	12 Dec 2010

The next IGS Workshop will take place in 2012. The dates and location will be selected by early 2011.

Publications Many papers, articles and presentations relating to IGS were published or presented in 2010. A partial listing of these is posted online at <<http://tinyurl.com/IGS-bibli>>.

Summary The IGS has continued its delivery of high quality products to the IERS, which represent a significant contribution to the realization of the ITRF. The quality of the IGS results continue to improve. More information regarding the IGS and related activities can be found on the IGS Central Bureau website < <http://www.igs.org/>>.

*Steven Fisher
on behalf of all IGS participants
who supported this body of work*