DATA CENTER ACTIVITIES
2001-2002

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Background

The data flow supporting the International GPS Service (IGS) is structured in a distributed fashion, allowing for redundant flow and archive of data and products, and thus providing the international GPS user community with a robust data archiving system to support scientific research. The IGS utilizes a hierarchy of data centers to distribute data from the network of tracking stations: operational, regional, and global data centers. This scheme provides for efficient access and storage of GPS data, thus reducing network traffic, as well as a level of redundancy allowing for security of the data holdings. The structure has been a key aspect to the success of the IGS within the user community.

GPS data, in both daily and hourly observation, navigation, and meteorological data files, are available from the IGS regional and global data centers in compressed RINEX format. IGS products, such as precise orbits, station positions, and atmospheric parameters are also accessible through these data centers. Table 1 lists the data centers supporting the IGS in 2001 and 2002; information on how to contact these data centers is available through the IGS Central Bureau web site.

Highlights for 2001-2002 and Plans for 2003

General

The past two years were once again a busy time for the IGS data centers. The IGN global data center was upgraded and once again became a fully-operational archive supporting the IGS in mid-2002. The increased size of the network, both of sites producing daily data sets as well as those capable of generating hourly data sets challenged the capacities of global and regional data centers. The timeliness of the hourly data product continued to improve as various levels of the IGS infrastructure reviewed data transmission methods and implemented improvements. However, as the IGS moves more toward supporting near real-time activities, it has become clear that the data centers must take further steps to ensure the reliability of hourly data operations. In 2001 the data centers, CDDIS, IGN, SOPAC, and BKG established a global redundancy of hourly observation files by maintaining identical archives.

In April 2002, the IGS Governing Board approved the establishment of the IGS Data Center Working Group, formed to address data center issues. Among the topics to be addressed by this group are an effective data flow redundancy/backup plan, reliability, security and consistency at data centers, and timely archive and dissemination of data as the IGS moves into a real-time mode for selected products. Efforts will continue in these areas during 2003. A new database-driven

system is in development at BKG to manage its archive of regional GPS data and to generate dynamic web pages for user query of data holdings; the staff hopes to have this system operational in late 2003.

IGS Data

The archives of the IGS global data centers continued to expand in support of the global network. By the end of 2002, SOPAC archived data from nearly 1,000 sites (supporting both the IGS and other global research activities), CDDIS archived data from over 260 sites (supporting both the IGS and NASA activities), and IGN archived data from approximately 170 sites.

The global network of IGS sites producing 30-second data on an hourly basis expanded to over 130 sites by the end of 2002. These hourly files are archived in compressed, compact RINEX format and are retained at the global data centers for three days. The daily observation and navigation files from these hourly sites, containing all 24 hours of data, are then transmitted through established data flow paths and archived indefinitely at the data centers. The timeliness of the hourly data improved during the past two years with sixty percent of the data available within fifteen minutes after the end of the previous hour and 85 percent available within thirty minutes. Efforts to further reduce the time delay of both daily and hourly data sets will continue during the coming months.

During 2001, data centers began supporting the IGS Pilot Project for Low Earth Orbiters (LEO). The CDDIS provided access to data from a network of over fifty sites providing high-rate (one-second) RINEX observation data in fifteen-minute files. Analysis centers participating in the LEO-PP, as well as the general IGS user community, will utilize these various data sets to produce orbits for the LEO missions and study the impact on the "classic" IGS products. Additional support of the LEO-PP consists of the archive of space borne receiver data, including SAC-C, CHAMP, Jason, and ICESat. The CDDIS began archiving data from these missions in January 2002.

Also starting in 2001, data supporting the IGS GPS Tide Gauge (TIGA) Benchmark Monitoring Pilot Project began to flow to the IGS data centers. The primary goal of the pilot project is to provide height coordinates and velocities of the vertical motion for the TIGA Observing Stations (TOS). The latency of the data flow for these stations is often much greater (up to one year) than that for the typical IGS station. Therefore data centers must retrieve data from participating stations using a flexible schedule.

The transition to operational status for the International GLONASS Service Pilot Project (IGLOS-PP) includes the incorporation of data from GPS+GLONASS receivers into the flow of IGS data and in the generation of IGS products. Starting in April 2002, the archive of these data were merged with existing GPS data structures at the IGS data centers.

IGS Products

The products generated by the IGS analysis centers, associate analysis centers, and various pilot projects continued to be archived at the IGS data centers in 2001 and 2002. These products include the weekly, standard orbit, clock, station position, and Earth rotation parameters (ERPs) from the seven IGS Analysis Centers and the combined product from the IGS Analysis

Coordinator. The accumulated IGR (rapid orbit) and combined IGU (ultra-rapid orbit) products were distributed and archived on a daily basis as well. IGS station coordinate and reference frame solutions were routinely provided by seven IGS Associate Analysis Centers as well as a combined solution by the IGS Reference Frame Coordinator. The IGS troposphere product, in the form of combined zenith path delay (ZPD) estimates for over 180 sites, was generated by GFZ and archived on a weekly basis at the global data centers. Individual ionosphere maps of total electron content (TEC) were derived on a daily basis by five IGS Associate Analysis Centers and were also archived at the global data centers. A daily file of these data in IONEX format includes twelve two-hour snapshots of the TEC and optional corresponding RMS information.

Table 1. Data Centers Supporting the IGS in 2001 and 2002

Operational Data Centers and Other Station Operations Agencies	
ASI	Italian Space Agency*†
AWI	Alfred Wegener Institute for Polar and Marine Research, Germany
BKG	Bundesamt für Kartographie und Geodäsie, Germany*
CASM	Chinese Academy of Surveying and Mapping
CNES	Centre National d'Etudes Spatiales, France
CRL	Communications Research Laboratory, Japan
DGFI	Deutsches Geodätisches ForschungsInstitut, Germany
DUT	Delft University of Technology, The Netherlands
ESOC	European Space Agency (ESA) Space Operations Center, Germany*
GA	Geoscience Australia (formerly Australian Surveying and Land Information Group) *
GFZ	GeoForschungsZentrum, Germany*†
GSI	Geographical Survey Institute, Japan
HartRAO	Hartebeesthoek Radio Astronomy Observatory, South Africa*
ISR	Institute for Space Research, Austria
JPL	Jet Propulsion Laboratory, USA*†
KAO	Korean Astronomical Observatory
KMS	National Survey & Cadastre, Denmark
NGI	National Geography Institute, Korea
NIMA	National Imagery and Mapping Agency, USA
NMA	Norwegian Mapping Authority
NOAA	National Oceanic and Atmospheric Administration, USA*
NRCan	Natural Resources of Canada*†
PGC	Pacific Geoscience Centre, NRCan, Canada*
RDAAC	Regional GPS Data Acquisition and Analysis Center on Northern Eurasia, Russia
SIO	Scripps Institution of Oceanography, USA†
UNAVCO	University NAVSTAR Consortium, USA
USGS	United States Geological Survey
Regional Data Centers	
BKG	Bundesamt für Kartographie und Geodäsie, Germany
GA	Geoscience Australia
HartRAO	Hartebeesthoek Radio Astronomy Observatory, South Africa
JPL	Jet Propulsion Laboratory, USA
NOAA	National Oceanic and Atmospheric Administration, USA
NRCan	Natural Resources of Canada
Global Data Centers	
CDDIS	Crustal Dynamics Data Information System, NASA GSFC, USA
IGN	Institut Géographique National, France
SIO	Scripps Institution of Oceanography, USA

Notes: * indicates operational data center forwarding hourly 30-second data to the IGS
† indicates operational data center forwarding hourly 1-second data to the IGS