

Network Issues – Position Paper

A. Moore, C. Bruyninx, B. Twilley

The IGS network is the foundation of all IGS activities. In the position paper for the Network Issues section, we will address IGS network documentation, including site configuration information and station operation guiding documents. Further, we will explore the growth of the IGS network, conflicting goals of inclusiveness and simplicity, relationships to dense regional networks, and network planning in light of newly available information on station usage across IGS products and projects, and progress toward near real-time or real-time analysis.

IGS Network Issues 2002-2004, Update Since Ottawa Workshop

M. Schmidt, A. Moore

The Network Session at the “Towards Real Time” IGS meeting in Ottawa in 2002 addressed a number of key issues associated with the robustness and integrity of the IGS Network. Specific recommendations were made in five areas: GPS / GNSS Modernization, Associate Regional Networks, Instrumentation / Site Changes, Data Exchange Format and Industrial Relations, Station Metrics as well as highlighting ancillary topics. Substantive progress has been made on some of these including new web-based site metrics, new site guidelines as well as other related items. This presentation will recap the details and provide an update on the substantive progress made since Ottawa and will also examine some of the outstanding issues.

Status of AFREF Project

Z. Altamimi

The African Reference Frame (AFREF) project is divided in sub-regional entities as North (NAFREF), West (WAFREF), East (EAFREF), Central (CAFREF) and Southern (SAFREF). The AFREF status of and planned activities will be summarized, and in particular the current NAFREF situation as result from NAFREF workshop held in Rabat in October 2003.

North Eurasian GPS Deformation Array, History and Current State

G. Steblou

The NEDA GPS Network spans Russia from the East European Platform to the Pacific Ocean and to Arctic Siberia. It makes a significant contribution to the global IGS polyhedron, and in research with low earth orbiters, in global navigation, and in geodynamics. The network is collocated with the GSN seismic network in Russia; such network design can significantly increase the observable frequency band for strong ground motions. The project benefits from collaboration between JPL and IRIS to support the project. NEDA is jointly operated by the Russian GPS Data Acquisition and Analysis Center (RDAAC / Russian Academy of Sciences) and Lamont-Doherty Earth Observatory of Columbia University (USA). Currently, the network consists of ten GPS stations registered as global stations of International GPS Service (IGS). Five NEDA stations provide the data stream in real time, 1-Hz sampling rate, while all ten stations report standard daily data by UTC midnight. Latency of our real time stations is 1-2 s. Latency of daily transfers to global data centers is 10 min past UTC midnight. All NEDA stations are uniformly equipped with Ashtech Z-12 receivers and Ashtech choke-ring antennas. The receiver at station YAKT is controlled by the cesium frequency standard. The computers at all sites are running under Linux and are directly connected to internet. At six stations (at all since 2004), the meteorological sensors Paroscientific MET3 are plugged into GPS receivers and provide readings with 1- or 5-min sampling. We designed the software to support a reliable, fully automated retrieval of observations from the network via internet. Several alternative communication lines were implemented to ensure a secure uninterrupted data flow.

International end users of the products of NEDA Network are: IGS, JPL, CDDIS, SuomiNet, and EUREF. All Analysis Centers of the International GPS Service process the data collected at the NEDA Network to estimate station positions and velocities, orbits, clocks, ionosphere, and the water vapor in the troposphere. The timely delivery of our observations allows IGS to include them in the derivation of ultra-rapid, rapid, and final products.

NEDA stations significantly improved definition of the Eurasian reference frame. NEDA stations observed since 1996 sample the stable core of Eurasia: East European and Siberian cratons. A hypothesis that the northeastern Eurasia belongs to the North American plate was recently proved from observations at NEDA and at regional networks supported by NEDA. This resulted in much better understanding of a style of deformation at the Eurasia - North America convergent plate boundary in east Asia.

Working with the IGS Network: The ESA/ESOC Experience

I. Romero, C. Garcia, J. Dow

ESA/ESOC provides GPS data to the IGS from a small but world-wide network. At the same time ESOC is an IGS Analysis Center and contributes to all the IGS processed products. The IGS has undergone many changes in the last few years particularly in terms of latency of the data and products. These changes, together with the increase in product types and the increase in data file submissions have meant stricter requirements for all IGS analysis centre activities. Based on the particular nature of the

ESA/ESOC setup and its wide contributions to the IGS, an overall view of the experience of working with the IGS network will be presented.

South Pacific Regional GPS Network

B. Twilley

The South Pacific Regional GPS Network (SPRGN) currently consists of ten permanent, geodetic quality GPS receivers, located on geologically stable marks, in the South Pacific Region. The main purpose of this network is to support the South Pacific Sea Level and Climate Monitoring Project (SPSLCMP) in the determination of Absolute Sea Level rise. It will also provide the fundamental framework for spatial data in each of the Nations and may contribute to global geodesy and the study of other earth processes such as crustal dynamics and atmospheric research.

This poster briefly describes the purpose and development of the SPRGN and gives a description of the establishment and operation of the CGPS stations in the regions.

Activities of the Astrogeodetic Observatory in Jozefoslaw in the Last Decade

J. B. Rogowski, J. Bogusz, M. Figurski, M. Klek, M. Kruczyk, L. Kujawa, W. Kurka, T. Liwosz

Astrogeodetic Observatory in Józefoslaw which belongs to the Institute of Geodesy and Geodetic Astronomy of the Warsaw University of Technology started to permanent observations in 1958. First of them was time service started in February 1958, coordinated by BIH. From 1959 astrometrical measurements have been done with aim to determine the parameters of the Earth rotation. In 1991 the Observatory was joined to the International GPS Service for Geodynamics (IGS) and started to operate as a permanent one in 1993. There have been performed many observations and scientific researches, such as: GPS in the frame of IGS/IGLOS/EUREF; tidal observations; absolute gravity measurements; changes of the vertical, based on the gravimetric measurements; astrometric observations and meteorology. Moreover studies on RTK and DGPS measurements using mobile phone for data transmission are performed since 1998. WUT EUREF Local Analysis Centre, one of the 16 Local Analysis Centres acting in Europe, is a very important part of the Observatory. The Centre makes continuous service of one-week solution in the frame of EUREF network, processes national and international GPS campaigns (CEGRN, EXTENDED SAGET etc.), models ionosphere and troposphere parameters, compute tidal components and changes of the vertical according to astrometric and gravimetric measurements. This paper presents current state of the art of the Observatory's activities and deals with the acting of it and operating of the WUT EUREF Local Analysis Centre.

EPN Network Coordination

C. Bruyninx, G. Carpentier, F. Roosbeek

The EUREF Permanent Network (EPN) consists of more than 150 permanent GPS stations distributed over 30 European countries with more than 100 participating agencies. The EPN is the European densification of the IGS and, as such, IGS standards and guidelines are followed as much as possible. This poster will give an overview of the network coordination activities performed by the EPN Central Bureau such as GPS data quality checks and monitoring of the data flow.

EUPOS - a new European Initiative of Establishment of the Multifunctional Reference Station System in Central and Eastern European Countries

J. Sledzinski

The Project EUPOS (European Position Determination System) was initiated by the Berlin Senate Department for Urban Development and European Academy of the Urban Development Berlin. The project consists in establishment of about 415 multifunctional satellite reference stations in Central and Eastern Europe. Fourteen countries intend to participate in the project. One common project standard set will be observed by all countries, however the project will include the existing or developed infrastructure in participating countries. The system will be compatible with the German network SAPOS and future European system Galileo. Experiences of establishing and operating satellite systems gained by other countries will also be used. The network of reference stations will provide signal for both positioning of the geodetic control points and for land, air and marine navigation. Several levels of positioning accuracy will be offered. The poster will reflect the newest version of the project including all recommendations resulting from the consultations with the representatives of European Commission.

Korean GPS Network (KGN) Activities

P.-H. Park, K.-D. Park, J.-U. Park

Korea Astronomy Observatory (KAO) has been operating an IGS station TAEJ (which was relocated to DAEJ in 1999) since 1994. National Geographic Information Institute has joined the global IGS network by installing an IGS site, SUWN, near the Seoul metropolitan area in 1999. Also, starting in the late 1990's, several governmental agencies began to install many permanent GPS tracking sites in South Korea, and the number of stations is growing fast and it is over 70 as of January 2004. Most of the sites are operated as geodetic-quality sites and their data are used for atmospheric science and other geophysical studies such as plate tectonics around the Korean Peninsula. Some sites are being operated as reference stations for vehicle/marine navigation in DGPS (Differential GPS) and RTK (Real-Time

Kinematic) applications. In this paper, we will introduce the Korean GPS Network (KGN) and research activities utilizing the KGN.

On the Use of Non-Permanent GPS Stations for Geokinematics

J. Krynski, Y. M. Zanimonskiy

Continuous data acquisition at the permanent GPS stations together with appropriate uniform strategy of data processing and use of suitable reference system make the basis for generating time series of GPS solutions that can be applied to interpret variations in positions determined in terms of geokinematics. Distribution of such stations is frequently insufficient to provide data on geokinematics in the region with required spatial resolution. The network of permanent GPS stations is therefore densified with the stations where GPS observations are conducted only periodically in the framework of time-limited observational campaigns.

Variations in the GPS-derived positions of such non-permanent GPS stations need a special care when interpreted in terms of geokinematics effects as referred to relatively short time and based on limited data set.

The differences between vector components obtained from different GPS campaigns can be viewed as a composition of two components. First one composed of quasi-stable or slowly changing terms has a systematic character. The second one composed of periodic and casual terms has a random character. The approaches of effective lowering of biases with use of repeated measurements, calibration and metrological tests of both antennas and receivers are reflected in numerous publications.

The problem of reliable precision estimate has to be carefully considered. The analysis of time series of GPS-solutions based on overlapped sessions is a useful tool to estimate biases and to improve the reliability of detection of geokinematics phenomena using data from non-permanent GPS stations. The results of numerous numerical experiments with use of EPN data processed with the Bernese v.4.2 software are presented. Practical suggestions concerning the use of non-permanent GPS stations for geokinematics are given. A special concern was paid for the determination of the optimum length of the campaign and the length of filtering window applied to process time series of GPS solutions.

South Pacific GPS Network (SPRGN)

B. Twilley, J. Manning, R. Govind

The South Pacific Regional GPS Network (SPRGN) currently consists of ten permanent, geodetic quality GPS receivers, located on geologically stable marks, in the South Pacific Region. The main purpose of this network is to support the South Pacific Sea Level and Climate Monitoring Project (SPSLCMP) in the determination of Absolute Sea Level rise. It will also provide the fundamental framework for spatial data in each of the Nations and may contribute to global geodesy and the study of other earth processes such as crustal dynamics and atmospheric research.

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Sub-Daily Site Coordinates Variations in EUREF Permanent Network

J. Hefty, M. Kovac, M. Igondova, M. Hrcka

The set of 30 EUREF permanent GPS network stations processed in LAC at Slovak University of Technology in Bratislava is besides the standard 24-hour intervals analyzed also in 4-hour batches. Network sites are distributed almost over the whole territory of the continent. Solutions are referred to actual ITRF2000 position of ZIMM IGS station. Processing of the sub-daily batches follow similar strategy as for 24-hour sessions. The only difference is that troposphere parameters and ambiguities for the 4-hour sessions are not estimated but adopted from 24-hour solutions. Corrections of ocean loading effects based on tidal maps are included in the processing. The sub-daily solutions yield the time series of site coordinate variations in n, e, and up components. Spectral analysis of the low-frequency filtered time series shows that dominant are the diurnal and semi-diurnal signals with S1, K1, O1, S2, K2 and M2 tidal frequencies. Their amplitudes are estimated using adjustment model comprising linear drift, seasonal terms and daily variations of the station coordinates. The residual variations (relatively to reference site ZIMM) in horizontal position and height are up to 3 mm. The origin of O1 and M2 could be associated with unmodelled ocean loading effect, S1 and S2 reflect probably the thermal and atmospheric effects at the observing sites. The spurious is the origin of K1 and K2 waves with relatively small ocean loading effects but non-negligible residual amplitudes from GPS data.

UNAVCO Support to the GPS Global Network (GGN) and the International GPS Service

O. Ruud, D. Stowers, S. Fisher, C. Meertens, V. Andreatta

The UNAVCO, Inc. Boulder Facility provides GPS project support to investigators funded by the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA), including the NASA Solid Earth and Natural Hazards (SENH) Research and Applications Program. As part of this agreement, support is provided to the NASA Jet Propulsion Laboratory (JPL) in their management of the NASA GPS Global Network (GGN) and to the International GPS Service (IGS) Central Bureau (CB), also located at JPL.

UNAVCO provides daily monitoring support for 67 NASA permanent GPS stations, 30 of which are part of the IGS LEO pilot project, three are part of the Deep Space Network (DSN), four are stations supporting Ionospheric Scintillation projects, and 26 sites are real-time 1Hz (high rate) global stations. NASA provides support for the GPS infrastructure through a network of permanent GPS stations called the GPS Global Network (GGN) which represents approximately 20% of the 362 stations (as of January 16th, 2004) that make up the IGS permanent station global network. On a global scale, these stations

contribute to IGS data and precise products, help realize an International Terrestrial Reference Frame (ITRF), determine station velocities for global tectonic models, and provide atmospheric, ionospheric, and essential ground network data for applications such as space weather forecasting and Low Earth Orbit (LEO) occultation missions. There has also been an increase in the deployment and operation of high-rate 1Hz GPS sites which provide both traditional IGS products (30s sample rate RINEX) as well as high-rate data as part of the IGS LEO pilot project. These sites also produce 1Hz data streams which are used for real-time global, differential corrections for dynamic positioning. JPL is currently receiving 1Hz data, in real-time, from about 36 global stations and UNAVCO's responsibility has increased to include operational and backup functions for many of these important high rate installations. Also, GGN stations represent approximately 50% of IGS stations that have data available on an hourly basis. UNAVCO also continues to provide data backup and distribution support to JPL for 50 GGN stations.