AFRICAN GEODETIC REFERENCE FRAME (AFREF)-NEWSLETTER

Secretariat: Regional Centre for Mapping of Resources for Development (RCMRD)

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Introduction

The purpose of this newsletter is to inform AFREF members the status of the establishment of AFREF within the African countries. It also creates a forum for discussions and exchange of information and experiences in the implementation of AFREF.

The objective of the AFREF initiative is to unify and modernize the geodetic reference frame in Africa. The initiative encourages African governments through their national mapping agencies to modernise their geodetic networks using modern GNSS technologies including establishments of a network of CORS providing a variety of services including DGPS/RTK correction and supporting variety of applications including mapping, engineering, cadastral, weather, geodynamics and so on.

When fully implemented, it will consist of a network of continuous, permanent GNSS stations such that a user anywhere in Africa would have access to the generated data.

GNSS data from AFREF CORS is being achieved at AFREF Operational Data Centre (AODC) (http://www.afrefdata.org/) currently being hosted by National Geo Information (NGI) agency in South Africa. You may check the current status.

RCMRD have also created web site on AFREF data centre(www.rcmrd.org/index.php/afref-data-centre/) where previous AFREF newsletter are achieved. RCMRD also hosts the RCMN IGS station and various products including raw data, RTK and DGPS data streams are available.

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EGNOS Signals to be Available in Africa

EGNOS AFRICA Joint Programme Office (JPO) is a panafrican 'implementing instrument' of GNSS/EGNOS in Africa. It has been created through the SAFIR project (**S**atellite navigation services for **AF**r**I**can **R**egion) within ACP/EC framework programme ''*Support to the Air Transport and Satellite services applications in Africa*''.

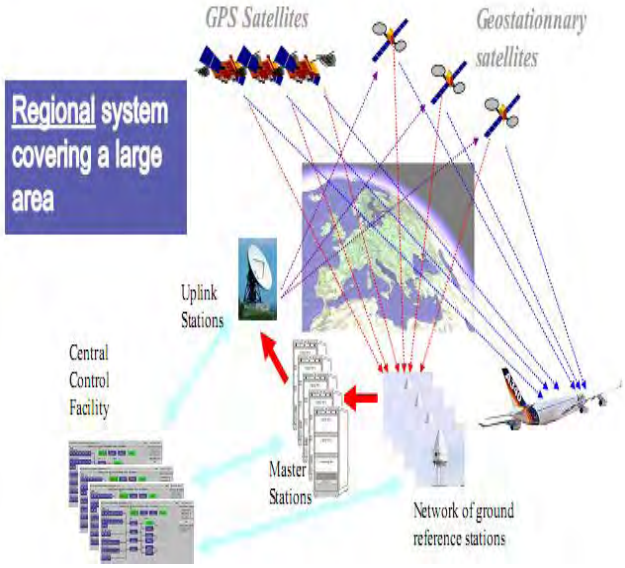
The SAFIR project aims to build a solid foundation for a successful implementation of EGNOS in AFRICA. It supports JPO setting up and organization of GNSS/EGNOS capacity building activities through an international consortium led by ASECNA.

In February 2014, the initial five Management staff members joined the JPO and are currently hosted by ASECNA in Dakar. The photo below from the left

are the some of the recruited management staff; Mr Ladislaus Matindi(JPO director), Mr. Semou Diouf(JPO Deputy director), Mr Abdel Nasser San'anna(GNSS prohramme Manager) and Mr. Mustapha Boukary(Certification and safety).

After completion of the two phases of recruitment, the personnel of the JPO will include ten highly qualified experts. Prior to their entry on duty, all the JPO staff went through an intensive training session delivered through a sister Project called TREGA (TRaining for EGNOS in Africa) led by UNESCO/ICTP (International Centre for Theoretical Physics). The first session dealt with ''Space Projects Management" and "Legal Regulatory Aspects" and took place in July/August 2013 while the second one addressed "GNSS Systems and Applications" , "Service Provision, User Support and Promotion of EGNOS Use in Africa" and took place from January to March 2014.

EGNOS is a Satellite Based Augmentation System (SBAS); designed to augment the navigation system constellation by broadcasting additional signals from geostationary (GEO) satellites. The basic scheme is to use a set of monitoring stations (at very well-known position) to receive GPS and



future GALILEO signals that will be processed in order to obtain estimations of errors (i.e. ionospheric errors, satellite position/clock errors, etc.) that are also applicable to the users. Once these estimations have been computed, they are transmitted in the form of "differential corrections" by means of a GEO satellite. Along with these correction messages which increase accuracy (within three meters today) , some integrity data for the satellites that are in the view of this network of monitoring stations are also broadcasted, increasing the confidence that a user can have in the satellite navigation positioning solution.
Today, EGNOS augments GPS L1 signals only and provides the following three services: Open Service (OS), Safety of Life (SoL) Service and EGNOS Data Access Service (EDAS)

The SoL service provides the most stringent level of signal-in space performance to all Safety of Life user communities. It is compliant with the aviation APV-I - Approach with Vertical Guidance requirements, as defined by ICAO in Annex 10.

EGNOS is in operation in Europe since 2009; EGNOS satellite's footprint covers Africa, thus making the services easy to extend by adding some ground monitoring stations.

The technical challenges regarding ionospheric scintillation, mainly in Equatorial Africa are also taken into consideration. For this reason, JPO will work in cooperation with another Team of two African GNSS experts who have been selected to work on a specific GNSS simulation platform dedicated to African environment.
Beyond the pure technical aspects, JPO work programme shall address operational issues among which the Governance structure applicable, System Safety, Certification and Liability policies, Applications development, System performance, Operations, Maintenance and Service provision
Besides the development of the service implementation roadmap for Sub-Saharan Africa, JPO will address the identification of the different stakeholders and enablers for the introduction of GNSS/EGNOS in all sectors and their relationships. It will also be necessary to identify institutional means in order to achieve a common interface of regulations as applied in other continents such as Europe and the regulations to be applied in the ACP countries for the use of EGNOS.
JPO is ready to support any African state or entity aiming to implement satellite navigation applications.

Namibia/Botswana Boundary Precisely Defined using GNSS Technologies

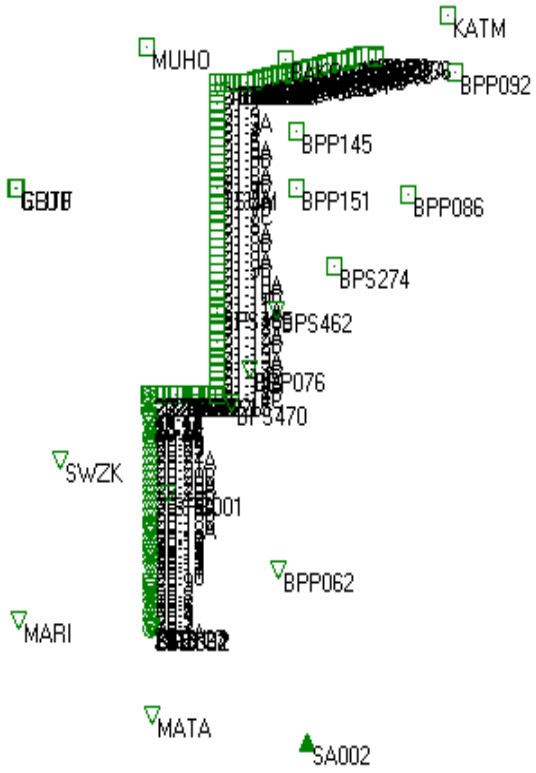
The boundary between Namibia and Botswana was surveyed last year by a team of surveyors from both countries assisted by RCMRD. 117 boundary beacons were established and GNSS static observations carried out using a mixture of Leica and Trimble GNSS receivers. 13 and 8 zero order control points from Botswana and Namibia respectively were used. The coordinates were computed using Leica Geo-Office GNSS software using IGS precise orbits. The coordinate systems in both countries are based on IRTF2000.

12 GNSS receivers were used to carry out static GNSS observations using Six (6) base receivers at controls points while the other six (6) were used as rovers for points along the boundary during the period of the 18th September to 18th October 2013.

The data was post processed using Leica Geo Office post processing software using IGS precise orbits. The precise orbits for the observation period were downloaded from International GNSS Service was (IGS). Baselines processing on all the data were carried out and only those with fixed ambiguities were accepted and saved. Acceptable accuracies (standard errors) on all baselines of up to 5mm in X, 5mm in Y and 10mm in Z were achieved.

Constrained adjustment was carried out in threefold using control points from each county, one based on the Botswana controls point only; second using Namibian Control points and the

third using control points from both countries. Some control points including Mata, SZ001… on either side were not fixed and were used as check the work.



The solutions on constraining with the Botswana controls were compared official coordinates of the Namibia controls points with average residuals of 5cm in the X and Y and 15cm in the height. And on constraining with the Namibian controls, the computed coordinates of the Botswana controls differed with the official values by an average of 4cm in the X, 7cm in the Y and 17cm in the height. The above two solutions above indicates that the controls points on either side are consistent with each other. Recall that all are based on common ellipsoid (WGS84/GRS80) and common ITRF2000).

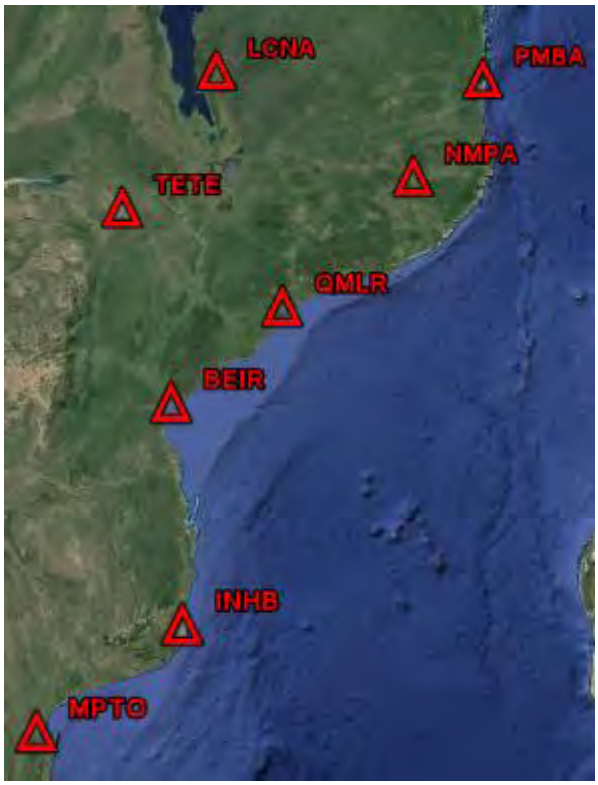
Based on the above solutions and that using more control would always give better solutions, A third and final solution was carried out using the controls from both countries. TSUM (Namibia) and BPZ002 (Botswana) were not fixed but were used to check the work. The residual of TSUM from official coordinate values was 4cm in the X, 3cm in the Y and 11cm in the height. And that of BPZ002 was 3cm in the X, 4cm in the Y and 10cm in the height. The accuracies archived in the final solution were within 5cm in all axes.

Rio Tinto Committed to Improving GNSS Land Network in Mozambique

(***2012-12-18***) Rio Tinto Coal Mozambique and CENACARTA recently installed in the city of Beira one additional Permanent GNSS Station (Global Navigation Satellite Systems), among others to be deployed with funding from Rio Tinto. Under this program, the first station was installed in Tete province.

The new stations will strengthen the GPS (Global Positioning System) network in the country, thus providing valuable data for the modernization of the National Geodetic Reference System (MOZNET). The GPS data will be used to enable greater efficiency and accuracy in collecting geo-referenced information on the country, supporting infrastructure development, urban planning, land mapping and a wide range of other initiatives.

Other facilities, after the one built in Beira, will be installed throughout the country and are expected to cover the cities of Quelimane and Lichinga in 2013. These cities will be connected to the existing network that already covers Maputo, Inhambane, Pemba, Nampula, Tete and Beira. All stations will meet the International GNSS Service (IGS) standards.



The installation of the facilities falls under the cooperation protocol signed in March this year with

the Ministry of Agriculture. This accord defines forms of technical and scientific cooperation in the deployment, use and maintenance of Permanent Satellite Stations in the Republic of Mozambique.

Under said protocol, Rio Tinto Coal Mozambique and the Ministry of Agriculture of Mozambique have committed to promote studies together, to improve the skills of local technicians, as well as solidify their ability to take an active role in several development projects already underway in country. There are also plans to support local universities to promote research in the areas of Space Geodesy, Geometrics and Geography in general (source: http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=mining&id=27102&tipo=one)

The AfricaGEO 2014 Conference & Exhibition, 1st to 3rd July 2014 in Cape Town, South Africa.

The AfricaGEO 2014 Conference & Exhibition will be held at Cape Town International Convention Centre (CTICC) from the 1st July to 3rd July 2014. The conference aims at facilitating interactions, discussions, collaboration and capacity building amongst the participants. It will provide a platform to share the latest developments in the industry of surveying and geo-information and the very pressing issue of sustainable development. The conference will also promote and showcase the latest products and services the industry has to offer.

AfricaGEO is being organized by South African Geomatics Associations, and enjoys the full support of; PLATO, SAGI, GISSA, the Hydrographic Society of South Africa, the Institute of Mining Surveyors of South Africa, the Association of Aircraft Survey Companies and the Department of Rural Development and Land Reform.

For more information, www.africageo.org

XXV FIG International Congress 16th -21st June 2014, Kuala Lumpur Malaysia

XXV Fig International Congress would be held in Kuala Lumpur, Malaysia, 16–21 June 2014 at Kuala Lumpur Convention Centre. The theme would be "*Engaging the Challenges, Enhancing the Relevance*"

The FIG Congress will for the first time since its beginning in1878 be held in Asia, and the silver jubilee Congress will be a culmination of the four-year FIG Work Plan as well as the start of a new 4 year term with a new FIG President who will be elected at the General Assembly.

For more information, www.fig.net/fig2014/

Training on AFREF and Processing of Global Navigation Satellite System (GNSS) Data

Training on African Geodetic Reference Frame (AFREF) and Processing of Global Navigation Satellite System (GNSS) workshop is scheduled from 1st September to 12th September 2014 at Regional Centre of Resources for Development for Resources (RCMRD), Nairobi, Kenya. Hereblow is 2013 AFREF participants.

The main objective of the course is to build the required technical capacity to implement and operate the Africa Reference Frame (AFREF) project. It is designed to provide practical skills in setting up Continuous Operating GNSS Reference Stations (CORS), processing of GNSS data and operationalization of AFREF project at national level. The topics to be covered will include GNSS technology, CORS instruments and set up, observation requirements and planning, CORS geodetic network design, reference systems and coordinate systems and GNSS data processing.

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