AFRICAN GEODETIC REFERENCE FRAME (AFREF)-NEWSLETTER

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

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Introduction

In this issue we report on AFREF activities in Nigeria and Kenya and present a report on permanent GNSS stations in Africa. We thank Mr. B. Jatau, Mr. O. Onabajo, Prof R. Fernandes and Mr. R. Wonnacott for their contributions. We appeal for your contributions to be included in the next issues of this newsletter, which is scheduled to come out in May 2008.

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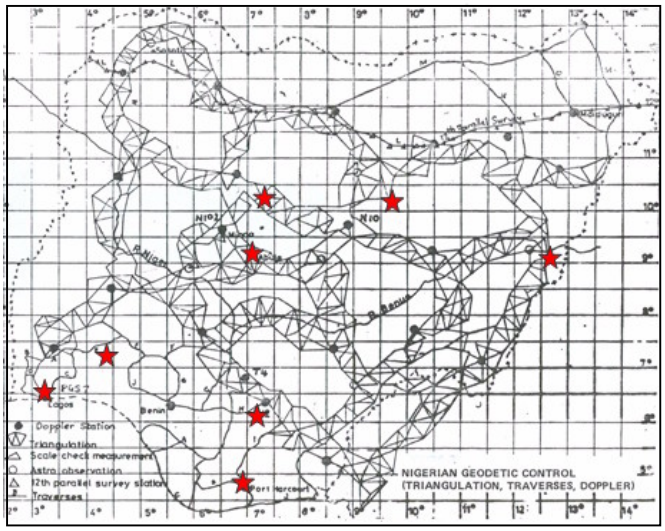
The First AFREF Stakeholders' Forum Held on 26th September 2007 in Nigeria

The maiden AFREF Stakeholders' Forum organized by the Office of the Surveyor General of the Federation (OSGOF) was held on 26th September 2007 in Abuja. Over one hundred stakeholders took part in the forum. They were drawn from the Nigerian Institution of Surveyors (NIS), Surveyors Council of Nigeria (SURCON), States Surveyors-General, National Inland Waterways Authority (NIWA), Nigeria Association of Geodesy (NAG), the Armed Forces, the Academia, Aviation industry, National Universities Commission, National Space Research and Development Agency (NASRDA), Regional Centre for Training in Aerospace Surveys (RECTAS), Chevron Nigeria Ltd, Shell Petroleum Development Company, and other private sector organization.

It was reported that the realization of sustainable socio-economic development in Nigeria depends on a reliable, unified coordinate framework. In Nigeria, AFREF will ensure the proper establishment of an acceptable unified reference frame which is the basis for mapping and surveying required for defence and national security purposes, civil aviation, disaster management, developmental planning and enhancement of atmospheric and weather monitoring etc. Most importantly AFREF is a solution to the disparity in cross-boundary mapping at State, National and Regional levels in Africa.

The Forum was to enable AFREF stakeholders contribute meaningfully to the development and provision of technical support for the AFREF project in Nigeria (NIREF) and Africa at large. The forum was also meant to identify the responsibilities of stakeholders, and viable sources of funding. At the technical sessions, the historical perception, roles of stakeholders, instrumentation and standard, relevance of Global Navigation Satellite Systems (GNSS), implementation plans, site proposals and co-ordination of AFREF were addressed.



Location of Proposed CORS in Nigeria

Some of the resolutions made by the stakeholders at the end of the meeting were as follows:

- That AFREF is a major project of relevance to our livelihood and sustenance as a nation. The Federal Government is therefore called upon to make a special budgetary allocation through OSGOF for the implementation of the Project.
- Supplementary funding should also be sourced through Public-Private Partnership e.g. the Oil & Gas companies, GSM Operators and other relevant stakeholders.
- To intensify advocacy campaigns to the State and Federal governments and general public on the relevance of AFREF Project to the nation's developmental goals e.g. the President's 7-point Agenda, Millennium Development Goals (MDGs) etc.
- To establish at least eight (8) Continuously Operating Reference Stations (CORS) in Nigeria, located at sites with suitable physical characteristics and available manpower in Geodesy.
- The OSGF should undertake inventory of existing GPS stations in Nigeria for coordination and standardization, taking advantage of the Survey Coordination Act.
- Establish National Working Committee (Implementation Committee) to examine possibilities

of States establishing and funding more CORS stations whilst also ensuring decision reached at AFREF Stakeholders' Fora are implemented.

- There is a need to have a unified datum transformation parameters for the entire country for converting coordinates from GPS (WGS84 system) to Minna datum and vice-versa. This is to be derived from the implementation of AFREF. The Oil and Gas companies are strongly urged to sponsor this project for immediate realization. Such unified datum transformation parameters are necessary to prevent adjacent boundary disputes.
- Funding should be provided for capacity building in training Surveyors and Geodesists by the Federal Government and other agencies
- The Nigerian Navy should establish at least nine (9) Tide Guage stations along the Nigerian coastlines for monitoring sea level rise associated with global warming /climate change and coastal subsidence.

For more information please contact Mr. B. Jatau (bjatau@hotmail.com)

Results of Questionnaire to Determine Situation with Respect to Status of Permanent GNSS Stations in Africa

In the past 2 years there has been a lot of activity in the installation of permanent GNSS base stations for different projects by many organizations throughout Africa. Although such installations are beneficial to the AFREF project, very little is known of the details of the installations such as date of installation, receiver and antenna type, type of monument and foundation material on which stations have been built, data type and contact details of data archive etc.

In an attempt to gauge the situation, the CODI–Geo AFREF Steering Committee prepared a questionnaire which was sent to all National Mapping Organizations, Universities and other organizations which are active or are showing interest in the AFREF project. In broad outline the questions covered topics such as;

- The number of permanent stations already installed in a country;
- The number of permanent stations planned for installation in a country;
- The name of the organization that installed or plans to install stations;
- The position of installed stations or proposed installations and so on.

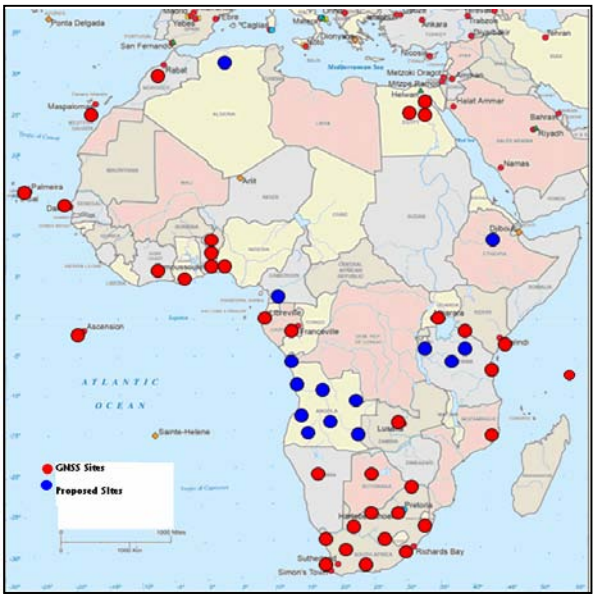
The questionnaire also included a section in which countries willing to host equipment through bilateral agreements where requested to respond.

The response to the questionnaire was not very good with only 7 countries or organizations responding. In spite of this, the following table was drawn up using the information provided through the questionnaire and other sources of information largely through word of mouth and personal correspondence.

Country	Stations Installed	Stations planned for installation	Stations for possible installation under bi-lateral agreement
Algeria		1	
Angola		8	
Benin	7		
Botswana	1		
Cameroon		1	2
Egypt	3		
Ethiopia	1	4	
Gabon	2		
Ghana	3		
Guinea			2
Ivory Coast	1		
Kenya	2		
Malawi			1
Mauritius	1		
Madagascar			1
Morocco	1		
Mozambique	3		
Namibia	1		
Nigeria	1		
Rwanda		1	
Senegal	1		
Seychelles	1		
South Africa	47	9	
Swaziland			1
Tanzania	1	3	2
Uganda	1		
Zambia	1		

The summary in the above table must be read with caution as it is not always clear whether the numbers are correct and whether or not installed stations are still operational. There is probably also some information that is missing and it would be appreciated if readers would correct mistakes or add to the above information by contacting the AFREF Secretariat. Although it would appear that many stations have been installed, it is not always known where

data from these stations is being hosted to allow users have access to the data. The easy and open access to AFREF data is one of the primary philosophies of AFREF and is in line with those of the IGS.



GNSS Sites in Africa

For more information please contact Mr. R. Wonnacott (RWONNACOTT@sli.wcape.gov.za)

CORS to be established in Kenya under RCMRD/NASA Cooperation

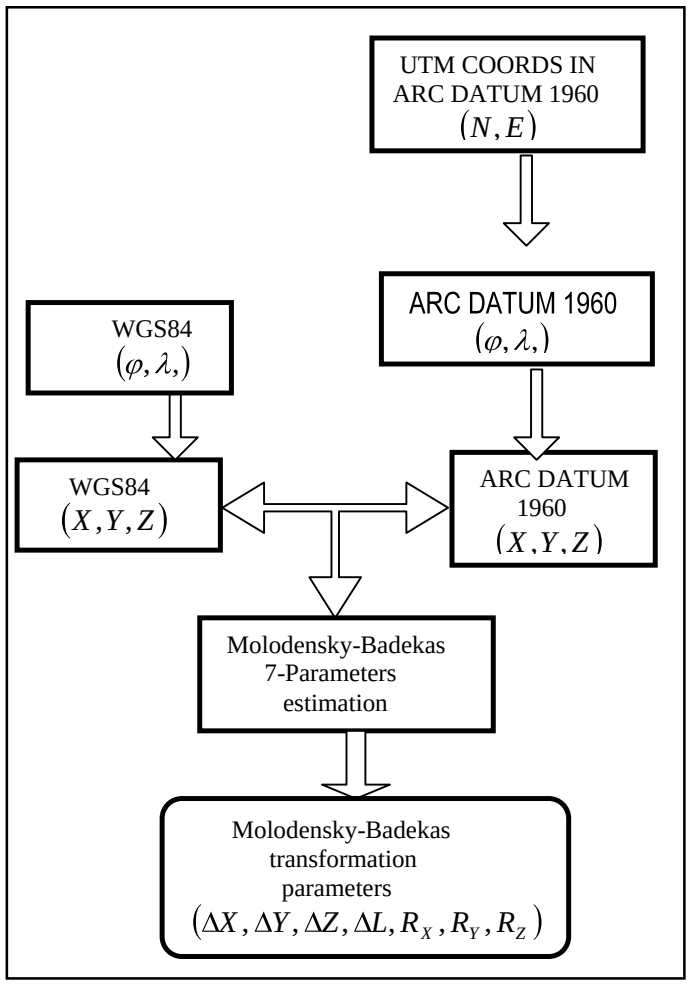
Under the NASA/RCMRD cooperation agreement in space geodesy, the Jet Propulsion Laboratory (JPL)/NASA through their agents UNACO is establishing one CORS in Kenya by February 2008. The station will be equipped with Ashtech UZ 12-CGRS receiver, Ashtech choke ring antenna, Computer for data offload from receiver and UPS (backup power) for computer.

This station will be part of Global GPS Network (GGN) stations and AFREF stations. The GGN stations are funded by NASA's Earth Surface and Interior Focus Area - Science Mission Directorate. The GGN stations provide the international GPS research community with timely and reliable GPS data to produce precise GPS orbits, tracking data, and other data products in support of atmospheric, geodetic, and geophysical research. The GGN stations contribute to the International GPS Service for Geodynamics (IGS) and are used by the IGS Analysis Centers for their GPS data product standards and activities as outline above.

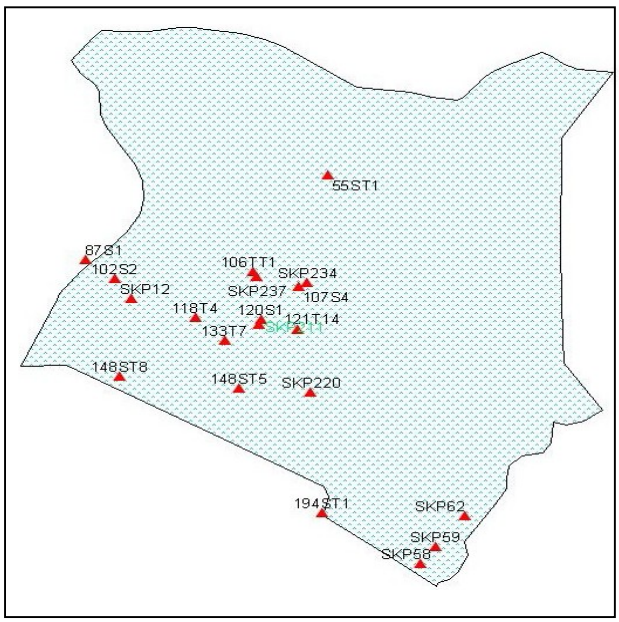
The GGN station data are archived at the Crustal Dynamics Data Information System (CDDIS) and the UNAVCO Archive, for use by investigators in their GPS related research work. This research covers a broad spectrum of disciplines such as climate change, natural-hazard assessment, weather prediction, and geodesy and geodynamics. In addition a few selected GGN stations will be used to support upcoming spaceborne GPS projects with continuous high frequency GPS data for atmospheric and Earth gravity field modeling.

Determation of Transformation parameters between WGS 84 and Arc 1960 Datum for Kenya completed

RCMRD and Survey of Kenya have completed a joint exercise to determine the transformation parameters between WGS 84 and Arc 1960 datum for Kenya. The out come of the exercise is also expected to act as a demonstration for other African countries that need a practical guide of how to undertake the transformation of datums at the national level. The procedures followed are show in the diagram below.



Twenty fairly distributed common points were used to estimate the national datum transformation parameters (see sketch map below).



The computed parameters are as shown below:

PARAMETER	VALUE	STD ERROR
ΔX	148.5133 m	0.2236 m
ΔY	-3.4865 m	0.2236 m
ΔZ	298.0307 m	0.2236 m
ΔL	-4.3955e-006	8.9012e-007
R_X	-5.9464 Sec	0.2389 Sec
R_Y	7.1414 Sec	0.2619 Sec
R_Z	2.8544 Sec	0.3574 Sec

The guidelines and the report on the above project is available from the AFREF secretariat and would also be put on the AFREF website soon.

Work on the first realization of African Reference Frame starts

The procedure for the computation of the first realization of AFREF, to be called AFREF08, was completed in December 2007. This first AFREF solution will be computed by RCMRD (with support from CGUL/IDL, Portugal) and HartRAO of South Africa. AFREF08 is being realized by simultaneously computing accurate positions of an extended set of GNSS points distributed on the entire African continent. The positions will be referred to the latest realization of ITRS (International Terrestrial Reference System), ITRF2005, by aligning the continental solution into this global frame at a defined epoch. AFREF08 will be the backbone fiducial network that will allow every country to start realizing its national system fully and directly consistent with the national realizations produced by neighbouring countries.

Tentatively, it is expected that a provisional solution will available by June 2008. The schedule of the work is as follows:

January 2008 – Circulation of document to AFREF Steering Committee and Scientific Advisory Committee

February 2008 – Call for participation in the AFREF08 solution

March 2008 – Final selection of the stations forming the AFREF08 points

April 2008 – Managers of the selected stations to provide two continuous weeks of data

May 2008 – Computation of the individual solutions.

June 2008 - Evaluation and publication of the results.

The AFREF secretariat will be contacting organizations operating GNSS/GPS stations for data that will be used to compute AFREF08. We request all organization that will be contacted to cooperate and make their data available.