

AFRICAN GEODETIC REFERENCE FRAME (AFREF)-NEWSLETTER

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Introduction

In this issue we report on establishment of GNSS stations in Ethiopia, Botswana and Kenya. We thank Mr. Eshetu Areru, Dr. Attie Combrink, Mr. John Msemwa, Prof. Rui Fernandes and Ms. Ruth Nelian 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 January 2009.

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Ethiopia Mapping Authority Installs Four Continuous Operating Reference GPS Stations

The Ethiopian Mapping Agency installed four (4) Continuous Operating Reference Stations (CORS) in December 2007. The stations are located in Addis Ababa and three other cities in Ethiopia. The installations were done with assistance of government of United States of America (USA) through USAID. The CORS will modernize and strengthen the geodetic network of Ethiopia. The network will also be used in the land survey and registration in Ethiopia.



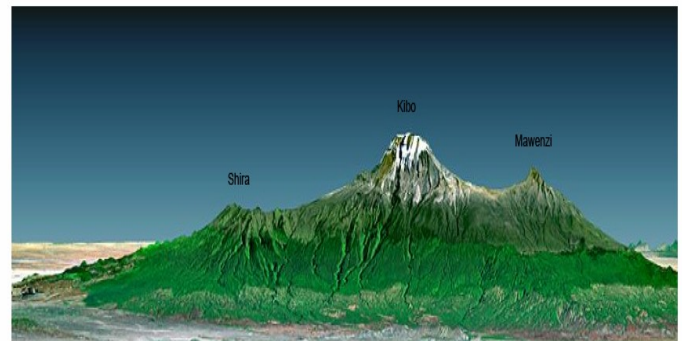
CORS installed in Addis Ababa

The CORS consists of Trimble NetR5 GPS receivers with Trimble Zephyr Geodetic Model 2 antennas. Three of the CORS are already connected by broadband internet so that observed raw data can be downloaded from the

receivers automatically to a centrally located server. Trimble GPSNET software is used to communicate between the central server and the receivers. The other GPS receiver is working and downloading is done manually. Currently the data quality verification is ongoing. The CORS that is installed in Addis Ababa on EMA building will also serve as an AFREF station. The data from this CORS will soon be available at IGS data holding websites

Kilimanjaro 200 Expedition

The exact height of Mount Kilimanjaro has been a fascination since colonial times 150 years ago. What has been even more amazing is that the mountain has a snow capped peak although it is located close to the equator. This had attracted a lot of interest as the reports of the first Europeans to see the mountain reached Europe. Because of this, several attempts have been made to determine the exact height of the mountain between 1889 and 1992. These methods have given varying results and differ by as much as 100 meters.



Kilimanjaro Seen From The South (NASA)

Modern and accurate methods of using Global Positioning System (GPS) and gravimetric observations will now be used to add to the long efforts to determine the exact height of the mountain. KILI2008 is a project to accurately measure the height of the Mount Kilimanjaro, the highest peak of Africa. It is collaboration between the Surveys and Mapping Department (SMD) of the Ministry of Lands, Housing and Human Settlements Development, United Republic of Tanzania, Centre of Geophysics of University of Lisbon, (CGUL), Portugal, and RCMRD. The project is scheduled to take place in October 2008.

The project intends to measure the orthometric height of Mount Kilimanjaro to an accuracy of a few centimetres. To achieve such goal, GPS data will be combined

with gravimetric observations. The gravimetric observations are necessary in order to construct the local geoid with sufficient accuracy.

Two teams will be active acquiring both GPS and gravimetric data. The first group will observe a dense grid (3-5 Km width) of points around Mount Kilimanjaro. Simultaneously, the second team will carry out GPS and gravimetric observations using two different paths (ascendant and descendant) to the summit. A third GPS station will be installed permanently in the area in order to provide a reference for the GPS observations to be carried out. Such station will be connected to the global reference frame, ITRF2005.

In order to accurately define the highest point in Africa, a small stainless steel plate(5-10cm diameter) will be installed in the Uhuru Peak. This plate will also be the testimony of the expedition. SMD and RCMRD will provide all local logistic support, whereas CGUL will guarantee the necessary equipment and expertise. The processing and analysis of the data will be done jointly by all teams.

The partners intend to disseminate the results of this project among the scientific community and to the general public. The project has a clear scientific value since particular techniques and procedures to obtain an accurate geoid in such difficult conditions, will be developed. This is fundamental for the determination of the orthometric height of Mount Kilimanjaro. In addition, the project has also a wide scope of audience since it will provide the most accurate measurement of the highest point in Africa. The publication of the results of this project will benefit the surveying and mapping community in general.

Besides the great scientific interest of this project, there is also an important component of attracting public interest and raising the profile of geodetic sciences. Therefore, additional partners interested to promote and support the project can also be included in future with the agreement of GST, CGUL and RCMRD.

GNSS Reference Station Installed in Botswana

In September 2007 Trimble(<http://www.trimble.com>) donated a GNSS reference station to serve as a node for the African Reference Frame (AFREF). This new station was installed at the Harry Oppenheimer Okavango Research Centre (HOORC) in Maun, a facility of the University of Botswana. The installation was undertaken by personnel from the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in South Africa. The team travelled for four days 2800km by road from

Hartebeesthoek through the beautiful Kalahari / Kgalagadi desert to Maun. It took two days to install and set up the Continuous Operating Reference Station and document the installation specifications. Logistic support for the station is provided by the University of Botswana. The data from this station will soon be published (with low latency) free of charge to all interested users at HartRAO's data archive <ftp://geoid.hartrao.ac.za/rinex>

CORS Established in Western Kenya

As part of implementation of an agreement between the Regional Centre for Mapping of Resources for Development (RCMRD) and National Aeronautical and Space Agency (NASA) to cooperate in space geodetic research, NASA donated permanent station GPS equipment to RCMRD. The GPS equipment was installed in April 2008 at Moi University situated in western part of Kenya. The equipment included Ashtec UZ12 GOS receiver with geodetic antenna and computer server with automatic data downloading software. GPS data would soon be freely available on the IGS data holding centers websites.



CORS in Eldoret, Kenya



Joint AFREF, Africa Array, IHY and AMMA Held

In June, unique meeting took place in Johannesburg, South Africa, at the University of Witwatersrand: a joint meeting between AFREF (geodesy), AfricaArray (geophysics), IHY (space weather), and AMMA-GPS (meteorology).

The Africa Reference Frame (AFREF) is an initiative to unify the many national coordinate reference systems in Africa using GNSS and in particular GPS as the primary tool. AfricaArray is an initiative to promote coupled training and research programs for building and maintaining a scientific workforce for Africa's natural resource sector. AfricaArray's initial focus is on geophysics to maintain and develop geophysical training programs in Africa.

Although a global project, the International Heliophysical Year (IHY) has strong interest in densifying its observing capability in the equatorial regions of Africa including the use of GNSS. The African Monsoon Multidisciplinary Analysis (AMMA) GPS project is primarily a meteorological project aimed at West Africa using GPS as a supporting observing technique. Lessons learned from AMMA-GPS can be extended to the rest of Africa where 59 percent of all natural disasters are caused either by drought or flooding. The meeting provided an opportunity to explore synergies between the activities, since AfricaArray, currently focusing on seismology, uses GPS as a positioning tool for seismic deployment and exploration surveys.

GPS/GNSS has matured to such a point that today, realizing a continental network is much easier than in the past when other GPS-based regional reference frames were being established - for example, EUREF, the European Reference Frame, and SIRGAS of South America. This enables AFREF and other projects to leap-frog older technologies with today's smaller, lighter, less expensive instrumentation, user-friendly interfaces, and trends towards greater sustainability of the necessary long-term observation data. These same characteristics make GPS a necessary utility in everyone's toolbox, and AfricaArray certainly recognizes this. (Adapted from Article by Ruth Nelian for GPS world Magazine)

Second GNSS Base Station Installation and Data Processing Training Course held at RCMRD

A two-week training course on *Establishment of Continuous Operating Reference Stations and GNSS Data Processing* was held at RCMRD, Nairobi Kenya from 18th to 29th August 2008. This was the second course organized by RCMRD in conjunction with the Center of Geophysics of the University of Lisbon, Portugal and Hartebeesthoek Radio Astronomy Observatory of South Africa. The objective of the course was to equip geodesists with practical skills in the establishment and operation of Continuous Operating Reference Stations. The topics discussed include AFREF implementation strategy, IGS products & data, hardware and software requirements to establish Continuous Operating Reference Stations, design

of geodetic networks and GNSS data processing. Participants from ten countries namely; Ethiopia, Kenya, Malawi, Niger, Nigeria, Portugal, Uganda, South Africa, Tanzania and Zambia took part in the course.

The course was officially opened by Mr. Ephantus Murage, the Director of Surveys of the Republic of Kenya. We wish to sincerely thank UNAVCO and Trimble Navigation Limited for supporting the course



Participants at the GNSS Installation & Data Processing Course

Recipients of Trimble GPS receivers Named

Trimble, GPS equipment manufacturing and positioning solutions, has donated equipment for five GPS reference stations to Africa through ECA. The donation was first announced during an AFREF training course workshop in Nairobi in August 2007 and confirmed during the "Trimble Dimensions" user-conference USA in November 2007.

Trimble's donation of the GPS equipment will add to the network of stations for the determination of the African reference frame as well as being part of network of continuously observing reference stations (CORS). The receivers will be installed in Niger, Botswana, Tanzania, Democratic Republic of Congo and Ethiopia. Two of the CORS have already been installed at Maun and Moshi in Botswana and Tanzania respectively. The other stations will be installed by the end of 2008.



President of Trimble with AFREF officials