

Towards Realisation of AFREF for Sustainable Development: AFREF Progress Report

Regional Centre for Training in Aerospace Surveys (RECTAS)
OAU CAMPUS, PMB 5545, ILE-IFE
URL: <http://www.rectas.org>

Regional GDI Workshop
RECTAS
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Introduction

- New Partnership for Africa's Development (NEPAD) - 2001
"African leaders have a pressing need to eradicate poverty and place their countries on path of sustainable development and to place their countries on a path of sustainable development."
- Many objectives of NEPAD rely on sound and reliable geo-spatial information.
- It is essential then that the co-ordinate reference system and its related reference frame on which this geospatial information is based be both uniform and based on modern positioning technology
- AFREF designed to unify horizontal and vertical co-ordinate reference frames in Africa to meet the needs of NEPAD among other things.

Rationale & Background

- Fundamental point of departure for projects, services or products requiring geo-spatial information is a uniform & reliable co-ordinate reference frame.
- Over 50 countries in Africa each with their own system and frame and some with 2 or more systems.
- Although there are many areas of conflict there are also areas where peace has been restored and require a lot of development.
- It is known that many private commercial enterprises are setting up own reference frames particularly in the oil industry.

Rationale & Background

- The concept of basing all geospatial information on an uniform reference frame is not new. In 1905 Sir Sydney Burrard expressed the following views:
 - Geodetic control prevents accumulation of errors not only in the country but between neighbouring countries;
 - Geodetic control is of great benefit for the unification of disparate surveys within a country to base all surveys on one origin and to free the country from internal and external boundary disputes; and
 - Geodetic control reduces the cost of topographical, cadastral, engineering and mining surveys.
- AFREF conceived as African initiative to unify reference frames based on the ITRF through a network of GPS base stations at a spacing such the users will be at most within ~500 km of a base station.

Africa Doppler Survey

- Used US NNSS (TRANSIT) commonly known as Doppler.
- Difficult logistics with simultaneous observations – inter-stations spacing ~500 km.
- ADOS was designed to unify geodetic frames in 1980's using Doppler to provide
 - Zero order control for mapping
 - Control datum for unification and strengthening
 - Accurate geoid for Africa
- Project didn't fully meet its planned objectives
 - Essential to have simultaneous observations – difficult without IGS
 - Rationale not fully understood by participating countries
 - Project planned entirely by IAG with little input from African countries
 - No set standards resulting in unacceptable standards

Africa Doppler Survey (cont)

- **Difference between ADOS and AFREF**
 - Using GNSS/GPS with better availability
 - GPS equipment much more readily available
 - African NMO's involved from the start
 - Have IGS with
 - Infrastructure of continuous base stations
 - Standards
 - Dedicated professional and technical support
 - Willingness of International community to support project

Objectives of AFREF

- Define & establish a continental geodetic reference frame for Africa - a network of permanent GPS stations, continuous or otherwise, such that a user anywhere in Africa would have free access to GPS data and products, and would be at most 500 km from such stations; includes a unified vertical datum
- Establish precise and uniform African Geoid
- Establish an in-country expertise for implementation, operation, management, analysis and presentation GNSS data and products.
- Determine transformation parameters between GNSS and ITRF to/from local reference systems

Objectives of AFREF.....

- Promote the use and application of GNSS technology for African development
- Identify the necessary geodetic requirements of participating nations and international agencies
- Promote African development through GNSS and ICT products and technology transfer within the continent and at international level

Scope of AFREF

- Sparse CORS GNSS network established and managed by IGS and partners
- Densification of IGS networks:
 - at least one GNSS CORS in every African country
 - network of CORS to form the basis of and act as focal points for the establishment of national GNSS networks
 - & integrated with IGS global network
- Determine relationship between the national geodetic systems, GNSS geodetic systems and the ITRF
- Refine the transformation parameters necessary to relate the national systems to ITRF

Scope of AFREF.....

- Densification by individual nations by way of establishing national GPS networks through either continuous or semi continuous permanent GNSS/GPS stations
- On full realisation of AFREF, every country shall have a CORS GNSS network with capabilities to broadcast differential corrections and other useful products to users
- Also, development of a more refined geoid model for Africa and the definition of a common vertical datum for the continent
 - ... shall also be done on country basis with regional and continental coordination
- For project's realisation, African countries are expected to actively participate by establishing tracking sites, data holding and analysis centres, with the necessary equipments and personnel for smooth and sustainable implementation and management.



The concept of local (in)consistency of spatial reference frames. From www.geod.nrcan.gc.ca.

Progress to Date

- Global Spatial Data Infrastructure (GSDI) meeting in Cape Town 2000
 - Need expressed for unified reference frame
- Perhaps 1st AFREF dedicated meeting held in Tunisia in May 2000 to find ways and means of unifying countries in North Africa – 6 countries attended
- Similar meeting in Cape Town March 2001:
 - to gauge level of interest among NMO's in region.
 - to inform potential international partners.
 - 8 countries attended and supported project.
 - IAG/IGS, EUREF, NIMA supported project.
 - Meeting requested that project go under IAG banner.

Progress to Date (cont)

- In 2002 UNOOSA / USA sponsored series of workshops on Use and Applications of GNSS
 - 1 of 4 held in Lusaka July 2002
 - Large number of African countries represented
 - One major outcome was recommendation to
 - Establish a continental reference for Africa or AFREF consistent with ITRF
- Windhoek Dec 2002
 - Meeting held prior to RCMRD technical meeting (Regional Centre for Mapping Resources for Development)
 - 8 Southern and East African member states represented
 - Prepared a selection of provisional cities / towns for permanent GPS base stations
 - Representative from UN ECA CODI also present
 - Prepared what has become known as "Windhoek Declaration"

Windhoek Declaration...

1. Further supported the concept of the AFREF project;
2. Expressed the importance of ECA and CODI in its implementation;
3. Requested the AU to recognize the importance of AFREF and urge its members to implement the project;
4. Urged UNOOSA to support AFREF because it is based on the application of GNSS;
5. Requested IGS being part of IUGG/IAG to continue supporting the project;
6. Further urged bilateral and multilateral partners to support the project implementation;
7. Agreed to submit this Declaration to the Committee for Development Information (CODI) 3 meeting which was held in May 2003 in Addis Ababa, Ethiopia;

Progress to Date (cont)

- August 2004, UNECA CODI-Geo EWG (Addis Ababa)
 - Accepted "Windhoek Declaration" and
 - Established a Working Group on AFREF
 - Nominated a Steering Committee
- October 2004, African Association of Remote Sensing of Environment (Nairobi)
 - Proposed organizational structure for AFREF;
 - Proposed terms of reference for SC; and
 - Proposed terms of reference for second level of WG.
- November 2004 UNOOSA meeting of GNSS experts (Vienna)
 - Endorsed project and pledged continued support

Progress to Date (cont)

- April 2005 FIG Working Week, Cairo.
 - Three AFREF related papers presented
 - Commenced planning for a Technical Workshop to be held in Cape Town in Jan/Feb 2006
 - Drafted a Call for Participation in AFREF
- October 2005
 - Call for Participation distributed
 - Letters of intent being received
- October/November 2005 AfricaGIS
 - Meeting of SC on AFREF
 - AFREF related papers presented
 - AFREF website established at ECA: <http://geoinfo.uneca.org>
 - Reviewed and intensified plans for tech workshop & CFP

IGS Permanent Stations in Africa

So far there are 18 IGS permanent stations located in or around Africa. These are:

1. HRAO, Hartebeesthoek, SA.
2. HARB, Hartebeesthoek, SA.
3. SUTH, Sutherland, SA.
4. SUTM, Sutherland, SA.
5. RBAY, Richardsbay, SA.
6. SIMO, Simonstown, SA.
7. MALI, Malindi, Kenya.
8. NAMI, Windhoek, Namibia.
9. SEYI, La Misere, Seychelles.
10. YKRO, Yamoussoukro, C. D'Ivoire.
11. TGCV, Tide Gauge, Cape Verde.
12. MBAR, Mbarara, Uganda.
13. MASI, Maspolmas, Grand Canaria.
14. MSKU, Masuku, Gabon.
15. NKLG, N'Kollang, Libreville, Gabon.
16. RABT, Rabat, Morocco.
17. ZAMB, Lusaka, Zambia and
18. DAKA, Dakar, Senegal.



Continued.....

- Based on this information, certain areas of Africa will need new permanent stations.
- For example there is a gap in central, the Sahara and the Horn of Africa areas.
- In the other areas, densification is necessary

Sub-regional AFREF Implementation

- For implementation of the AFREF project, Africa is divided into five sub-regions:
- 1.SAFREF for the southern Africa states
 - 2.EAFREF for the eastern and horn of Africa states
 - 3.CAFREF for central Africa
 - 4.NAFREF for northern Africa states and
 - 5.WAFREF for western Africa

Of the 5, WAFREF and CAFREF have performed poorly

ECA/CODI Steering Committee on AFREF (adopted at CODI-IV)

- 1.RCMRD, the Director General, Chair
- 2.AO CRS, the General Secretary, Co chair
- 3.RECTAS, the Executive Director
- 4.IAG S. C. 1.3d on Reference Frames, Africa
- 5.NAFREF, head of National Surveys & Mapping Organisation, Tunisia
- 6.EAFREF, Director of Surveys & Mapping, Tanzania
- 7.WAFREF represented by head of NMO, Nigeria
- 8.SAFREF represented by Director of Surveys & Mapping, Namibia
- 9.CAFREF represented by head of NMO, Congo Brazaville

At national level, NMOs are expected to spearhead the formation of an all inclusive national working groups (comparable with NSDI structure). They are also required to draw up their own TORs

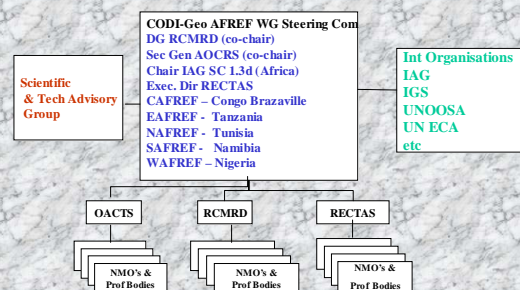
ToR for Steering Committee

- Coordinate implementation of AFREF project at continental level
- Set guidelines and standards for the AFREF project
- Provide justification, communication and publicity for the project to political groupings, stakeholder-international organisations and other users
- Secure funding and other resources such as equipment to ensure the success of the project
- Liaise with international organisations to provide guidance, expertise and training
- Co-ordinate training, workshops and seminars and
- Report to CODI and funding agencies with respect to progress and future actions`

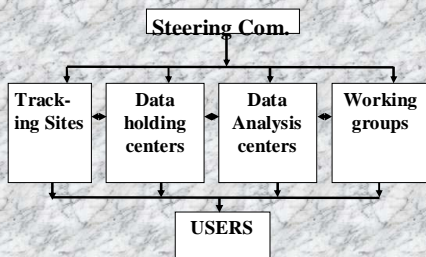
ToR for Regional Centres

- Provide justification, communication and publicity for the project to political groupings, stake holder organisations and other users at regional level
- Coordinate the implementation at regional level
- Assist member states to secure funds
- Carry out trainings specific to AFREF requirements
- Liaise with international bodies
- Assist member states in selection and installation of CORS
- Coordinate data processing, storage and dissemination
- Act as regional data holding centres and;
- Make progress reports to steering committee for every six months

Structure



Operational structure



Call for Participation

- Tracking station networks and centres
- GNSS hardware and software, ancillary equipment, communications infrastructure
- Data Holding Centres
- Data Analysis Centres
- Coordination Centres
- Capacity Building Resources
- Technical support of international geodetic and related scientific bodies
- Industry Partners
- Financial and support in-kind

Medium-Term Plan

- Prepare and distribute "Call for Participation". 1 June 2005
- Prepare and distribute questionnaire of in-country reference frame, available resources and expertise. 1 July 2005
- Letter of intent to submit Participation Proposal to be received by 1st August 2005
- Detailed Participation Proposals to be received by 1st October
- Review of the Participation Proposals by Steering Committee during AfricaGIS, Pretoria 31 October 2005
- Technical working meeting (5 days) proposed for Cape Town in January 2006
- Demonstration of initial concept phase to be completed with streaming of first AFREF GNSS data - January 2007.
See <http://geoinfo.uneca.org/afref>

Technical Workshop

- 5-day workshop in January 2006 in Cape Town. To cover:
- Review of scientific rationale, general applications of the project and current technology available for the project based on Scientific and Expert Panel submission
 - Review existing in-country situation based on questionnaire with respect to:
 - § National reference frames;
 - § Available resources; and
 - § Available in-country expertise.
 - Network design and site selection
 - Review of IGS authored "Guide Line of Specifications and Standards"
 - Data archiving and processing strategy
 - Tutorial on site selection and installation options and best practices.

Publicity & Awareness

- Post information to website: <http://geoinfo.uneca.org/afref>
- Other centres may host mirrored UN-ECA AFREF pages in their websites
- IGS is already hosting an AFREF page including AFREF news
- Other supporting international organizations may link to UNECA-AFREF site
- Make presentations at African and international fora or submit publications to national and international journals
- AfricaGIS Pretoria South Africa
- Workshop for Heads of NMO's of West African countries and Cameroon & Chad in RECTAS
- International fora including IAG, FIG etc meetings
- GIM magazine etc.

Present situation

- There are about 15 IGS stations in Africa
- Are others which have been installed at academic institutions or airports but are not registered as IGS stations.
 - Many of these stations need little or no upgrade to meet IGS standards.
 - South Africa has network of 36 continuous GPS base stations.
- There are a number of contractors setting up own local systems such as in oil industry.

Present situation (cont)

Number of countries in which activities are underway to install permanent base stations or move towards ITRF such as:

Algeria	Namibia
Angola	Nigeria
Egypt	Mozambique
Ethiopia	South Africa
Botswana	Swaziland
Kenya	Zambia
Moroco	Zimbabwe

Institutional Acceptance of AFREF

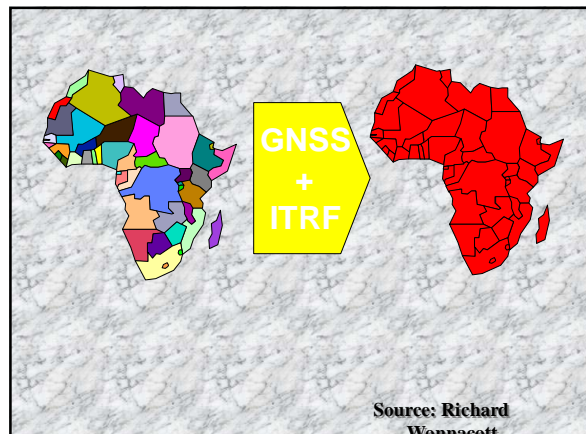
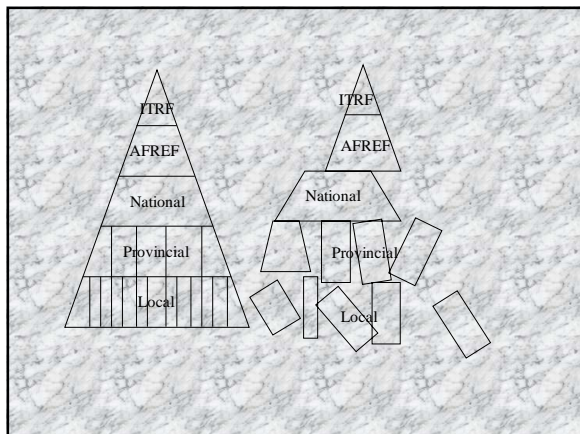
- UN ECA CODI (Committee on Development information)
 - Has adopted the Windhoek Declaration
 - Accepted the importance of AFREF and created a Working Group to deal specifically with AFREF
- UN OOSA (UN Office for Outer Space Affairs)
 - Has recognized importance of AFREF for variety of applications
 - Has been approached to assist with securing project funding
- IAG (International Association of Geodesy)
 - Recognized importance of AFREF and committed support
 - Has created structures to co-ordinate project and provide technical assistance expertise
- IGS (International GNSS Service)
 - Has strong commitment to support AFREF
- FIG (International Federation of Surveyors)

AFREF Way Forward

- **Publicity**
 - Convince NMO's, Govts and International Agencies of importance of AFREF – can't plan or do things unless you know where you are!!
- **Steering Committee has prepared "Call for Participation" which has been distributed to:**
 - African NMO's
 - International Organisations
 - Funding agencies
 - Appropriate equipment manufacturers and vendors
 - See <http://geoinfo.uneca.org> for CFP and other details
- **Effort to go into getting commitment from NMO's and role players.**
- **Get project "NEPAD" registered**

AFREF Way Forward (cont)

- **Funding**
 - Seek assistance to source funding
 - Funding includes donation of equipment and material
- **Information and Communication Technology (ICT)**
 - Identified as a major challenge in Africa by numerous speakers
 - AFREF doesn't require massive bandwidth rather reliability and very high % up-time but broad bandwidth require for other GDI activities.
- **Planning and implementing:**
 - Planning workshop of experts to:
 - To design network
 - To discuss practicalities of station installation etc.
 - Cape Town January/February 2006



Some Relevant URL

- www.space.gc.ca/TIGER : free access to RADARSAT Data
- www.gsdi.org : for SDI issues + subscription to SDI-Africa newsletter
- www.fig.net/pub/subscriptions/getnewsletter.htm : for FIG e-Newsletter
- <http://geoinfo.uneca.org/AFREF> : Information on ECA CODI
- www.fig.net/pub/Cairo : FIG/GSDI-8 Cairo Proceedings
- www.fig.net/accra/ : 5th FIG Regional Conference for Africa in Accra, March 8 – 11, 2006