

AFREF

Background & Progress Towards a Unified Reference Frame for Africa

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Introduction

- New Partnership for Africa's Development (NEPAD)
 - African leaders have pressing need to eradicate poverty and place countries on path of sustainable development.
- Many objectives of NEPAD rely on sound and reliable geo-spatial information.
- Africa Reference Framework (AFREF) is African initiative with strong International support
- 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.
- AFREF conceived as African initiative to unify reference frames based on the ITRF through network of GPS base stations at spacing such the users will be at most within ~1000 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 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 meet 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

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"

Progress to Date (cont)

- August 2004, UNECA CODI (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

Objectives of AFREF

- To determine a continental reference system for Africa consistent and homogeneous with the global reference frame of the ITRF as a basis for national 3-d reference networks.
- To realize a unified vertical datum and to support efforts to establish a precise African geoid.
- To establish continuous, permanent GPS base stations at a spacing such that the users will be within 1000km of a base station and that data is freely available to all nations.

Objectives of AFREF

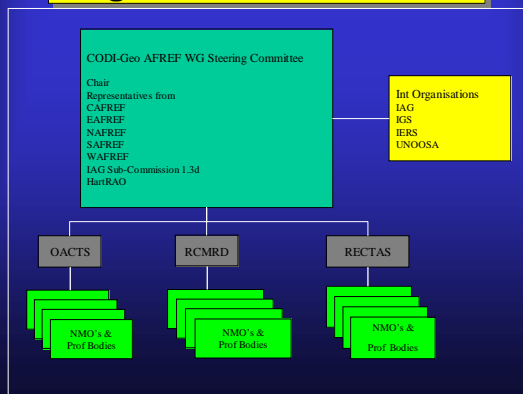
- To provide a sustainable development environment for technology transfer so that these activities will enhance the national networks and other applications.
- Understand the necessary geodetic requirements of participating national and international agencies
- Assist in establishing in-country expertise for implementation , operation, processing and analysis of modern geodetic techniques, primarily GPS

Organizational Structure

The structure reflects the broad concepts of AFREF that:

- It is to be designed, managed and executed from within African;
- It is to be organized on a regional basis;
- It is to be executed at the national level; and
- Technical expertise and support will come from the international geodetic community.

Organizational Structure



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 activities underway to install permanent base stations or move towards ITRF

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

Present situation (cont)



Institutional Acceptance

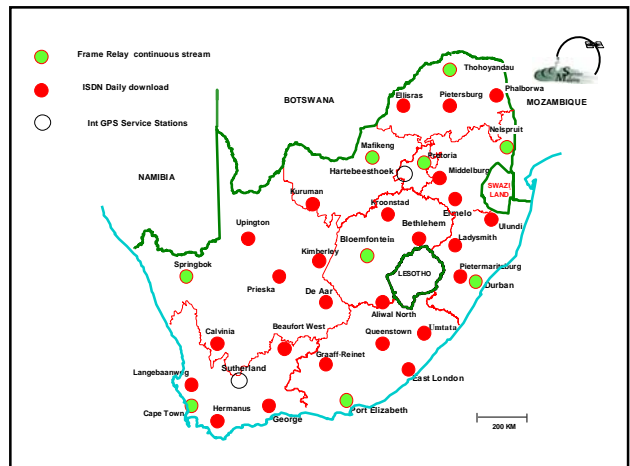
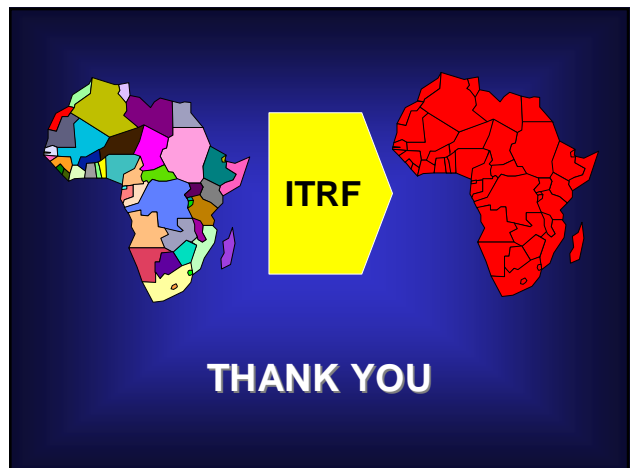
- UN ECA CODI (Committee on Development information)
 - Have adopted the Windhoek Declaration
 - Have accepted the importance of AFREF and created a Working Group to deal specifically with AFREF
- UN OOSA (UN Office for Outer Space Affairs)
 - Have recognized importance of AFREF for variety of applications
 - Have been approached to assist with securing project funding
- IAG (International Association of Geodesy)
 - Have recognized importance of AFREF and have committed support
 - Have created structures to co-ordinate project and provide technical assistance expertise
- IGS (International GPS Service)
 - Has strong commitment to support AFREF
- FIG (International Federation of Surveyors)
 - Wouldn't be here without support of FIG

Way Forward

- **Publicity**
 - Convince NMO's, Govts and Internatioanl Agencies of importance AFREF – can't plan or do things unless you know where you are!!
- **Commitment from NMO's**
 - Develop a document that calls for participants to contribute or play various roles
 - Get project "NEPAD" registered
- **Funding**
 - Seek assistance to source funding
 - Funding includes donation of equipment and material

Way Forward (cont)

- Steering Committee preparing "Call for Participation" to be distributed to:
 - African NMO's
 - International Organisations
 - Funding agencies
 - Appropriate equipment manufacturers and vendors
- Start planning and implementing
 - Planning workshop of experts and African geodesits to;
 - To design network
 - To discuss practicalities of station installation etc.
 - Cape Town January 2006
- Web site to be hosted by UN ECA from about June 2005
 - <http://geoinfo.uneca.org/afref>



Progress (cont.)

UNOOSA GNSS Workshop - Lusaka, July 2002

Surveying, Mapping and Earth Science, Recommendation 1:
 "Establish a continental reference for Africa, or African Reference Frame (AFREF), consistent with the International Terrestrial Reference Frame"

- A uniform coordinate reference system is fundamental to any project, application, service or product that requires some form of geo-referencing.
- used for national surveying, mapping, photogrammetry, remote sensing, Spatial Data Infrastructure (SDI), Geographical Information Systems (GIS), development programs, and hazard mitigation (earthquake studies, fault motion, volcano monitoring, severe storms).
- making cross-border or regional mapping, development, and project planning very difficult.
- The benefits of GNSS technology cut across applications and across countries.
- It is further emphasized that the importance of simultaneous development of information and communications technology (ICT) and related infrastructure

Progress (cont.)

- Windhoek Dec 2002
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 - 8 Southern and East African member states represented
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(See "Objectives" later)



Progress (cont.)

- IAG re-organization adopted in 2003. Implemented a new structure that
 - Will have a focus
 - Is based on the three pillars of modern geodesy, namely
 - geometric shape of the Earth
 - Earth's gravity field, and
 - orientation of the Earth in space
 - Will better incorporate the very successful IAG services, among others, by representation in the IAG Executive Committee
 - AFREF initiative has strong support of the IAG Exec. Committee
 - IAG new structure is a mechanism to engage and support AFREF
 - Commission 1, Reference Frames (Prof. Herman Drewes)
 - Sub-commission 1.3 Regional Reference Frames (Zuheir Altamimi)
 - Sub-commission 1.3(d) Africa (Richard Wonnacott)
 - IAG new project the Global Geodetic Observing System (GGOS)
 - Focuses on importance of long term geodetic measurements as integral component of Earth system science
- <http://www.iag-aig.org/>

Progress (cont.)

- International GPS Service
 - The economics of GPS make the measurement technology readily available and globally accessible to *all* users
 - The organization and outreach of the IGS enables users to take advantage of data, systems, and products developed cooperatively with the top international GPS/GNSS experts
 - Standards are developed and adopted worldwide through the IGS activities
 - contributing to robust, homogenous reference system
 - implementing common processes
 - IGS is a supporting global foundation for nearly all regional and national GPS and GLONASS geodetic networks, projects, and numerous applications worldwide
 - Must ensure appropriate evolution, coordination, and interoperability of multiple GNSS systems for *societal and scientific benefit*
 - IGS has long term commitment to AFREF
 - AFREF is for Africa, must be an African led project
 - Success is a long term effort
 - Count on strong partnership with IGS

Progress (cont.)

- UN ECA CODI (Committee on Development Information)
 - Adopted the Windhoek Declaration April 2004
 - Established a Working Group on AFREF
- African Association of Remote Sensing of the Environment (AARSE) (October 2004)
 - Pre-conference AFREF meeting
 - Representatives from all regions
 - Settled on WG structure
 - Drew up Terms of Reference for various levels in structure

Progress in Southern Africa

- Botswana
 - Converted to ITRF 2000 ~2 years ago
 - Has 1 known permanent IGS base stations
 - Used GPS data from South Africa
- Namibia
 - In process of establishing base stations
 - Windhoek has number base stations + 1 IGS base station
- Mozambique
 - US AID interested in installing stations
- South Africa
 - Converted to ITRF 91 (1994.0) ~5 years ago
 - Has network of 35 TrigNet + 4 IGS base stations
- Zambia
 - Has 1 permanent IGS base station

Terms of Reference

ToR for Steering Committee:

- Co-ordinate the implementation of the AFREF project at the continental level;
- Coordinate data processing, storage and dissemination at the continental level;
- Set guidelines and standards to be used for the AFREF project;
- Provide justification, communication and publicity for the project to political groupings, stake holder international organisations and other users. Political groupings will include NEPAD while ICAO is an example of a stake holder international organisation;
- Secure funding and other resources such as equipment to ensure the success of the project;
- Liaison 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.

Terms of Reference

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 at the regional level;
- Act as regional data holding centres and;
- Make six monthly progress reports to the steering committee.