

# The AFREF Project: Background Rationale and Progress

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## Overview

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- The Africa Doppler Survey (ADOS)
- Progress to Date
- Windhoek Declaration
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## Introduction

- New Partnership for Africa's Development (NEPAD) - 2001
  - African leaders have pressing need to eradicate poverty and place countries on path of sustainable development.
- Six sectoral priorities of NEPAD
  - Bridging infrastructure gap
    - Water
    - Transport
    - Energy
    - ICT
  - Human resource development
    - Reverse brain drain
  - Agriculture
  - Environment initiatives
  - Culture
  - Science and Technology platforms
    - GIS

## Introduction

- 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

## 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 topo, cadastral, engineering and mining surveys.

## 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 is, therefore, an 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 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

## Progress to Date

- Global Spatial Data Infrastructure (GSDI) meeting in Cape Town 2000
  - Need expressed for unified reference frame
- Perhaps 1<sup>st</sup> 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 Declaration Dec 2002
- August 2004, UNECA CODI (Addis Ababa)
  - Accepted "Windhoek Declaration" and
  - Established a Working Group on AFREF
  - Nominated a Steering Committee

## Progress to Date (cont)

- 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
- 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

## Windhoek Declaration

- 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

In broad terms the Declaration is a commitment by the 8 signatory countries to:

- Support the AFREF project;
- Publicize & promote the project within their respective Governments and international organizations;

and that

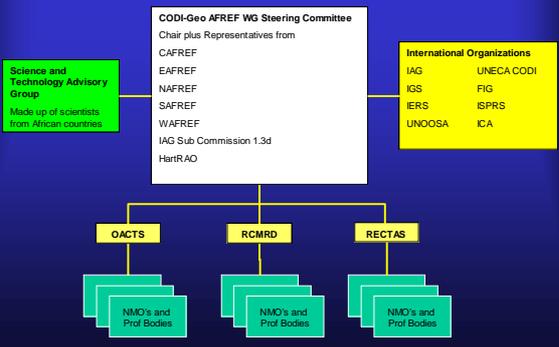
- The UNECA should accept the principles & concepts of AFREF and these be accepted and implemented by UNECA CODI;
- UNOOSA be requested to support the project; and
- The IAG and the IGS be requested to continue to support the project and assist with it's implementation.

## 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



## 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

## Present situation

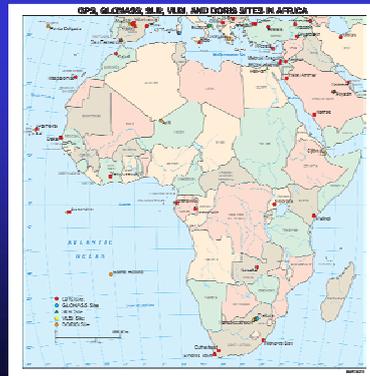
- There are about 15 IGS stations in Africa
- There are others which have been installed at academic institutions or airports but are not registered as IGS stations.
  - Many of these stations need little or no upgrade to meet IGS standards.
  - Côte d'Ivoire has a network of XXX permanent base stations
  - South Africa has network of 38 continuous 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	Mozambique
Angola	Namibia
Botswana	Nigeria
Côte d'Ivoire	South Africa
Egypt	Swaziland
Ethiopia	Zambia
Kenya	Zimbabwe
Morocco	

## 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 GNSS Service)
  - Has strong commitment to support AFREF
- FIG (International Federation of Surveyors)
  - Has sponsored workshops in Cairo and now Accra

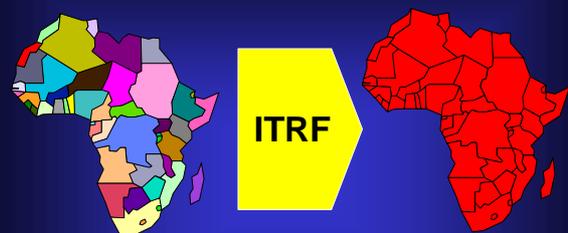
## Way Forward

- Publicity
  - Convince NMO's, Govts and International Agencies of importance 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
- Effort to go into getting commitment from NMO's and role players.
- Get project "NEPAD" registered

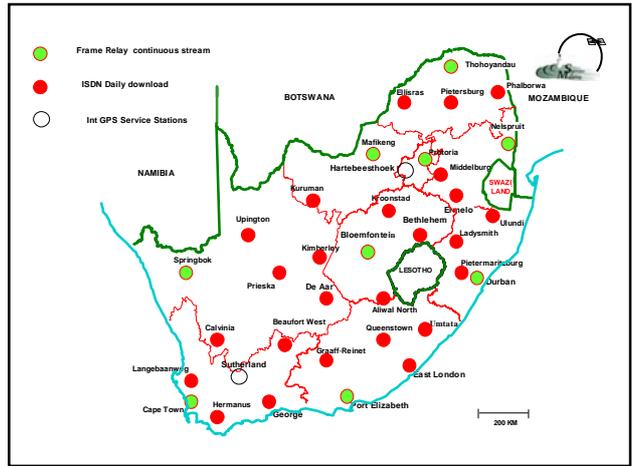
## Way Forward (cont)

- Funding
  - Seek assistance to source funding
  - Funding includes donation of equipment and material
- Start planning and implementing:
  - Planning workshop of experts and African geodesits to:
    - To design network
    - To discuss practicalities of station installation etc.
  - Cape Town July 2006
- Web site hosted by UN ECA has been established:

<http://geoinfo.uneca.org/afref>



THANK YOU



### 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
  - Meeting held prior to RCMRD meeting
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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.