

The AFREF Project

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Overview

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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 geospatial 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 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 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 July 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

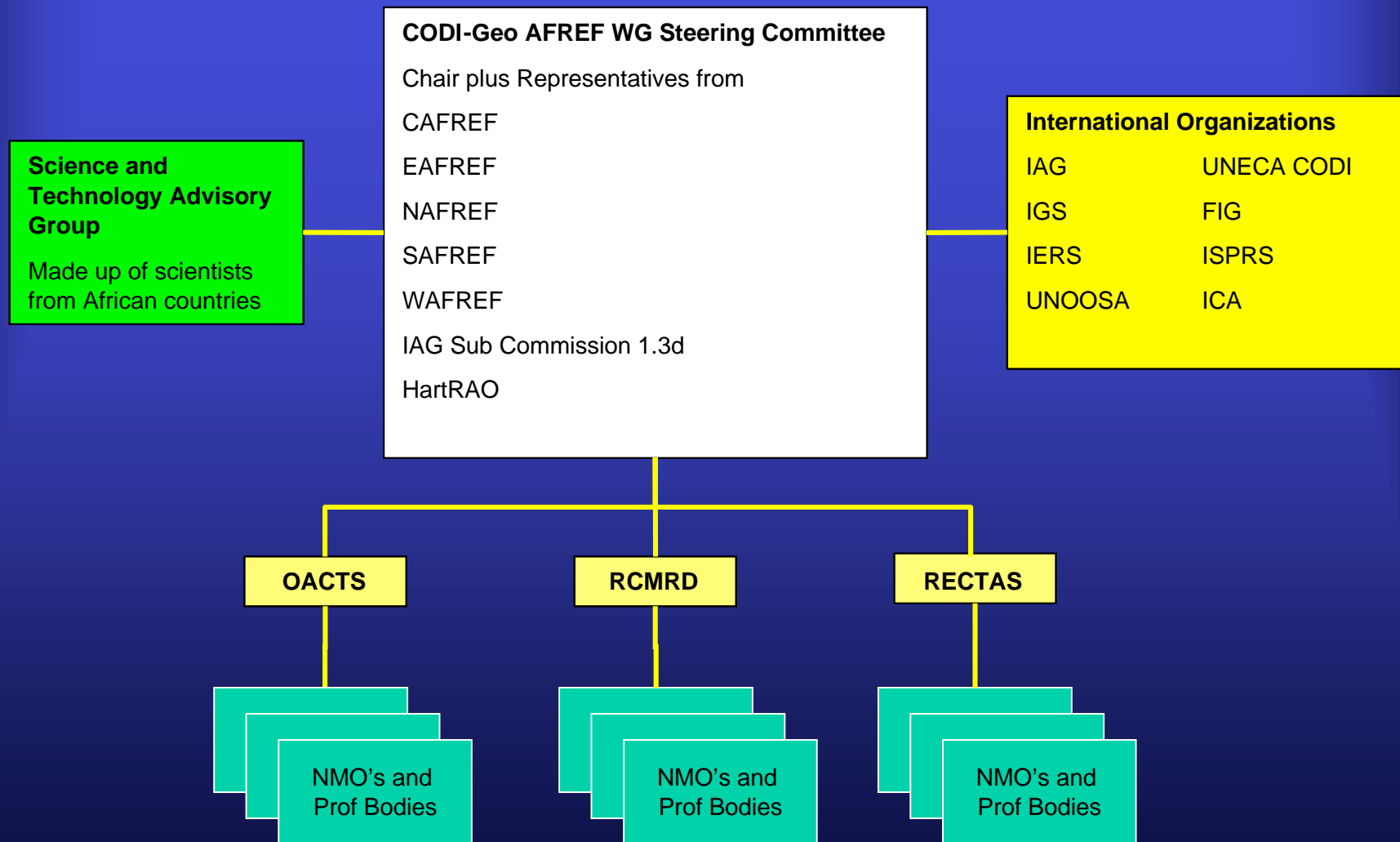
- The UNECA should accept the principles & concepts of AFREF and these be accepted and implemented by UNECA CODI;
- UNOOSA be requested to support the project; and
- The IAG and the IGS be requested to continue to support the project and assist with it's implementation.

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.
 - 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.
- There are some aid agencies and scientific institutions supporting installation of continuous GNSS stations
 - US AID assisting Ethiopia and Mozambique for surveying and GIS applications
 - GFZ donated equipment for use in Mozambique for IGS TIGA project
 - NOAA Space Environment Centre plan to install 5 or 6 receivers in Sub-Sahara Africa in support of 2007 IHY and Africa Monsoon Multi-disciplinary Analysis (AMMA) project in West Africa.

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

Egypt

South Africa

Ethiopia

Swaziland

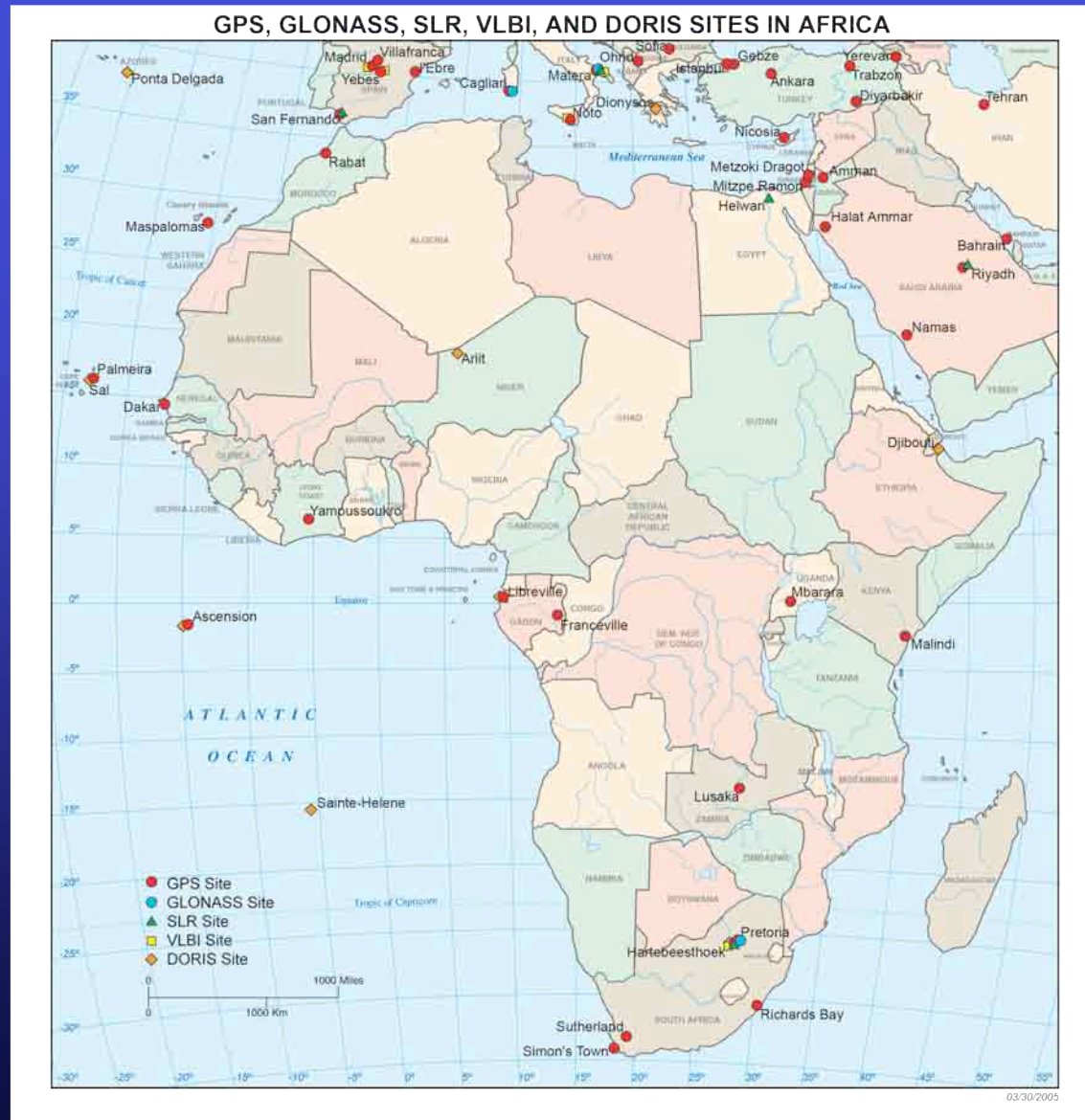
Kenya

Zambia

Morocco

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

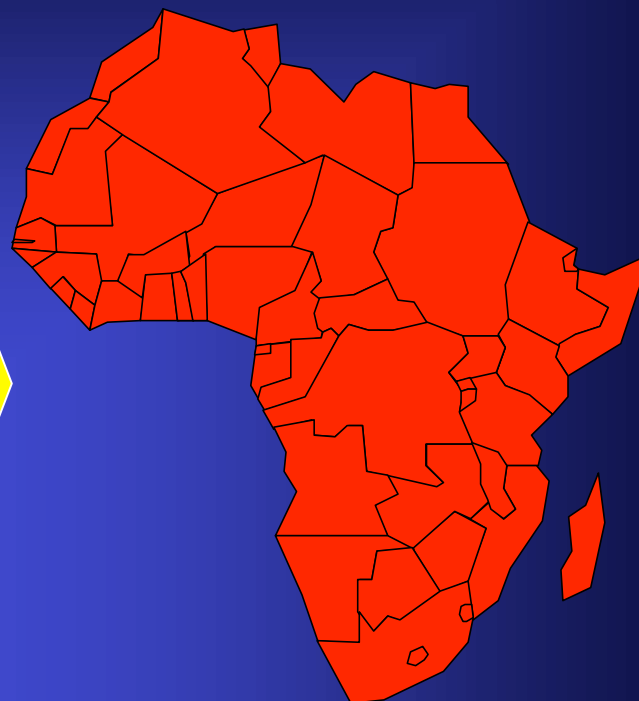
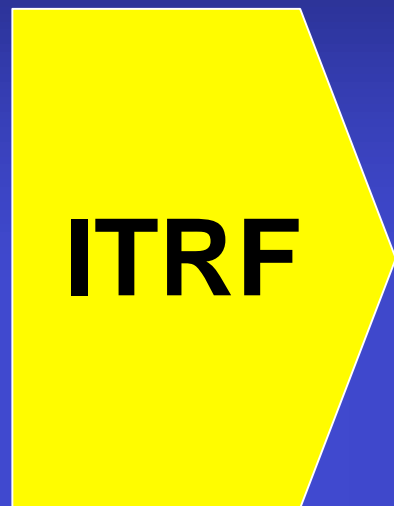
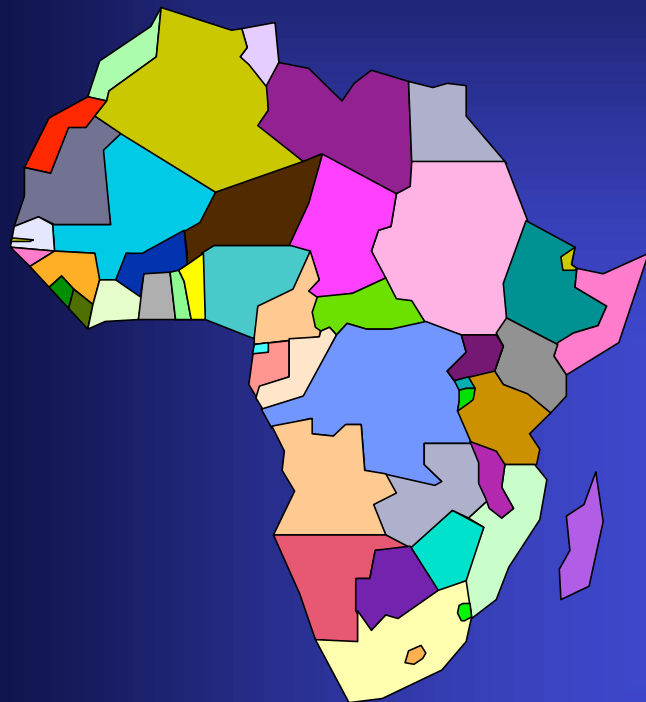
Way Forward

- **Publicity**
 - Convince NMO's, Govts and Internatioanl Agencies of importance AFREF – can't plan or do things unless you know where you are!!
- **Steering Committee has prepared “Call for Participation” which has been distributed to:**
 - African NMO's
 - International Organisations
 - Funding agencies
 - Appropriate equipment maunfacturers and vendors
- **Effort to go into getting commitment from NMO's and role players.**
- **Get project “NEPAD” registered**

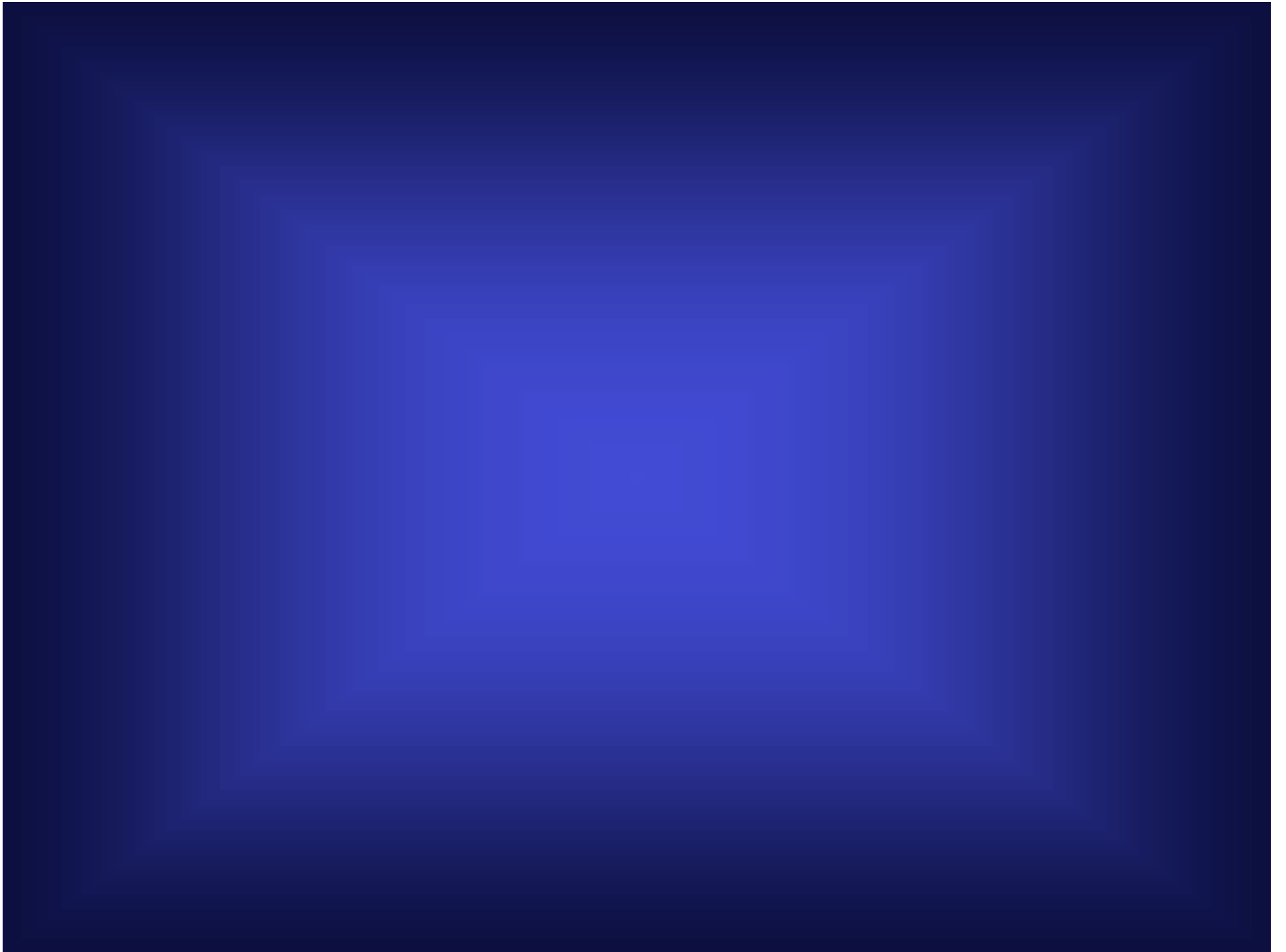
Way Forward (cont)

- **Funding**
 - Seek assistance to source funding
 - Funding includes donation of equipment and material
- **Start planning and implementing:**
 - Planning workshop of experts and African geodesists 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>








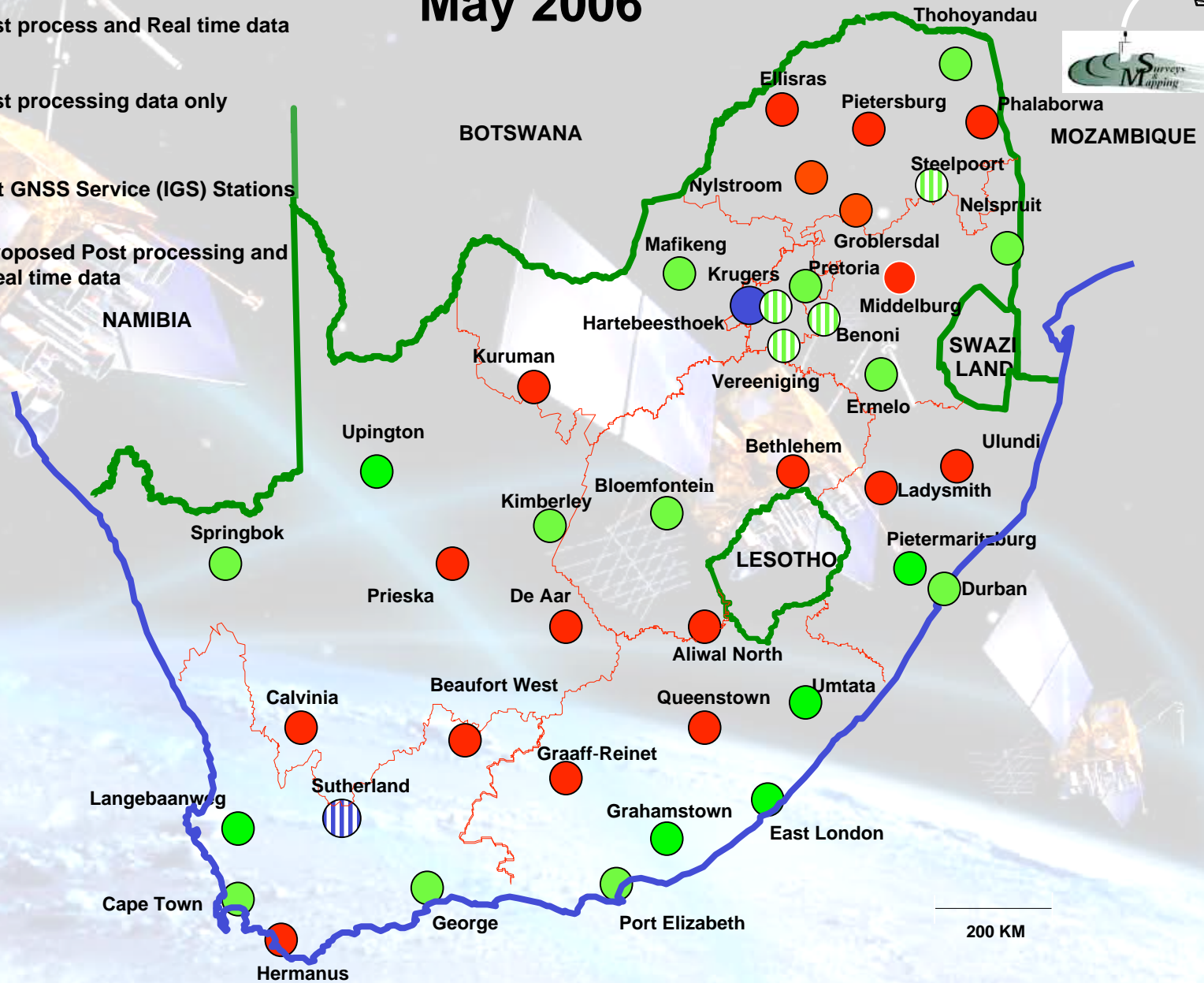
THANK YOU



May 2006



-  Post process and Real time data
-  Post processing data only
-  Int GNSS Service (IGS) Stations
-   Proposed Post processing and Real time data



200 KM

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
 - 8 Southern and East African member states represented
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(See “Objectives” later)

Existing and Proposed GPS Base stations for East and Southern Africa
December 2002



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 interoperation 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 form 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.