



AFREF: Concept and Progress

**United Nations Regional Cartographic Conference
for**

Asia and the Pacific

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Bangkok

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Overview

- **Background**
- **Rationale for AFREF**
- **Objectives & Structure**
- **Progress**
- **Capacity building**
- **What Next?**
- **Challenges**
- **Conclusion**



Background

- In the 1980's the Africa Doppler Survey (ADOS) was undertaken driven primarily by the International Association of Geodesy.
- ADOS was designed to unify geodetic frames of Africa using Doppler to provide:
 - Zero order control for mapping;
 - Control datum for unification and strengthening of a continental reference frame for Africa; and
 - Accurate geoid for Africa
- Project didn't really meet it's objectives:
 - Essential to have simultaneous observations – difficult without IGS type infrastructure
 - Rationale not fully understood by participating countries
 - Project planned entirely by IAG with little input from African countries
 - No clear standards



Rationale for AFREF

- Over 50 countries in Africa each with their own geodetic reference system and frame and some with 2 or more frames.
- Although there are many areas of conflict there are also areas where peace has been restored and require a lot of development.
- African Union has requested that countries resolve international boundary issues within next couple of years.
- It is known that many private commercial enterprises are setting up their own reference frames particularly in the oil and mining industries.
- **AFREF is, therefore, an African initiative to unify the geodetic reference frames of Africa based on the ITRF through a network of GNSS base stations at a spacing such users will be at most within ~1000 km of a base station.**



Objectives of AFREF

Formally established with Windhoek Declaration in 2002:

- To determine a continental reference frame 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 a network of continuously operating, permanent GNSS 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 determine the relationship between the existing national reference frames and the ITRF to preserve legacy information based on existing frames.
- To provide a sustainable development environment for technology transfer so that these activities will enhance the national networks and other applications.
- Assist in establishing in-country expertise for implementation , operation, processing and analysis of modern geodetic techniques, primarily GNSS.



Current AFREF Structure

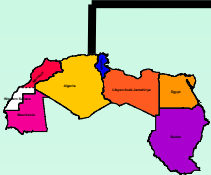
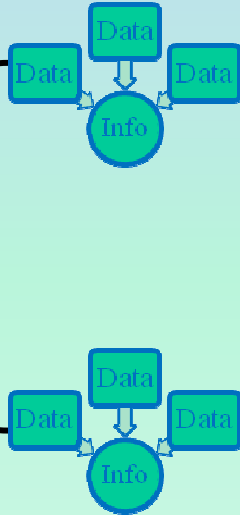
AFREF Steering Committee
Co-Chairs: RCMRD & AOCRS
RECTAS
Regional Reps
IAG Sub-commission 1.3d (Africa)
Dir Central Bureau IGS

Scientific advisory group

**UN ECA
CODIST**

AFREF Secretariat

Operational Data Centres



NAFREF



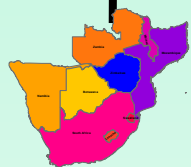
WAFREF



CAFREF



EAFREF

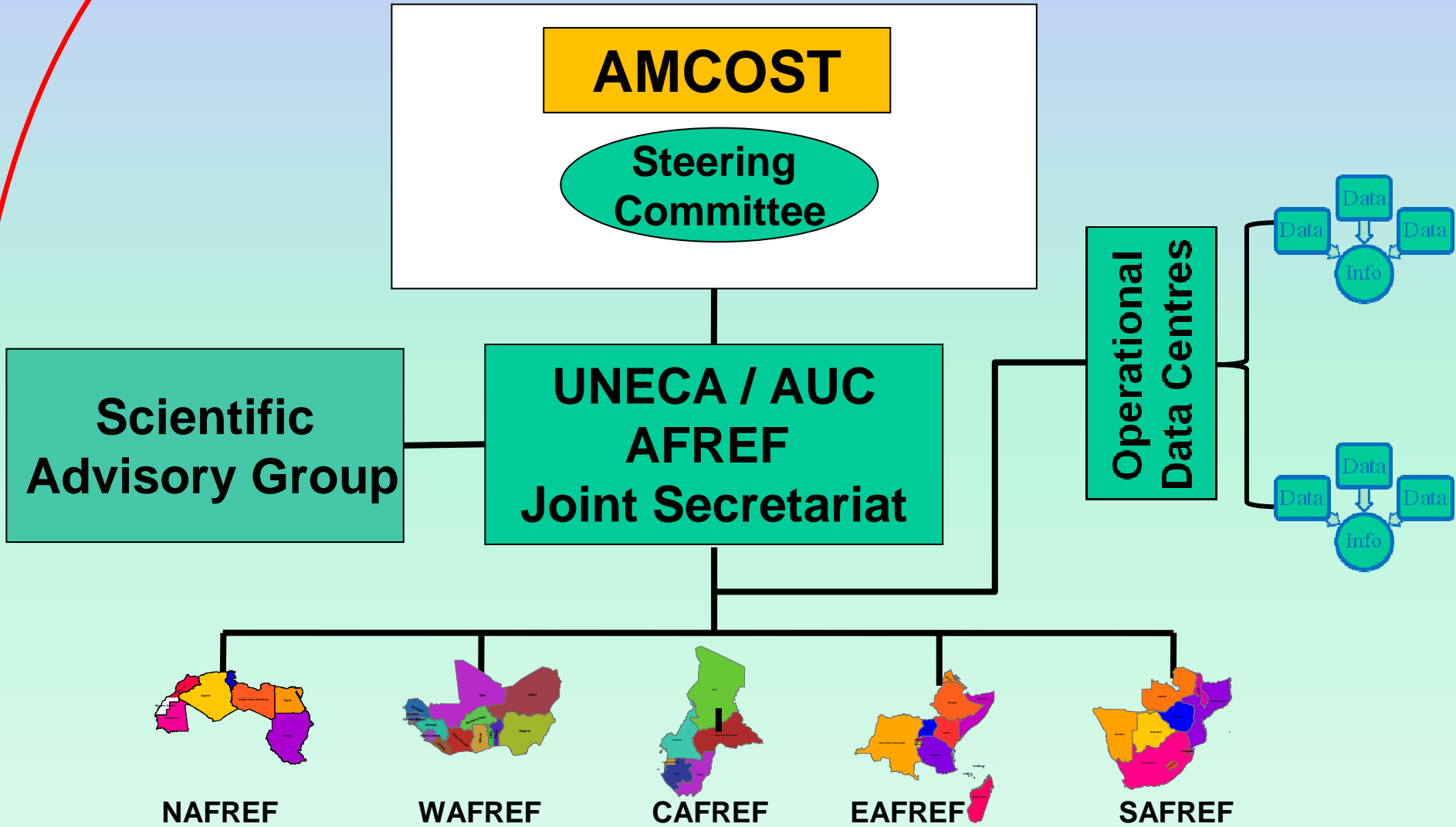


SAFREF

CODIST - Committee on Development Information, Science &



Proposed AFREF Structure



AMCOST - African Ministerial Conference of Science & Technology



International Endorsement

- **UN ECA CODIST**
 - Have adopted the Windhoek Declaration
 - Created a Working Group to deal specifically with AFREF
- **UN OOSA**
 - Have recognized the importance of AFREF for variety of applications
 - Supported travel for some AFREF activities
- **IAG**
 - Have created structures to co-ordinate the project and provide technical assistance and expertise
- **IGS**
 - Has strong commitment to support AFREF
- **FIG**
 - Have sponsored meetings and Working Weeks



Progress to Date

Various of activities underway in a number of countries to install permanent base stations or move towards ITRF:

Algeria

Benin

Cameroon

Ethiopia

Kenya

Malawi

Mozambique

Nigeria

South Africa

Tanzania

Uganda

Angola

Botswana

Egypt

Ghana

Lesotho

Morocco

Namibia

Rwanda

Swaziland

Tunisia

Zambia



Progress to Date

As agreed at CODIST I (April 2009), an AFREF Operational Data Centre (ODC) has been established.

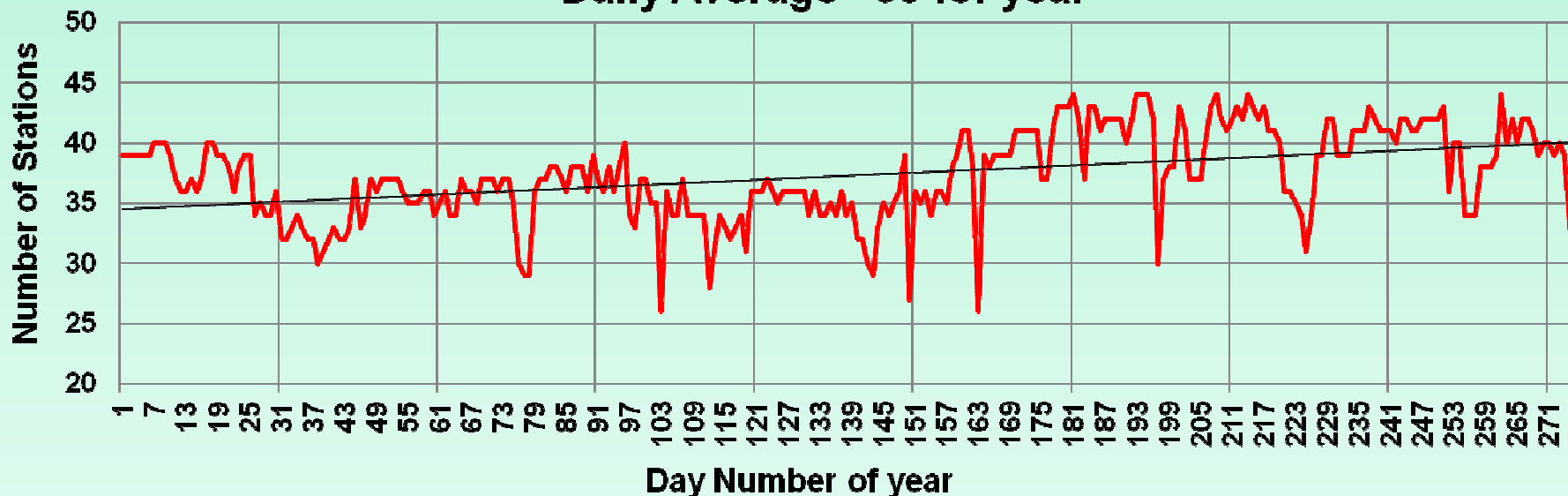
- www.afrefdata.org or [ftp.afrefdata.org](ftp://ftp.afrefdata.org)
- Data from continuous stations brought together from number of data centres into one place. Data centres include:
 - International GNSS Service (IGS Global Data Centres eg CDDIS)
 - Hartebeesthoek Radio Astronomy Observatory (South Africa)
 - National Geodetic Survey (USA)
 - TrigNet (South Africa)
 - UNAVCO (Africa Array)
 - Nignet
 - SEGAL
 - etc
- ODC is recognised by IGS



Progress to Date

- The AFREF ODC is currently archiving on a daily or near daily basis data from nearly **73** permanent GNSS base stations at average of **38** stations daily (as at Sept 2012).
- Data is freely and openly available to all users.

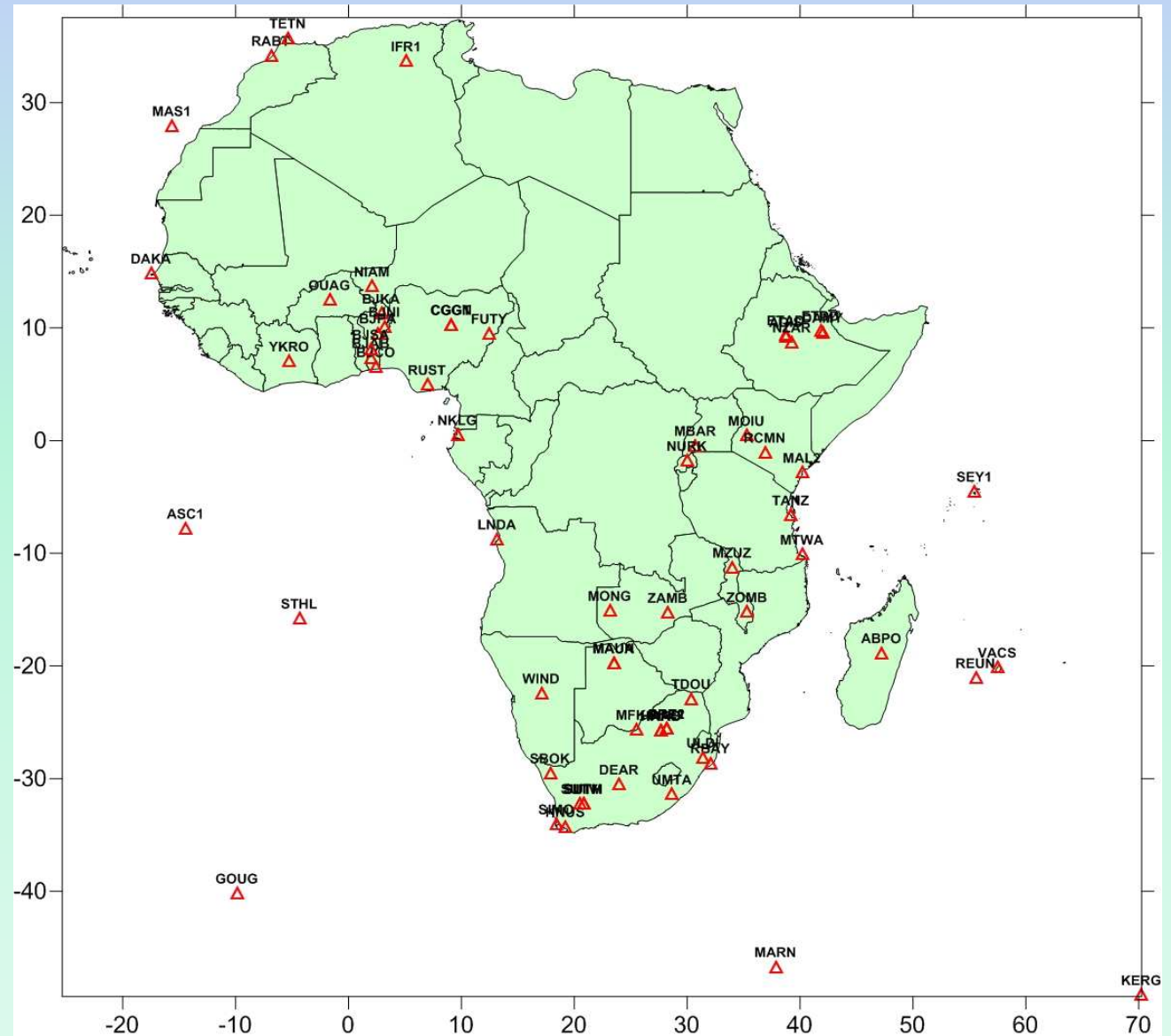
Number of stations archived daily: Jan to Sept 2012
Daily Average - 38 for year





Progress to Date

Active stations
being archived at
AFREF
Operational Data
Centre (May
2012)





Progress to Date

More co-ordination required: MTWA & MTVE 3km apart!!!

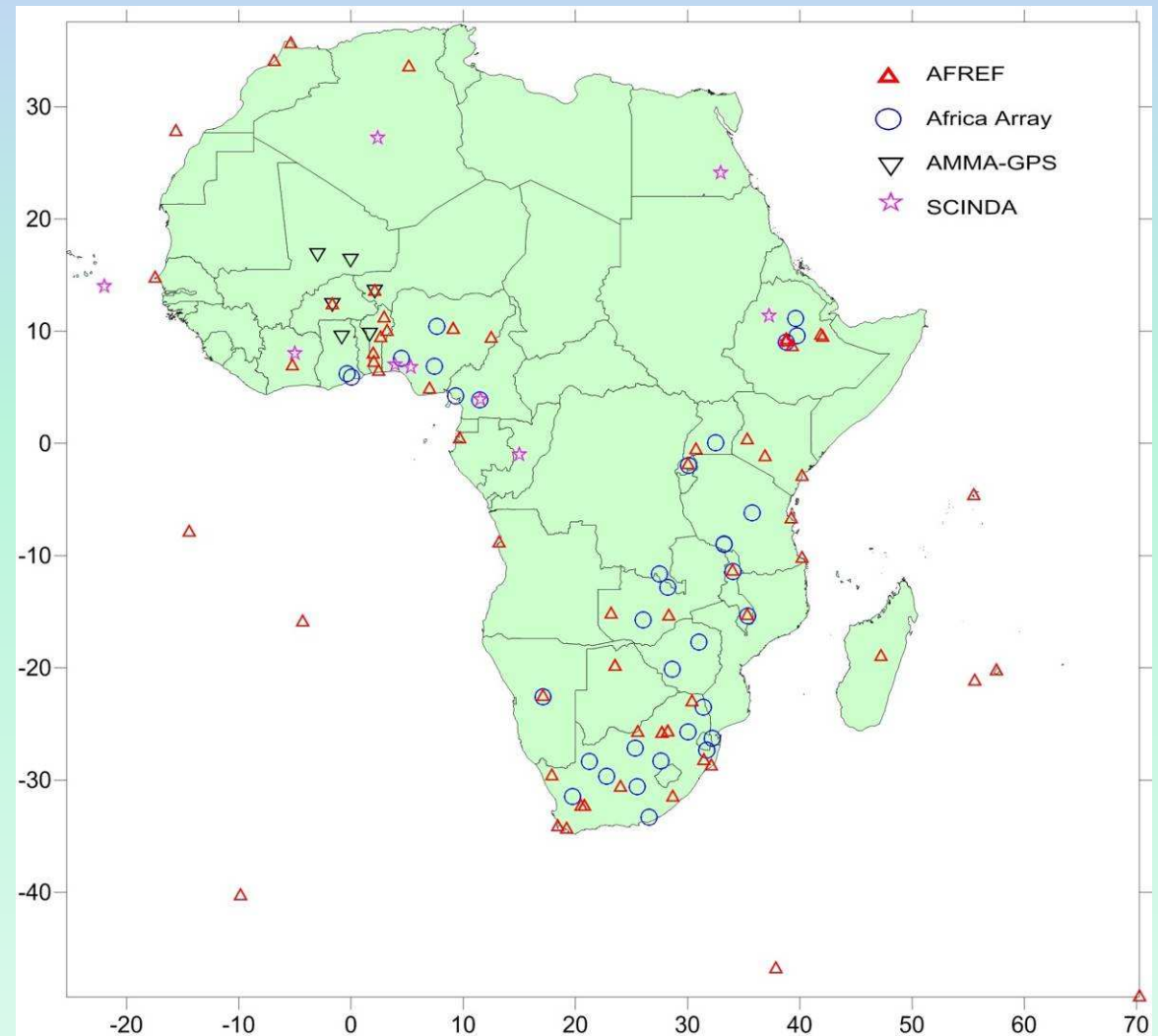




Inter-disciplinary Collaboration

**Number of disciplines
make use of GNSS
signal in space:**

**Geodesy: AFREF
Seismology: Africa Array
Meteorology: AMMA-GPS
Space weather: SCINDA**





Capacity Building

- **Annual training courses at the technician level** on the establishment of continuous reference stations and the processing of GNSS data are offered by RCMRD in Kenya and are well attended.
- On-going training on all aspects of satellite based mapping and positioning is conducted throughout the year at RECTAS in Nigeria.
- **Meetings of the heads of NMAs** are held from time to time to reinforce the importance permanent GNSS base stations and ITRF based National reference frames



What Next?

Project has reached the stage where the following can be done:

1. At the Continent level:

- **Computation of network of fiducial stations based on well established stations with long term reliability and publically available data;**
- **An initial processing will provide set of co-ordinates for use at National level - static set of co-ordinates;**
- **In addition must continue with ongoing processing to maintain network, to provide a set of velocity vectors and to make allowance for the addition of new stations;**
- **NB: GNSS is an observing tool that has to be calibrated from time to time - CORS station coordinates to be updated to reflect plate motion – co-ordinates derived from AFREF CORS will have to be transformed to AFREF static co-ordinates.**



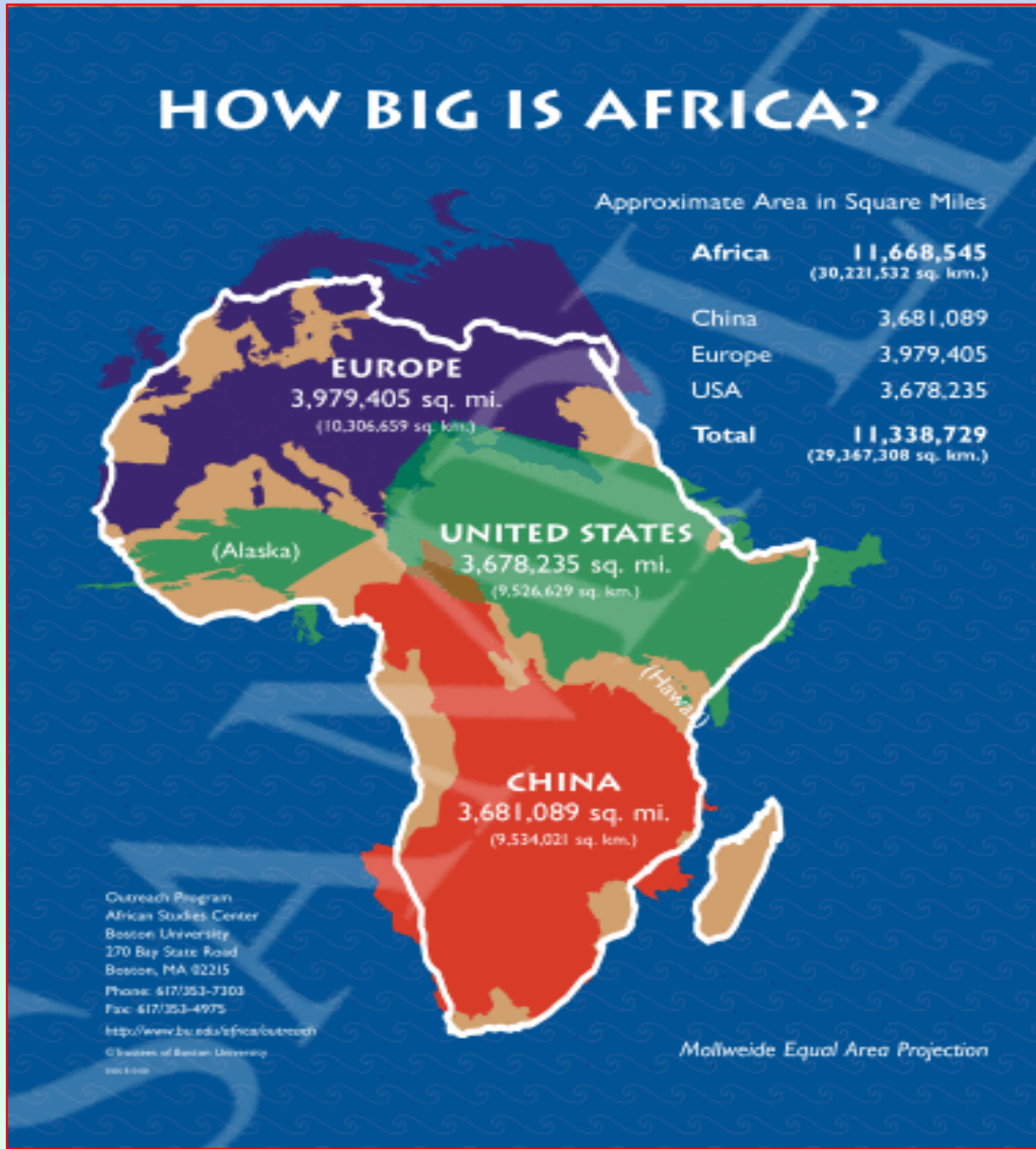
What Next?

2. At the National level:

- **Major objective of project is conversion of National geodetic networks to AFREF and hence ITRF;**
- **NMAs will have to occupy and survey a number of strategically placed points whose co-ordinates are well established in the National frame using GNSS relative to AFREF/ IGS CORS;**
- **Processing could be as series of campaigns using permanent stations to convert or transform current National reference frame to AFREF.**



Challenges





Challenges

- **Apparent** lack of enthusiasm for project by NMA's
 - Lack of understanding?
 - Lack of resources – capacity and financial?

- **Political buy-in**
 - Again lack of understanding of benefits?
 - Geodesy, Reference Frames etc doesn't buy votes!
 - AFREF talks a technical language

- **Political instability and security**
 - Not much we can do about this



Conclusion

- Progress has been slow.
- Co-operation with other disciplines has been of benefit to AFREF and the co-operating disciplines **BUT**;
- Greater co-ordination between countries and especially participating disciplines required.
- The proposed new structure to place AFREF within the African Union (AU) structures, AMCOST, should bring the project closer to political leaders.
- AFREF is at stage where a provisional static ITRF based reference frame for Africa can be produced to be used by NMAs

Thank You



Websites for further information and data

www.afrefdata.org

[ftp.afrefdata.org](ftp://ftp.afrefdata.org)