The State and Utilization of the Nigeria CORS Network

Presented by:

Surv. AbuduGaniyu. A. Adebomehin
(Assistant Director of Geodesy)
Office of the Surveyor General of the Federation
Abuja, Nigeria.

International Training Workshop on Global Navigation Satellite Systems (GNSS), Ile-Ife, Nigeria from 8th - 13th Aug., 2016.

OUTLINE OF THE PRESENTATION

- Introduction
- Brief History
- Aims and Objectives
- Site Selection
- NIGNET Site Information
- Progress made in Areas of Research and Training
- Projects and Research work, using CORS
- Challenges emanating from Current NIGNET Status
- NIGNET Future Road Map
- CONCLUSION

INTRODUCTION

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- And some of the research work carried out since 2009 in the implementation of Nigerian GNSS Reference Network (NIGNET), in pursuant of the African Geodetic Reference Frame (AFREF) Project, by the Office of the Surveyor General of the Federation (OSGoF).

BRIEF HISTORY OF NIGNET

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CODIS (Committee on Development Information, Science and Technology)



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UNECA (United Nation Economic Commission For Africa)



CODIS (Committee on Development Information, Science and Technology)



AFREF(African Geodetic Reference Frame)

BRIEF HISTORY OF NIGNET

- **To establish a continental reference system as a basis for national reference networks.**
- **To establish permanent GNSS base stations such that users will be within 500km of a base station and that data is freely available to all users.**
- **To realize a unified vertical datum and to support efforts to establish a precise African geoid.**

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CODIS (Committee on Development Information)



AFREF(African Geodetic Reference Frame)



NIGNET (Nigerian Permanent GNSS Network)

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Figure 1 – Location of the NIGNET CORS stations (green and yellow). Also shown the stations installed in the framework of Land Reform project (purple) and the station from RECTAS (red).

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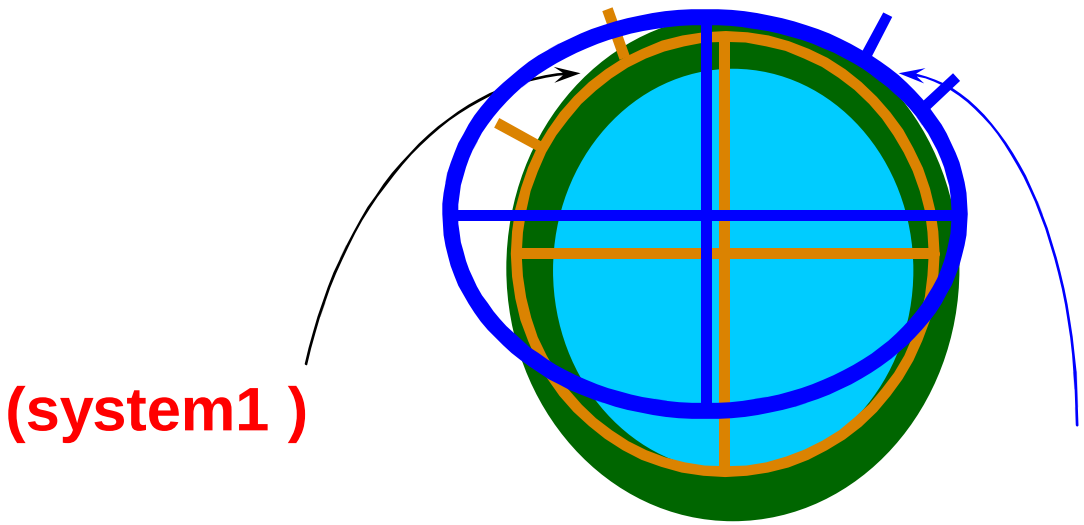
- To present some of the efforts OSGoF has made in the sustenance of the project and some of the challenges being faced.
- To present some the Projects and Research work conducted/supported by the NIGNET Network.
- In addition, to seek for collaboration and support from both Local & International Communities in the area of capacity building

PROBLEMS OF THE OLD SYSTEM

q Traditionally each country has its own geodetic reference system.



q Maps in neighbouring countries do not match at the national boundaries.

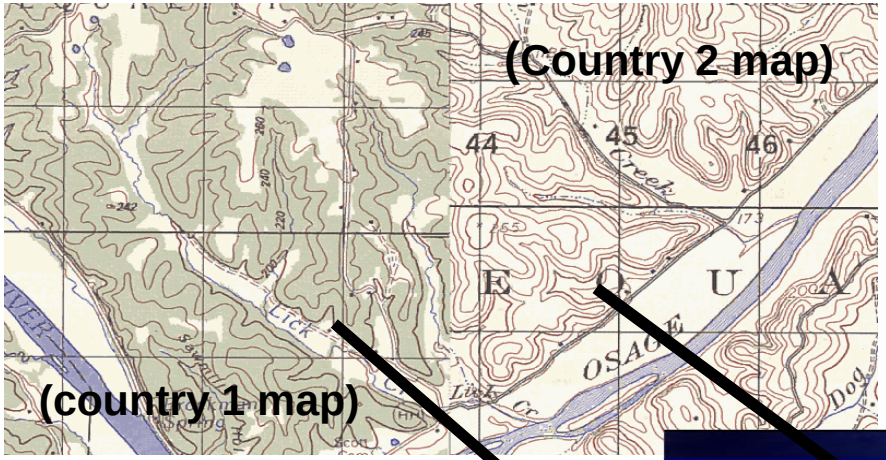
Limitations to the Traditional Approach

- **Many nations established their own references**
  - ***Standards and Procedures Vary Widely***
- **Coordinates from different references are completely incompatible**
  - ***Relative to Initial Point of Datum***
  - ***Will vary as a function of Ellipsoid parameters***

PROBLEMS - CONSEQUENCES :

- **Confusion within countries as to appropriate datums, projections and transformations to be used**
- **Confusion and conflict regarding international borders**
- **Confusion and delays in cross-border projects - boundary definition, transport corridors, mapping, exploitation of mineral resources**

Consequences of using reference systems that are not consistent !





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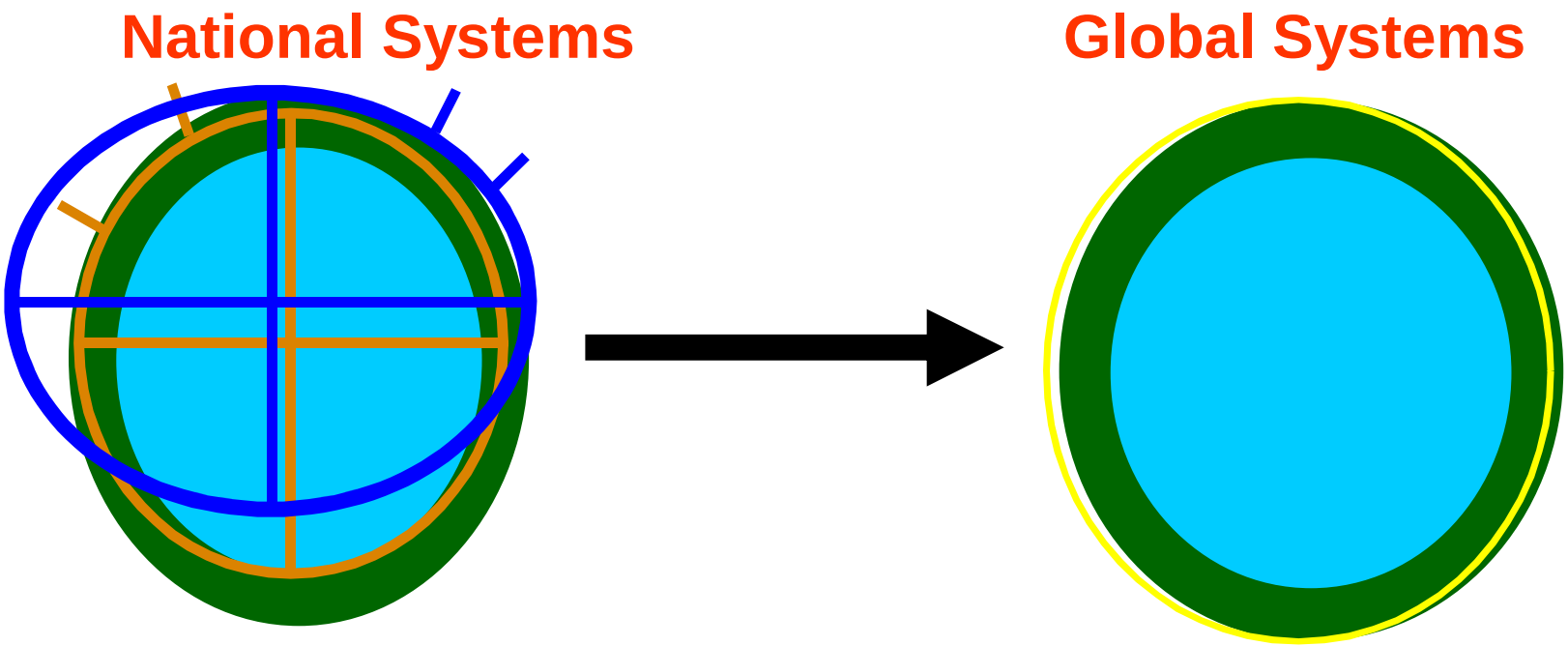

WHY NIGNET / AFREF CORS?

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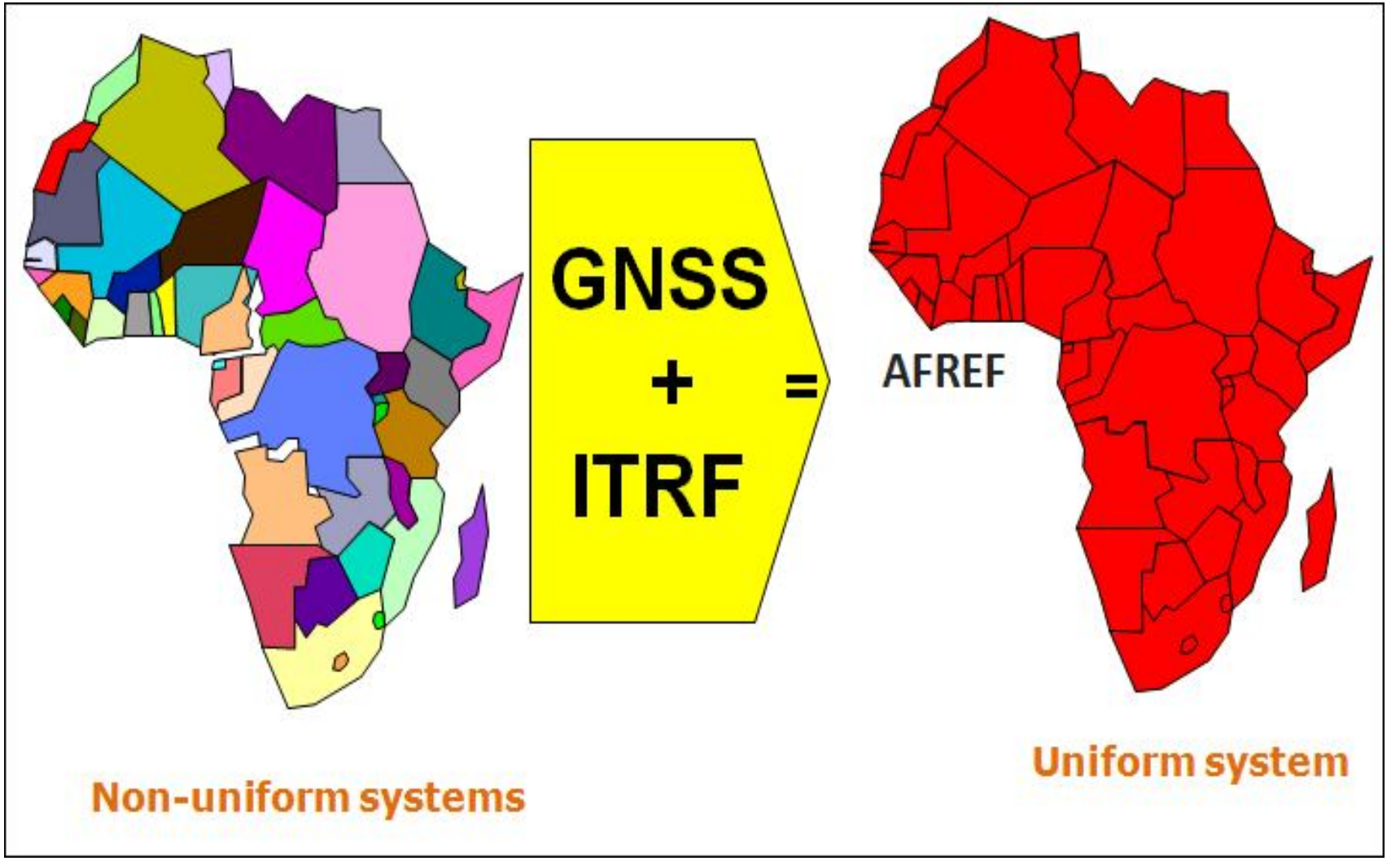

WHY NIGNET / AFREF CORS?



SITE SELECTION CRITERION USED

- **Some of the criteria considered are as follows:**
- Monumentation, Mounting and Marking Antenna Reference Point were according to IGS Specifications.



SITE SELECTION CRITERION USED

- **Some of the criteria considered are as follows:**

- Stability: a stable base site was considered.



SITE SELECTION CRITERION USED

- **Some of the criteria considered are as follows:**
- Clear sky visibility and locations free from interferences due to Radio Frequency (RF) from other sources.





SITE SELECTION CRITERION USED

- **Some of the criteria considered are as follows:**
- Ground based mounting were executed in accordance to the specifications for a ground based mounting.





SITE SELECTION CRITERION USED

- **Some of the criteria considered are as follows:**
- For the roof-based monument, all the stations were built on buildings that are at least 5 years old





NIGNET SITE INFORMATION

- **OSGF**

Abuja

Station	OSGF
Location	OSGoF, Abuja
Date of Installation	12-10-2009





NIGNET SITE INFORMATION

- **CGGT**

Toro

Station	CGGT
Location	Center of Geodesy and Geodynamics, Toro
Date of Installation	06-02-2010



NIGNET SITES INFORMATION CONT...

Yola

Station	FUTY
Location	Federal University of Technology, Yola
Date of Installation	07-02-2010





NIGNET SITES INFORMATION CONT...





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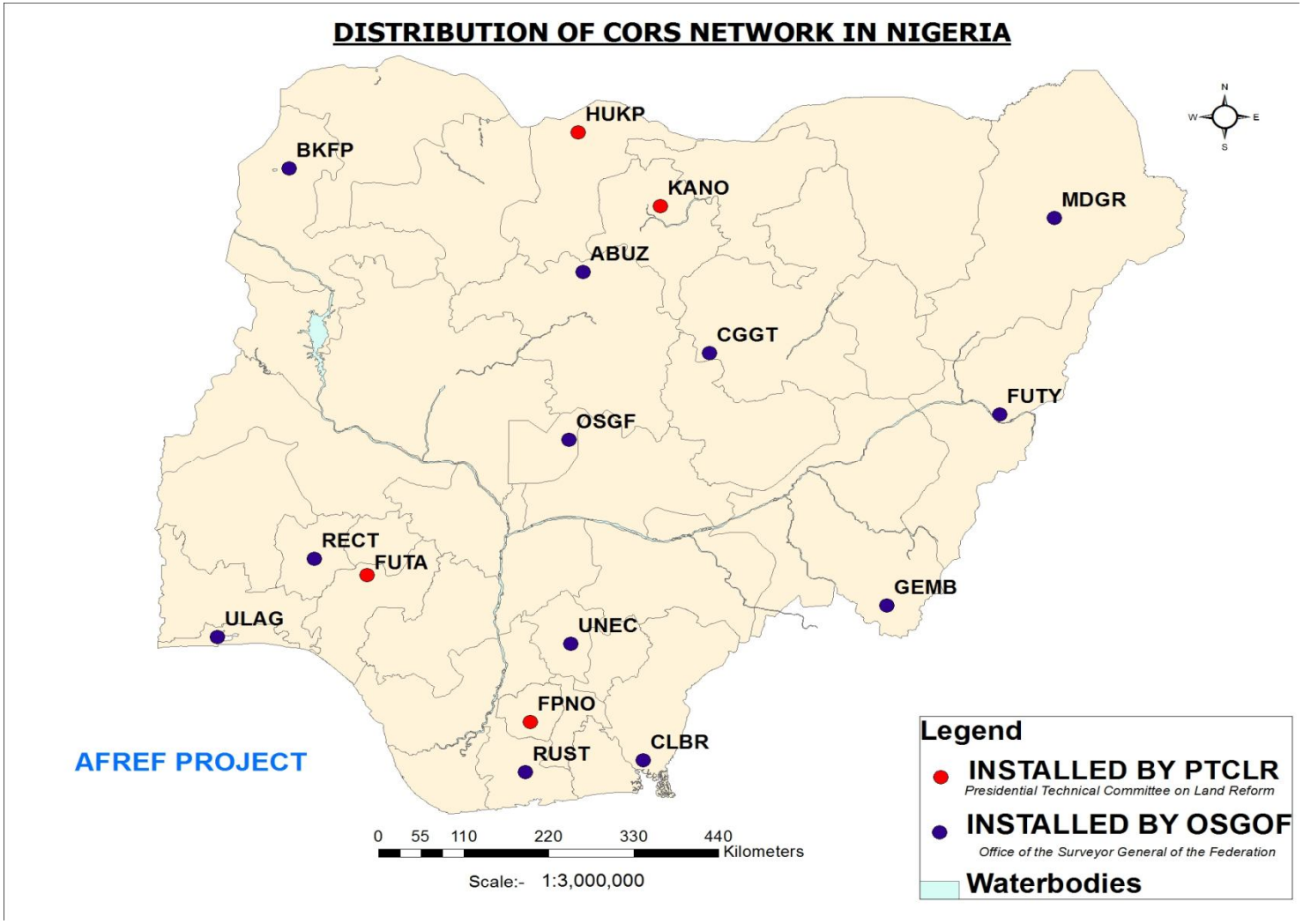
EFFORTS MADE BY OSGOF



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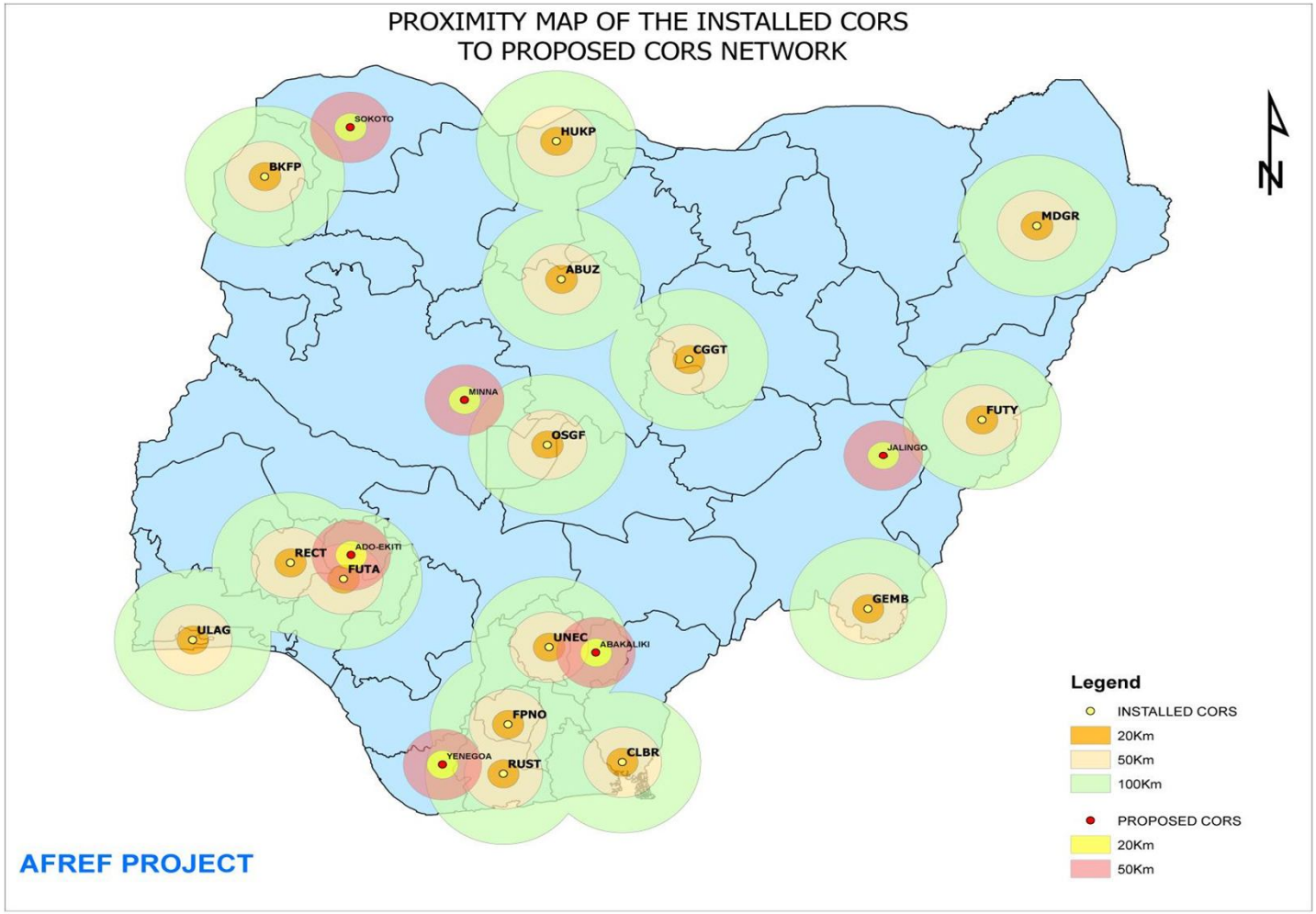

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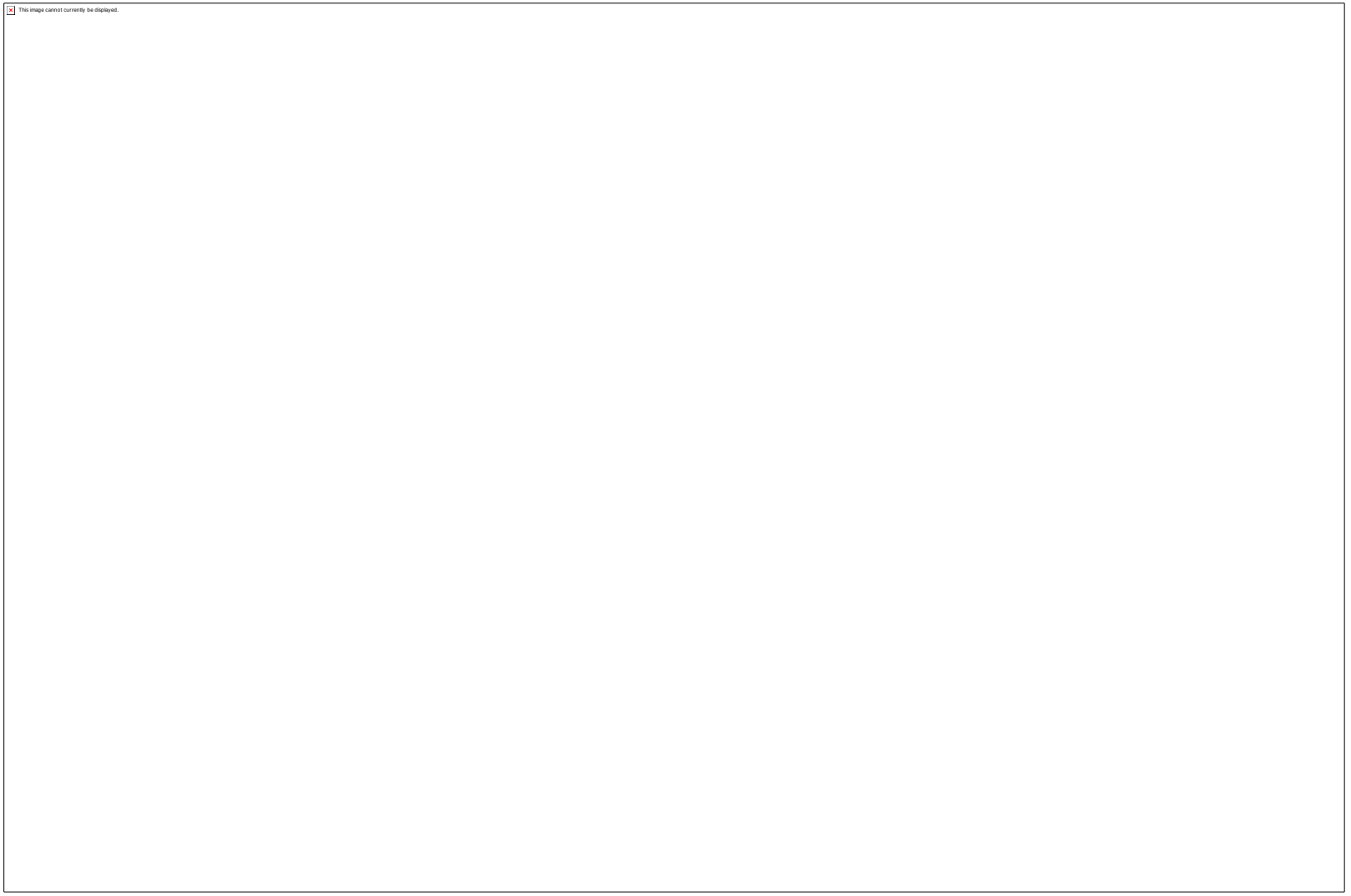

EFFORTS MADE BY OSGOF

Data holdings Summary

SITE	Initial Date	Final Date	Years	Total Files
FUTY	07/02/2010	22/03/2012	2.1	771
OSGF	12/10/2009	27/03/2012	2.4	751
ABUZ	24/01/2010	27/03/2012	2.1	743
BKFP	25/01/2010	27/03/2012	2.1	725
UNEC	03/02/2010	26/03/2012	2.1	721
ULAG	05/10/2009	17/02/2012	2.4	650
RUST	12/02/2010	08/03/2012	2.0	600
CGGT	06/02/2010	10/02/2012	2.0	582
RECT	21/07/2007	03/04/2011	3.7	504
MDGR	15/03/2011	08/12/2011	0.7	261
CLBR	20/03/2011	27/03/2012	1.0	122
GEMB	08/02/2010	09/09/2011	1.6	063

EFFORTS MADE BY OSGOF

Cartesian Coordinates of NIGNET Stations (Ref. Epoch: 01-01-2011)

SITE	X (m)	Y (m)	Z (m)
ABUZ	6203493.800	833088.700	1225614.600
BKFP	6211960.300	459365.480	1368115.000
CGGT	6201032.300	995277.250	1113815.500
CLBR	6287174.200	922979.450	546713.770
FUTY	6145058.500	1362078.900	1029389.900
GEMB	6213520.300	1228500.400	763260.960
MDGR	6080449.300	1418433.500	1299949.400
OSGF	6246471.200	820848.740	994267.930
RECT	6304424.300	498878.890	827626.470
RUST	6308859.000	772229.930	530354.460
ULAG	6326097.300	375576.110	719131.690
UNEC	6284298.300	827900.520	708988.590

EFFORTS MADE BY OSGOF

Geodetic Coordinates of NIGNET stations (Ref. Epoch: 01-01-2011)

SITE	Latitude (°)	Longitude (°)	H (m)
ABUZ	11.15173993	7.648687381	705.0536
BKFP	12.46857675	4.229242193	249.9995
CGGT	10.12309481	9.118311777	916.4321
CLBR	4.950301137	8.351568778	57.1295
FUTY	9.349742673	12.49779789	247.3917
GEMB	6.917199389	11.1839406	1795.6148
MDGR	11.8380904	13.13100177	348.2558
OSGF	9.027665856	7.486341811	532.6372
RECT	7.505487761	4.524475951	281.9434
RUST	4.801836019	6.978521446	45.5766
ULAG	6.5173266	3.397623484	44.5625
UNEC	6.424806025	7.504991338	254.3912

EFFORTS MADE BY OSGOF

- **The following trainings/Workshops were supported by OSGOF:**

  - GNSS Base station installation and data processing in Regional Centre for Mapping of Resources for Development (RCMRD) Nairobi, Kenya.
  - 1st AFREF Stakeholders' Forum was held on 26th September, 2007 at Rockview Hotel, Abuja.
  - AFREF Expert Group Meeting at Regional Centre for Training in Aerospace Surveys, (RECTAS), Ile- Ife, Nigeria in 2007.
  - GNSS/AFREF Workshop at Regional Centre for Training in Aerospace Surveys, (RECTAS), Ile- Ife, Nigeria in 2009.

EFFORT MADE BY THE OSGOF Cont.

- **The following trainings/Workshops were supported by OSGOF:**

- Training on the use of Trimble Business Centre (TBC) Commercial software Held in Abuja Nigeria 2010.

- International Training Workshop on GNSS Organized by ARCSSTEE-E in conjunction with Africa/Asia-Pacific (RCSSTEAP) UN-Regional Centre's and Beihang University, Beijing, China, OAU Campus,Ile-Ife, Nigeria in 2016.

- In addition, few staffs of the Office went for Masters Programme in relevant fields to enhance the management of the NIGNET Network.

EFFORT MADE BY THE OSGOF Cont.

- **The following Programmes were supported by OSGOF:**
  - UN-ITALY, Masters in Navigation and Related applications at Politecnico di Torino, Italy.
  - Masters in Computer Science and Engineering with GNSS applications at the University of Beira Interior, Covilha, Portugal.
  - Masters in Computer Science and Engineering at various Nigerian Universities.

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- Establishment of National Geodetic Controls for the transformation parameter.

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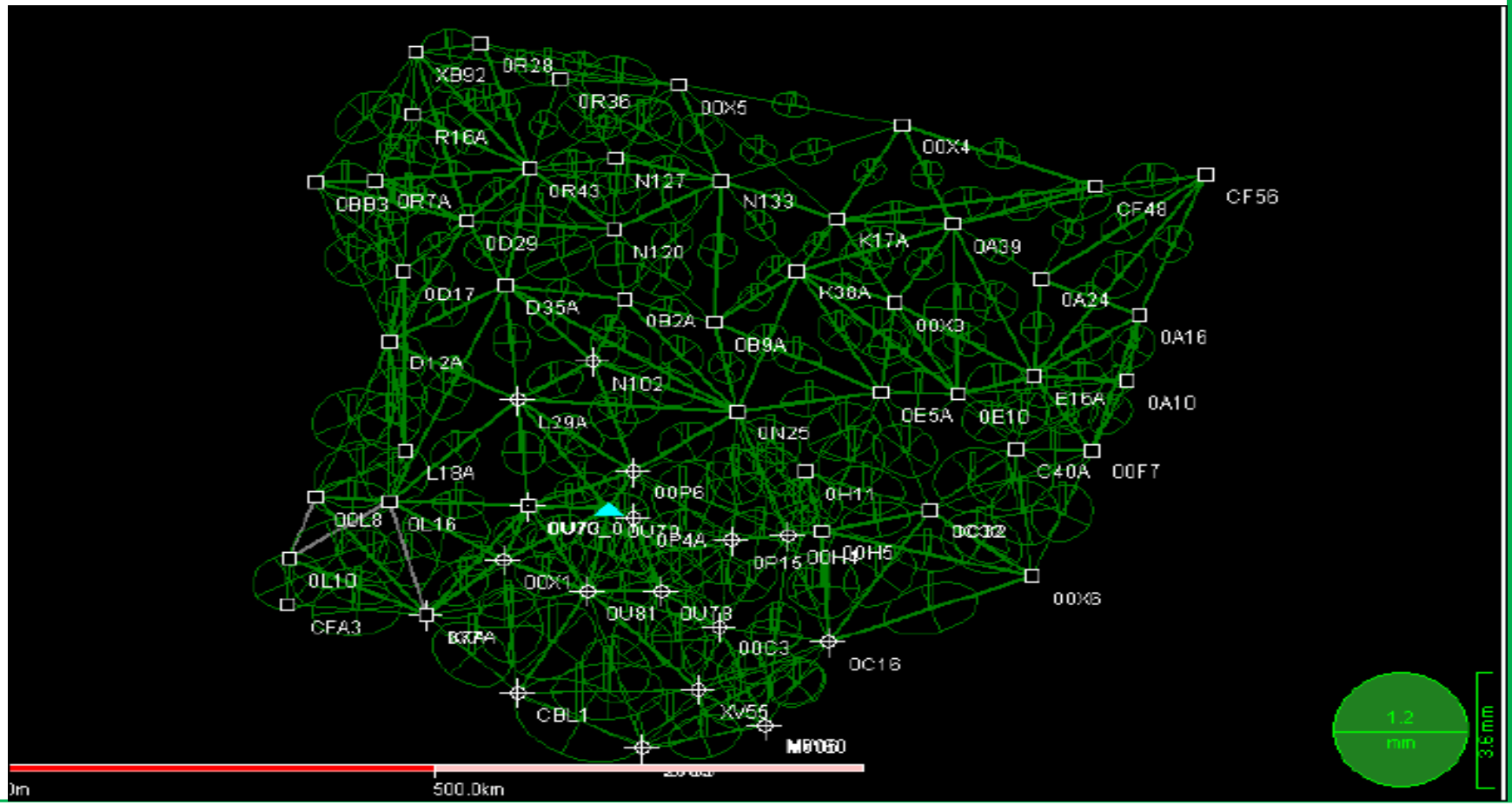

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- Research works on stability & Integrity of the NIGNET network using Precise Point Positioning technique.

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- On-going research work on the determination of Nigerian Geocentric Datum.

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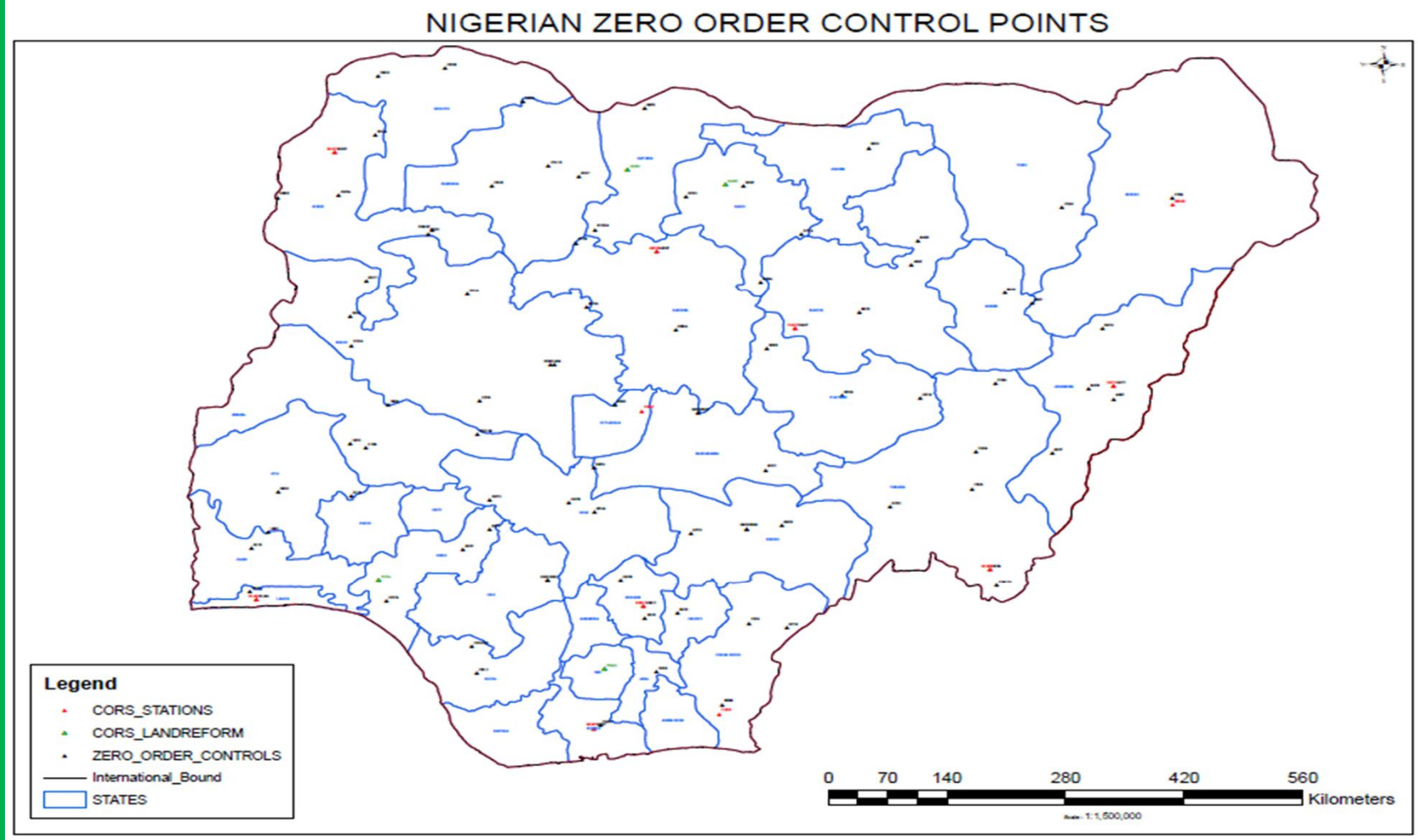
- On-going research work on the analysis of NIGNET stability using on-line Precise Point Positioning technique.

The establishment of the National Geodetic Controls for the transformation parameter



Analysis Result of NIGNET Stability using Precise Point Positioning Technique from 2011 to 2014



Deductions from the Analysis of the Stability of the NIGNET

- There is stability in the vertical movement.
- There is uniform movement in both North and East components:- The movements as it can be seen from the figure above, been represented by a vector resolution is of the magnitude of 7cm.
- The Displacements of 7cm is in the same direction for all the stations and at 45 degrees, which is positive for all, and indicates uniform movements of the plates.

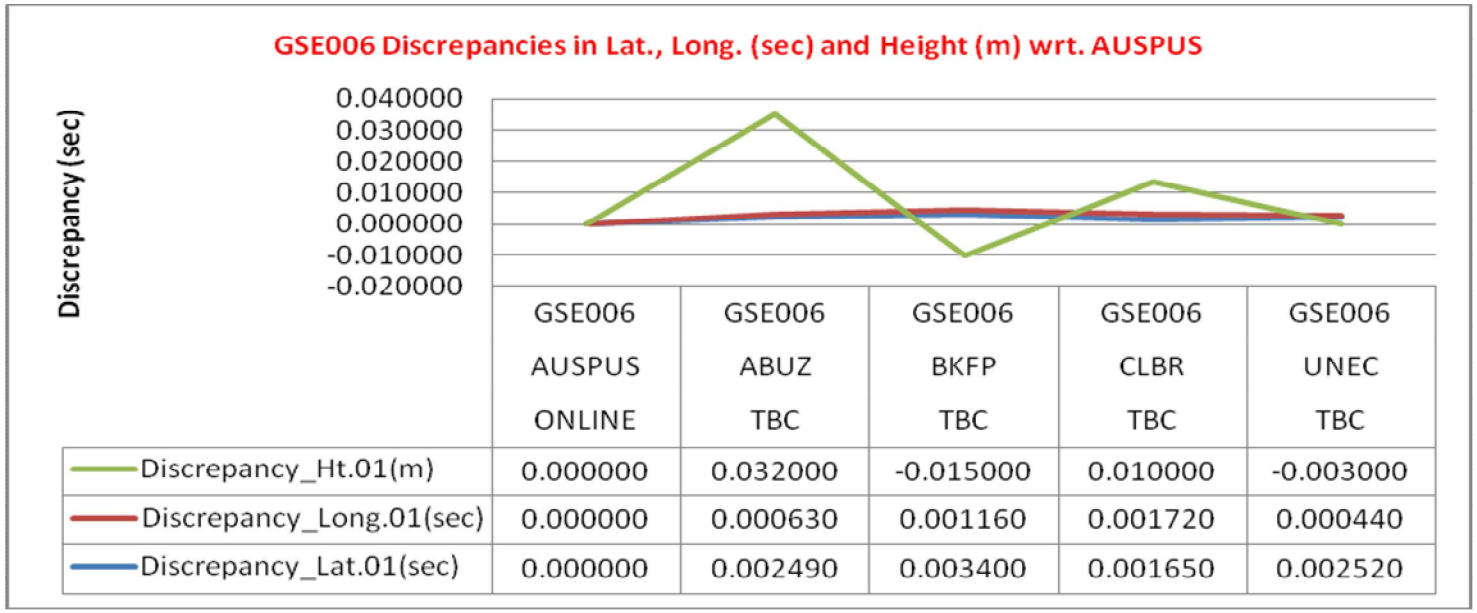
Deductions from the Analysis of the Stability of the NIGNET cont…

- From the uniform movement, it can be deduced that there is no any anomaly with any of the stations in terms of displacement.

- From the results it means there is a plate movement of around **2cm per year,** which seems to be in harmony with the Information obtained from:

https://en.wikipedia.org/wiki/African_Plate

Investigation on the Accuracy of the Rover Positions Determined from the NIGNET CORS Network



Software	CORS	Rover	Discrepancy_Lat.01(sec)	Discrepancy_Long.01(sec)	Discrepancy_ Ht.01(m)
ONLINE	AUSPOS	GSE006	0.000000	0.000000	0.000000
TBC	ABUZ	GSE006	0.002490	0.000630	0.032000
TBC	BKFP	GSE006	0.003400	0.001160	-0.015000
TBC	CLBR	GSE006	0.001650	0.001720	0.010000
TBC	UNEC	GSE006	0.002520	0.000440	-0.003000

Challenges Emanating from the Current NIGNET Status

- The present number of CORS are highly insufficient for implementation of several GNSS applications within the country such as Networked RTK, LBS etc.
- Data streaming from the remote stations to the data control Centre has been a serious issue due to non availability of stable Internet communication services.
- The technical support will need to be more than it is at the moment looking at the prospects in the near future

NIGNET Future Road map

- Developing a policy that mandates unification of Reference Frame based on NIGNET Network for the entire country.
- Installation of at least four (4) CORS Station per year.(Subject to budgetary support).
- Implementation of Networked Transport of RTCM via Internet Protocol (NTRIP) for Real Time Kinematics (RTK) Services.

NIGNET Future Road map Cont...

- Seeking International collaboration and support in GNSS technology in area of capacity building.
- Creation of awareness for end users especially within surveying and Geoinformatics community.

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- Applications of GNSS CORS technology for the enhancement of good governance in line with International best practices is our mission.
- Therefore, we are open to any collaboration that can accelerate the realization of our mission.







THANK YOU

NIGNET WESITE: www.nignet.net



