UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy Country Reports - Summary

18 Countries

Uganda; Senegal; Madagascar; Côte d'Ivoire; Zambia; South Africa; Nigeria; Kenya; Ethiopia; Malawi; Mauritania; Morocco; Cameroon; Botswana; Burkina Faso, Zimbabwe, Sierra Leon, Mali

Day 3, Session 4 *[3_4_3]*

Geodesy Country Reports

Summary of sections – 18 countries

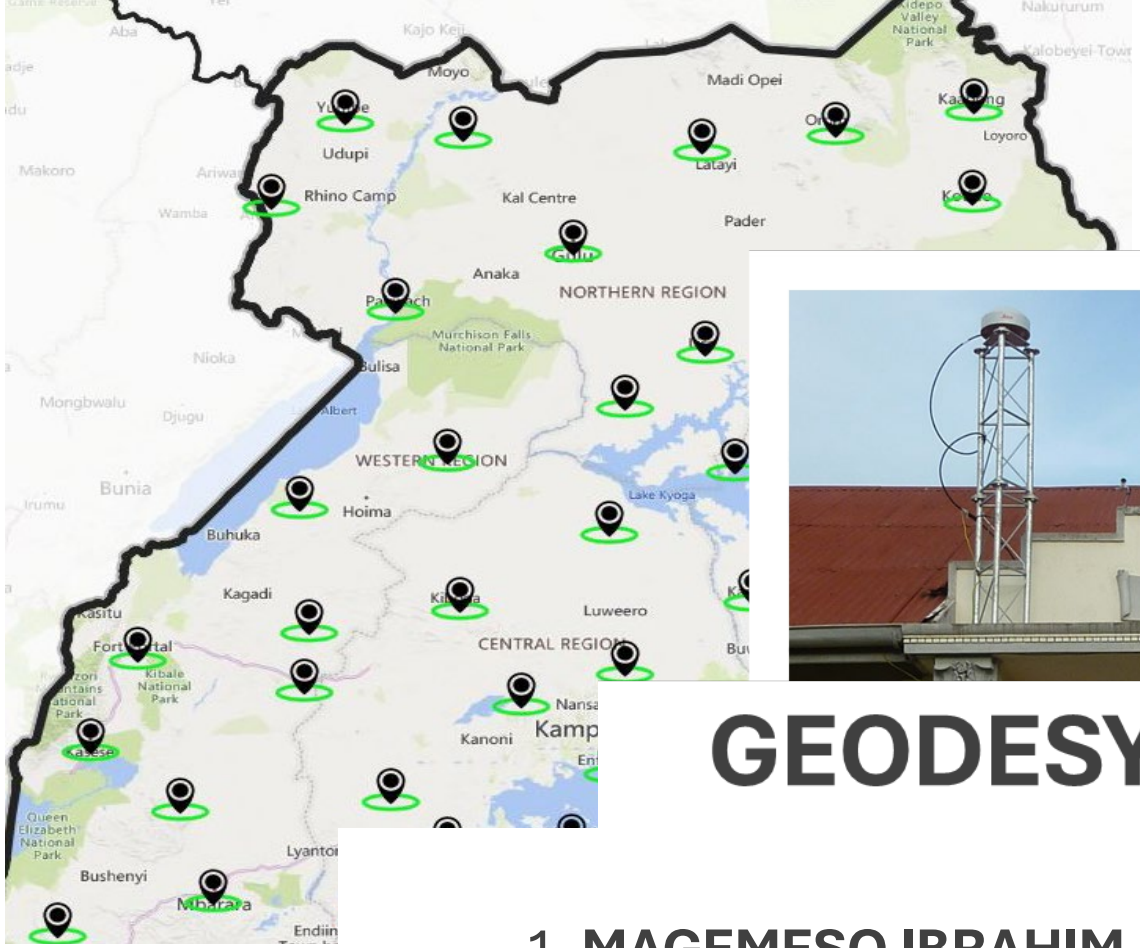
UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Uganda

Edna Ahebwa
Bruno Kyamulesire
Ibrahim Magemeso

Day 3, Session 4 *[3_4_3]*



GEODESY IN UGANDA

1. **MAGEMESO IBRAHIM-** -MINISTRY OF LANDS, HOUSING & URBAN DEVELOPPENT

2. **KYAMULESIRE BRUNO**--- KYAMBOGO UNIVERSITY

3. **AHEBWA EDINAH**-IGNFI/UGRF

Why Geodesy Matters In Uganda

- Infrastructure development in the country i.e. roads, bridges and pipeline(EACOP).
- Solving land disputes due to unclear boundaries and supporting land administration.
- Monitoring and mitigating natural disasters e.g. Bududa landslides on the slopes of Mt Elgon
- Plate tectonics and seismic monitoring as Uganda lies in the active East African rift valley
- Weather forecasting and climate monitoring since the country relies on agriculture the most.

KAMPALA FLYOVER

State of Geodesy in Uganda

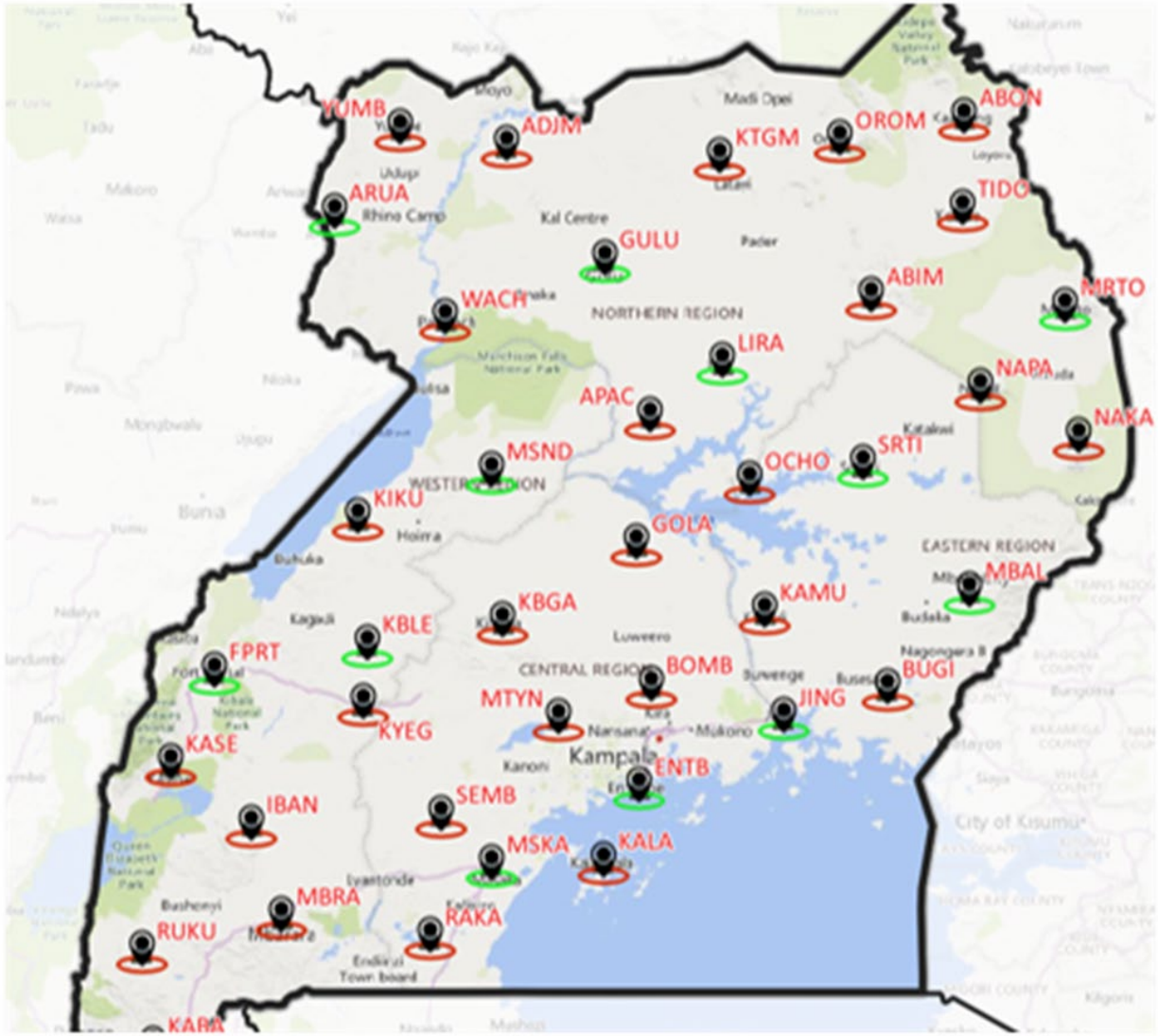
- Currently we have 84 CORS stations and 426 passive controls in the country with;

-40 Government CORS (UGRF)

- 44 Private CORS providers(EAGLECORS, SURVNET)

- Establishment of the Uganda Geodetic Reference Network(UGRN), submission of 4 stations to IGS hopefully to be approved in June.

- Adoption to new technologies, legal framework, internet.



Call to Action

- Amendment of Legal framework
- Complete transfer to UGRN within the country.
- Capacity building—to keep structure in place
- Improve transformation parameters between new and old system.
- Add our stations to AFREF

UGANDA GEODETIC REFERENCE FRAMEWORK(UGRF)

UGRF PORTAL- https://ugrf.mlhud.go.ug

KYAMBOGO UNIVERSITY--https://kyu.ac.ug

MINISTRY OF LANDS, HOUSING AND URBAN DEVELOPMENT--https://mlhud.go.ug

THANK YOU FOR LISTENING

FOR GOD AND OUR COUNTRY

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Senegal

Diogoye Diouf
Ousseynou NIANG

Day 3, Session 4 *[3_4_3]*

REPUBLIQUE DU SENEGAL
MINISTERE DES FINANCES ET DU BUDGET

United Nations Global Geodetic Centre of Excellence

UN-HABITAT

GLTN
GLOBAL LAND TOOL NETWORK

PROCASEF
PROJET CADASTRE ET SECURISATION FONCIERE

UNIVERSITE IBA DER THIAM DE THIES
U.I.D.T

Issues and challenges involved in modernizing Senegal's geodetic reference frame.

19-23 may 2025
Nairobi, Kenya

Dr. Diogoye DIOUF, Teacher-Researcher, UIDT.

Ousseynou NIANG,
Ing.géomaticien Responsable BD/SIF - PROCASEF.

01. Why is Geodesy Essential in Senegal?

🛰️ Geodesy provides the scientific and technical foundation essential for key sectors such as cartography, land use planning, land taxation, navigation, Reseach, Monitoring, Agriculture, atmospheric sciences, infrastructure management, and climate resilience.

🏛️ It supports effective and sustainable public policies by driving the digital transformation of the State and the deep modernization of land governance.

🌐 This modernization will facilitate the construction of cross-border infrastructures, the establishment of a local or even regional geoid model, and the optimal implementation of emerging GNSS positioning techniques such as PPP in Senegal.

🖥️ **Concrete example**: The SIFCOM (Communal Land Information System) relies on a reliable geodetic reference system to secure land rights, ensure data accuracy, and optimize local taxation.

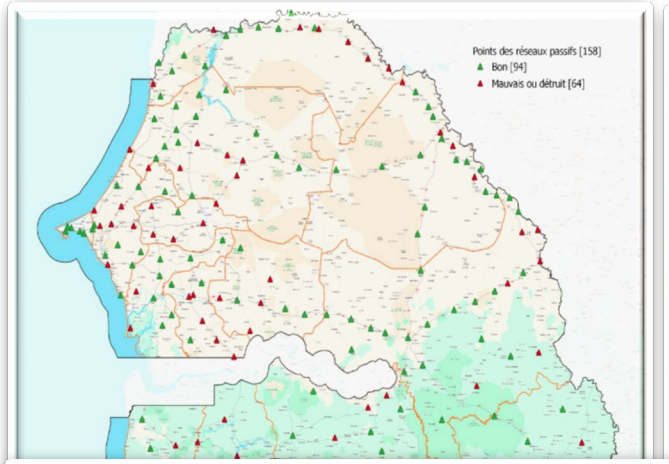
Strategy for modernizing the National Geodetic Frame (NGF) – **SEN-CORS**

Key components of the NGF Modernization Project– SEN-CORS.

FOLLOWING A NATIONAL FEASIBILITY STUDY

Rehabilitation of the passive geodetic frame

Rehabilitation and modernization of 1st and 2nd order points, including the installation of terminals and license plates to reinforce the reliability of the national geodetic network.

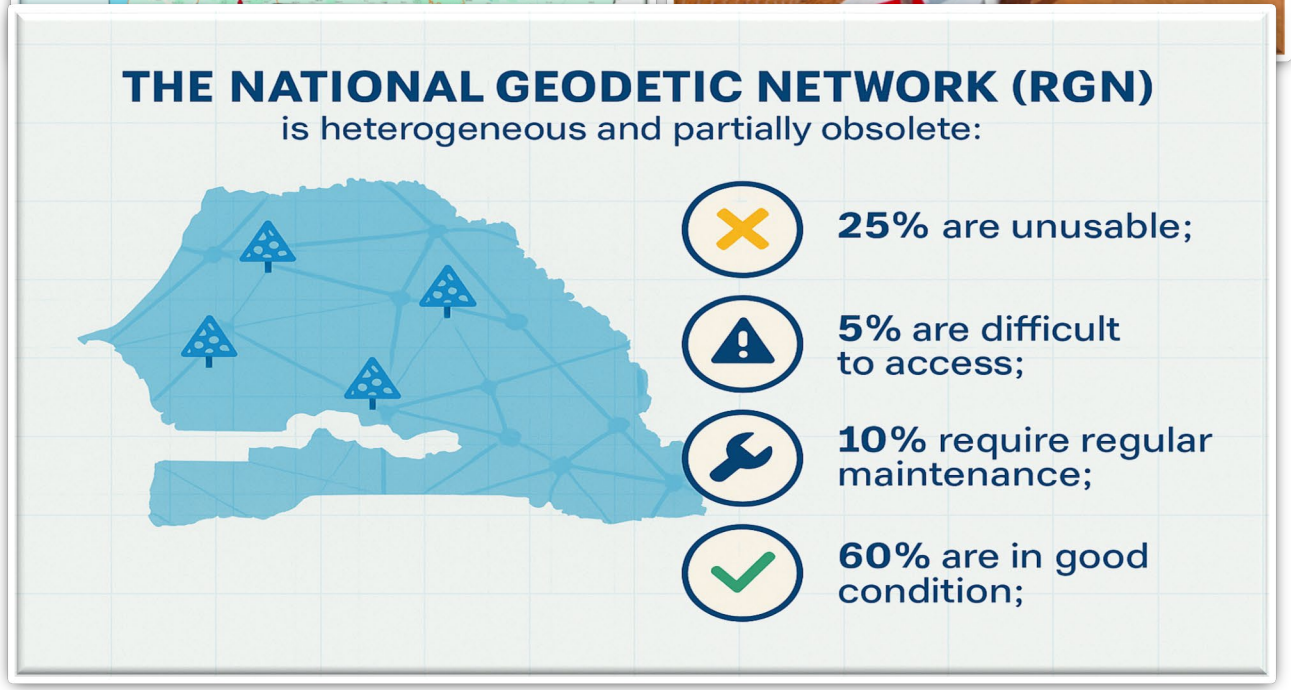


Installation of a network CORS

Creation of a CORS network to guarantee a homogeneous, accurate, reliable and accessible repository

Setting up control centers and the geodetic database

Creation of two control centers for centralized management and optimal use of geospatial data



CREATION OF A NATIONAL NETWORK OF 27 CORS

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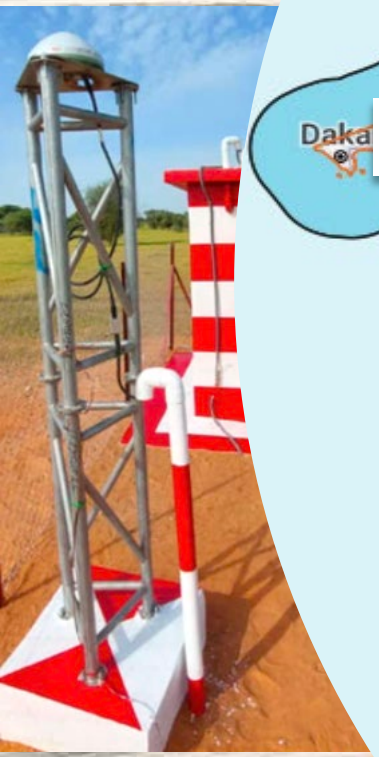
Répartition des Stations CORS au niveau national

Saint Louis
Richard-Toll
Ndioum
Matam
Louga
Linguére
Bambeye
Touba
Kidira
Sokone
Tambacounda
Sédhiou
Kolda
Bignona
Ziguinchor
Kédougou



PROCASEF
PROJET CADASTRE ET SECURISATION FONCIERE

04. Next Steps and Call to Action

Key Needs

Capacity Building

Strengthen technical and institutional capacities at both national and local levels

Legal and Economic Framework

Develop a legal framework and a sustainable economic model for the operational management of Senegalese CORS Network (SEN-CORS)

System Interoperability

Provide reliable, accurate, accessible support to ensure geospatial data consistency and interoperability of geospatial information systems

Geodetic Infrastructure Maintenance

Ensure regular maintenance and monitoring of geodetic infrastructure, particularly first- and second-order points, to extend their lifespan and usability.

Regional Leadership

Position Senegal as a regional hub for geodesy and geospatial data, through shared CORS infrastructure, geodetic data available exchange of best practices, and cooperation with neighboring countries;

Digital Transformation

Accelerate digital transformation under the Technological New Deal, by reinforcing digital sovereignty and access to data

Land Governance Reform

Provide a modern, coherent geodetic infrastructure capable of supporting initiatives to modernize land governance and management in senegal, aligned with Senegal Vision 2050, for greater transparency and efficiency.

Continental & Global Integration

Actively contribute to continental and global geodetic initiatives, including AFREF and ITRF, in order to strengthen Senegal's role in initiatives taken by the international geospatial community.

QUESTIONS?

COMMENTS...

THANKS !

REPUBLIQUE DU SENEGAL
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Issues and challenges involved in modernizing Senegal's geodetic reference frame.

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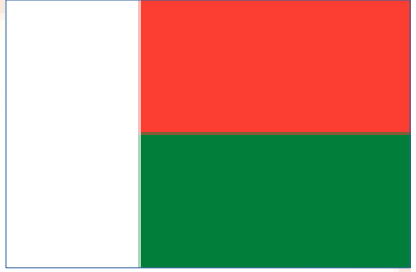
UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Madagascar

Misan ANDRIANARISON

Day 3, Session 4 *[3_4_3]*



GEODESY IN MADAGASCAR

UN-GGCE Geodesy Capacity Development Workshop for Africa on Transitioning to a Modern Geospatial Reference System

NAIROBI, 22 May 2025

ANDRIANARISON Misan'ny Farany Nirina
Head of Geodesic, Levelling and Hydrographic Service

Foiben-Taosarintanin'i Madagasikara - FTM
National Geographic and Hydrographic Institute of Madagascar

FTM

IMPORTANCE OF GEODESY IN MADAGASCAR

The main mission of the institute - FTM is to provide **reference** and **authoritative geospatial data and derived basic topographic maps** for all users, especially in public administration for decision making.

Establish a Geodetic network so that all database will be carry out in **homogeneous geodetic system**, and all land survey can use them in their daily work in order **to reduce land properties conflict**.

As a Hydrographic Institute, We are also responsible of maritime charts. It means that **sea level** is part of our duties.

In daily life, Many project of road construction need **geodetic point**

It is said that, Madagascar will be separated in three parts (Geophysics). Geodesy is crucial for **research**.

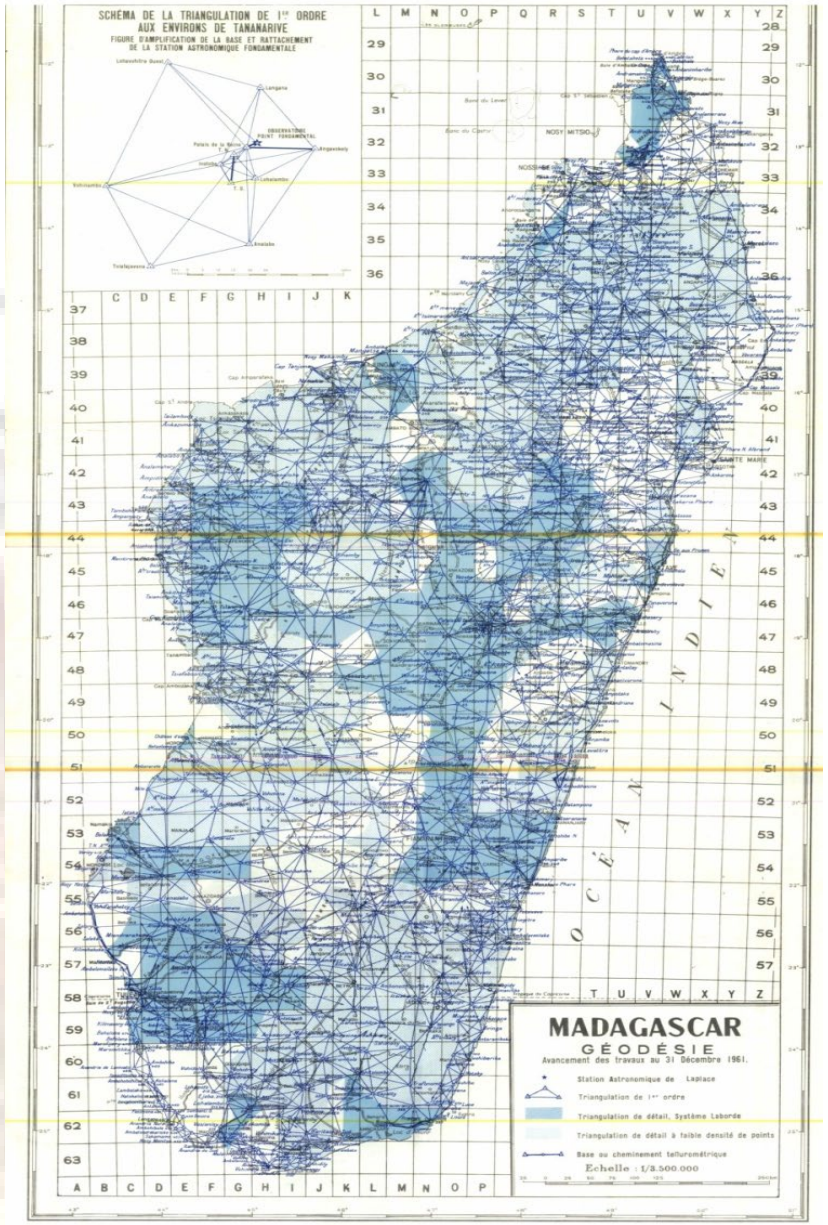
GEODESY : HISTORY

Geodetic Network of Madagascar 1965

The official geodetic reference system in use in Madagascar is the "Réseau Géodésique de Madagascar 1965 so-called RGM65" (Geodetic Network of Madagascar 1965). It consists of 996 materialized bench mark observed by triangulation between 1924 and 1965. The reference spheroid associated is **Hayford International 1924**.

Projection system: the projection associated with the RGM65 geodetic reference system is the "**Laborde Madagascar**" grid. It is a conformal projection closely similar with an **Oblique Mercator projection**.

- 996 geodetic point 1st order
- 1267 Geodetic point 2nd order
- 3510 Geodetic points 3rd order
- At all, 7313 Geodetic points



GEODETIC NETWORK STATUS IN MADAGASCAR

- 92 Geodetic points Reference Network of Madagascar in 2023
- Spacing: About 100km

GEODESY CHALLENGE IN MADAGASCAR

- Administration:
  - Policy needs to be emphasized: All users should be convinced of the necessity of using and referring to the national geodetic reference system; A legal or regulatory framework should be established that will define the legal coordinate reference system to be used in Madagascar
  - Convinced Government to support Geodesy
- Human resources: Capacity Building
- Technical support
  - Make available a grid transformation Local to ITRF and Improve by establishing NTv2 Grid Format
- Geodesy Equipment and Infrastructure:
  - CORS
  - Improve infrastructure by densifying geodetic points
- To be part of the world, we need regional coordination

MISAOTRA !
THANK YOU!

Foiben-Taosarintanin'i Madagasikara (FTM)

National Geographic and Hydrographic Institute of Madagascar

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Côte d'Ivoire

Bienvenue N'Gbaba YANGOH

Day 3, Session 4 *[3_4_3]*

bnetd

LA GEODESIE EN COTE D'IVOIRE

Fernand BALE
Directeur du CIGN

Bienvenue KOUTOUAN
Chef de service Géodésie au BNETD/CIGN

19 mai 2025

Pourquoi la géodésie est-elle importante?

En Côte d'Ivoire la géodésie est essentielle utilisée pour:

- **Le cadastre et la sécurisation foncière**
- **La gestion durable des ressources naturelles**
- **Les infrastructures(les routes, bâtiments, l'agriculture de précision)**
- **La surveillance du trait de côte**

Exemple concret : Projet de sécurisation foncière

La mise en place des stations GNSS CORS a permis de **réduire significativement le temps et les erreurs dans les opérations de délimitation des terres villageoises**, renforçant la paix sociale et la transparence foncière

Objectifs:

- Délimiter les territoires de 117 villages
- Délivrer 53 400 certificats fonciers dans les zones du projet

Résultats:

- 95 territoires de villages délimités et bornés, soit un taux de réalisation de 81,19%
- 48 070 certificats fonciers délivrés soit 90%

Etat actuel de la géodésie

Infrastructure actuelle :

- Réseau structuré en 4 niveaux (RECI, RGIR, RGIO, RGID) ;
- 5 stations permanentes GNSS en service (RECI), centre de contrôle fonctionnel ;
- Projection nationale : TMCI-5.5, référentiel ITRF2014.

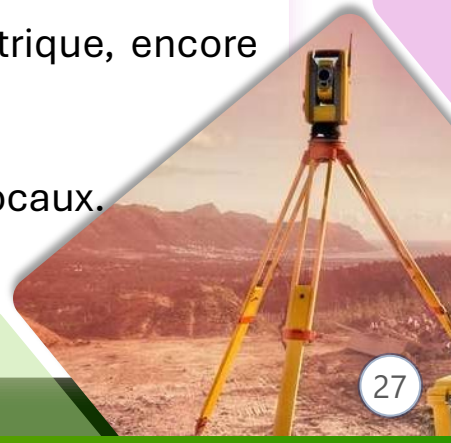
Niveaux	Nom	Acronyme	Composition
Ordre 0	Réseau CORS Ivoirien	RECI	5 CORS + 1 Station IGS (YKRO)
Ordre 1	Réseau Géodésique Ivoirien de Référence	RGIR	43 Bornes
Ordre 2	Réseau Géodésique Ivoirien Opérationnel	RGIO	716 Bornes
Ordre 3	Réseau Géodésique Ivoirien de Détail	RGID	Evolutif

Réalisations majeures :

- Rattachement au référentiel mondial ITRF2014 ;
- Mise en service du premier réseau GNSS grâce au soutien de l'AFOR et de la Banque Mondiale (PAMOFOR) ;
- Réobservation de plus de 479 bornes géodésiques dans le nouveau référentiel.

Défis :

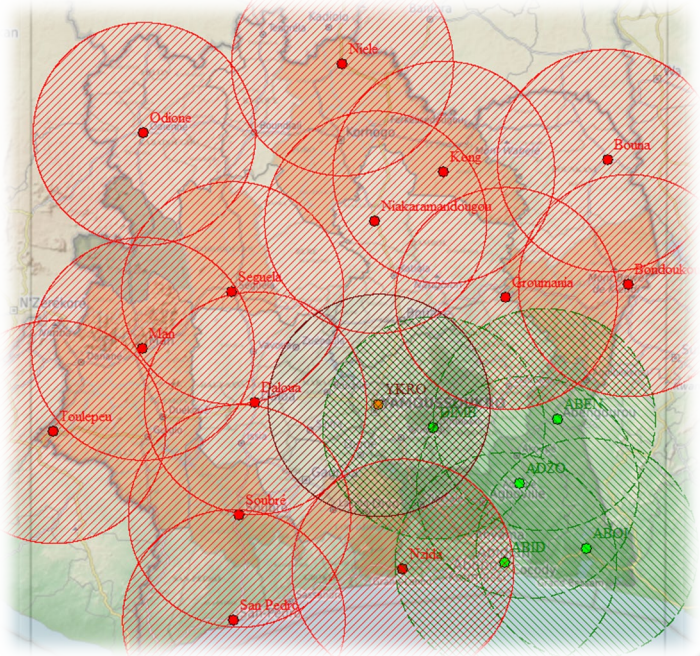
- Extension du réseau GNSS nécessaire, avec un déficit marqué au nord et à l'ouest du pays ;
- Modernisation urgente du système altimétrique, encore basé sur des références anciennes ;
- Renforcement des capacités des acteurs locaux.



Prochaines étapes

Besoins prioritaires :

- Densification du réseau GNSS : Extension du réseau national de stations permanentes GNSS, actuellement limité à 6 stations localisées dans le sud-est du pays.(15 stations prévues cette années)
- Redéfinition du système altimétrique national avec un modèle de géoïde ;
- Renforcement des capacités nationales par la formation d'acteurs locaux en géodésie.



Collaborations internationales:

- Participation au sous comité de géodésie;
- Coordination du groupe de travail de UN-GGIM sur la géodésie;
- Participation à l'AFREF;
- Collaboration avec IGS.

bnetd

MERCI POUR VOTRE ATTENTION

Fernand BALE

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UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Zambia

Levi Mutambo
Twapewa Chikopa
Chitalu Victoria Mwila

Day 3, Session 4 *[3_4_3]*

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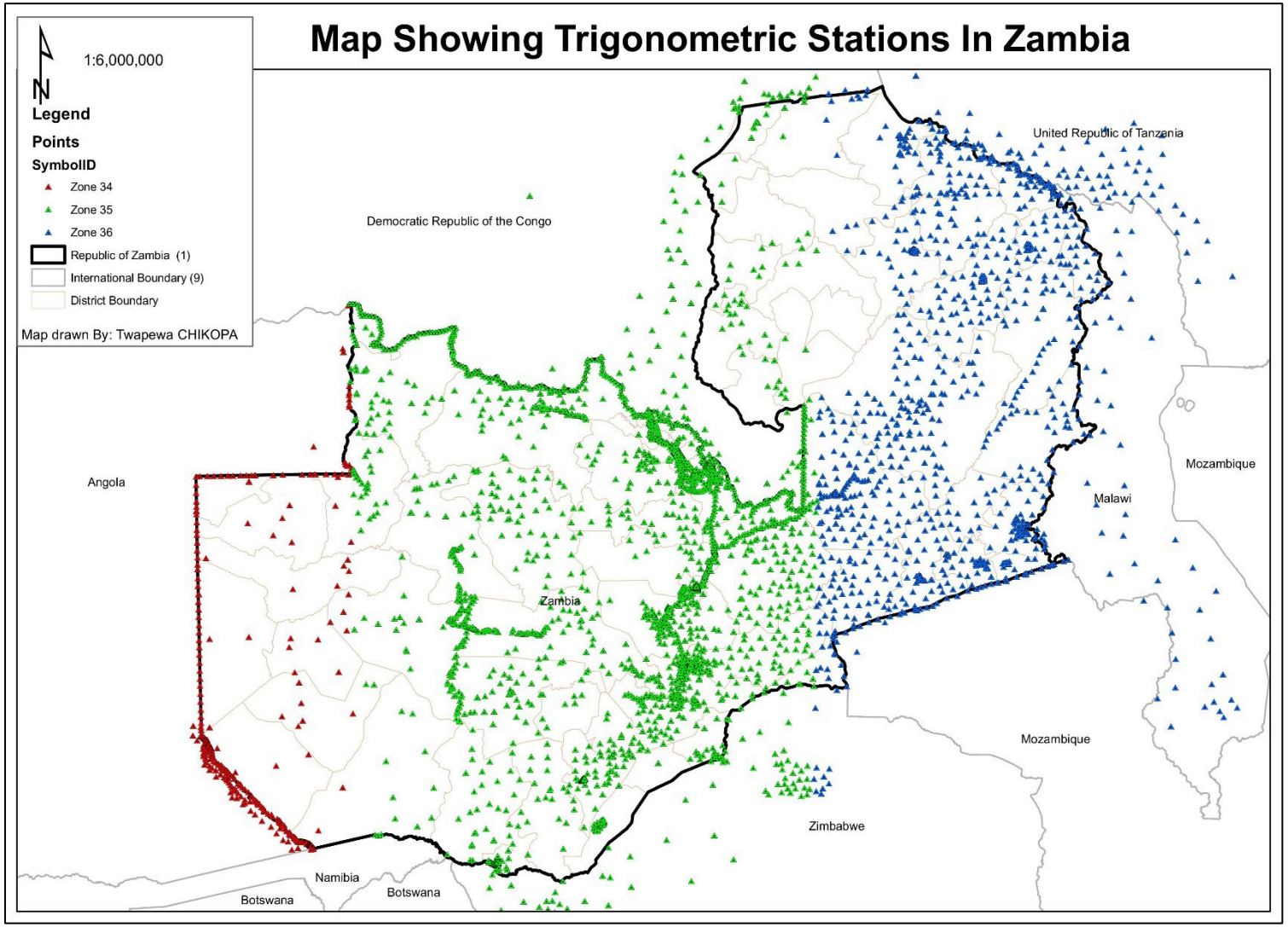
Current State and Future Outlook

Contributors to this Presentation:

1) Levi MUTAMBO, PhD; *Lecturer and Researcher, Copperbelt University, Zambia*

2) Chitalu M. SITHOLE; *Land Surveyor, Ministry of Lands and Natural Resources*

3) Twapewa CHIKOPA ; *Land Surveyor, Ministry of Local Government and Rural Development*



Why Geodesy Matters in Zambia

Critical Importance to Zambia

- Geodesy **provides the fundamental framework** for all spatial data in Zambia
- **Supports** land administration, mining operations, and agricultural planning
- **Essential** for infrastructure projects
- Vital for managing our natural resources across 750,000 square kilometers

Real-World Example

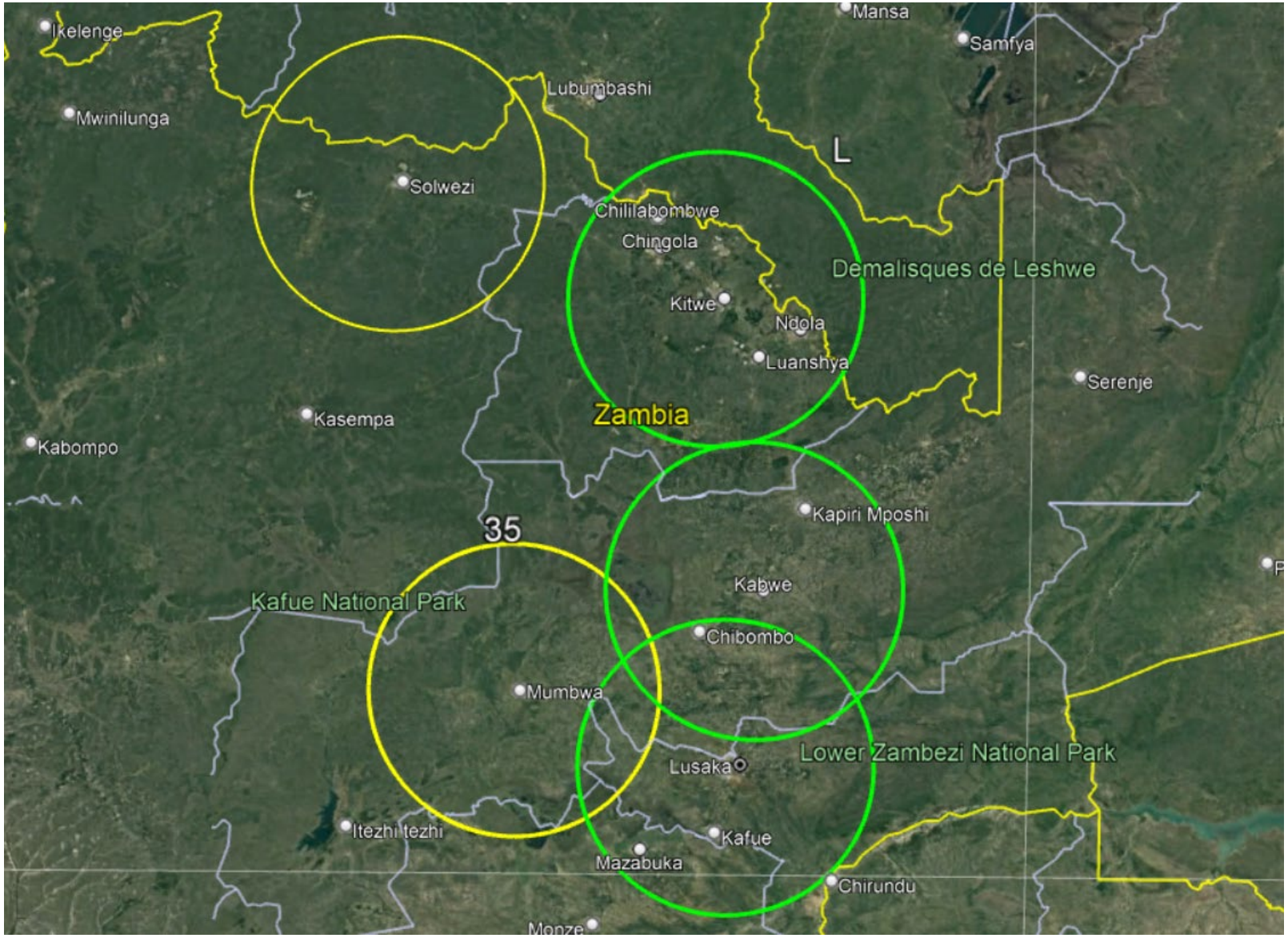
- The **Kafue Gorge Lower Hydropower Project** (750MW capacity)
- Precise geodetic measurements prevented construction errors and saved lives and money
- Required **centimeter-level accuracy** across challenging terrain
- Demonstrates how **geodesy** directly contributes to our energy security and economic growth

Supporting Zambia's Development Through Precision Positioning

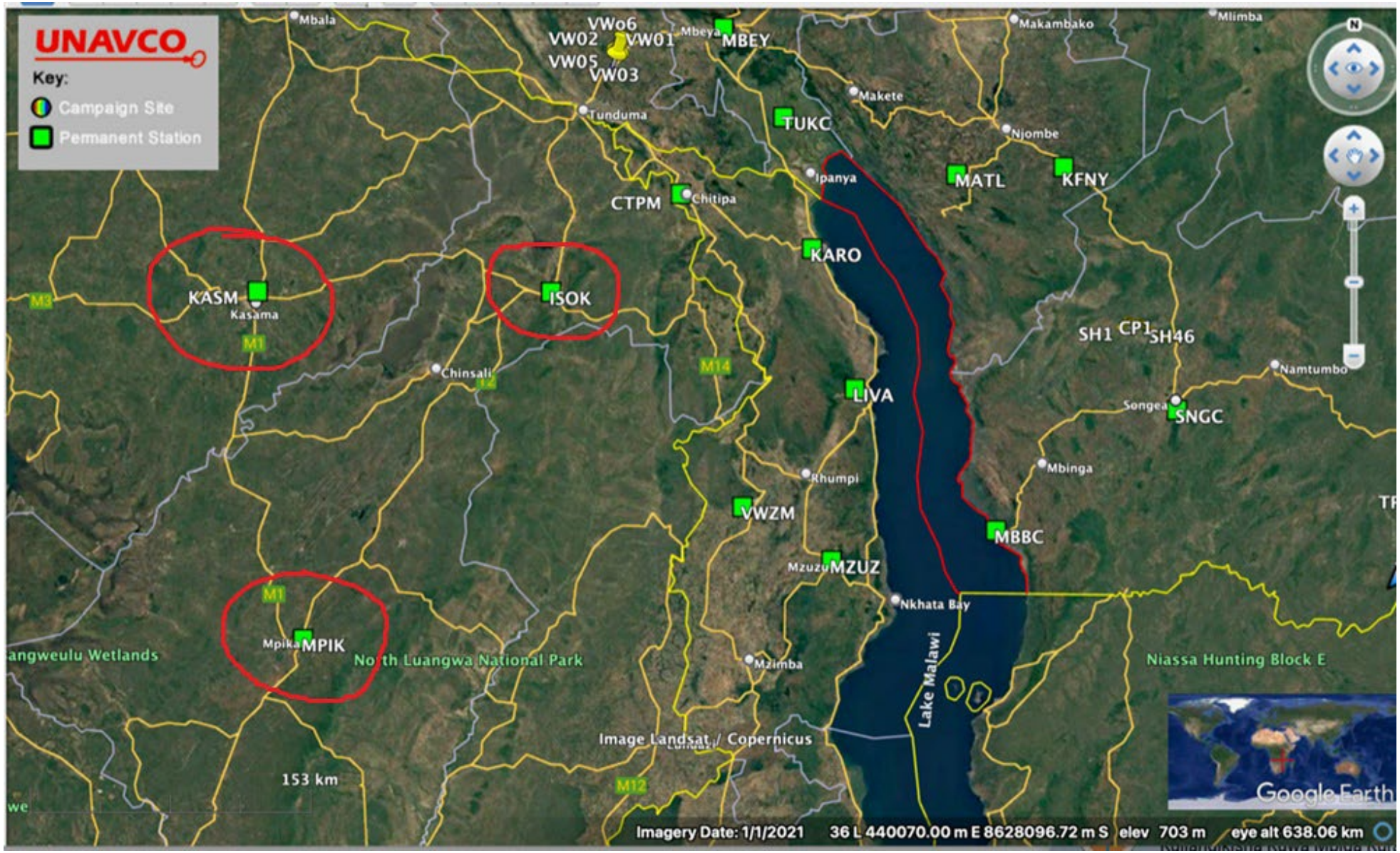
The State of Geodesy in Zambia (26 CORS)

No	Institution	Infrastructure/Contribution	Remarks
1.	1,000 legacy Trig. Stations	Primary, Sec., Tertiary, Quaternary	Partly vandalised
2.	International GNSS Service (IGS)/Survey Department	ZAMB-an IGS station	Static (Active; Established in 2002
3.	Advanced Mapping and Positioning	4 x CORS (Pioneer)	Static & RTK (Active, Commercial, since 2018)
4.	Survey Department/EU	15 x CORS	Yet to be commissioned
5.	Zambia SEED 2006 GPS campaign	41 Trig Stations GNSS observations for ITRF2000 parameters-Arc150	Seven parameters
6.	University NAVSTAR Consortium (UNAVCO)	3 x CORS	Static (Linked to AFREF; Established by Tanzanian researcher; One active)
7.	First Quantum Mining (Kalumbila & Kansanshi)	2 x CORS	Static & RTK (Active, Private)
8	Barrick Mining (Lumwana)	1 x CORS	Static & RTK (Active, Private)
9.	University of Zambia	Geodesy Teaching & Research	Academic outreach
10.	Copperbelt University	Geodesy Teaching & Research	Academic outreach

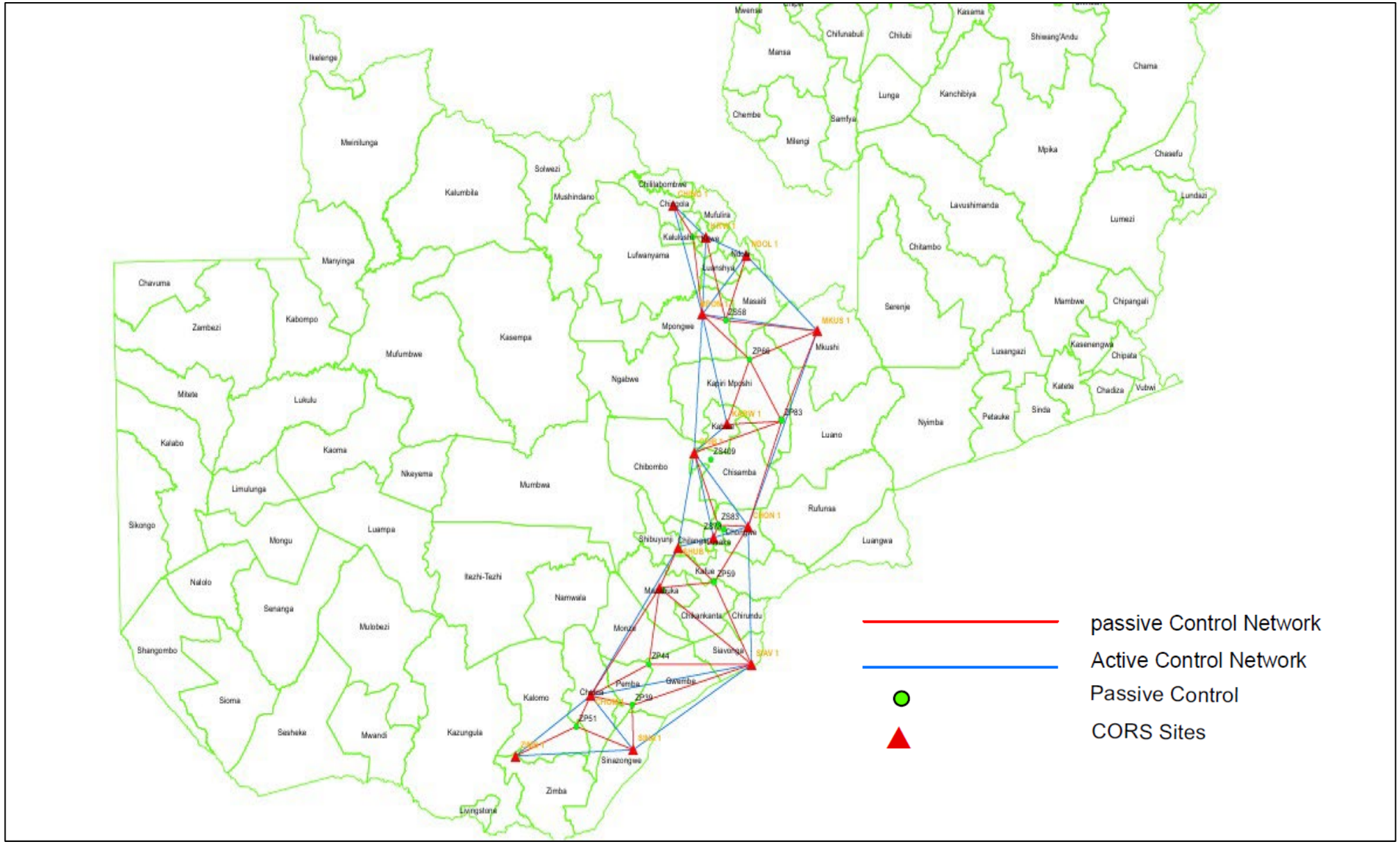
The State of Geodesy in Zambia – Private Sector CORS (AMP)



The State of Geodesy in Zambia – UNAVCO AFREF



The State of Geodesy in Zambia – Government CORS



The State of Geodesy in Zambia

Major Challenge

- **Vandalism** of physical geodetic markers across the country
- **Uneven CORS coverage** with significant gaps outside the line of rail which runs north-south of the central part of the country.
- **Limited technical capacity** with very few geodetic specialists nationwide
- **Funding constraints** for network maintenance, densification and scientific GNSS post-processing software like Bernese
- **Inconsistent National Reference frame** (only partial adjustment)
- Lack of **publicity** on Geodesy

Call to Action

Our Plans and Needs

- **Densification Project**: Establish 15 additional CORS stations by 2027
- **Capacity Building**: Technical training needed for 50 geodetic specialists
- **Repair & Maintenance:** Repair, rebuild and observe damaged Trigonometric Stations (Funds needed).
- **Regional Coordination**: Strengthen ties with AFREF (African Geodetic Reference Frame)
- **Policy Support**: Develop a National Geodetic Data Policy

Priorities for International Partnerships

- **Technology transfer** for modern geodetic techniques
- **Funding support** for equipment and software (Bernese GNSS) procurement
- **Technical exchange programmes** with regional and international institutions
- **Cloud-based geodetic solutions**: data processing and storage

Thank you!

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UNAVCO

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UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - South Africa

Siphiwe Mphuthi
Pilisiwe masiba

Day 3, Session 4 *[3_4_3]*

Geodesy in South Africa

Presenter: Dr. Siphiwe Mphuthi

Affiliation: Division of Geomatics, University of Cape Town

Why Geodesy Matters

- Geodesy underpins all spatial referencing in South Africa—critical for mapping, land use planning, engineering, and disaster management.

- **Real-world example:** Inconsistent height systems (e.g. Land Levelling Datum vs. IHRS) and inconsistent national horizontal geodetic reference frames vs ITRF, complicate flood modelling and infrastructure design, affecting service delivery and disaster response.

The State of Geodesy

South Africa's geodetic system is maintained by CD: NGI via the National Control Survey System (NCSS).

Key assets: Tide gauge benchmarks (Cape Town, Durban, East London, Port Elizabeth); models like SAGEOID10 and CDSM09A.

One achievement: Ongoing research and testing of gravimetric geoid models for modern height referencing.

One challenge: Legacy systems like the Cape datum, Hart94 datum; LLD are misaligned with global frameworks (e.g. ITRF, IHRS), limiting integration with international systems.

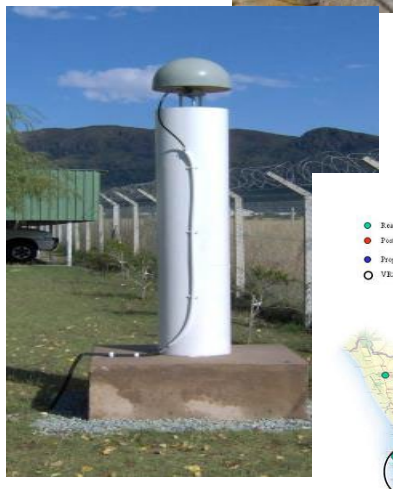
Geodetic Infrastructure in South Africa

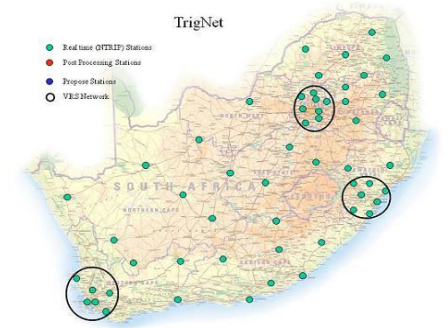
Terrestrial Infrastructure:

- **Vertical:** Land Levelling Datum (LLD) realised by Fundamental Bench Marks (FBMs), Bench Marks (BMs), and precisely levelled Trigonometrical Survey Marks (TSMs), referenced to the Table Bay FBM (1906).

- **Horizontal:** National trigonometrical network of ~28,000 beacons and an equivalent number of TSMs.

- **Active Network:** TrigNet GNSS base station network provides real-time corrections and supports modern geodetic applications (www.trignet.co.za).





Geodetic Infrastructure in South Africa…

Space-Based Infrastructure:

- **Active stations:** VLBI, SLR, DORIS, and multiple GNSS sites forming part of the International GNSS Service (IGS).

- **Future developments:** Potential expansion of geodetic VLBI in support of the SKA project, enhancing continental geodetic capability.

What’s Next / Call to Action

- A roadmap is needed to unify horizontal and vertical reference systems in line with **IHRS** and **AFREF**.

- Priorities include:
  - ✓Upgrading gravity data infrastructure
  - ✓Establishing a geoid-based national height datum
  - ✓Supporting postgraduate research to grow local capacity
  - ✓Encouraging policy alignment with UN-GGIM guidelines

Thank you!

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UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Nigeria

Semiu Ayinde ; Israel Taiwo
Izuegbu Ogochukwu Uju ;Joseph Danasabe Dodo
Suleiman Samir IBRAHIM

Day 3, Session 4 *[3_4_3]*

GEODESY IN NIGERIA

19-23 May, 2025 @ Conference Room 9, UN Complex, Nairobi, Kenya.

OFFICE OF THE SURVEYOR-GENERAL OF THE FEDERATION

https://osgof.gov.ng/

https://central.nasrda.gov.ng/

AFRIGIST

https://afrigist.org/

THE FEDERAL POLYTECHNIC ADO-EKITI

https://fedpolyado.edu.ng/

❑ WHY IS GEODESY CRITICAL IN NIGERIA?

- Fiducial network that will define and a new reference frame based on space-geodetic techniques and linked to AFREF.
- For accurate Navigation, spatial information management.
- For disaster risk reduction and emergency responses.
- To serve as framework for engineering, surveying and mapping activities.
- For effective land administration, parcel delineation, property demarcation and property registration.
- For proper alignment for construction of infrastructures. E.g. Roads, Bridges, Housing.

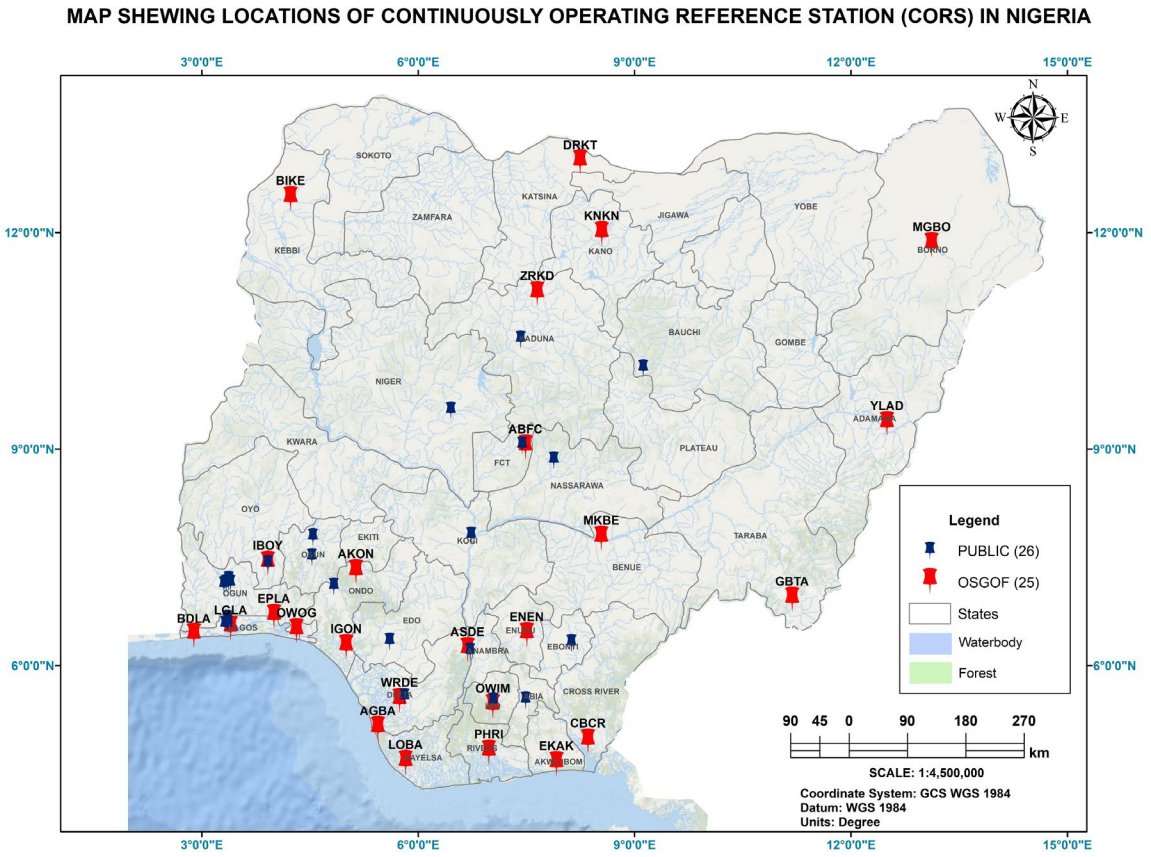
THE STATE OF GEODESY

- **Government Establishment**
  i. Office of the Surveyor General of the Federation (OSGoF)
  ii. National Space Research and Development Agency (NASRDA)
  iii. Centre for Geodesy and Geodynamics (CGG)
  iv. African Regional Institute for Geospatial Information Science and Technology (AFRIGIST)
- **Academic**
  i. Universities
  ii. Polytechnics
- **Professional Body**
  i. Surveyors Council of Nigeria (SURCON)
  ii. Nigeria Institution of Surveyors (NIS)

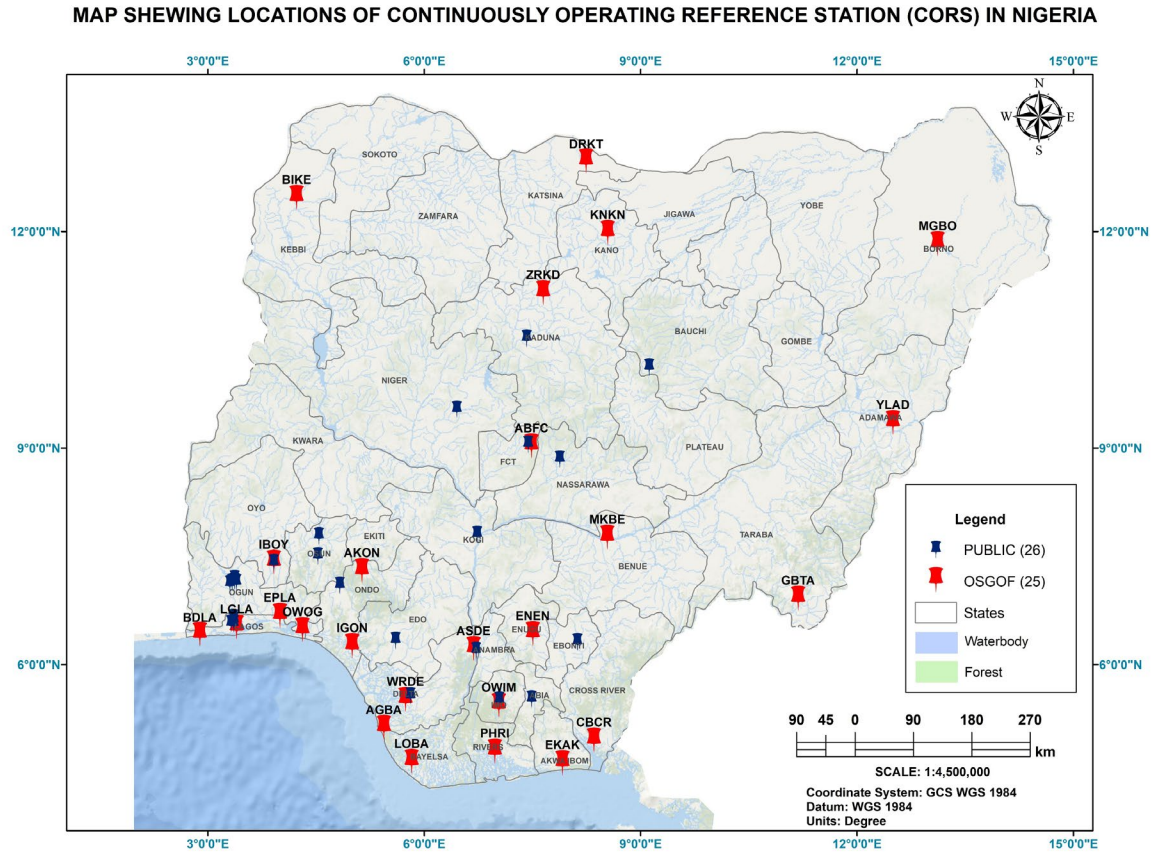
❑ THE STATE OF GEODESY

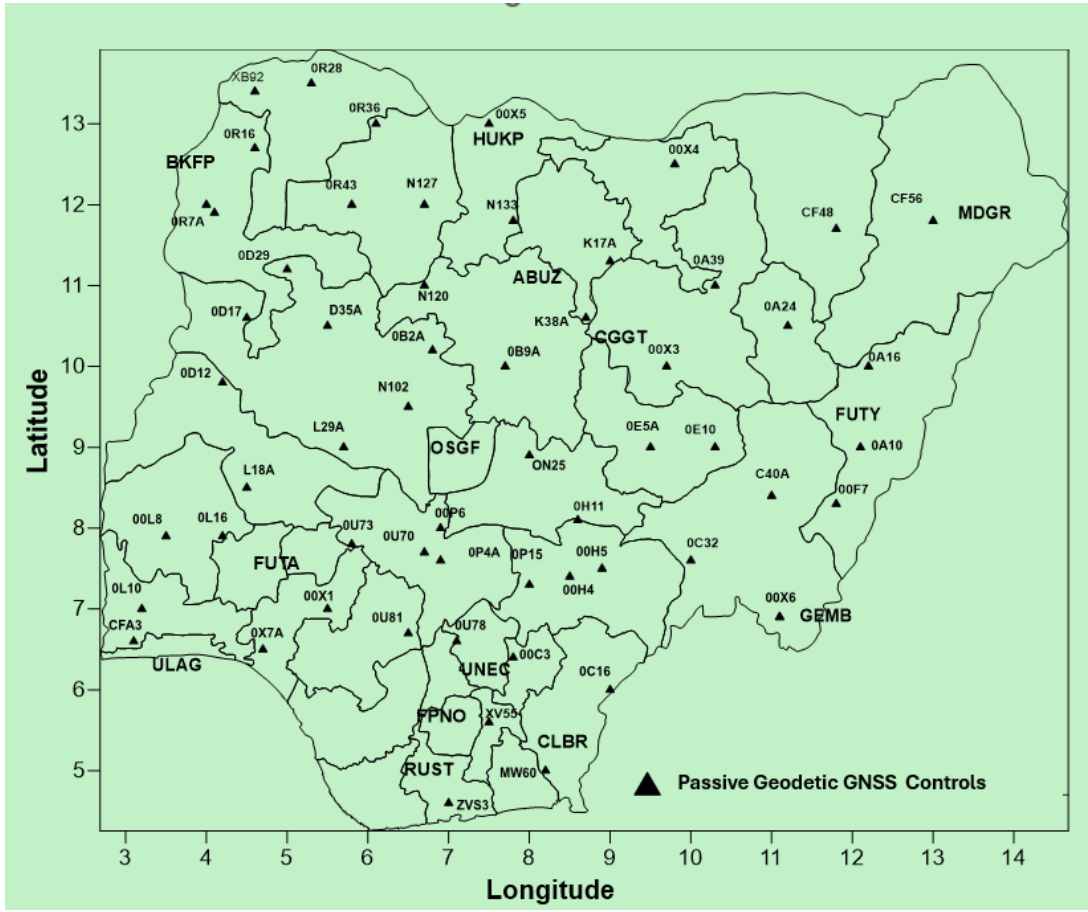
❑ Current Infrastructure in Nigeria

- ➢ **Active Controls**; Continuously Operating Reference Stations (CORS) established by the Government and Private Institutions;
- ➢ Government CORS: 25 Nos.
- ➢ Private Institutions: 26 Nos.
- ➢ CORS Website : https://miranet.nignet.net/
- ➢ Passive Geodetic GNSS Controls: Over 60



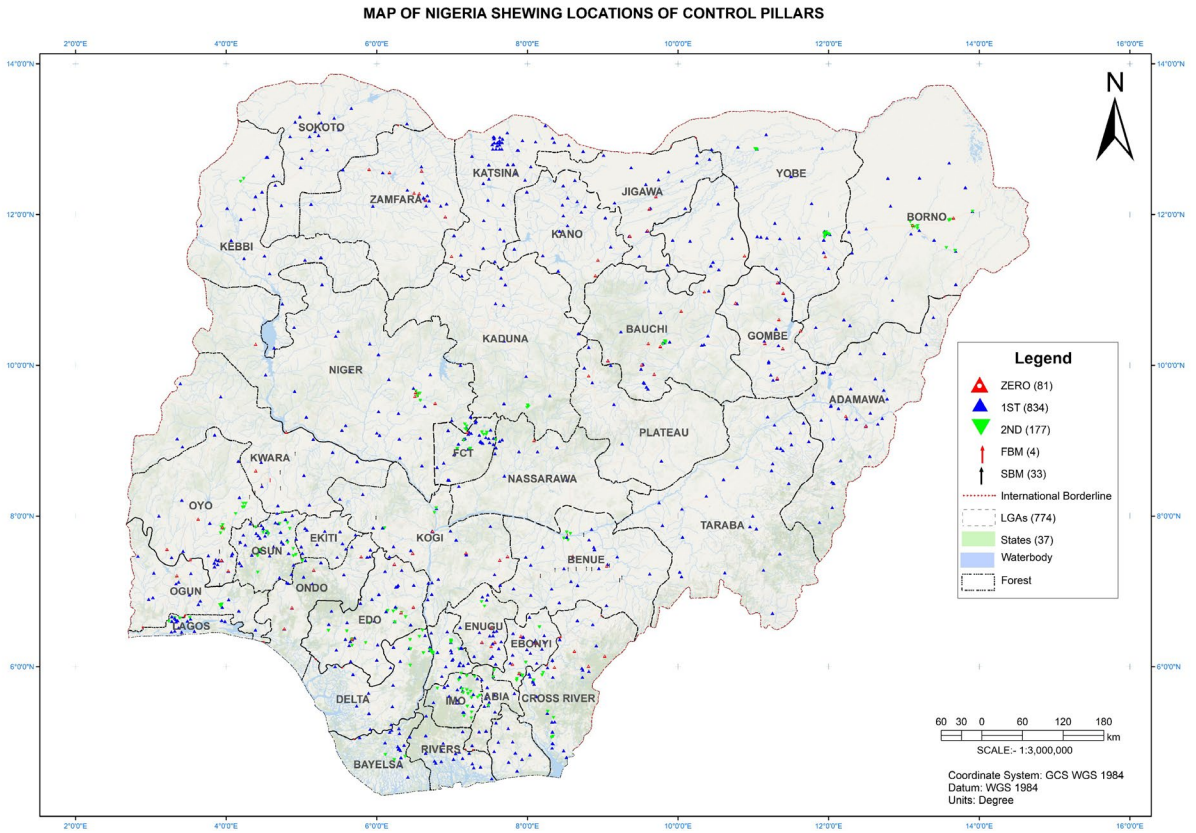
The State of Geodesy: Current Infrastructure in Nigeria



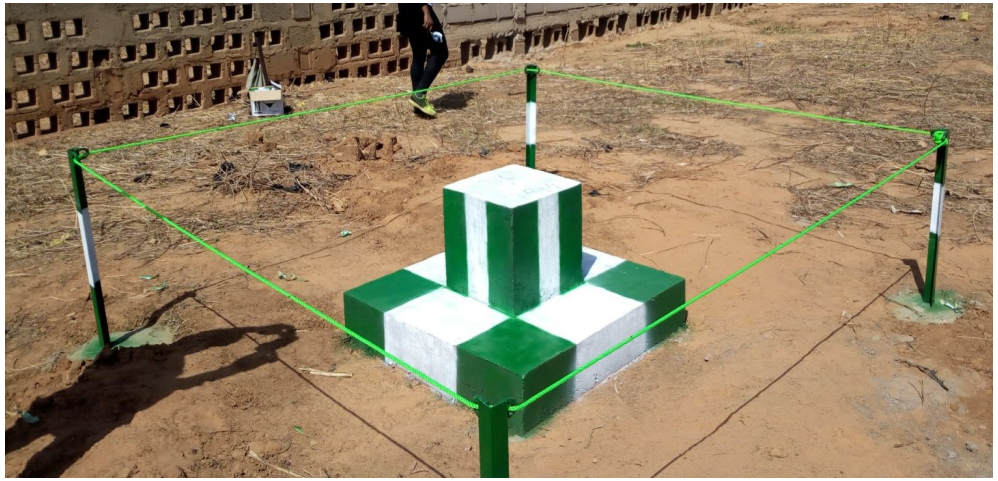


- ❑ **THE STATE OF GEODESY**
- ❑ **CURRENT INFRASTRUCTURE:**
  - ➢ **Passive Controls consisting of Trig-points, bench marks and GPS controls which are in three orders;**

i. Zero Order
ii. First Order
iii. Second Order



A Zero Order Control Pillar

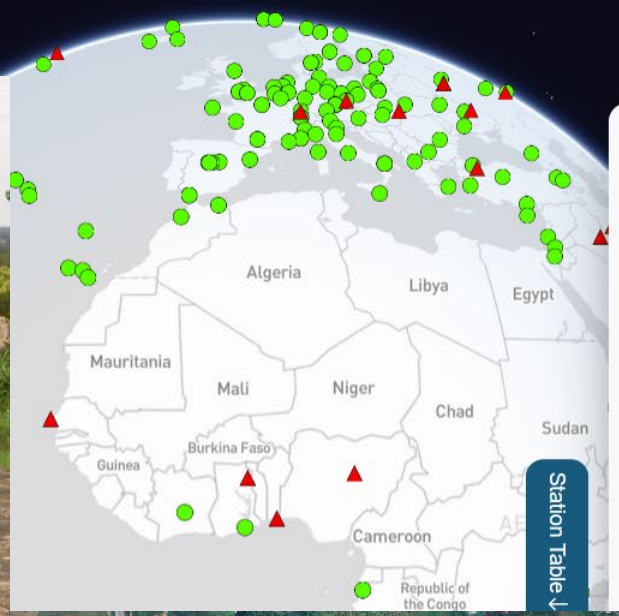


A First Order Control Pillar

A Second Order Control Pillar

The State of Geodesy: Current Infrastructure in Nigeria

IGS Station



IGS INTERNATIONAL GNSS SERVICE

Search | Filter | Projections | Layers

Site Name	Country/Region	Receiver	Antenna - Radome	S
CAGS00CAN	Canada	TRIMBLE NETR8	TRM59800.00 - NONE	G
CAS100ATA	Antarctica	TRIMBLE ALLOY	LEIAR25.R3 - LEIT	G
CCJ200JPN	Japan	TRIMBLE ALLOY	TRM59800.00 - SCIS	G
CEBR00ESP	Spain	SEPT POLARX5TR	SEPCHOKE_B3E6 - NONE	G
CEDU00AUS	Australia	TRIMBLE ALLOY	LEIAR25.R4 - NONE	G
CGGN00NGA	Nigeria	JAVAD TRE_G3TH DELTA	ASH701945B_M - NONE	G
CHAN00CHN	China	ASHTECH UZ-12	ASH701945C_M - NONE	G
CHIL00USA	United Stat…	TPS NET-G3A	TPSCR.G3 - SCPL	G
CHOF00JPN	Japan	JAVAD TRE_G3TH DELTA	TRM57971.00 - NONE	G
CHPG00BRA	Brazil	TRIMBLE ALLOY	TRM59800.00 - NONE	G
CHPI00BRA	Brazil	SEPT POLARX5	TPSCR.G3 - NONE	G
CHTI00NZL	New Zealand	TRIMBLE ALLOY	TRM115000.00 - NONE	G

Show 25 stations | CSV | JSON | 1 2 3 … 21

International GNSS Station (IGS) at the Centre for Geodesy and Geodynamics (CGG)

The State of Geodesy: Current Infrastructure in Nigeria

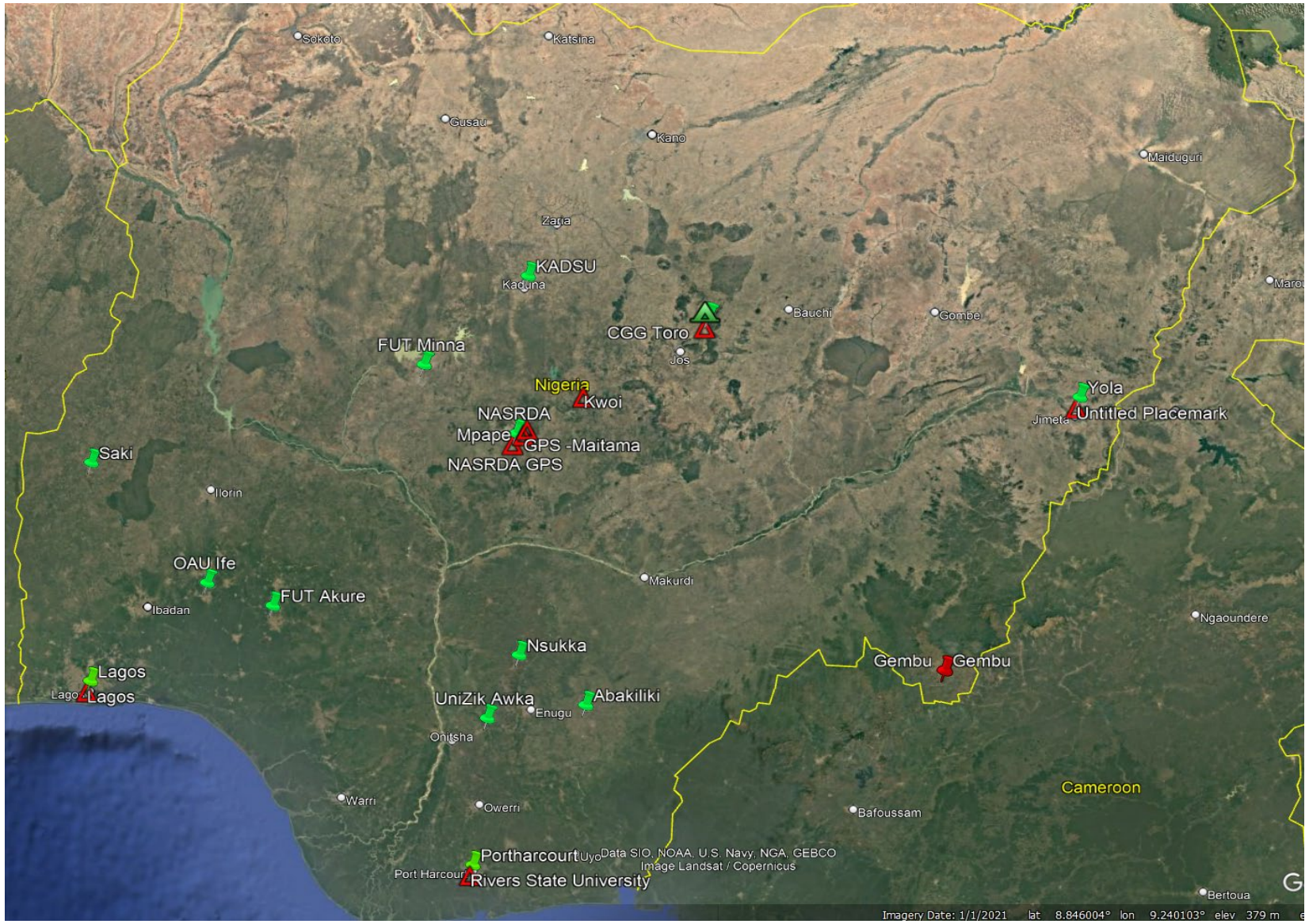
CORS Antenna Monument

CORS Receiver, Comms and Power unit

CORS Unit Overview

OSGoF CORS at Federal University of Technology Akure (FUTA), Akure, Ondo State, NIGERIA

The State of Geodesy: Current Infrastructure in Nigeria



23 Stations

9 GNSS
15 Seismic

GNSS + Seismic = Integrated Station

Plan: Geodetic Weather

Location of the CGG Integrated Earthquake Monitoring Stations in Nigeria

The State of Geodesy: Current Infrastructure in Nigeria

CGG Integrated Earthquake Monitoring station at NASRDA Headquarters Nigeria.

The State of Geodesy: Current Infrastructure in Nigeria

Software:

1. Bernese GNSS Scientific Software: 5 License
2. Trimble Business Centre – License for Server
3. Trimble Pivot: License

GNSS Data Processing and Analysis Center @ CGG Toro- Nigeria

The State of Geodesy: Current Infrastructure in Nigeria

Ongoing Construction of the VGOS at the CGG Toro in Bauchi State, Nigeria

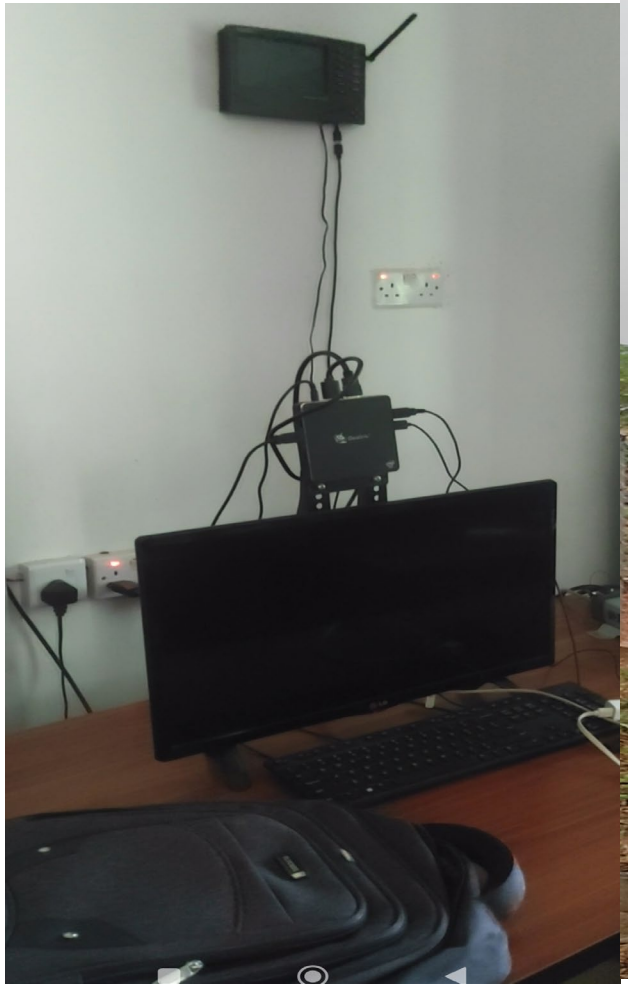
The State of Geodesy: Current Infrastructure in Nigeria

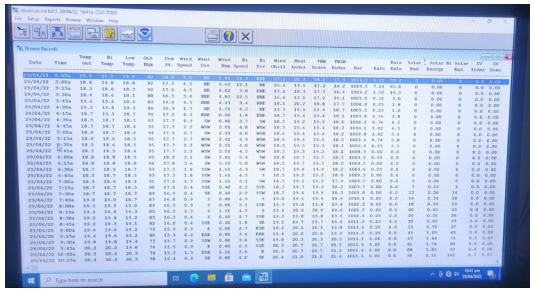
Gravity Network

Mineral Exploration

CG5 Gravimeter @ CGG for Gravity Measurement

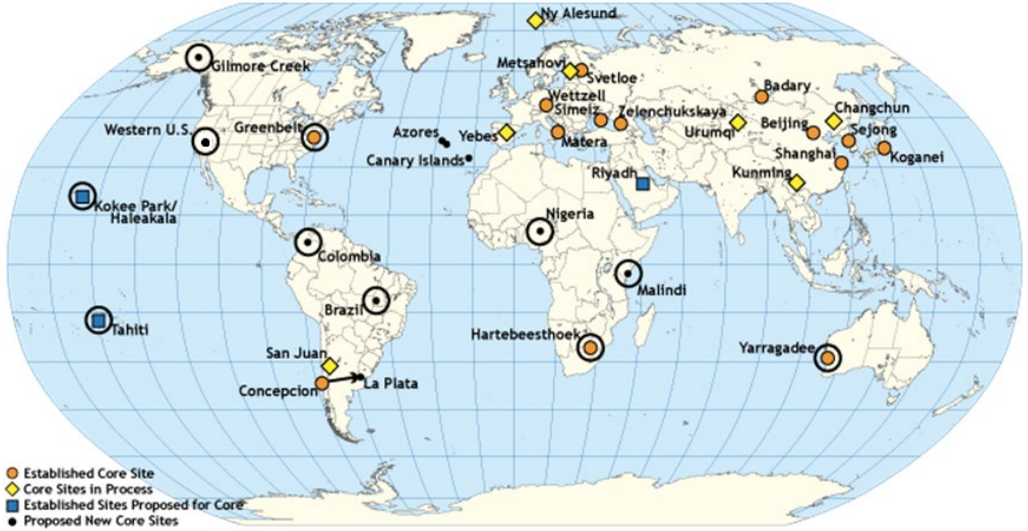
The State of Geodesy: Current Infrastructure in Nigeria

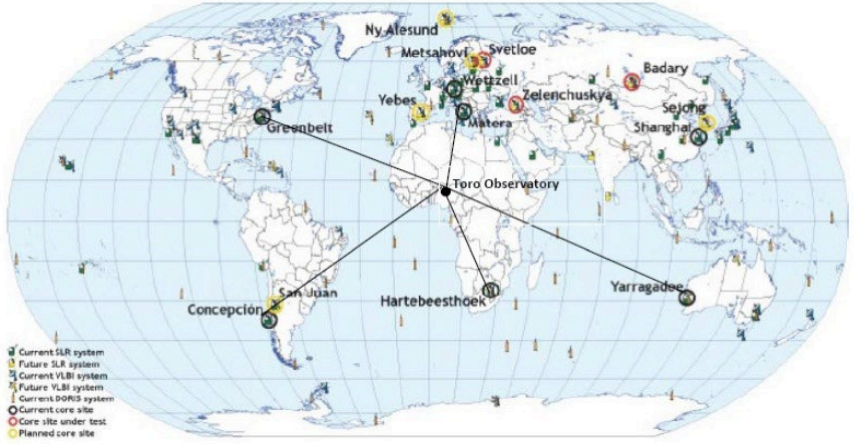




Centre for Geodesy and Geodynamics: Geodetic Weather Station

The State of Geodesy: Current Infrastructure in Nigeria





Centre for Geodesy and Geodynamics : A Global Space Geodetic Observatory- GGOS Approval as a “Candidate Site”

KEY ACHIEVEMENT

- Development of Nigerian Geocentric Datum 2012
- Development of Nigerian Geocentric Datum 2023
- Establishment of Integrated Earthquake Monitoring Network
- Densification of the CORS across the country
- Hosting of an IGS Station
- Building of a Geodetic VLBI
- AFREF Data Processing Centre

❑ CHALLENGES OR GAPS

- Inadequate budgetary allocation.
- Inadequate infrastructure.
- Poor distribution of CORS for a network solution.
- Capacity building.
- Acceptability and adoption of technology.
- The operation of independent CORS establishments in silos hinders collaboration.
- Collaboration within Africa

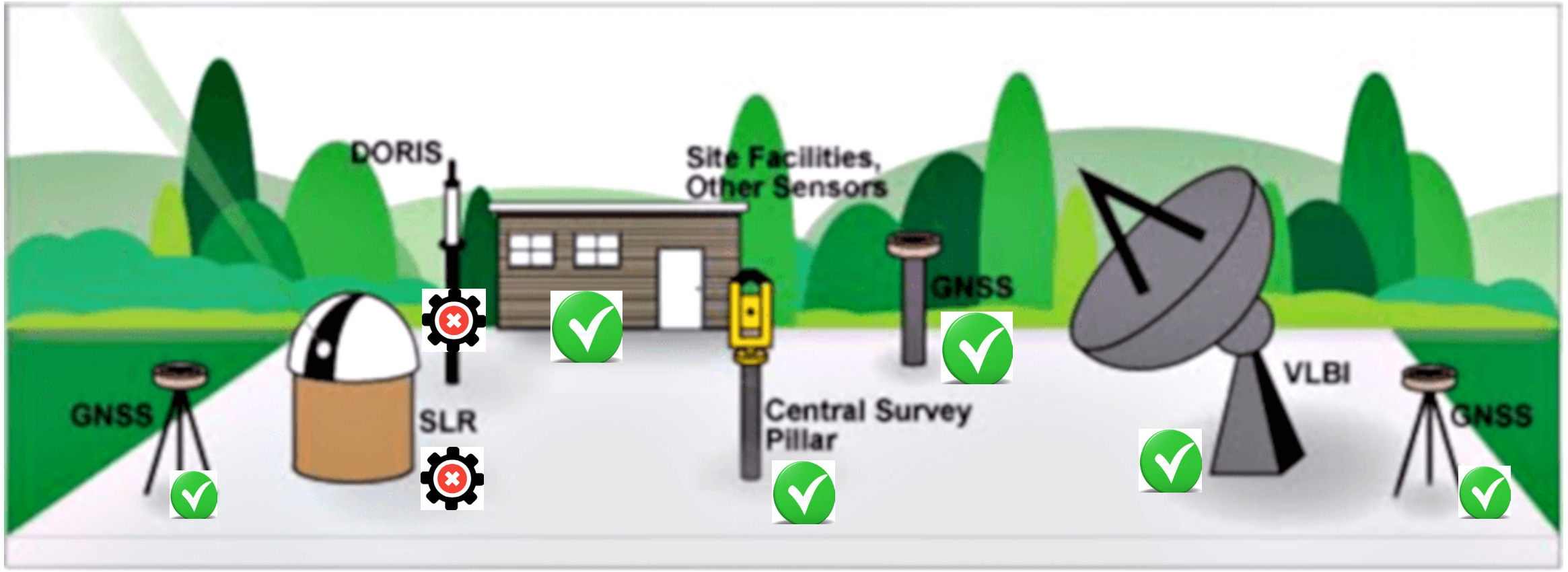
❑ WHAT'S NEXT/CALL TO ACTION

- ➢ Foreign support from Geodetic organizations.
- ➢ Collaboration with Stakeholders, Original Equipment Manufacturers (OEM's), MDAs, and end users of the CORS infrastructure.
- ➢ Sensitization on acceptability and adoption of technology.
- ➢ Capacity building on the relevance of geodesy and its applications
- ➢ Densification of CORS infrastructure to 194.
- ➢ Sensitization on the importance of geodesy.
- ➢ Nigeria as a Core Space Geodesy Observatory at CGG Toro
  - ➢ Very Long Baseline Interferometry (VLBI)
  - ➢ Global Navigation Satellite System (GNSS)
  - ➢ Satellite Laser Ranging

● In progress

MAP OF PROPOSED LOCATIONS FOR DENSIFICATION OF NIGERIA NETWORK OF CONTINUOUSLY OPERATING REFERENCE STATIONS

A SPACE GEODESY OBSERVATORY AT CGG TORO



❑ THANK YOU

- On behalf of Nigeria, our extensive gratitude goes to UN-GGCE for the great opportunity given to us to attend and participate in this intellectual, educative and insightful capacity building workshop. It is a great privilege for us and a wonderful learning curve to strengthen our intellectuality towards being productive and achieving both UN-GGCE and our organizational goals. We are very grateful and most appreciative.
- We appreciate our organizations for releasing us to attend this important program.

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UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Kenya

Sammy Mwangi Matara
Victoria Obura
Rachael Gedion

Day 3, Session 4 *[3_4_3]*

Geodesy in Kenya

Sammy Mwangi MATARA, LS(K), MISK, RPL

Tutorial Fellow; Department of Geospatial and Space Technology, University of Nairobi – Kenya

Victoria OBURA, Category A Hydrographer, Dip. Law of the Sea.

Principal Hydrographer, National Hydrographic Office, Survey of Kenya.

Rachael UMAZI

Principal surveyor; Regional Centre for Mapping of Resources for Development (RCMRD)

Why Geodesy Matters for Kenya

1. Definition of Geodetic Reference Systems and Frames - through establishment of Horizontal and Vertical Geodetic Datums - chart datums for nautical charting

2. Land Administration & Cadastral Surveys – Property Boundaries & Urban/Regional Planning – Key in Georeferencing of Parcel Boundaries.

3. Infrastructure Development – Transport Networks & Energy Projects – pipeline routing

4. Disaster Risk Management – Earthquake Monitoring &Flood Modelling

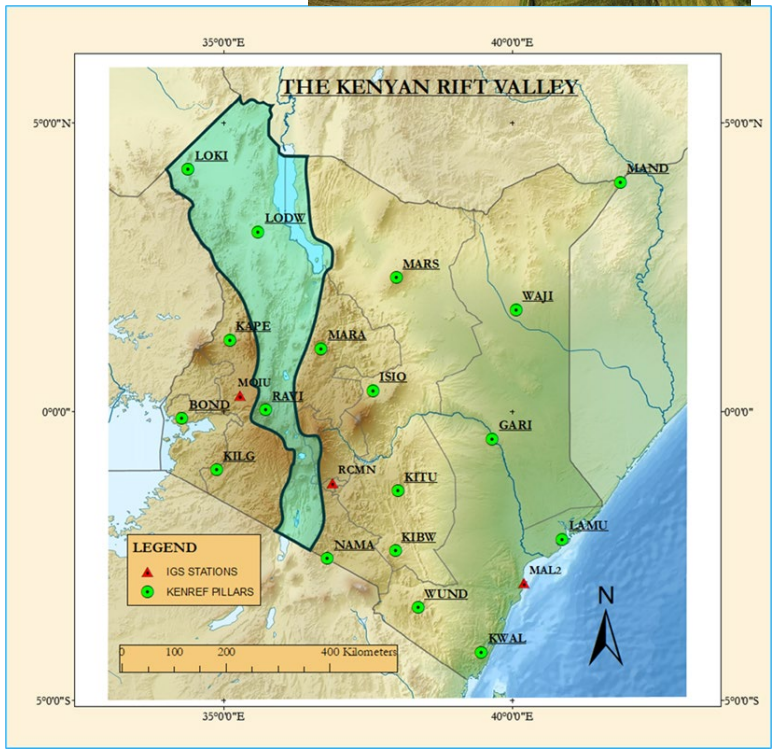
5. Agriculture & Food Security – Precision Agriculture & Soil Surveys

6. Marine & Blue Economy – Port Development and Offshore Oil/Gas exploration

7. Climate Change Resilience – Sea Level Rise Monitoring

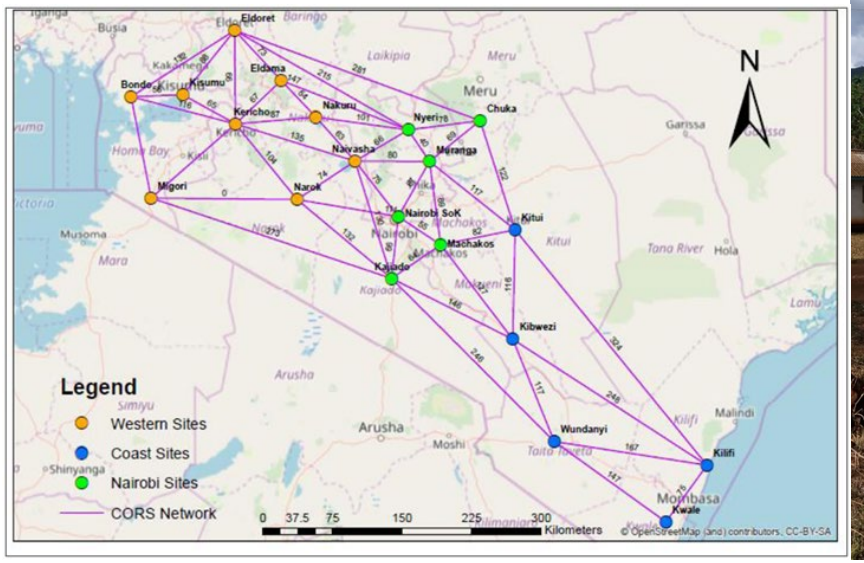
8. Roll out of KNSDI

9. Scientific Research - geophysics, geodynamics, glaciology, oceanography, and atmospheric sciences, providing crucial data for studying Earth's processes and phenomena.



The State of Geodesy in Kenya

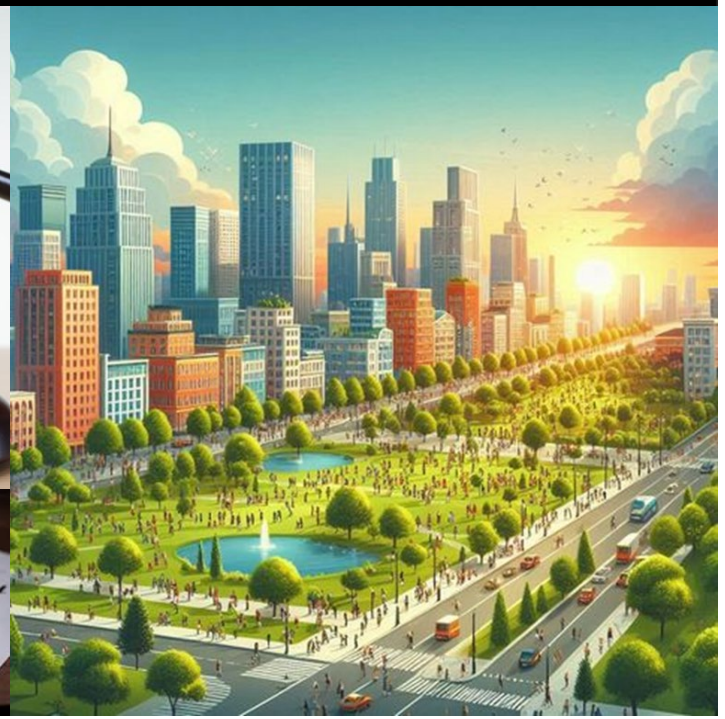
1. **Disjointed and Outdated Geodetic Infrastructure**
   - Reliance on old horizontal and vertical datums and coordinate Systems(Cassini Soldner, UTM Arc 1960, and Local Datums)
   - Insufficient CORS Coverage
2. **Lack of a Unified National Coordinate System**
   - Poor integration with African Geodetic Reference Frame (AFREF)
   - No standardized transformation parameters
3. **Inadequate Passive Control Networks**
   - Sparse geodetic control points and benchmarks
   - Weak levelling and height reference system
4. **Limited Geoid Modelling Data**
   - Incomplete/sparse gravimetric survey data
   - Lack of a precise geoid model
5. **A large pool of well trained geospatial professionals**
6. **KENREF Project, Tier 3 CORS and Legacy Network Densification**
7. **Lack of political will and inadequate funding**



Way Forward/ Call to Action

- World Bank Funded Project to Develop a Stra for the Kenya Geodetic Reference System and Large-Scale Mapping
- Capacity-building to support modernization,
- Policy Review support to anchor Geodetic Network modernization and use of Modern Technology for Survey
- Regional Coordination and Integration

No.	Class	Interstation Distance	No. of Stations	Accuracy
1.	Zero Order (Tier 1 & 2 CORS)	200Km	25	0.01 ppm
2.	First Order	100Km	70	0.10 ppm
3.	Second Oder/ Tier 3 CORS	50 – 70 Km	134	1.00 ppm
4.	Third Order	5 – 30Km	600	10.0 ppm



?????????

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Rachael Umazi:- rgedion@rcmrd.org

UNIVERSITY OF NAIROBI

REPUBLIC OF KENYA

MINISTRY OF LANDS, PUBLIC WORKS, HOUSING AND URBAN DEVELOPMENT
STATE DEPARTMENT FOR LAND AND PHYSICAL PLANNING

REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT

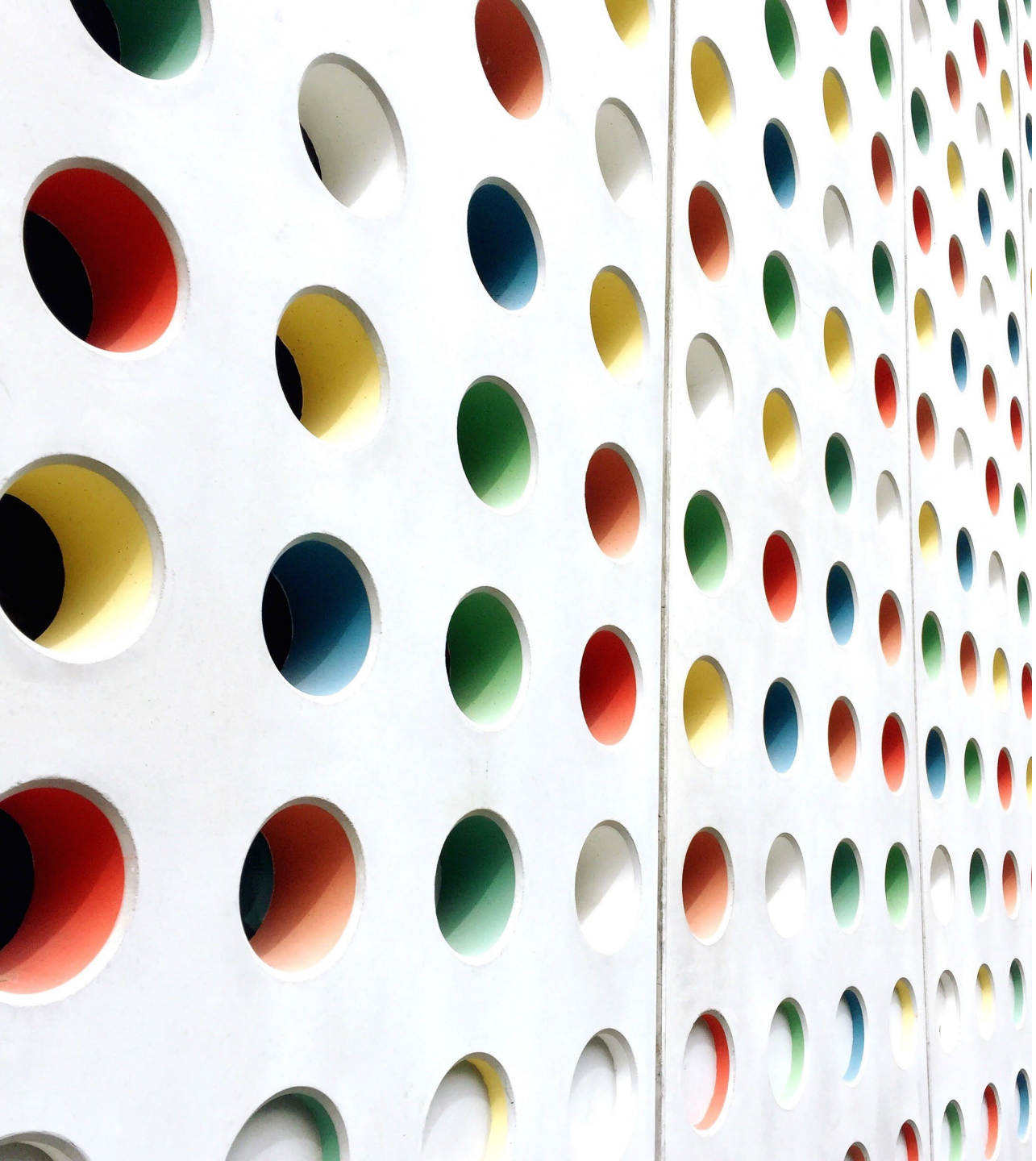
UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Ethiopia

Sintayehu Abe

Day 3, Session 4 *[3_4_3]*



Geodesy in Ethiopia

Presenter: Sintayehu ABIE

Lecturer, Addis Ababa University

Why Geodesy matters?

City Planning & Infrastructure

Disaster Management

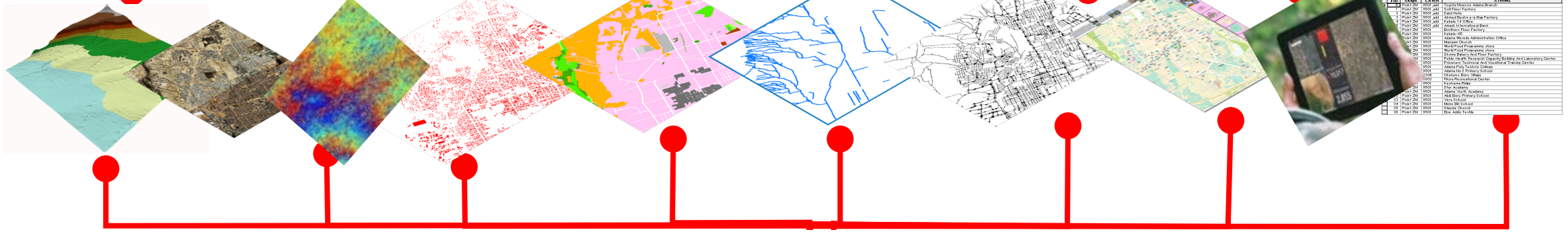
Agriculture Promotion

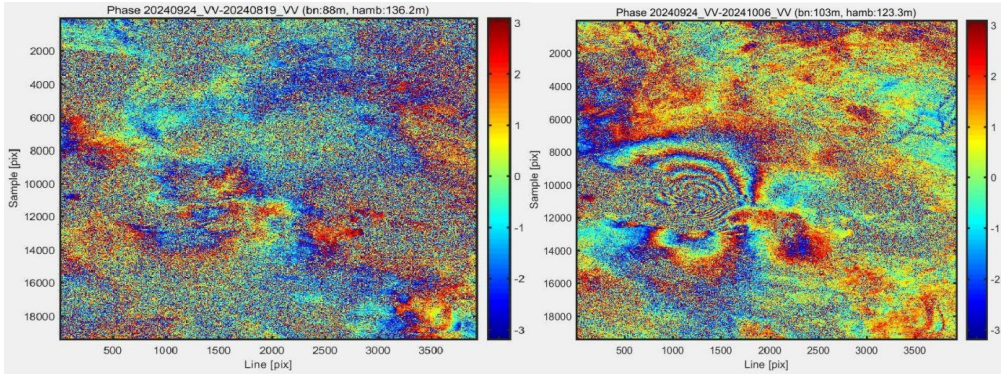
Nature Resource Management

Cadastral Survey

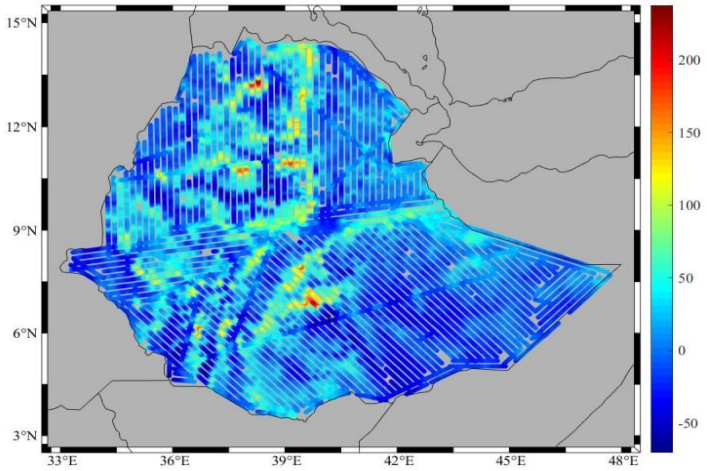
Military Sector

Transport

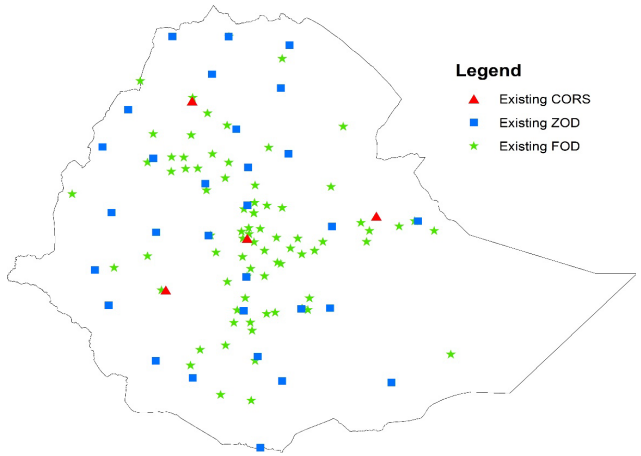




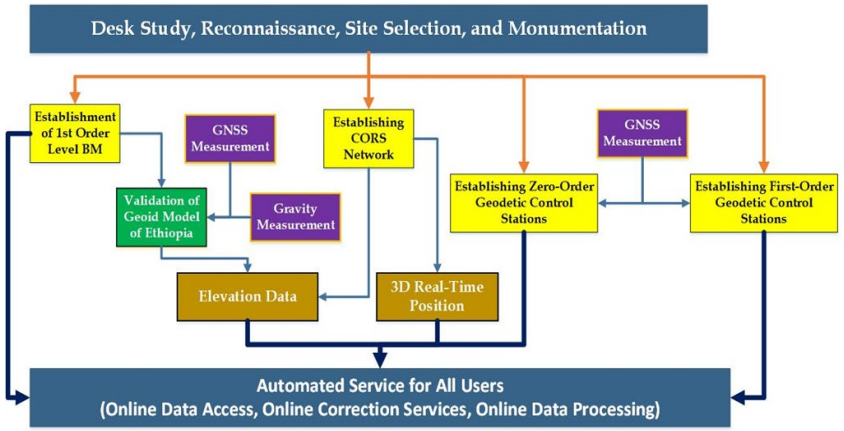
The state of Geodesy



Airborn Gravity Data (2006 - 2008



Geodetic Network



FUTURE PLAN

INSTITUTES

- **CHALLENGE: PROBLEM IN DATA HANDLING**

Call to Action

Thank you

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UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Malawi

Charles Bakolo

Day 3, Session 4 *[3_4_3]*

STATE OF GEODESY IN MALAWI

Nairobi, Kenya
19-23 May 2025

Charles Bakolo

MALAWI

MINISTRY OF LANDS, DEPARTMENT OF SURVEYS AND MAPPING

CURRENT GEODETIC INFRASTRUCTURE IN MALAWI

- Managed by the Department of Surveys, Ministry of Lands.
- National GNSS network under development; aligned with ITRF (**International Terrestrial Reference Frame).**
- Achievement: Migration to MGRF2003 (Malawi Geodetic Reference Frame 2003), enhancing mapping accuracy.
- In addition, there has been international boundary demarcation in WGS84 (Malawi-Zambia).
- Challenge: Limited real-time data access, funding gaps, outdated gravity data. The country is planning to transition to using the Continuous Operating Reference System (CORS).

NEXT STEPS AND REGIONAL COOPERATION

- ❑ Malawi plans to expand the GNSS network and build a National Spatial Data Infrastructure (NSDI).

- ❑ Needs include:
- ✓ Capacity building for geodetic professionals
- ✓ Access to gravity data and geoid modelling
- ✓ Regional coordination and data-sharing platforms

- ❑ We welcome partnerships to support training, modernization, and regional alignment.

Thank you for the opportunity to share our geodetic journey.

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Ministry of Lands – Department of Surveys

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Mauritania

Abderrahmane Dia

Day 3, Session 4 *[3_4_3]*

United Nations

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE (UN-GGCE), STATISTICS DIVISION)

DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS

MINISTERE DE L'HABITAT DE L'URBANISME DE L'AMENAGEMENT DU TERRITOIRE

DIRECTION DE LA CARTOGRAPHIE ET DE L'INFORMATION GÉOGRAPHIQUE

DCIG

Atelier de développement des capacités en géodésie pour l'Afrique sur la transition vers un système de référence géospatial moderne

SYSTÈME DE REFERENCE GEODESIQUE EN MAURITANIE

PAR : ABDERRAHMANE DIA/CHEF DE SERVICE DES LEVES TERRESTRES

18 Mai 2025

SOMMAIRE

- CONTEXTE
- SITUATION GEOGRAPHIQUE DE LA MAURITANIE
- HISTORIQUE
- NOUVEAU SYSTÈME DE REFERENCE GEODESIQUE (RGM 2020)
- RESEAU GNSS EN MAURITANIE
- CONCLUSION

CONTEXTE

Dans le cadre de sa politique de gestion de l'aménagement du territoire, le gouvernement mauritanien a décidé de moderniser l'infrastructure géodésique du pays, en programmant la mise en place :

- **Un nouveau système de référence en Mauritanie**

- **Un réseau GNSS de 5 stations et deux serveurs**

SITUATION GEOGRAPHIQE

Un pays de l'Afrique de l'Ouest, la Mauritanie se situe entre 15 et 27 degrés de latitude nord et 5 et 17 degrés de longitude ouest

HISTORIQUE

- Un réseau de 25 points fut élaboré par IGN
- La loi n°99.013 portant code minier fait objet de la création du premier réseau géodésique de référence national
- Ce réseau était composé de 32 points répartis dans les différentes régions du pays
- Il fait l'objet de d'un géoréférencement dans le système mondial ITRF 96 (97)

GeodeticDatum [Mauritania 1999]

Code: *EPSG::6702*
Name: *Mauritania 1999*
Anchor Definition: ITRF96 at epoch 1997.0
Realization Epoch: 1997-01-01

HISTORIQUE

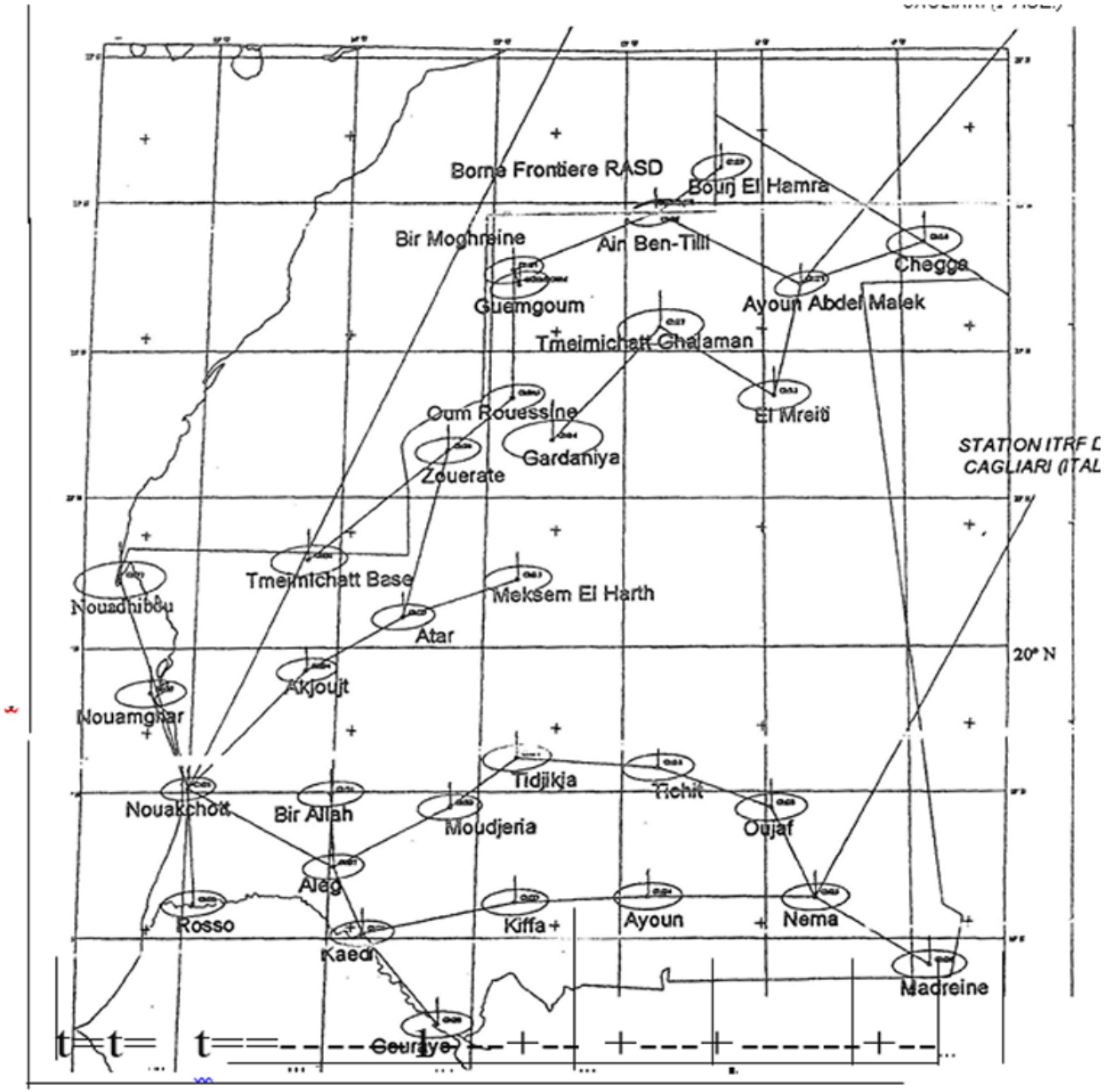


Figure 1 : Ancien réseau Cadastre Minier

NOUVEAU SYSTÈME DE REFERENCE GEODESIQUE RGM 2020

- C'est un réseau géodésique de 1er Ordre, il est constitué de 60 bornes en béton couvrant l'ensemble du pays
- Géoréférencement : Système de Référence Terrestre tridimensionnel géocentrique ITRF2020 (Epoch 2015)
- Ellipsoïde de révolution associé au RGM2020 fournissant des coordonnées géographiques (λ,ϕ,h) : IAG-GRS80
- Représentation plane associée au RGM2020 fournissant des coordonnées planes (Est Nord) : **UTM 28N-29N-30N**

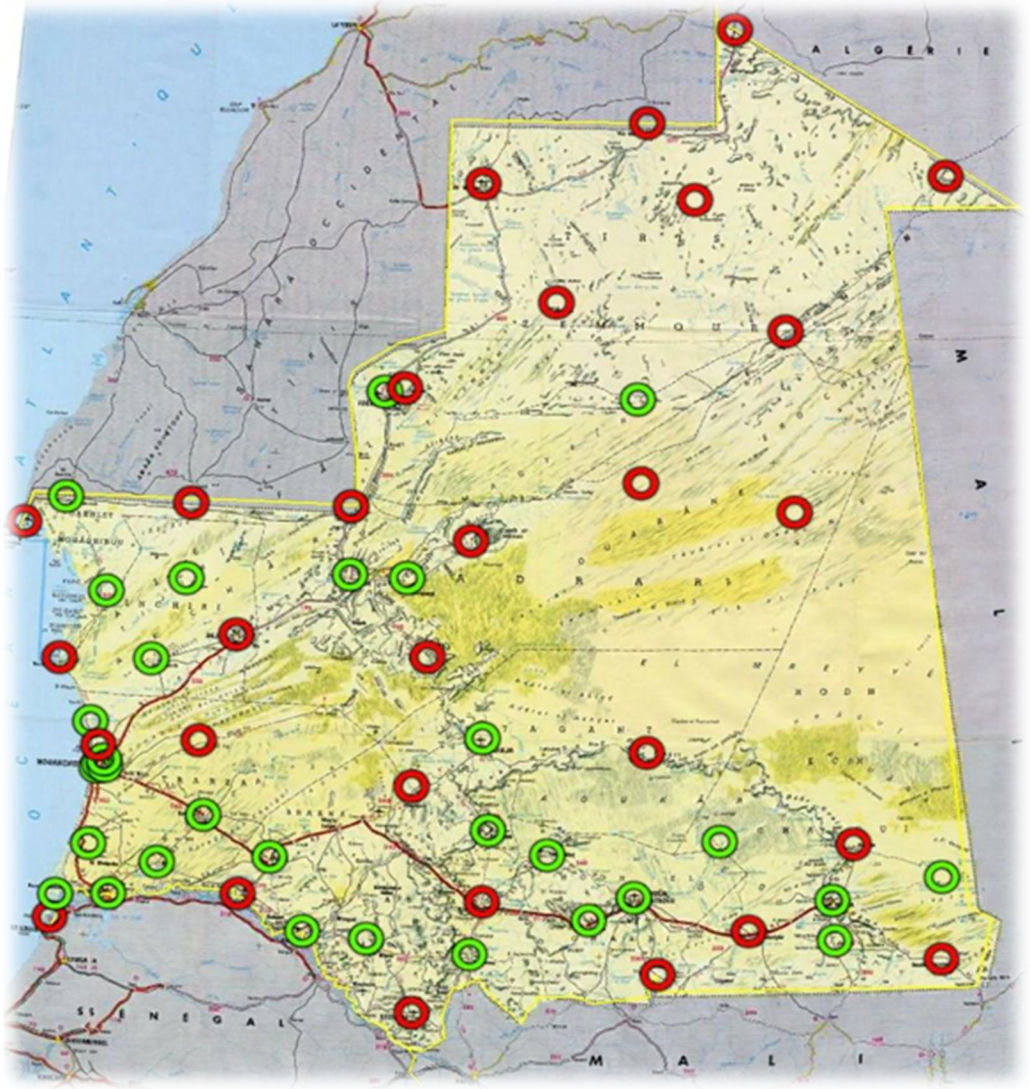
NOUVEAU SYSTÈME DE REFERENCE GEODESIQUE RGM 2020

- Par rapport à la composante altimétrique, la Mauritanie ne dispose pas un réseau de nivellement de référence ni un model géoïde national

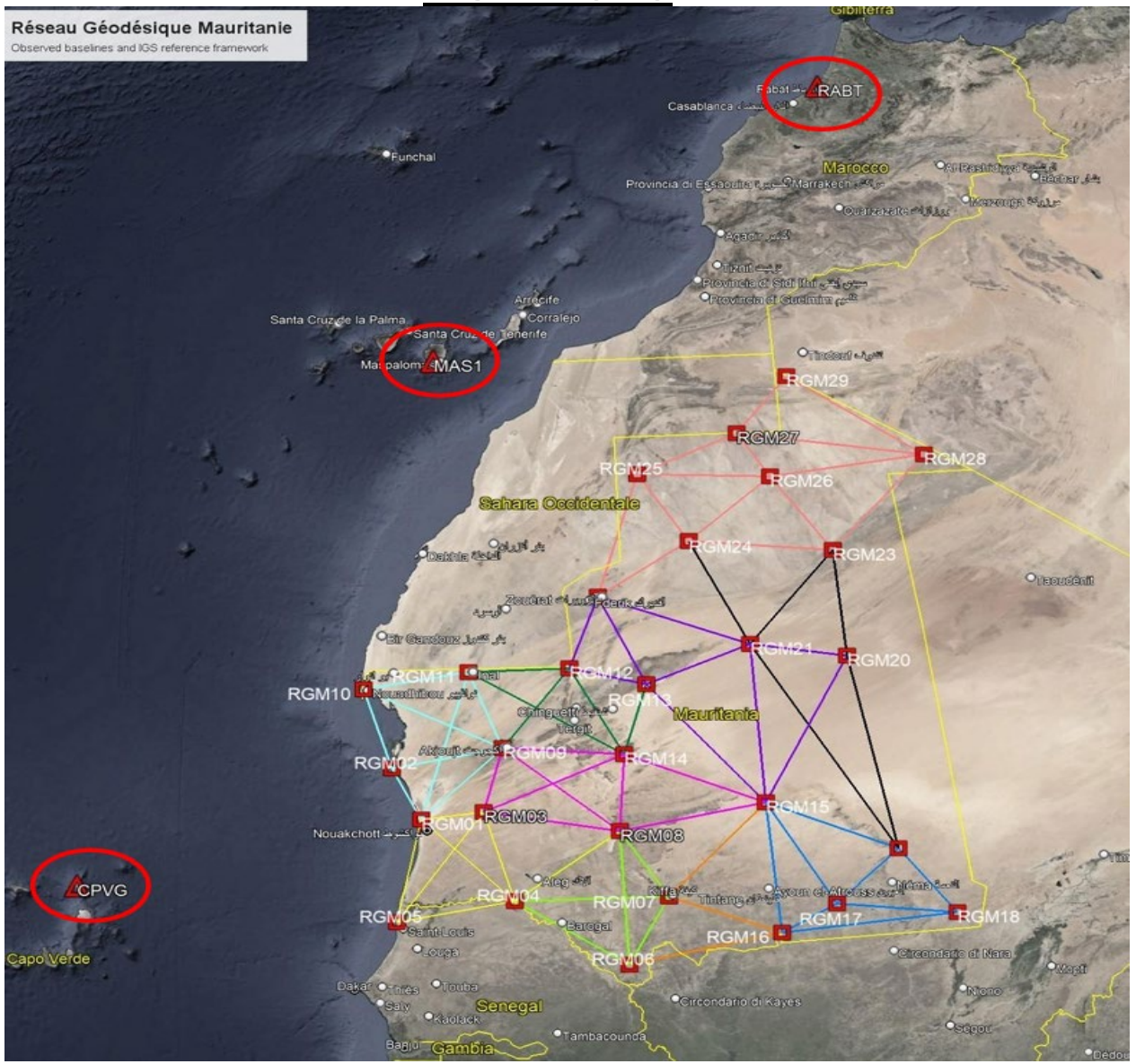
- Les hauteurs sont déterminées par rapport à l'ellipsoide à l'aide d'un model géoïde international EGM 2008

- Un nouveau marégraphe est installé à terme, la référence altimétrique terrestre conventionnelle définitive destinée à être utilisée en tant que zéro terrestre

NOUVEAU SYSTÈME DE REFERENCE GEODESIQUE RGM 2020



NOUVEAU SYSTÈME DE REFERENCE GEODESIQUE
RGM 2020



RESEAU GNSS EN MAURITANIE

- Un réseau de 5stations et deux serveurs sont installés :
- Ces stations sont entres autres : Nouakchott, Tanit Nouadhibou, Rosso et Aleg
- Ils ont été installés et connectés par réseau TERIA avec un service temps réel via un Protocol standard NTRIP et de la connexion internet et le format de correction RTCM
- Les coordonnées de ces stations sont calculées dans le système Mauritania 1999 (ITRF 96 ép. 97)

RESEAU GNSS EN MAURITANIE

CONCLUSION

- **Une volonté politique claire de moderniser la géodésie en Mauritanie**
- **Une nette amélioration sur la précision des données géodésiques**
- **Un impact direct sur différents secteurs : l'Urbanisme, Bâtiments et Travaux Publics, l'Agriculture ...etc.**

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Morocco

Abdelilah Tahayt

Day 3, Session 4 *[3_4_3]*

Kingdom of Morocco
Abdelmalek Essaadi University

Geodesy in Morocco

Prof. Abdelilah Tahayt

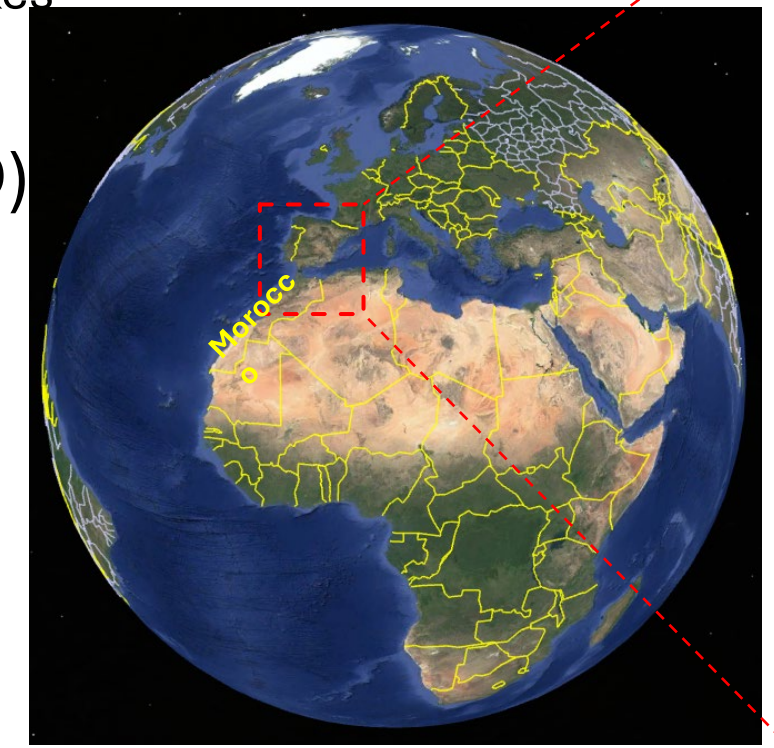
Department of Earth Sciences

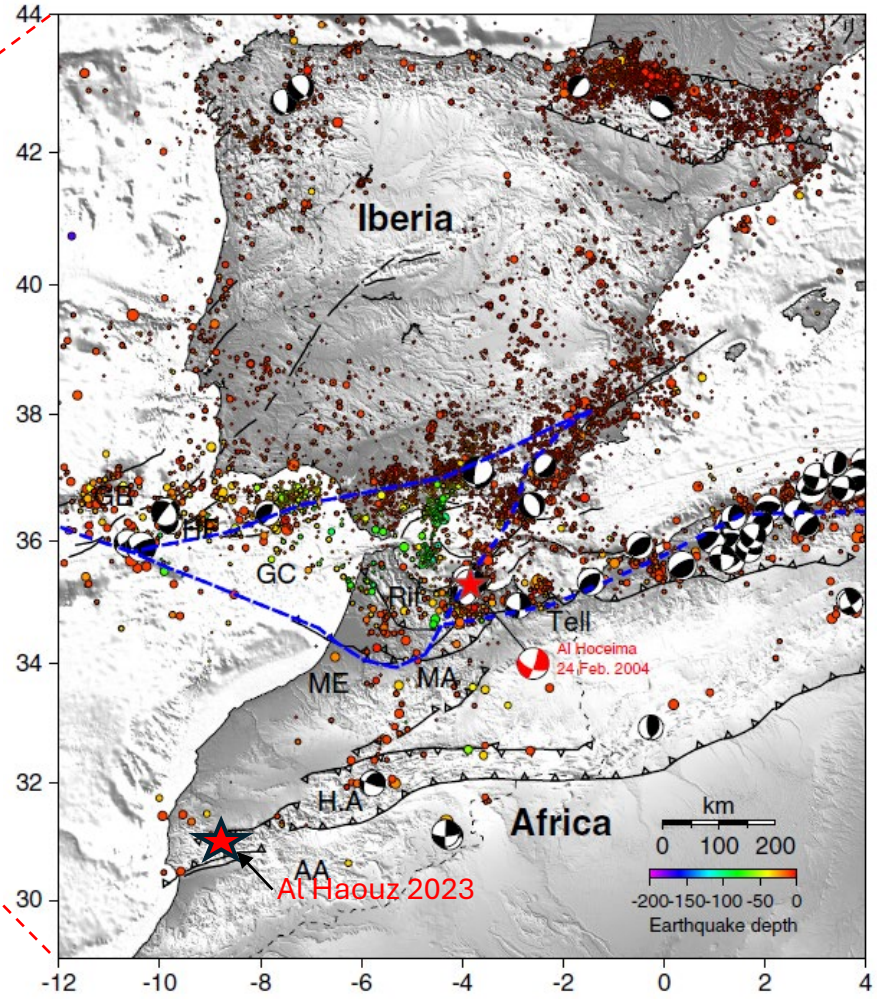
Tangier

Collaborations:

Why Geodesy Matters?

- Tectonic studies
  - Deformation / Earthquakes
  - Plate boundary
- Troposphere (ZTD)
  - Precipitable water
- Ionosphere (TEC)
  - Space weather
- Reference Frame

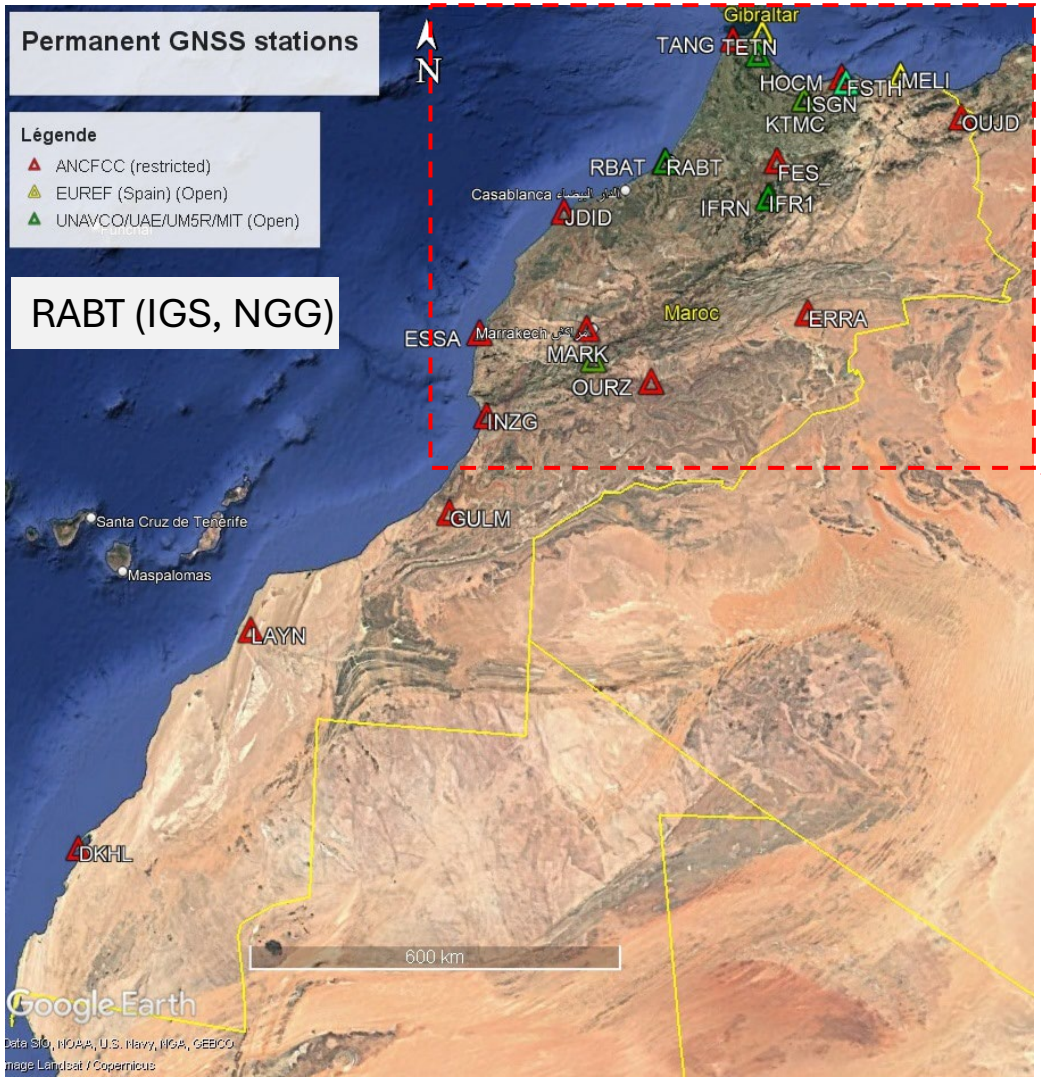


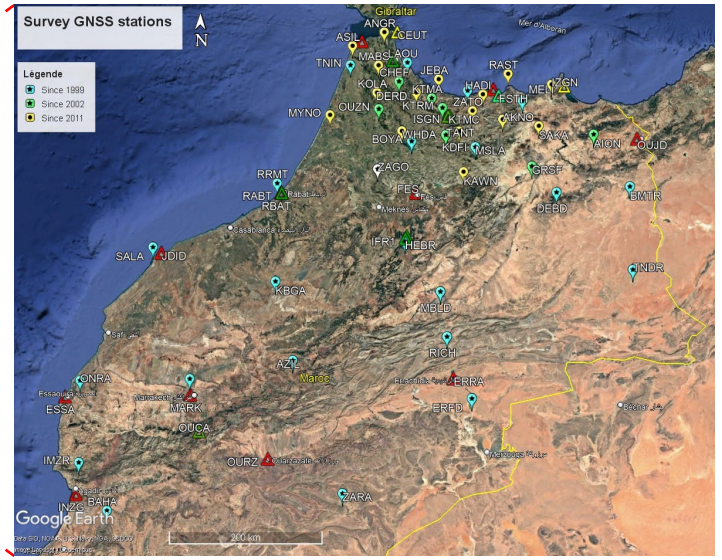


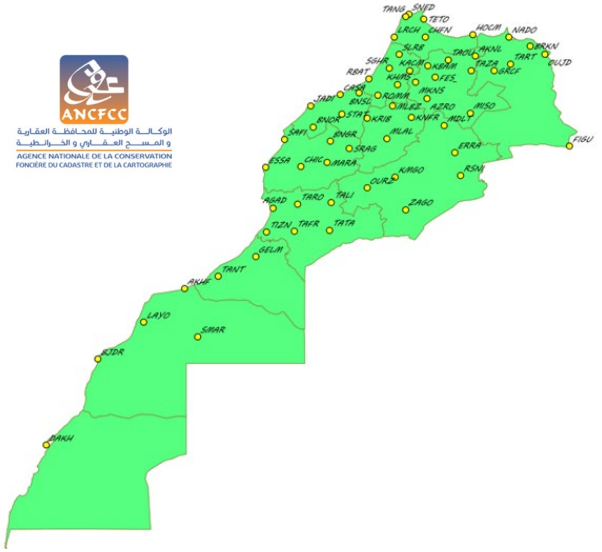
The State of Geodesy

The development of GNSS networks Since 1999

Archived datasets are published with GAGE's DOI

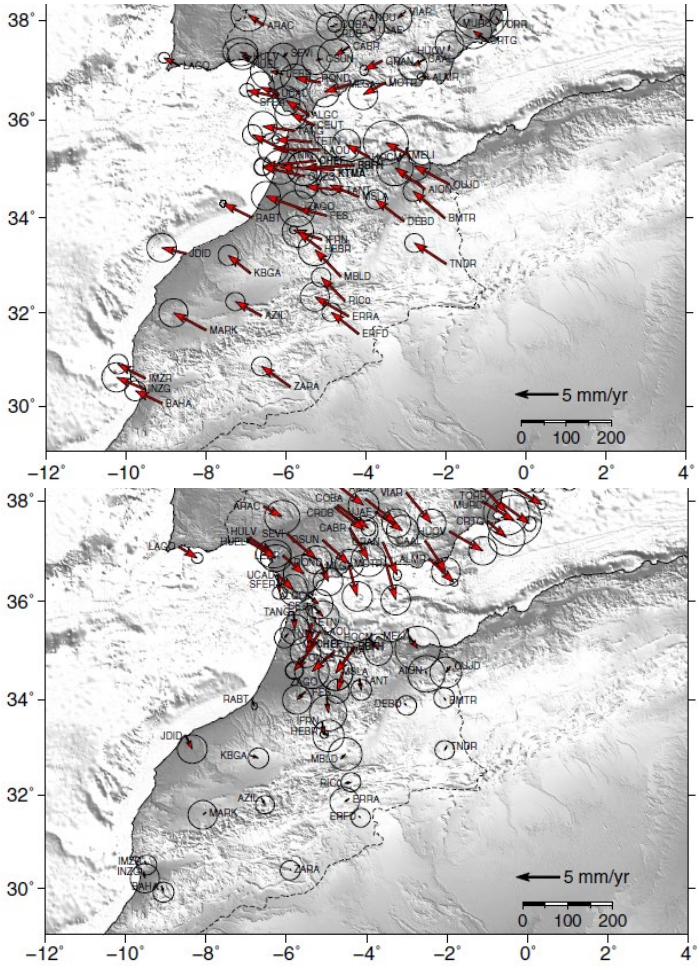






Processing : GAMIT/GLOBK

Precise coordiantes & Velocities



What's Next / Call to Action

- National collaborations :
  - Universities, ANCFCC & others
  - Teaching of space geodesy
  - Annual and semi-annual Surveys
  - Permanent stations maintenance
  - Combine all GNSS stations
  - National data center

- International collaborations:
  - Research
  - Contribute to AFREF

جامعة عبد المالك السعدي
Université Abdelmalek Essaâdi

كلية العلوم و التقنيات بطنجة
Faculté des Sciences et Techniques de Tanger

Thank You

atahayt@uae.ac.ma
abdelilah.tahayt@gmail.com

Massachusetts Institute of Technology

UNIVERSITÉ DE MONTPELLIER

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Cameroon

Loudi Yap

Day 3, Session 4 *[3_4_3]*

Geodesy in Cameroon: An Overview of the Current Landscape

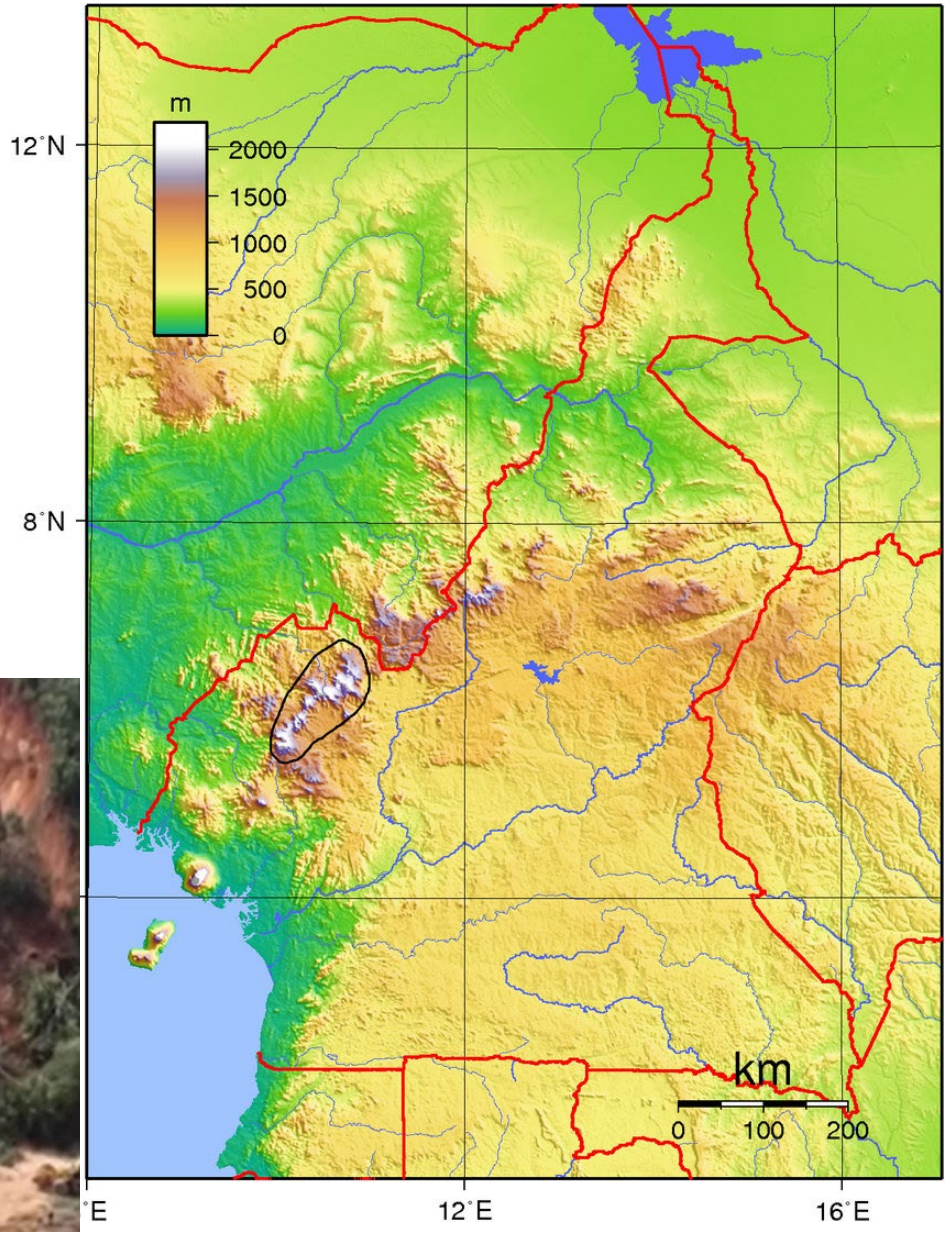
Loudi Yap, PhD

Head of Research Laboratory in Geodesy, National Institute of Cartography, Cameroon

Geodesy Capacity Development Workshop for Africa

Nairobi, 19-23 May 2025

1. Introduction



Double landslide on the Dschang road, 2024, killed at least 25 people.

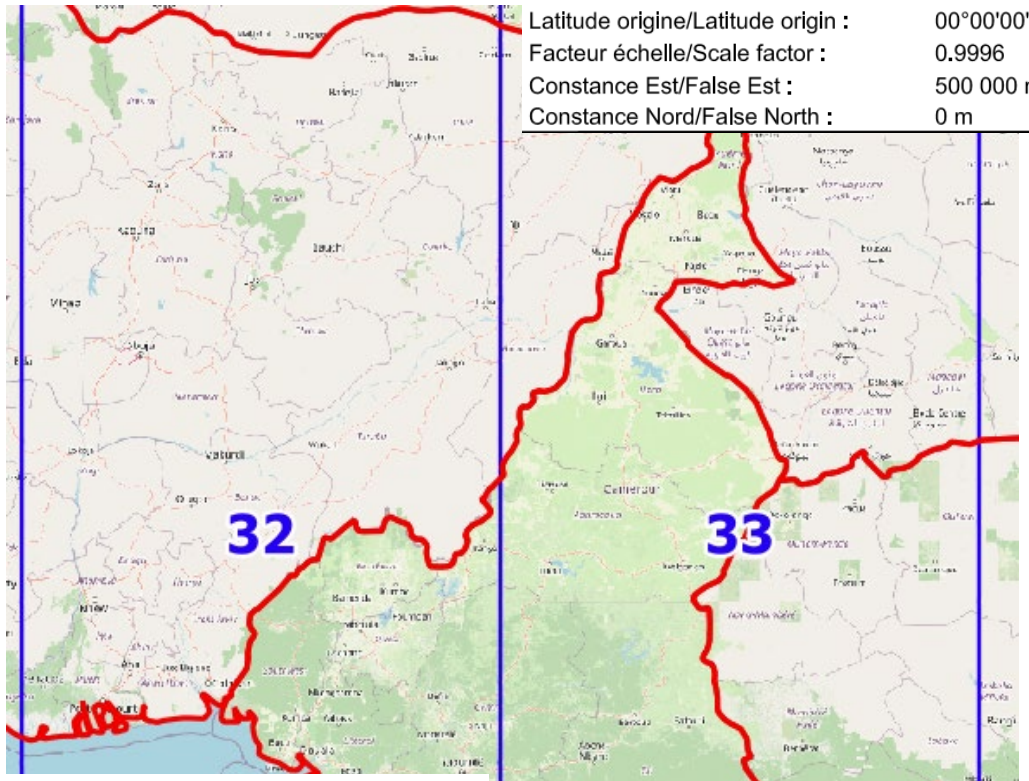
2023 Mbankolo landslide destroyed homes and fatalities at least 40 people.

2.Why Geodesy Matters

Photos of a bridge near the Mekin Dam before and after the dam was impounded.

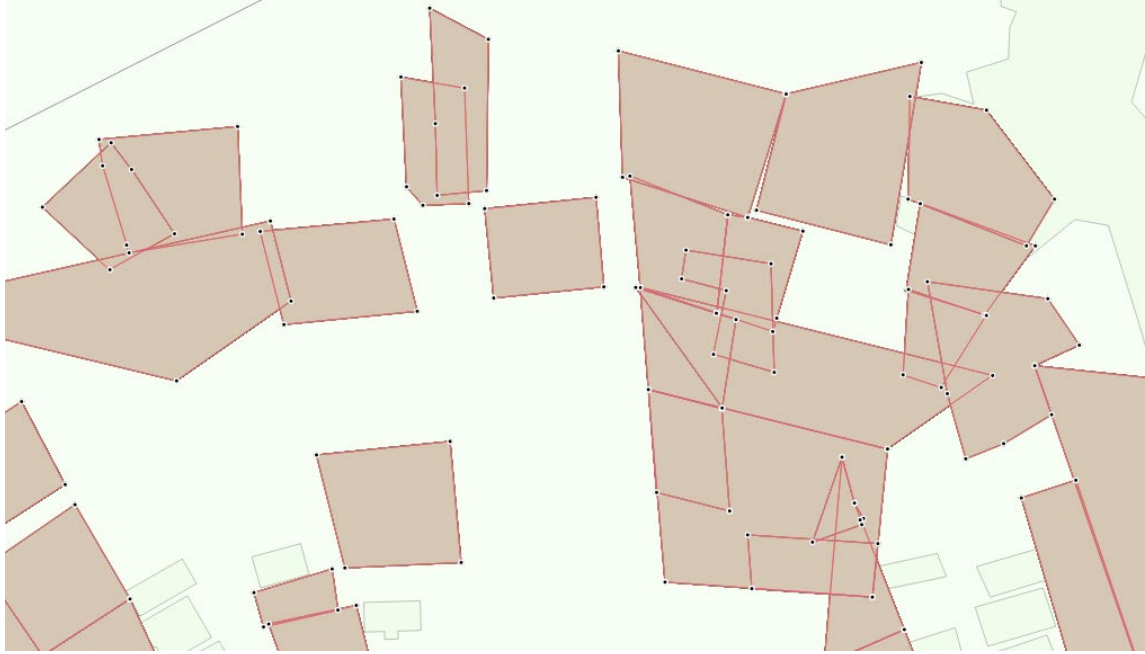
Cameroon also faces recurrent flooding, particularly in coastal areas and regions near dams, posing significant risks to infrastructure, livelihoods, and public safety

2.Why Geodesy Matters



Projection/Projection :	UTM 33 N
Méridien central/Central Meridian :	15°00'00" E
Latitude origine/Latitude origin :	00°00'00" N
Facteur échelle/Scale factor :	0.9996
Constance Est/False Est :	500 000 m
Constance Nord/False North :	0 m

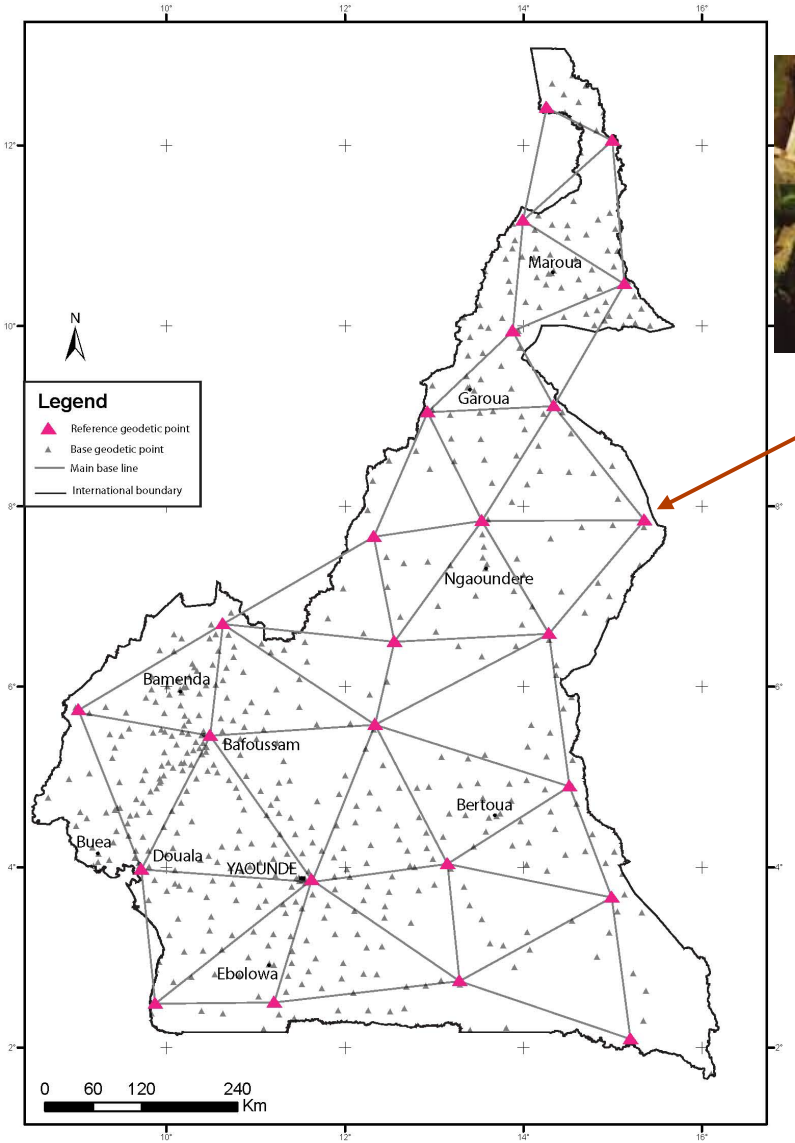
Projection/Projection :	UTM 32 N
Méridien central/Central Meridian :	9°00'00" E
Latitude origine/Latitude origin :	00°00'00" N
Facteur échelle/Scale factor :	0.9996
Constance Est/False Est :	500 000 m
Constance Nord/False North :	0 m



- The projection system straddles two UTM zones, and there is no unified projection system currently in place in Cameroon
- In the land management, subdivisions were historically referenced to various local geodetic datums, resulting in inconsistencies and overlaps in property titles

3. The State of Geodesy: Current situation of the geodetic infrastructure

3.1. National Coordinate System



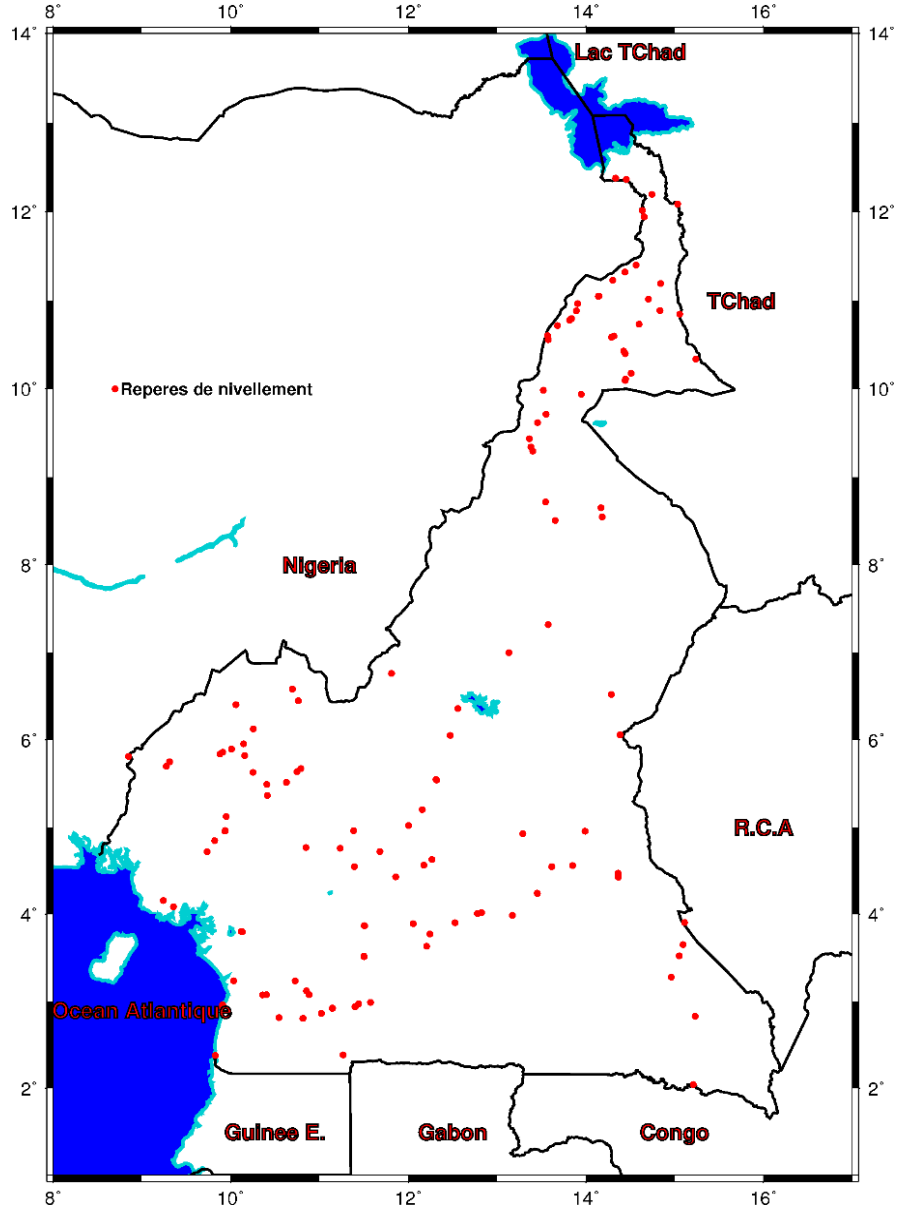
- Began during the colonial period (1960) in the main cities and was not connected in any way at a national level ;

- Modernized from GNSS technology in single national GRS in 2011 Including 2 networks:
  I order : 25 ref. pillars (approx. 1 pillar every 00 kms)
  II order : 500 pts (spaced points of 20 to 30 km

Geodetic parameters

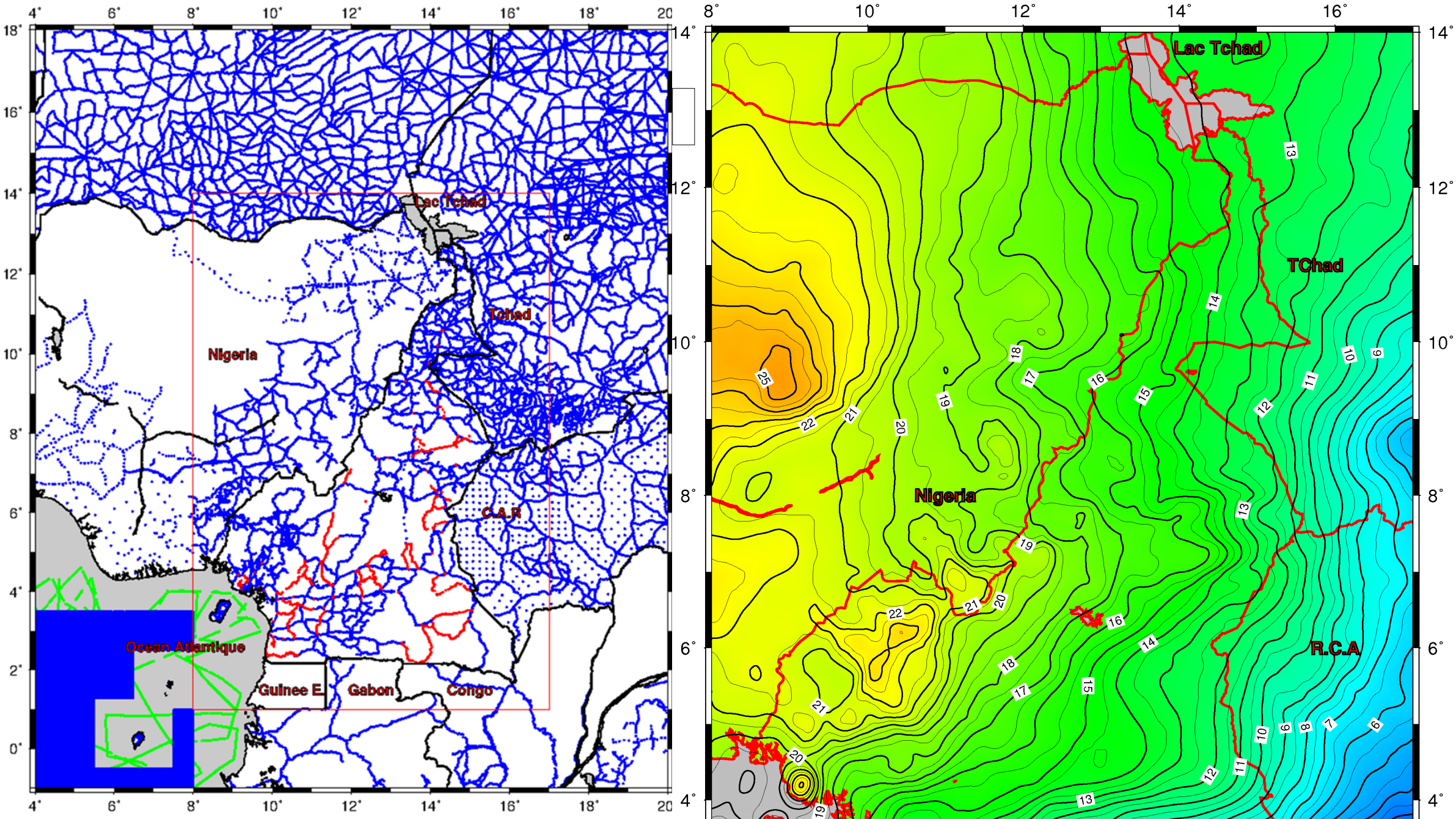
- **System: ITRS (ITRF 2008)**
- **Ellipsoid: GRS 80**
- **Projection: UTM**

3.2. National height system

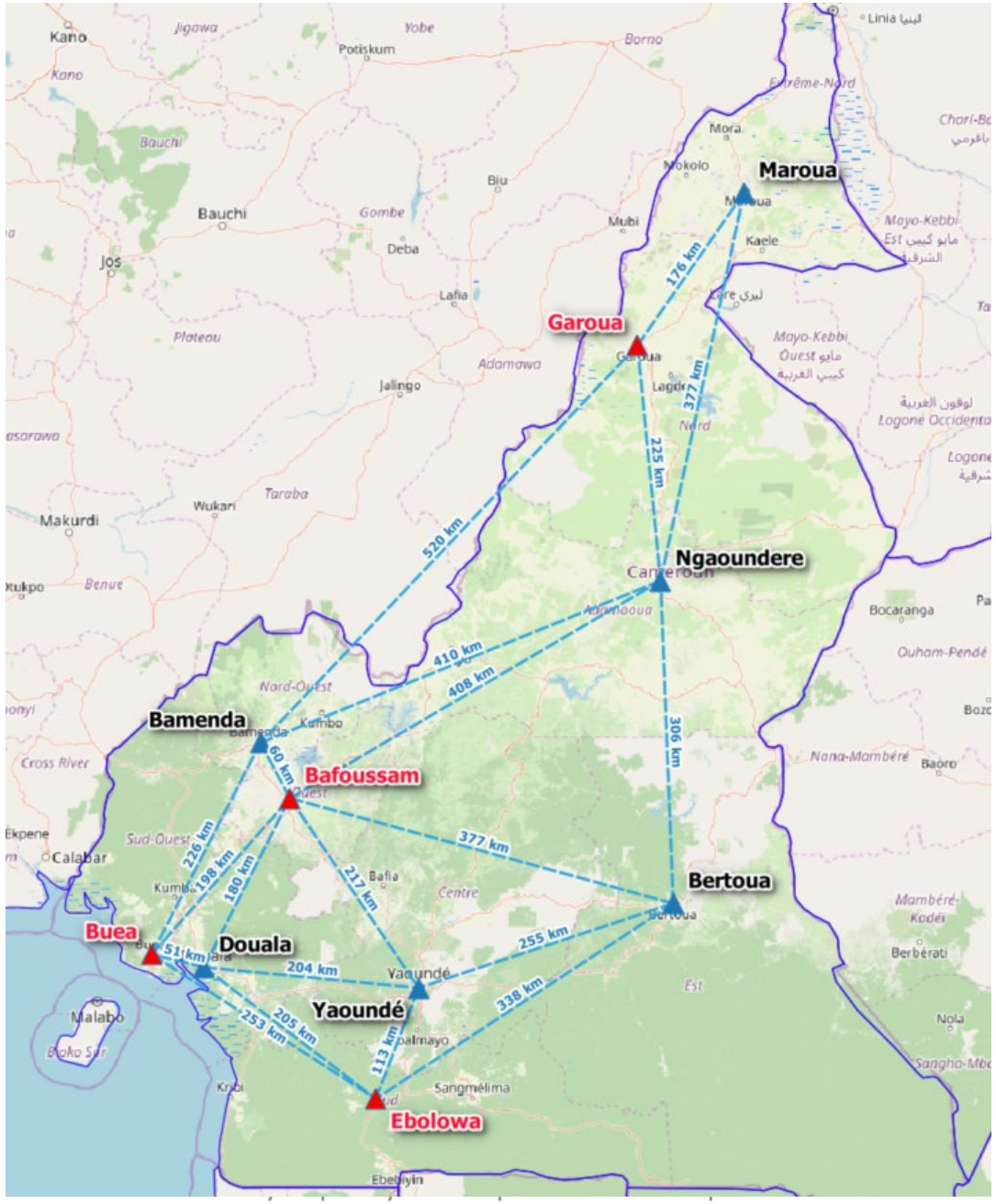


- Central African General Levelling (NGAC) between 1948 and 1971 by IGN ;
- Its zero reference point was established using tide gauge data from the “Brillé” station in Pointe-Noire Including 2 network ;
-
- To date, only 142 of the 3,600 benchmarks have been formally identified in the field

3.3. National terrestrial gravity network and local geoid model CGM20



3.4. Continous Operating Reference Station (CORS)



The technical design studies for the CORS system have been completed, and we are currently awaiting government funding to begin the installation phase.

There are some private initiatives in two main cities (Douala, Yaoundé), which could be integrated into the AFREF framework.

3.5. GNSS-IR

Photos of Edea dam taken during the field visit last week

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Botswana

Lopang Maphale

Day 3, Session 4 *[3_4_3]*

MODERNISATION of NATIONAL SPATIAL REFERENCE SYSTEMS IN BOTSWANA

By: L. Maphale

University of Botswana

NSRS Summary

- Two datums
  - A local datum – Cape Datum.
    - Extension of South African Trigonometric Stations
    - System of Trigonometric Stations developed through conventional survey -Directorate of Overseas Surveys (DOS) between 1963 and 1966
    - System have distortions
  - GNSS Compliant Datum – BNGRS2002
    - GPS Campaigns of 2001
    - Connected to IGS Stations

Transformation Between the two Systems

- Transformations between BTRS and BNGRS02 and vice-versa have been determined at national level and found to be at an accuracy of ±5m.
- This level of accuracy is not suitable for drives such as ：
  - physical planning,
  - cadastral surveys and
  - engineering works which require
- Migration from local system to BNGRS2002 could not be implemented
- A modern System with acceptable transformation is required
- A national Policy Spatial Reference Framework

Current Resources

- Country has 69 CORS
  - Based on BNGRS2002
  - Need for System Development

Research Work

- A research endeavour geared at finding solutions for Botswana NSRS
- Creation of a modern NSRS
- Migration of geodetic products to modern NSRS

Objectives

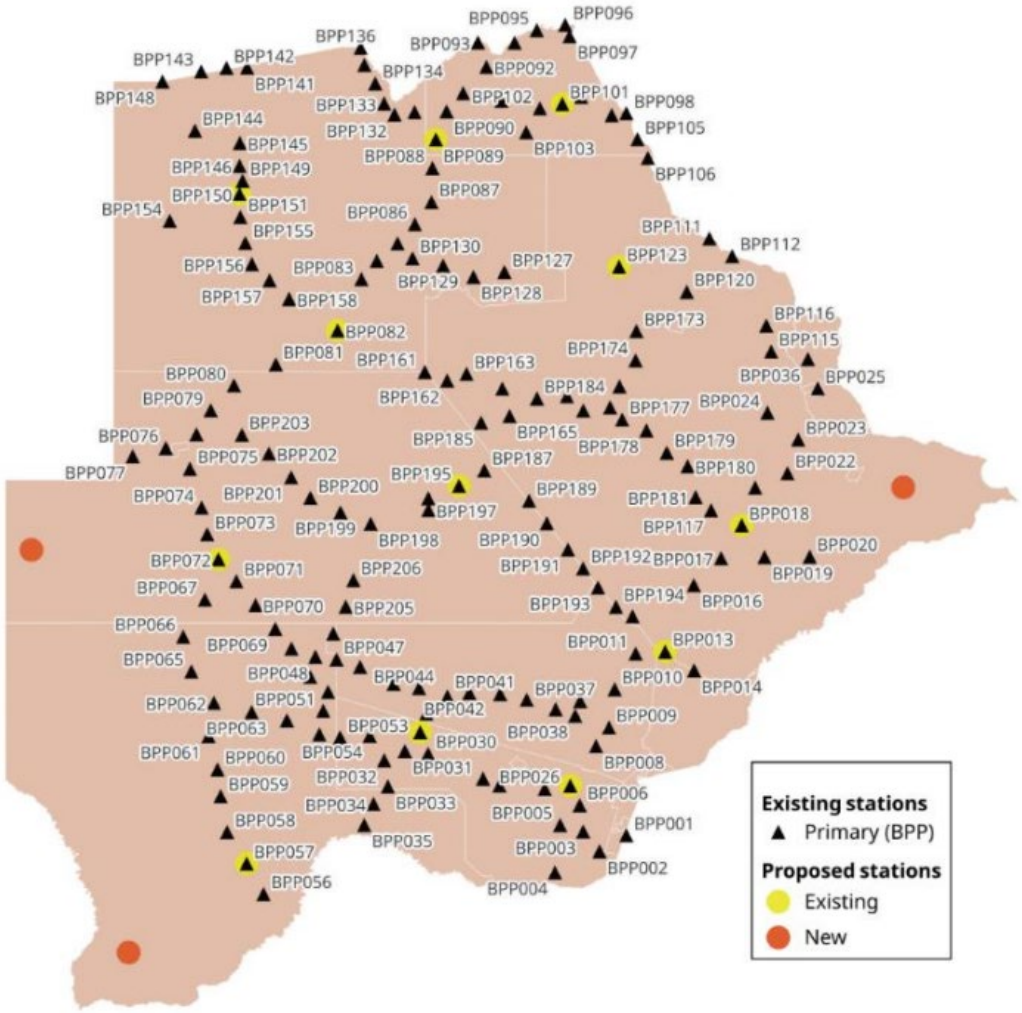
- The objectives of this research are:
  - To conduct a comprehensive study that investigates approaches for the development of National Spatial Reference Systems (NSRS) to appreciate shortcomings of the BNGSRS02
  - To develop a modern and functional National Spatial Referencing System based on ITRF2020 as per international standards.
  - To design an Integrated Geospatial Information Framework Policy for Botswana anchored on modern geospatial technologies.

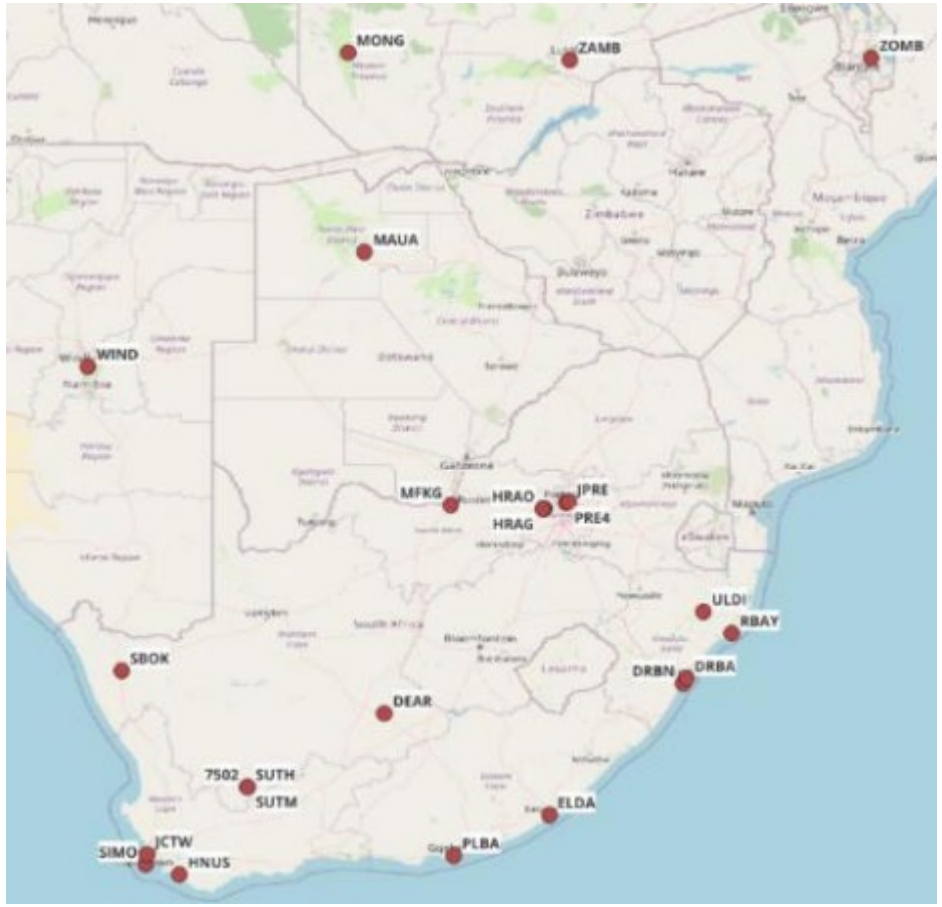
Methodology

- Document Analysis
- Geodesy Fact Sheet – UN GGCE Approach
- Re-computations of old data
- Observations and development of new NRS based on the most recent ITRF Realization
- Integrated Geospatial Information framework design – Comprehensive Stakeholder Consultation (UN GGCE Approach)

Method – Observation Consideration

69 CORS and 15 stations simultaneously





Expected knowledge outputs and outcomes

- Adoption of GNSS compliant datum
- Increased accuracy in point determination
- Determination of Transformation Parameters
- Coordinate migration
- Ease of data sharing
- Improved Applications

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Burkina Faso

Abdoul Moumouni OUEDRAOGO

Day 3, Session 4 *[3_4_3]*

INSTITUT GEOGRAPHIQUE DU BURKINA

INFRASTRUCTURES GEODESIQUES AU BURKINA FASO

Présenté par:

Abdoul Moumouni OUEDRAOGO

Ingénieur Géomètre-Topographe

Directeur des Prestations et de la Recherche

+226 62 14 88 47

Une carte vaut mieux que milles mots

http://www.igb.bf/

Plan

I. Importance de la géodésie

II. Situation actuelle

III. Perspectives

I. Importance de la géodésie

- La géodésie est une science qui permet l'étude de la forme et des dimensions de la terre.
- Elle facilite l'aménagement de l'espace et de sa gestion.

Exemple : les inondations, la gestion du foncier, la gestion de l'agriculture et de l'irrigation, etc

II. Situation actuelle

❑ Infrastructures géodésiques:

- ✓ **Réseau de 13 stations permanentes GNSS/CORS + 11 nouvelles**
- ✓ **Borne géodésique du 1er ordre : 55 bornes**

  (1996-1998/Maille de 80 à 100 Km)
- ✓ **Borne géodésique du 2nd ordre : 702 bornes**

  (Maille 25 à 35 km)
- ✓ **Borne communale : 704 bornes**

  (2 bornes par commune)

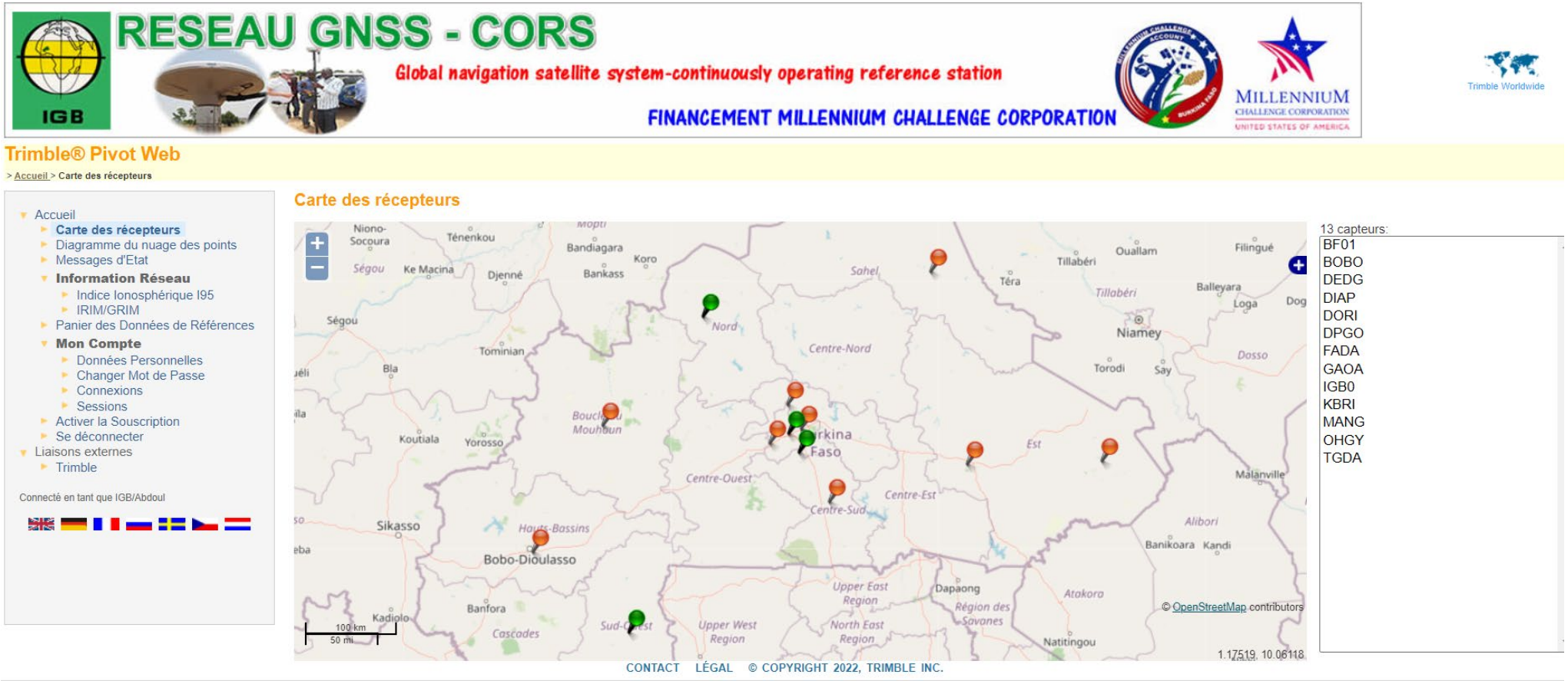
Référentiel Géodésique actuel: ITRF2008, époque 2011

Système de projection: BFTM

❑ Infrastructures de nivellement: 2180 bornes.

II. Situation actuelle (Suite)

Réseau actif: 13 STATIONS GNSS CORS BURKINA

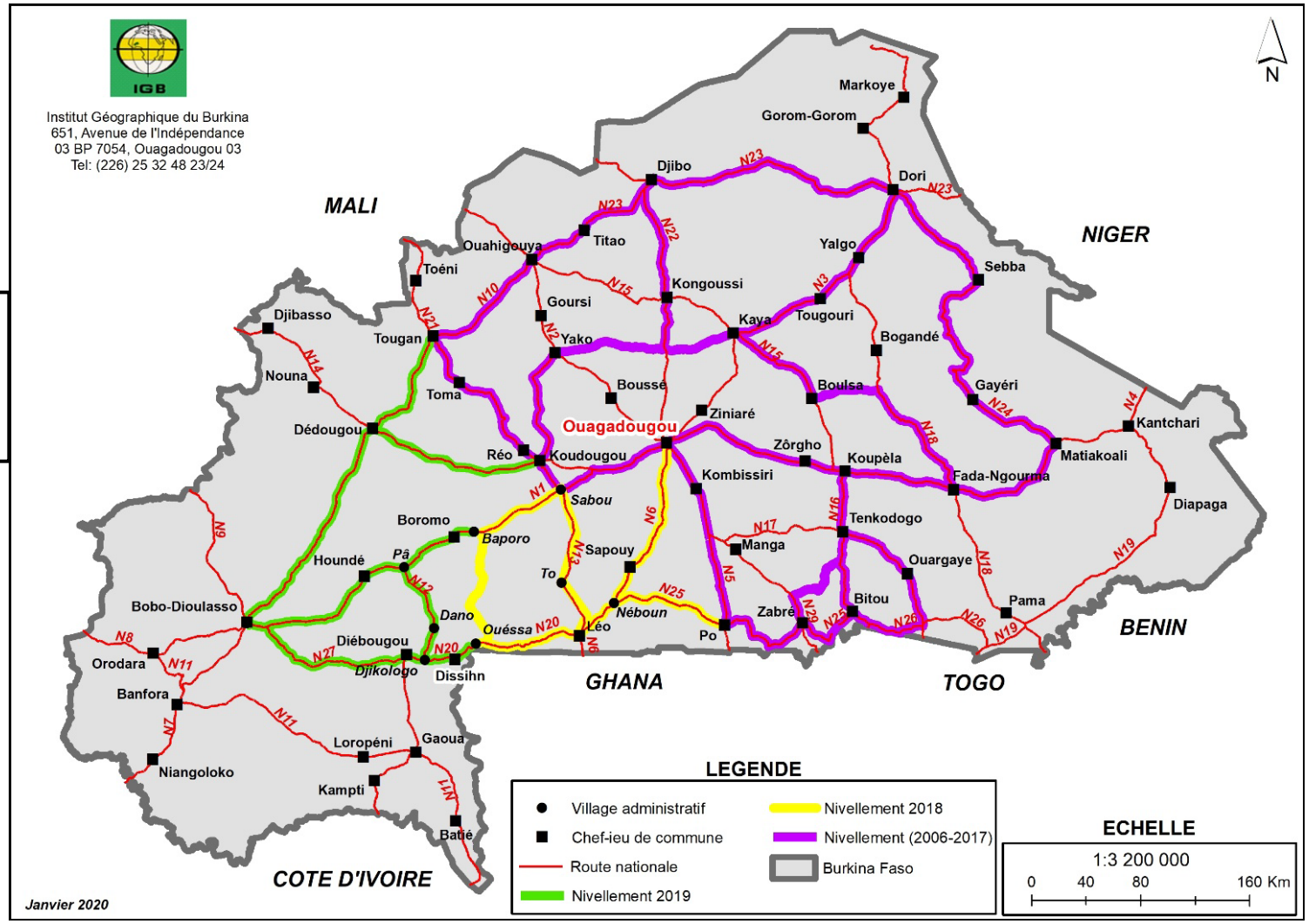


II. Situation actuelle (suite)

Réseau de nivellement:

Environ **5170 km de nivellement**

Projet en cours:
Densification progressive dans les villes urbaines



III. Perspectives

- ***densification du réseau de stations GNSS CORS (11 nouvelles stations GNSS CORS) (en cours en 2025)***
- ***Densification du réseau géodésique au sol (création d'un réseau de 3ème ordre) ;***
- ***Adaptation des modèles de géoïde globaux (EGM2008)***
- ***Mise en place d'un réseau de gravimétrie ;***
- ***Mise en place des trois (3) bases fondamentales de la géodésie :***

  SLR,VLBI et DORIS
- ***Formation des cadres.***

MERCI

Institut Géographique du Burkina
651, avenue de l'Indépendance, 03 BP 7054 Ouagadougou 03,
Tél: +226 25 33 19 73/ 70 21 21 92
E-mail: infogeo.bf@gmail,com

Une carte vaut mieux que milles mots

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports - Zimbabwe

Charles Paradzayi

Day 3, Session 4 *[3_4_3]*

Geodesy in Zimbabwe

Charles Paradzayi

Executive Dean - Faculty of the Built Environment, Art and Design

Vice Chairman - Council of Land Surveyors of Zimbabwe

Managing Director - C Paradzayi Land Surveyors

1. Why Geodesy Matters

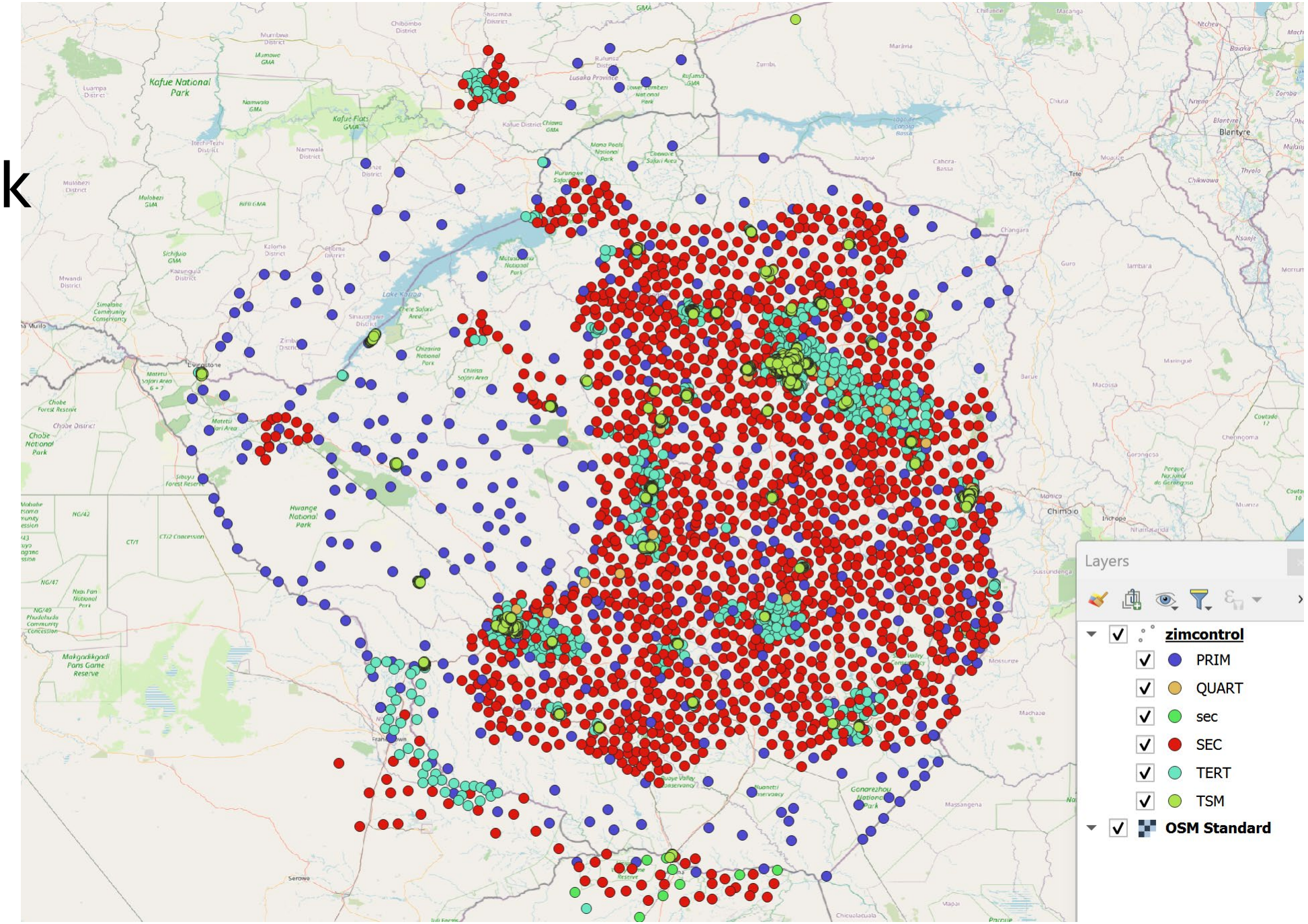
- National Development Strategy 1
- Vision 2030 and beyond - Upper middle class income society
- Geodesy is critical in Zimbabwe for
  - Land tenure security
  - Navigation,
  - Disaster risk reduction
  - Infrastructure development projects
- Land tenure security - Title surveys based on National Trig System and CORS

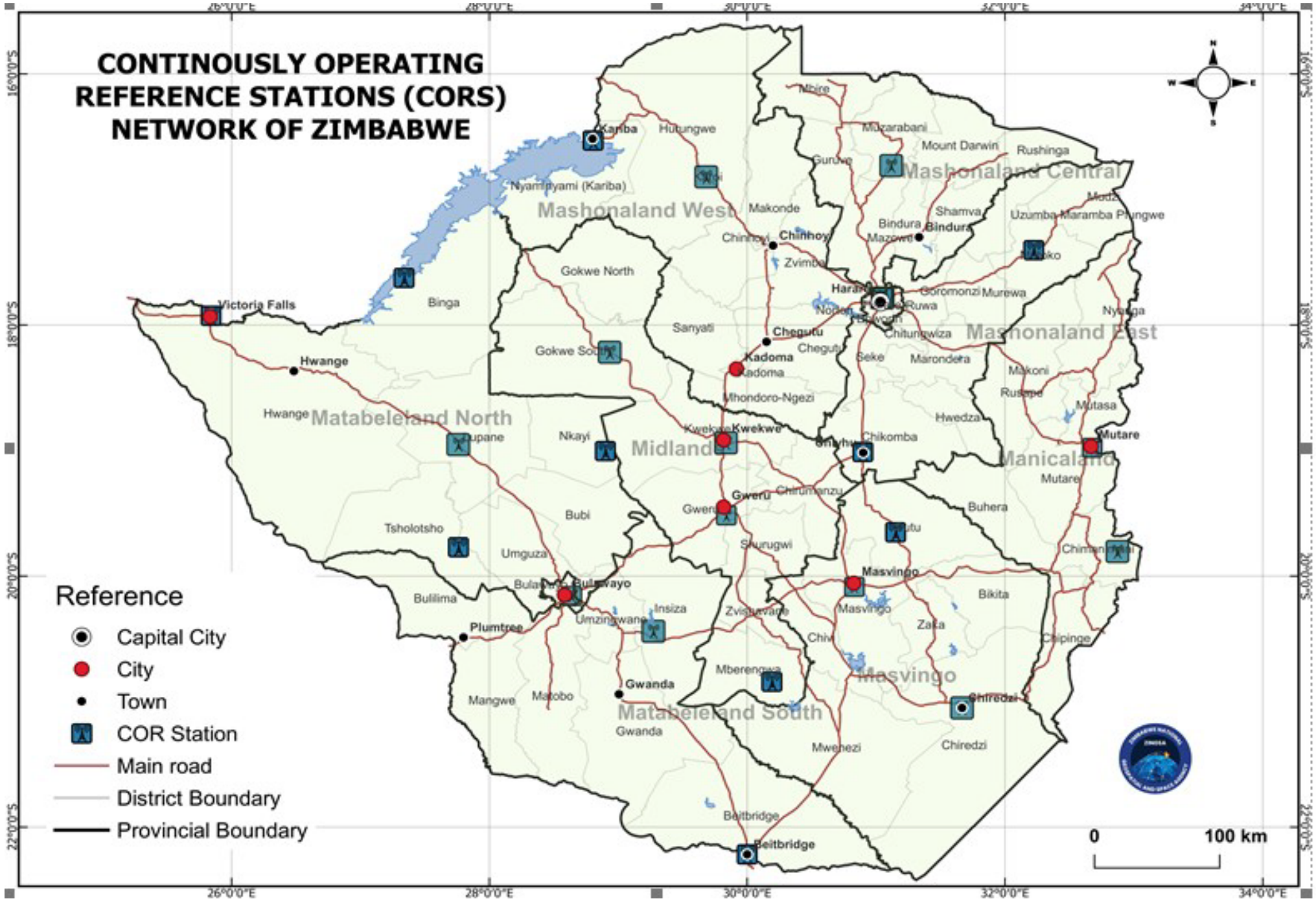
2. The State of Geodesy

- Maintained National Trig Network
- Country wide CORS Network now in place
- No geoid
- Data migration issues
-

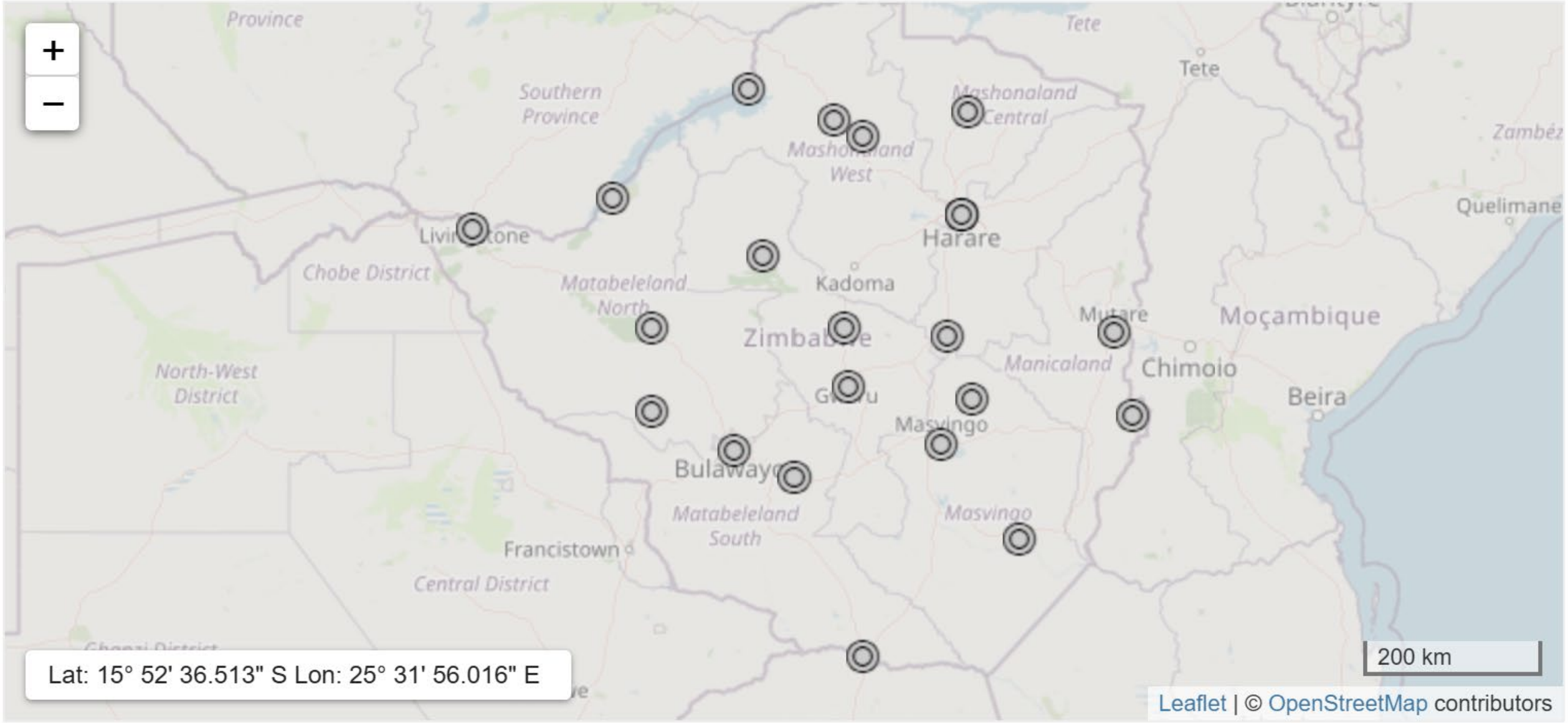
LEAD GOVERNMENT INSTITUTION/S	The Department of The Surveyor General
COUNTRY LEVEL STEERING / WORKING GROUP	Council of Land Surveyors of Zimbabwe Survey Institute of Zimbabwe Zimbabwe Institute of Geomatics
OTHER GOVERNMENT INSTITUTIONS	Ministry of Environment Ministry of Mines Ministry of Transport Ministry of Local Government
ACADEMIC	State Universities
INDUSTRY PARTNERS	
INTERNATIONAL ENGAGEMENT	Regional Centre for Mapping of Resources for Development (RCMRD)

National Trig Netywork




CONTINOUSLY OPERATING REFERENCE STATIONS (CORS) NETWORK OF ZIMBABWE
Reference
Capital City
City
Town
COR Station
Main road
District Boundary
Provincial Boundary
Victoria Falls
Hwange
Kariba
Binga
Nyamhyami (Kariba)
Hurungwe
Makonde
Chinhoyi
Zvimba
Mount Darwin
Mazarabani
Rushinga
Mashonaland Central
Mashonaland West
Bindura
Shamva
Uzumba-Maramba Pfungwe
Harare
Goromonzi
Murewa
Mashonaland East
Gokwe North
Gokwe South
Sanyati
Chegutu
Kadoma
Mhondoro-Ngezi
Seke
Marondera
Hwedza
Makoni
Mutasa
Mutare
Manicaland
Chikomba
Matabeleland North
Hwange
Lupane
Nkayi
Midlands
Kwekwe
Gweru
Chirumanzu
Buhera
Bubi
Tsholotsho
Umguza
Shurugwi
Masvingo
Bikita
Zaka
Chipinge
Bulilima
Plumtree
Bulawayo
Insiza
Umzingwane
Gwanda
Mangwe
Matobo
Matabeleland South
Mberengwa
Chiredzi
Mwenezi
Beitbridge
0
100 km

ZINGSA 21, DSG 5/10 (10 in process), CoH



3. What’s Next / Call to Action

- Increased government support
- Strengthening of academic institutions
- More Geodesists - Geodesy specialisation in academia

Ndatenda, Thank you, Merci, Zikomo, Asante Sana, Kealeboga

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

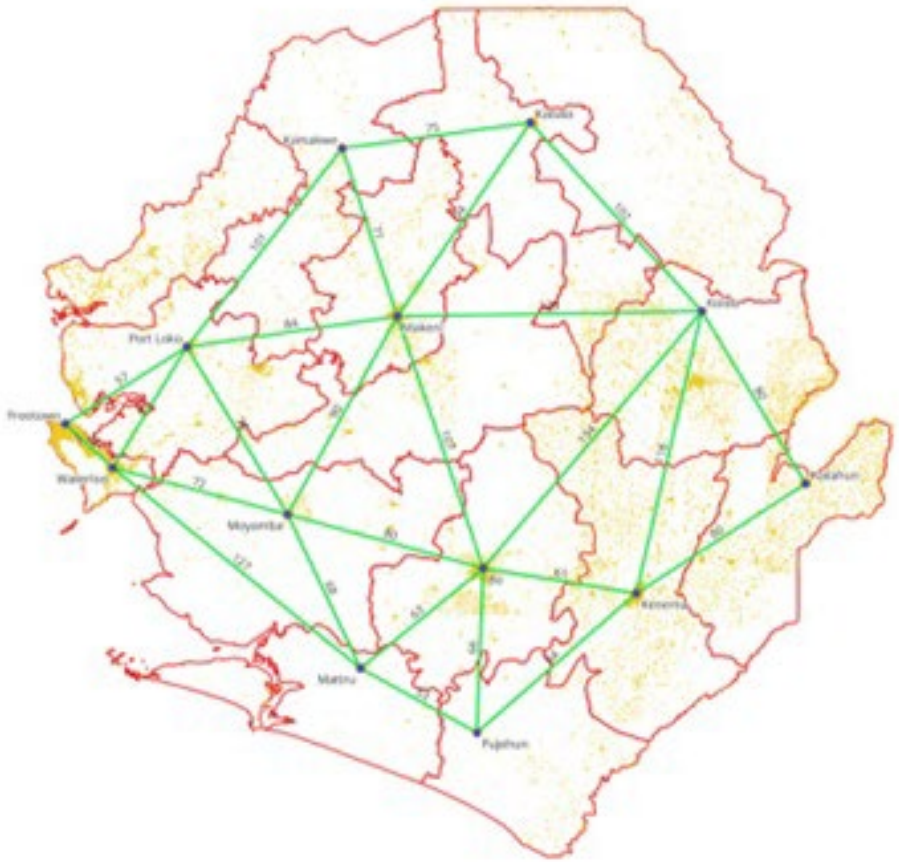
MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports – Sierra Leon

Buawah Jobo

Day 3, Session 4 *[3_4_3]*

OPTIMISED CORS NETWORK FOR 10+3 STATIONS



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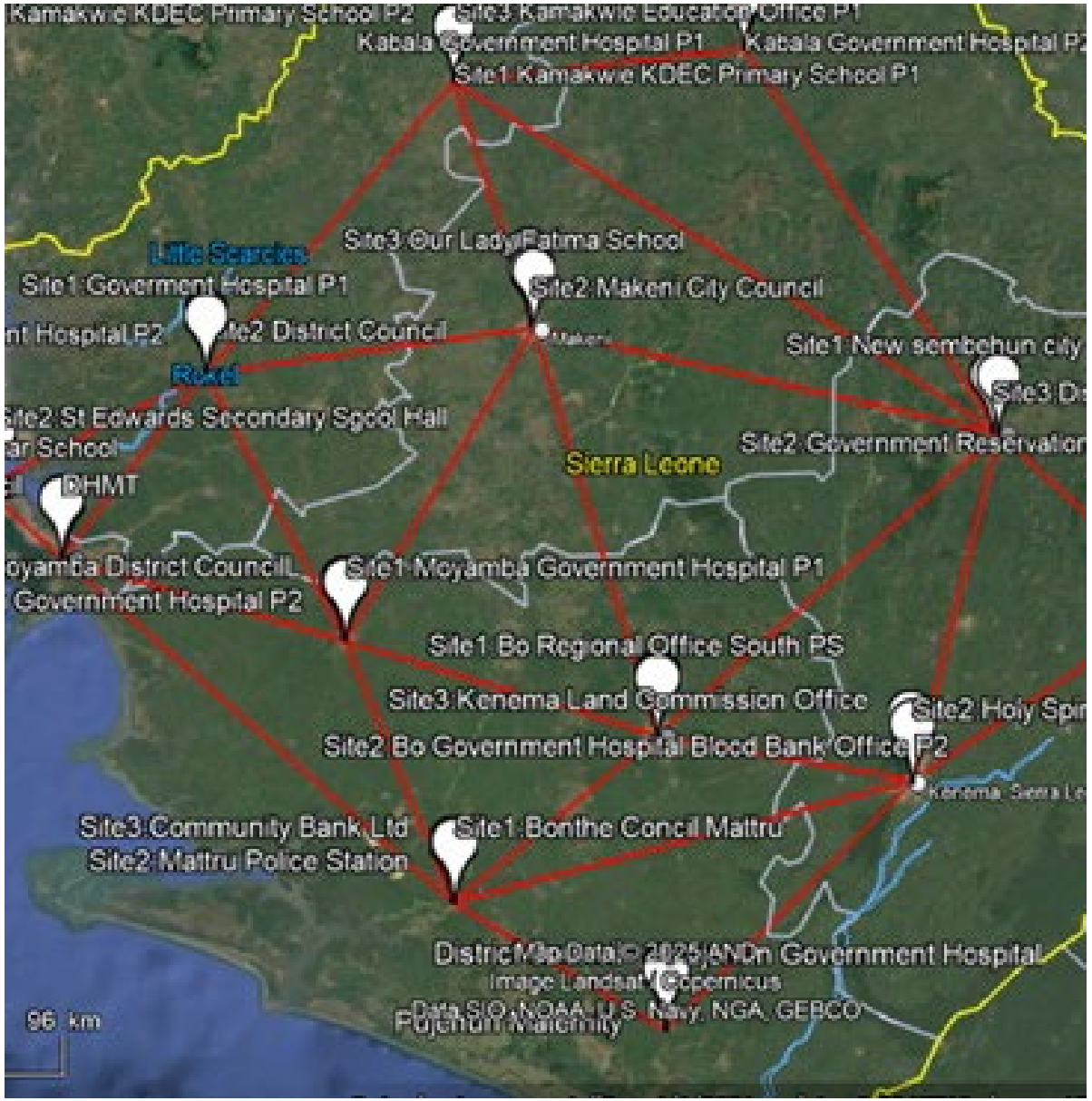


UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

Geodesy country reports – Mali

Mahamadi S. TOURE

Day 3, Session 4 *[3_4_3]*

CENTRE D'EXCELLENCE GEODESIQUE MONDIAL DES NATIONS UNIES (UN-GGCE)

NAIROBI, KENYA DU 19 AU 23 MAI 2025

ATELIER DE RENFORCEMENT DES CAPACITES EN GEODIE DE L'UN-GGCE POUR L'AFRIQUE, PORTANT SUR LA TRANSITION VERS UN SYSTEME DE REFERENCE GEOSPATIALE MODERNE

COMPLEXE DES NATIONS UNIES, SALLE DE CONFERENCE No 9

REFERENTIEL GEODESIQUE DU MALI

INSTITUT GEOGRAPHIQUE DU MALI

Mahamadi S. TOURE

Contact IGM:
Tel: +223 20 20 28 40 / +223 20 20 33 14
Site Web: www.igm-mali.ml / Email: igmorangemali.net

Mai, 2025

SOMMAIRE

- MISSIONS DE L'INSTITUT GEOGRAPHIQUE DU MALI
- POLITIQUE NATIONALE DE L'INFORMATION GEOGRAPHIQUE
- ETAT DES LIEUX DU REFERENTIEL GEODESIQUE
- PERSPECTIVES
- RECOMMANDATIONS

MISSIONS IGM

◄ MISSIONS DE L'IGM

- La mission principale de l'IGM est l'élaboration, la coordination, la mise en œuvre et le
- suivi de la Politique Nationale de l'Information Géographique.

- A ce titre, l'IGM est chargé spécifiquement de:

☛ concevoir, établir et mettre à jour la carte de base du territoire national ;

☛ **établir, protéger, entretenir et densifier les réseaux géodésiques ;**

☛ assurer la couverture systématique du territoire national en photographies aériennes et en imageries satellitaires ;

☛ participer aux travaux techniques de matérialisation des frontières nationales ;

◄ MISSIONS DE L'IGM (suite)

☛ apporter son concours aux administrations, aux collectivités territoriales et aux organismes privés dans ses domaines de compétences ;

☛ participer à la formation et à la recherche appliquée dans les domaines de la Géodésie, de la Cartographie, de la Photogrammétrie, de la Télédétection et de la Topographie ;

☛ coordonner et contrôler les travaux cartographiques et topographiques;

☛ coordonner et contrôler la production, la centralisation et le partage de l'information géographique se rapportant notamment au génie civil.

POLITIQUE NATIONALE DE L'INFORMATION GEOGRAPHIQUE AU MALI

JUSTIFICATION ET CONTEXTE

La Politique Nationale de l'Information Géographique est un processus dans lequel l'ensemble des producteurs et utilisateurs de données géographiques au Mali se retrouvent pour une harmonisation de la production nationale de l'information géographique.

L'ensemble des données (fondamentales et thématiques) produites ici au Mali doivent être cohérentes et répondre aux mêmes normes.

La politique nationale de l'information géographique a été adoptée en conseil des ministres par le gouvernement du Mali le 26 janvier 2012 et avec comme recommandations:

- Le renforcement de la filière géodésie de l'école nationale d'ingénieurs du Mali à la place de la création d'un centre de formation en Géoinformation,

- La création et l'adoption d'un référentiel géodésique national et son application sur l'ensemble du territoire national,

- et la dotation du pays d'une carte de base à l'échelle du 1 / 50000 à la place de la carte 1 / 200000 mise en place depuis l'administration coloniale.

◄ LA POLITIQUE NATIONALE DE L'INFORMATION GEOGRAPHIQUE

Au Mali, le cloisonnement institutionnel et les difficultés d'accès aux données et information géographiques, la disparité des normes et formats, le manque de coordination dans la production ont longtemps paralysé le processus de partage et d'échange des données.

C'est ainsi que le Gouvernement a approuvé la création d'un Conseil Interministériel d'Information Géographique (CIIG) et d'un Comité National d'Information Géographique (CNIG) en vue de surmonter les difficultés.

Ces cadres de concertation ont contribué à l'élaboration de la Politique Nationale de l'Information Géographique du Mali qui a été adoptée au Conseil des Ministres du 26 janvier 2012,

ETAT DES LIEUX DU REFERENTIEL GEODESIQUE

- **RESEAUX GEODESIQUES ET DE NIVELLEMENT**

- **Points Astronomiques – 800 points**
- **Points de Triangulation et de Polygonation - 76 points**
- **Points de Géodésie Spatiale - 69 points**
- **Réseau Altimétrique du Mali - 2 500 repères de nivellement**
- **Projet de Réseau Géodésique de Reference du Mali (RGRM) - 23 870 bornes géodésiques et 7000 repères de nivellement (en prevision)**

Le Mali utilisait comme référentiels géodésiques: l'Ellipsoïde Clarke 1880 et la chaine du 12ème parallèle traversant le Mali sur une longueur de 925 km

Avec la réfection des cartes topographiques au 200000ème en 2016; on a adopté le WGS84

- **RESEAUX GEODESIQUES ET DE NIVELLEMENT**

En 2023, le décret portant adoption d'un référentiel Géodésique en République du Mali a été signé en conseil de Ministre et un autre décret portant sur le payement de la redevance sur les équipements géodésiques

- **Le référentiel géodésique planimétrique en République du Mali est le système WGS84 utilisant l'ellipsoïde IAG-GRS80 avec comme système de projection UTM.**

- **Le référentiel géodésique altimétrique en République du Mali est le niveau moyen de la mer à Dakar ou le marégraphe de Dakar**

❖ BORNES GEODESIQUES

On peut constater ici trois types de bornes: Les bornes de triangulation, les bornes RGRM et les bornes frontières

1 et **2 : Borne du triangulation**

3 et **4 : Bornes du Réseau Géodésique de Reference (RGRM)**

5 : Borne Frontière

- ***EQUIPEMENTS GEODESIQUES***

☛ Terrain – pour la collecte des données (GPS differentiels, Stations Totales, Niveaux Automatiques, etc.);

☛Bureau – pour l' intégration, le traitement et l'analyse des données (Ordinateurs et logiciels, Scanners, Traceurs, etc.);

☛deux (2) Stations Permanentes non fonctionnelle non fonctionnelles

DIFFICULTES ET CONTRAINTES DE L'IGM

◄ DIFFICULTES ET CONTRAINTES DE L'IGM

L' Institut Géographique du Mali est confronté à un certain nombre de difficultés parmi lesquelles :

- l' insuffisance des ressources financières pour faire face à ses missions régaliennes;
- le manque de dynamisme dans le payement de la redevance;
- le vieillissement des équipements disponibles;
- Le besoin en formation du personnel
- la faiblesse de la coordination des volets cartographiques des projets de développement ;
- la grandeur du territoire qui rend difficile sa couvertures en équipements;
- etc…

PERSPECTIVES

◄ PERSPECTIVES DE L'IGM

- Faire une transition réussie de la transformation des données (bornes) qui sont dans les anciens systèmes de référence utilisés dans le nouveau référentiel national adopté;
- Avoir une assistance technique pour les observations et le calcul des coordonnées de cent soixante une (161) bornes du premier ordre avant la construction de celles du deuxième ordre et du troisième ordre ;
- sensibiliser davantage les acteurs sur les modalités de perception de la redevance sur l'exploitation des équipements géodésiques;
- Mettre notre plan d'action 2026-2030 en œuvre avec huit (8) stations permanentes en 2026, sept (7) en 2027 et cinq (5) en 2028;
- Dans le cadre de la vision Mali 2063, nous comptons avoir 100 stations permanentes à l'horizon 2063;
- En collaboration avec l'Université, avoir une agence spatiale en activité à l'horizon 2063

VISION MALI 2063 / EQUIPEMENTS GEODESIQUES DU TERRITOIRE

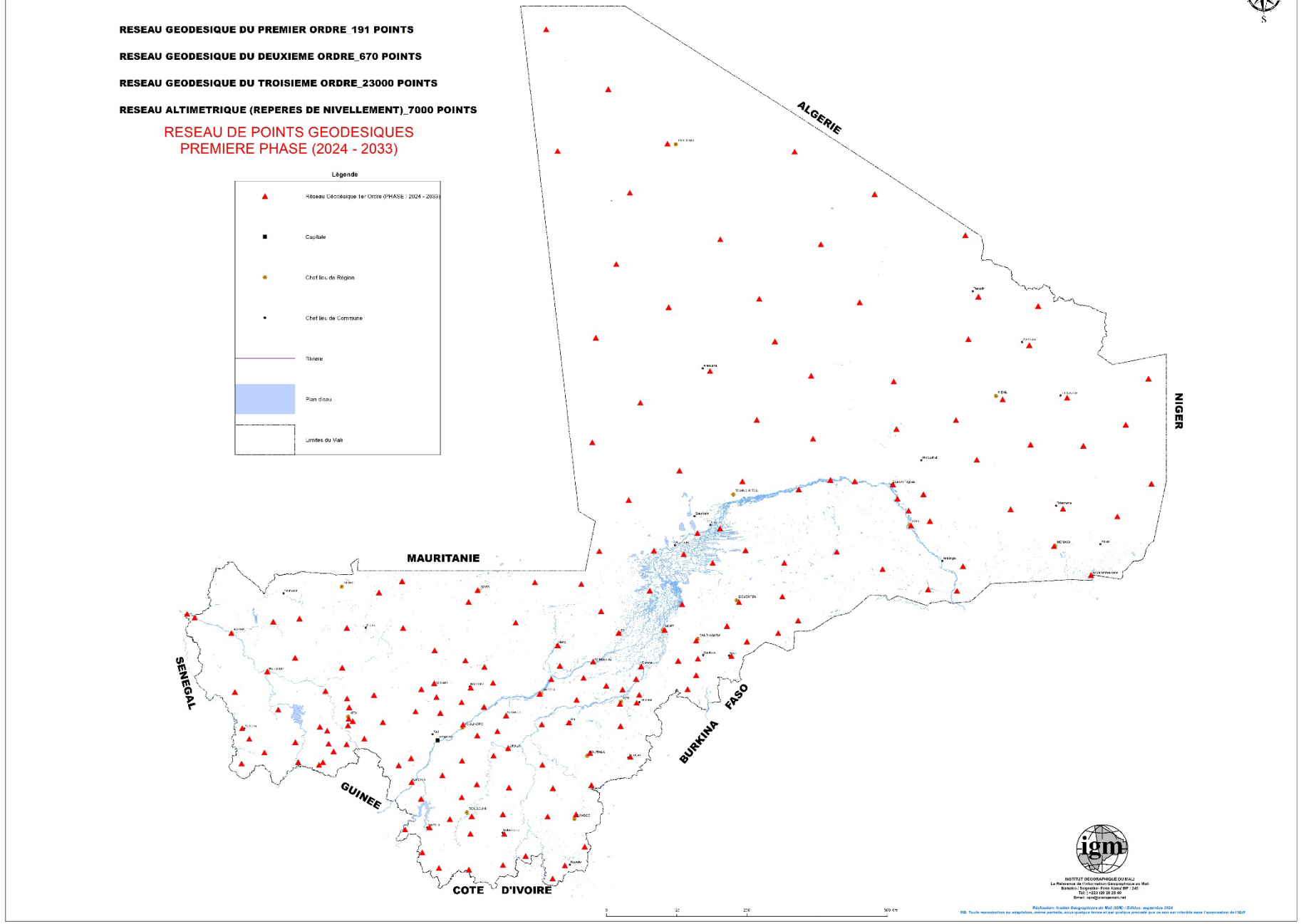
RESEAU GEODESIQUE DU PREMIER ORDRE_191 POINTS

RESEAU GEODESIQUE DU DEUXIEME ORDRE_670 POINTS

RESEAU GEODESIQUE DU TROISIEME ORDRE_23000 POINTS

RESEAU ALTIMETRIQUE (REPERES DE NIVELLEMENT)_7000 POINTS

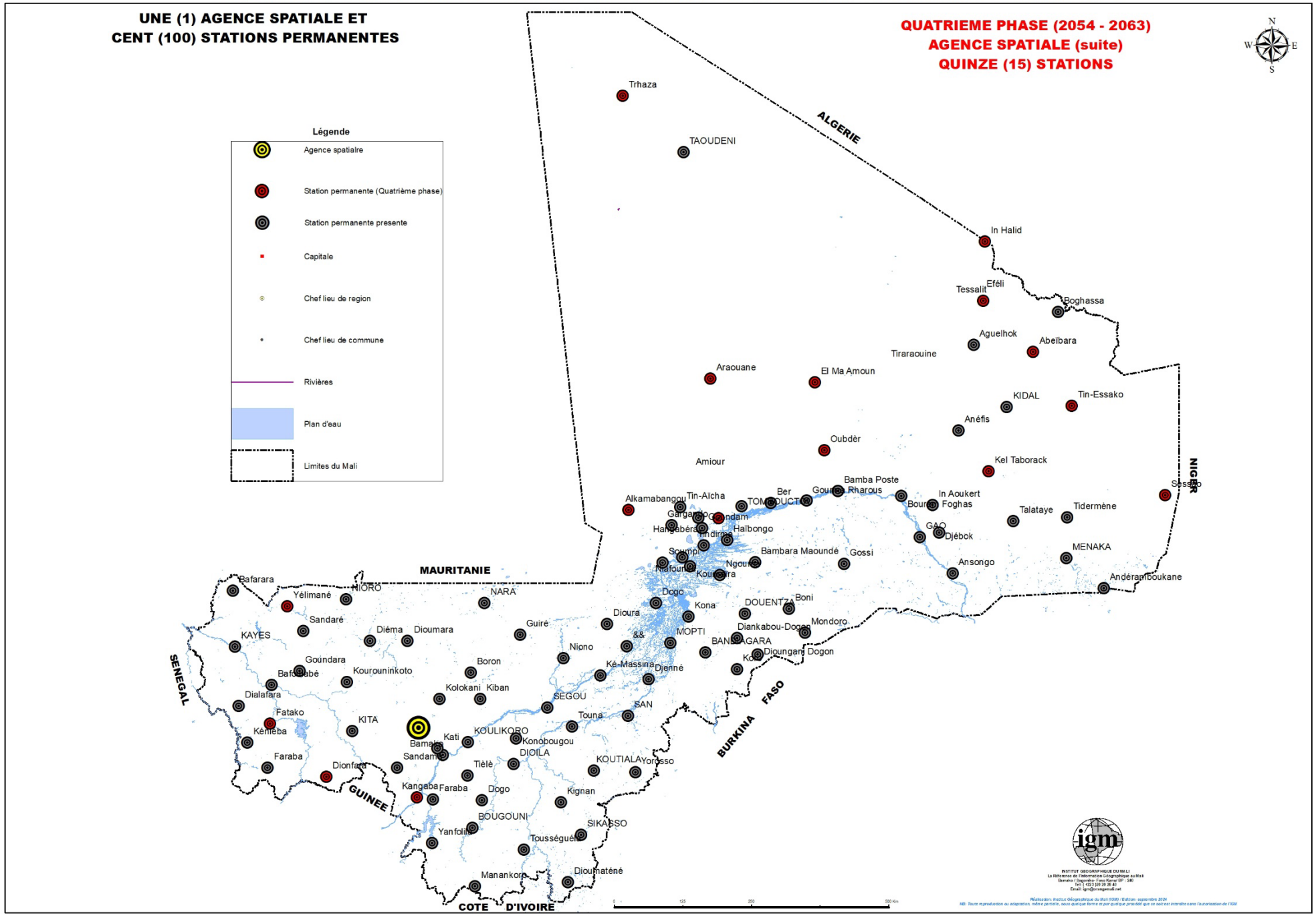
RESEAU DE POINTS GEODESIQUES
PREMIERE PHASE (2024 - 2033)



VISION MALI 2063 / AGENCE SPATIALE ET COUVERTURE DU TERRITOIRE EN STATIONS PERMANENTES

UNE (1) AGENCE SPATIALE ET
CENT (100) STATIONS PERMANENTES

QUATRIEME PHASE (2054 - 2063)
AGENCE SPATIALE (suite)
QUINZE (15) STATIONS

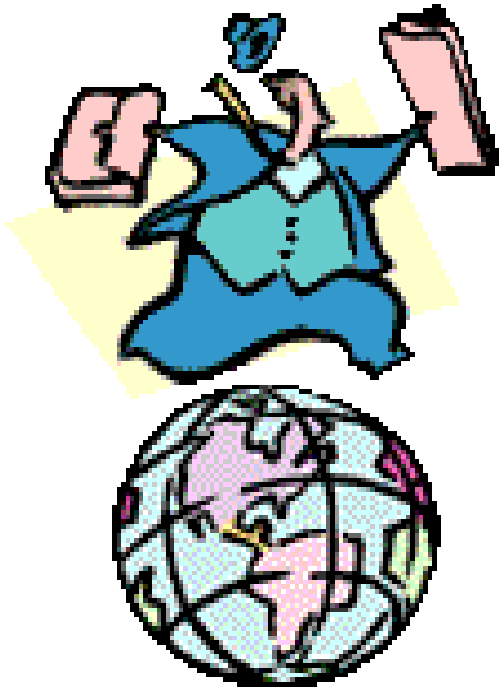


◄ PERSPECTIVES DE L'IGM (suite)

Renforcer les capacités du personnel de l'IGM;

- **développer la coopération nationale et internationale;**
- **développer la Synergie avec les acteurs d'information géographique au Mali, en Afrique et dans le monde.**

MERCI POUR VOTRE ATTENTION



UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

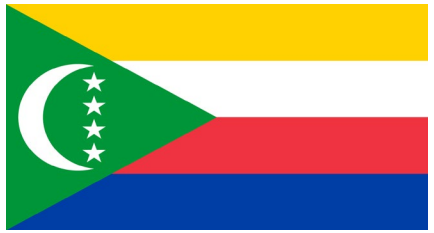
MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

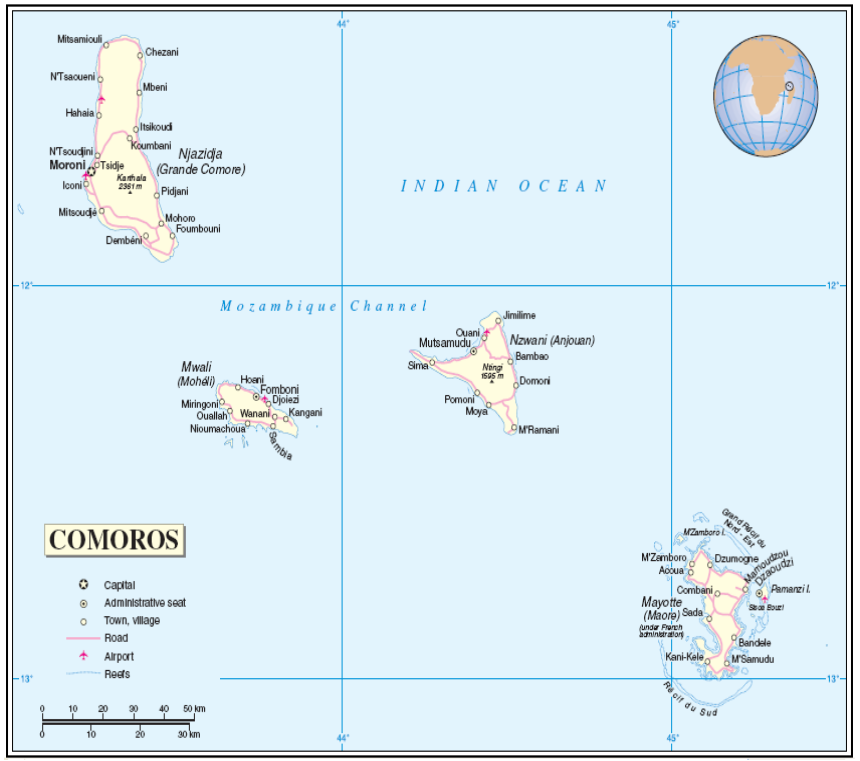
Geodesy country reports – Comoros

NAIR ABOUBACAR

Day 3, Session 4 *[3_4_3]*

SITUATION GEODESIE EN UNION DES COMORES





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CELLULE DE CARTOGRAPHIE
LA CARTOGRAPHIE
AU SERVICE DU DÉVELOPPEMENT

Why geodesy matters :

- **Climate change**

The Union of Comoros an island state is subject to various geophysical dynamics (earthquakes, volcanic activity) and the consequences of climate change, which require ongoing monitoring and measurements (Coastal erosion affecting population living along the coastline) to provide accurate information for better decision-making.

- **Land affairs**

The national topographic service produces sketch maps that serve as cadastral maps, but these maps lack geographic coordinates.
Only a few private surveyors use precision GPS devices for plot demarcation. These leads to land conflict between communities

- **Infrastructures**

The Union of Comoros tends to be an emerging country by 2030 , this implies contruction of new infrastructures (Ports , roads , airports etc ...)

- **Mining exploration**

Current state, one key achievement, one challenge

- Recent creation (2022) of a cartographic unit within the ministry of territorial planning that plays the role of a national reference mapping center/agency with a reliable database such as country boundaries, infrastructure, etc.

- No geodetic infrastructure currently exists.
  For GIS and mapping activities, the WGS 84 coordinate system, UTM zone 38 S, is used.

The country has topographic maps produced by IGN France (National Geographic Institute) in digital format (scanned maps), on which a network of geodetic points can be identified.
A total of 54 points can be identified on the map, distributed as follows: 26 points on Ngazidja Island, 11 points on Mwali Island, and 17 points on Ndzuani Island. The difficulty is that we have no information on these points (coordinates, projection system used, etc.).

What’s next or key needs :

- The cartographic unit plans to acquire a CORS station , which will serve as a pilot (around the capital city) through a project funded by the French Development Agency.
  This infrastructure will help fill gaps and align with the reference system used by other countries in the region.
  Capacity building of staff and the establishment of geodetic infrastructure are critical ,
- Need to Identify different stakeholders, sensitize them about the importance of having a modern geodetic infrastructure and capture their needs.


• Marahaba Mengui !
• Merci !
• Thank you !
• Muito obrigado !