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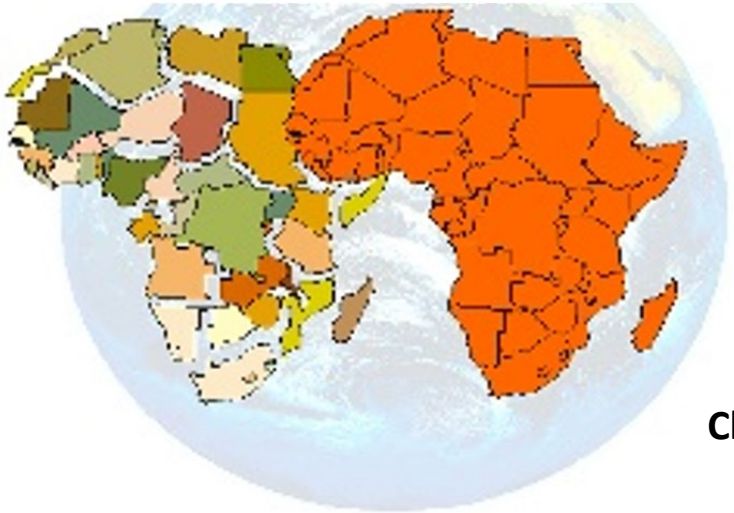
Africa Geodesy Capacity Development Workshop
Modernizing your Country Geospatial Reference System
19 to 23 May 2025
Nairobi, Kenya

History of **AFREF**

African Geodetic Reference Frame



Aslam Parker:

Chief Director: National Geospatial Information

land reform & rural development

Department:
Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA

2030 NDP

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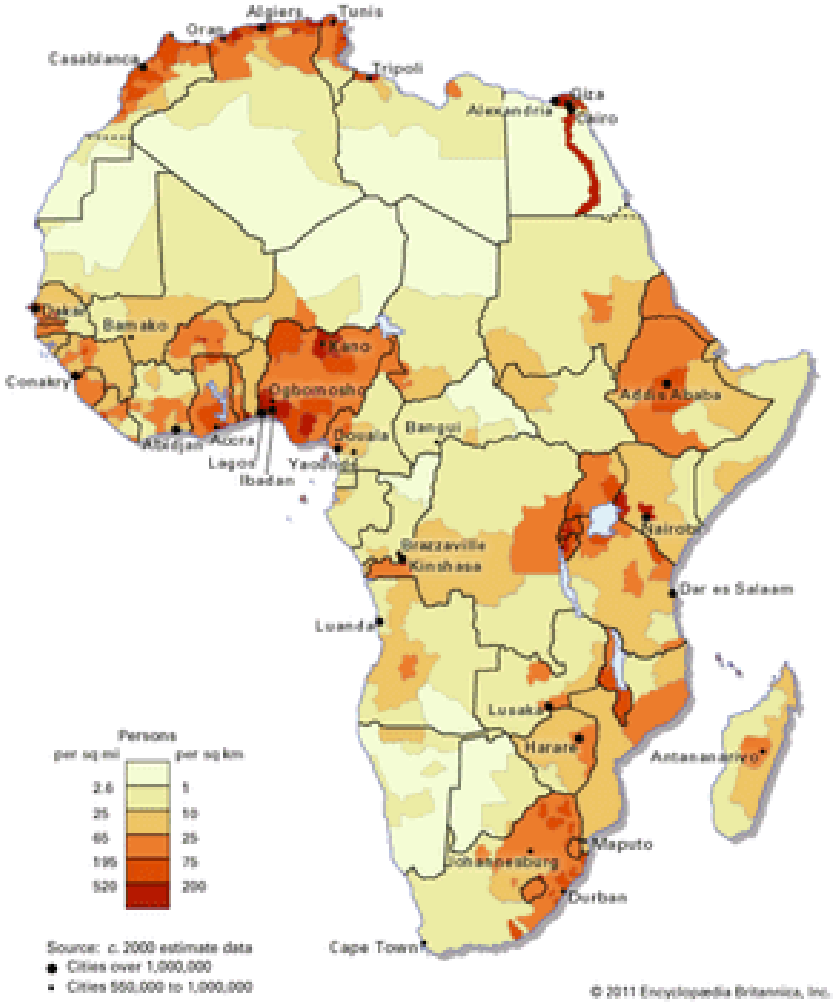
Africa is BIG!!

China	9596915 sq km
USA	9372570 sq km
Europe	4933927 sq km
India	3280465 sq km
Argentina	2758826 sq km
New Zealand	268674 sq km
Total	**30 211 377 sq km**
Africa	**30 321 130 sq km**



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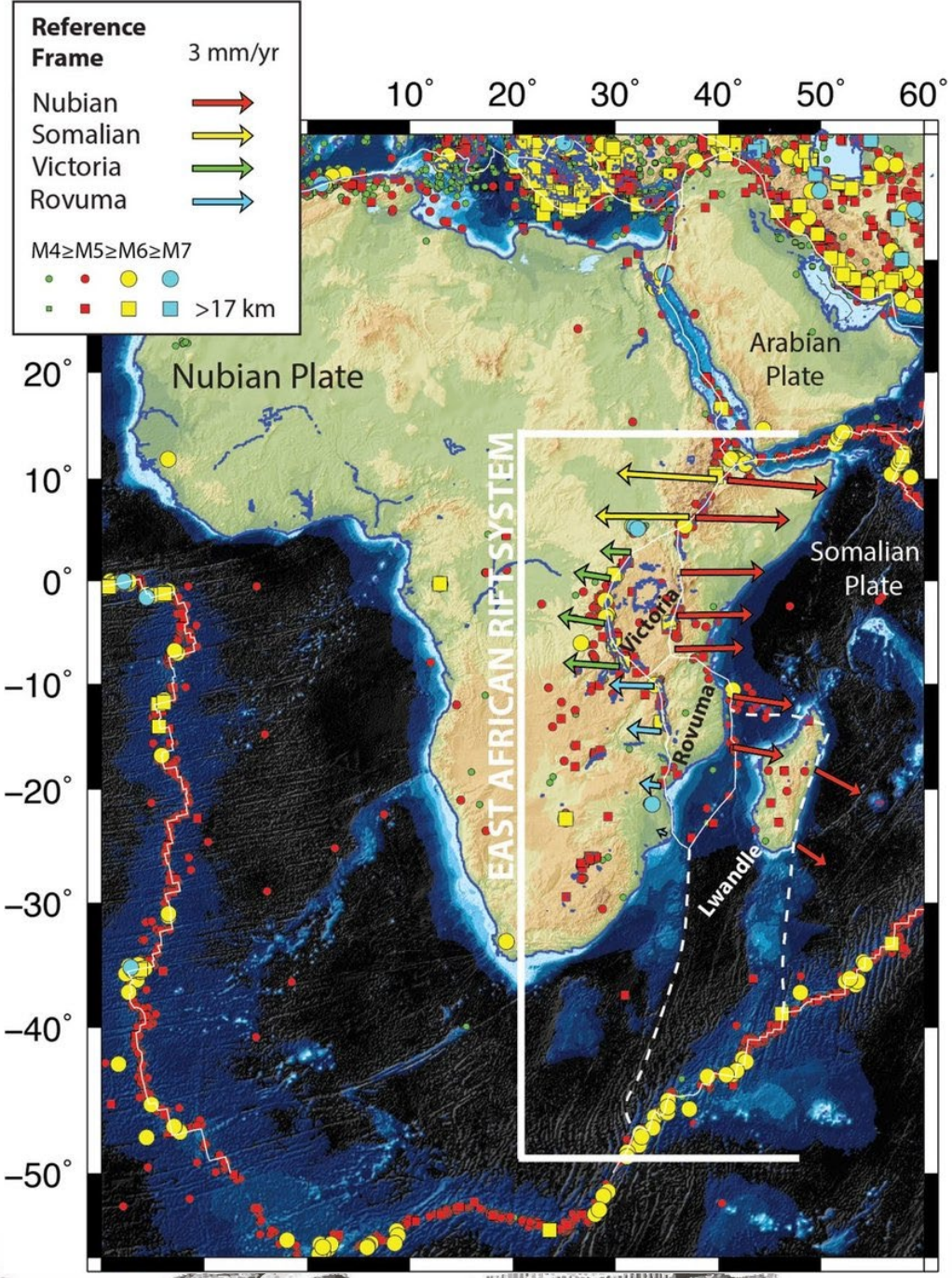
Africa is in not moving uniformly !



Tectonic-setting-of-Africa-and-the-East-African-Rift-System-OR-Okavangu-Rift-LR_fig2_322506987

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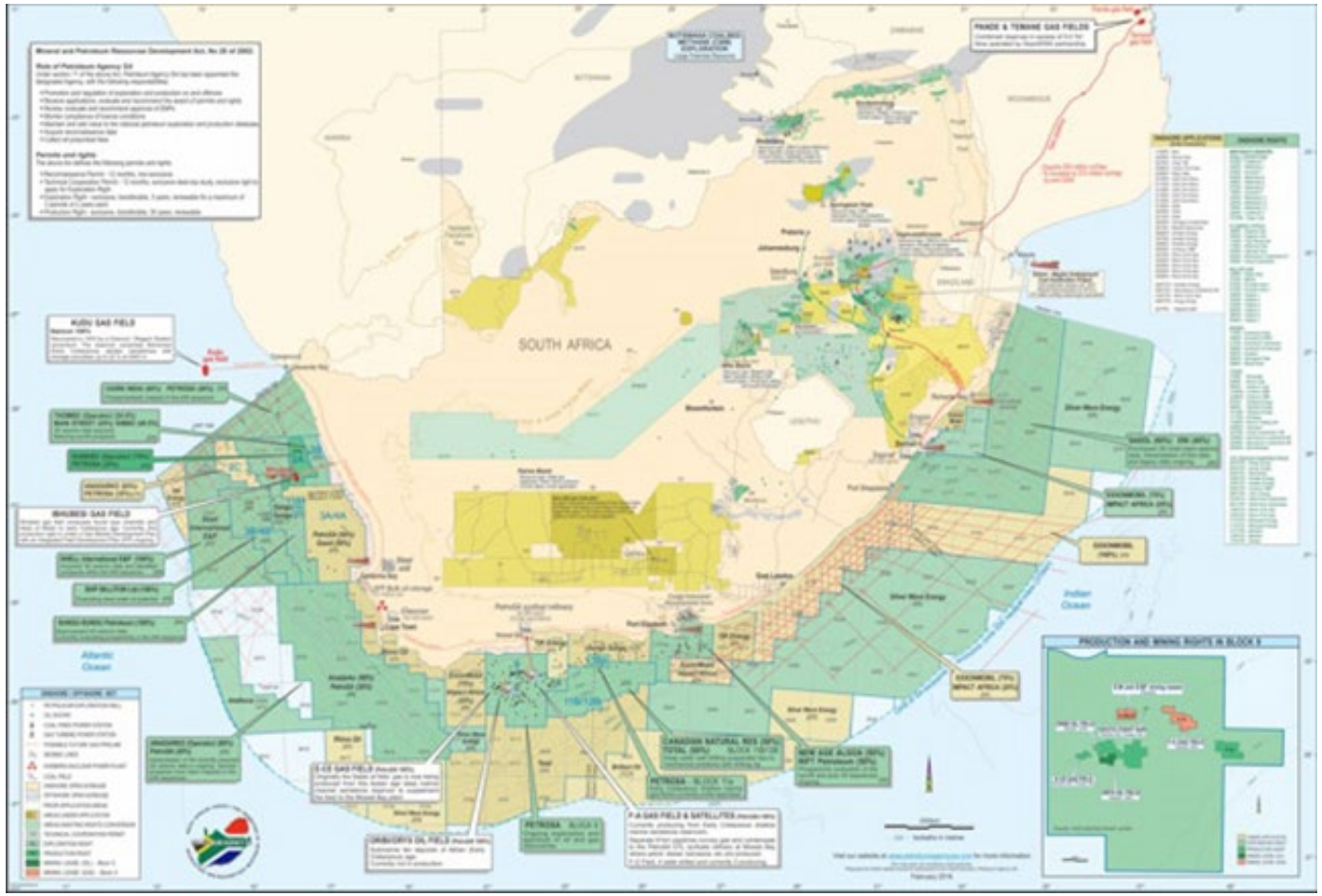
Investment in Africa

- Huge infrastructure investments in Africa, both inland and offshore.
- Massive prospecting and exploitation of mineral and natural resources.
- Economic and socio-political cost of ambiguously defined rights on land and sea.
- Uncertainty and conflict regarding international borders



Geodetic infrastructure underpins the NSDI

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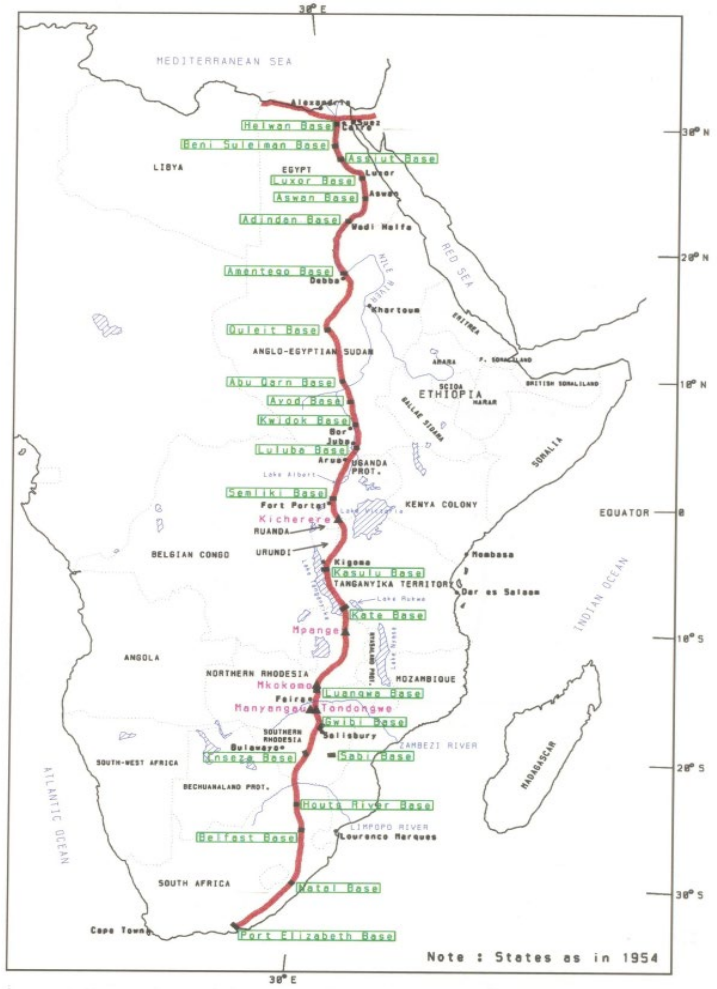
First attempt at an AFREF



- 30th Arc of Meridian
- The *Arc of the 30th Meridian* is known to surveyors worldwide as a triangulation system that stretches from South Africa northwards all the way to Cairo.
  - 1879: David Gill initiates the project.
  - 1910: The arc measurement is completed up to about 9° South.
  - 1950: The whole arc is nearly completed, except for a 1000 km gap in Northern Uganda/Southern Sudan.
  - 1953-1954: The US Army Map Service closes the gap.-
  - June 8, 2004: A plaque is unveiled at uniformly in the Eastern Cape of South Africa to commemorate the 125th anniversary of the project's conception and the 50th anniversary of its completion.[1]

https://www.fig.net/news/archive/news_2004/30th_meridian_arc_june_2004.asp

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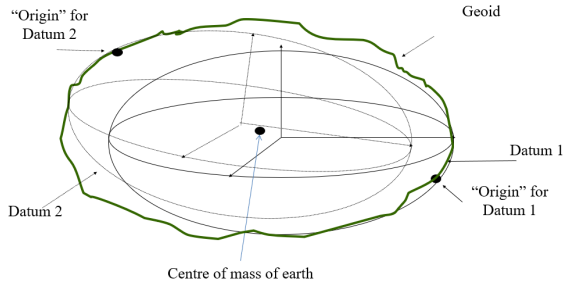
Context



- Africa is characterised by a multitude of different non-geocentric datums, ellipsoids and different projections and levelling datums with a clear correlation with colonial past.
- Problem is compounded by lack of authoritative and publicly available information and standards for many countries.
- In many instances, records of legacy systems either destroyed or not well preserved.

- In certain countries up to 4 datums (Angola has 4, Mozambique 3)
- Unclear strategy within countries as to appropriate datums, projections and transformations strategies to use.

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African Geodetic Reference Frame (AFREF)

- Cconceived to be a unified geodetic reference framework, **tailored for Africa**
- Fully compatible with the International Terrestrial Reference Frame (ITRF).
- Serves as the cornerstone for developing national and regional reference networks of 3D coordinates across the continent.
- Will primarily consist of a network of CORS stations, 500km apart, where precise observations will be systematically recorded and will then be utilized to establish the most optimal datum for Africa.
- Positioning professionals (surveyors, engineers, environmentalists, agriculturalists, mining prospectors, etc.) would always be within a reasonable distance of a reference station, regardless of their location in Africa with network parameters provided to practitioners free of charge.

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Meetings of AFREF Working Groups

- The concept first proposed at the Global Spatial Data Infrastructure (GSDI) meeting held in Cape Town, South Africa, in 2000.
- Since then, many meetings and workshops have been held to address AFREF, key ones:
- In 2002, AFREF was formalised as a project within UNECA .. Windhoek Declaration.
- 1st AFREF WG Meeting held in April 2016 during 4th High Level Forum UN-GGIM at UNECA
- 2nd AFREF WG Meeting held in Nov. 2017 during Africa GIS2017 at UNECA
- 3rd AFREF WG in in April 2018 at UNECA, Addis, where proposal was made for revised governing structure
- Then , Covid…. No subsequent meetings nor progress reports.

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AFREF Technical Workshop (South Africa 2006)

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Introduction: AFREF Working Group

- A resolution on GGRF for SD was passed by the 69th UNGA in February 2015.
- The GGRF system is realized at three (3) levels;
  - Global level – International Terrestrial Reference Frame (ITRF);
  - Regional level – the African Geodetic Reference Frame (AFREF); and
  - Local level – National Geodetic Reference Frame e.g. Hartebeesthoek94; South Africa

Introduction: UN-GGIM: AFRICA Geodesy WG

- At the 10th meeting of the Regional Committee of UNGGIM for Africa, held in Addis Ababa (hybrid), 30 October–1 November 2024, it was resolved to reinstate an executive working group of the Regional Committee in Geodesy.
- Call for participation was sent out and extended.
- Formal announcement expected very soon.
- Africa cannot afford to lose momentum to formalise this and confirm the TOR.

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Working Groups of UNGGIM-Africa

UN-GGIM: Africa | Executive Working Groups

UN-IGIF Integrated Geospatial Information Framework	GSGF Integration of Geospatial and Statistical Information	AFREF African Geodetic Reference Frame	LMIS Land Administration and Management
Convenor : South Africa	**Convenor : Namibia**	**Convenor : Côte d'Ivoire**	**Convenor : Morocco**
AFRIGIST Secretariat	AFRIGIST Secretariat	RCMRD Secretariat	RCMRD Secretariat
Cameroon	Cameroon	Cameroon	Cameroon
Côte d'Ivoire		Côte d'Ivoire	
Madagascar		Madagascar	
Mali	Mali		
Morocco		Morocco	
Mozambique	Mozambique		
South Africa	South Africa	South Africa	South Africa
Uganda		Uganda	

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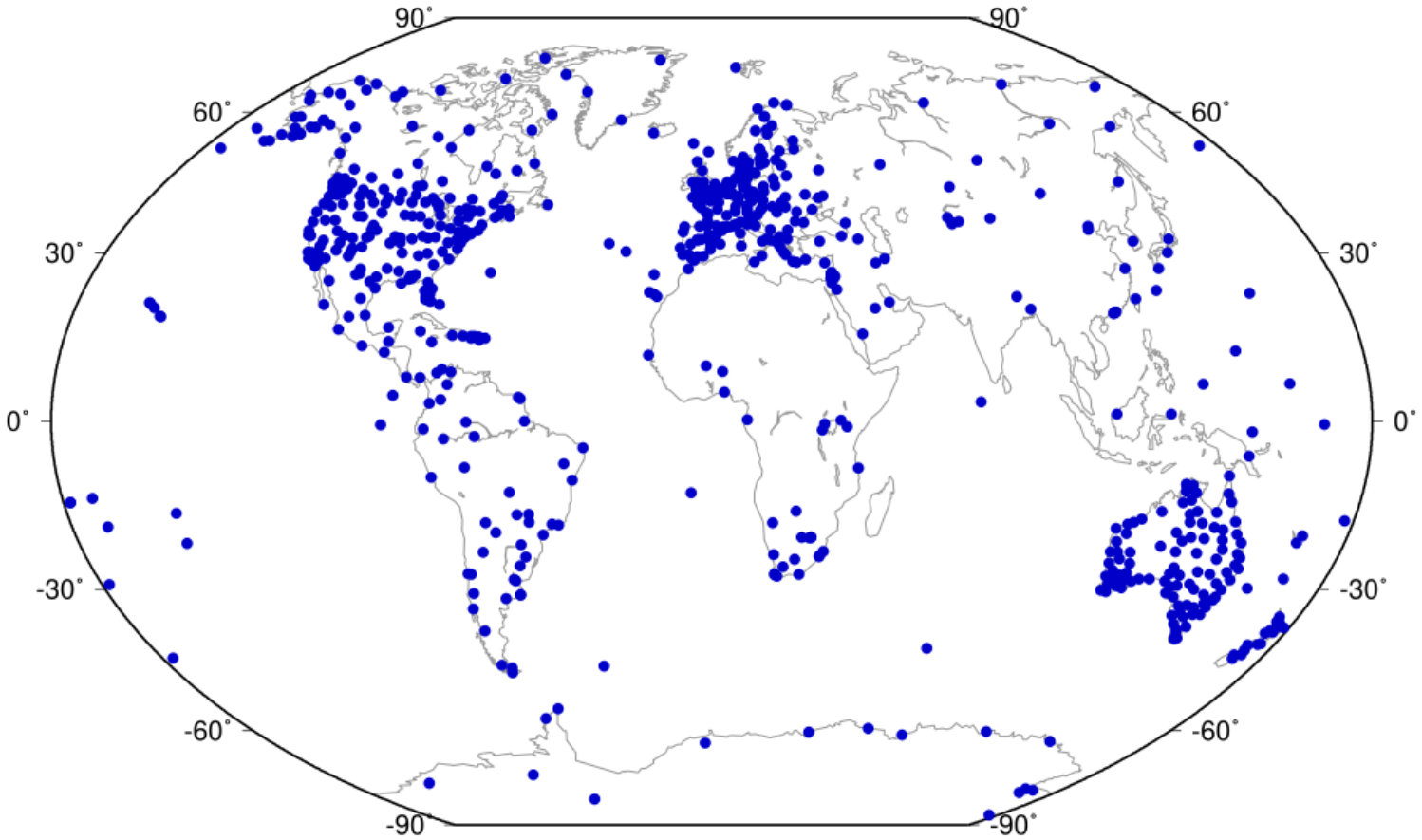
Contribution of Africa to ITRF 2020-u2023



https://itrf.ign.fr/images/solutions/itrf2020-u2023/ITRF2020-u2023-NNRSF-stations.png

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Possible Structure of the UNGGIM-Africa Geodesy WG (AFREF Project Steering Group)

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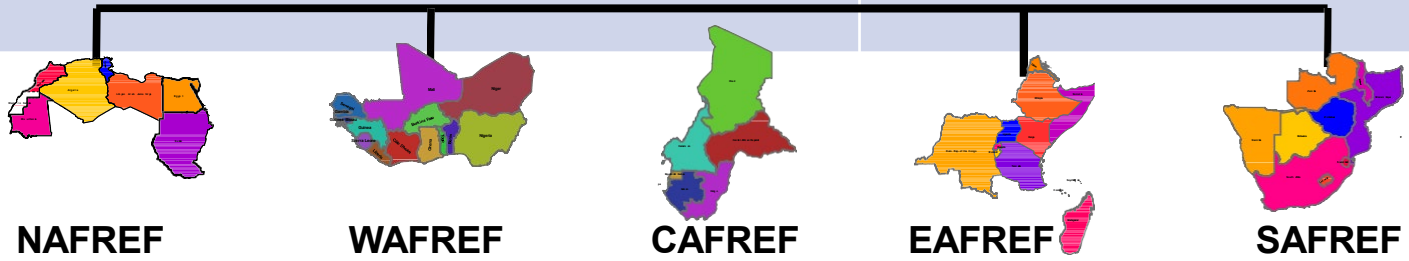
Chair
- Vice Chair

One Sub-Regional Rep from each of Central Africa
- East Africa
- North Africa
- Southern Africa
- West Africa
- Central Africa
- 2 x University & Research Organisation Reps

Ex Officio Members
- UNECA (Secretariat)
- UNGGCE
- DG of RCMRD
- DG of AFRIGIST
- Chair IAG Sub-Com 1.3d
- Analysis Centre Coordinator
- Manager of Central Bureau
- FIG (Commission 5)



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Main Objectives of AFREF Project

- To develop regional reference frame, AFREF, in line with UN-GGRF to enable direct and seamless application of GI.
- To establish a continental reference system, AFREF, 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.
- To align AFREF to UN-GGRF.

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Terms of Reference of WG – AFREF

- Provide justification, communication and publicity for the project to political groupings, in particular the Africa Union (AU), stakeholder, international organization and other users;
- Provide advice and relevant assistance to member States, in conjunction with the regional centres, IAG and other stakeholders, for the improvement and maintenance of appropriate national geodetic infrastructure, to enhance the AFREF;
- Co-ordinate the implementation of the AFREF project at the continental level, including the establishment of more AFREF Data Centers and an African Data Analysis Centre/s;
- Ensure the alignment of AFREF with the Global Geodetic Reference Frame (GGRF)
- Set guidelines and standards for the AFREF **in coordination** with International Association of Geodesy (IAG)

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Terms of Reference ...continued

- Secure funding, equipment and other resources to ensure the success of the AFREF;
- Liaison with international organizations, in particular the IAG and UN-GGIM SoG, for guidance, human and infrastructure capacity development in conjunction with the regional centers to organize training, workshops, seminars etc;
- To assist member States, in conjunction with the GGCE and regional centres, to develop and implement outreach programmes for societies to appreciate the utility values of the national, regional and global geodetic reference frames.
- Undertake any other activity that may be deemed relevant to the activities of the WG.

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Review of AFREF Progress so far…

There is no AFREF yet

- ✓Networking among institutions and practitioners
- ✓Last computation was in 2014
- ✓AFREF Permanent Stations Guidelines published
- ✓Capacity building on AFREF done annually at RCMRD, next one June 2025
- ✓Established interim AFREF Data Holding Centre at NGI, South Africa
- ✓South Africa leading new initiative to establish GGOS Africa
- This implementation tool of UN-GGIM for Africa proposes the following on AFREF under section A2.2.1.1 to A2.2.1.4:
  - Undertook an inventory of already established CORS in every country through a questionnaire/online ;

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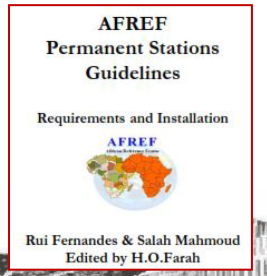
Distribution of GNSS Stations in Africa

- Some African countries with GNSS CORS are not sharing the data.
- In spite of recent progress on GNSS site distribution, the current CORS gap in Africa exceed 50%, Nubian plate being mainly affected.
- Different methods can be used to determine optimal number of GNSS to meet AFREF criteria. However, there is a need to come up with a practicable ways that can be achievable.
- Many countries are in the process of establishing GNSS networks soon while following the AFREF guidelines.
- Operational funding biggest challenge
- Proliferation of commercial CORS networks and networks operated by other agencies that NMO has no control of.
- Unknown scientific networks.



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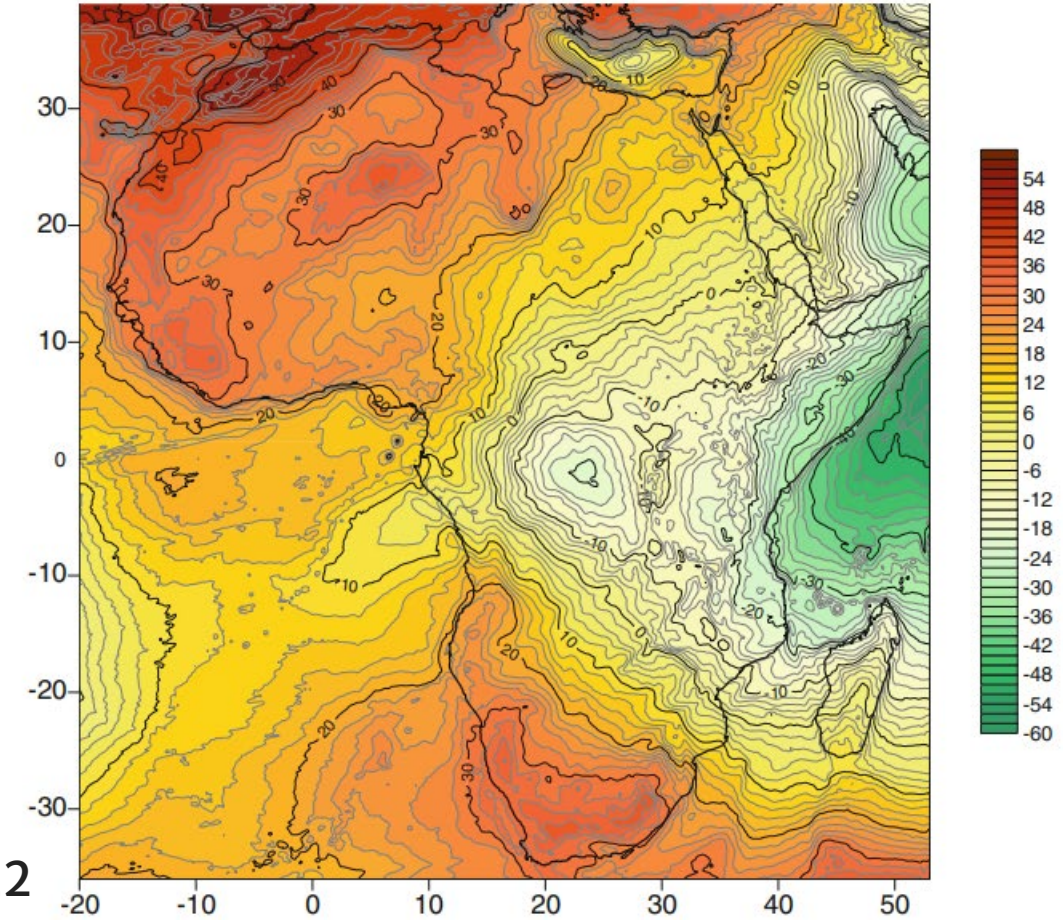
African Geoid Project

A Precise Geoid Model for Africa: AFRgeo2019 Hussein A. Abd-Elmotaal, Norbert Kühtreiber, Kurt Seitz, and Bernhard Heck

Fig. 6 The AFRgeo2019 African de-trended geoid model. Contour interval: 2 m



https://doi.org/10.1007/1345_2020_122

AFREF Hosting ….

- GNSS data from “AFREF” CORS is currently being achieved at AFREF Operational Data Centre, (AODC), http://www.afrefdata.org, temporarily on ftp://ftp.trignet.co.za currently being hosted by National Geo Information (NGI) agency in South Africa.
- Other documents relating to AFREF can be found at AFREF website at UNECA and at RCMRD
- One may check the current status of AFREF.

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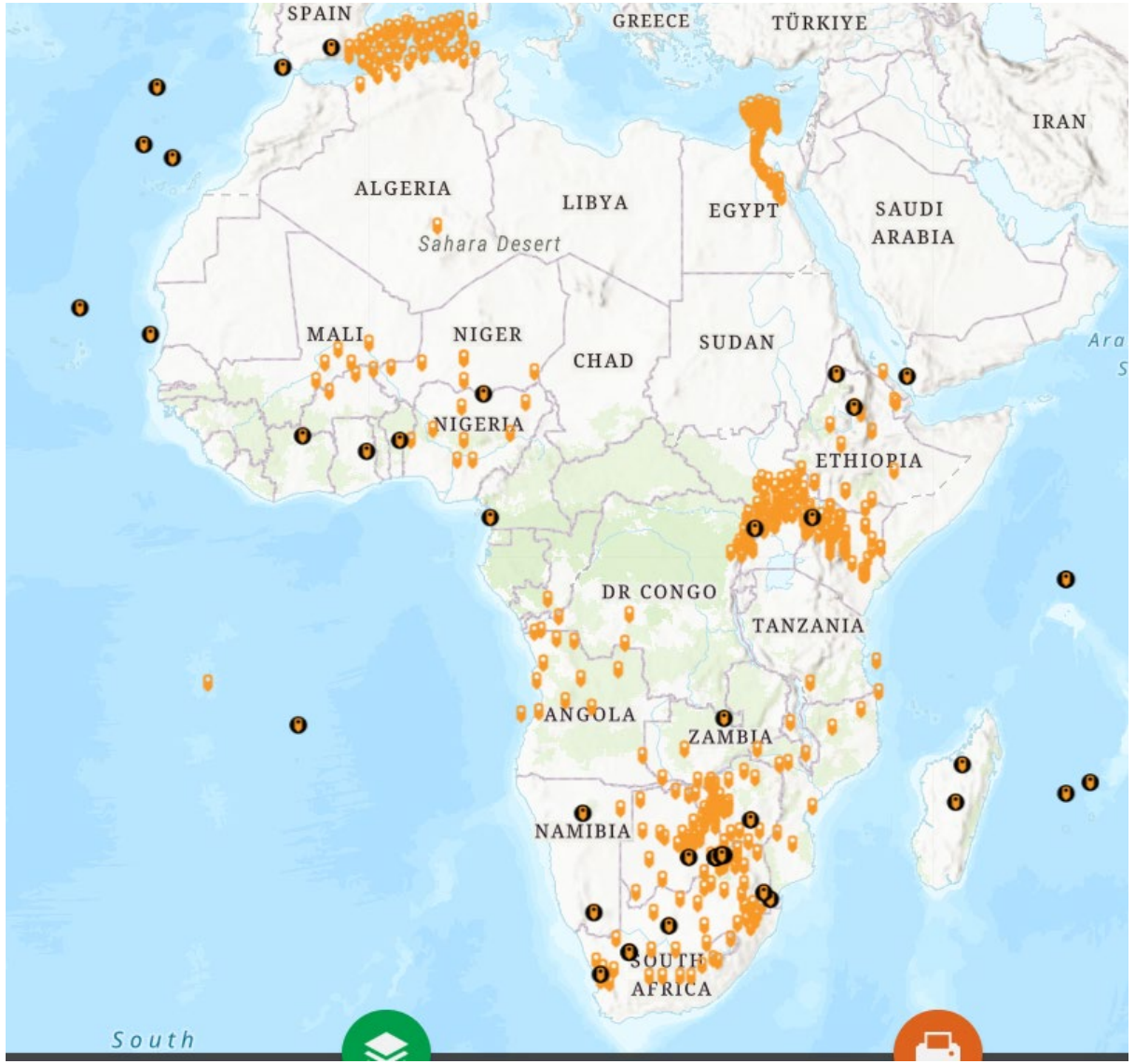
RCMRD CORSMAP

Map of non-commercial reference CORS



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Conclusion

- Most countries in Africa needs roadmap to modern geodetic reference frame.
- The UNGGIM-Africa Working Group on Geodesy proposed to coordinate AFREF activities.
- The success of the new AFREF Project governing structure will depend on support and commitment from of member states, UN organs , scientific associations, FIG and academia.
- SoG Africa members are expected to play a key role as regional coordinators. (Burkina Faso, Cameroon, Côte d'Ivoire, Madagascar, Morocco, Nigeria, South Africa, Tanzania, Tunisia).

XXVIII FIG CONGRESS

The Future We Want – The SDGs and Beyond

24–29 MAY 2026

Cape Town, South Africa

land reform &
rural development

Department:
Land Reform and Rural Development
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