

AFREF

Current Status and Way Forward

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IGS YKRO station, Côte d'Ivoire

What AFREF was built to deliver

1

One continental frame

Unified geodetic reference frame for Africa, fully consistent and homogeneous with the ITRF.

2

≤ 500 km from a station

Ongoing discussions with Trimble within UNGGIM: Africa and CHNAV within IGS for stations donation to selected African countries.

3

Open access to data

Free access to observations and station coordinates for all users on the continent.

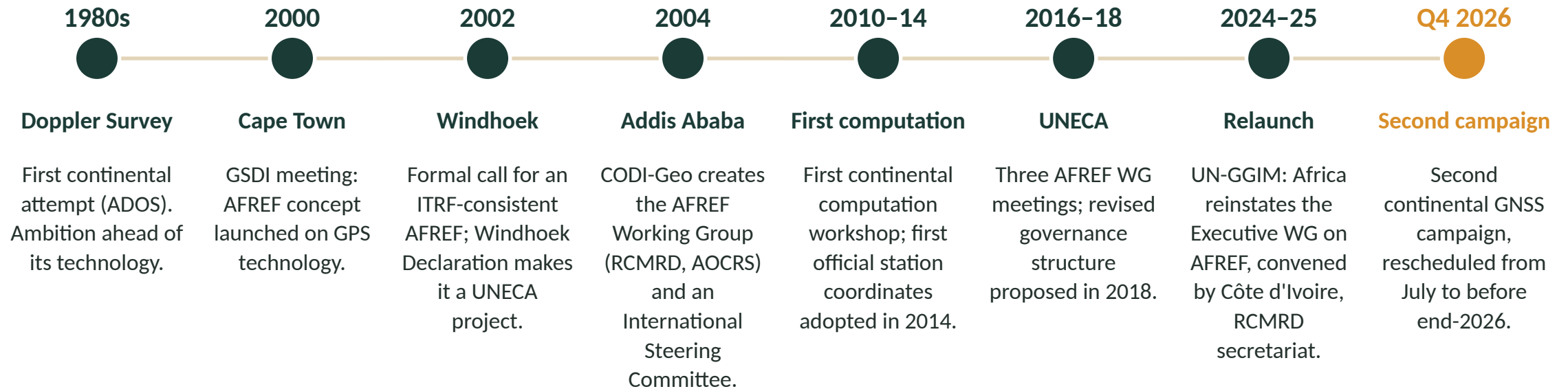
4

A vertical component

A unified African vertical datum and support for a precise continental geoid.

The vision has not aged. The delivery model has.

AFREF never left the African agenda



Every decade, Africa came back to AFREF, with better technology and stronger institutions.

We are not starting from zero

1 Governance

Executive WG on AFREF under UN-GGIM: Africa, convened by Côte d'Ivoire, RCMRD secretariat, terms of reference, five sub-regional seats designed.

2 Standards

AFREF Permanent Stations Guidelines published: site requirements and installation rules that new national networks now follow.

3 Data centre

AFREF Operational Data Centre (afrefdata.org), hosted by NGI South Africa, archives GNSS data from AFREF stations.

4 Coordinates

First continental computation in 2010; first official station coordinates adopted in 2014.

5 Capacity

Annual AFREF training at RCMRD; AFRIGIST, UN-GGCE and FIG now in the capacity-development effort.

6 Partners

Twenty years of backing from UNECA, UNOOSA, IAG, IGS, FIG and the private sector.

The foundation is built. What it needs now is strong and sustainable governance.

AFREF Network: what the first survey found

116+

GPS base stations identified
across Africa by the survey of
GPS sites

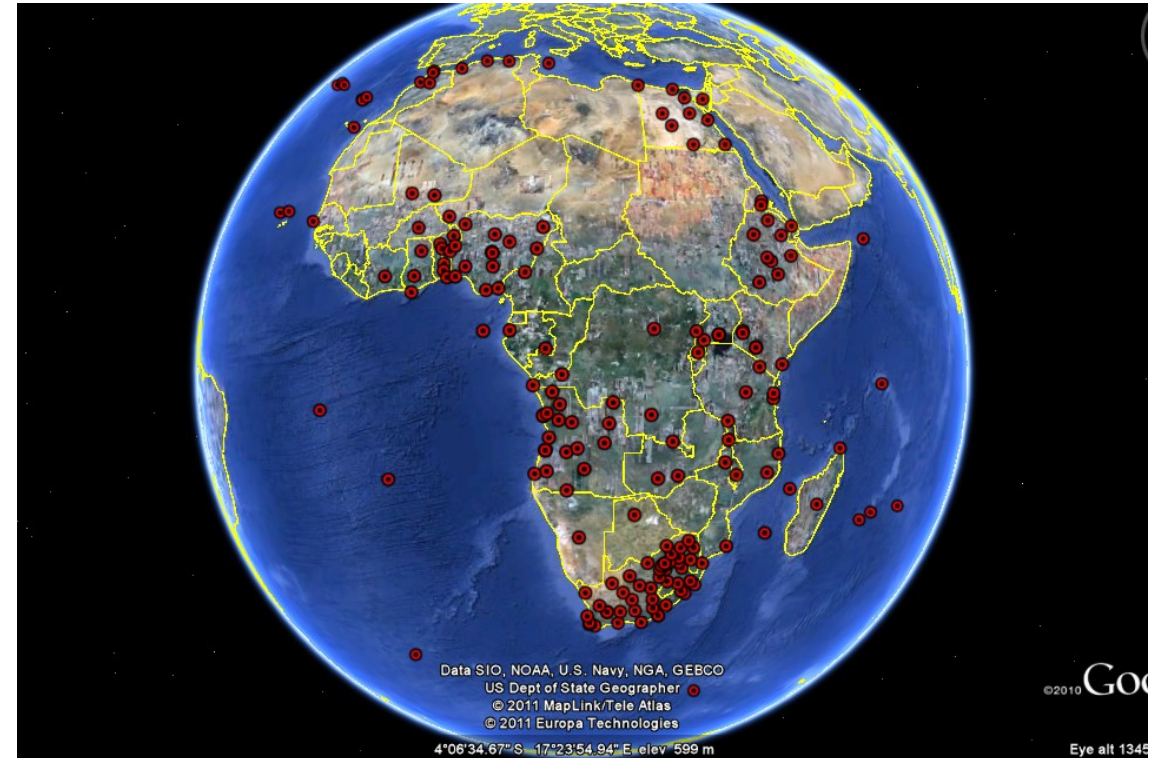
43

stations broadcasting data
usable for position solutions and
analysis

Donations to the network

- Trimble: 5 stations already installed
- Trimble: 10 stations to be rolled out
- Ordnance Survey: 75 stations

- **Where are the gaps?**
- **Where are the optimum locations to establish new stations?**



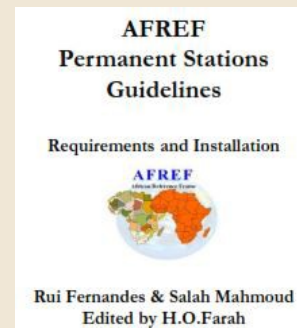
Survey of GPS base stations across Africa — AFREF

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 exceeds 50%, the Nubian plate being mainly affected.
- Different methods can determine the optimal number of GNSS stations to meet AFREF criteria; we need practicable ways that are achievable.
- Many countries are establishing GNSS networks following the AFREF guidelines.
- **Operational funding is the biggest challenge.**
- Proliferation of commercial CORS networks, and networks run by other agencies outside NMO control.
- Unknown scientific networks.

AFREF hosting

- GNSS data from AFREF CORS archived at the AFREF Operational Data Centre (AODC), hosted by NGI, South Africa.



Key findings from the continental CORS survey

UN-GGIM survey on GNSS CORS — responses from 11 African national agencies, January–October 2024

7 of 11

countries run a national CORS network. Three have none; in Madagascar the two IGS stations are operated from abroad.

4+

different ITRF realisations and epochs across seven networks (ITRF2000 to ITRF2014, epochs 2005 to 2018), and one local grid.

4 of 11

still use a classical datum as official reference: Arc 1950, Cape, RGM65, Schwarzeck.

5 of 7

networks share RINEX data free of charge. Openness is already the norm.

2 of 7

network operators say they cannot build or maintain stations on their own.

100–200 km

typical station spacing (3 of 7 networks), well inside the AFREF 500 km target.

Networks are growing. Frames are not converging. Converging them is AFREF's job.

What national agencies reported

Country	National CORS	Avg spacing	Frame & epoch	Official datum	RINEX	Can build & maintain
Burundi	No	—	Not yet	ITRF2008	—	Yes
Cameroon	No	—	—	RGNC (GRS80)	—	Yes
Comoros	No	—	—	WGS84 / UTM 38S	—	Not sure
Côte d'Ivoire	Yes — RECI	100–200 km	ITRF2014 @2010	RGCI (GRS80)	Free	Yes
Lesotho	Yes	50–100 km	Local grid (LO27/29)	Cape Datum (Clarke 1880)	Not sure	No
Madagascar	2 IGS stations, run from abroad	—	—	RGM65 (Hayford 1924)	—	—
Namibia	Yes	> 200 km	ITRF2000 @2005	Schwarzeck (Bessel 1841)	Other	No
Nigeria	Yes — MIRANET	100–200 km	ITRF2014*	WGS84	Free	Yes
South Africa	Yes — TrigNet	100–200 km	ITRF2014 @2018	Hartebeesthoek94	Free	Yes
Uganda	Yes — UGRF	50–100 km	ITRF2005 @2010	UGRN (GRS80)	Free	Yes
Zimbabwe	Yes — Zimbabwe CORS	> 200 km	ITRF2014 @2018	Arc 1950 (Clarke 1880)	Free	Yes

Source: UN-GGIM survey on GNSS CORS, responses January–October 2024; one national-agency response per country.

* A second response from the same Nigerian agency gives ITRF2008, epoch 2011.

What a regional frame looks like when it runs

SIRGAS Americas & Caribbean

SIRGAS-CON: the continuously operating GNSS network of the Americas

~500

permanent GNSS sites, 67 of them IGS stations

50+

organisations install and operate the stations

27

national networks aligned to SIRGAS

12

local processing centres in 10 countries

11

national data centres

3

independent solutions computed for every station

Weekly loosely constrained solutions (SINEX), weekly ITRF-aligned positions, multi-year positions and velocities. Core analysis: IGS RNAAC SIRGAS (DGFI-TUM). Combination: IBGE (Brazil) and DGFI-TUM.

APREF

Asia-Pacific

1 100+

stations in 39 countries; an annual campaign ties national frames together.

EUREF

Europe

400+

EPN stations since 1996; weekly solutions, open data, a permanent Central Bureau.

ARABREF

Arab States

Apr 2026

Steering Committee set up; IAG Commission 1 registration filed.

SIRGAS shows what AFREF can become: a region that processes its own frame, every week.

Four structural levers, none of them technical

1

Governance

The structure exists: WG3 convened by Côte d'Ivoire, RCMRD secretariat, terms of reference, five sub-regional seats designed.

2

Data flow

The receivers are largely in place. The gain now comes from opening them up: stations that stream, data that is shared, archives that are discoverable. Every station with open daily RINEX strengthens the frame.

3

Product

Campaigns lay the groundwork; a frame turns them into a service: coordinates and velocities at a declared epoch, in a declared ITRF realisation, published on a regular cycle.

4

Analytical sovereignty

Africa already contributes the data. The next step is to compute it here: African analysis centres processing African data, inside a reference frame Africa owns.

Beyond all four: a unified African vertical datum, the next frontier.

The future of geodesy in Africa will be secured by **governments** working together with **scientific organizations** and the **private sector**, moving beyond reliance on largely voluntary contributions.

The greatest threat to AFREF is **political**.

A geodetic reference frame is a club good

PUBLIC GOOD

Funded by taxes

- Benefits spread across every sector; upkeep falls on one budget line.
- Stations are installed with project money, then go silent when the project ends.

CLUB GOOD

Funded by its members

- Those who use the network share its upkeep and set its rules.
- Each new member lowers everyone's cost.
- J. M. Buchanan, An Economic Theory of Clubs (1965).

PRIVATE GOOD

Funded by the market

- Commercial RTK networks serve paying users.
- Each in its own frame, outside NMA control;

Geodesy is an in-between good: benefits are diffuse, upkeep costs are concentrated. A club closes that gap.

Côte d'Ivoire: one network, many members

1 → 20

national CORS in five years

\$4M+

invested over five years by the programmes that use the network

RECI — Réseau CORS Ivoirien · ITRF2014, epoch 2010

The members

Rural land administration (AFOR) and urban resilience (PARU), both funded by the World Bank, plus the cadastre. Each programme financed its share; every administration uses the whole network.

The rules

A collaboration framed by the IGIF. IGS CORS standards. Every site assessed and validated against raw observation data before installation.

The services

RINEX, DGNSS, RTK, post-processing, free at the point of use. Other administrations and private surveyors trained to use them.

Several programmes, one network: each paid its share, all of them use all of it. BNETD is operating, maintaining and upgrading.

One mandate, two instruments, one workplan

WG3 — UN-GGIM: Africa

Speaks to governments

- Political and institutional mandate
- National commitments and data policy
- Reporting into UN-GGIM sessions
- Ministerial and financing advocacy

GGOS-Africa

Speaks to observatories, analysis centres and the global services

- Scientific and technical programme
- Infrastructure assessment and simulation
- Analysis centres and computation standards
- Early-career training and retention

A minimum coordination and implementation function is critical for an effective geodetic governance in Africa

Africa Geodesy Capacity Development Workshop on Transitioning to a Modern Geospatial Reference System, 19 - 23 March 2025, Nairobi, Kenya



Capacity development now has an engine: AFRIGIST and RCMRD, in partnership with the UN-GGCE and FIG.

Twenty years proved a continental frame for Africa is possible.

The next five have to prove we can maintain one.

That distance is not measured in stations. It is measured in committees that meet, data that flows, products published on time, and people still here in ten years to sign them.

Turn AFREF from a project into an institution.

Thank you. · Fernand Eanes BALÉ · BNETD, Côte d'Ivoire