

Presented at the FIG Working Week 2024,
19-24 May 2024 in Accra, Ghana

Exploring the IGS Network

Engaging with the Global GNSS Community

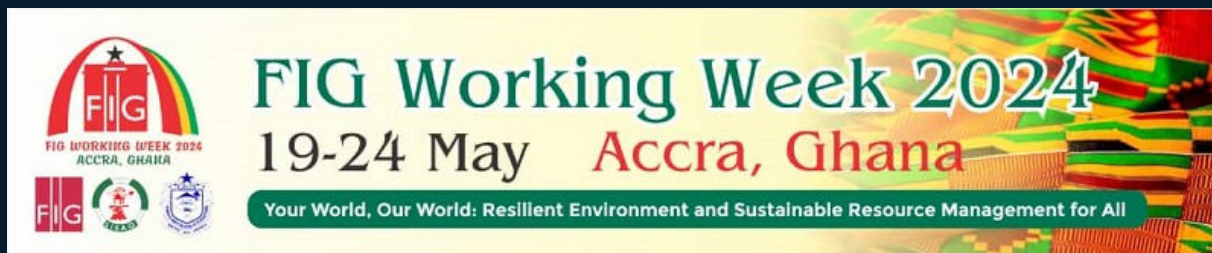
Markus Bradke¹, Ryan Ruddick², Allison B. Craddock³, Dr. [Ryan Keenan](#)⁴

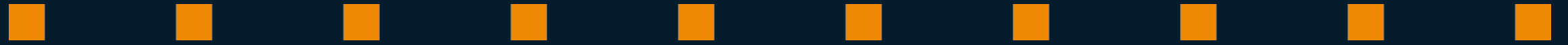
¹ Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences, Potsdam, Germany

² Geoscience Australia, Canberra, Australia

³ NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

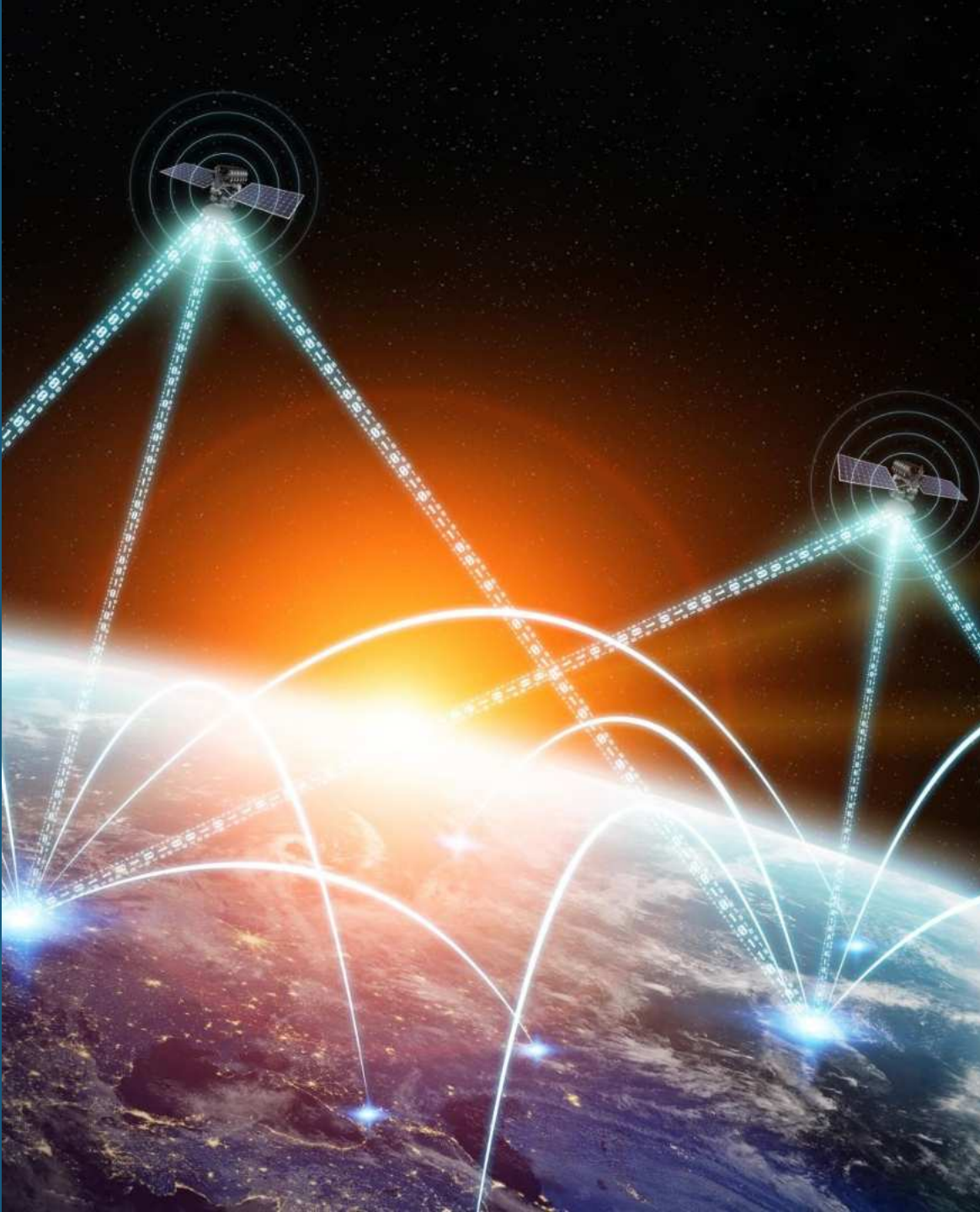
⁴ Positioning Insights, Melbourne, Australia





01

About the IGS



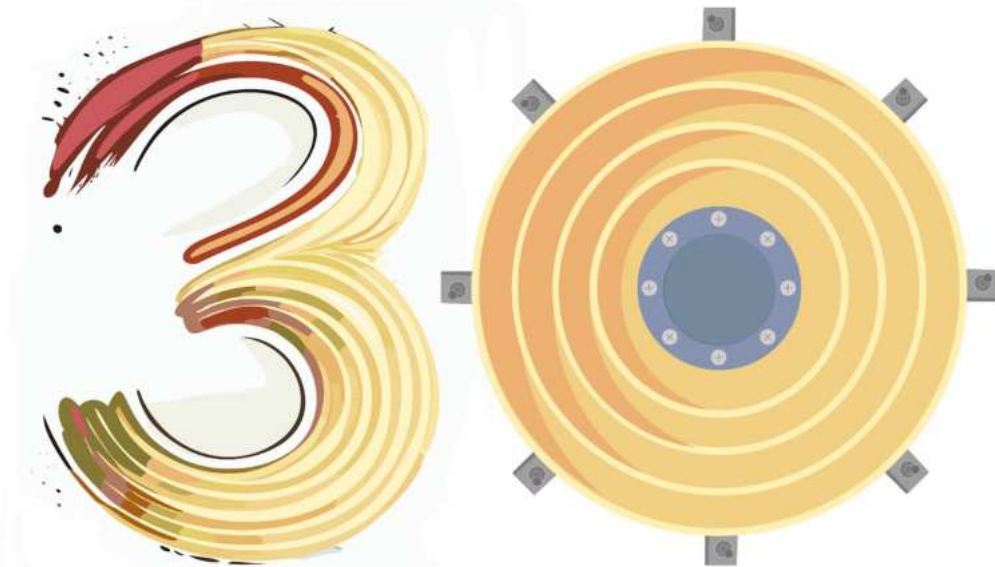
IGS Mission

The International GNSS Service (IGS) provides, on an openly available basis, the **highest-quality Global Navigation Satellite System (GNSS)** data, products, services in support of:

- the Terrestrial Reference Frame
- Earth observation and research
- Positioning, Navigation and Timing (PNT)
- other applications benefitting science and society

IGS 30th Anniversary

CELEBRATING

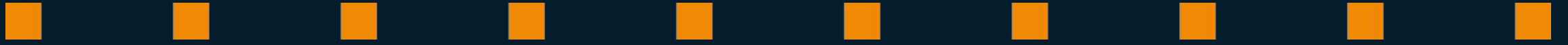


YEARS OF IGS

- Over the last thirty years, the IGS has grown and evolved as a dynamic and indispensable global collaborative platform, **leveraging the collective contributions** of its diverse members to provide unparalleled access to GNSS data.
- The IGS not only serves as a **technological innovator** but also as a **catalyst for scientific advancements**, actively engaging with global organizations to ensure its impact extends far beyond the immediate GNSS community.
- Through open access, collaboration, and a commitment to leadership in analysis and processing, the IGS stands as a beacon for entities invested in GNSS research, offering **transformative benefits for scientific, practical, and technological domains** on a worldwide scale.

IGS Goals

- 1** Serve as the premier source of the highest-quality GNSS related standards and conventions, data and products, openly available to all user communities.
- 2** Attract leading-edge expertise to pursue challenging, innovative projects in a collegial, collaborative, and creative culture.
- 3** Incorporate and integrate new developments, systems, technologies, applications, and changing user needs into IGS products and services.
- 4** Facilitate the integration of IGS into the International Association of Geodesy (IAG) Global Geodetic Observing System (GGOS) and other more broadly based Earth observing, geodetic, and global navigation systems and services.
- 5** Maintain an international federation with committed contributions from its members, and with effective leadership, management, and governance.
- 6** Promote the value and benefits of IGS to society, the broader scientific community, and in particular to policy makers and funding entities.



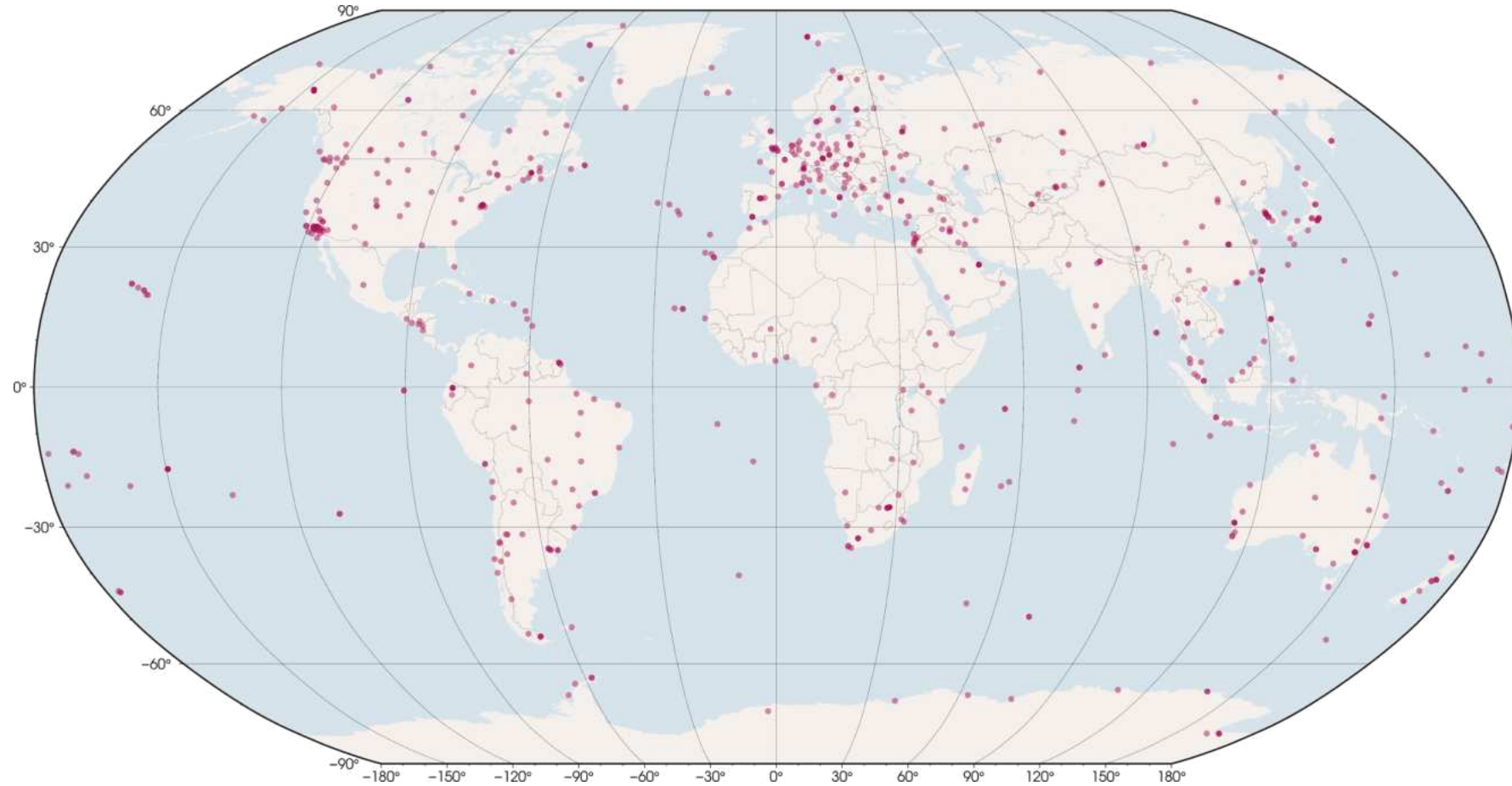
02

The IGS Network

IGS Network

515
stations in

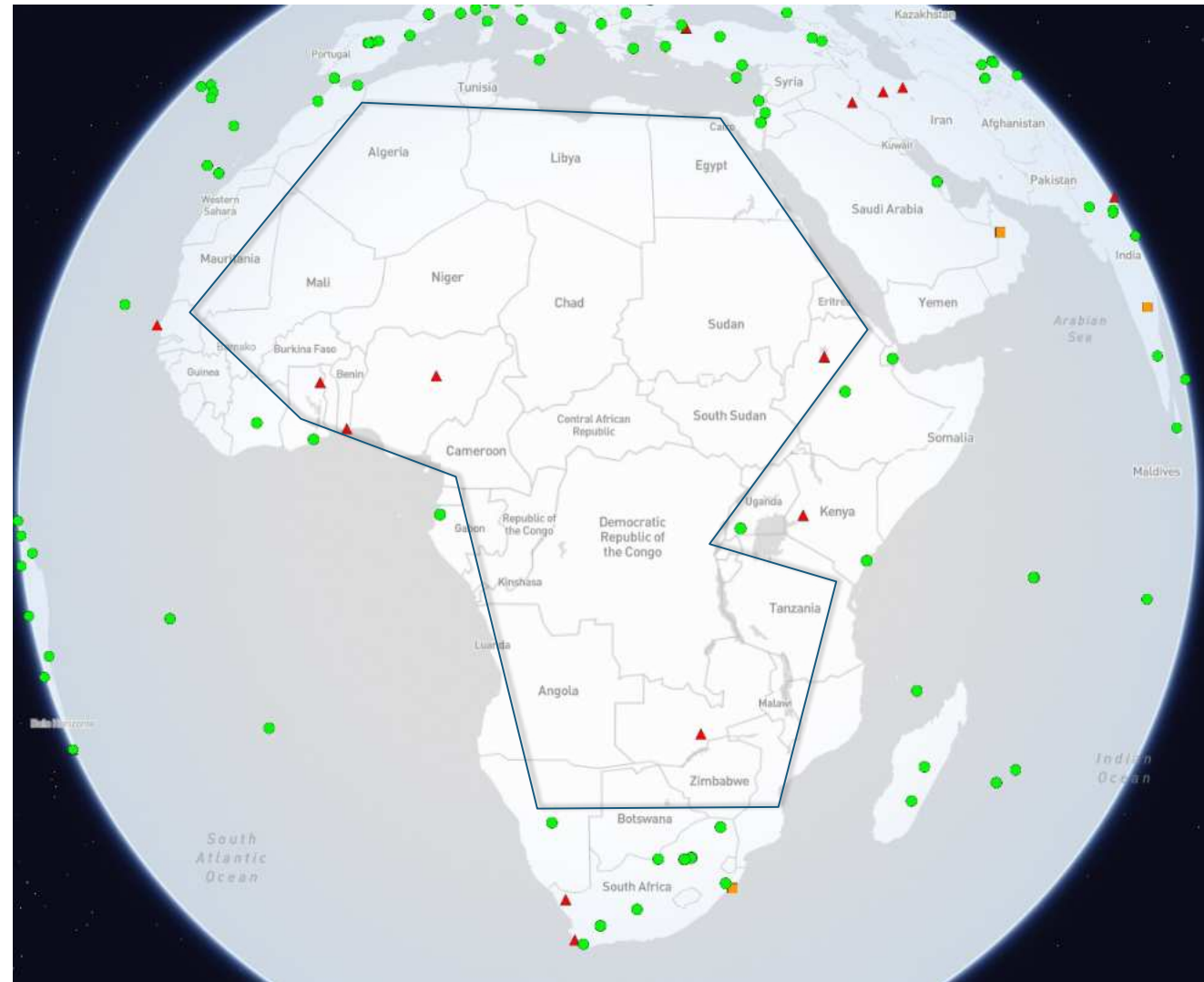
116
countries/
regions



To explore all stations, visit
<https://network.igs.org>.

IGS CORS Contributions from Africa

Currently, there are 20* African countries contributing CORS to the IGS Network, 34 countries don't have single CORS within their national territory. Most of the stations are maintained by foreign partners. There is a significant gap in central Africa, where contributions are notably lacking.



Benefits of contributing to the IGS Network

1

Global Impact: Contribute to a global effort in advancing precise positioning and understanding of Earth.

2

Support for Scientific Research: Support scientific research in geodesy, Earth sciences, and related fields by providing essential data.

3

Network Collaboration: Collaborate with a diverse network of international partners, fostering knowledge exchange and collaboration opportunities.

4

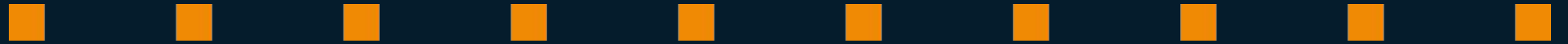
Contribution to Global Reference Frame: Contribute to the development and maintenance of a global reference frame crucial for various scientific and societal applications.

5

Capacity Building: Access training resources and capacity-building initiatives aimed at enhancing skills in GNSS data analysis and interpretation.

6

Recognition and Visibility: Gain recognition and visibility as a contributor to a globally known organization focused on Earth observation and positioning technologies.



03

Establishing CORS

	3
Table of Contents	
References	4
1 Introduction	8
1.1 Procedure for Becoming an IGS Station	8
1.2 Waivers for non-compliant Stations	9
2 Summary of IGS CORS Guidelines	10
3 IGS CORS Establishment and Operation	16
3.1 Signal Quality	16
3.1.1 Sky Visibility	16
3.1.2 Multipath	17
3.1.3 Radio Interference Sources	17
3.2 Site Stability	18
3.2.1 Monument Foundation	18
3.2.2 Antenna Monuments	18
3.2.3 Antenna Mounts	19
3.3 Power and Communications	20
3.3.1 Power Supply	20
3.3.2 Communications	20
4 GNSS Equipment	22
4.1 GNSS Receiver	22
4.2 GNSS Antenna	23
4.3 Antenna Cable	25
4.4 Meteorological Sensors	27
5 Data and Metadata	28
5.1 Signal Tracking and Data Recording	28
5.1.1 High-Rate Data	29
5.1.2 Real-Time Data	29
5.1.3 Meteorological Data	30
5.2 File Naming Conventions	30
5.2.1 RINEX v.4/v.3	30
5.2.2 RINEX v.2	30
5.3 Data Quality	33
5.4 Metadata	34
5.4.1 IGS Site Log/GeodesyML	34
5.4.2 RINEX Headers	35
5.4.3 Digital Photographs	36
5.4.4 Individual Antenna Calibrations	37
5.4.5 Data Protection Compliance	37
5.5 Announcements	38

CORS Guidelines

The “
[Guidelines for Continuously Operating Reference Stations in the IGS](#)
 ”

is now available to assist station owners and operators in planning and maintaining CORS. Translations to other languages than English would be welcome.



Guidelines in a Nutshell

Site stability and signal quality

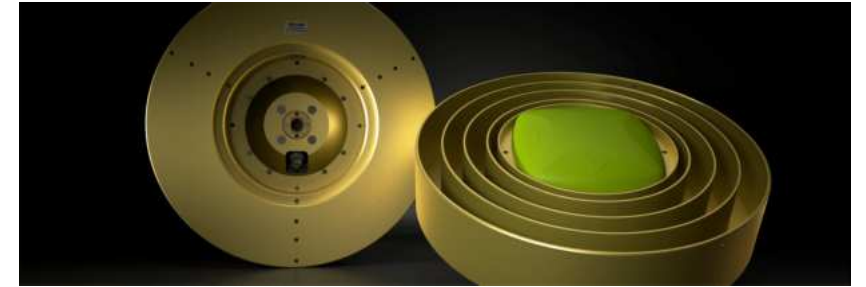
- Monuments ideally fixed to bedrock to provide long-term stability
- Sufficient height to minimise obstructions
- No obstructions above 10° elevation
- Simple design with low maintenance
- Minimise multipath and radio interference sources



Guidelines in a Nutshell

The right equipment: geodetic quality antennas and receivers

- Full-spectrum Multi-GNSS receivers and antennas with all-in-view tracking
- Preferably use of choke-ring antennas with Dorne-Margolin elements
- Antenna needs to have an absolute antenna calibration
- Use of antenna radomes is discouraged



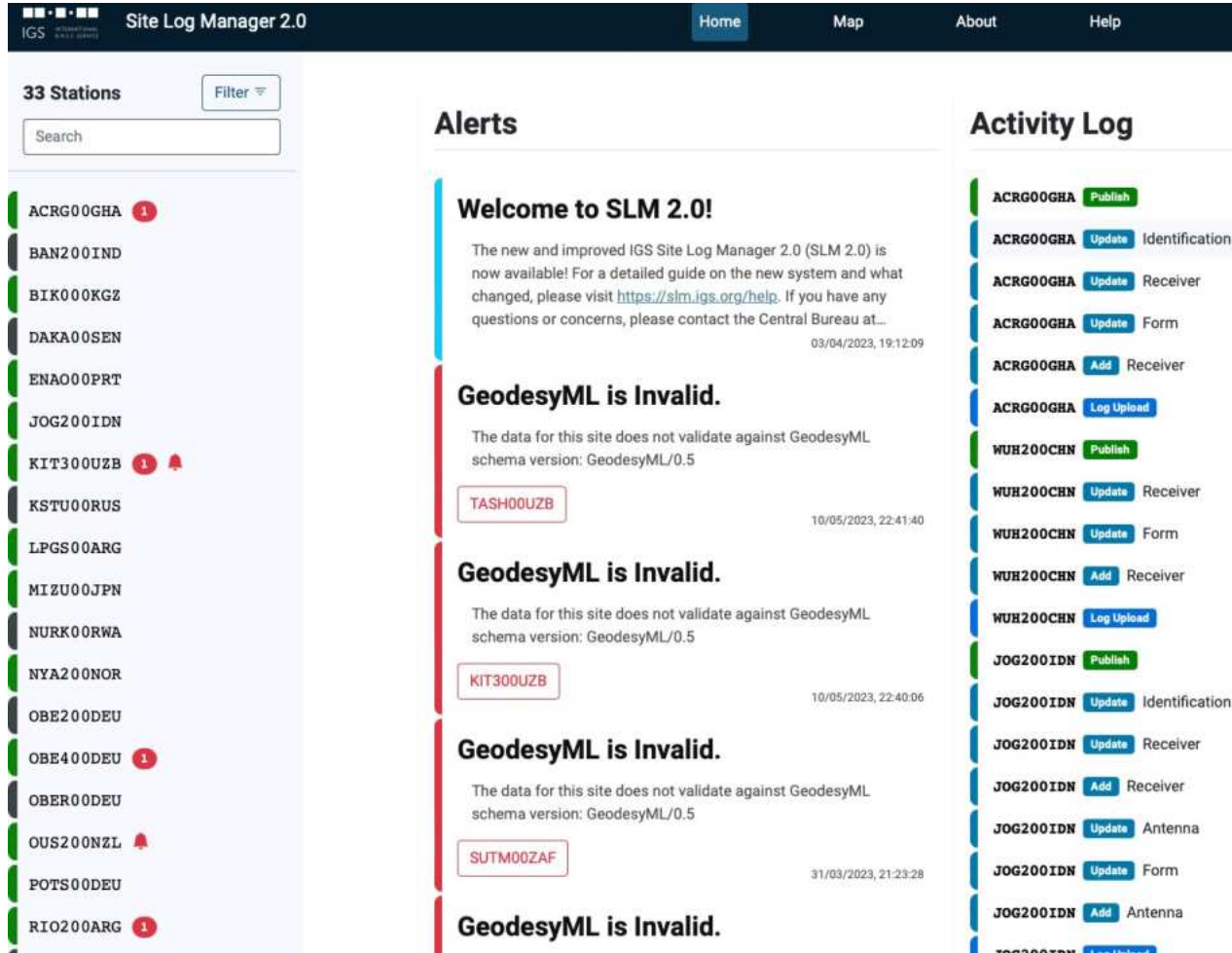
Data Recording and Transmission

- Real-Time data is encouraged¹
- Minimum submission of RINEX 3/4 daily files² (hourly and high-rate data is encouraged)



1

https://files.igs.org/pub/resource/guidelines/Guidelines-for-IGS-Real-Time-Broadcasters-and-Stations_v1.0.pdf
2 https://files.igs.org/pub/data/format/rinex_4.01.pdf



The screenshot shows the IGS Site Log Manager 2.0 interface. At the top, there is a navigation bar with 'Home', 'Map', 'About', and 'Help' links. Below this, the main content is divided into three sections:

- 33 Stations:** A list of station identifiers with a search bar and a filter dropdown. Stations include ACRG00GHA, BAN200IND, BIK000KGZ, DAKA00SEN, ENAO00PRT, JOG200IDN, KIT300UZB, KSTU00RUS, LPGS00ARG, MIZU00JPN, NURK00RWA, NYA200NOR, OBE200DEU, OBE400DEU, OBER00DEU, OUS200NZL, POTS00DEU, and RIO200ARG.
- Alerts:** A section with three alerts. The first is a welcome message for SLM 2.0. The second and third are 'GeodesyML is Invalid' messages for stations TASH00UZB and KIT300UZB, respectively, with timestamps. The fourth is another 'GeodesyML is Invalid' message for station SUTM00ZAF.
- Activity Log:** A list of recent activities for various stations, each with a button for a specific action like 'Publish', 'Update', 'Receiver', 'Form', 'Add', or 'Log Upload'.

Site Log Manager

The IGS Site Log Manager (SLM) is a web based online application designed for the purpose of managing the metadata of IGS CORS.

<https://slm.igs.org/>

Register your CORS

You can register your CORS by filling out the form: <https://igs.org/network-resources>

A dedicated committee will assess your proposal and provide feedback.



Interested in providing a station for the IGS?

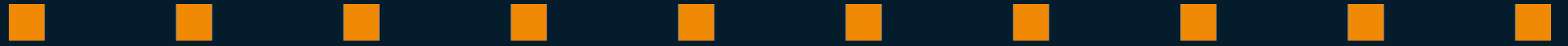
To initiate the application, review the [Guidelines for Continuously Operating Reference Stations \(CORS\) in the IGS document](#) and complete the online application below.

Agency or Organization *

Name *

Prefix

First Middle Last Suffix



04

Conclusion

Conclusion

- The IGS plays a crucial role in advancing our understanding of Earth and supporting a wide range of applications benefiting science and society
- Through its global network of reference stations and collaborative efforts, the IGS provides high-quality GNSS data, products, and services essential for precise positioning and Earth observation
- A notable gap remains in central Africa that needs to be addressed through increased outreach and collaboration to ensure broader participation and representation from all regions
- We will continue advocating for the expansion of the IGS network, particularly in underrepresented areas



IGS

INTERNATIONAL
GNSS SERVICE

Thank You!

Markus Bradke

markus.bradke@gfz-potsdam.de

Ryan Ruddick

ryan.ruddick@ga.gov.au