HOW

UNITED NATIONS GLOBAL GEODETIC CENTRE OF EXCELLENCE

MODERNISING GEOSPATIAL REFERENCE SYSTEM CAPACITY DEVELOPMENT WORKSHOP

International Geodesy Initiatives & Partner Organisations

Ryan Keenan
Senior Consultant for UN-GGCE

Day 2, Session 4 [2_4_2]

Acknowledgements: *Allison Craddock (IGS), Richard Gross (IAG), Sharafat Gadimova (UNOOSA), Laura Sanchez (GGOS), Ryan Keenan (FIG), Zuheir Altamimi (IUGG)*

Session Overview

Purpose of the Session

To provide participants with overview:

- International Geodesy Organisations and their initiatives
- Partners involved with the Geodesy community
- Setting the scene around opportunities for participation and collaboration

Open Q&A across the session

IUGG | Mission

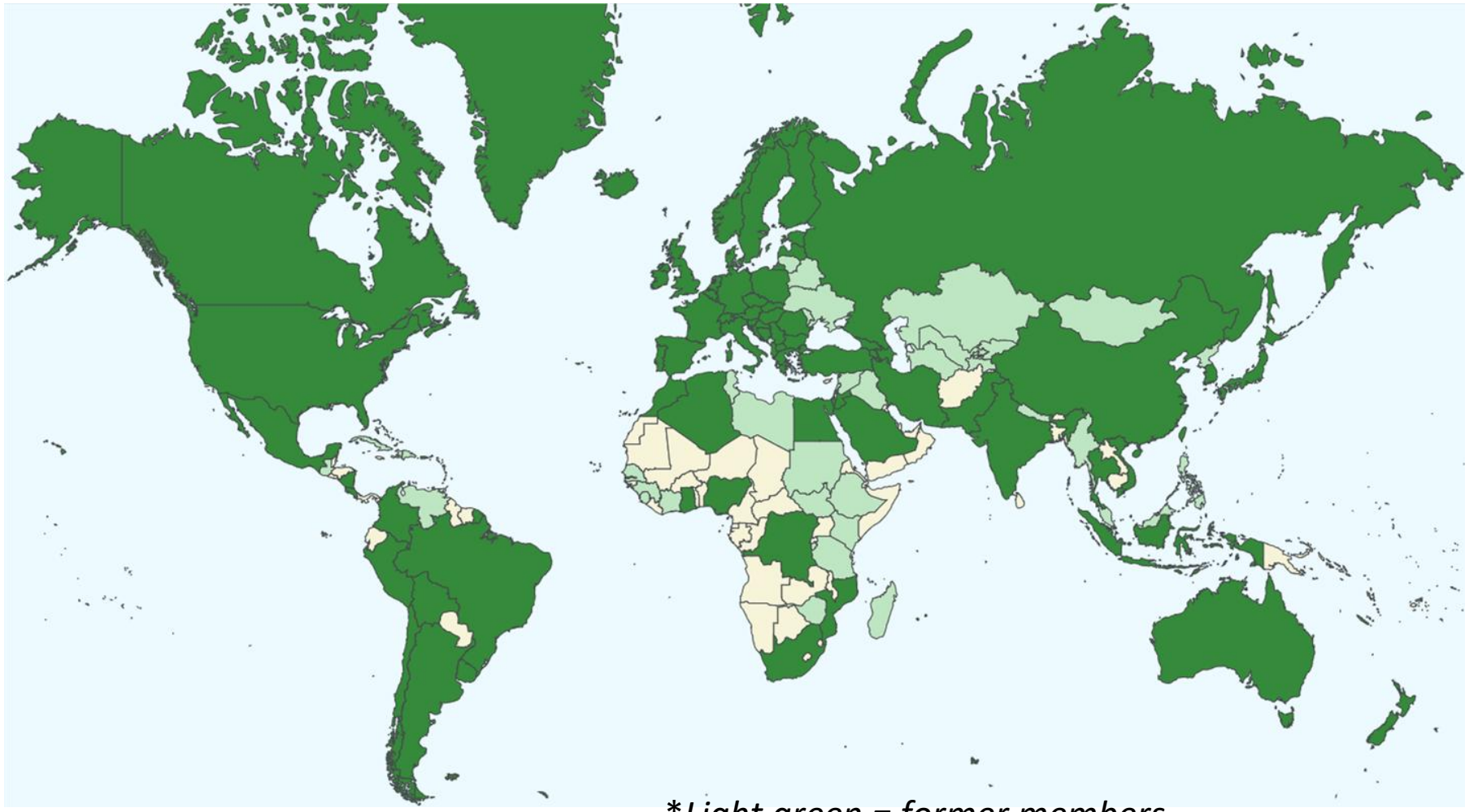
Founded in 1919, the International Union of Geodesy and Geophysics (IUGG) *is the international organization dedicated to* ***advancing, promoting, and communicating knowledge*** *of the Earth system, its space environment, and the dynamical processes causing change.*

Through its ***constituent Associations, Commissions, and services, IUGG convenes international assemblies and workshops****, undertakes research, assembles observations, gains insights, coordinates activities,* ***liaises with other scientific bodies, plays an advocacy role, contributes to education, and works to expand capabilities and participation worldwide.***

International Science Council
The global voice for science

Funded by
DFG Deutsche Forschungsgemeinschaft
German Research Foundation

IUGG | 74 Member Countries (dark green)

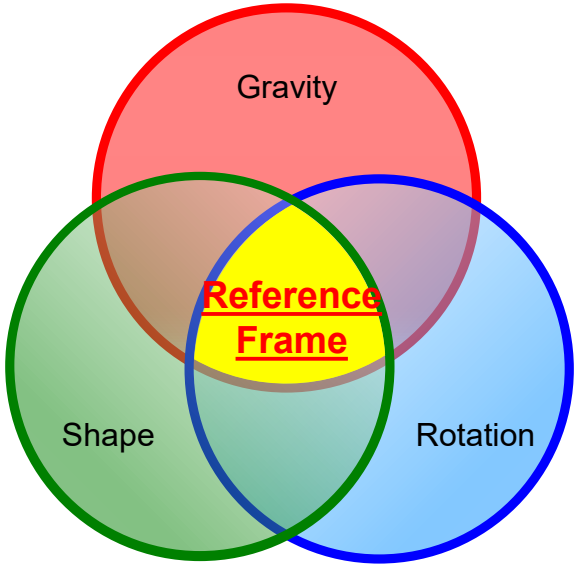


*Light green = former members

International Association of Geodesy (IAG)

Geodesy is the science of accurately measuring and understanding three fundamental properties of the Earth and their changes in time

- Geometric shape
- Rotation and orientation in space
- Gravity field



Establishing and disseminating the
Terrestrial Reference Frame (TRF)
is central to Geodesy

International Association of Geodesy
Organizational Structure

- 4 Commissions
- 3 Inter-Commission Committees
- 1 Project
- **GGOS Global Geodetic Observing System**
- 12 Services
- Communication and Outreach Branch

- Council
- Executive Committee
- Bureau
- Office

Geometric & General Services

IERS

IGS INTERNATIONAL GNSS SERVICE

International Laser Ranging Service

IVS

IDS

PSMSL

Gravity Services

International Association of Geodesy
IAG
I G F S

I C G E M

iDEMS

IGETS

ISG

BGI
Bureau Gravimétrique International
International Gravimetric Bureau

source: ggos.org

Global Geodetic Observing System

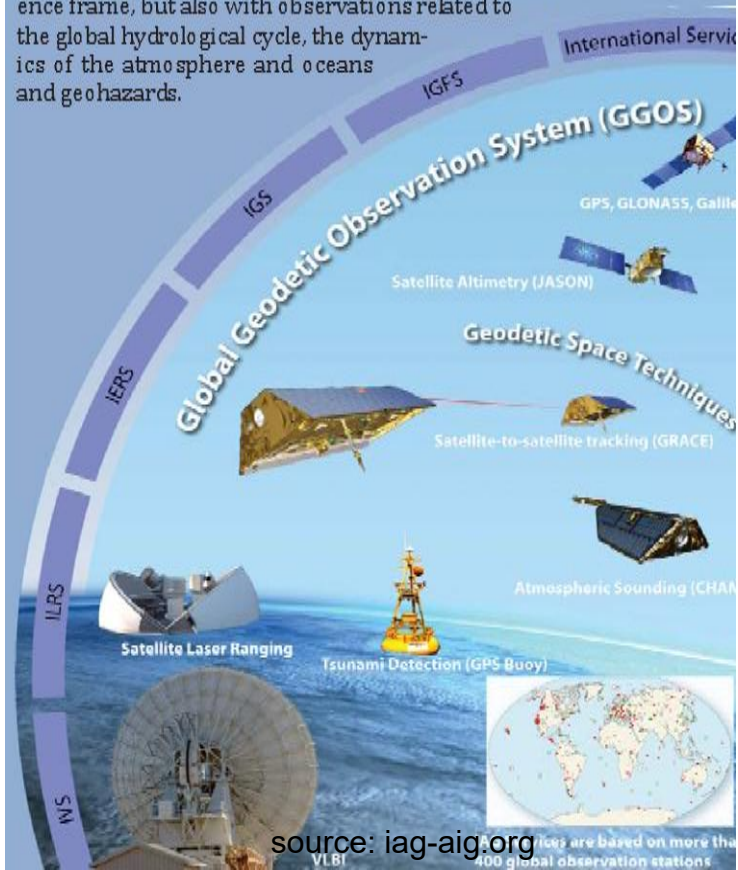
The Global Geodetic Observing System (GGOS)

URL: http://www.ggos.org

GGOS is an official component of IAG as well as a participating organization of the Group on Earth Observations (GEO).

GGOS provides observations of the three fundamental geodetic observables and their variations, that is the Earth's shape, the Earth's gravity field, and the Earth's rotational motion. Thus GGOS ensures the basis to maintain a stable, accurate and global reference frame, which is crucial for all Earth observation.

GGOS contributes to the Global Earth Observing System of Systems (GEOSS) not only with the global reference frame, but also with observations related to the global hydrological cycle, the dynamics of the atmosphere and oceans and geohazards.



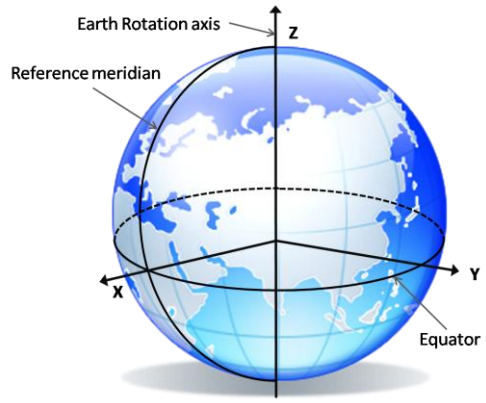
source: iag-aig.org

Terrestrial Reference Frame (TRF)

GGOS
Global Geodetic Observing System

Definition

- The TRF is an accurate, stable set of positions and velocities of reference points on Earth's surface
- The TRF provides the stable coordinate system that allows us to link measurements over space and time for numerous scientific and societal applications
- including critical climate and sea level change studies



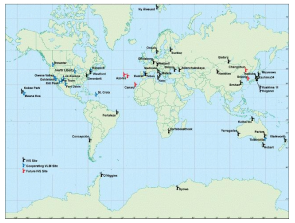
Terrestrial Reference Frame

Determination

- The GNSS, SLR, VLBI & DORIS geodetic networks, along with ground surveys of stations at co-located sites to tie the networks together, provide the data for determining the TRF as well as for direct science investigations


GNSS


SLR


VLBI

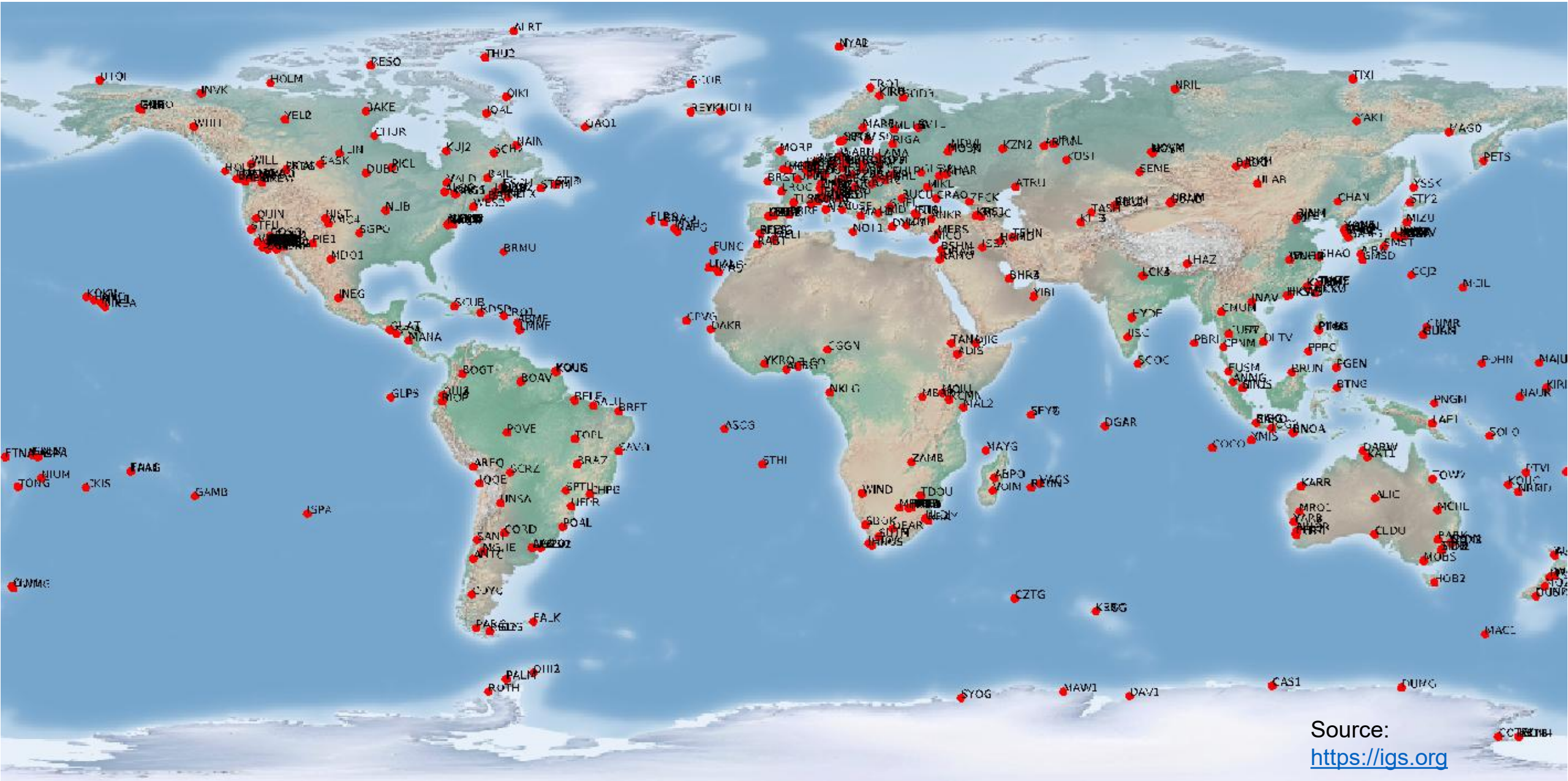

DORIS

Improvement (through co-organised efforts under GGOS)

- An improved TRF is needed for numerous scientific and societal applications including critical climate and sea level change studies

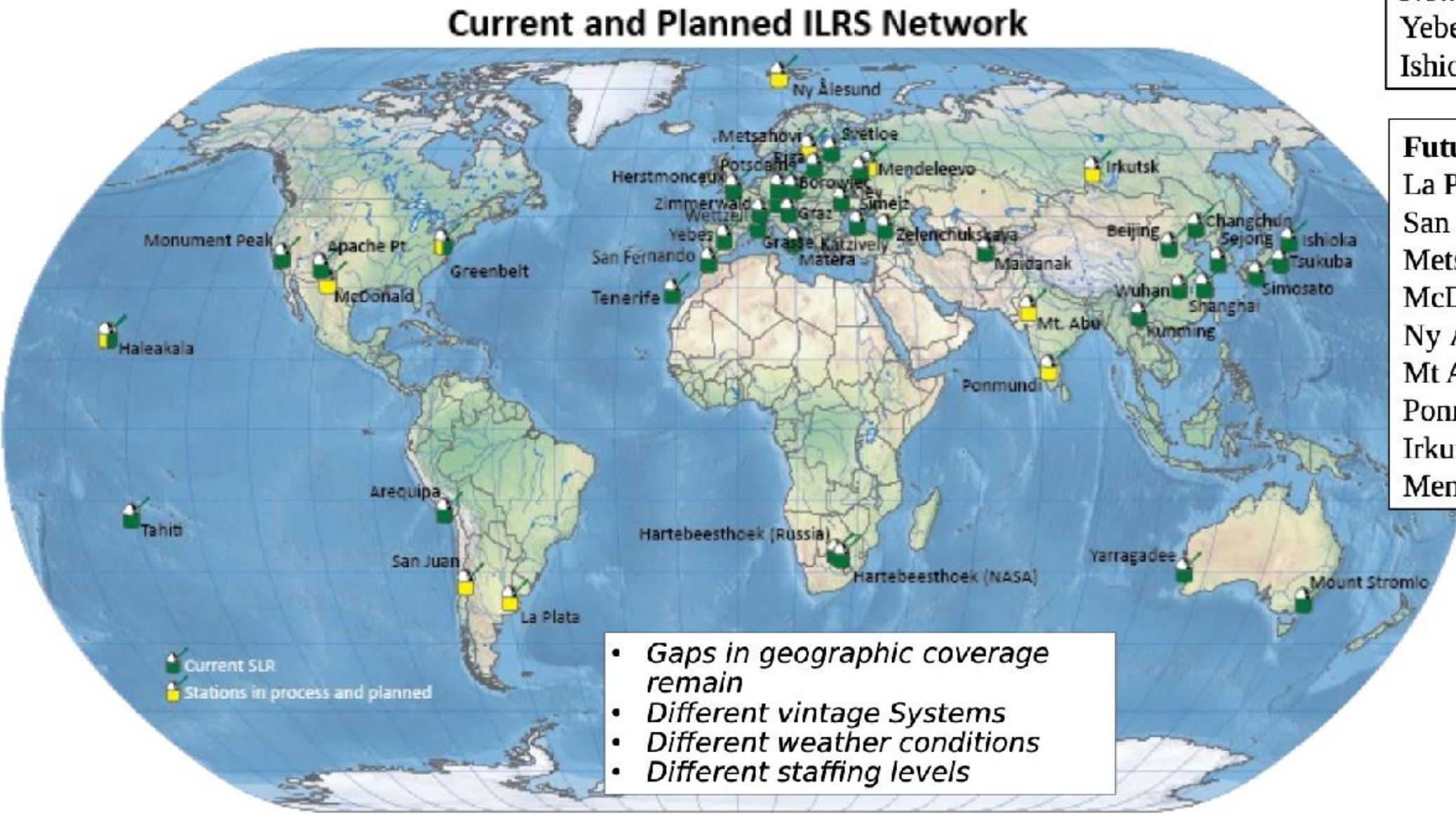
GGOS Goal: TRF accurate to better than 1 mm, stable to better than 0.1 mm/yr over a decade

International GNSS Service (IGS)



Source:
https://igs.org

International Laser Ranging Service (ILRS)

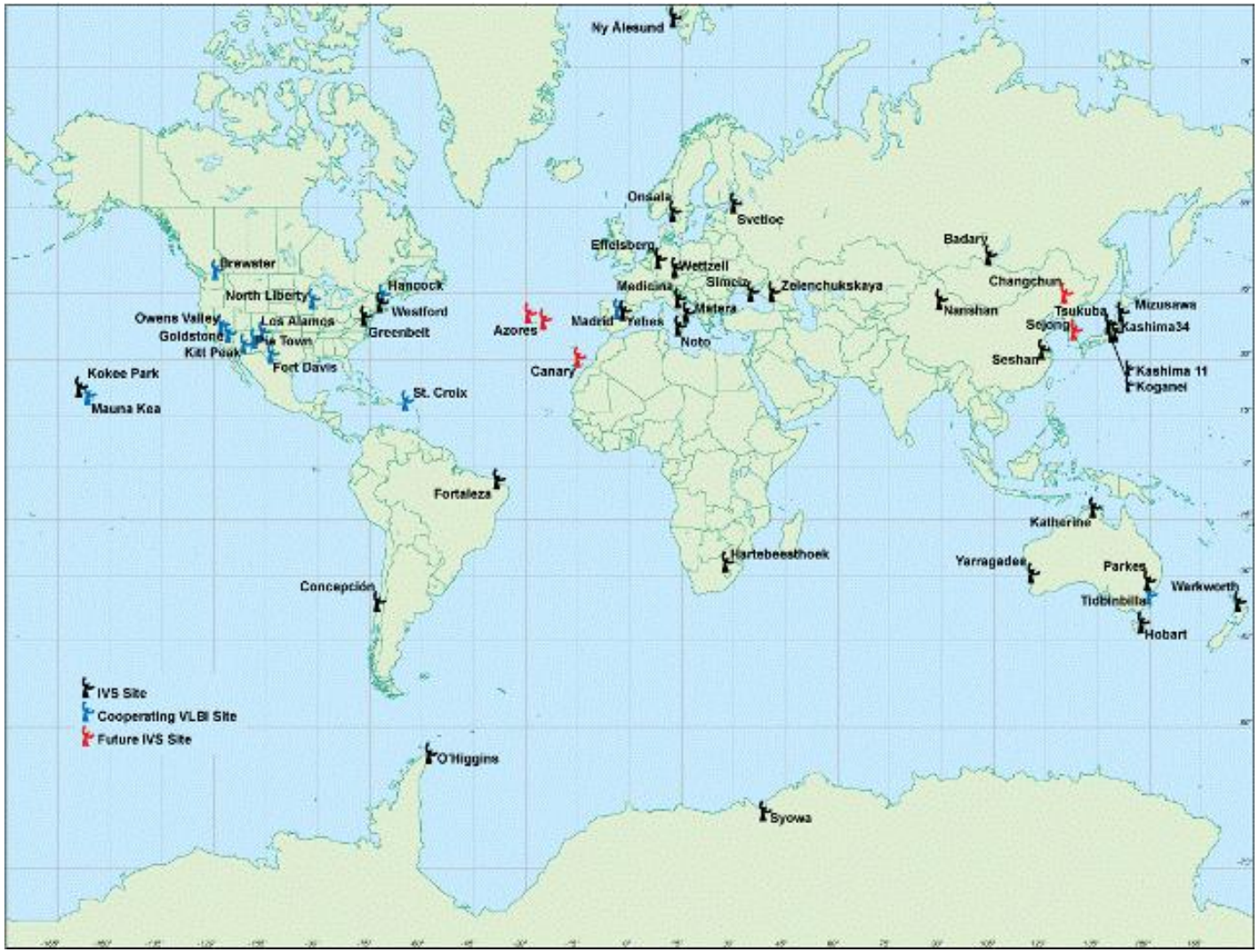


New Stations (2023-2024)
Yebes, Spain
Ishioka, Japan

Future Stations (2024-2027)
La Plata, Argentina
San Juan, Argentina
Metsähovi, Finland
McDonald, TX, USA
Ny Ålesund, Norway
Mt Abu, India
Ponmundi, India
Irkutsk (Tochka), Russia
Mendeleevo (Tochka), Russia

Source:
https://ilrs.gsfc.nasa.gov

International VLBI Service (IVS)
for Geodesy and Astrometry



Source:
https://ivscc.gsfc.nasa.gov

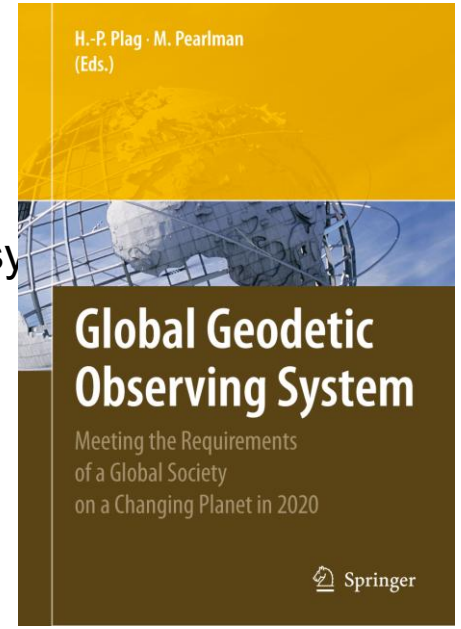
International DORIS Service (IDS)

Source: https://ids-doris.org

GGOS Global Geodetic Observing System

https://ggos.org

- Forum for international collaboration
  - Improve integrated, global geodetic infrastructure
  - Improve geodetic products
    - Unified Analysis Workshops co-organized with IERS
- Advocate for geodesy to broader community
  - Group on Earth Observations; Committee on Earth Observation Satellites
    - Provide Earth observations (including geodetic) needed to make informed decisions
  - UN Global Geodetic Center of Excellence and UN-GGIM Subcommittee on Geodesy
    - Emerging policy-making organizations in geodesy
    - Emerging forum for international collaboration
- Incubator for new initiatives in geodesy
  - Geohazards Monitoring (Chair: Tim Melbourne, USA)
  - Geodetic Space Weather Research (Chair: Michael Schmidt, Germany)
  - Artificial Intelligence for Geodesy (Chair: Benedikt Soja, Switzerland)
- Requirements-setting organization for geodesy
  - GGOS 2020 book and its update
  - Essential Geodetic Variables



https://link.springer.com/book/10.1007/978-3-642-02687-4

Exploring the IGS Network

Engaging with the Global GNSS Community

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 (TRF)
- Earth observation and research
- Positioning, Navigation and Timing (PNT)
- other applications benefitting science and society

IGS INTERNATIONAL GNSS SERVICE

IGS Network

515*

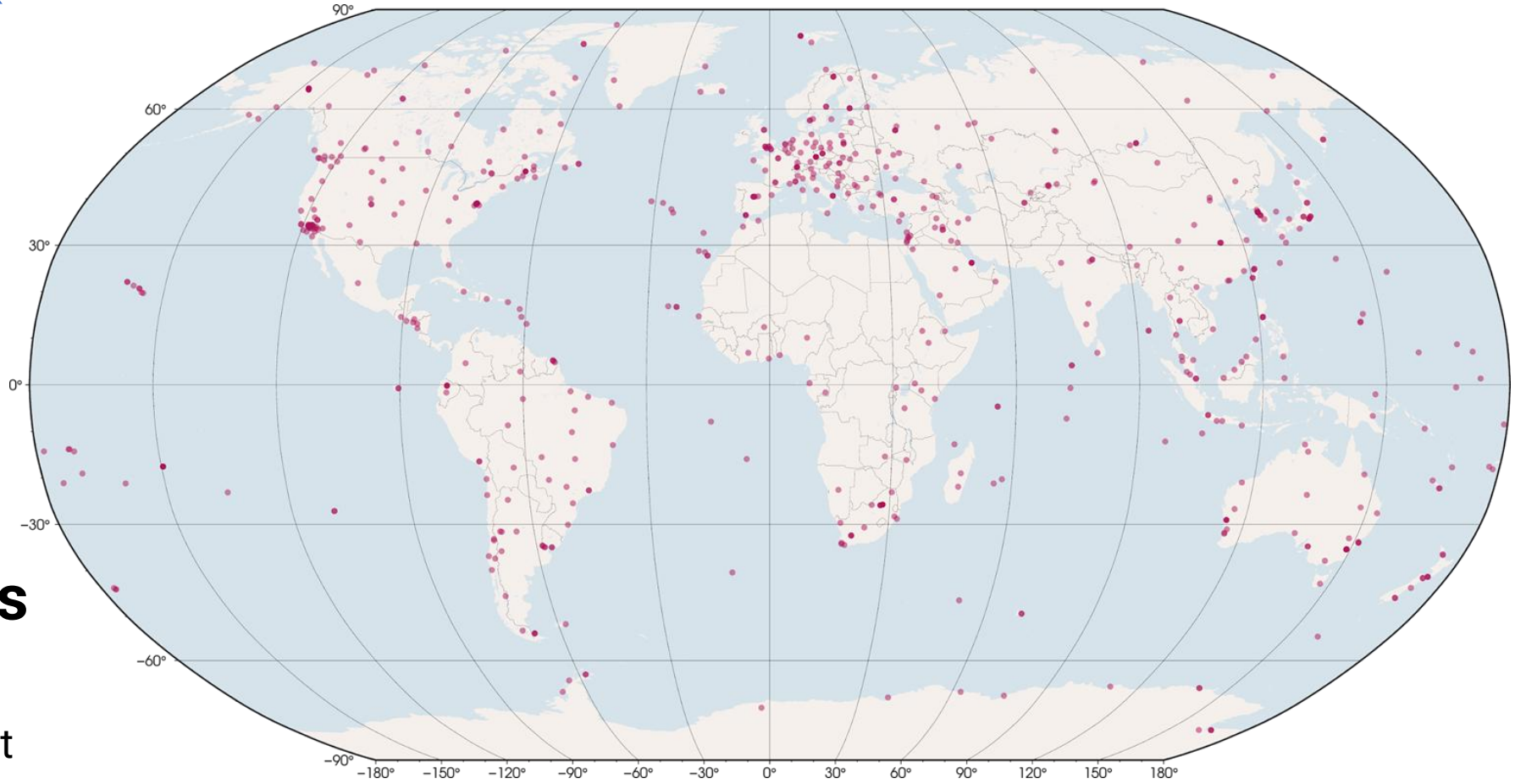
stations in

116*

countries/regions

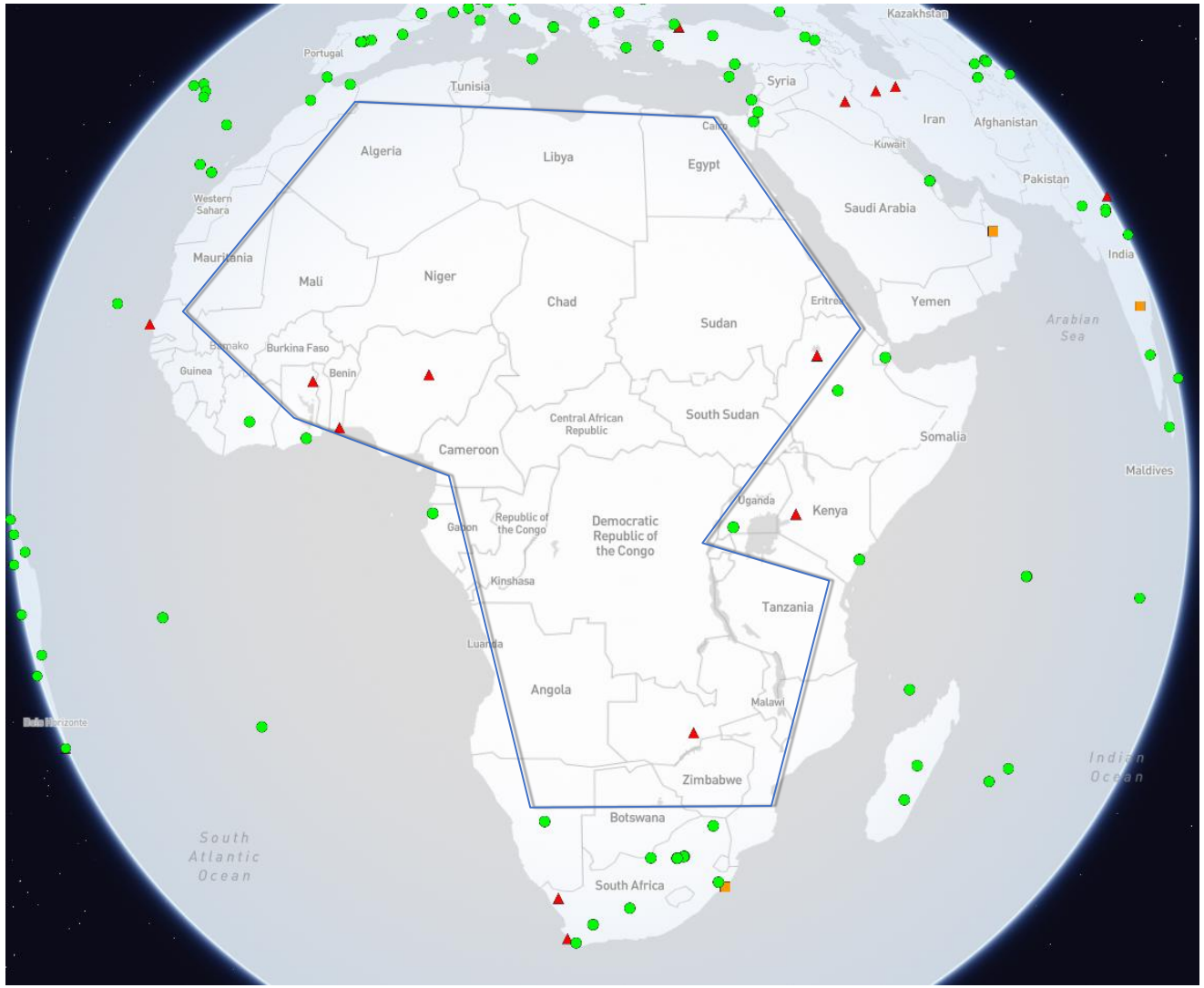
To explore all stations, visit https://network.igs.org.

**may not be up to date*



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.



* with recent data: 15 countries

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.

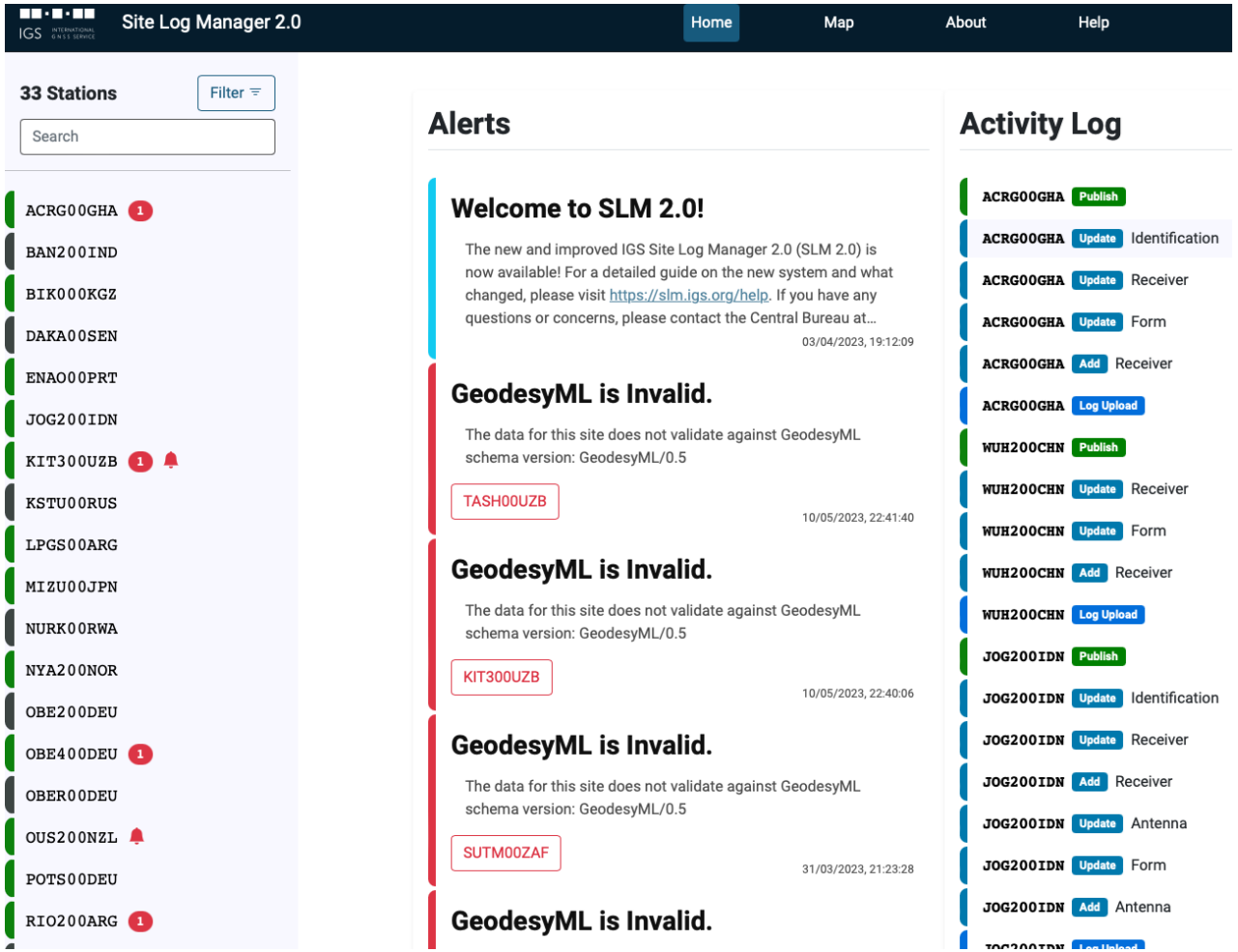
6 **Recognition and Visibility**: Gain recognition and visibility as a contributor to a globally known organization focused on Earth observation and positioning technologies.

Table of Contents

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.

https://files.igs.org/pub/resource/guidelines/Guidelines_for_Continuously_Operating_Reference_Stations_in_the_IGS_v1.0.pdf



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.

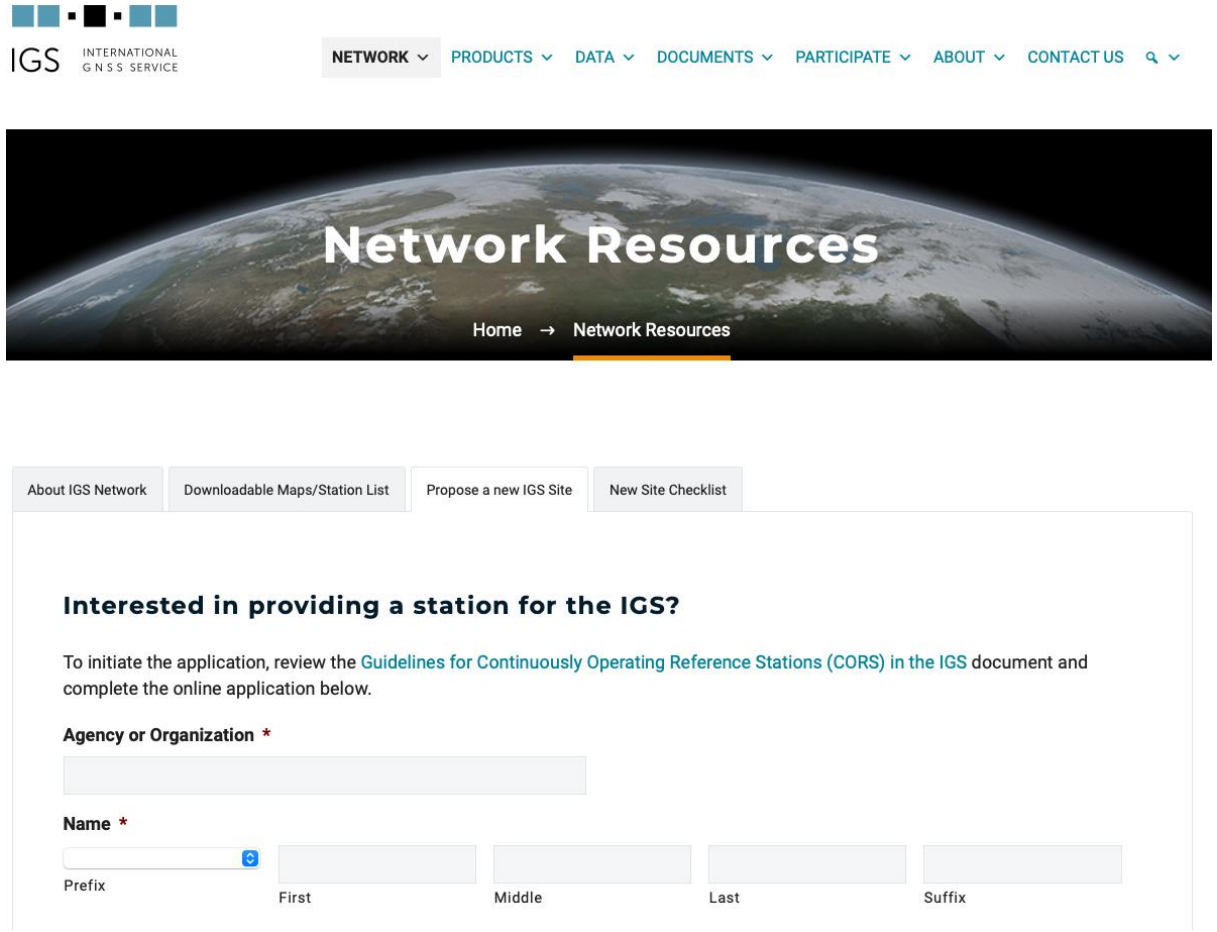
https://slm.igs.org/

IGS INTERNATIONAL GNSS SERVICE

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.



IGS INTERNATIONAL GNSS SERVICE

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 Associate Membership

What is an IGS Associate Member?

The Associate Members of the IGS are described in the terms of reference as "…persons representing organizations that participate in any of the IGS components. The membership is balanced with respect to IGS components, organizational representation and geography, and is meant to represent institutions which contribute significantly to the IGS on a continuous basis"

Visit IGS Associate Membership Guidelines to learn more.

https://igs.org/am/

STRONGER.
TOGETHER.

Webinar: Tour de l'IGS - Spotlight on Africa - 04 June 2025

igs.org

7th Stop: Spotlight on Africa 6th Stop: Galileo Constellation Spotlight 5th Stop: GNSS for Natural Hazards 4th Stop: BDS Constellation Spotlight

3rd Stop: GNSS processing 2nd Stop: Infrastructure 1st Stop: Repro3

IGS INTERNATIONAL GNSS SERVICE

Tour de l'IGS 7th Stop: Spotlight on Africa

04 June 2025, 1200-1520 UTC

This 7th stop focuses on the African continent.

Virtual Organising Committee: Fernand Balé (Bureau National d'Etudes Techniques et de Développement, Côte d'Ivoire) and Babatunde Rabiu (National Space Research and Development Agency, Nigeria).

Registration: https://forms.gle/A5nyo8g9sjUDog3D9.

Time (UTC)	Speaker	Institution	Title
1200-1210	Fernand Balé; Babatunde Rabiu; Allison Craddock	Bureau National d'Etudes Techniques et de Développement, Côte d'Ivoire; National Space Research and Development Agency, Nigeria; NASA Jet Propulsion Laboratory & International GNSS Service Central Bureau, USA	Welcoming Remarks
1210-1230	Aslam Parker	South African Mapping Authority, South Africa	The TrigNet CORS network
1230-1250	Oumar Ka	National Mapping Agency, ANAT, Senegal	Modernizing Geodetic Infrastructure in Senegal: Operational GNSS Initiatives and Perspectives
1250-1310	Olusegun Jonah	SRI International, USA	Need for a Continuous Network of GNSS Receivers in Equatorial and Low-Latitude

STRONGER.
TOGETHER.

International Federation of Surveyors
Fédération Internationale des Géomètres
International Vereinigung der Vermessungsingenieure

F.I.G. – A Partner to UN-GGCE

Presentation to UN-GGCE Geodesy Capability Development Workshop 2025

UN-GGIM
UNITED NATIONS
COMMITTEE OF EXPERTS ON
GLOBAL GEOSPATIAL
INFORMATION MANAGEMENT

UN-GGCE
United Nations
Global Geodetic
Centre of Excellence

April 2025

Ryan Keenan – Chair, FIG Commission 5 Positioning & Measurement
Member, Task Force International Trends; Member, Asia Pacific CDN

WHO

Who is F.I.G.?

International Federation of Surveyors
Fédération Internationale des Géomètres
International Vereinigung der Vermessungsingenieure

FIG – the global umbrella organisation for Surveyors

- Established in 1878 in Paris
- Federation of national surveying associations and organisations
- Only international body representing all surveying disciplines
- UN-recognised Non-Governmental organisation (NGO) and non-profit organisation

FIG represents the interests of surveyors worldwide

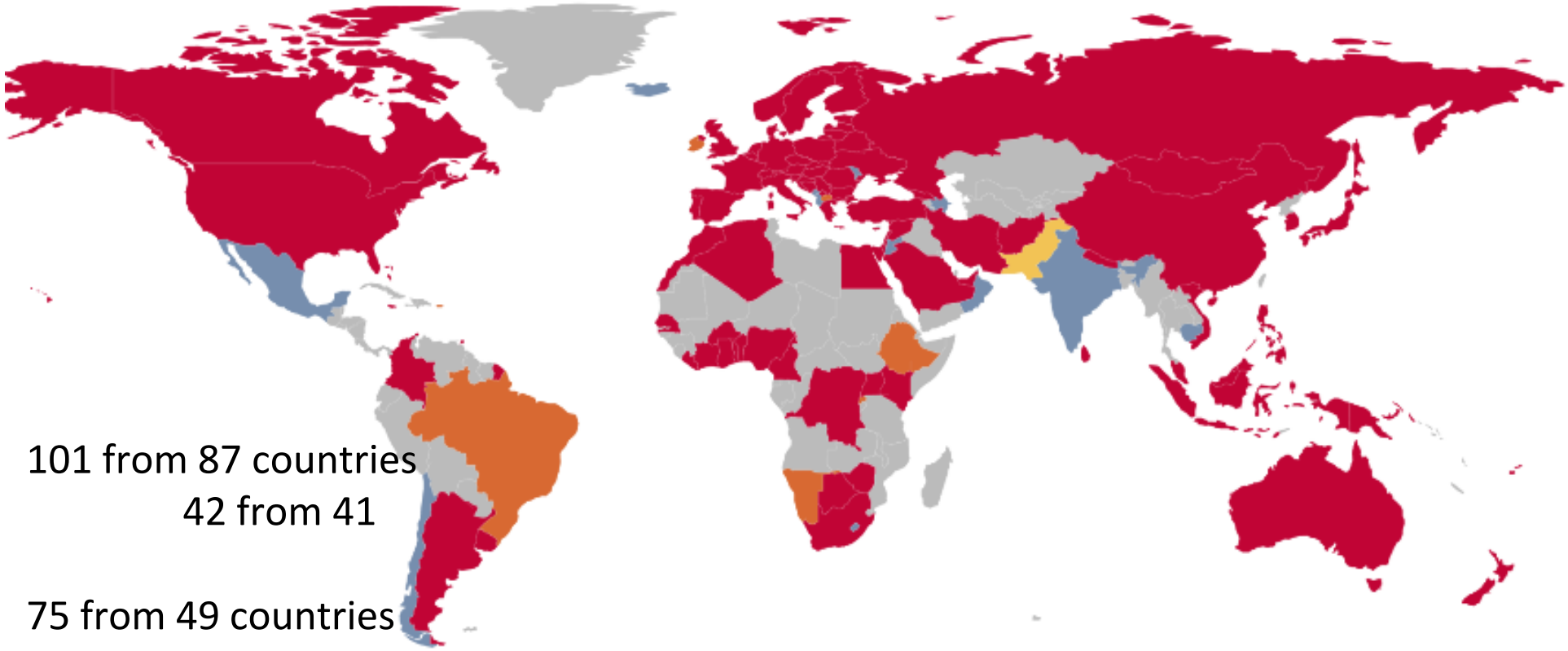
WHAT


Positioning
Building surveying
Surveying
Geo-information
Cadaster
Construction Surveying
Topographic Surveying
Mapping
Property surveying
Real Estate Management
Hydrography
Land Governance
Valuation
Engineer Surveying
Quantity Surveying
Spatial Planning
Land Management
Geodesy
Marine

WHO

Who are the members of FIG?

Over 120 countries represented in 2022 – more than 300,000 individuals

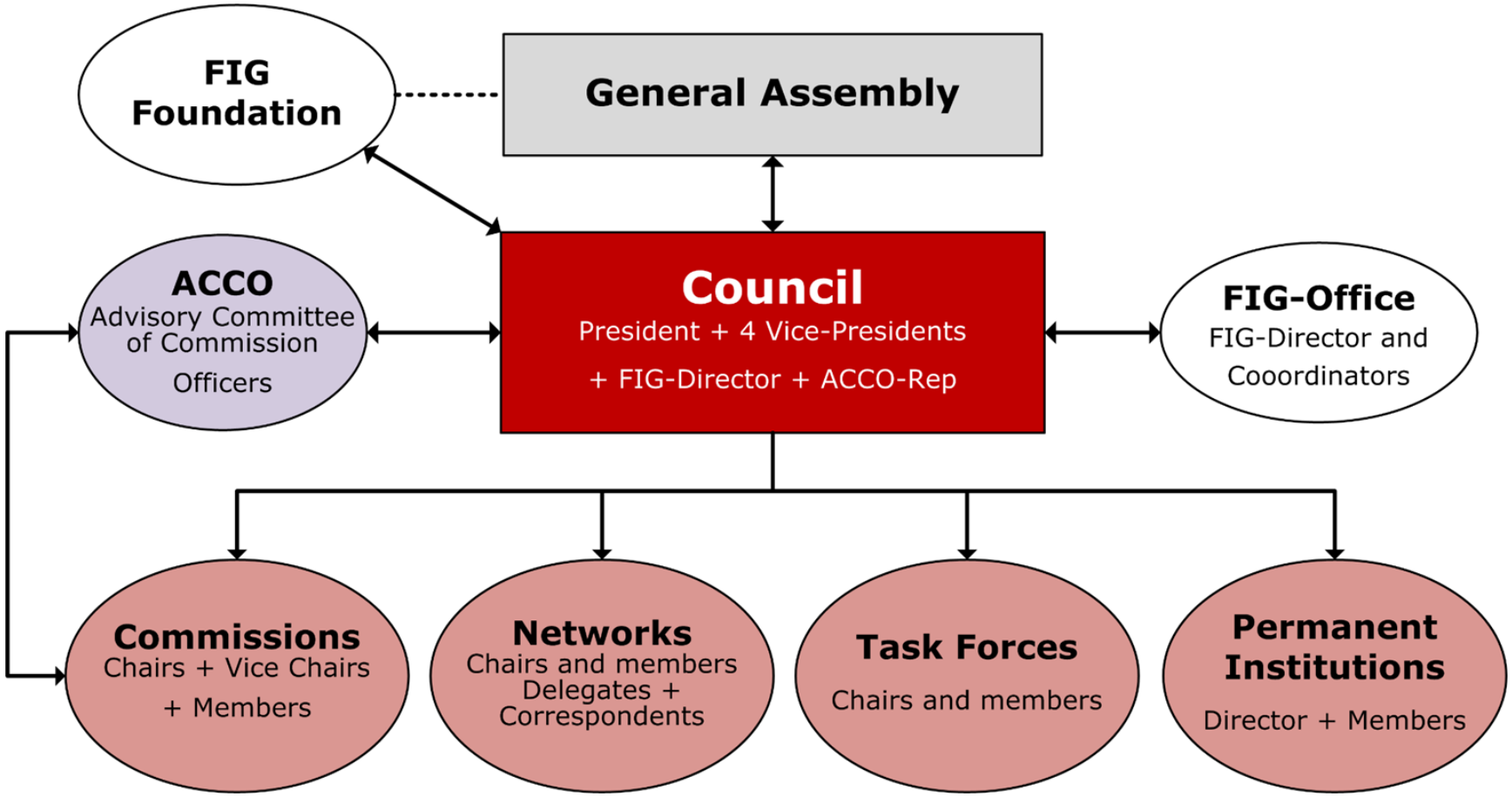


Membership categories:

- Member associations 101 from 87 countries
- Affiliate members 42 from 41 countries
- Academic members 75 from 49 countries
- Corporate members 20
- Correspondents 5
- Honorary presidents 8
- Honorary members 31
- Honorary ambassadors 2

HOW

How is FIG organized ?



- 10 Commissions
- Young Surveyors
- Standards
- Regional Development (Africa, Asia/Pacific, Americas)
- FIG and the SDGs
- Diversity – next generation
- Geospatial trends
- Climate Compass
- History
- OICRF

HOW

Commission 4:

Hydrography

- Hydrographic Standards and Guidelines(WG 4.1)
- Sustainable Oceans and Hydrography (WG 4.2)
- Mapping the Plastic (WG 4.3)
- Hydrospatial Domain and Marine Administration(WG 4.4)
- Climate Change Induced Sea Level Rice and Adaptation (WG 4.5)

Commission 5:

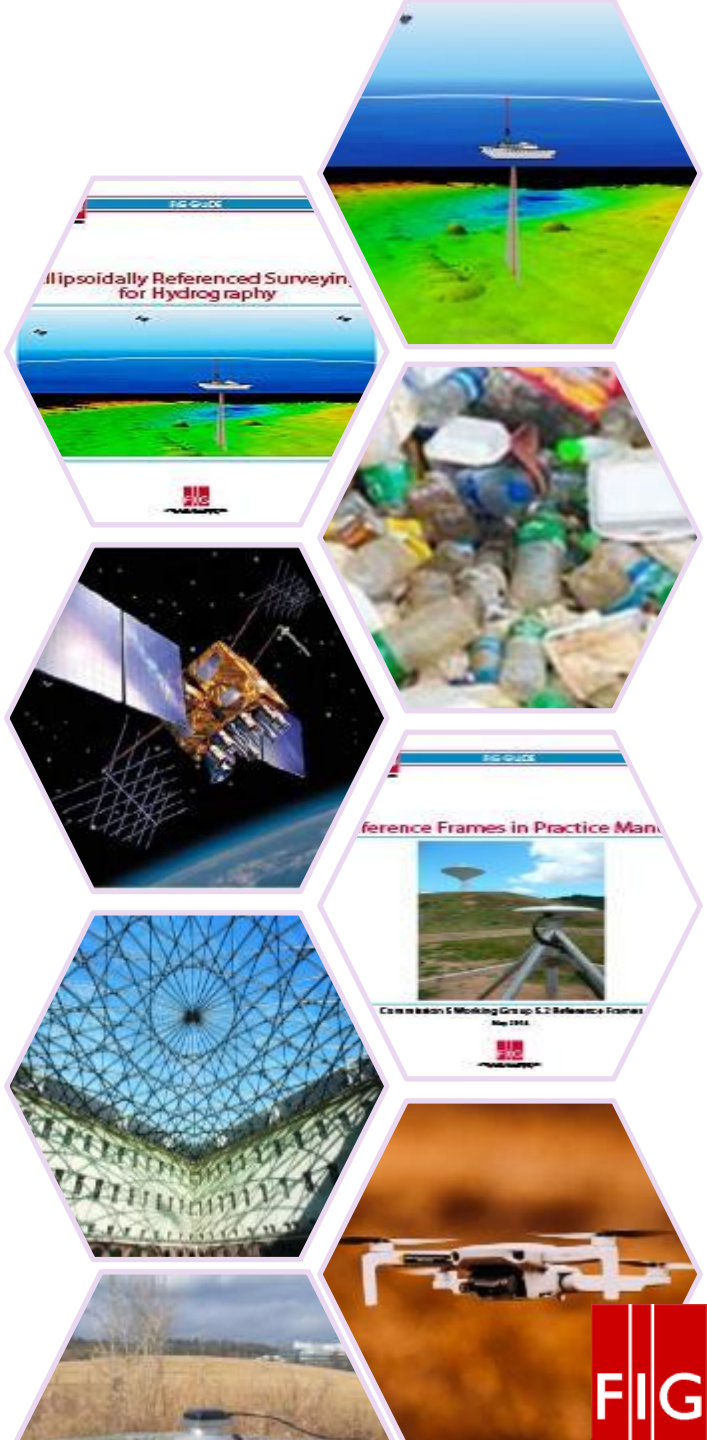
Positioning and Measurement

- Standards, Quality Assurance and Calibration (WG 5.1)
- 3D Reference Frames (WG 5.2)
- Vertical Reference Frames (WG 5.3)
- GNSS (WG 5.4)
- Multi-Sensor-Systems (WG 5.5)
- Cost Effective Positioning (WG5.6)
- Resilient PNT (WG5.7)

Commission 6:

Engineering Surveys

- Deformation Monitoring and Analysis (WG 6.1)
- Dynamic Structural Monitoring(WG 6.2)
- Applications of immersive technologies in Engineering Geodesy (WG 6.3)
- Engineering Surveying Outreach (WG 6.4)



HOW

Task Forces

Current topics that need research and to advise on matters of an administrative or of a general policy nature.

Current Task Forces:

- FIG and the SDGs
- FIG Climate Compass Task Force
- The Role of FIG in International Trends and Future Geospatial Information Ecosystem
- The Surveyor's Profession: Evolutionary Diversity and Inclusion

FIG

HOW

FIG FOUNDATION

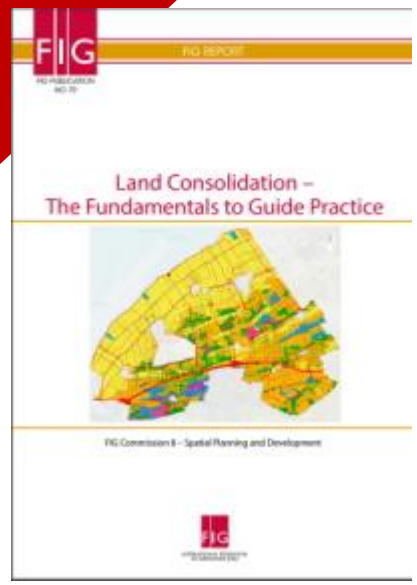
- Building a Sustainable Future

THE FIG FOUNDATION

The FIG Foundation raises funds to secure a sustainable future for surveyors. Donations finance educational and capacity building projects and scholarships, especially in developing countries and countries in transition, and encourage research into all disciplines of surveying and help disseminate the results of that research.

WHAT

PUBLICATIONS



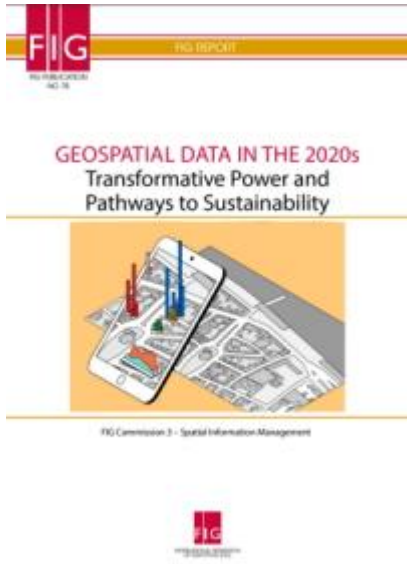


FIG Publication Series – 81 Publications

Conference Proceedings

FIG Peer Review Journal

Annual Review

Three millennia of Measurement on Earth – Special edition
35 years of research – 3,000 pages – over 350 illustrations

Food and Agriculture Organization of the United Nations
UNECE
FIG

Publications with partners

Web site

Special sites

https://www.fig.net/resources/publications/index.asp

FIG WORKING WEEK 2025
AND Locate25 THE NATIONAL GEOSPATIAL CONFERENCE
FIG Geospatial Council of Australia
Collaboration, Innovation and Resilience: Championing a Digital Generation
Brisbane, Australia 6–10 April

Commission 5 Positioning and Measurement

FIG Commission 5
Positioning and Measurement

Ryan Keenan
Chair (2023-2026)

5 days, 1 pre-event, 7 sessions,
~55 presentations, ~670 attendees,
1000s of great memories yet ONE vision..

Positioning and Measurement Technologies: Answering the Question of Where

Working Groups

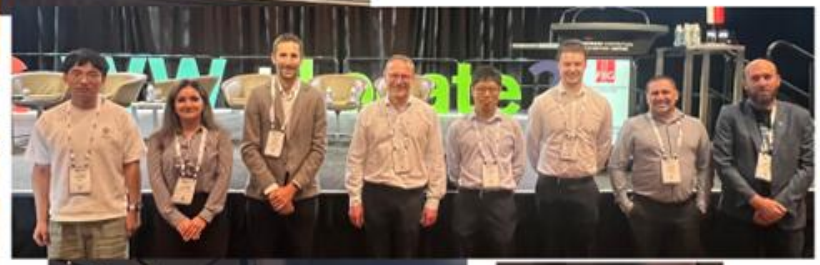
- 5.1 **Standards**
- 5.2 **3D Reference Frames**
- 5.3 **Vertical Reference Frames** *(with Comm 4)*
- 5.4 **GNSS**
- 5.5 **Multi-Sensor Systems** *(with Comm 6 / IAG)*
- 5.6 **Cost-effective Positioning**
- 5.7 **Emerging Technologies for PNT** *(with IAG)*

FIG Commission 5
Positioning and Measurement

Progress through Partnerships. Within FIG and beyond. Together.

Asia/Pacific
(AP-CPD)

- **SIDS with Asia Pacific CDN**



Pacific Community
Communauté du Pacifique

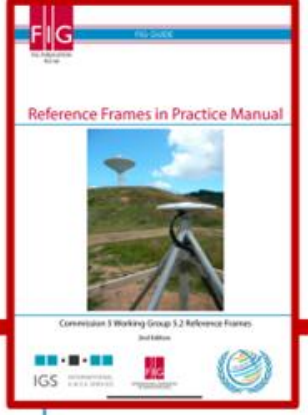
IGS INTERNATIONAL GNSS SERVICE

Australian Government
Geoscience Australia

Toitū Te Whenua
Land Information New Zealand

Strengthening the Global Geodetic Reference Frame for Everyone. Together.

FIG Commission 5
Positioning and Measurement



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United Nations Global Geodetic Centre of Excellence

64 attendees, 22 countries, 5 continents including 3 funded attendees ->
- Nepal, Iran and Sri Lanka

Pacific Community
Communauté du Pacifique

International Committee on Global Navigation Satellite Systems
ICG

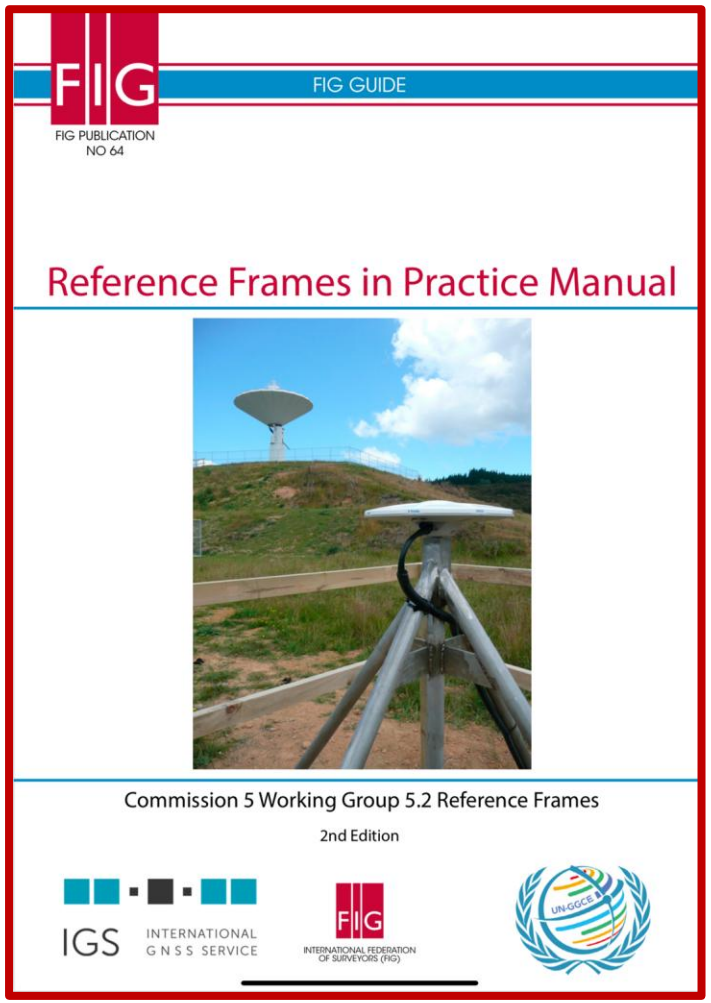
Trimble

Australian Government
Geoscience Australia

Toitū Te Whenua
Land Information New Zealand

IAG

FIG Publication – RFIP Manual Ed.2 Update



- The 2024 update to the 2014 edition (Publication #64) was completed
- Including:
  - New Contributions from IGS and UN-GGCE
  - Updates on Global Geodesy Initiatives, and GNSS Constellations
- Announced at WW24 Accra during RFIP
  - Digital PDF available in English
  - Hardcopy & additional languages considered

https://fig.net/resources/publications/figpub/pub64/Figpub64.pdf

Upcoming Events (www.fig.net/events/index.asp)

FIG Commission 5
Positioning and Measurement

FIG WW2028 Paris, France
150th Anniversary

International Committee on GNSS (ICG)

Recent Developments

UNITED NATIONS
Office for Outer Space Affairs

https://www.unoosa.org/oosa/en/ourwork/icg/icg.html

18th Meeting of ICG

Annual Meeting of GNSS Providers

https://www.unoosa.org/oosa/en/ourwork/icg/meetings/ICG-2024.html

Hosted by Australia and New Zealand

6 – 11 October 2024, Wellington, New Zealand

	AM		PM	
Sunday 6 October			1st Providers' Forum Meeting (chaired by the United States)	Meeting with the Working Groups Co-chairs
Monday 7 October	1st Plenary Session of ICG - Welcome Remarks - GNSS Systems Updates	Lunch Break	Presentations by Members, Associate Members, Observers, Invited observers, etc. on matters of interest to ICG	Experts Seminar
				Welcome Reception
Tuesday 8 October	(in parallel) Working Groups Meetings		(in parallel) Working Groups Meetings (Continued)	
Wednesday 9 October	(in parallel) Working Groups Meetings (Continued)		Technical Tour	
Thursday 10 October	(in parallel) Working Groups Meetings (Continued)		2nd Plenary session of ICG	2nd Providers' Forum Meeting (Chaired by the United States)
Friday 11 October	3rd Plenary Session of ICG			

Working Groups within ICG

- **Systems, Signals and Services** (*United States & Russian Federation*): Compatibility and spectrum protection; interoperability and service standards; system-of-system operations

- **Enhancement of GNSS Performance, New Services and Capabilities** (*India, China & ESA*): Future & novel integrity solutions; implementation of interoperable GNSS Space Service Volume (SSV) examination of performance of atmospheric models, *establish dialogue with space weather*/RS communities and its evolution;

- **Information Dissemination and Capacity Building** (*UNOOSA*): Focused on education and training programmes, promoting GNSS for scientific exploration (incl., *space weather and its effects on GNSS*)

- **Reference Frames, Timing and Applications** (*IAG, IGS & FIG*): Focused on monitoring and reference station networks

https://www.unoosa.org/oosa/en/ourwork/icg/working-groups.html

Geodesy-relevant Task Force in ICG

Publication of a Policy Brief on the Uses of GNSS for Disaster Risk Reduction

The "Applications of GNSS for Disaster Risk Reduction" Task Force is exploring how GNSS technology can enhance disaster risk reduction strategies and bolster natural hazard early warning systems. Currently, TF focuses on four GNSS-based techniques, which have broad applications, spanning for instance earthquakes, tsunamis, floods and solar storms

- *Precise Point Positioning (GNSS-PPP)*
- *Reflectometry (GNSS-R)*
- *Radio Occultation (GNSS-RO)*
- *Ground based Total Electron Content (GNSS-TEC)*

- ❑ To publish the policy Brief on the Uses of GNSS for Disaster Risk Reduction
- ❑ Website: https://www.unoosa.org/oosa/en/ourwork/icg/working-groups/d.html
- ❑ Templates on Geodetic and Timing References: https://www.unoosa.org/oosa/en/ourwork/icg/resources/Regl-ref.html

Summary - International Geodesy Initiatives & Partners

An understanding of the various Organisations featuring geodesy

International Geodesy Initiatives

- IUGG, IAG, IGS, GGOS

Partnerships

- FIG, UN-ICG

Volunteer organisations contribute significantly to Geodesy activities

- typically contributing with ‘in kind' efforts (***unpaid volunteers***)
- supporting one another (typically larger) initiatives and organisations
- **Building capabilities to develop capacity**

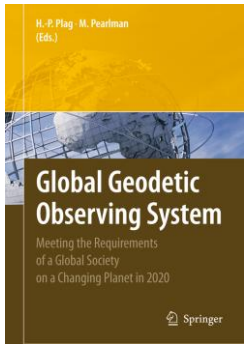
Given the importance of humans within the Global Geodesy Supply Chain, their continued efforts are critical for sustainable geodesy

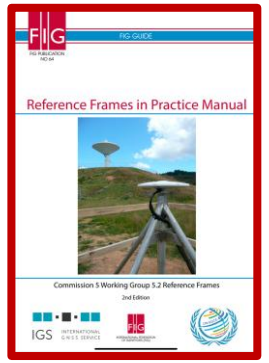
- Recommendations for participants to get involved

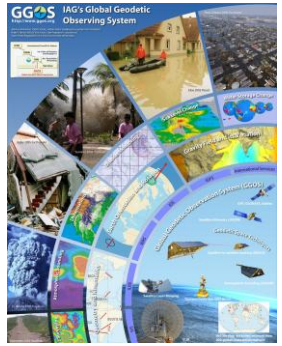
Q&A around these Initiatives and Partnerships

STRONGER.
TOGETHER.

Further Activities







- Check out Websites
  (with resources, publications, videos)
- Review Publications IGS CORS Guidelines, FIG RFIP Manual
- Consider joining organisations, initiatives, WGs, commissions, networks and events
  - Become a GGOS Affiliate
  - Become an IGS Associate Member
- Get involved with FIG as Member (academic, commission, network etc)
- Share your data!

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TOGETHER.