



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 3, Session 3 [3_3_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

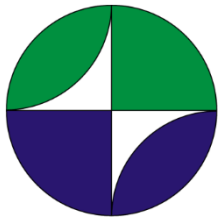
To provide participants with overview:

- 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



**STRONGER.
TOGETHER.**



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

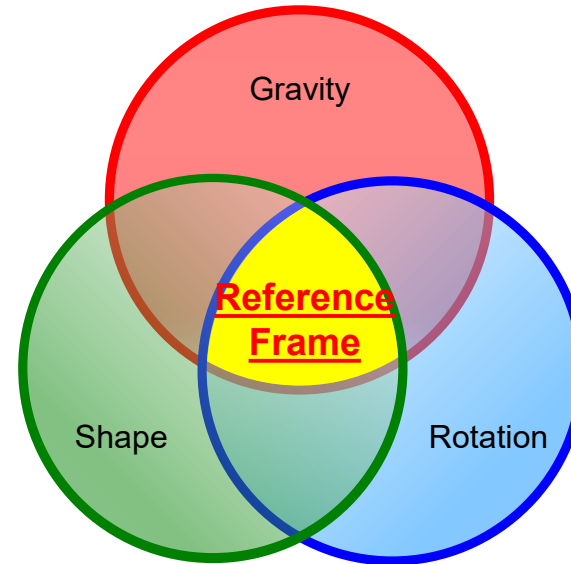


Deutsche
Forschungsgemeinschaft
German Research Foundation

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

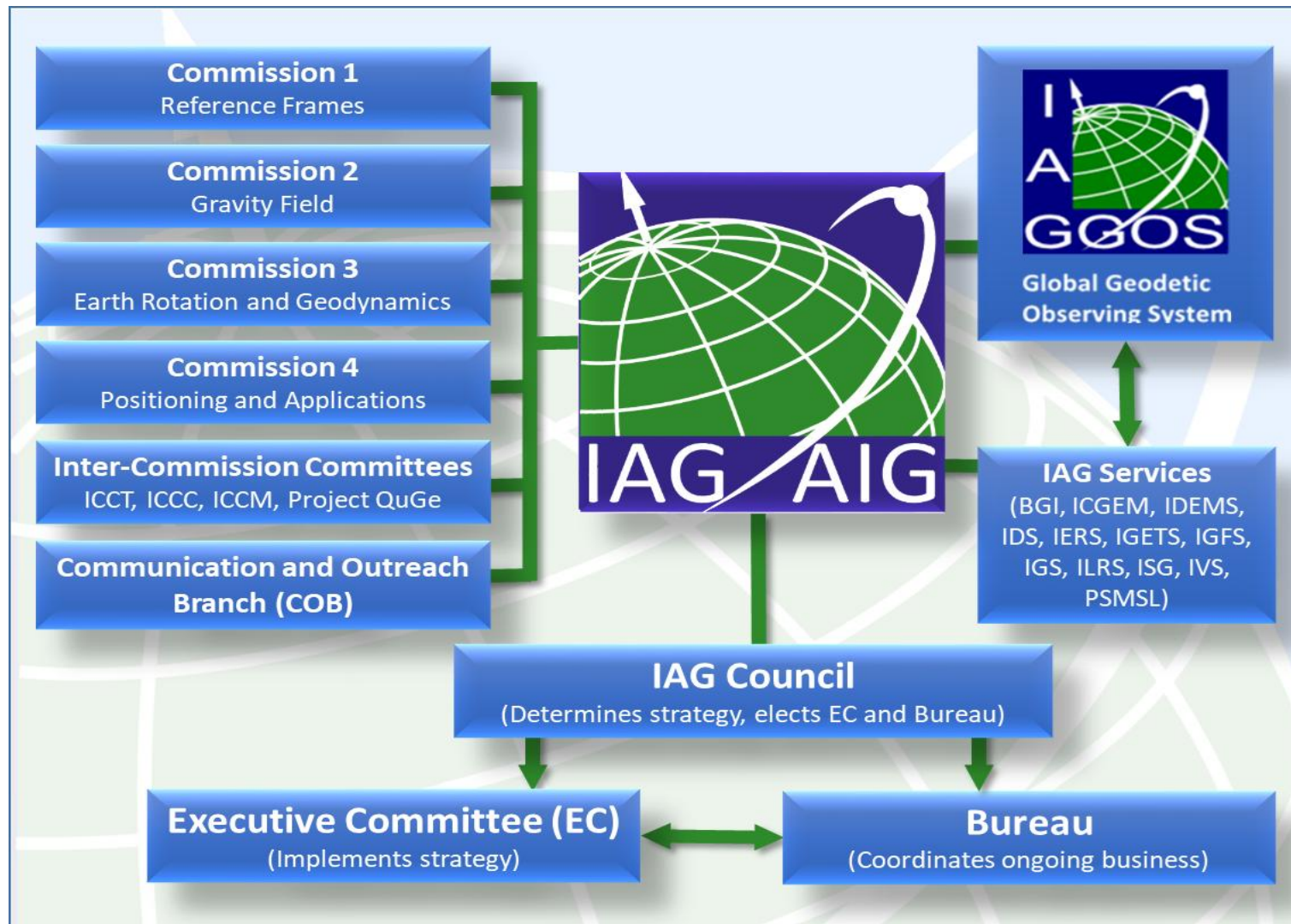
- Geometric shape
- Rotation and orientation in space
- Gravity field



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

International Association of Geodesy

Organizational Structure



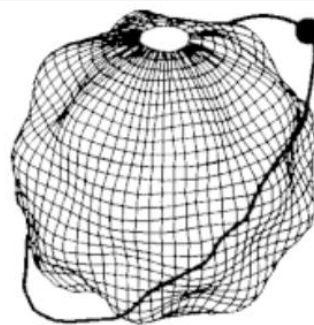
- 4 Commissions
 - 3 Inter-Commission Committees
 - 1 Project
 - **GGOS Global Geodetic Observing System**
 - 12 Services
 - **Communication and Outreach Branch**
-
- Council
 - Executive Committee
 - Bureau
 - Office

Geometric & General Services



source: ggoss.org

Gravity Services



ISG



Bureau Gravimétrique International
International Gravimetric Bureau

Global Geodetic Observing System

The Global Geodetic Observing System (GGOS)

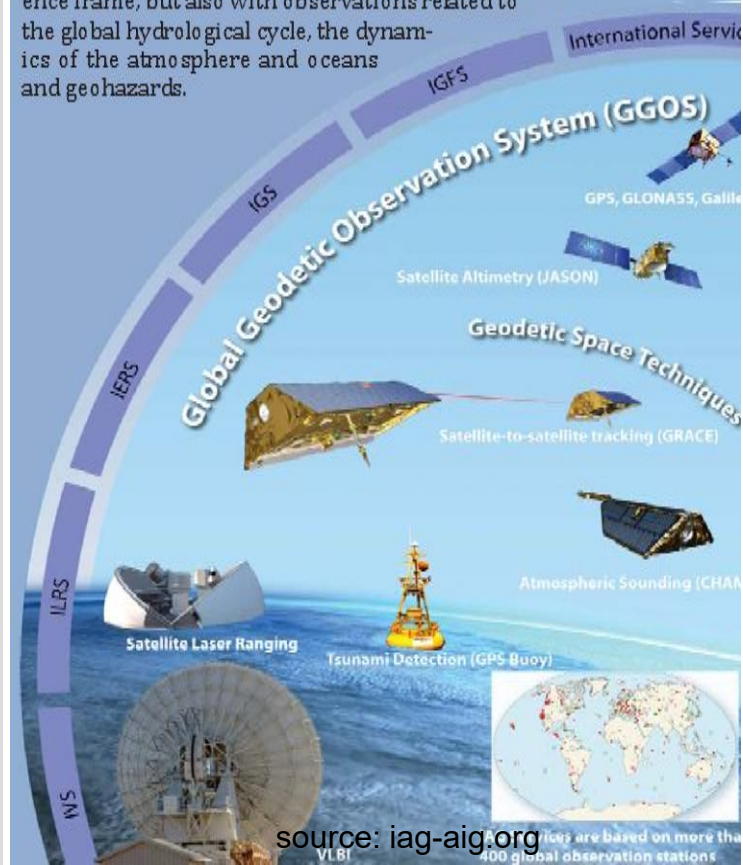
URL: <http://www.ggos.org>



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

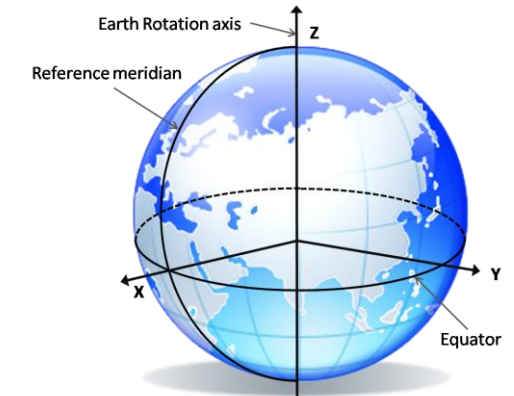
Terrestrial Reference Frame (TRF)



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

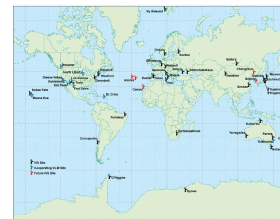
- The GNSS, SLR, VLBI & DORIS geodetic networks, along with ground surveys of stations at co-located sites to tie the networks together, provide the data for determining the TRF as well as for direct science investigations



GNSS



SLR



VLBI



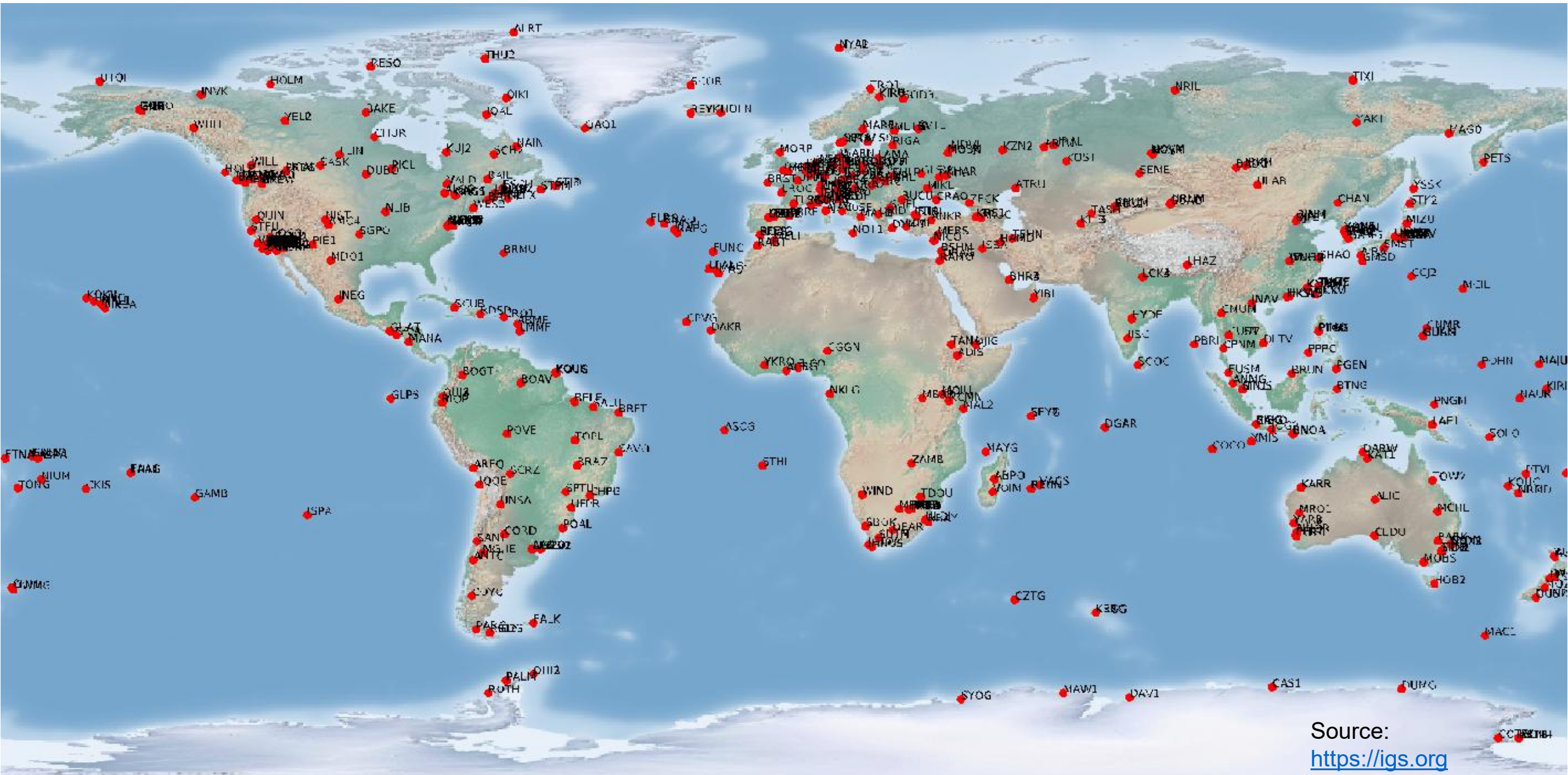
DORIS

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

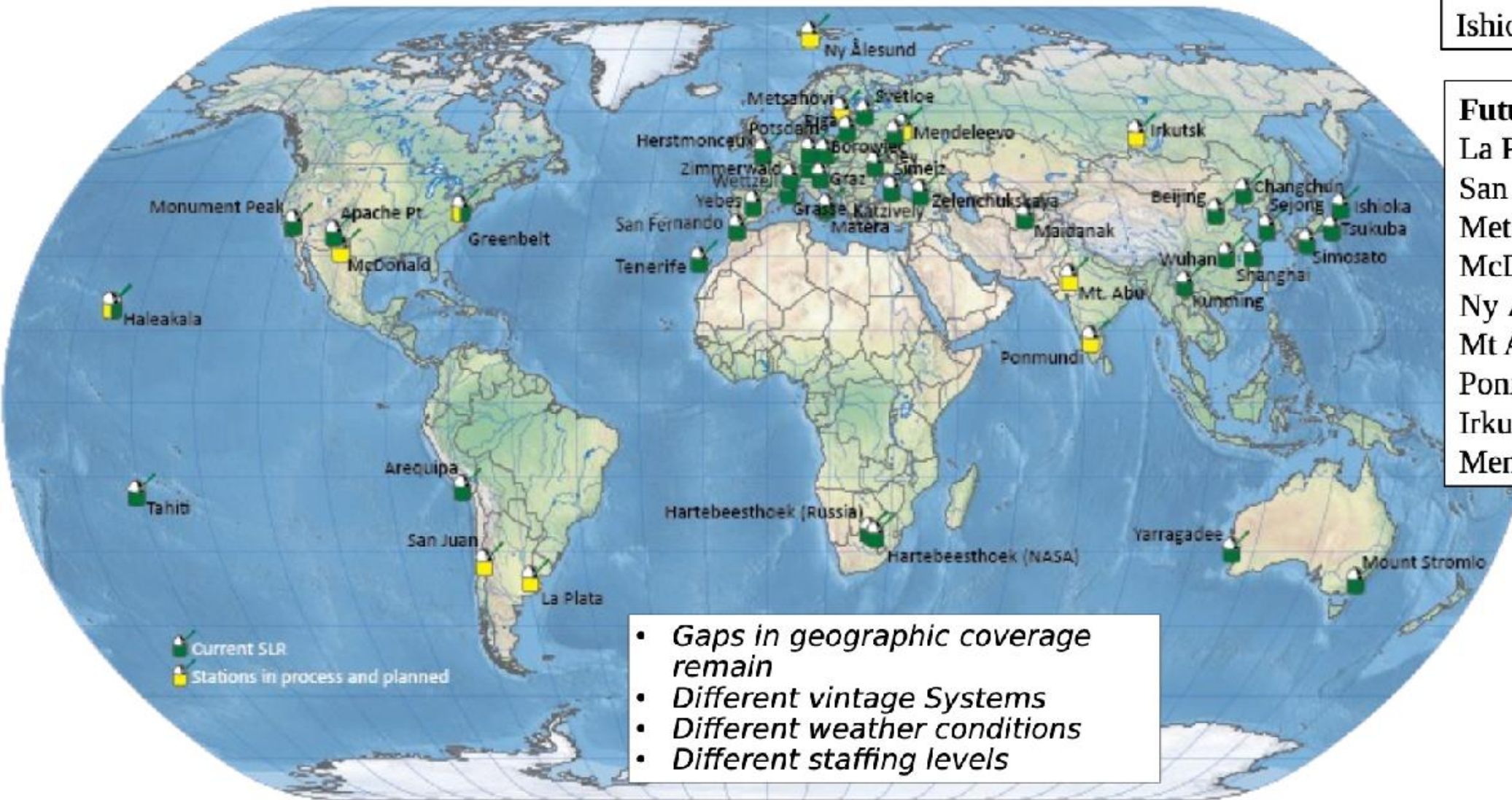
GGOS Goal: TRF accurate to better than 1 mm, stable to better than 0.1 mm/yr over a decade

International GNSS Service (IGS)



International Laser Ranging Service (ILRS)

Current and Planned ILRS Network



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

Ponmudi, India

Irkutsk (Tochka), Russia

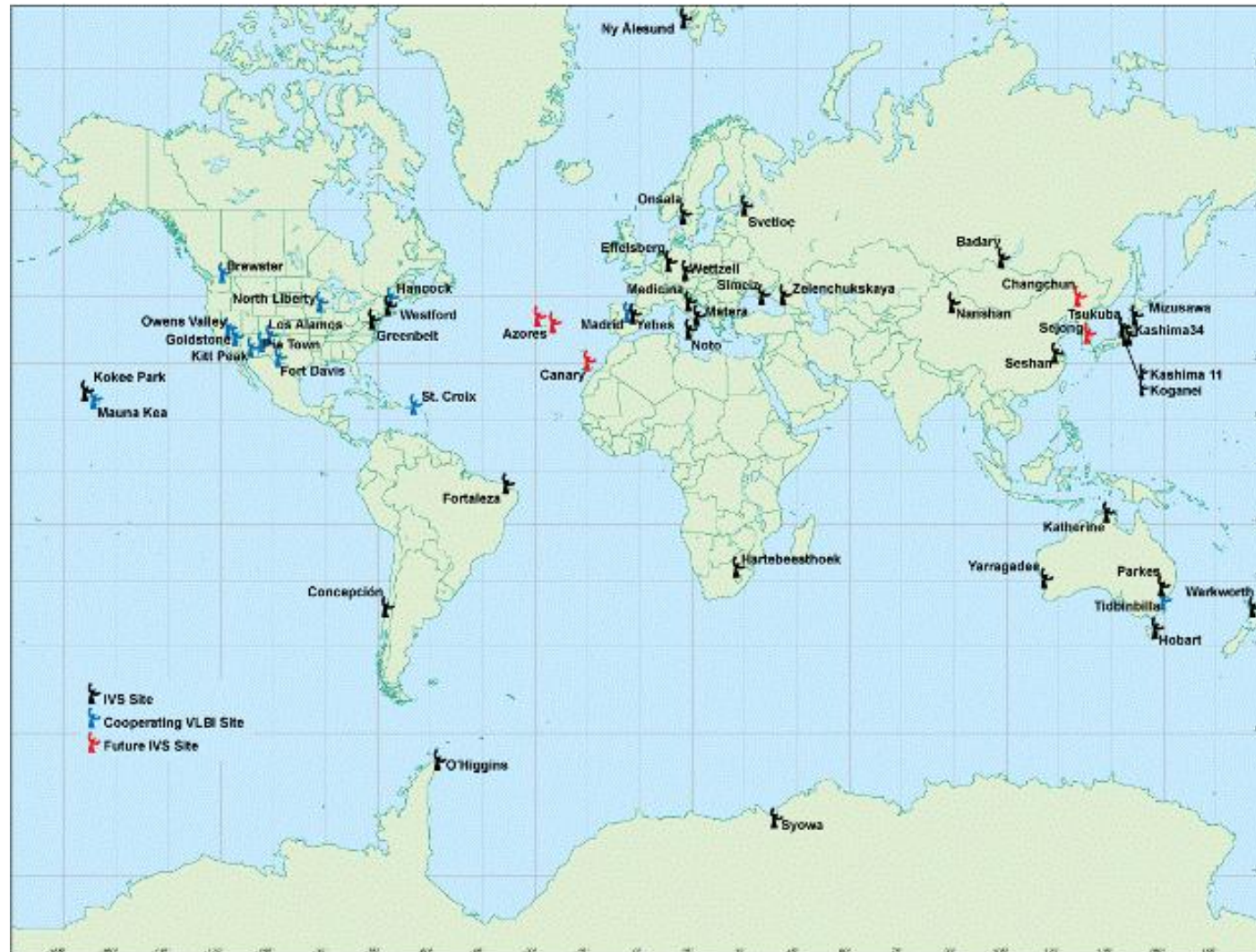
Mendeleevo (Tochka), Russia

- *Gaps in geographic coverage remain*
- *Different vintage Systems*
- *Different weather conditions*
- *Different staffing levels*

Source:

<https://ilrs.gsfc.nasa.gov>

International VLBI Service (IVS) for Geodesy and Astrometry



Source:
<https://ivsc.gsfc.nasa.gov>

International DORIS Service (IDS)



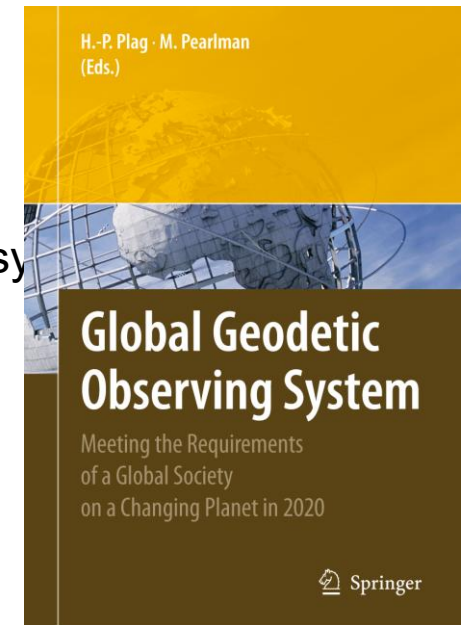
Source: <https://ids-doris.org>



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

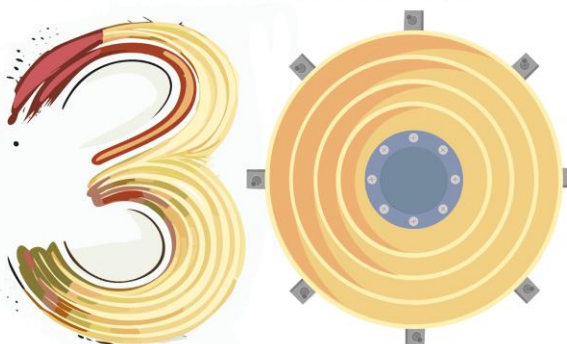


IGS Mission

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

CELEBRATING



YEARS OF IGS

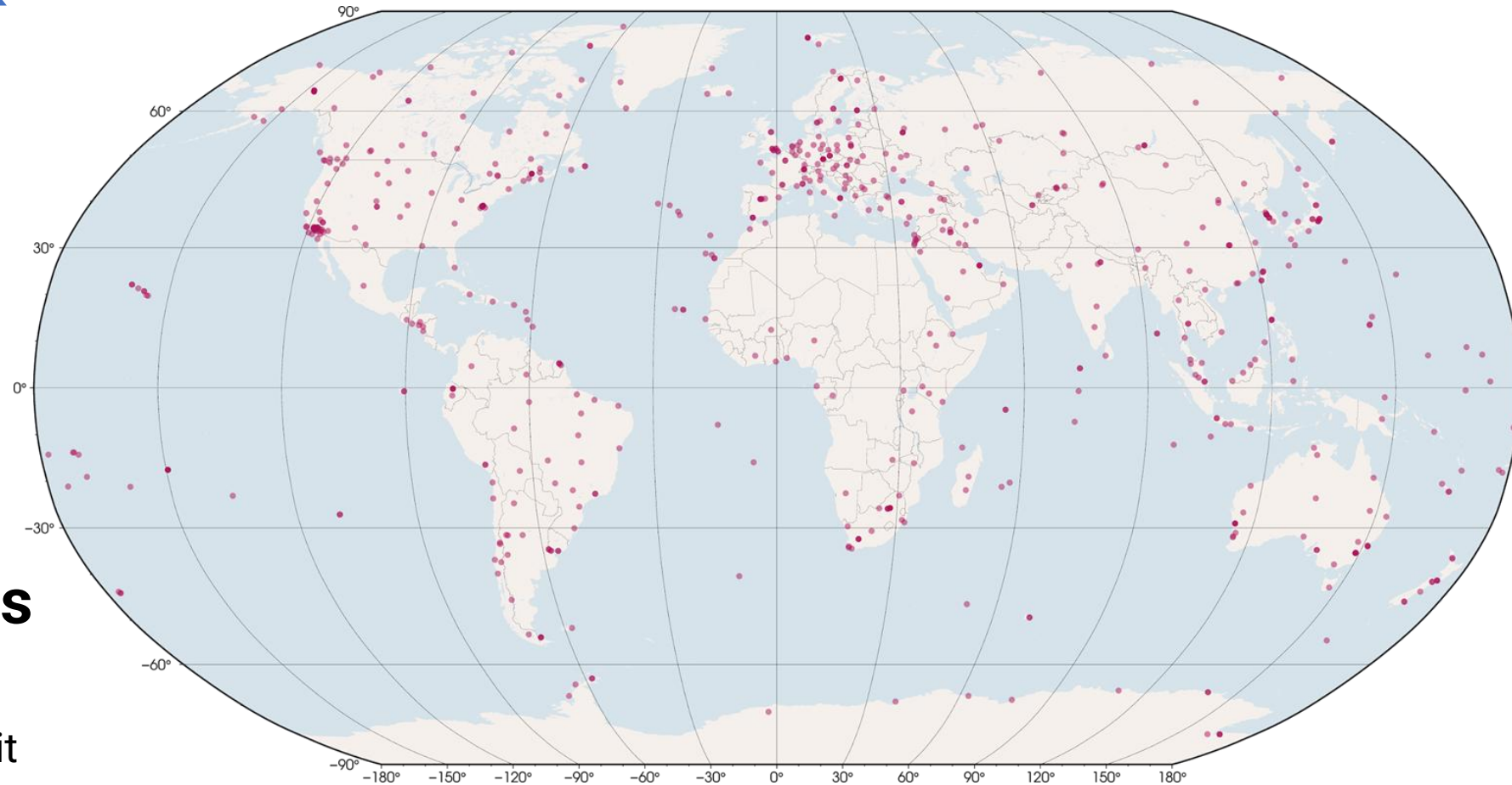
IGS Network

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.



Benefits of contributing to the IGS Network

1

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

4

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

2

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

5

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

3

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

6

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

■ ■ ■ ■ ■ ■ ■ ■ ■ ■	3
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CORS Guidelines

The “[Guidelines for Continuously Operating Reference Stations in the IGS](https://files.igs.org/pub/resource/guidelines/Guidelines_for_Continuously_Operating_Reference_Stations_in_the_IGS_v1.0.pdf)” is now available to assist station owners and operators in planning and maintaining CORS. Translations to other languages than English would be welcome.



Site Log Manager 2.0

HomeMapAboutHelp

33 Stations

Filter

Search

ACRG00GHA

1

BAN200IND

BIK000KGZ

DAKA00SEN

ENAO00PRT

JOG200IDN

KIT300UZH

1

KSTU00RUS

LPGS00ARG

MIZU00JPN

NURK00RWA

NYA200NOR

OBE200DEU

OBE400DEU

1

OBER00DEU

OUS200NZL

POTS00DEU

RIO200ARG

1

Alerts

Welcome to SLM 2.0!

The new and improved IGS Site Log Manager 2.0 (SLM 2.0) is now available! For a detailed guide on the new system and what changed, please visit <https://slm.igs.org/help>. If you have any questions or concerns, please contact the Central Bureau at...
03/04/2023, 19:12:09

GeodesyML is Invalid.

The data for this site does not validate against GeodesyML schema version: GeodesyML/0.5
TASH00UZH
10/05/2023, 22:41:40

GeodesyML is Invalid.

The data for this site does not validate against GeodesyML schema version: GeodesyML/0.5
KIT300UZH
10/05/2023, 22:40:06

GeodesyML is Invalid.

The data for this site does not validate against GeodesyML schema version: GeodesyML/0.5
SUTM00ZAF
31/03/2023, 21:23:28

GeodesyML is Invalid.

Activity Log

ACRG00GHA

Publish

ACRG00GHA

Update

Identification

ACRG00GHA

Update

Receiver

ACRG00GHA

Update

Form

ACRG00GHA

Add

Receiver

ACRG00GHA

Log Upload

WUH200CHN

Publish

WUH200CHN

Update

Receiver

WUH200CHN

Update

Form

WUH200CHN

Add

Receiver

WUH200CHN

Log Upload

JOG200IDN

Publish

JOG200IDN

Update

Identification

JOG200IDN

Update

Receiver

JOG200IDN

Add

Receiver

JOG200IDN

Update

Antenna

JOG200IDN

Update

Form

JOG200IDN

Add

Antenna

JOG200IDN

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.

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.

Network Resources

Home → Network Resources

[About IGS Network](#)[Downloadable Maps/Station List](#)[Propose a new IGS Site](#)[New Site Checklist](#)

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

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/>



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TOGETHER.**

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



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 Rabi (National Space Research and Development Agency, Nigeria).

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

Time (UTC)	Speaker	Institution	Title
1200-1210	Fernand Balé; Babatunde Rabi; 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 Africa: the GONGA Network



**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



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 is F.I.G.?

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

- 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 – the global umbrella
organisation for Surveyors*

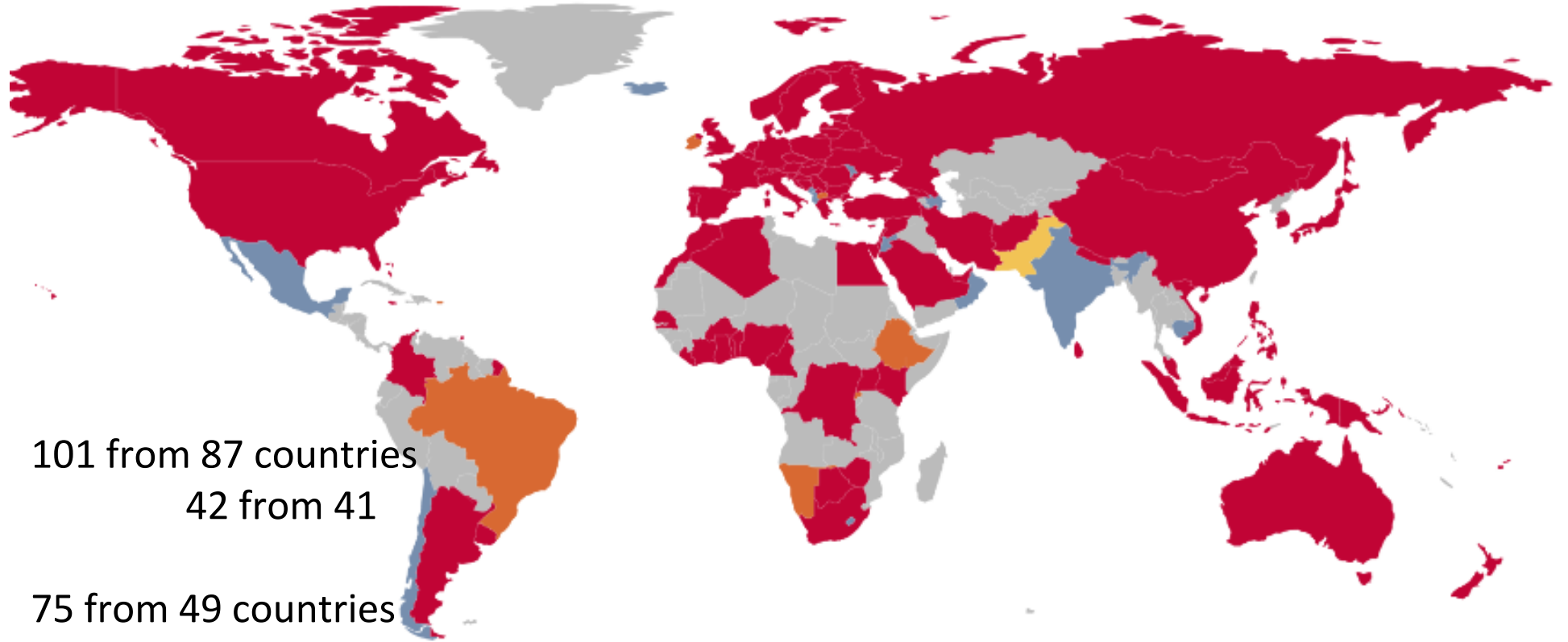
FIG represents the interests of surveyors worldwide

WHAT



Who are the members of FIG?

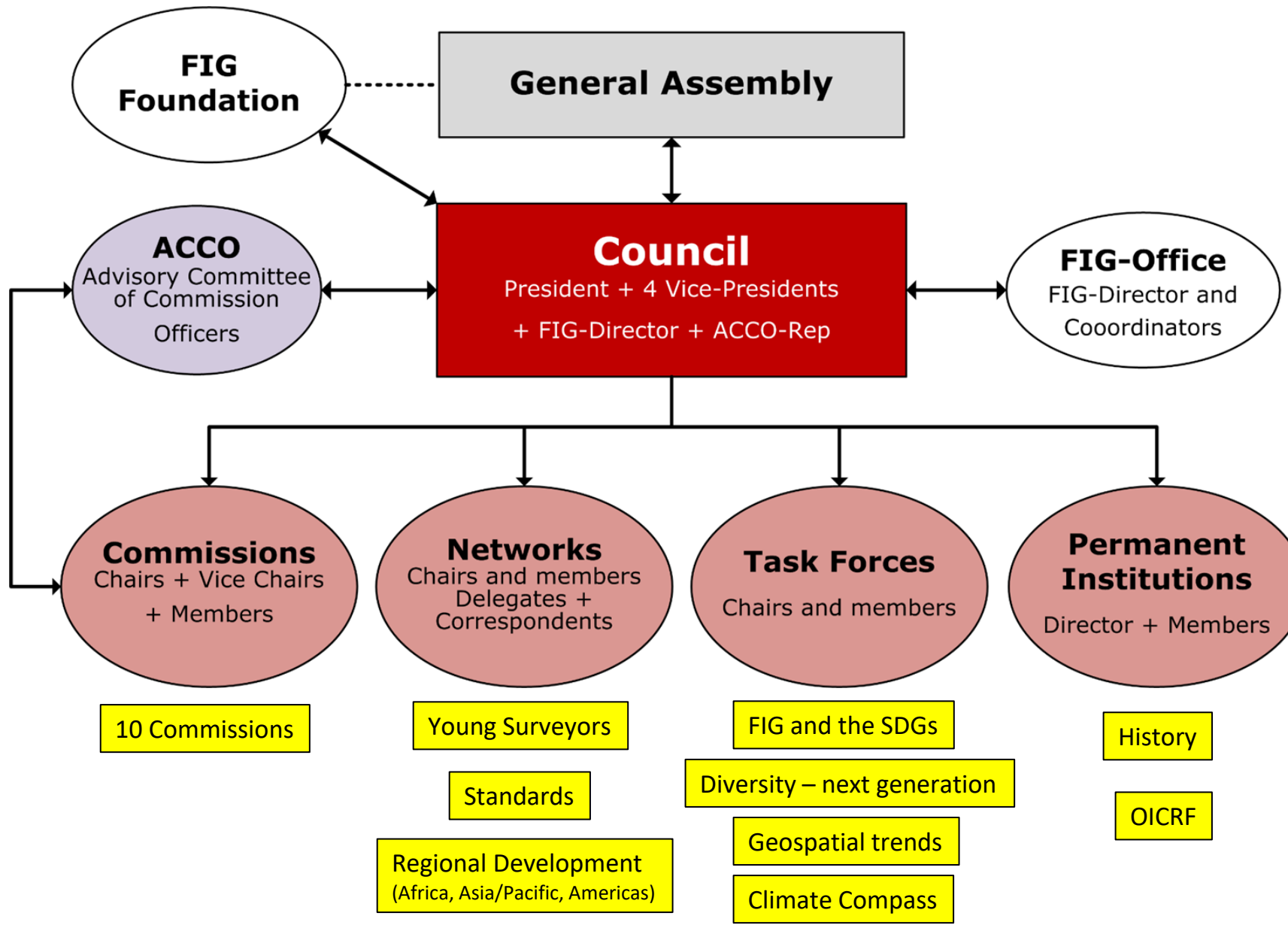
Over 120 countries represented in 2022 – more than 300,000 individuals



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 is **FIG** organized ?



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 Rise 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)



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



HOW

FIG FOUNDATION

- Building a Sustainable Future



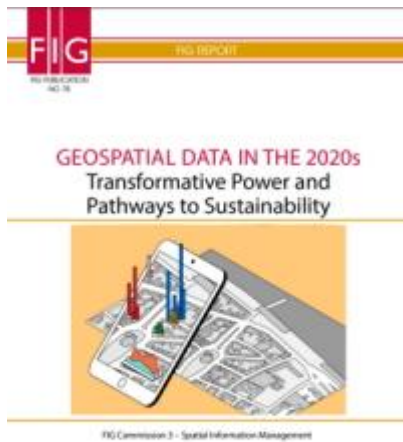
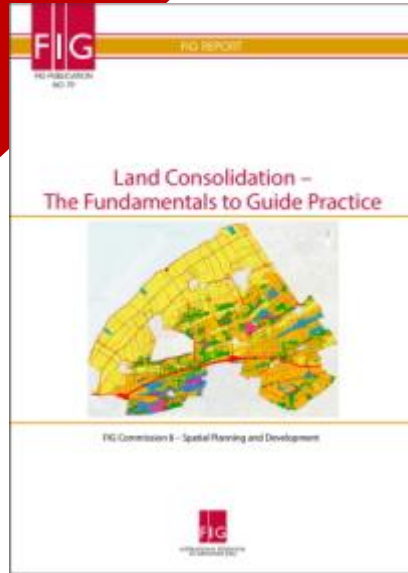
THE FIG
FOUNDATION

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



Conference Proceedings

FIG Peer Review Journal

Annual Review

FIG Publication Series – 81 Publications

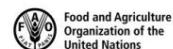


FIG Commissions and the Sustainable Development Goals

Below the relevant Sustainable Development Goals (SDGs), targets and indicators for each FIG Commission are mentioned. FIG members can contribute to the SDG's in two main ways. On the one hand they can create awareness and contribute to achieving the SDG's and the specific targets. On the other hand they can collect relevant data to contribute to the measurement of the targets by using the indicators.

To go directly to the individual Commissions SDG view, click on the links below:

- Commission 1 - Professional Standards and Practice
- Commission 2 - Professional Education
- Commission 3 - Spatial Information Management
- Commission 4 - Hydrography
- Commission 5 - Positioning and Measurement
- Commission 6 - Engineering Surveys
- Commission 7 - Cadastre and Land Management
- Commission 8 - Spatial Planning and Development
- Commission 9 - Valuation and the Management of Real Estate
- Commission 10 - Construction Economics and Management

Special sites

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

Publications with partners

Web site

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



Collaboration, Innovation and Resilience: Championing a Digital Generation

Brisbane, Australia 6–10 April



Commission 5 Positioning and Measurement



Ryan Keenan
Chair (2023-2026)



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)*

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

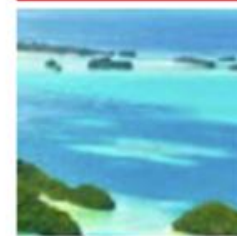


Positioning and Measurement Technologies: Answering the Question of Where



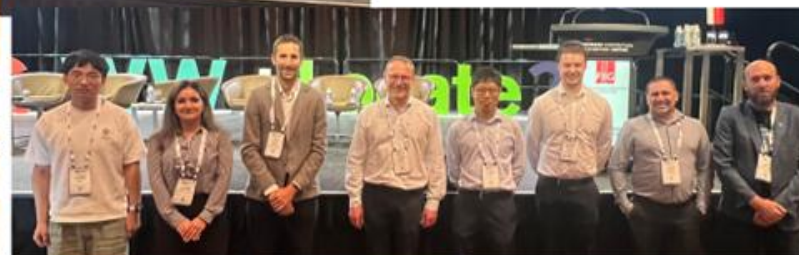
FIG Commission 5
Positioning and Measurement

Progress through Partnerships. Within FIG and beyond. Together.



Asia/Pacific
(AP-CPD)

SIDS with Asia Pacific CDN



Pacific Community
Communauté du Pacifique



Australian Government
Geoscience Australia



Toitū Te Whenua
Land Information
New Zealand



IGS
INTERNATIONAL
GNSS SERVICE



FIG Commission 5
Positioning and Measurement

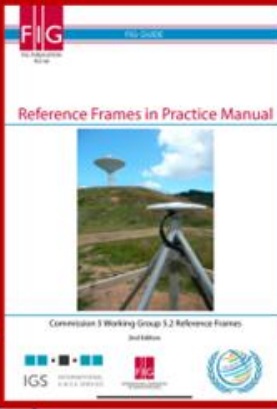
Strengthening the Global Geodetic Reference Frame for Everyone. Together.



IGS INTERNATIONAL
GNSS SERVICE



United Nations
Global Geodetic
Centre of Excellence



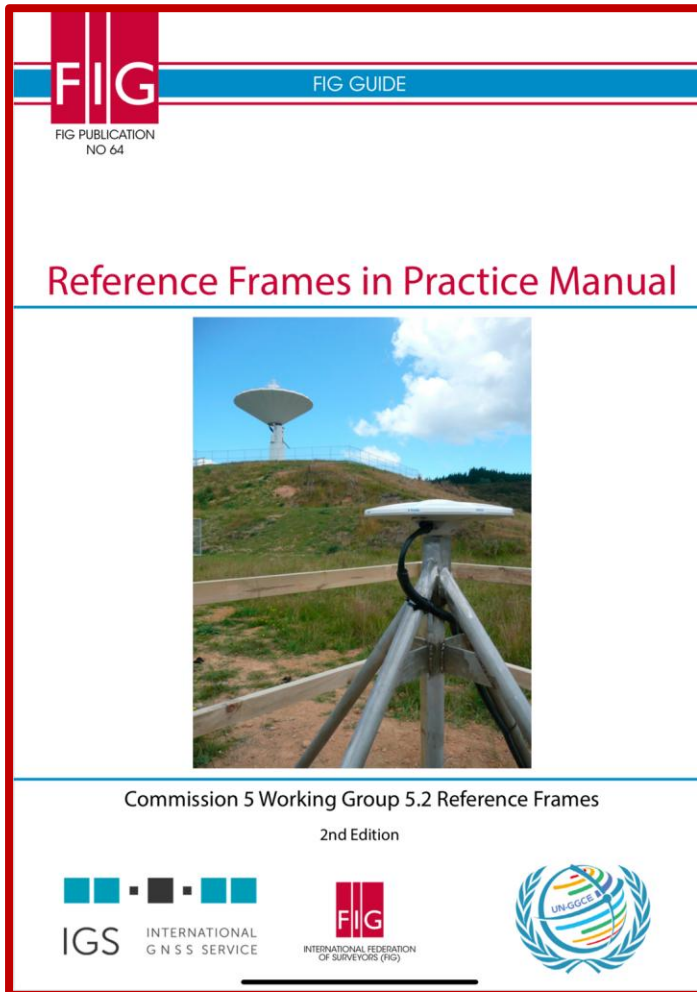
64 attendees, 22 countries, 5 continents including 3 funded attendees ->
- Nepal, Iran and Sri Lanka



Australian Government
Geoscience Australia



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 WW2028 Paris, France
150th Anniversary



International Committee on GNSS (ICG)



Recent Developments



UNITED NATIONS
Office for Outer Space Affairs

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			1 st Providers' Forum Meeting (chaired by the United States)	Meeting with the Working Groups Co-chairs
Monday 7 October	1 st 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
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)		2 nd Plenary session of ICG	2 nd Providers' Forum Meeting (Chaired by the United States)
Friday 11 October	3 rd 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

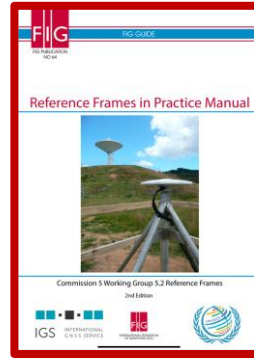
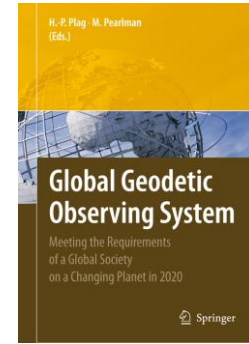


Q&A around these Initiatives and Partnerships

**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.**