International GNSS Service (IGS)

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Governing Board Vice-Chair: Elisabetta D'Anastasio (New Zealand)
Central Bureau Director: Allison B. Craddock (USA)
Central Bureau Deputy Director: Camille Martire (USA)

IGS website - https://www.igs.org

1 Introduction

In 2024, the International GNSS Service (IGS) marked 30 years of delivering high-quality, open and freely available geodetic and numerous other products as an operational service of the IAG. These products include GNSS satellite orbits, clock corrections, Earth rotation parameters, reference frame, ionospheric, tropospheric, and tide-gauge referencing contributions that support scientific and societal applications such as geodetic engineering, land surveying, geodynamic monitoring, weather forecasting, space weather monitoring, sea-level studies, and even orbit determination of low orbiting satellites, e.g., for Earth monitoring purposes. Over the decades, IGS has significantly reduced product latency, evolving from a two-week final solution to rapid (sub-daily), ultra-rapid (3-hour latency), as well as real-time services since 2013. These advancements are made possible by a global network of voluntary contributors committed to open data access, continuous quality improvement, and the expansion toward a full multi-GNSS service integrating all constellations and frequencies. The IGS is governed by an elected Governing Board (GB) that oversees strategy, sets policy, and ensures alignment with international geodetic efforts through active collaboration with the International Association of Geodesy (IAG), its Global Geodetic Observing System (GGOS), the International Committee on GNSS (ICG, managed by the United Nations Office for Outer Space Affairs), the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), and the recently established United Nations Global Geodetic Center of Excellence (UN-GGCE). Following a period of remote operations during the global pandemic, the GB has resumed annual in-person meetings aligned with major scientific events. The 30th anniversary was celebrated at the IGS Symposium and Workshop held in Bern, Switzerland in July 2024, reaffirming the service's commitment to

global cooperation, scientific excellence, and sustainable geodetic infrastructure. While this Chapter gives a short overview of the IGS' latest and most important progress, the IGS' official and most complete updates can be found detailed in the IGS's Technical Reports (https://files.igs.org/pub/resource/technical_reports/).

Fig. 1. "IGS at Glance", showcasing the key numbers describing the IGS, as of May 2025. See also the IGS website, at https://igs.org.

2 Governance and Membership

The IGS membership comprises the Governing Board (GB), the Central Bureau (CB), and over 250 Associate Members representing 46 countries and regions. The GB, consisting of 44 members, provides strategic leadership for the IGS by setting policies, monitoring progress, guiding activities across IGS components, and aligning the IGS' objectives to its strategic implementation plan. GB members are elected by the Associate Members, who represent the most broadly active and involved group of contributors to the IGS. The 6-member CB functions as the executive arm of the IGS, tasked with operationalizing strategic goals (including multi-GNSS technical excellence, public outreach and engagement, and organizational sustainability and resilience) based on directives from the GB. As of the end of 2024, the IGS comprised overall 100+ agencies operating GNSS Network Tracking Stations, 6 Global Data

Centers, 13 Analysis Centers, 31 Associate Analysis Centers, 5 Product Coordinators, 22 Regional/Operational/Project Data Centers, 10 Committees, 4 Pilot Projects, and 1 Working Group.

As of 2024, the GB continues to be led by Rolf Dach (AIUB, Switzerland) in collaboration with GB Vice-Chair Elisabetta D'Anastasio (GNS Science Te Pū Ao, New Zealand). Key personnel in the GB, CB Director Allison Craddock and Deputy Director Camille Martire (NASA JPL, USA) also continue their appointments. In 2024, a new Analysis Centre Coordinator (ACC) team was elected, and Taylor Yates (NASA Goddard Space Flight Center, USA) was chosen as its representative to the GB (see more details in the dedicated Section below). Another notable step forward in 2024 was the execution of an in-depth campaign to identify and recruit IGS Component Vice-Chairs, who will play an important role in supporting the long-term sustainability of the IGS. The most current Governing Board and Central Bureau full memberships lists can be consulted at https://igs.org/governance-management/.

As of 2024, the CB remains funded by the United States National Aeronautics and Space Administration (NASA) and hosted at the Jet Propulsion Laboratory (JPL; Pasadena, California, USA) at a full-time equivalent effort of approximately 2.5 FTE. The CB notably serves as the command-and-control centre for tracking network operations, overseen by Network Coordinator David Maggert (EarthScope Consortium, USA). Additionally, CB Information Systems Manager Robert Khachikyan (Raytheon Technologies, USA) oversees the primary portal for IGS web, data, and email services.

3 Major Accomplishments and Decisions during the Reporting Period 2023-2025

3.1 Nominal Operations

In 2023 and 2024, the IGS continued seamlessly delivering on its mandate. Ephemerides (clock and orbit) combinations continued to be carried out by the Analysis Centre Coordinator team (comprising Geoscience Australia and the Massachusetts Institute of Technology). More and more Analysis Centres provide multi-GNSS products in an effort to move to a fully multi-GNSS IGS, while the relevant combination software capability is still under development. Terrestrial reference frame solutions (Earth rotation parameters, station coordinates and velocities, geocentre coordinates, post-seismic deformations) continued to be produced by the Institut National de l'Information Géographique et Forestière (IGN, France). Path correction products (ionosphere, troposphere, biases) continued to be provided out by the respective IGS Components. The CB continued supporting the dissemination of numerous IGS Guidelines, Formats, and Standards including namely the RINEX 4.02 format (drafted by the RINEX Committee), the Procedure for Becoming an IGS Station and IGS CORS Guidelines (drafted by the Infrastructure Committee) and their translations in various languages (German, Spanish, French, Arabic, and Chinese, thanks to the IDEA Working Group – see "Community Engagement" below), the IGS Guidelines for Long Product Filenames (IC), the IGS Governing Board Elections Process (Standing Elections Committee), the Guidelines and Code of Conduct for IGS Events (IDEA), the Guidelines for IGS Analysis Centers (Analysis Centre Coordinator), and the IGS Statement on Inclusion, Diversity, Equity, and Accessibility (IDEA). Over 2023 and 2024, 20 new stations were added to the IGS Network and 11 were decommissioned, bringing the total number of sites to 522. The number of multi-GNSS stations increased from 317 to 388 (+71), the number of real-time-capable stations increased from 301 to 327 (+26), 85 updates to antenna calibrations were recorded, and 526 station logs were updated. IGS Global and Regional Data Centres continued their collection and

stewardship of all IGS Data and Products - reaching a total of 62 terabytes (over 453 million files) at the end of 2024.

3.2 Updates to the Terms of Reference

In July 2023, the IGS revised its Terms of Reference (ToR), available at https://files.igs.org/pub/resource/governance/IGS-Terms-of-Reference.pdf. Building on the 2019 version, the 2023 IGS ToR aligns IGS Components to the IAG nomenclature: in general, long-standing Working Groups were renamed Committees, experimental Working Groups were renamed Pilot Projects, and Pilot Projects were renamed Working Groups; the new nomenclature is consultable at https://igs.org/wg-pp/. A 2-year term limit was implemented for Appointed GB Members, and the number of available Appointed Member positions was doubled from 3 to 6 in an effort to steer the GB to become more diverse and inclusive. The term limit for the GB Vice-Chair was extended from 2 to 4 years, enhancing continuity in leadership. The roles of the two "IAG Representative to the IGS" were renamed to "IAG President" and "GGOS President" for clarity and reflecting their organisational affiliations. Finally, the updated ToR clarified that an individual may only hold up to 2 roles within the IGS and will possess only one voting right, ensuring transparency and accountability in the decision-making process. In February 2024, this important update to the IGS ToR was supplemented by a separate "Policy for the establishment and governance of IGS Committees, Working Groups and Pilot Projects" carefully researched by the dedicated IGS Committee on Sustainable Working Group Governance.

3.3 Analysis Centres and Analysis Center Coordination

The IGS Analysis Center Coordinator (ACC), a crucial component of the IGS responsible for the operational combination of IGS products (namely GNSS satellite ephemerides, Earth rotation parameters, and clock corrections), reached the end of its nominal term in 2024. Consequently, the GB and CB coordinated a transition plan from 2022 to 2024 to successfully find a successor to the current team (Geoscience Australia, GA, and the Massachusetts Institute of Technology, MIT, USA). The process namely included the conceptualisation of a fair voting procedure since, for the very first time, multiple candidates came forward. The new ACC team, selected and announced at the IGS Workshop in July 2024, is a NASA/GA + MIT / GFZ (Deutsches GeoForschungsZentrum) / NRCan (Natural Resources Canada) partnership that combines the strengths of its four geographically diverse organisations and the experience of the current GA+MIT ACC team. From mid-2024 to the end of 2025, the two ACC teams will overlap to ensure a seamless transition and proper training. Complementary to this, the Chinese Academy of Science and Wuhan University proposed to run parallel combination efforts that will allow both the testing of innovative strategies and advanced comparison and testing of the operational ACC; this was formalised through the creation of the Wuhan Combination Centre (WCC) Pilot Project in December 2024.

In 2023, IGS welcomed a new global Analysis Centre (coded JGX), jointly led by the Geospatial Information Authority of Japan (GSI) and the Japan Aerospace Exploration Agency (JAXA).

3.4 Event Coordination

In 2024, the IGS GB and CB also successfully organised the 2024 IGS Symposium and Workshop, marking the 30th Anniversary of the IGS. Supported by the CB, the Local and Scientific Organising Committees (staffed by GB members from the CODE consortium) fully

developed the event, agenda, website, and all necessary in-person planning efforts. Ensuring successful workshops directly contributes to the goals and objectives of the IGS 2021+ Strategic Plan, providing facilitation, coordination, incubation, and advocacy for multi-GNSS technical excellence, community engagement, and organisational resilience.

The 2024 IGS Symposium and Workshop was hosted by the University of Bern together with the partners from the CODE consortium (AIUB: Astronomical Institute of the University of Bern, Switzerland; swisstopo: Swiss Federal Office of Topography, Wabern, Switzerland; BKG: Federal Agency for Cartography and Geodesy, Frankfurt a. M., Germany; IAPG/TUM: Institute for Astronomical and Physical Geodesy, Technical University of Munich, Germany). Presentations and posters may be viewed on the IGS website: https://igs.org/workshop/2024/.

3.5 Community Engagement

Between 2022 and June 2024, the CB developed and deployed a new Associate Member (AM) database and registration system (https://igs.org/am/) and carefully transitioned all AMs from the previous, legacy database to this new one, proceeding in batches so that all transfers may be double-checked by the IGS Governance. The revised AM Database system allows a centralised management of community members applications and the automated generation of a comprehensive list of all AMs (https://igs.org/am/list/) which also provides access to individual profile pages. A secure login mechanism allows all AMs to manage, update, and/or edit their profiles on their own. Finally, the system also sends automated reminders for AMs to renew their membership at regular intervals; this allows the AM Database to remain as current as possible and to periodically remove members who retired from the IGS.

In early 2024, the IGS Governing Board established the IGS IDEA (Inclusivity, Diversity, Equity, and Accessibility) Working Group under co-leadership by Camille Martire (NASA JPL, USA) and Elisabetta D'Anastasio (GNS Science Te Pū Ao, New Zealand). The WG is dedicated to embedding these ideals in all IGS activities and decisions. So far, the WG developed a formal statement to communicate IGS' commitment (see IGS working-groups) and coordinated efforts to translate various IGS Guidelines into various languages (see above). Going forward, the WG will assess and enhance these efforts through developing more guidelines and metrics to track improvements.

3.6 Communications, Advocacy, and Outreach

As highlighted in the introduction, the GB maintains robust affiliations with international entities, including the International Association of Geodesy (IAG), the Global Geodetic Observing System (GGOS), and the United Nations Global Geospatial Information Management (UN-GGIM). Active participation in these bodies over the course of 2023-2024 ensured that IGS remained highly integrated into the global geodetic community. Notably, GB members contributed to sustainability-focused geodetic policy through advocacy with the United Nations Global Geodetic Centre of Excellence (UN-GGCE), directly supporting long-term viability of the global geodesy supply chain.

The CB played a central role in the United Nations' Office for Outer Space Affairs' International Committee on GNSS, notably through co-chairing Working Group D (WG-D) on Reference Frames, Timing, and Applications. This role was undertaken alongside key international partners such as BIPM, CNES, and FIG. The IGS also spearheaded the newly created Disaster Risk Reduction (DRR) Task Force and provided leadership to the International GNSS Monitoring and Assessment (IGMA) Task Force. These positions highlight the

IGS's instrumental contribution to global GNSS coordination. The DRR TF, in particular, successfully advanced GNSS applications in humanitarian contexts by recommending the deployment of a multi-GNSS station in an area of sparse coverage for the demonstration of the usefulness of GNSS for natural hazards monitoring (at IGC-17 in October 2023) and most recently publishing a policy brief on this topic (at ICG-18 in October 2024).

The "Tour de l'IGS" virtual mini-workshop series continued to provide a high-impact platform for knowledge exchange and community feedback. These efforts ensure sustained visibility and stakeholder alignment across our decentralised, voluntary scientific community. In 2023, two Tour de l'IGS "stops" were organised: one on "GNSS for Natural Hazards in the South Pacific" and another spotlighting the Galileo constellation. The Tour de l'IGS will return in 2025 with an event dedicated to efforts led by and focusing on the African continent. The agendas and presentations for all the Tour de l'IGS stops are available at https://igs.org/tour-de-ligs.

Over 2023 and 2024, the CB expanded the IGS' digital presence and public engagement efforts. Building on previous success, the CB maintained a strong, multidimensional social media presence across LinkedIn, YouTube, and X (formerly Twitter), amplifying IGS activities and research updates. In particular, CB Director Allison Craddock provided the English-language voiceover for the GGOS outreach video on Terrestrial Reference Frames in 2023, translating technical geodetic content into accessible media and thus advancing science communication objectives. The recordings of presentations given during the 30th-Anniversary IGS Workshop, made available on the IGS' YouTube channel in 2024, collected thousands of views, showcasing the interest of the public and community for IGS news and asynchronous conference attendance.

4 Publications and Official IGS Citation

Official publications pertaining to the IGS are:

- Technical Reports (https://files.igs.org/pub/resource/technical_reports/):
  - 2023 (https://files.igs.org/pub/resource/technical_reports/2023_techreport.pdf)
  - 2024 (https://files.igs.org/pub/resource/technical_reports/2024_techreport.pdf)
- Terms of Reference:
  - 2019 (https://files.igs.org/pub/resource/governance/IGS-Terms-of-Reference-2019.pdf)
  - 2023 (https://files.igs.org/pub/resource/governance/IGS-Terms-of-Reference-2023.pdf)

It is expected that the IGS is properly acknowledged by referencing the IGS chapter found in the 2017 Springer Handbook of Global Navigation Satellite Systems:

- Johnston, G., Riddell, A., Hausler, G. (2017). The International GNSS Service. In Teunissen, Peter J.G., & Montenbruck, O. (Eds.), Springer Handbook of Global Navigation Satellite Systems (1st ed., pp. 967-982). Cham, Switzerland: Springer International Publishing. DOI: 10.1007/978-3-319-42928-1.