GGOS: The Global Observing System of the International Association of Geodesy

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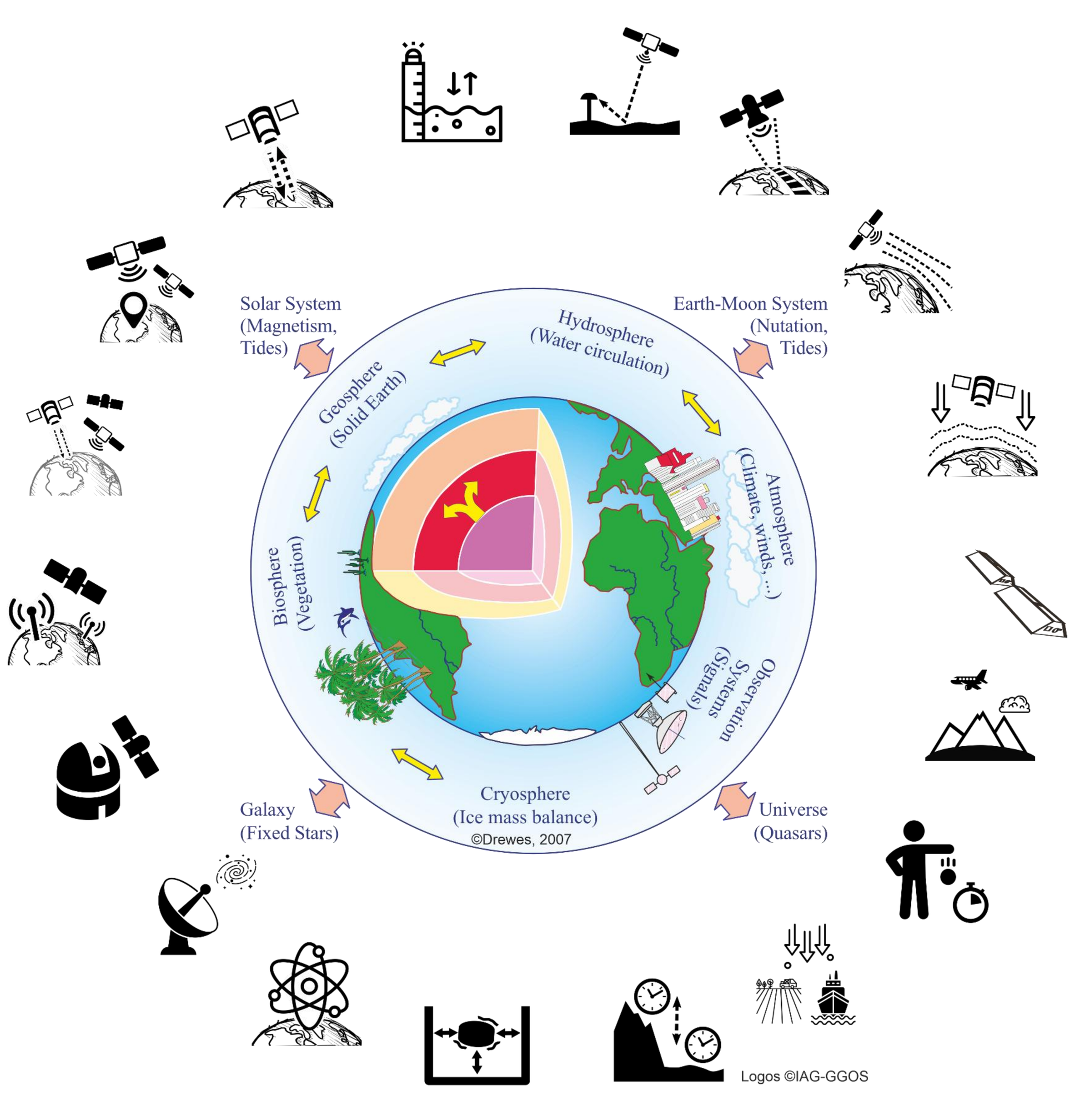
A - What is GGOS?

The **Global Geodetic Observing System (GGOS)**, established by the **International Association of Geodesy (IAG)**, is a global effort to monitor the Earth system. GGOS provides the essential foundation for the **accurate measurement, modelling and interpretation** of Earth processes, supporting research on global change, Earth deformation and mass exchange within the Earth system.



By measuring the Earth's shape, rotation and gravity field in relation to precise and stable reference frames, GGOS delivers important insights into changes between and within the geosphere, atmosphere, hydrosphere, cryosphere and biosphere.

B – Driving challenges for GGOS

Observing infrastructure
Identifying gaps in the global geodetic infrastructure and advocating for its **modernisation, extension and maintenance**.

Consistent analysis
Ensuring that the **same standards, conventions, models and parameters** are used in all data analysis and modelling of Earth system processes.

Integrated analysis and interpretation
Combining geometric, gravimetric and Earth rotation observations in data analysis and data assimilation for comprehensive Earth system modelling.

Serving science and society
Defining **requirements for geodetic products** based on scientific and societal needs as well as identifying and addressing service gaps.

Raising awareness
Promoting geodesy by **improving the accessibility and visibility** of data and products.

The IAG established GGOS to expand geodesy beyond mapping the Earth's surface, aiming to serve both science and society. The main goal is to develop an integrated framework that merges different geodetic data into consistent, comprehensive products, enabling reliable modelling and interpretation of Earth system processes and interactions.

C - GGOS organisational elements

GGOS Bureau of Networks & Observations (GGOS-BNO)
focuses on the **global geodetic infrastructure**.It assesses the status of the infrastructure and advocates its modernisation, expansion and maintenance.

GGOS Bureau of Products & Standards (GGOS-BPS)
focuses on **standardisation, integration and optimisation** of geodetic products, including identifying (new) products that could meet emerging needs.

GGOS Coordinating Office (GGOS-CO)
is responsible for **outreach, communication and the GGOS Portal**.It hosts activities related to the use of DOIs and FAIR practices in geodesy.

GGOS Focus Areas (GGOS-FAs)
are incubators for new research topics and innovative geodetic products. Current GGOS-FAs:
- **Geohazards**
- **Geodetic Space Weather Research**
- **AI for Geodesy.**

GGOS Affiliates
are national or regional organisations that enable greater collaboration in geodesy. Current GGOS Affiliates:
- **GGOS Japan**
- **GGOS D-A-CH**
- **GGOS IberAtlantic**
- **GGOS Africa** (in implementation).

GGOS builds as much as possible on existing geodetic networks, data systems and research, incorporating improvements from IAG components. GGOS also includes dedicated organisational structures that unify various geodetic areas and support the achievement of the GGOS goals.

D - GGOS building blocks

Observing Infrastructure
Ground, air, and space sensors measuring changes of Earth's geometry, gravity and orientation
Main actors
National and international agencies owning and managing the sensors and providing observational data for further analysis, GGOS-BNO

Data Infrastructure
Managing, archiving, and disseminating geodetic data
Main actors
Observing infrastructure owners, IAG Services, data centres, GGOS-BNO, GGOS-BPS

Analysis Infrastructure
Transforming observations into geodetic products
Main actors
IAG Services, analysis and combination centres, GGOS-BPS, GGOS-BNO

Research Infrastructure
Advance knowledge, innovation, and technology in geodesy
Main actors
IAG Commissions, Inter-Commission Committees, Projects and Services, GGOS Focus Areas

Reference Frame Infrastructure
ICRF ITRF IHRF ITGRF
Global geodetic reference frames as basis for describing Earth's geometry, gravity field and rotation, and measuring Earth system changes.
Main actors
IAG Services supported by IAG Commissions, GGOS-BNO and GGOS-BPS

GGOS Portal
Central access point for geodetic data and products
Main actors
GGOS Coordinating Office supported by IAG Services, GGOS-BPS and GGOS-BNO

GGOS relies on the expertise of the IAG and its components: Commissions, Committees, Inter-Commission Committees and Projects drive scientific progress and provide research infrastructure, while the IAG Services coordinate global observation, drive data analysis, and deliver high-accuracy geodetic products.

E- Current challenges

To meet the GGOS goals, the observing infrastructure and expertise in geodesy as well as multidisciplinary research must be in place. Following challenges are in focus:

- Infrastructure gaps, ageing instruments, global data disparities.
- Limited funding for satellite missions and ground stations.
- Geodetic reference products on a best-effort basis (long-term operational activities not ensured).
- Challenging transition from research to operational services.
- Decreasing human resources and limited new talent (fewer university students in geodesy).
- Lack of awareness in the policy arena, international high-level initiatives, other Earth sciences and industry.
- Difficulty in translating technical geodetic information into actionable insights for decision-makers and the public.

F - Strategic actions in progress

Continue advancing geodesy by:
- Providing a comprehensive, unified global geodetic frame of reference for geometry, gravity field, and rotation.
- Ensuring an integrated geodetic monitoring/ observation system, rather than a multitude of technique-dependent products.

Opportunities
- A central interface between science and society.
- A transformative role for geodesy.
- Geodetic data and products serve science and society far beyond the usual applications of mapping, positioning, navigation and timing.
- Geodesy is critical for monitoring the Earth system and tracking global change with unprecedented precision.

Defining Essential Geodetic Variables (EGVs) to leverage the use of geodesy in broader international and multidisciplinary Earth observation initiatives.

Opportunities
- Geodesy shares a common language with other Global Observing Systems.
- Clearer communication of geodesy's essential role in monitoring the Earth system and supporting socio-economic systems.
- Increased visibility of geodesy within the geosciences, government agencies and policy-making bodies.
- The requirements for supporting EGVs provide a strategic approach to improving the precision, reliability and timeliness of geodetic data and products.

Supporting the UN Global Geodetic Centre of Excellence (UN-GGCE) in the implementation of the UN Resolution 69/266 "A Global Geodetic Reference Frame for Sustainable Development" by identifying tangible geodetic contributions to UN Sustainable Development Goals

Opportunities
- Geodesy in the policy arena.
- Geodesy infrastructure critical for sustainable development.
- Strengthen the geodetic community, infrastructure, and its visibility in policy making.
- A call for sustained investment in geodesy.

Further reading at https://geodesy.science/ggos/