

# The International VLBI Service for Geodesy and Astrometry (IVS) and the Global Geodetic Observing System (GGOS)

[Laura Sánchez, GGOS President \(2023 – 2027\)](#)

Deutsches Geodätisches Forschungsinstitut (DGFI-TUM),  
Technische Universität München, Germany

[Basara Miyahara, GGOS President \(2019 – 2023\)](#)

Geospatial Information Authority of Japan,  
Tsukuba, Japan

International VLBI Service for Geodesy and Astrometry (IVS)

25<sup>th</sup> Anniversary Event

Tsukuba, Japan, March 6, 2024

# GGOS: The Global Geodetic Observing System of the International Association of Geodesy (IAG)

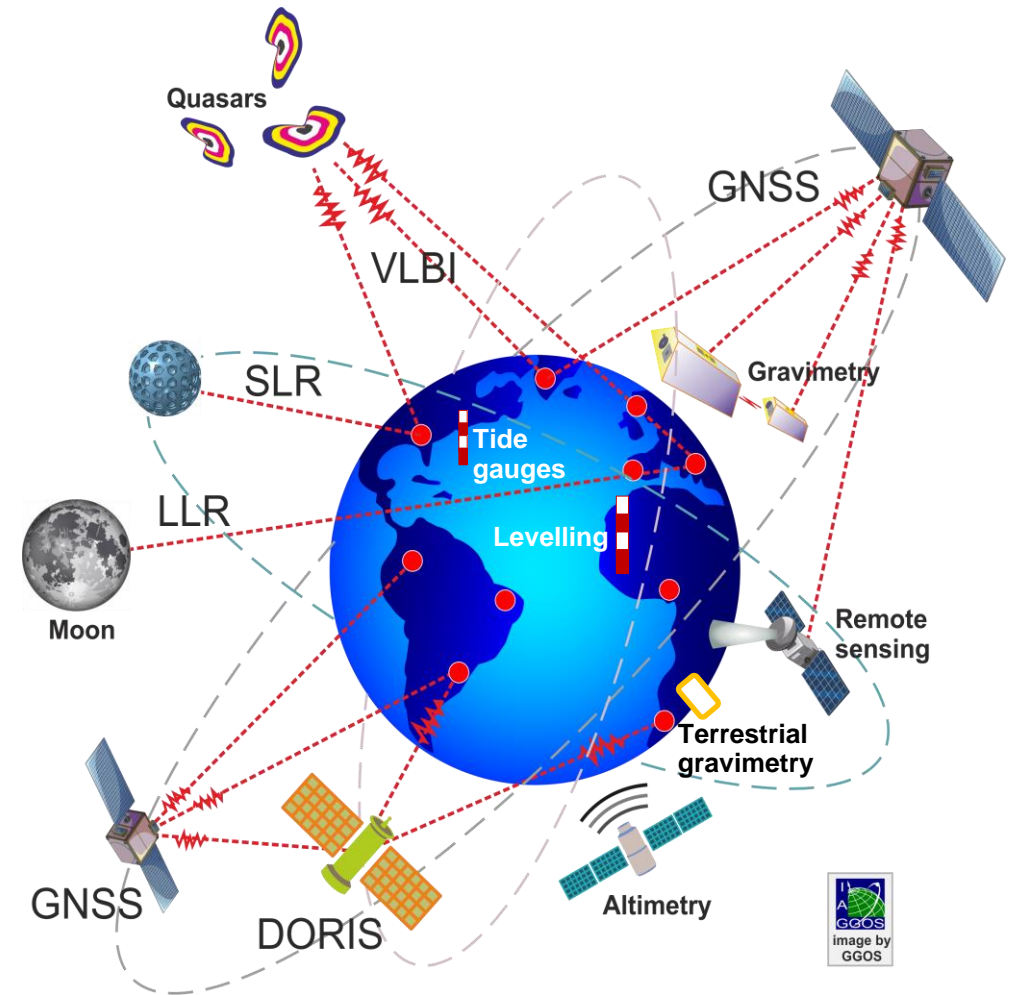


GGOS was established as the **integrating framework for all IAG Components** (Services, Commissions, Inter-Commission Committees and Projects) to

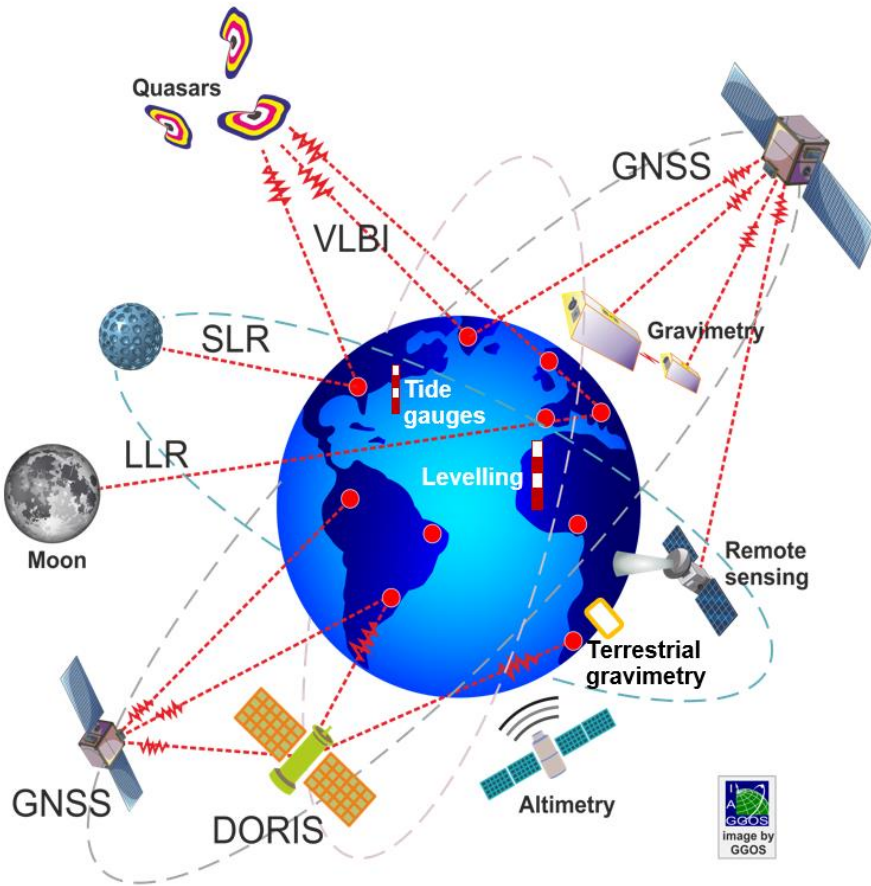
- move from the provision of the basic geodetic products (station coordinates, geoid, Earth orientation parameters) to a level of **consistent modelling and interpretation of Earths System processes and interactions**, and
- ensure an **integrated observing system** rather than a flood of technique-specific products.

GGOS is the contribution of Geodesy to the **Global Earth Observation System of Systems (GEOSS)** through

- the **reference frames** needed for all position-dependent observations, thus contributing to the basis of most Earth observations, and
- measuring **changes in the Earth's shape, size, gravity field and rotation** over time and space.



# From geodetic measurements to Earth system modelling



## Level 0: Raw data collection

Measuring infrastructure (ground- and space-based techniques)

## Level 1: Consistent data analysis

Unified standards, one integrated frame of reference for geometry, gravity and orientation

## Level 2: Integration/Combination

Separation of true geodetic/geophysical signals from technique-specific system biases

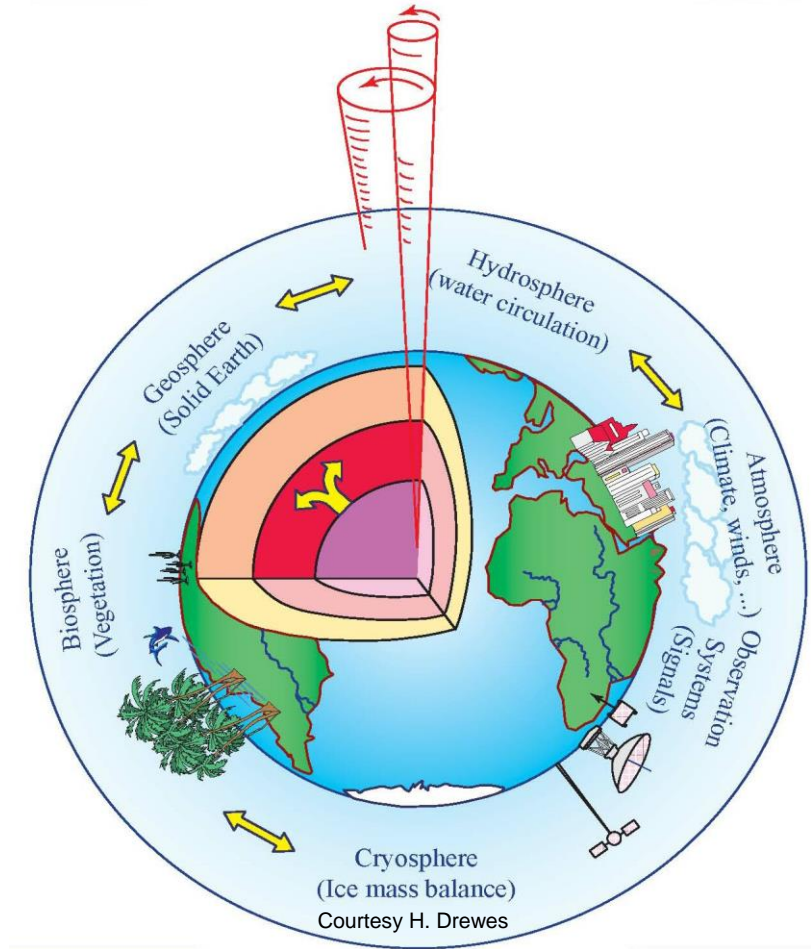
Better understanding of the Earth system signals because different manifestations of the same phenomena can be detected by different techniques

## Level 3: Modelling and interpretation

Relationship between geodetic parameters and geophysical processes

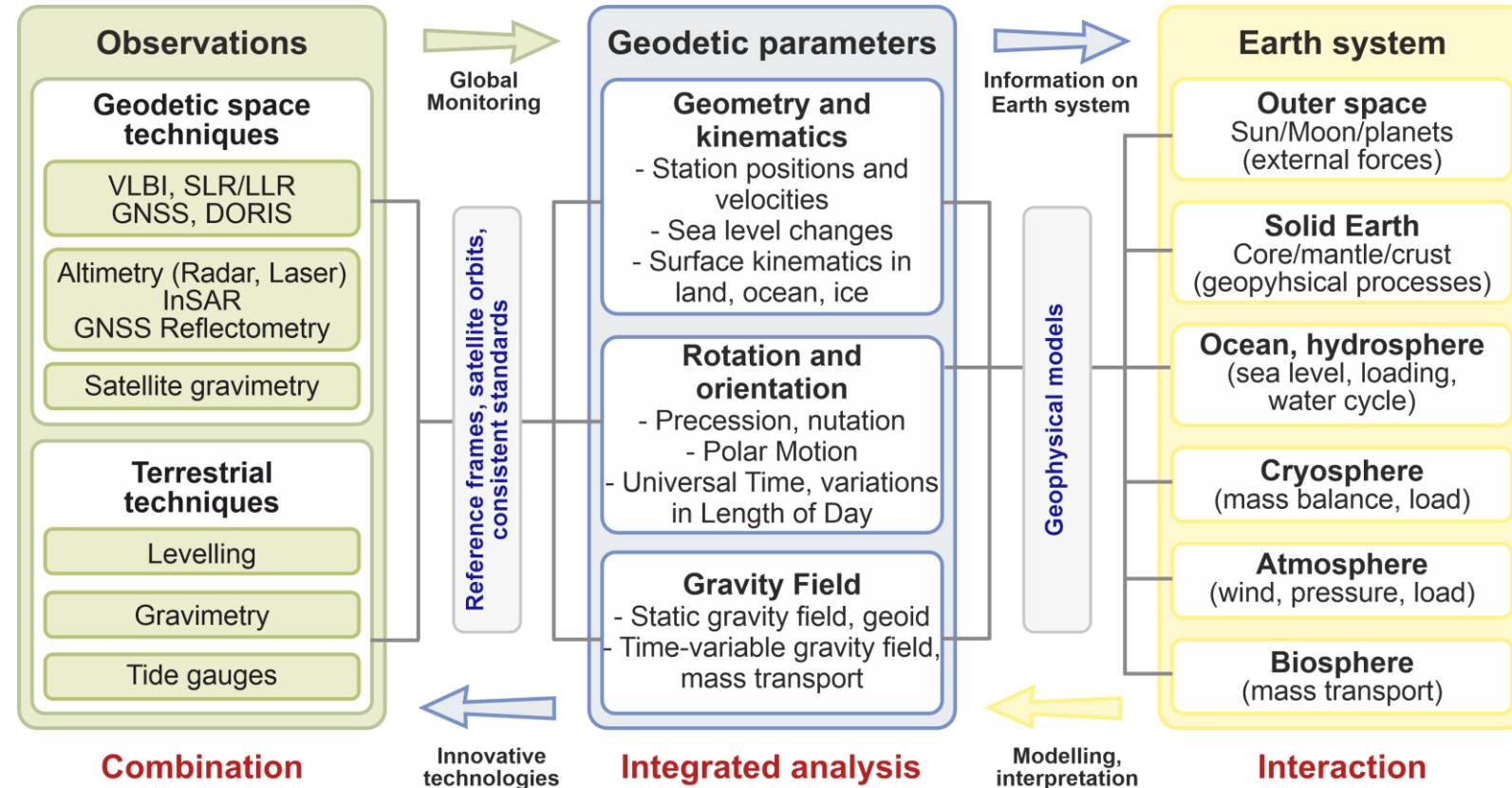
## Level 4: Applications

Benefits to science and society



# From geodetic measurements to Earth system modelling

- GGOS focuses on the **integrated analysis** of the time-varying Earth's size, shape, rotation and gravity field to generate highly **accurate, consistent, and long-term stable geodetic products**.
- Through these efforts, GGOS enables **improved monitoring of the Earth system** components and provides the **fundamental basis** for a better understanding of geodynamic processes and a reliable quantification of global change phenomena (e.g. sea level rise, melting of ice sheets, variations in terrestrial water storage, etc.).



# Current GGOS Goals



## GOAL 1



Visibility and  
Engagement

**GGOS portal, one-stop shop for geodetic data and products**, to improve the accessibility of geodetic observations, information and products to the widest range of users.

## GOAL 2



Science-Policy  
Networking

**Geodetic products as Essential Geodetic (Earth Observation) Variables** to address science and societal needs and to serve as a central interface between science and society. Close cooperation with the *UN Global Geodetic Centre of Excellence*.

## GOAL 3



Capacity  
Enhancement and  
Sustainability

**Improve global geodetic infrastructure and strengthen sustainable geodetic capabilities** through capacity enhancement and knowledge sharing.

## GOAL 4



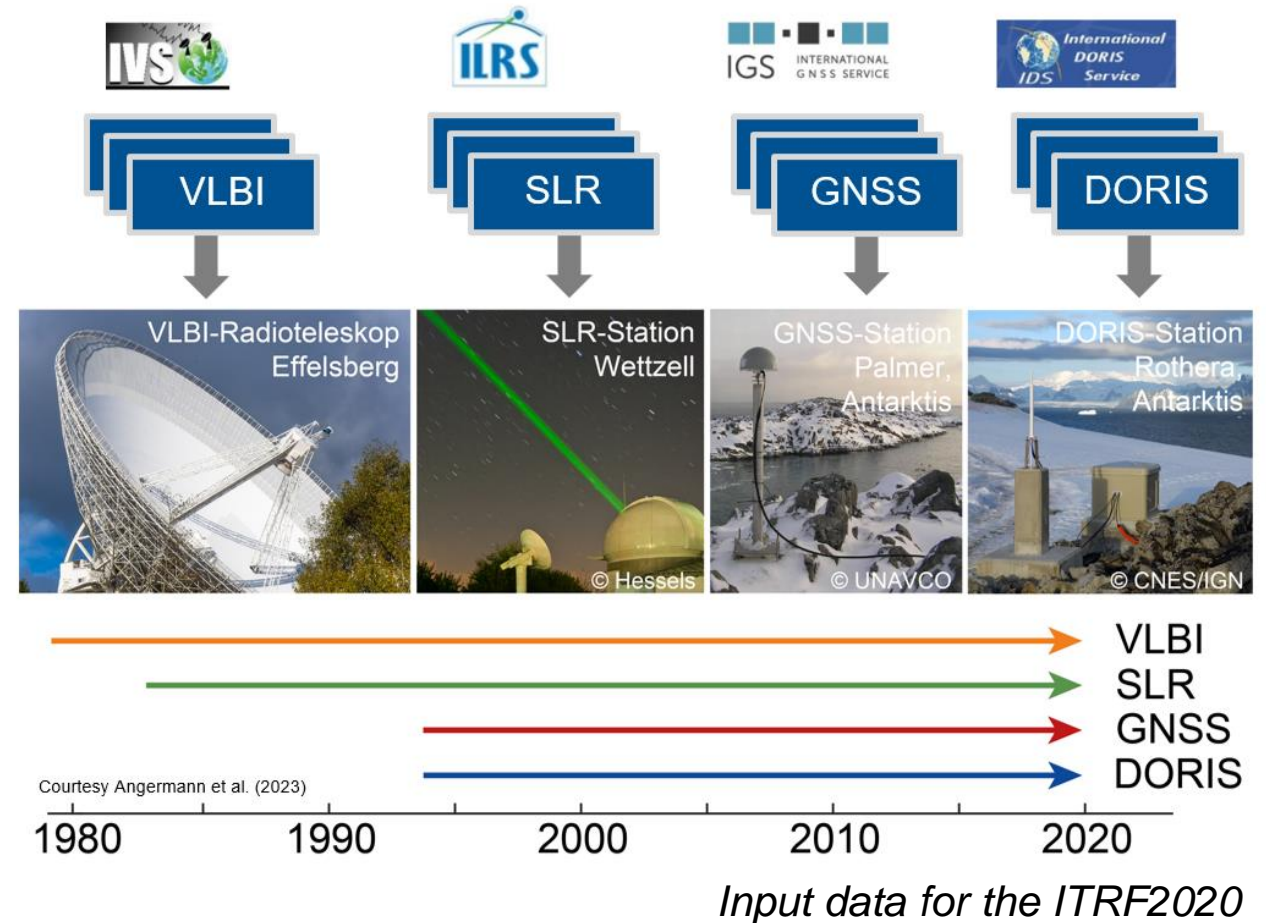
Comprehensive and  
Cross-cutting  
Analysis

**Combine geometric, gravimetric, and Earth rotation observations** in data analysis and assimilation, to consistently estimate and model Earth system signals that influence geodetic observations.

# Why is IVS essential for GGOS?



- IVS globally **coordinates all geodetic activities related to VLBI** and ensures the generation of highly accurate and reliable VLBI geodetic products.
- Thanks to IVS, a **very long VLBI time series of geodetic parameters** (Earth rotation, station positions and velocities) is available for the calculation of the terrestrial reference frame (TRF).
- VLBI is the only technique that has **direct observational access to the inertial celestial reference system/frame** (CRS/F), the other space techniques can only refer to quasi-inertial systems.
- VLBI is the only technique capable of providing **the full set of Earth orientation parameters (EOPs)**. In particular, it is the only technique that provides UT1-UTC and the celestial pole coordinates.



# Why is IVS essential for GGOS?

- Changes in the EOPs (i.e. variations in the Earth's rotation) **reflect mass shifts** between and within the components of the Earth system.
- **EOPs are of paramount importance for Earth observation** as they are needed to link the satellites with the Earth.
- High-altitude satellites (GNSS and Laser ranging satellites) together with observations to Quasars and the Moon are essential for **establishing and maintaining global reference frames**.
- Low orbiting satellites are crucial for determining the **Earth's gravity field and mapping the Earth's surface**, including topography, oceans, ice caps, lakes, rivers, and soil moisture.
- Although the essential role of VLBI in satellite Earth observations is not obvious, **IVS products are strongly embedded** in the appropriate use of these techniques.



# Take home message



- The International VLBI Service for Geodesy and Astrometry (**IVS**) is an **essential partner of GGOS**.
- IVS provides **unique and fundamental parameters** for the realisation and maintenance of the global reference frames (celestial and terrestrial) and provides **important information for the monitoring of the Earth system**.
- VLBI has some extraordinary capabilities that cannot be achieved by other techniques, but together they form a **great geodetic tool for observing and modelling changes** between and within the components of the Earth system.
- GGOS cannot operate without the IVS and the other services of the IAG. The main role of the GGOS is to act as an **interface between the scientific expertise of the IAG and society** to demonstrate the fundamental value of geodesy and to facilitate access to geodetic data and products needed to detect, locate, understand and warn of changes in terrestrial ecosystems.
- **GGOS congratulates the IVS on its 25th anniversary and wishes it every success in the next 25 years!**

