

# GNSS is the Core Technology to Support GGOS Applications

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*President, IAG*



International  
Association of  
Geodesy

A Constituent Association of the IUGG



... advancing geodesy ...



# IAG Structure



**International Union of Geodesy and Geophysics (IUGG)**  
 Member of ICSU, 65 Member Countries, 8 Associations

**International Association of Geodesy (IAG)**

Council

Exec Committee

Bureau

Office

COB

**Commission 1**

Reference Frames

**Commission 2**

Gravity Field

**Commission 3**  
Earth Rotation &  
Geodynamics

**Commission 4**  
Positioning &  
Applications

**Inter-Commission Committee on Theory (ICCT)**

**Services:**

IERS

IGS

IGFS

BGI

ICET

BIPM

IAS

ILRS

IVS

IDS

ICGEM

IGeS

IDEMS

PSMSL

IBS

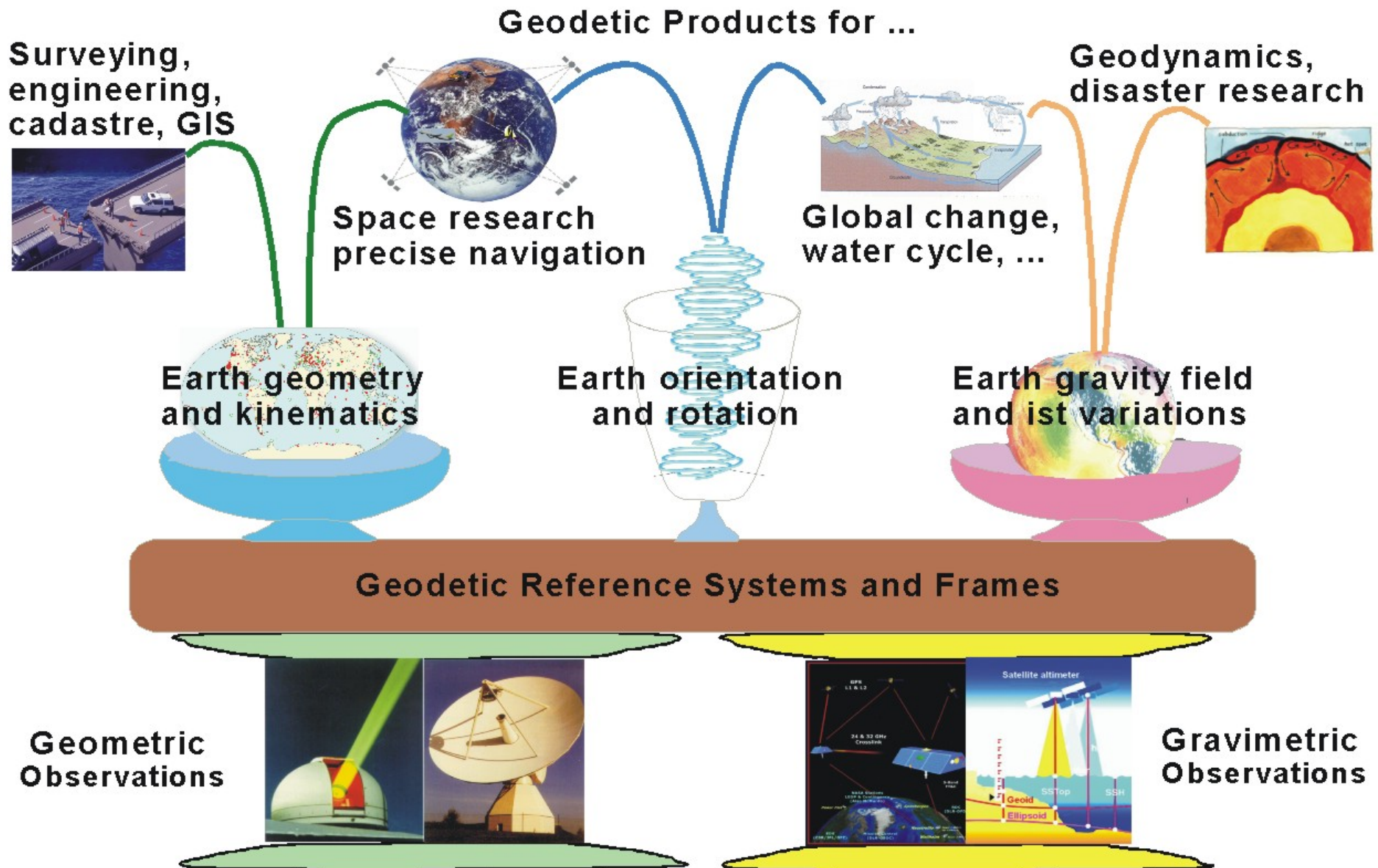
**Global Geodetic Observing System (GGOS)**

# Global Geodetic Observing System

- GGOS links all components of the IAG, *e.g. Services, Commissions, ICCT, etc.*
- GGOS is the combined global geodetic infrastructure, *i.e. physical, IT & analysis components.*
- GGOS products include individual service products that have been “value-added”, *e.g. WHS, time series, etc.*
- GGOS will support long term geodesy goals, *e.g. stable reference frames.*
- GGOS seeks integrated modelling of all observations, *so as to improve geodetic parameter estimation for earth science.*
- GGOS will provide single “portal” for users, *i.e. a “one stop shop”.*



# Global Geodetic Observing System



International Terrestrial Reference Frame (ITRFxx)

International Earth Rotation and Reference Systems Service (IERS)

Radio source positions, precise GNSS orbits and clocks, Earth orientation parameters (EOP), station coordinates and velocities

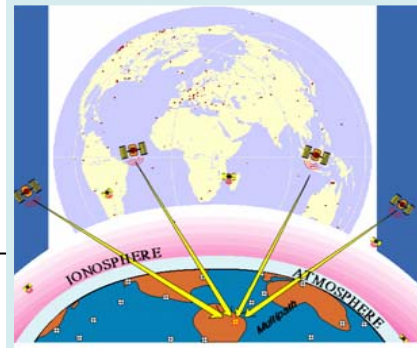
Very Long Baseline Interferometry (IVS)



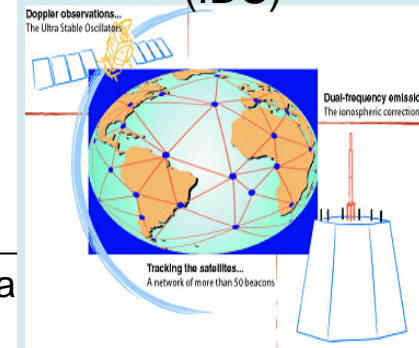
Satellite Laser Ranging (ILRS)



Global Navigation Satellite Systems (IGS)



Doppler Orbit Determination and Radiopositioning Integrated on Satellite (IDS)



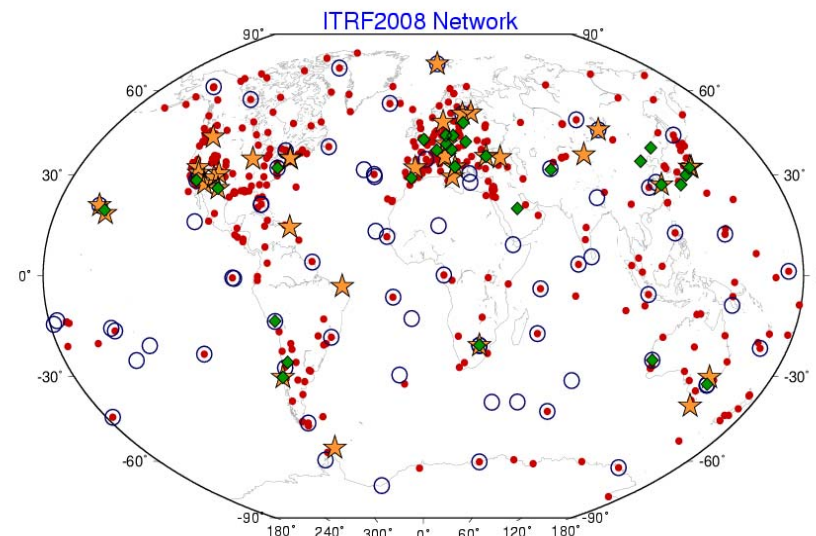
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# International Terrestrial Reference System (ITRS)

- Realised and maintained by **ITRS Product Centre** of the IERS.
- Its realisation is the "International Terrestrial Reference Frame" (**ITRF**).
- Set of station positions and velocities, **estimated by combination** of VLBI, SLR, GPS and DORIS individual TRF solutions.
- **Based on Co-location sites.**

**Adopted by IAG & IUGG in 1991 and 2007 for all Earth Science Applications**



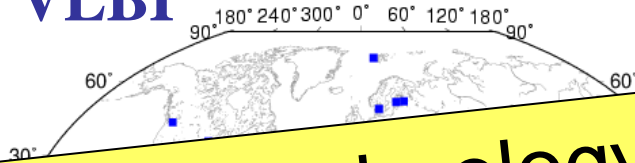
**Available: ITRF88, ..., 2000, 2005**  
**Latest : ITRF2008**  
**Coming: ITRF2013**

<http://itrf.ign.fr>



# Current Space Geodesy Networks for ITRF

VLBI



SLR

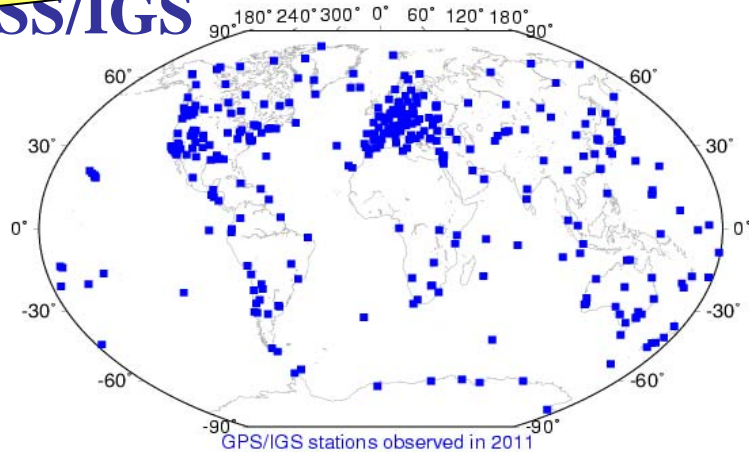


GNSS technology & IGS products crucial to ITRF definition & to its **relevance...**

*By virtue of ease-of-connection to it anywhere on Earth using precise GNSS positioning techniques*

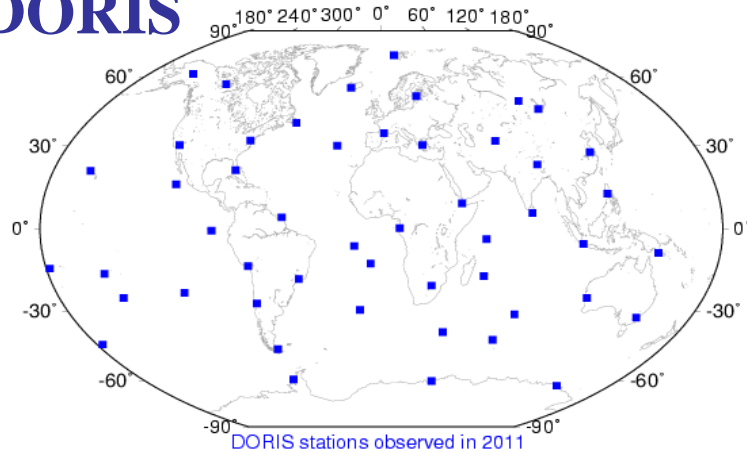
SLR stations observed in 2011

GNSS/IGS



GPS/IGS stations observed in 2011

DORIS



DORIS stations observed in 2011



# Illuminating the Earth With GNSS

Scientific Drivers – Extending the Reference Frame to Multiple Applications



IONOSPHERE

OCEANS

SOLID EARTH

ATMOSPHERE

High resolution 3D ionospheric imaging

Earth rotation  
Polar motion

Almost all GGOS scientific challenges require high fidelity, long term, ultra-precise RF and GNSS technology...

E.g. 4D GNSS positioning & atmospheric sounding from terrestrial and satellite-borne receivers, taking advantage of GGOS infrastructure...

Precise ion cal for OD, SAR, altimetry

Precise global reference frame

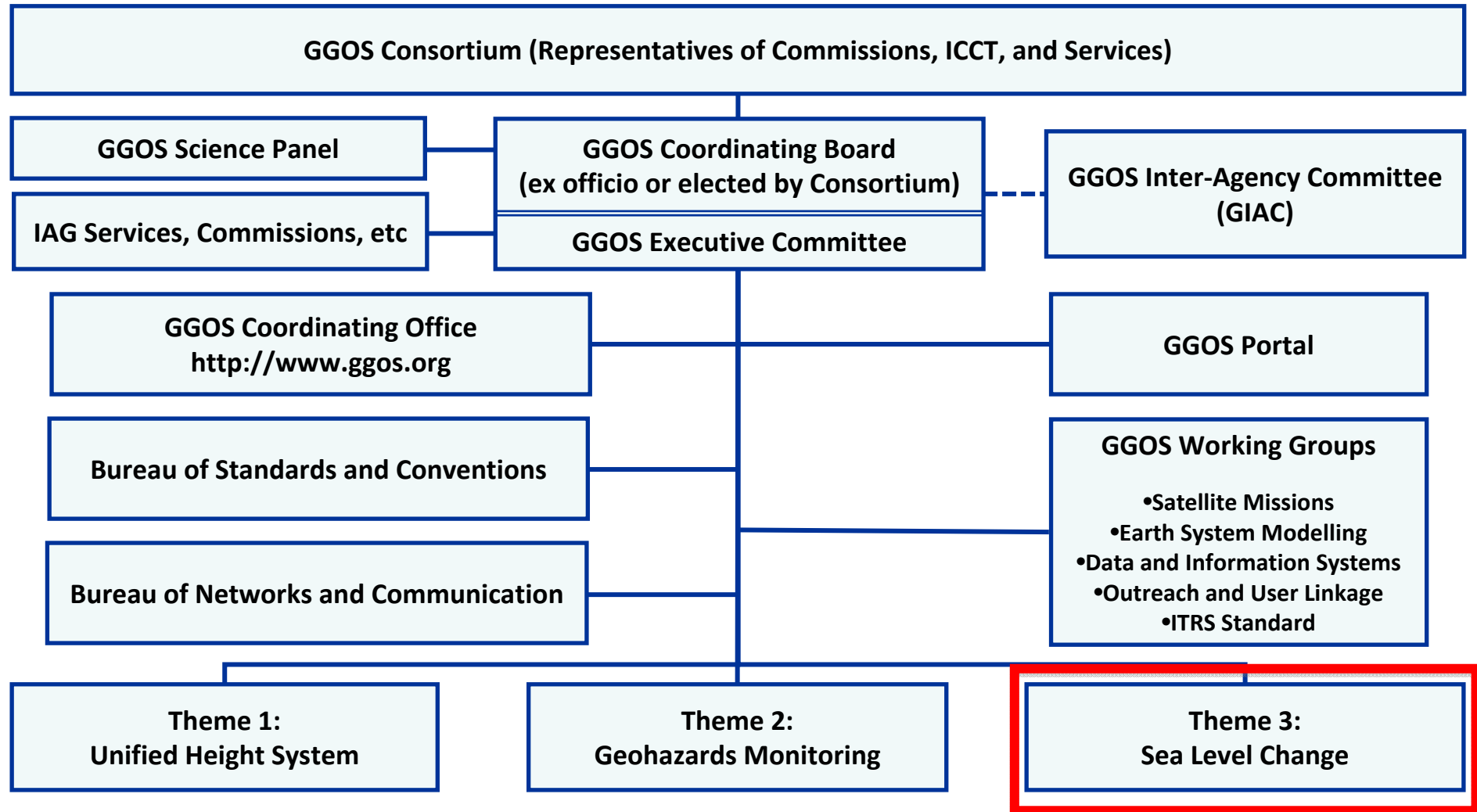
Structure & evolution of surface/atmosphere boundary layer

Tropospheric water vapor distribution

of the deep interior



# Global Geodetic Observing System



# Example of Complexity of Data & Missions: *Sea Level Change & Ice-Mass Balances*

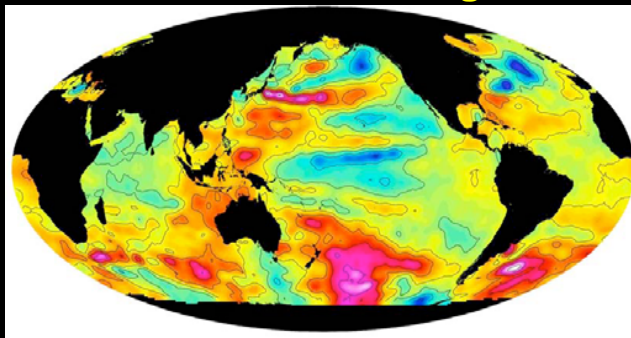
Altimetry missions

Data processing

Gravimetry missions

Such complexity requires the coordination of several geodetic technologies & services...  
*integrated to generate “high level products” that science and society can directly use...*

Ocean modelling



Sea-level change (mm/a)

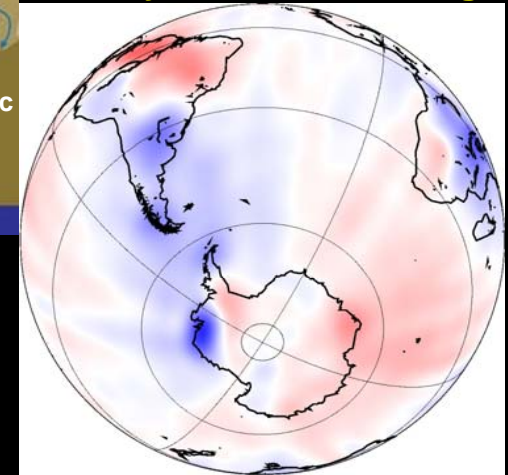
Terrestrial networks



Tide gauge GPS

Glacial-isostatic adjustment

Geodynamic modelling



Geoid change (mm/a)

# Global Geodetic Observing System

- Vision: *continuous, synoptic, high-accuracy Earth Observing System that can monitor geometric & gravimetric effects in 4D.*
- The goal of GGOS: *improve the accuracy, resolution, reliability & timeliness of geodetic products by an order of magnitude by end of decade.*
- Operationalise “millimetre-geodesy” in order to monitor faint global change & geodetic signatures.
- Support centimetre-level Precise Positioning GNSS for geoscience & geospatial applications.
- **1mm accuracy Reference Frame, & stability of 0.1mm/yr.**
- GNSS is the key space geodesy technology to deliver GGOS’s vision.



Thank You!



**150th  
Anniversary**

**1862-2012**

