The International Association of Geodesy (IAG) and its Global Geodetic Observing System (GGOS)

Dr. Daniel Roman
Co-Chair, North American Reference Frame (IAG 1.3c)

Structure of the International Association of Geodesy

International Council for Science (ICSU): 142 Countries, 31 Unions

IAU | IGU | ISPRS | **IUGG** | IUGS | ICA | other Unions

International Union of Geodesy and Geophysics (IUGG)

IACS | **IAG** | IAHS | IAGA | IAMAS | IAPSO | IASPEI | IAVCEI

International Association of Geodesy (IAG)

Commissions

1 Reference Frames | 2 Gravity Field | 3 Earth Rotation and Geodynamics | 4 Positioning and Applications

Inter-Commission Committee on Theory

Scientific Services

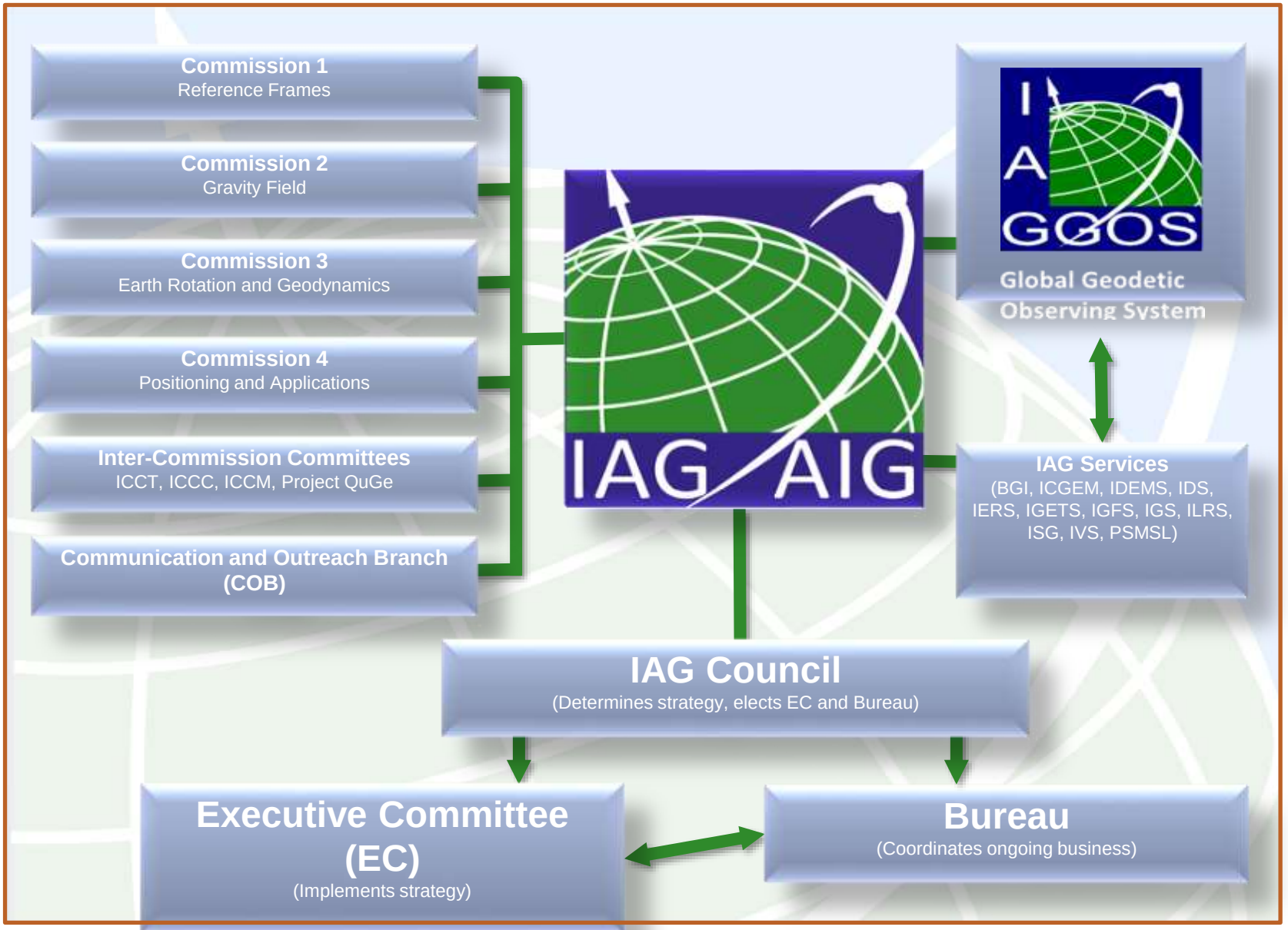
Geometry: IERS, IDS, IGS, ILRS, IVS

Gravity: IGFS, BGI, ICGEM, IDEMS, ISG, IGETS

Combining: BIPM, PSMSL

Global Geodetic Observing System (GGOS)

IAG Organization



IAG Leadership

IAG Bureau

President:	Zuheir Altamimi	France
Vice-President:	Richard Gross	USA
Secretary General:	Markku Poutanen	Finland

IAG Commissions and Inter-Commission Committees (ICC)

Commission 1: Reference Frames	Christopher Kotsakis	Greece
Commission 2: Gravity Field	Adrian Jäggi	Switzerland
Commission 3: Earth Rotation and Geodynamics	Janusz Bogusz	Poland
Commission 4: Positioning and Applications	Allison Kealy	Australia
Inter-Commission Committee on Theory	Pavel Novák	Czech Republic
Inter-Commission Committee on Geodesy for Climate Research	Annette Eicker	Germany
Inter-Commission Committee on Marine Geodesy	Valerie Ballu	France
Project Novel Sensors and Quantum Technology for Geodesy	Jürgen Müller	Germany

IAG Commissions

Commission 1: Reference Frames

SC1.1: Coordination of Space Techniques
SC1.2: Global Reference Frames
SC1.3: Regional Reference Frames
a) Europe, **b) South and Central America, c) North America,**
d) Africa, e) Asia-Pacific, f) Antarctica
SC1.4: Interaction of Celestial and Terrestrial Reference Frames

Commission 2: Gravity Fields

SC2.1: Land, Marine and Airborne Gravimetry
SC2.2: Geoid, Physical Height Systems and Vertical Datum Unification
SC2.3: Satellite Gravity Missions
SC2.4: Regional Geoid Determination
a) Europe**, b) South America, c) North and Central America**, d) Africa, e) Asia-Pacific, f) Antarctica
SC2.5: Satellite Altimetry
SC2.6: Gravity Inversion and Mass Transport in the Earth System

IAG Commissions

Commission 3: Earth Rotation and Geodynamics

SC3.1: Earth Tides and Geodynamics
SC3.2: Volcano Geodesy (joint with IAVCEI)
SC3.3: Earth Rotation and Geophysical Fluids
SC3.4: Cryospheric Deformation
SC3.5: Seismogeodesy

Commission 4: Positioning and Applications

SC4.1: Emerging Positioning Technologies and GNSS Augmentation
SC4.2: Multi-frequency Multi-constellation GNSS
SC4.3: Atmosphere Remote Sensing
SC4.4: GNSS Integrity and Quality Control

IAG Global Geodetic Observing System (GGOS)

Chair: Basara Miyahara, Japan

IAG Communication and Outreach Branch (COB)

Chair: Szabolcs Rózsa, Hungary

IAG Services

IAG Services

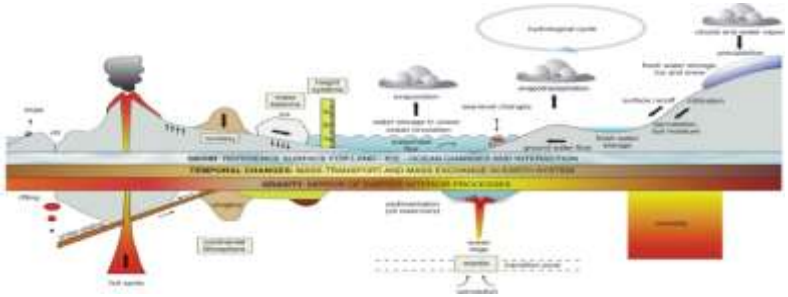
Bureau Gravimetrique International (BGI)
International Geodynamics and Earth Tide Service (IGETS)
International Centre for Global Earth Models (ICGEM)
International Digital Elevation Model Service (IDEMS)
International DORIS Service (IDS)
International Earth Rotation and Reference Systems Service (IERS)
International Service for the Geoid (ISG)
International Gravity Field Service (IGFS)
International GNSS Service (IGS)
International Laser Ranging Service (ILRS)
International Service for Geodesy and Astrometry (IVS)
Permanent Service for Mean Sea Level (PSMSL)

IAG WEB Site

https://iag-aig.org

IAG Central Objective: Geodetic Observation of Solid Earth Processes

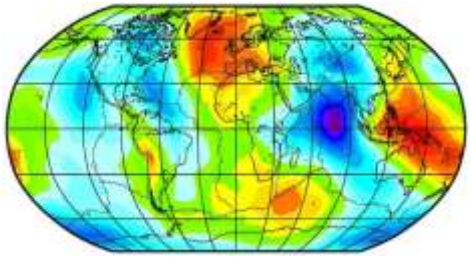
Processes in the solid Earth: geodynamics (deformation)



Processes in the atmosphere and hydrosphere: water cycle

deformations

variations of the rotation and the gravity field



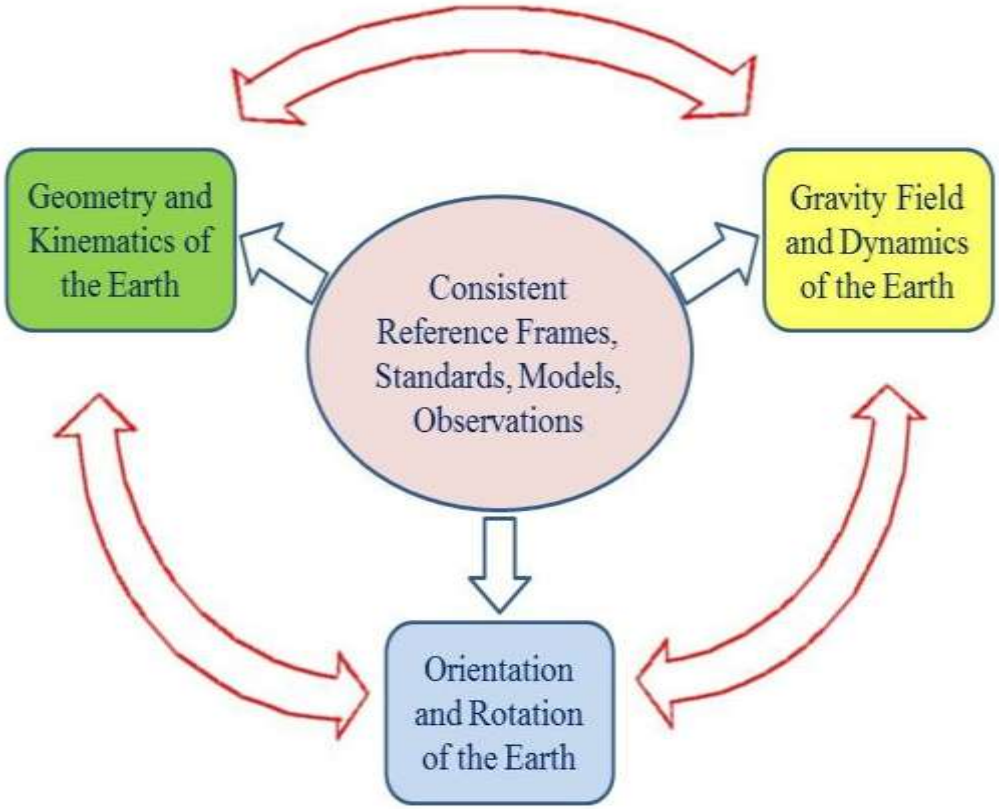
point positioning

surface scanning

gravity measurement

Fundamental Requirement for Monitoring Global Change

The study, understanding and modelling of the effects of global change require precise, consistent and stable reference frames, standards and models for the three geodetic parameter groups: Earth geometry and kinematics, Earth gravity field and dynamics, Earth orientation and rotation.



The reference frames must fulfil the following conditions:

- One order more precise than the magnitude of the phenomena to be analysed;
- Globally consistent and reliable (high precision at any place of the Earth's surface);
- Stable over long periods (high precision at any time).

Structure and Activities of the IAG Commission 1

Reference Frames (President: Christopher Kotsakis, Greece)

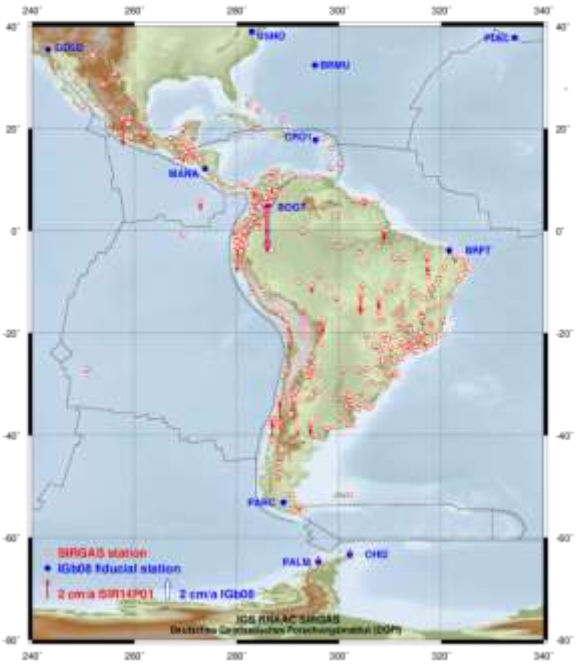
Sub-commissions:

SC 1.1: Coordination of space techniques;

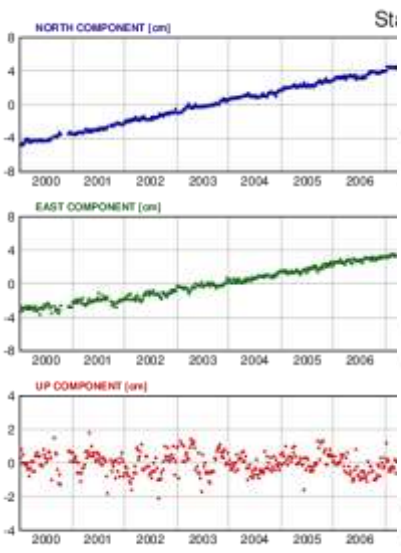
SC 1.2: Global reference frames;

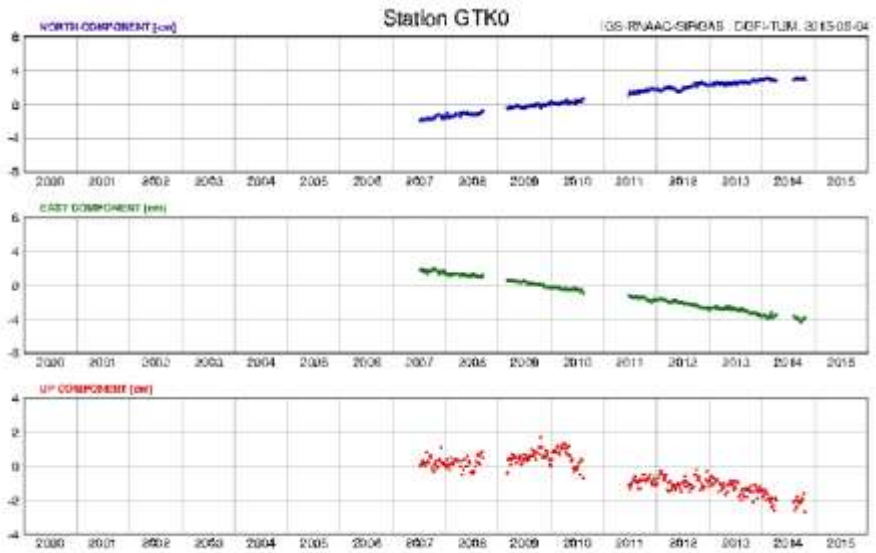
SC 1.3: Regional reference frames;

SC 1.4: Interaction of celestial and terrestrial reference frames.



Example of results: SC 1.3b (www.sirgas.org)



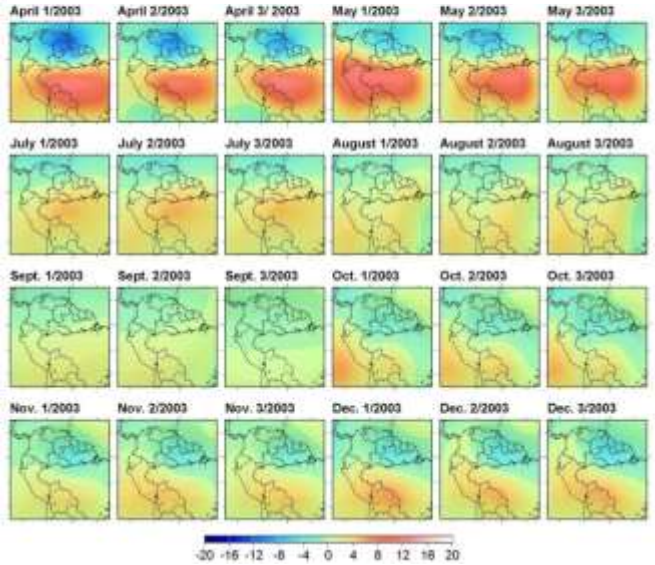


Structure and Activities of the IAG Commission 2

Gravity Field (President: Adrian Jäggi, Switzerland)

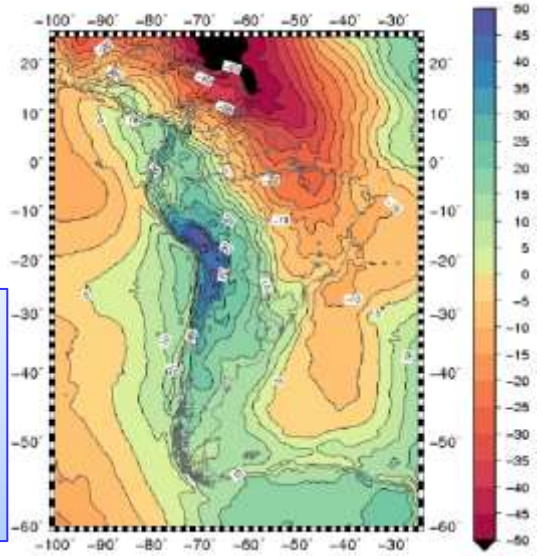
Sub-commissions:

SC 2.1: Gravimetry and gravity networks;
SC 2.2: Methodology for geoid and height determination;
SC 2.3: Satellite gravity missions;
SC 2.4: Regional geoid determination;
SC 2.5: Satellite altimetry;
SC 2.6: Gravity and mass transport in the Earth System.



Example of results:
← SC 2.3: Time series of gravity from GRACE

SC 2.4b: Regional geoid for South America and the Caribbean region →



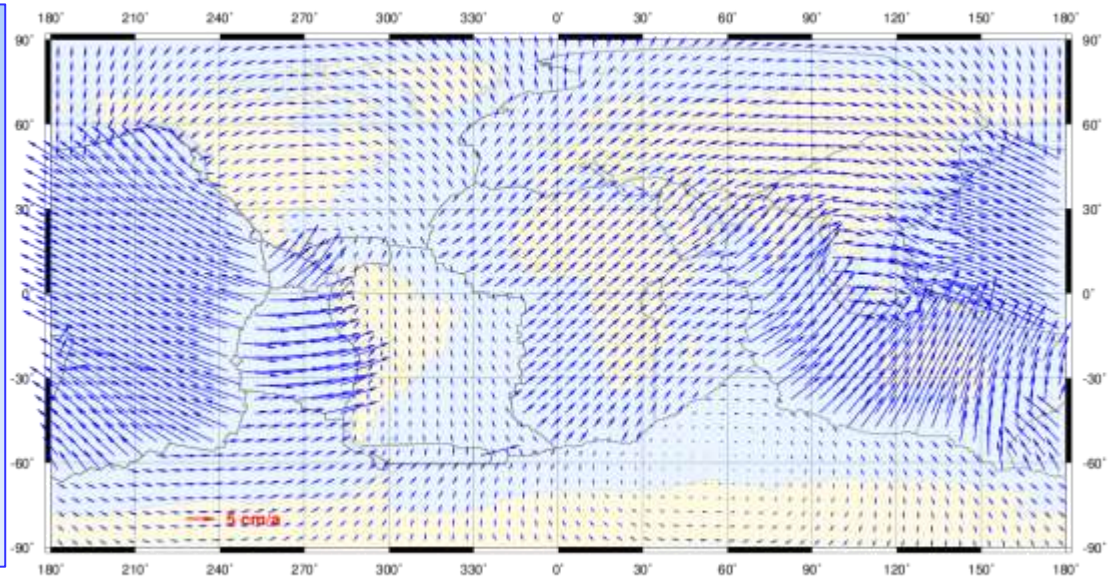
Structure and Activities of the IAG Commission 3

Earth Rotation and Geodynamics (President: Janusz Bogusz, Poland)

Sub-commissions:

SC 3.1: Earth tides and geodynamics;
SC 3.2: Crustal deformation;
SC 3.3: Earth rotation and geophysical fluids;
SC 3.4: Cryospheric deformation;
SC 3.5: Tectonics and earthquake geodesy.

Example of results:
SC 3.2: Present crustal deformation model based on geodetic observations (ITRF2008) and lithosphere structure from geophysical plate models.



Structure and Activities of the IAG Commission 4

Positioning and Applications (President: Allison Kealy, Australia)

Sub-commissions:

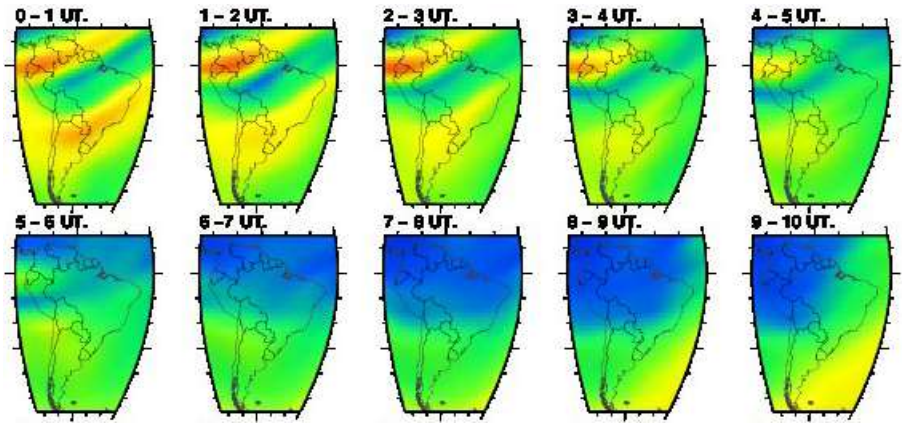
SC 4.1: Emerging positioning technologies and GNSS augmentation;

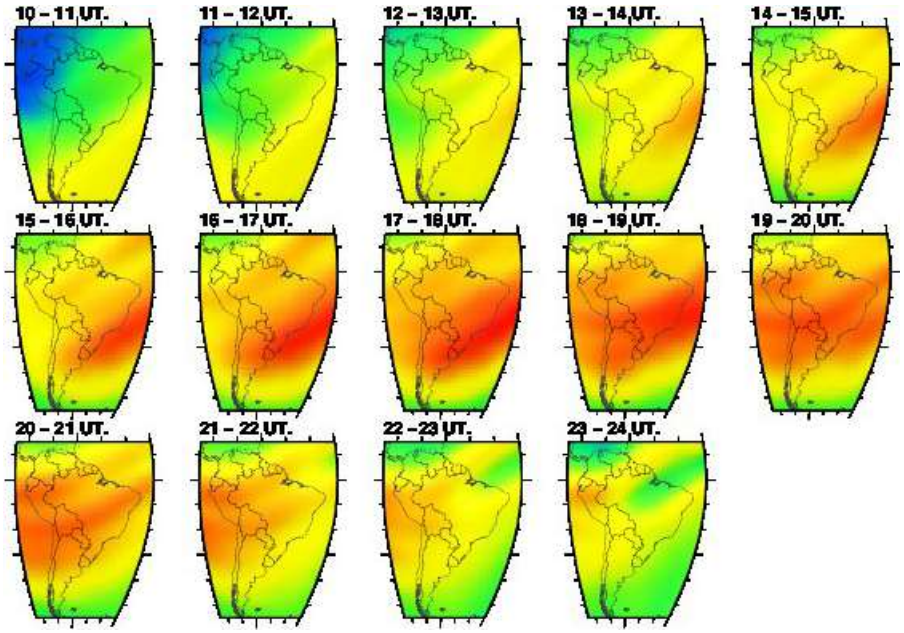
SC 4.2: Geo-spatial mapping and geodetic engineering;

SC 4.3: Atmosphere remote sensing;

SC 4.4: Multi-constellation GNSS.

Example of results:
SC 4.3: Hourly ionosphere model from GNSS (www.sirgas.org)





Structure of the Inter-Commission Committee on Theory

ICCT (President: Pavel Novak, Czech Republic)

Joint Study Groups (together with Commissions, GGOS and Services)**:**

JSG 0.10: High-rate GNSS
JSG 0.11: Multi-resolutional aspects of the potential field theory
JSG 0.12: Advanced methods for high-resolution gravity field models
JSG 0.13: Integral equations of potential theory for gravitational observables
JSG 0.14: Fusion of multi-technique satellite geodetic data
JSG 0.15: Regional geoid/quasi-geoid modelling
JSG 0.16: Earth's inner structure from combined geophysical sources
JSG 0.17: Multi-GNSS theory and algorithms
JSG 0.18: High resolution harmonic analysis and synthesis of potential fields
JSG 0.19: Time series analysis in geodesy
JSG 0.20: Space weather and ionosphere
JSG 0.21: Geophysical modelling of time variations in deformation and gravity

IAG Services

Geometry

IERS: International Earth Rotation and Reference Systems Service

IDS: International DORIS Service

IGS: International GNSS Service

ILRS: International Laser Ranging Service

IVS: International VLBI Service

Gravimetry

IGFS: International Gravity Field Service

BGI: Bureau Gravimetrique International

ICGEM: International Centre for Global Earth Models

IDEMS: International Digital Elevation Models Service

IGETS: International Geodynamics and Earth Tide Service

Ocean

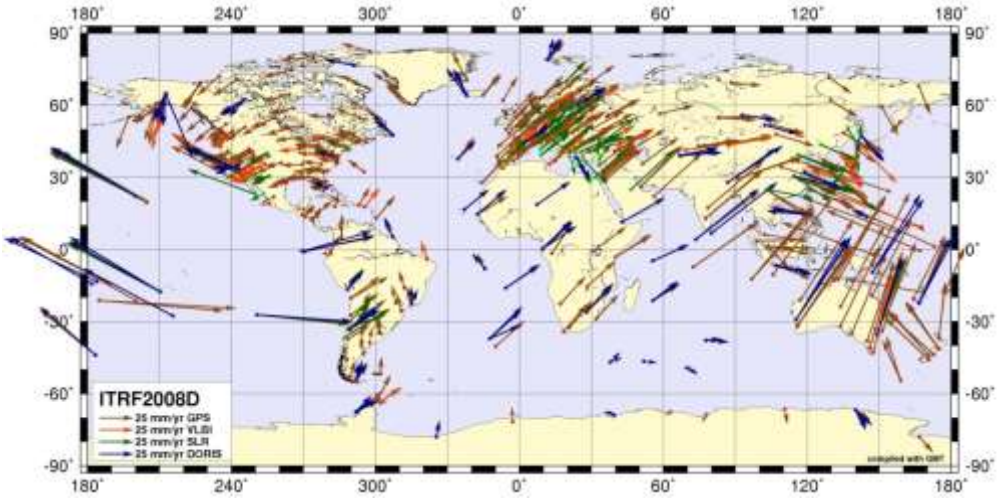
ISG: International Service for the Geoid

PSMSL: Permanent Service for Mean Sea Level

Stds

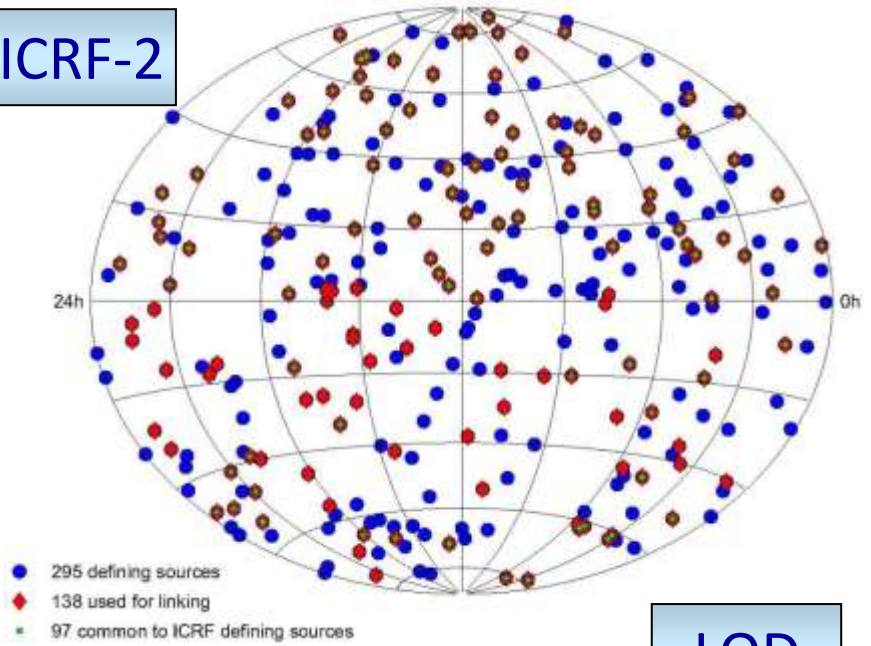
BIPM: Bureau International des Poids et Mesures

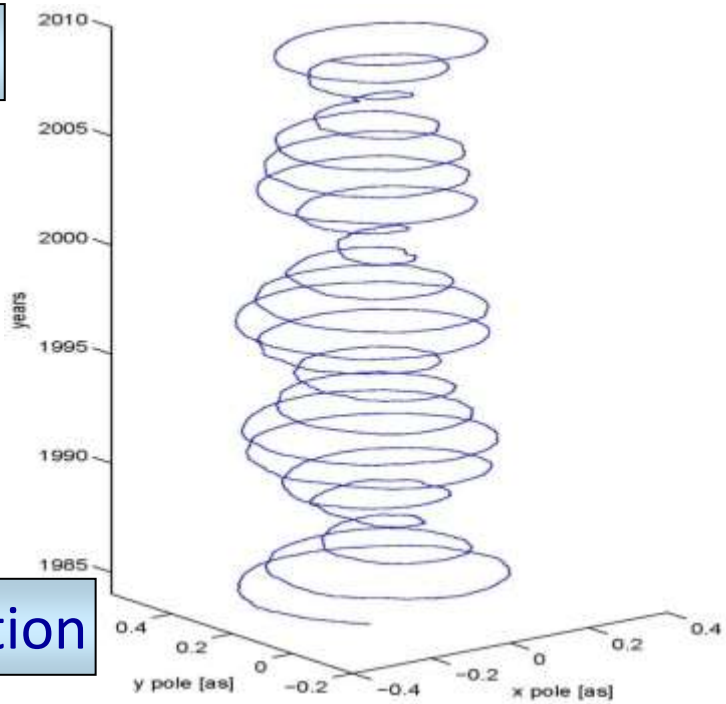
Example of IERS Products: Reference Systems



ITRF2014

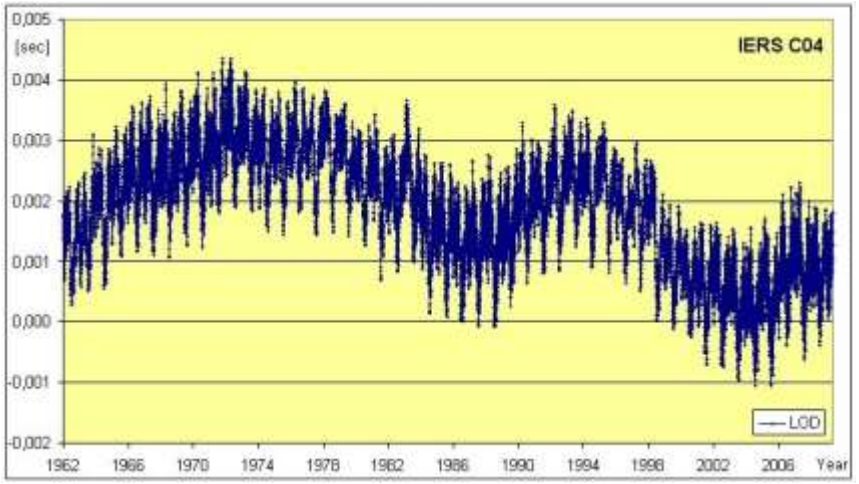
ICRF-2





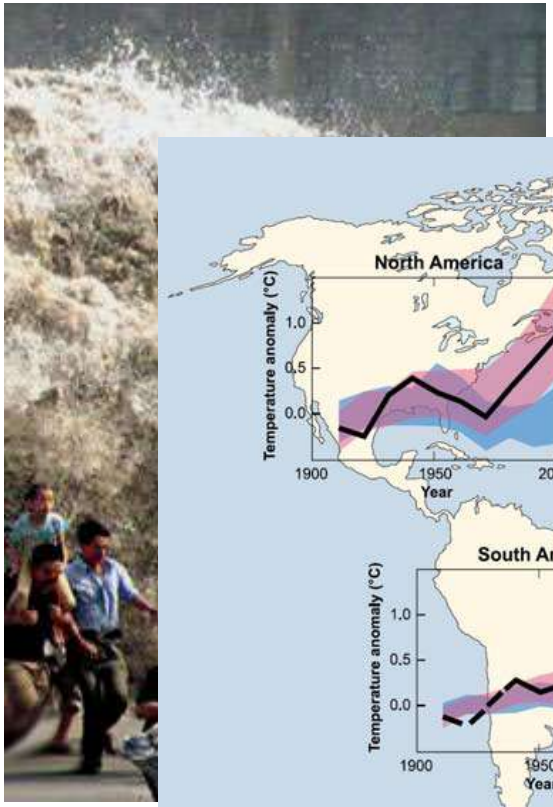
Polar motion

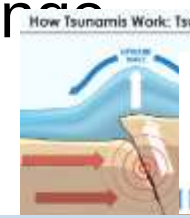
LOD

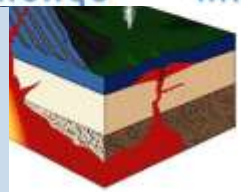


New challenges in geoscience

- Increase of natural disasters (e.g. typhoons, flooding, …)
  - Strong demand for prediction and warning
- Global climate change







GGOS today

IAG Bylaws 1(d)

"*The Global Geodetic Observing System works with the IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and global change research.*"

The vision of GGOS is

"*Advancing our understanding of the dynamic Earth system by* ***quantifying*** *our planet's changes in space and time.*"

Approaches of GGOS

- combination and integration of all available observations, methods, ...
- combine physical measurements and geometric techniques
- improve our understanding of the interactions in ”System Earth“

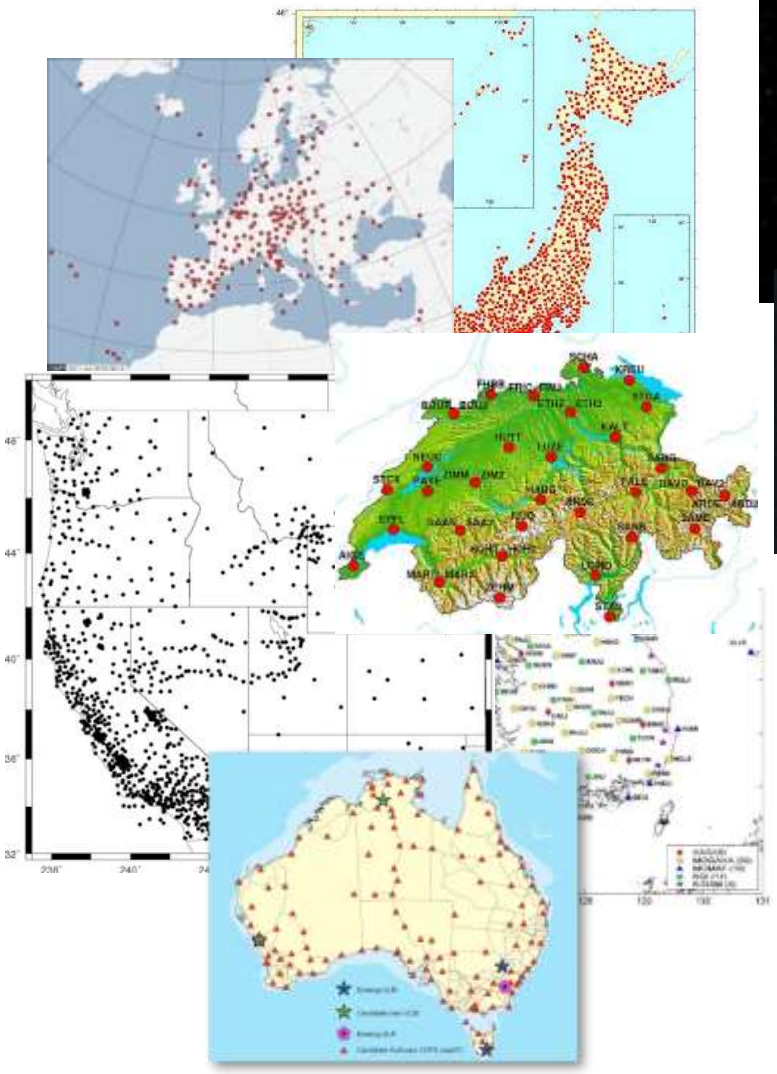
GGOS – general goals

- **1 mm position and 0.1 mm/yr velocity** accuracy on global scales for the ITRF
- **continuous measurements** (time series of EOP, station positions and baselines)
- measurements in **near real-time**
- **highest reliability** and **redundancy**
- **low cost** for construction and operation of geodetic infrastructure

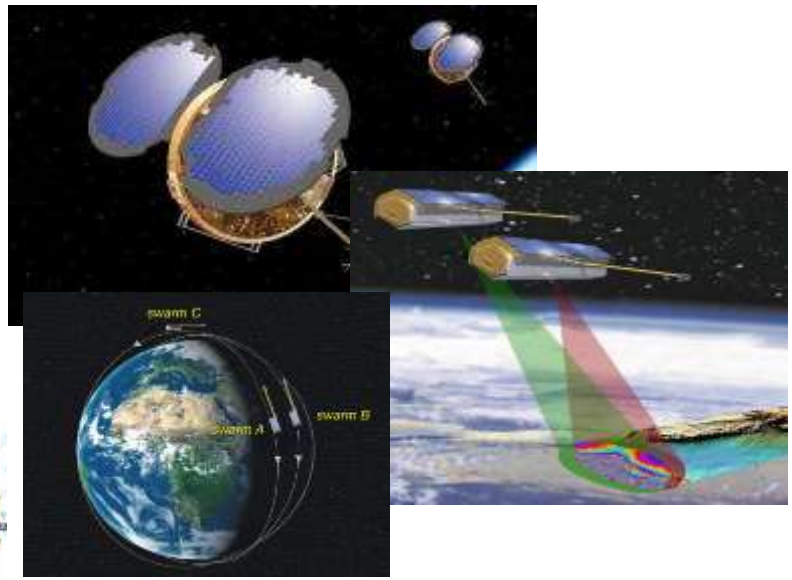
➢ ***10 answers why we need to achieve these ambitious goals will be given***

Look into the Future (2025)

GPS, GLONASS,
GALILEO, COMPASS
→ > 120 satellites



dense regional GNSS networks
> 100 000 stations



new satellite constellations,
formation flying, …

→ VLBI, SLR, GNSS, DORIS:
co-location

Conclusions

- Challenges in Earth observation:
  - very small but significant trends need to be monitored (plate tectonics, sea level change, global isostatic adjustment (GIA), climate change, …)
  - very fast events (earthquakes, tsunami, land slides, …)
- Geodesy can contribute to the exploration and understanding of our planet
- Global Geodetic Observing System (GGOS) is **the** geodetic contribution to Earth observation (within **GEOSS**, the **G**lobal **E**arth **O**bserving **S**ystem of **S**ystems under **GEO**, the **G**roup on **E**arth **O**bservations)
- GGOS provides the metrological basis (in terms of **reference frames, time and frequency transfer**) for a multitude of other Earth observations

See you in Berlin!

IUGG
BERLIN 2023

THE 28TH GENERAL ASSEMBLY
OF THE INTERNATIONAL UNION
OF GEODESY AND GEOPHYSICS

11–20 July
2023

30 September 2022
- Online registration and abstract submission opens
- Online accommodation reservations open
- Travel grant applications open

14 February 2023
- Closing of abstract submission
- Closing of grant application submission

17 March 2023
- Abstract/grant acceptance sent to participants

28 April 2023
- Early-bird registration closes

02 May 2023
- Newsletter on field trips and accommodation reservations

12 May 2023
- Complete scientific program and guidelines for presenters published

www.iugg2023berlin.org