



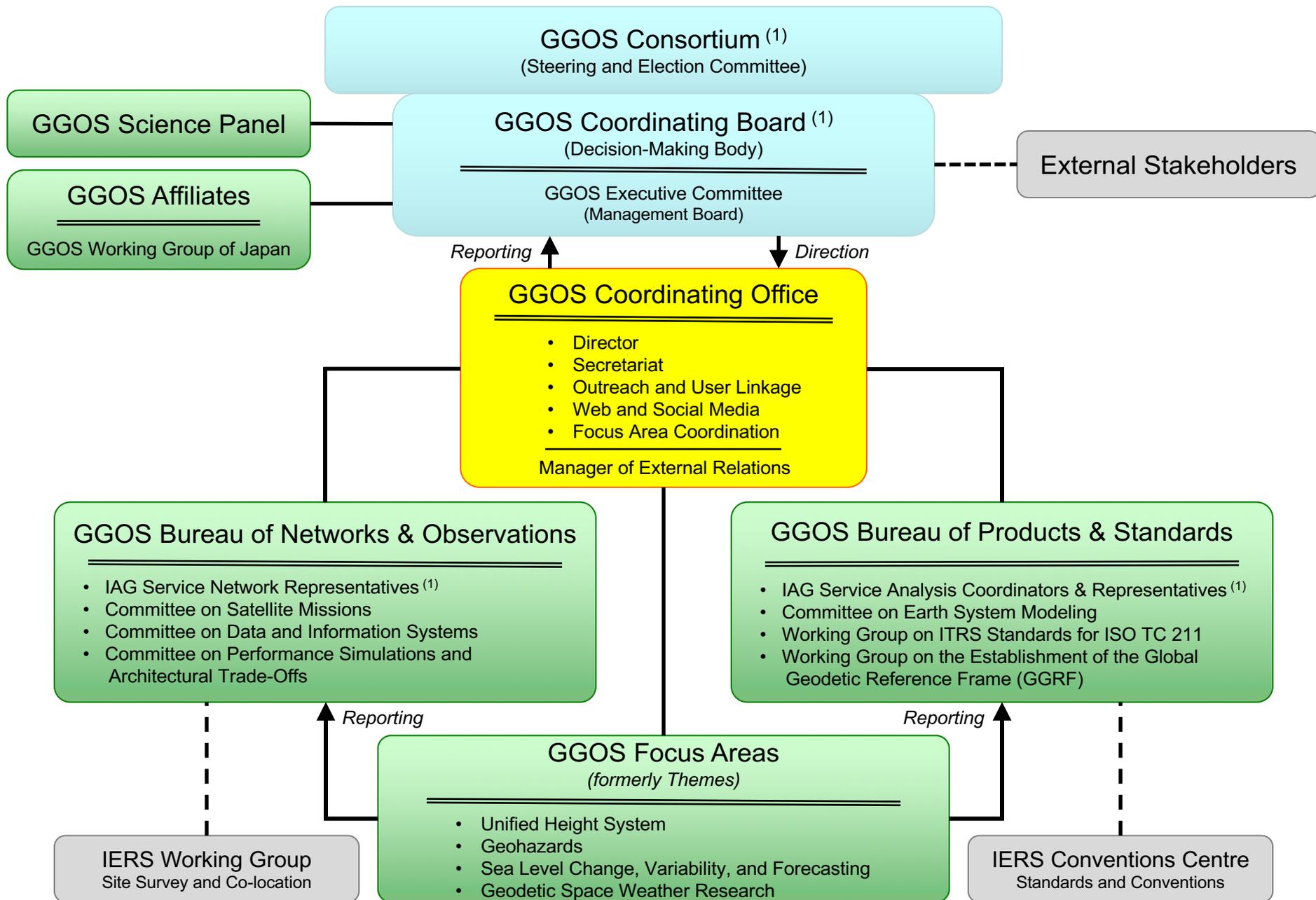
The Global Geodetic Observing System: Recent Activities

Richard Gross

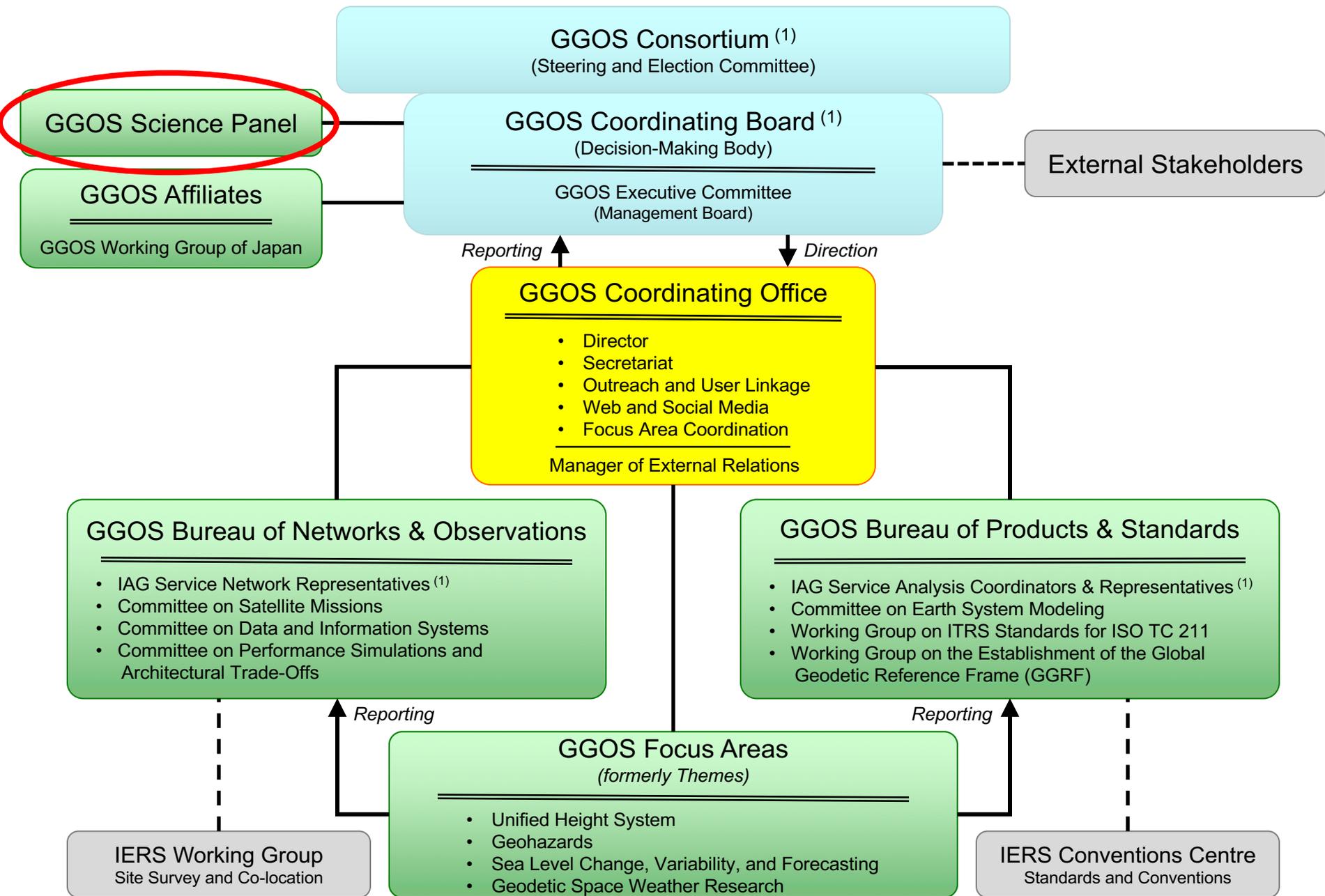
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California, USA

Japan Geoscience Union
Annual Meeting 2018

May 20–24, 2018
Chiba, Japan



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Science Panel

- **Role**

- **Independent, multi-disciplinary advisory board**

- Provides scientific support & guidance to GGOS steering & coordination entities
- Represents geodetic and geoscience communities at GGOS meetings

- **Activities**

- **Supports all other GGOS entities upon request**

- **Contributes to GGOS publications**

- Reference document, journal articles

- **Organizes & participates in GGOS Science workshops**

- Geodesy, Astronomy, and Geophysics in Earth Rotation, Wuhan, July 2016

- **Co-Organizes (with IERS) Unified Analysis Workshops**

- Paris, France; July 2017

- **Organizes & participates in GGOS sessions at conferences**

- EGU, AGU, IAG, IUGG, AOGS, JpGU

- **Participates in GGOS meetings**

- Consortium, Coordinating Board, Executive Committee

Science Panel Members

IAG Commission 1

Geoff Blewitt (USA)

Markus Rothacher (Switzerland)

IAG Commission 2

Thomas Gruber (Germany)

Kosuke Heki, Chair (Japan)

IAG Commission 3

Jianli Chen (USA)

José Ferrándiz (Spain)

IAG Commission 4

Pawel Wielgosz (Poland)

Jens Wickert (Germany)

IAG ICC Theory

Mattia Crespi (Italy)

Yoshiyuki Tanaka (Japan)

GGOS Focus Area 1

(Unified Height System)

Bernhard Heck (Germany)

GGOS Focus Area 2

(Geohazards)

Diego Melgar (USA)

GGOS Focus Area 3

(Sea Level Change)

Don Chambers (USA)

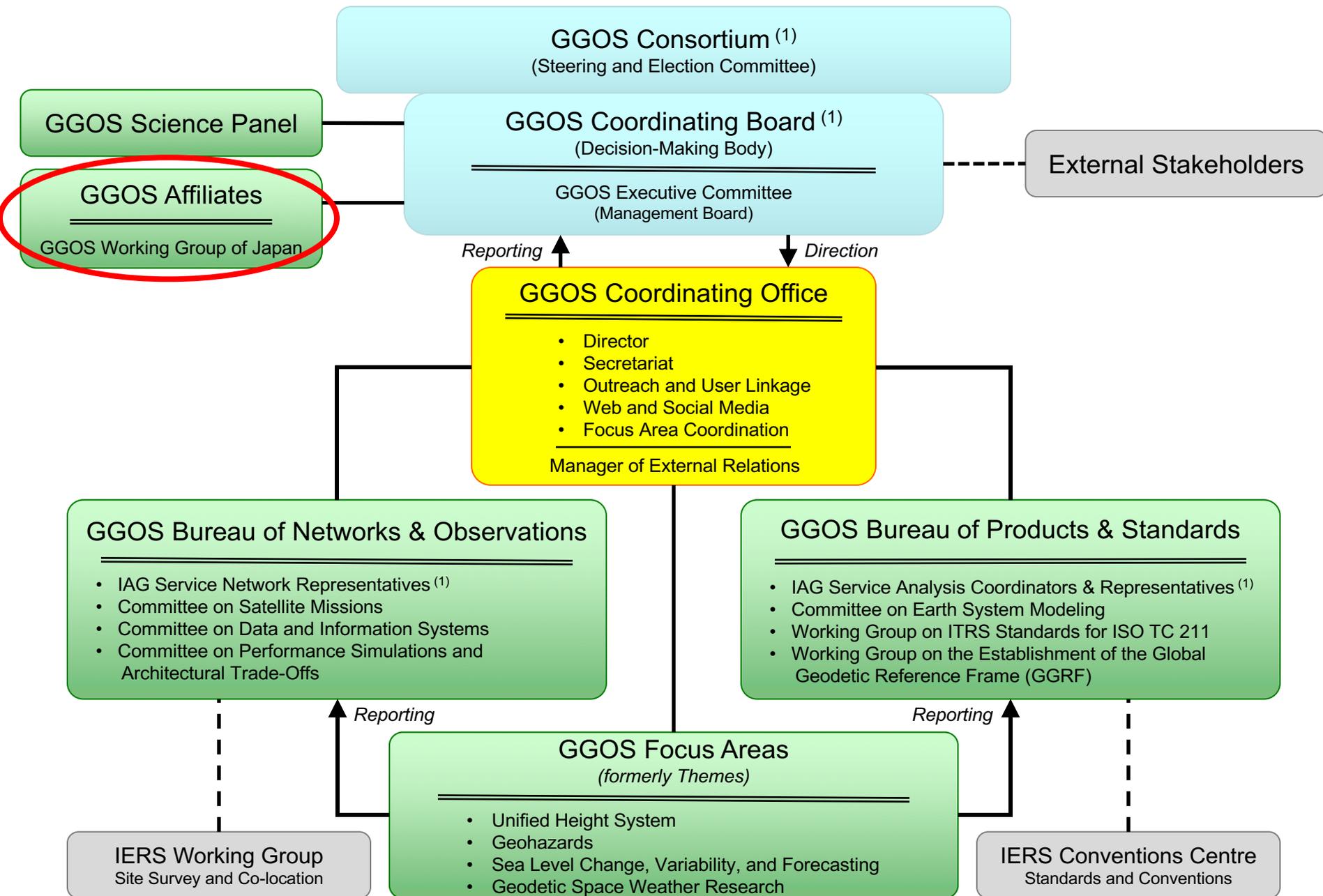
GGOS Focus Area 4

(Space Weather Research)

Ehsan Forootan (UK)

Immediate Past Chair

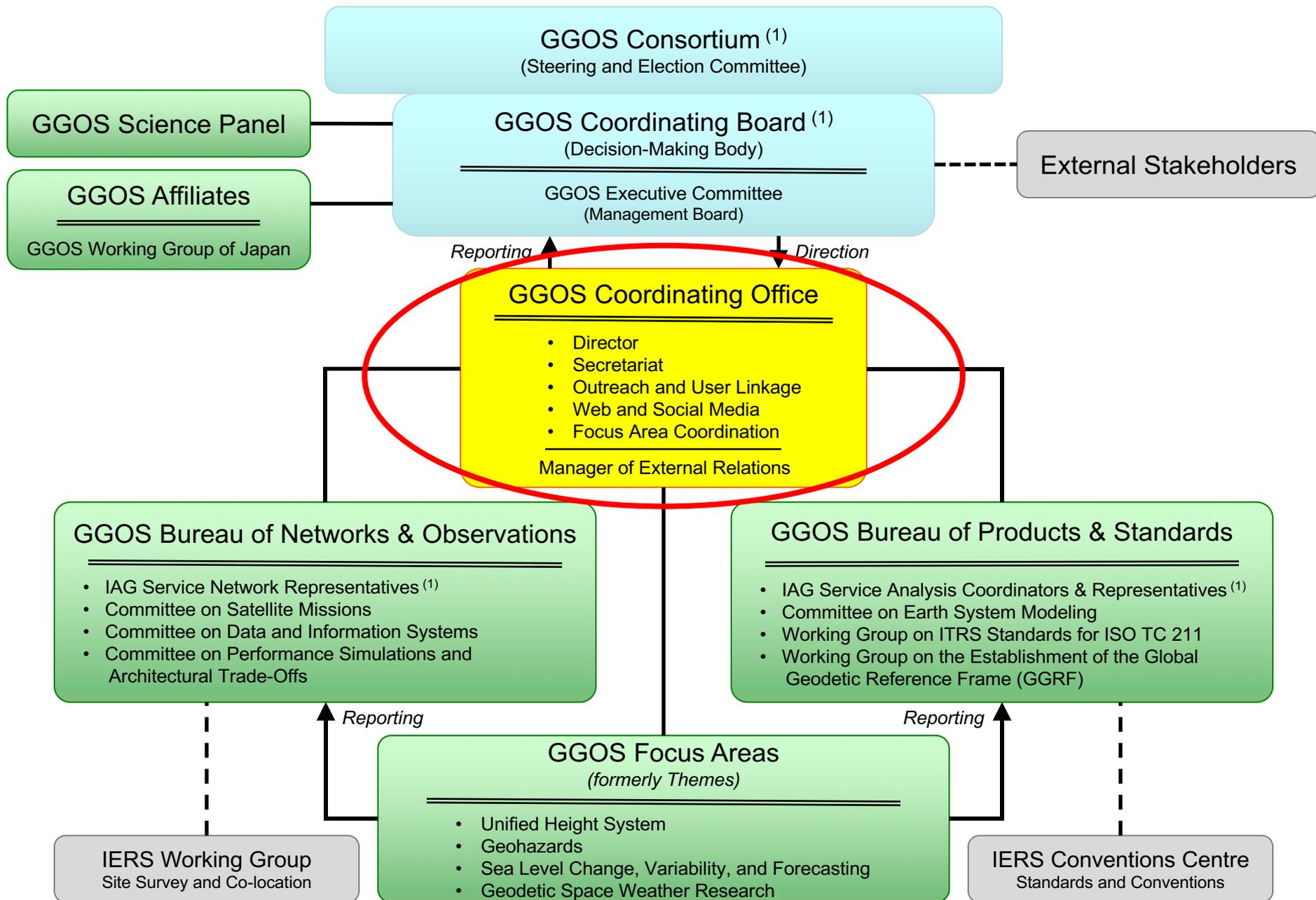
Richard Gross (USA)



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GGOS Affiliate

- National or regional organization
 - That coordinates space-geodetic activities there
- Established to increase participation in GGOS
 - Particularly from under-represented areas
 - Africa, Asia, South and Central America
- Is a component of GGOS
 - With representation on Consortium and Coordinating Board
 - Each GGOS Affiliate has 1 representative to Consortium
 - Collectively they have 2 representatives to Coordinating Board
- First GGOS Affiliate
 - GGOS Working Group of Japan
 - Established in 2013; Chair: Toshi Otsubo of Hitotsubashi University, Japan
 - Provides forum for multi-technique, space-geodetic discussions within Japan
 - Strives to improve quality of observations & encourage collaboration in Japan
- Encourage others to become GGOS Affiliates
 - Particularly important for nations/regions where multiple agencies own space-geodetic equipment



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Manager of External Relations

- Expanding involvement in external organizations
 - Group on Earth Observations (GEO)
 - GGOS Chair appointed to GEO Programme Board for 2018-2020
 - Committee on Earth Observation Satellites (CEOS)
 - Limited participation at present
 - Should be expanded to complement GGOS participation in GEO
 - UN-GGIM Subcommittee on Geodesy
 - Will establish an appropriate governance mechanism for sustaining GGRF
- Requires better approach to managing activities
 - Past approach rather *ad hoc* in nature
 - Volunteer-based
 - Little long-term stability in representation
- Position of Manager of External Relations created
 - To coordinate GGOS engagement with external organizations
 - Resides within GGOS Coordinating Office
 - Appointed by GGOS Chair subject to approval by GGOS Coordinating Board
 - Member of Coordinating Board and Executive Committee
- Allison Craddock selected as first Manager

GGOS External Relations

GGOS External Relations Near-Term Goals
Connecting GGOS with the United Nations



There is tremendous potential to increase the exposure and impact of GGOS by identifying potential contributions and connecting existing relevant work to efforts in support of both UN SDGs and the Sendai Framework.

GGOS has the potential to facilitate linkages to agencies and other providers of geodetic data, make existing geodetic data discoverable and easily accessible, and to work toward standardization.

Group on Earth Observations (GEO)



- GGOS represents the IAG in the Group on Earth Observations as a contributor to the GEO Foundational Task **GEOSS In-Situ Earth Observation Resources**;
- IAG/GGOS has been selected to be a member of the **GEO Programme Board during 2018-2020**, with Gross being the Principal Representative and Craddock acting as alternate.
- External Relations also connects the GGOS CO to the GEO Communicators Network.

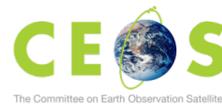
UN GGIM Subcommittee on Geodesy



United Nations

- GGOS supports and, as needed, represents the IAG at the United Nations Committee of Experts on Global Geospatial Information Management (UN GGIM).
- GGOS Consortium members H. Schuh and D. Angermann participate in Subcommittee Focus Groups on behalf of the IAG, with Consortium members Gross, Craddock, and G. Johnston participating on behalf of their nations.

Committee on Earth Observation Satellites (CEOS)

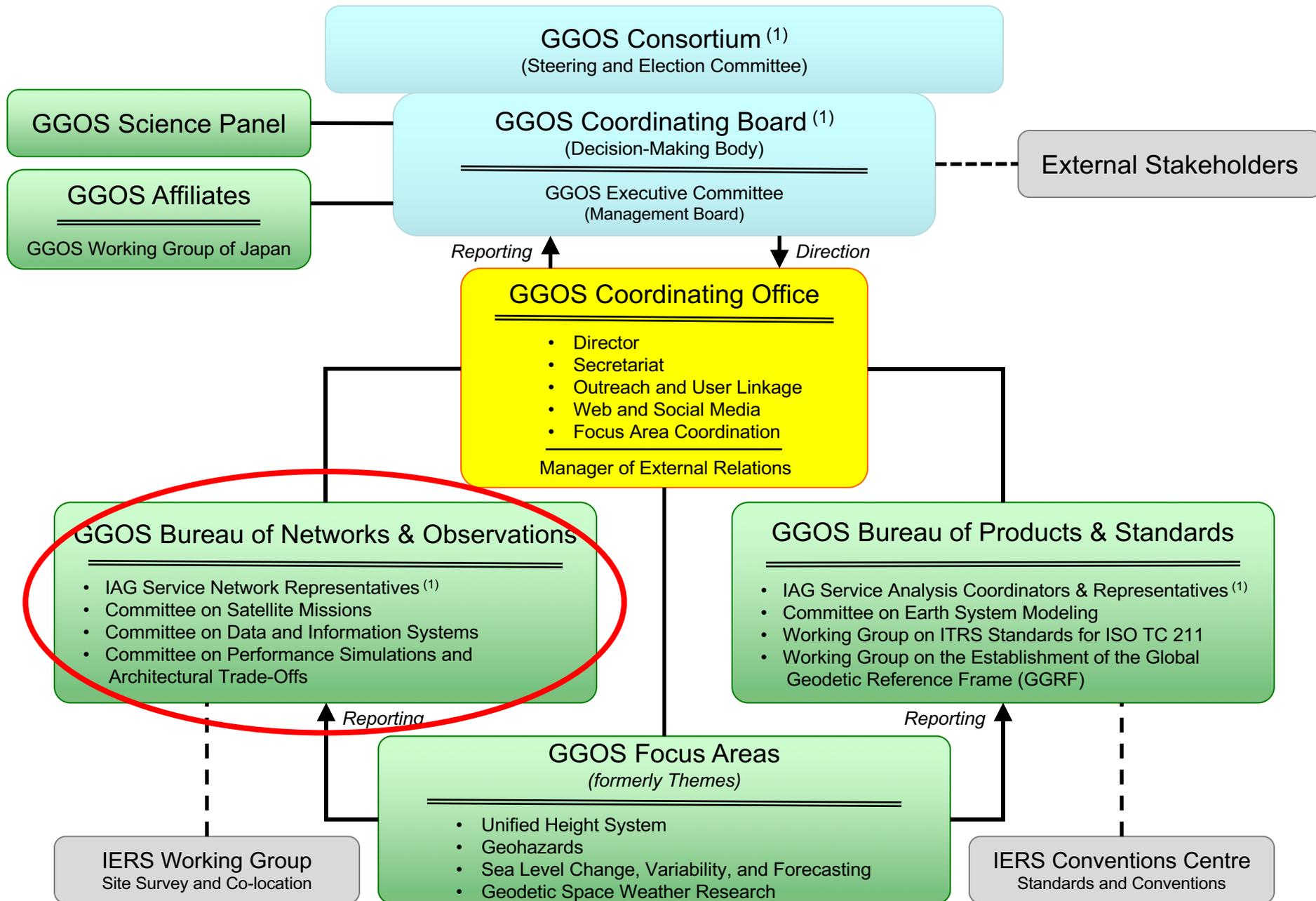


- GGOS has renewed its engagement with CEOS by appointing Craddock as the GGOS representative to their **Ad Hoc Team on the Sustainable Development Goals (AHT SDG)**, which highlights the potential role for Earth observations in supporting the global indicator framework of the United Nations Sustainable Development Goals

International Council for Science (ICSU) World Data System (WDS)



- GGOS, a partner member of ICSU-WDS, may play an important part in encouraging data providers of the WDS to adopt or renew their **CoreTrustSeal**, the new WDS data certification process.
- ICSU is also developing **Essential Sustainability Variables**, which would be in alignment with GGOS's own recent initiative to define Essential Geodetic Variables.



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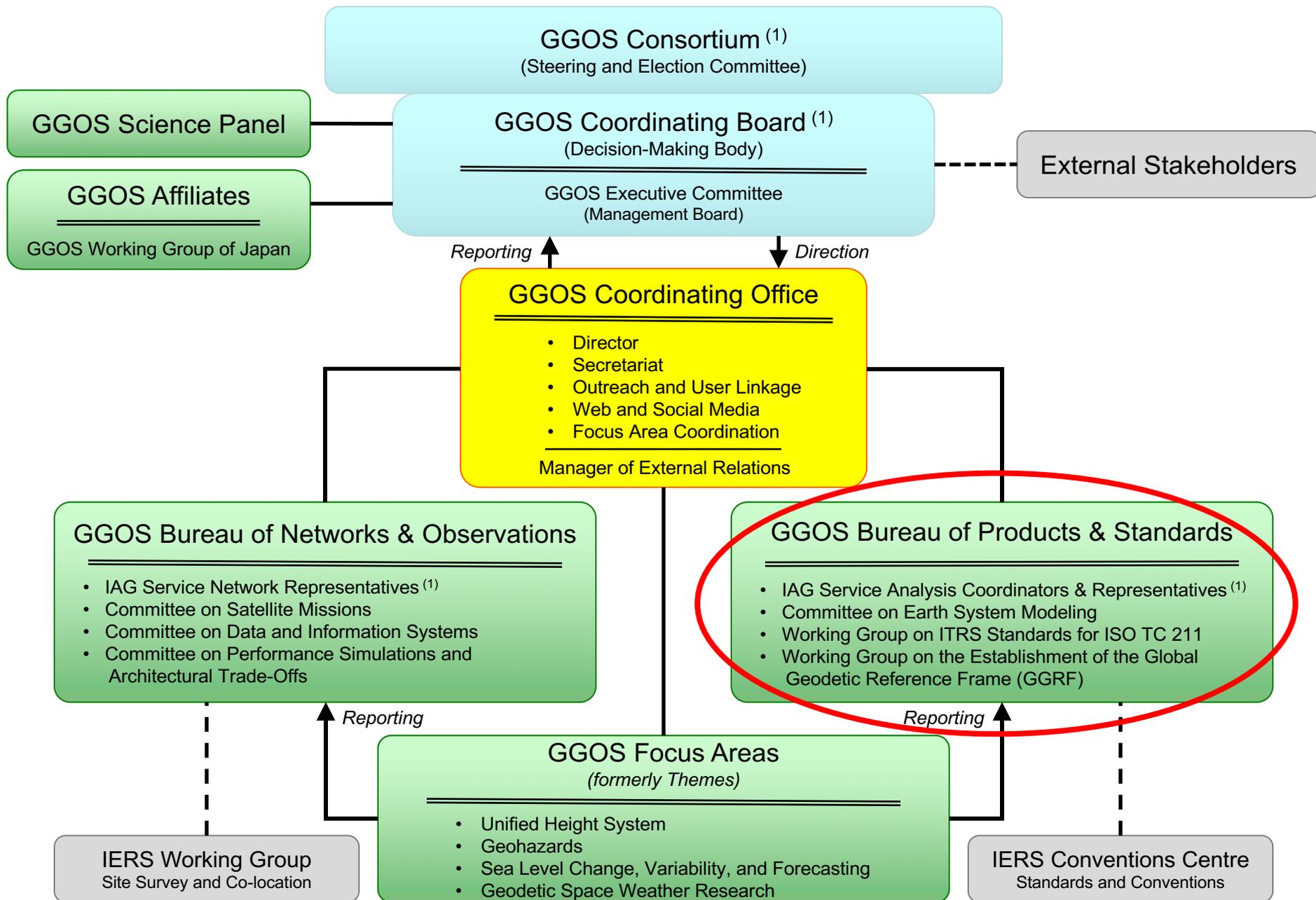
Bureau of Networks and Observations

- Provide a forum for the Services and Standing Committees/Working Groups to share and discuss plans, progress, and issues, meetings in conjunction with annual AGU and EGU.
- Advocate for new and increased network participation, encouraging formation of new partnerships to develop new sites, monitored the status of the networks; meetings and communications held with representatives from Russia, Italy, Brazil, Japan, Spain, France, Korea, and Saudi Arabia to discuss implementation of new stations and upgrade of legacy stations.
- Continue the Bureau's "Call for Participation in the Global Geodetic Core Network: Foundation for Monitoring the Earth System"; 19 submissions have been received covering 114 sites that include legacy sites, new technology co-location and core sites, sites under development, and sites offered for future participation; a number of new sites plan to join once they are operational.
- See: <http://www.ggos.org/Components/BNO/>



Bureau Activities

- Maintain and update the “Site Requirements for GGOS Core Sites” document (with the IAG Services); the next major step will be to include the requirements for the gravity field once it is fully documented by the IGFS and the IGRF working group; Work with the IGFS in the definition of its requirements.
- Advocate for the GGOS integrated global geodetic ground-based infrastructure through talks and posters at AGU, EGU, AOGS, APSG (China), JpGU-AGU, IAG, etc. and meetings and special presentations at GSI (Japan), IMPE (Brazil), IAP (Russia) etc.; support efforts to integrate relevant parameters from other ground networks (gravity field, tide gauges, etc.) into the GGOS network to support GGOS requirements.
- Work with the BP&S and the IGFS to help define the gravity field and unified height systems measurement requirements and encourage deployment of the field measurement systems.



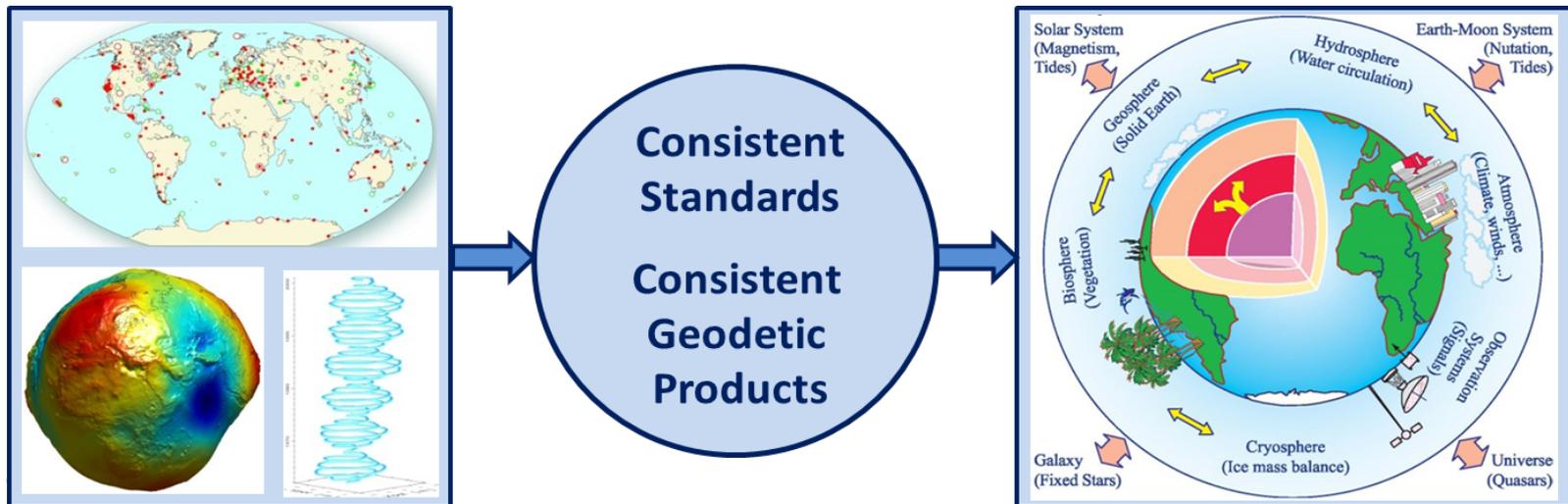
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GOS Bureau of Products and Standards (BPS)

The BPS supports GGOS in its key goals to obtain consistent products describing the geometry, rotation and gravity field of the Earth.

Mission and objectives

- to serve as contact and coordinating point for the homogenization of IAG/GGOS standards and products;
- to keep track of the adopted geodetic standards and conventions across all IAG components, and initiate steps to close gaps and deficiencies;
- to focus on the integration of geometric and gravimetric parameters and to develop new products, needed for Earth sciences and society.



BPS Inventory

The BPS has compiled an inventory on standards and conventions used for the generation of IAG products:

- Review of numerical standards;
- Focus on IAG products: CRS/CRF, TRS/TRF, EOP, GNSS satellite orbits, gravity and geoid, heights;
- Assessment of the present status, identification of gaps, recommendations.

BPS inventory is published in the **IAG Geodesist's Handbook 2016**:
Angermann D., Gruber T., Gerstl M., Heinkelmann R., Hugentobler U., Sánchez L., Steigenberger P.: **GGOS Bureau of Products and Standards: Inventory of standards and conventions used for the generation of IAG products**. In: Drewes H., Kuglitsch F., Adám J. (Eds.) The Geodesist's Handbook 2016. Journal of Geodesy 90(10), 1095-1156, [10.1007/s00190-016-0948-z](https://doi.org/10.1007/s00190-016-0948-z), 2016

Preface

Scope of the document

Acknowledgements

1 Introduction

1.1 GGOS: Mission, goals and structure

1.2 Standards and conventions

2 GGOS Bureau of Products and Standards

2.1 Mission and objectives

2.2 Tasks

2.3 Staff and representatives

3 Evaluation of numerical standards

3.1 Defining parameters

3.2 Solid Earth tide systems

3.3 Geopotential value W_0

3.4 Open problems and recommendations

4 Product-based review

4.1 Celestial reference systems and frames

4.2 Terrestrial reference systems and frames

4.3 Earth Orientation Parameters (EOP)

4.4 GNSS satellite orbits

4.5 Gravity and geoid

4.6 Height systems and their realizations

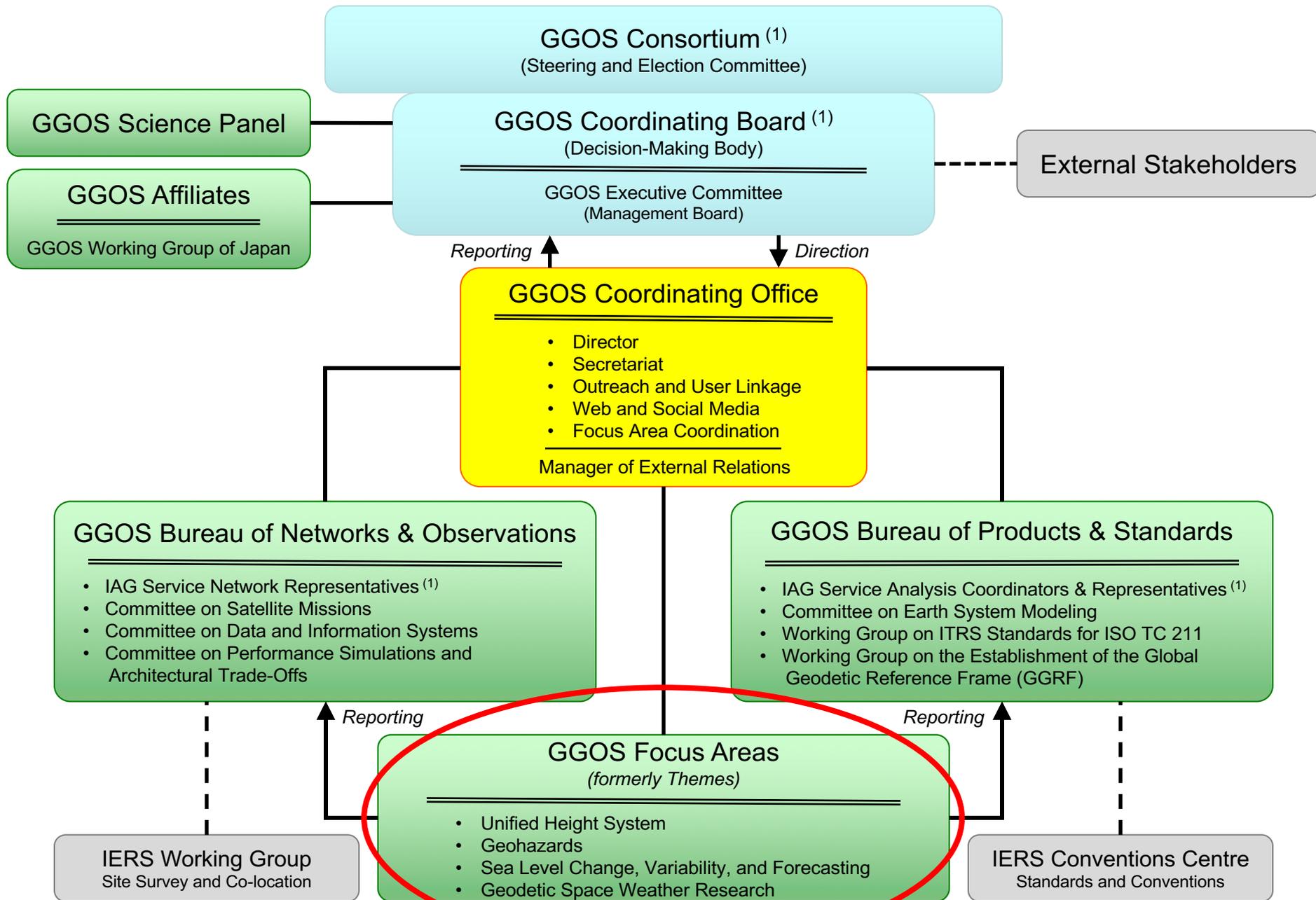
5 Summary

Glossary

Bibliography

Essential Geodetic Variables

- **Observed variables**
 - Crucial to characterizing geodetic properties of Earth
 - Key to sustainable geodetic observations
 - Positions of reference objects (ground stations, radio sources), EOPs
 - Gravity measurements (ground-based, space-based)
- **Assign requirements to each EGV**
 - Accuracy, spatial and temporal resolution, latency, stability, ...
- **Derive requirements**
 - On EGV-dependent products (TRF, CRF, ...)
 - On infrastructure (observing systems)
- **Can be used to update GGOS2020 book**
 - Bottoms-up approach to deriving requirements
 - Complements top-down approach used in GGOS2020 book (user needs)
- **Establish Committee within GGOS BPS**
 - To create list of EGVs, assign requirements to them, etc.
 - Committee will include representatives of
 - IAG Services, Commissions, Intercommission Committees, GGOS Focus Areas



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Global Geodetic Observing System

1. Requirements-setting organization for geodesy
 - GGOS 2020 book and its update
 - Essential Geodetic Variables
2. Forum for international collaboration
 - Improve integrated, global geodetic infrastructure
 - Improve geodetic products
 - Unified Analysis Workshops
3. Advocate for geodesy to broader community
 - Group on Earth Observations; Committee on Earth Obs. Satellites
 - Provide Earth observations (including geodetic) needed to make informed decisions
 - UN-GGIM Subcommittee on Geodesy
 - Emerging policy-making organization in geodesy
 - Emerging forum for international collaboration
4. Incubator for new initiatives in geodesy
 - Unified Height System
 - Sea Level Change, Variability, and Forecasting
 - Geohazards
 - Geodetic Space Weather Research

GGOS Days 2018

GSI Headquarters
Tsukuba, Japan
October 2–5, 2018

Will include excursion to
Ishioka Geodetic Observing Station

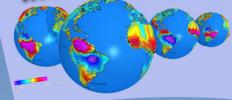
Please Attend!



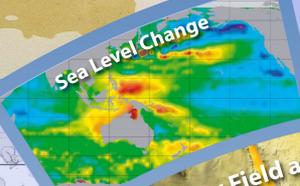
Markus Rothacher (GGOS Chair), Achim Helm (GeoForschungsZentrum Potsdam)
Ruth E. Neillan (GGOS Vice-Chair) (Jet Propulsion Laboratory)
Hans-Peter Plag (GGOS Vice-Chair) (University of Nevada)



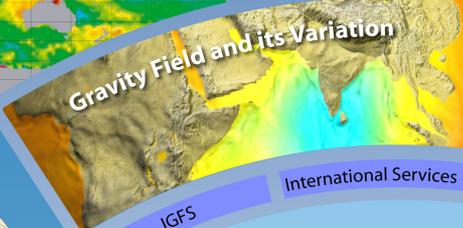
Water Storage Change



Sea Level Change



Gravity Field and its Variation



Disaster Monitoring



Earth Orientation and Rotation



International Services

Global Geodetic Observation System (GGOS)

GPS, GLONASS, Galileo

Satellite Altimetry (JASON)

Geodetic Space Techniques

Satellite-to-satellite tracking (GRACE)

Atmospheric Sounding (CHAMP)

Satellite Laser Ranging

Tsunami Detection (GPS Buoy)

Atmospheric Sounding



Geometry and Kinematics



Surveying



IAG Services are based on more than 400 global observation stations



