Bundesamt für Kartographie und Geodäsie

Presented at the FIG Working Week 2017,
May 29 – June 2, 2017 in Helsinki, Finland

GGOS – The Global Geodetic Observing System of the International Association of Geodesy

Hansjörg Kutterer

BKG, Germany

Content

- Introduction
- Strategy
- Organization
- Practice
- Conclusions

Motivation: The Earth is a dynamic system






Motivation

Everything is moving !

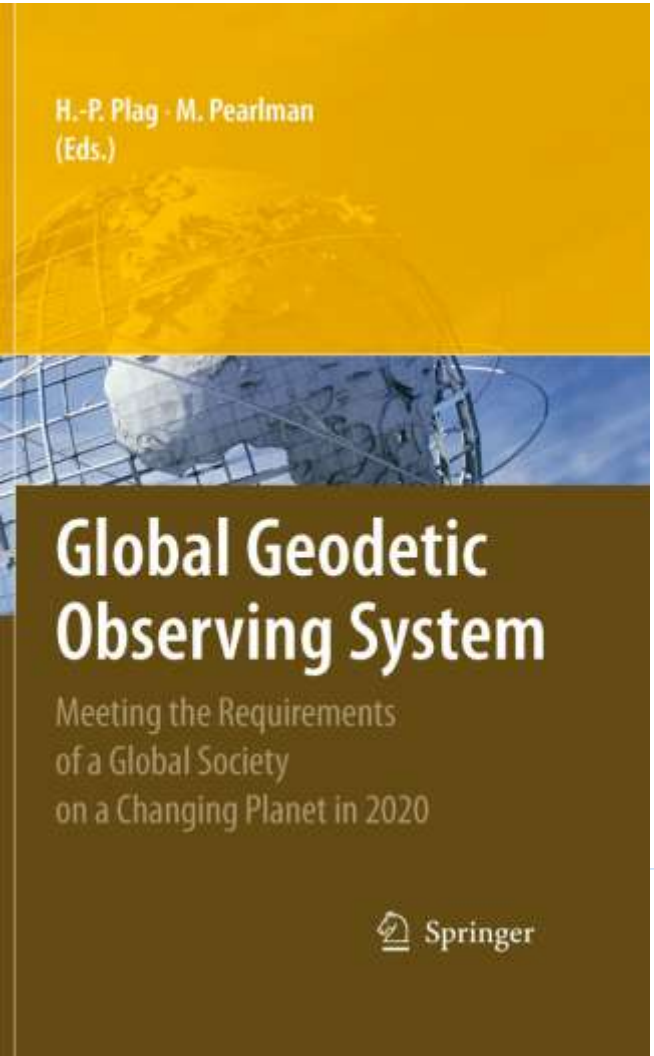
Examples

- Earth rotation
- Plate motions
- Earthquakes
- Solid Earth tides (caused by Sun and Moon)
- Loading phenomena (ice, ocean, atmosphere)
- Sea-level change

Continuous monitoring is absolutely crucial !

GGOS 2020 Book (2009)

GGOS: Meeting the Requirements of a Global Society on a Changing Planet in 2020. Eds. H.-P. Plag and M. Pearlman. Springer 2009. p. 332



Content: Arguments for GGOS

- Goals, achievements and tools of modern geodesy
- Earth science requirements for geodesy
- Maintaining a modern society (9 societal benefit areas) → GEO
- Future geodetic reference frames
- Future Global Geodetic Observing System (GGOS)
- GGOS 2020

Global Geodetic Observing System (GGOS)

Terms of Reference

Vision

ADVANCING OUR UNDERSTANDING OF THE DYNAMIC EARTH SYSTEM BY QUANTIFYING OUR PLANET'S CHANGES IN SPACE AND TIME.

Mission

To provide the observations needed to monitor, map, and understand changes in the Earth's shape, rotation, and mass distribution.

To provide the global geodetic frame of reference that is the fundamental backbone for measuring and consistently interpreting key global change processes and for many other scientific and societal applications.

To benefit science and society by providing the foundation upon which advances in Earth and planetary system science and applications are built.

Source: GGOS Terms of Reference (2015)

GGOS Strategy

Overarching Strategic Areas

1. **Geodetic Information and Expertise** *(intangible assets)*

GGOS outcomes will support the development and maintenance of organizational intangible assets, including geodetic information and expertise. The development of this strategic focus area will benefit all other goals and objectives.

2. **Global Geodetic Infrastructure** *(advocacy for, and sustenance of, tangible assets)*

Development of, advocacy for, and maintenance of existing global geodetic infrastructure is in direct support of each GGOS goal.

3. **Services, Standardization, and Support** *(internal and external coordination)*

Optimal coordination, support, and utilization of IAG services, as well as leveraging existing IAG resources, are critical to the progress of all GGOS goals and objectives.

4. **Communication, Education, and Outreach** *(public relations, external education and outreach, internal continuing education and training)*

Marketing, outreach, and engagement are critical elements for sustaining the organizational fabric of GGOS.

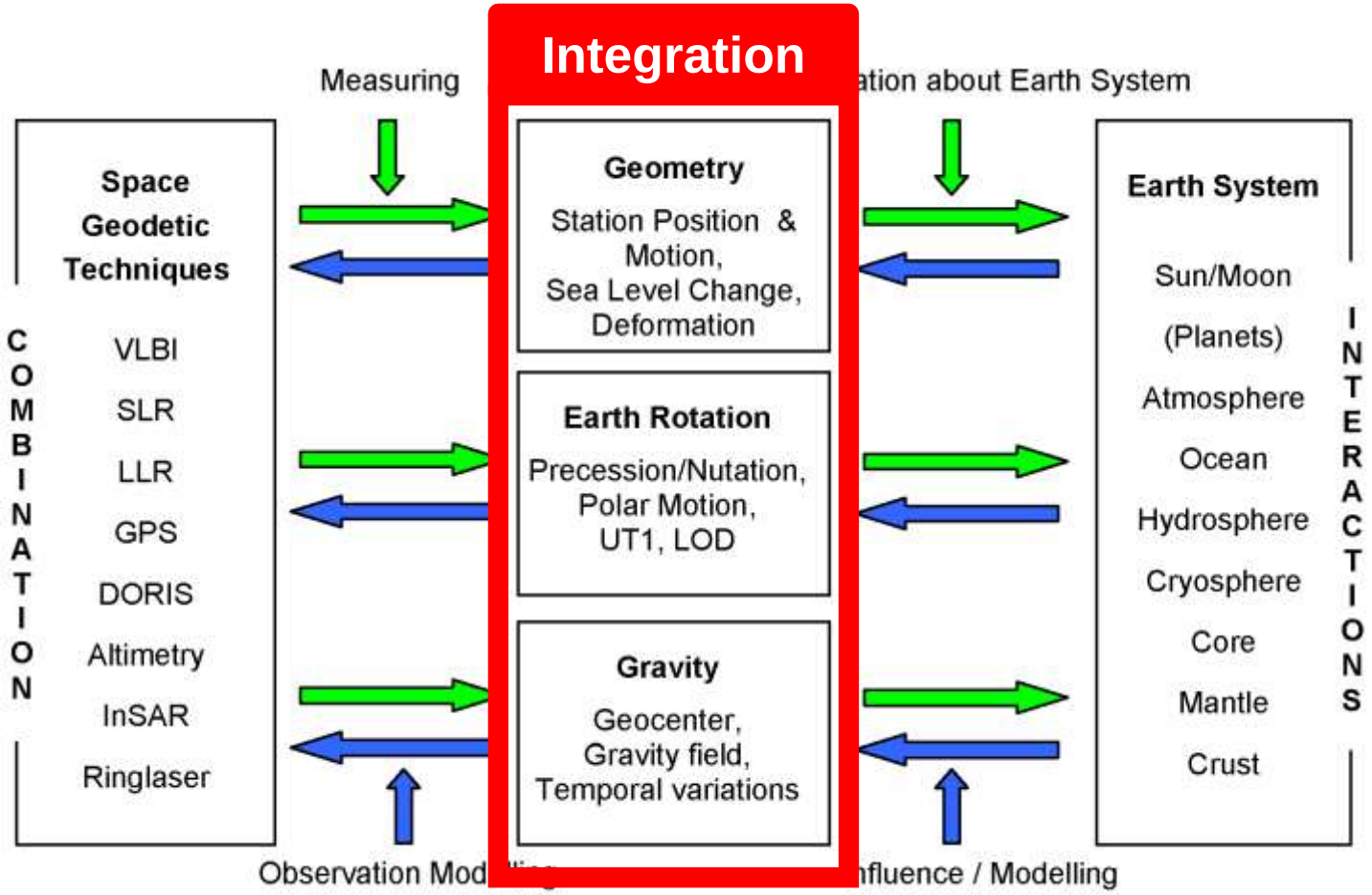
IAG‘s view on GGOS

Perspectives

- GGOS as an Observing System
- GGOS as an Organization
- GGOS as a Brand

GGOS as an Observing System

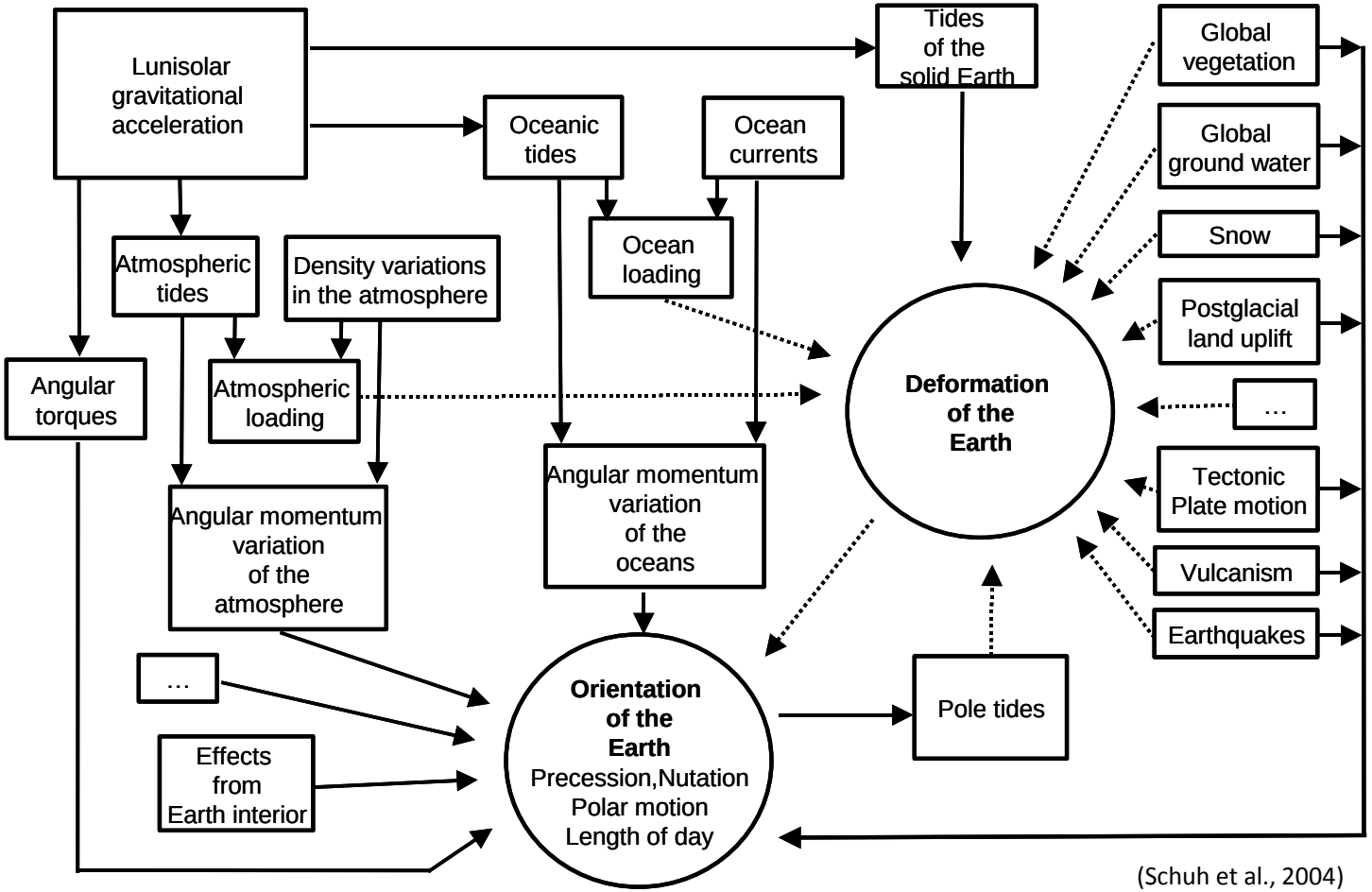
The three pillars of Geodesy



(Schuh et al., 2004)

GGOS as an Observing System

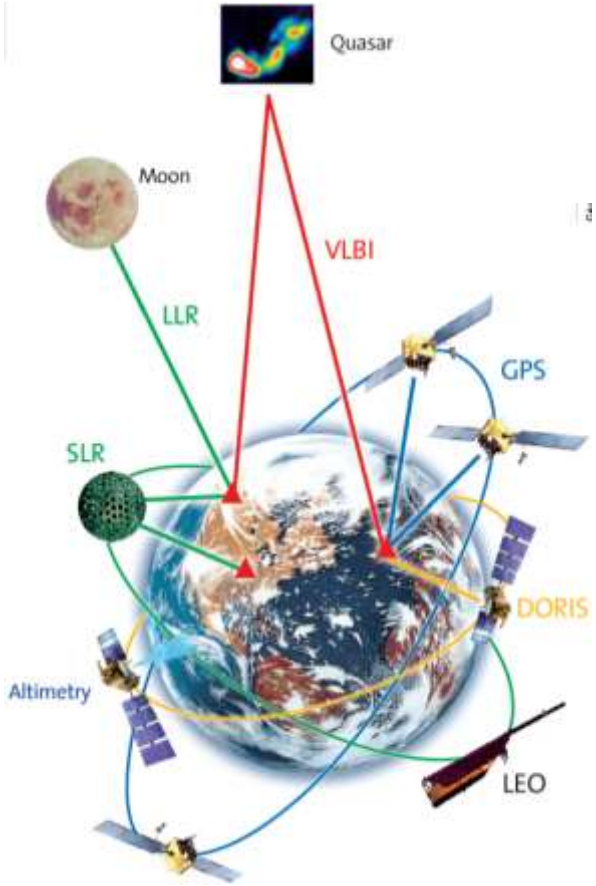
Complexity of processes within Earth System



(Schuh et al., 2004)

GGOS as an Observing System

Observation architecture



Five levels

Level 1:
Ground stations, terrestrial measurements

Level 2:
Low Earth Orbiters

Level 3:
Medium / Geostationary Earth Orbiters

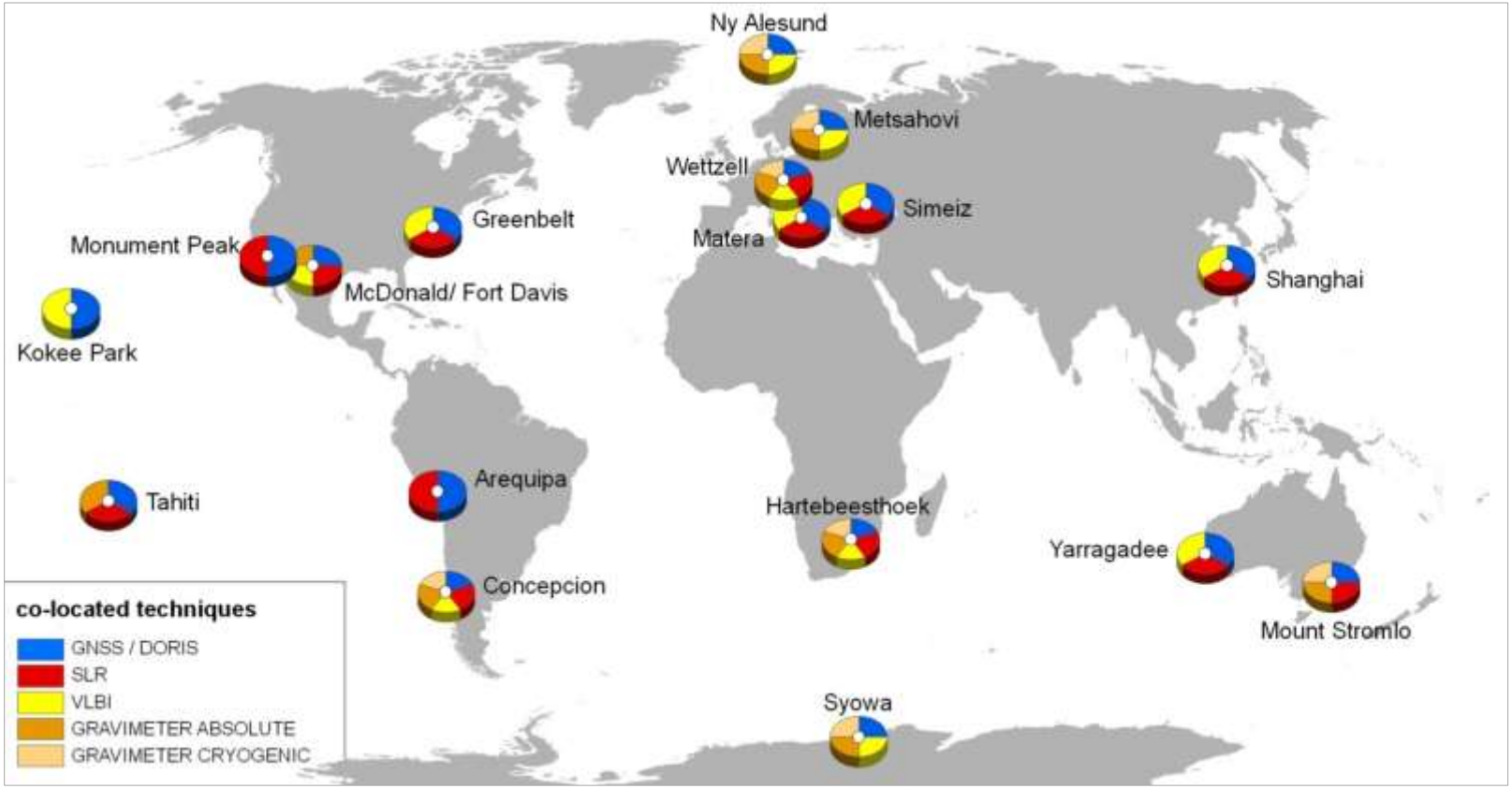
Level 4:
Moon, Planets

Ebene 5:
Quasars

Source: Plag et al. (2009)

GGOS as an Observing System

Exemplary ground segment



GGOS Core Sites

GGOS as an Observing System

Geodetic Observatories – Example Wettzell

1. Zeitkeller
2. Turm mit Globales Navigationssatellitensystem (GNSS)
3. Hauptgebäude
4. Gravimeter 1
5. TWIN-Teleskop 1
6. TWIN-Betriebsgebäude
7. Wettzell Laser Ranging System (WLRS)
8. TWIN-Teleskop 2
9. Satellite Observing System-Wettzell (SOS-W)
10. Betriebsgebäude Radioteleskop
11. Das 20 m-Radioteleskop Wettzell (RTW)
12. Großringlaser G

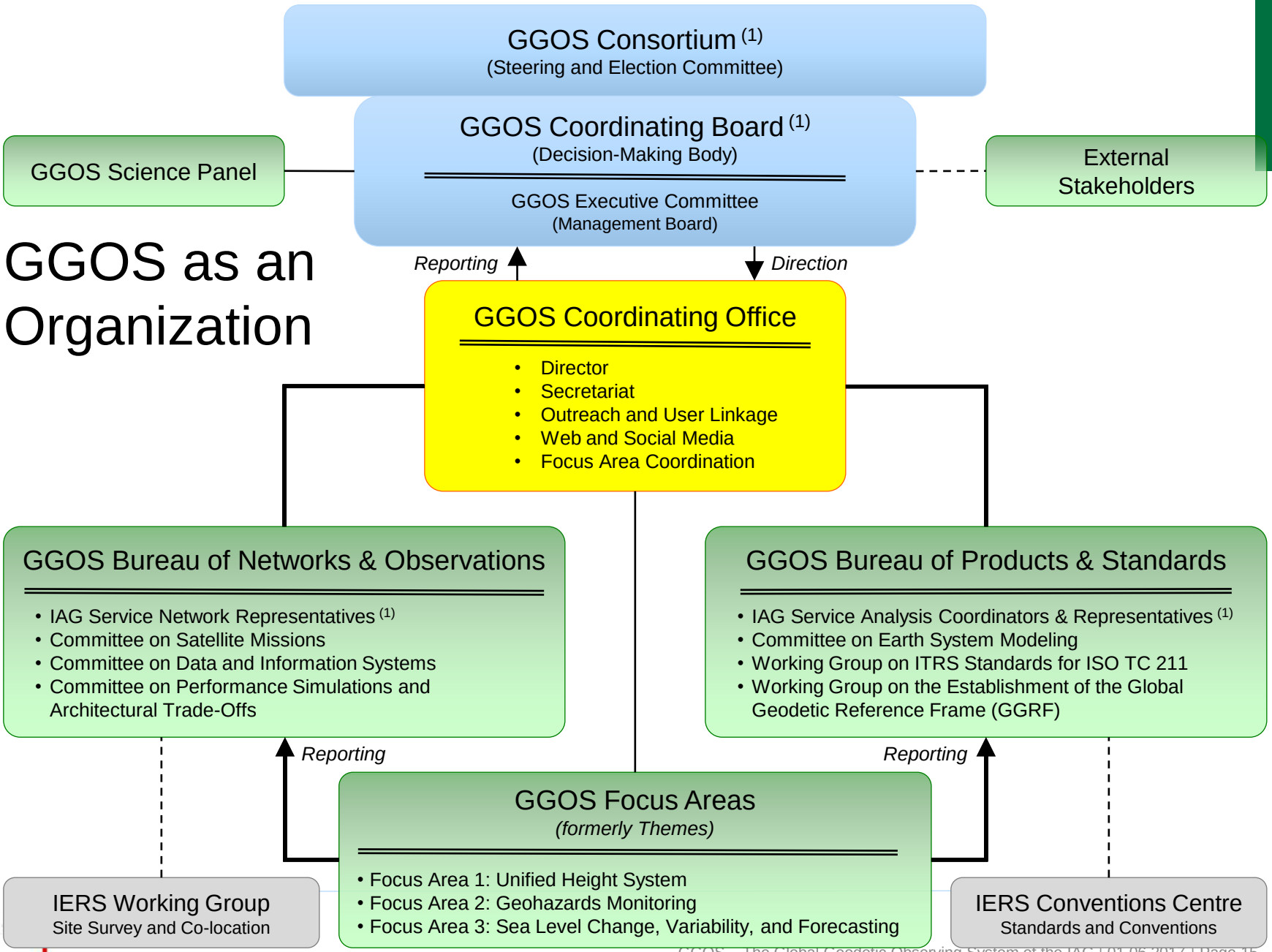
GGOS as an Observing System

Accuracy goals

Celestial reference frame	25 μas with 3 μas/y (positions)
Terrestrial reference frame	1 mm with 0.1 mm/y (positions) 0.1 ppb with 0.01 ppb/y (scale)
Daily EOP	1 mm (2 weeks delay) 3 mm (real-time)
Static geoid	1 mm with 0.1 mm/y → 3 mm (10 km resolution)
Time-variable geoid	1 mm with 0.1 mm/y (50 km spatial resolution, 10 days temporal resolution)

Source: Plag and Pearlman (2009)

GGOS as an Organization



(1) GGOS is built upon the foundation provided by the IAG Services, Commissions, and Inter-Commission Committees

GGOS as an Organization

Interfaces to other IAG components

Strategic Level – membership in GGOS entities

- GGOS Consortium (Steering Body)
- GGOS Coordinating Board (Decision-making Body)
- GGOS Executive Committee
- GGOS Science Panel

Operational Level – membership and JWGs, …

- BNO → Simulation of networks, …
- BPS → Inventory of standards and conventions, …
- Focus Areas (see next slide)

GGOS as an Organization

Focus Areas

- Focus Area on Unified Height System (L. Sanchez)
- Focus Area on Geohazards (J. LaBrecque)
- Focus Area on Sea level (T. Schöne)
- Focus Area on Geodetic Space Weather Research (M. Schmidt)

GGOS as an Organization

Representation of IAG

- Group on Earth Observation (GEO/GEOSS)
- Committee on Earth Observation Satellites (CEOS)
- ICSU World Data System (WDS)
- UN CoE Global Geospatial Information Management (GGIM): Sub-Committee on Geodesy
- …

Conclusions

- GGOS is a unique and complementary component of IAG.
- It is well established and operational.
- It has a strong role in geodetic science and technology.
- Performance is – as always – a question of available ressources and commitment.

Thank you!

Prof. Dr.-Ing. Hansjörg Kutterer

Director General

Bundesamt für Kartographie und Geodäsie
Richard-Strauss-Allee 11
60598 Frankfurt

Tel.: + 49 – 69 – 6333 226

Fax: + 49 – 69 – 6333 441

E-Mail: vorzimmerpraesident@bkg.bund.de