

Global Geodetic Observing System (GGOS)

Markus Rothacher

Institute of Geodesy and Photogrammetry (IGP)
ETH Zurich, Switzerland



Session TS 6C: GGOS and APREF I
XXIV FIG International Congress 2010
April 11-16, 2010, Sydney, Australia



XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia



Overview

- **Motivation**
- **Monitoring and Modeling the Earth System**
- **Structure of GGOS**
- **Thematic (Geodetic) Observing Systems / Integrated GGOS Products**
- **Conclusions**

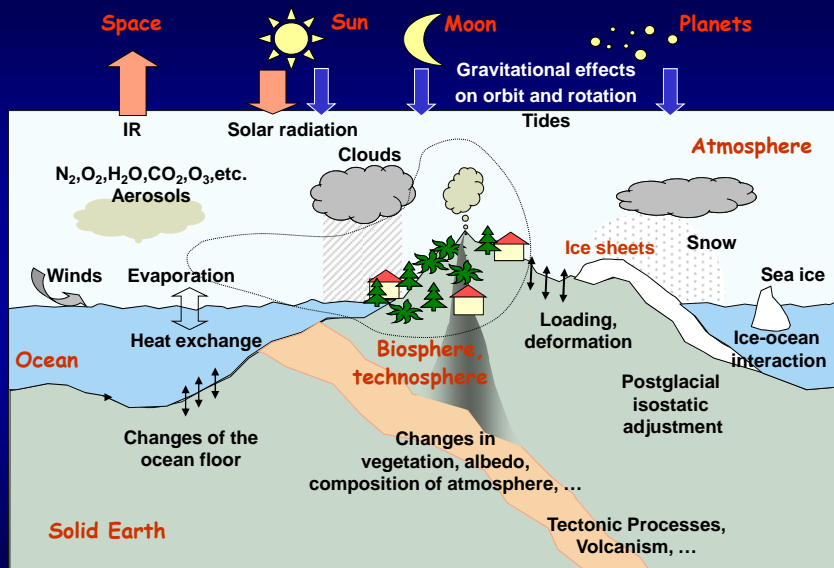


XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia



Motivation

System Earth (-Mankind): a Very Complex System



Source: Kandel, 1980

One of the Problems: Insufficient Data Basis / Quality

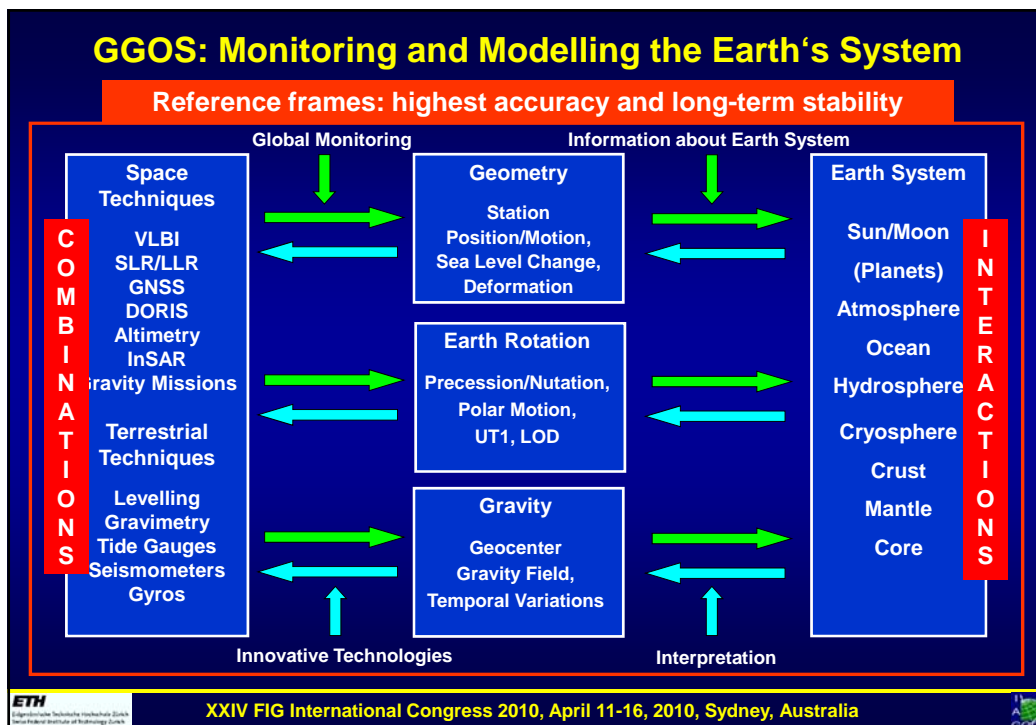


Warming debate highlights poor data

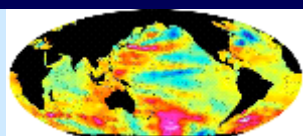
Nature, 18.08.2005

- Need for a Global Earth Observing System of Systems (GEOSS) realized by the Group on Earth Observation (GEO)
- Global Geodetic Observing System (GGOS): geodetic component and metrological basis of GEOSS

Monitoring and Modeling of the Earth System



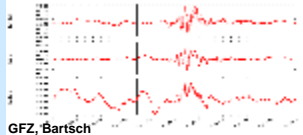
Challenges for Planet Earth Monitoring with GGOS



GFZ, Schöne

Sea Level: Altimetry

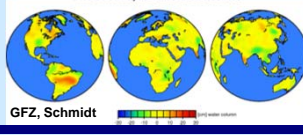
- **Reliable detection of small, long-term trends:** long time series from reprocessing of ground / satellite data



GFZ, Bartsch

Earthquake: GPS (Nias)

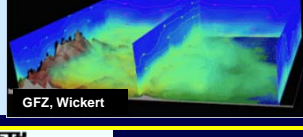
- **Fast event detection and quantification:** Real-time processing for early warning systems (tsunami, slides, earthquakes, ...)



GFZ, Schmidt

Water Cycle: GRACE

- **Integration and Separation:** Sensor combinations; separation of signals with complementary data



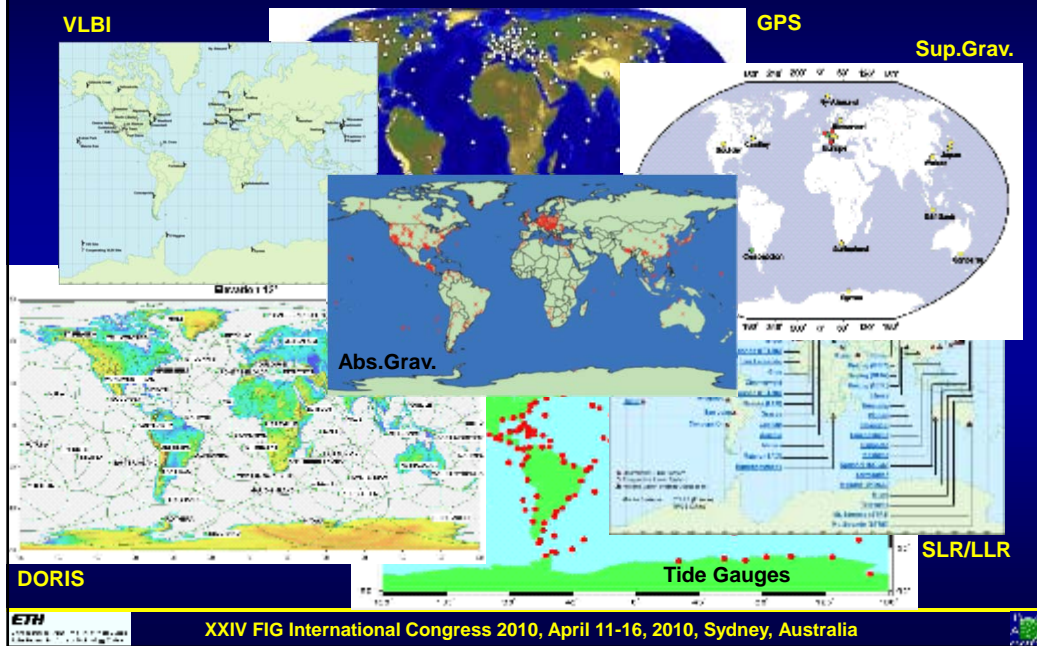
GFZ, Wickert

Water Vapor: GPS / VLBI

- **Information exploitation:** portals, up-to-date methods of visualization, information/knowledge management

ETH XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia

Ground-Based Component of GGOS



Space-Based Component of GGOS



Structure of GGOS

IAG Services: Backbone of GGOS

Geometry

IERS: International Earth Rotation and Reference Systems Service
IGS: International GNSS Service
IVS: International VLBI Service
ILRS: International Laser Ranging Service
IDS: International DORIS Service

Gravimetry

IGFS: International Gravity Field Service
BGI: Bureau Gravimetrique International
IGeS: International Geoid Service
ICET: International Center for Earth Tides
ICGEM: International Center for Global Earth Models
IDEMS: International Digital Elevation Models Service

Ocean

PSMSL: Permanent Service for Mean Sea Level
IAS: International Altimetry Service (in preparation)

Std

BIPM: Bureau International des Poids et Mesures
IBS: IAG Bibliographic Service

New GGOS Components in Place

Established New Components (January 2009):

- Bureau for Networks and Communication: Cambridge Center for Astrophysics / NASA (Chair: M. Pearlman)
- Bureau for Standards and Conventions: Research Group on Satellite Geodesy in Munich (FGS: FESG, DGFI, IAPG; Chair: U. Hugentobler)
- Bureau for Satellite Missions → GGOS WG on Satellite and Space Missions: Ohio State University (OSU; Chair C.K. Shum)

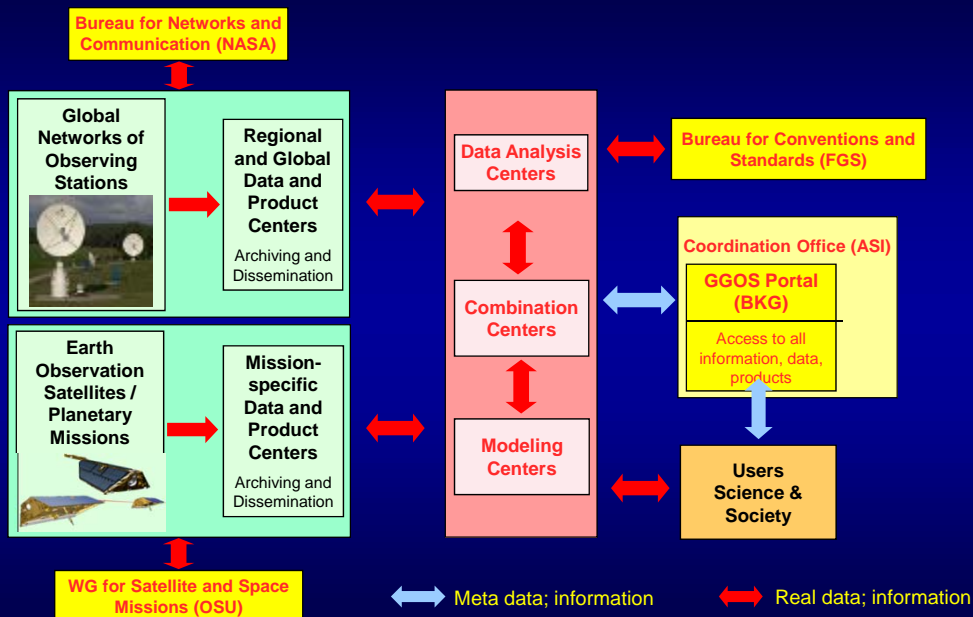
GGOS Portal (January 2009):

- GGOS Portal: BKG (Federal Agency of Cartography and Geodesy, Frankfurt)

GGOS Coordination Office (January 2010):

- ASI (Italian Space Agency) in charge of the Coordination Office

New Organizational Elements of GGOS



GGOS Portal (BKG): Main Page

Global Geodetic Observing System
GGOS Portal

Topics Discovery Viewer GGOS Products

Science Applications
Deformation Water Storage Change Sea Level Change Disaster Monitoring

Natural Hazards

Home

The Global Geodetic Observing System Portal (GGOS Portal)

GGOS is the Observing System of the International Association of Geodesy (IAG). GGOS works with the IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and for global change research.

The GGOS Portal will provide a unique access point to all geodetic products. Thus, the Portal will emphasize Geodesy's contribution to Earth Observation for assessing geohazards and reducing disaster. The Portal consists of the GGOS Web site and the portal itself, comprising geoportals like a clearinghouse, a map viewer, and a metadata editor.

The GGOS Portal is currently under development. The GGOS Web site will be launched in December 2009 and a first basic version of the portal will be available in the beginning of 2010.

Source: A. Helm (GFZ) Source: BKG

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zürich

XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia

GGOS Portal (BKG): Topics

Global Geodetic Observing System
GGOS Portal

Topics Discovery Viewer GGOS Products

Topics

Natural Hazards
Science Applications

Search

Service

Home Topics

Natural Hazards
Earthquakes
This section will present information regarding earthquakes ...
More

Science Applications
Science Applications
This section will present Science Applications topics like disaster monitoring, water storage change ...
More

Earthquakes
Floodings
Storm

Disaster Monitoring
water storage change

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zürich

XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia

GGOS Portal (BKG): Discovery / Search

**Global Geodetic Observing System
GGOS Portal**

Topics **Discovery** Viewer GGOS Products

Discovery
Simple Search
Advanced Search
Assistent

Search
search item

Service
News
Meetings
Library
Links
Acronyms
Sitemap
Legal & Privacy
Contact

Home > Discovery

Discovery

Simple search
Direct search link without additional specifications.

Advanced search
Refine your search with respect to space, category and time.

Assisted search
Our assistant will guide you through the advanced search to the results.

Print Recommend page
© 2010 - IAG :: Global Geodetic Observing System - GGOS :: All rights reserved. Modification date: 20 Jan 2010

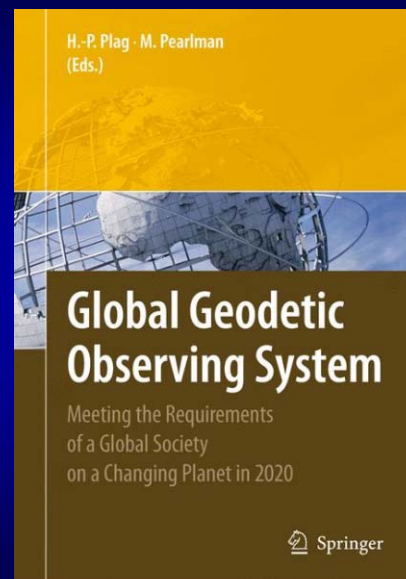
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zürich

XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia

IAG

GGOS200 Book

- Published by Springer in Summer 2009
- Editors: H.P. Plag and M. Pearlman; many co-authors
- ISBN: 978-3-642-02686-7
- 332 pages, 129.95 €
- Reference book for all GGOS-related activities and planning
- Adopted as such in the Frankfurt Declaration (Meeting on a GGOS Inter-governmental Committee)



GGOS Intergovernmental Committee (GIC)

Problem: long-term support and sustainability of the IAG Services and the global GGOS infrastructure

GGOS Intergovernmental Committee (GIC) to support GGOS in attaining its goals by:

- Forum for the coordination of resources provided by the member organisations for sustainable GGOS activities
- Promotion of GGOS to international entities that require intergovernmental representation (UN, etc.)
- Options to link GGOS to higher intergovernmental bodies (e.g., UN Cartographic Conference, UNOOSA, OECD Global Science Forum, etc.)

First step: white paper and an inter-agency agreement prepared by the GIC Planning Group

Thematic (Geodetic) Observing Systems Integrated GGOS Products

Thematic (Geodetic) Observing Systems / Integrated GGOS Products

Ideas by Reiner Rummel (Gravity Workshop in Graz):

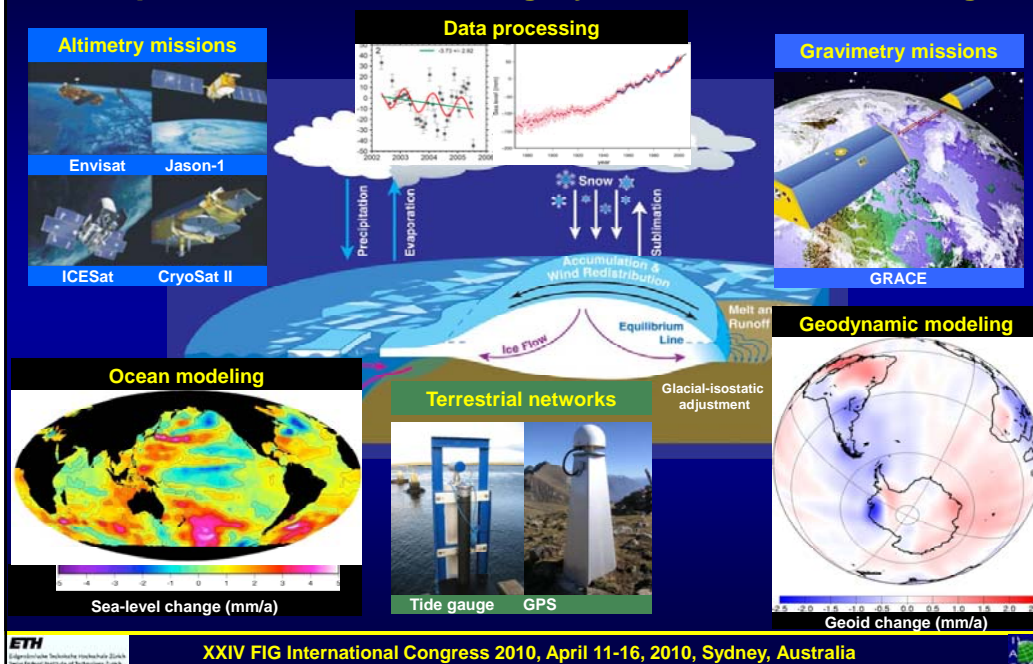
Part 1: Thematic (Geodetic) Observing Systems (and Models) in order to be able to:

- cope with the complexity of the Earth system
- work on an integrated but limited / manageable part of the Earth system
- generate suitable integrated GGOS products

Part 2: Connect and link the themes to GGOS:

- as partial systems of global Earth system studies
- for consistency and quality checks between the thematic (geodetic) observing systems

Example: Thematic Observing System “Sea-Level Change”

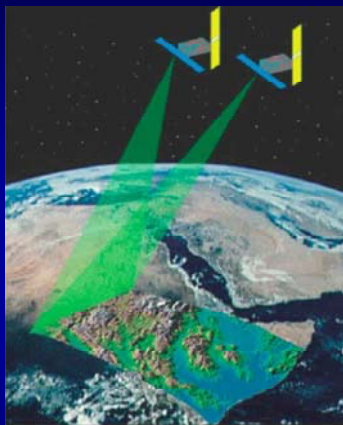


Three Themes / Integrated Products Selected (1)

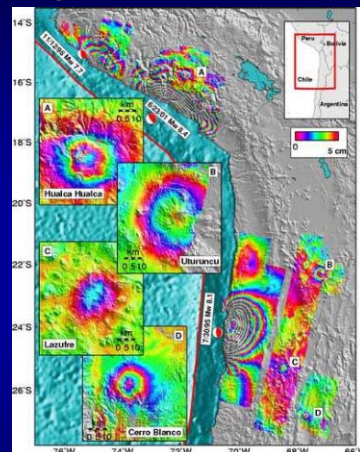
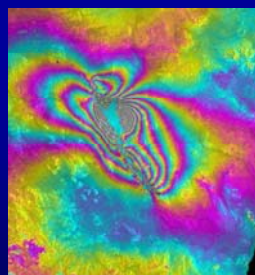
Selected at GGOS Retreat in Miami, Feb. 2010:

- **Theme 1: Global Unified Height System (M. Sideris et al.)**
 - IAG Inter-Commission Project 1.2: Vertical Reference Frames
 - Complementing the geometric reference frame ITRF
 - Unification of existing vertical datums
 - GOCE mission as a major contributor and driver
 - Enable global GNSS leveling at the 1 cm level
- **Theme 2: Geohazards (global Earth surface deformations and strain rates for geohazards assessment and disaster prevention) (T. Dixon et al.)**
 - SAR / INSAR data sharing, product benchmarking, standards, combined products through coordination among agencies
 - Improve effectiveness of geodetic community in geohazards
 - Work toward an international InSAR service

InSAR: Densification of Earth's Geometrie (e.g. of GNSS Networks)



Hector Mine earthquake
(Courtesy G. Peltzer, UCLA)



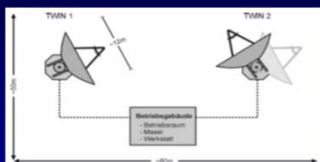
Volcanoes in the Andes
(Pritchard & Simons, 2002)

→ **Combination with GNSS**

Three Themes / Integrated Products Selected (2)

- **Theme 3: Sea-Level Change, Variability and Forecasting (H.-P. Plag et al.)**
 - Frequent assessment of the global sea level curve and its error budget: GGOS Sea Level Panel
 - Understanding mass balance in the global water cycle
 - Sea level rise hazard maps for local sea level
 - **Global GGOS network of core sites (crucial for all themes):**
 - Co-location of space geodetic techniques (SLR/LLR, VLBI, GNSS, DORIS) with latest technologies and permanent local tie monitoring
 - Many auxiliary instruments (clocks, gravimeters, seismometers, meteo sensors, water vapor radiometers, ...)
- **Call for Participation in the Global Geodetic Core Network in preparation**

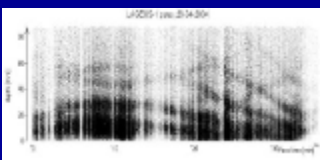
Space Geodetic Techniques: Latest Technologies



VLBI Twin Telescope (Wettzell)

VLBI:

- High slew rates ($> 5 \text{ deg/s}$)
- 1-3 small telescopes at a site
- Continuous frequency range (2-18 GHz)



kHz Laser: Lageos Spin (Graz)

SLR:

- kHz laser technology
- 2 frequency systems
- Higher quantum efficiency



Galileo Experimental Sensor Station (GESS)



DORIS Beacon (Thule)

DORIS:

- 3rd generation DORIS systems

GNSS:

- GPS, Glonass, Galileo, Compass, ...
- Sampling $> 10 \text{ Hz}$
- Real-time
- 3 antennas/receivers

Conclusions

- **A better monitoring of the Earth system is required to understand the Earth as a system**
- **GGOS is the geodetic contribution to GEO and to GEOSS**
- **GGOS, through the IAG Services, already now provides very important geodetic/geophysical products to society and science**
- **Major structural components of GGOS in place**
- **GGOS is now working on**
 - **integrated geodetic products based on observation themes**
 - **implementation plan for GGOS in 2020, especially for the Global Geodetic Core Network (GGCN)**
 - **sustainability of support: GGOS Intergovernmental Committee**

Thank you for your attention !



Global Geodetic Observing System
International Association of Geodesy

Do we understand the Earth System ?



ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zürich

XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia



Earthquake of Basel 1356 (History Painter Karl Jauslin)



ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zürich

XXIV FIG International Congress 2010, April 11-16, 2010, Sydney, Australia



Mission of GGOS

The mission of GGOS is to advance geodetic observing methods for Earth and planetary system science and applications by:

- **defining the geodetic infrastructure needed by science and society;**
- **advocating for the establishment and maintenance of this geodetic infrastructure;**
- **improving the quality and accessibility of geodetic observations and products;**
- **coordinating interaction between the IAG Services, Commissions, and stakeholders; and**
- **educating the scientific community about the benefits of geodetic research and the public about the fundamental role that geodesy plays in society.**