The Interactions between IGS and GGOS

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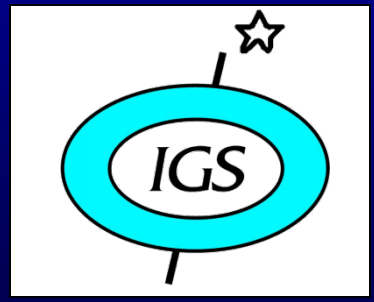


Overview

- GGOS Vision, Mission and Goals
- GGOS Status, Structure and Themes
- What does GGOS expect from the IGS ?
- How does the IGS benefit from GGOS ?
- Conclusions

Motivation: 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**

GGOS Vision and Mission

Vision of GGOS (2011)

Advancing our understanding

of the

dynamic Earth system

by

quantifying our planet's changes

in

space and time

Mission of GGOS (2011)

We live on a dynamic planet in constant motion requiring for its understanding long-term, continuous quantification of its changes in a truly stable frame of reference.

The mission of GGOS is:

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

http://www.ggos.org/

Goals of GGOS (2011)

The goals of GGOS are:

1. **To be the primary source for all global geodetic information and expertise serving society and Earth system science.**
2. **To actively promote, sustain, improve and evolve the global geodetic infrastructure needed to meeting Earth science and societal requirements.**
3. **To coordinate the international geodetic Services that are the main source of key parameters needed to realize a stable global frame of reference and to observe and study changes in the dynamic Earth system.**
4. **To communicate and advocate the benefits of GGOS to user communities, policy makers, funding organizations, and society.**

http://www.ggos.org/

GGOS Status, Structure and Themes

Building up the GGOS Structure (yellow: new comp.)

Bureau for Networks and Communication (NASA)

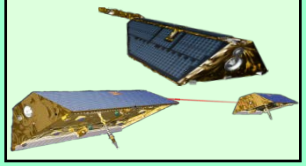
01/2009
01/2010

Global Networks of Observing Stations

Regional and Global Data and Product Centers

Archiving and Dissemination

Earth Observation Satellites / Planetary Missions



Mission-specific Data and Product Centers

Archiving and Dissemination

Data Analysis Centers

Combination Centers

Modeling Centers

Bureau for Conventions and Standards (DGFI, TUM)

Coordination Office (ASI)

GGOS Portal (BKG)

Users Science & Society

WG on Satellite and Space Missions (I.Panet / R.Pail)

WG on Earth System Modeling (M.Thomas)

GGOS: Organizational Structure (2011)

GGOS Consortium

Representatives of IAG Scientific Services

- Int'l GNSS Service (IGS)
- Int'l VLBI Service for Geodesy and Astrometry (IVS)
- Int'l Laser Ranging Service (ILRS)
- Int'l Doris Service (IDS)
- Int'l Earth Rotation and Reference Systems Service (IERS)
- Int'l Gravity Field Service (IGFS)
- Int'l Geoid Service (IGeS)
- Int'l Gravimetric Bureau (BGI)
- Bureau International des Poids et Mesures (BIPM)
- Int'l Altimetry Services (IAS)
- Int'l Center for Earth Tides (ICET)
- Int'l Centre for Global Earth Models (ICGEM)
- Int'l Digital Elevation Model Service (IDEMS)
- IAG Bibliographic Service (IBS)
- Permanent Service for Mean Sea Level (PSMSL)

Representatives of IAG Commissions

- Reference Frames
- Gravity Field
- Earth Rotation and Geodynamics
- Positioning and Applications

Representatives of Other Entities

- Int'l Federation of Surveyors (FIG)
- Universities
- Research Organizations
- Space Agencies
- ICSU Bodies
- UN Bodies
- GEO

GGOS Science Panel

GGOS Coordinating Board (GGOS CB)

Executive Committee

GGOS Inter-Agency Planning Committee (GIAC)

GGOS Coordinating Office (GGOS CO) ggos.org

GGOS Portal

Bureau of Networks and Communication

GGOS Working Groups

- Satellite Missions
- Earth System Modeling
- Data and Information Systems
- Outreach and User Linkage
- ITRS Standard

Bureau of Standards And Conventions

Theme 1: Unified Height System

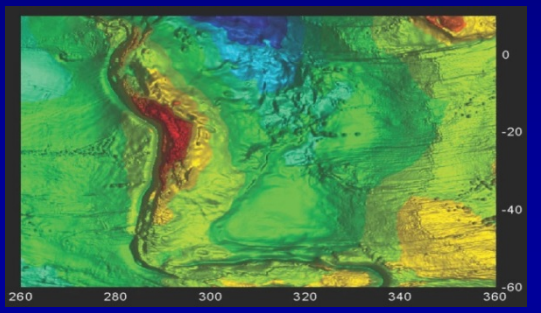
Theme 2: Geohazards

Theme 3: Sea-Level Change, Variability and Forecasting

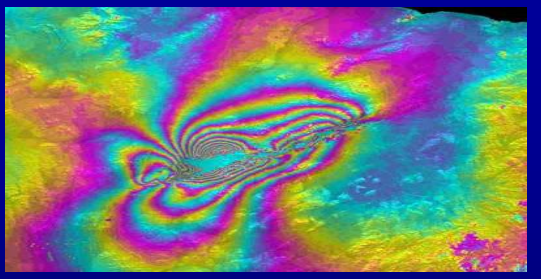
Three GGOS Themes (Integrated Products)

Ideas by Reiner Rummel (Gravity Workshop in Graz): work on thematic (geodetic) observing systems (and products)
→ **GGOS Retreat in Miami, Febuary 2010:** 3 themes selected

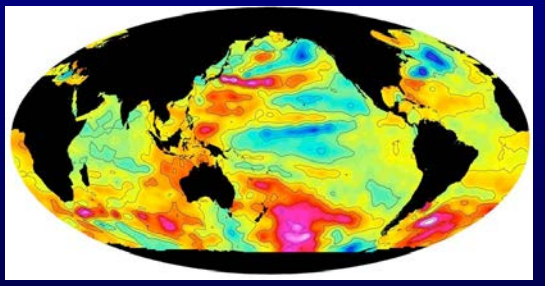
- **Theme 1: Global Unified Height System** (M. Sideris, J. Ihde et al.): together with IAG ICP 1.2; ESA project (TUM, BKG, Univ. Calgary), GOCE



- **Theme 2: Geohazards** (T. Dixon, F. Amelung, R. Gross): InSAR data availability for supersites; Internat. InSAR Service; now: displacement service



- **Theme 3: Sea-Level Change, Variability and Forecasting** (C.K. Shum, M. Tamisiea, T. Schöne): action plan has been consolidated, CfP



GGOS Implementation Work

GGOS Retreat June 26 - 28, 2012 → actions based on GGOS goals:

- Identify the gaps for Theme 2 (geohazards)
- New action plan integrating retreat outcome and existing
- Communications plan (internal, external, services, comm., internat., …)
- Fill the GGOS Portal with GGOS data and products (metadata)
- Extract user requirements and identify user categories (Science Panel)
- Infrastructure development plan and identify priority countries
- Stronger involvement of gravity community
- Promotion of the International Altimetry Service (IAS)
- Plan GGOS participation in international organizations (GEO, CEOS, …)
- Generation of outreach material
- Need of a GGOS Bibliographic Service

IGS → GGOS

What does GGOS expect from the IGS ?

Looking at the GGOS mission, goals, themes we identify:

- **Reference Frame (global and regional), GGOS core sites**
- **Contributions to Theme 2 (geohazards) and Theme 3 (sea level)**
- **Combination and integration**
- **Products**
- **GGOS Portal**
- **Outreach (mention GGOS at least once per presentation)**

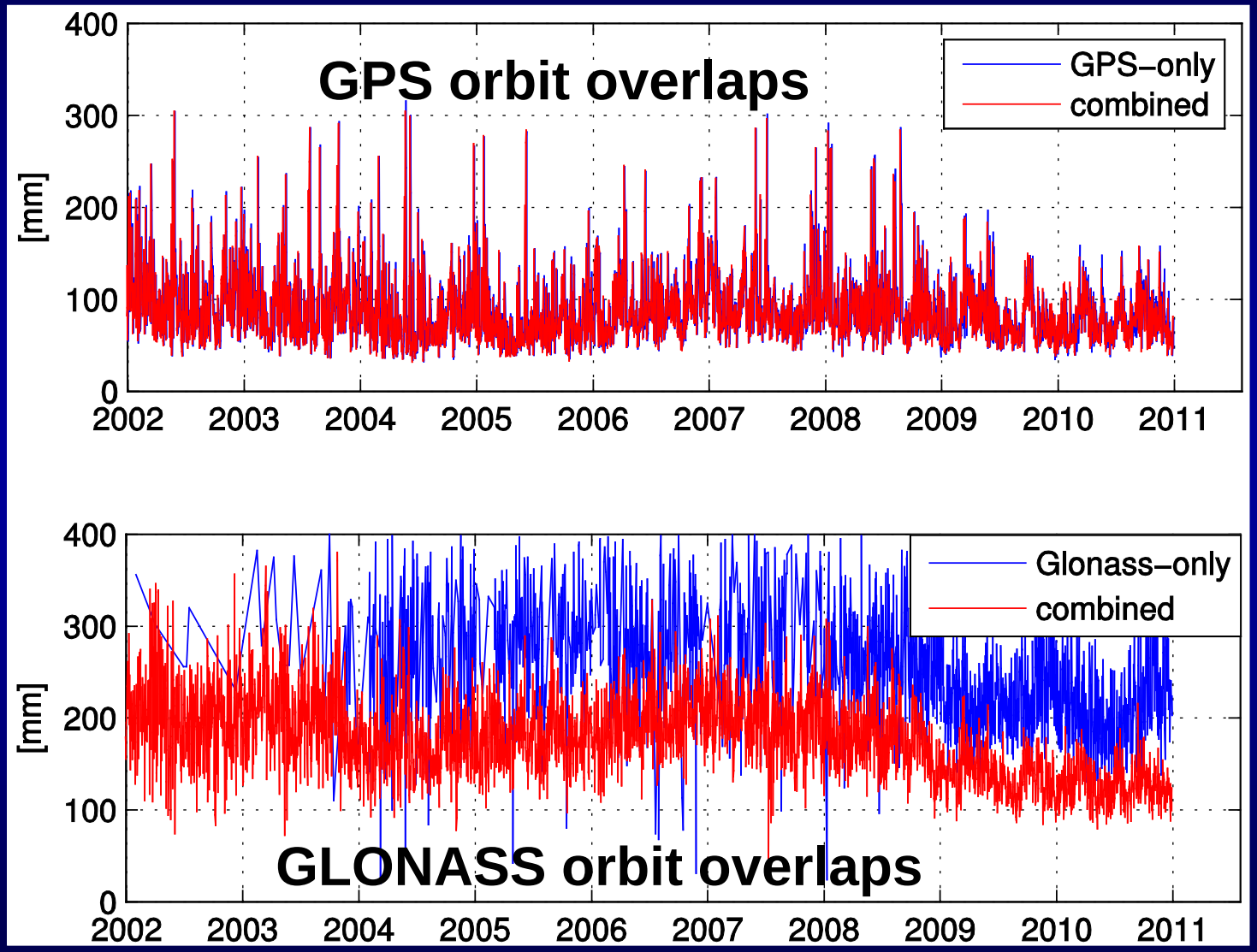
IGS products are also GGOS products

Reference Frame Issues (Small Long-Term Trends)

- **Reprocessing:**
  - IGS already did a very big and successful effort
  - Reprocessing should be possible every few years to allow for homogeneous time series with latest models and param.
- **Systematic Biases:**
  - Satellite antenna offsets and phase center variations
  - Orbit modeling deficiencies
- **Antenna/receiver chances destroy long-term quality:**
  - Run new hardware in parallel for some months, even better: have 2-3 permanent antennas and receivers
  - Concept for transition to GALILEO-capable antennas/receiv.

Reprocessing of GNSS (GPS, GLONASS, SLR)

Project with TU Dresden, ETH Zürich, AIUB, TU München



Reprocessing of GNSS (GPS, GLONASS, SLR)

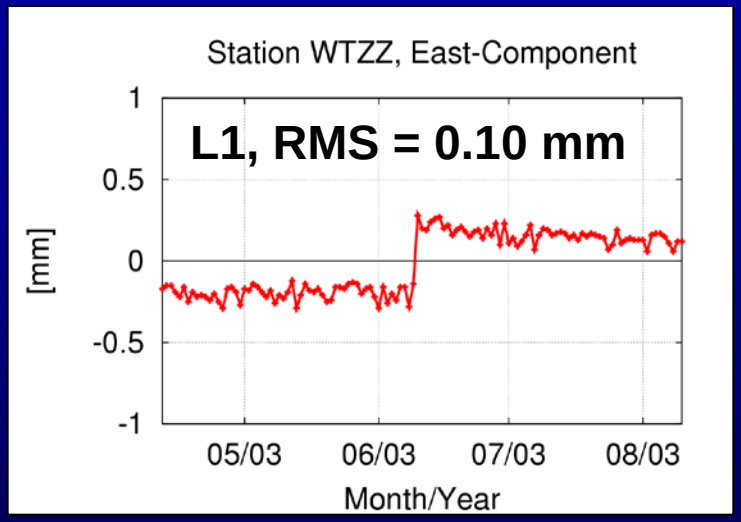
Earth rotation parameters compared to the IGS series
RMS differences for the year 2010 (~19 Glonass sat.):

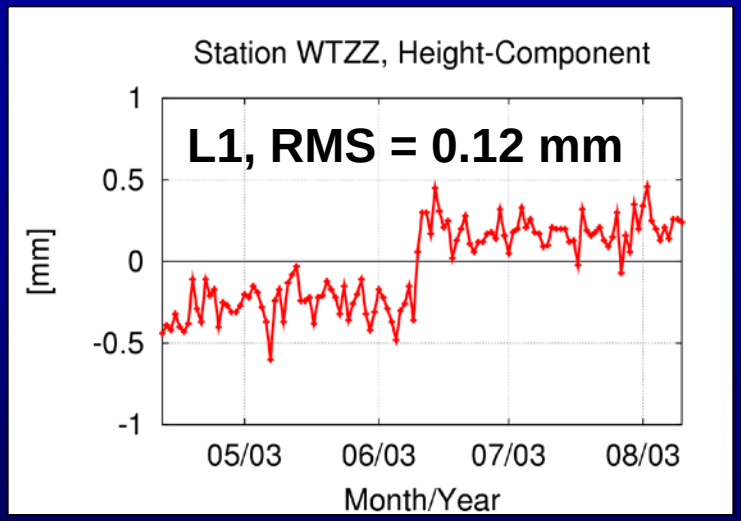
	Glonass-only solution	GPS-only solution	Combined solution
XP [0.001”]	0.356	0.080	0.075
YP [0.001”]	0.338	0.089	0.086
XP rate [0.001”/day]	0.553	0.245	0.227
YP rate [0.001”/day]	0.649	0.252	0.241
LOD [ms/day]	0.262	0.128	0.115

GNSS at GGOS Core Sites

Characteristics:

- 3 antennas and receivers to allow for equipment changes
- Tracking all GNSS (GPS, GLONASS, GALILEO, COMPASS, QZSS, …)
- Real-time capabilities and high-rate data
- Dense L1 network for atmosphere tomogr.

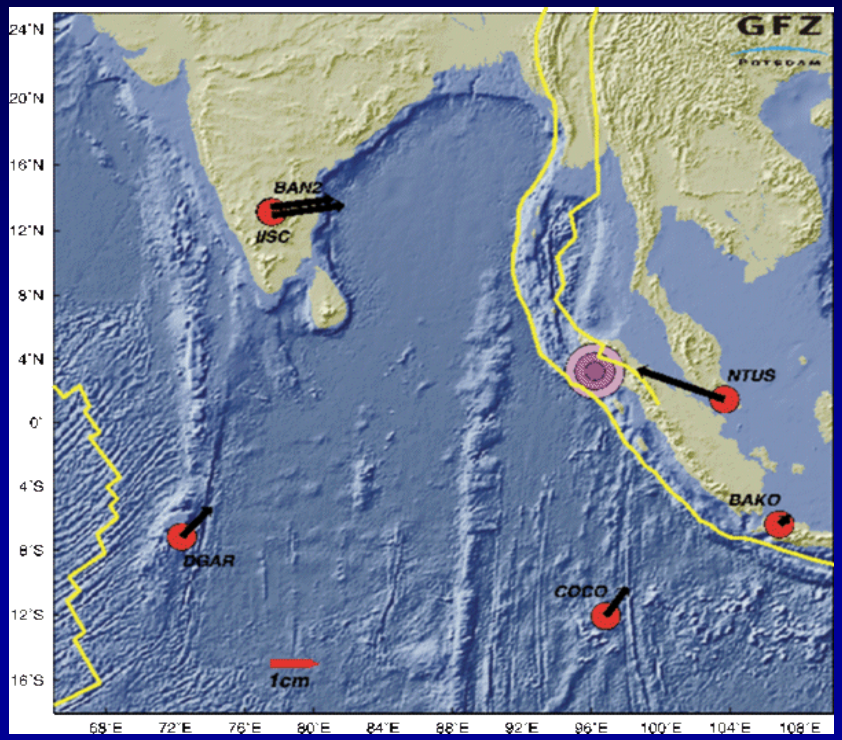




Wettzell antenna array: monitoring equipment change

Galileo Experimental Sensor Station (GESS)

Theme 2: Displacement/Deformation Service



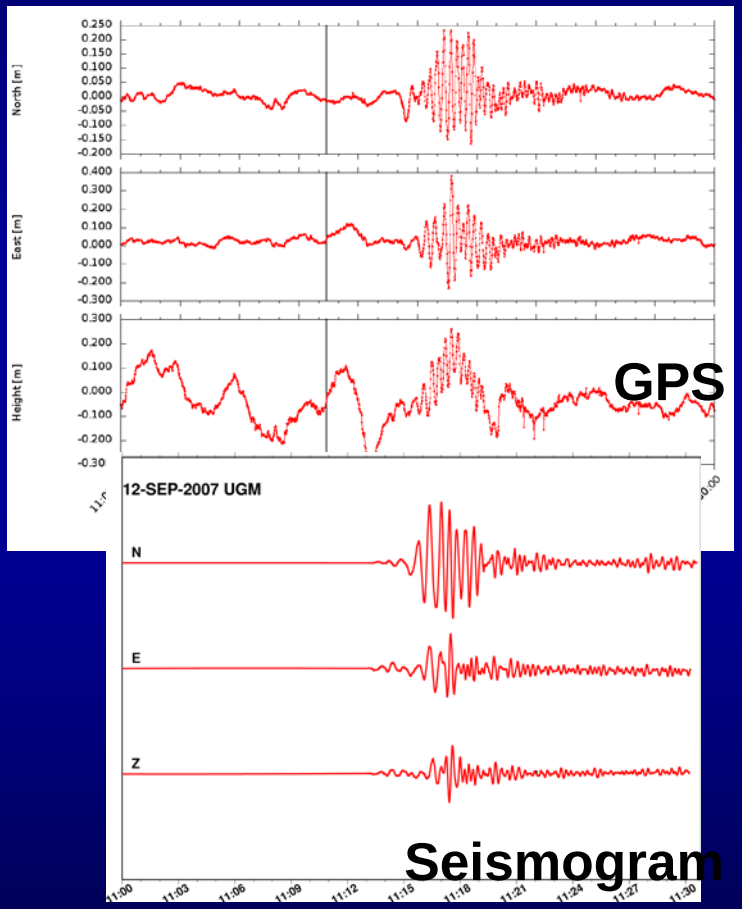
Earthquake in Chile, Feb. 27, 2010 (DGFI)

in Sumatra, Dec. 26, 2004 (GFZ)

- **Events show that a fast reaction to natural hazards is important also on the global level**
- **Real- or near real-time global displacement service of the IGS should be established; include also long-term deformation**

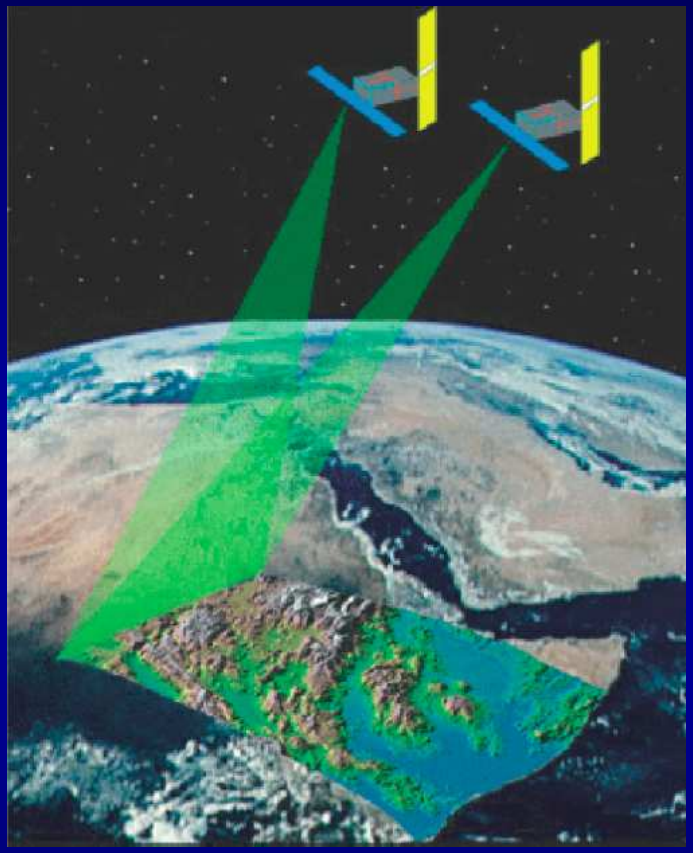
Theme 2: Displacement/Deformation Service

- IGS real-time developments extremely important
- High-precision predicted GNSS orbits and clocks essential for many applications:
  - Early warning systems
  - High-precision orbits for LEOs (e.g. crucial for InSAR)
- High-rate GNSS data (10-100 Hz):
  - Buffering: transfer of high-rate data only in case of an interesting event
  - Monitoring of seismic waves (GNSS seismology)
  - Earthquake magnitude, earthquake rupture process, better tsunami prediction

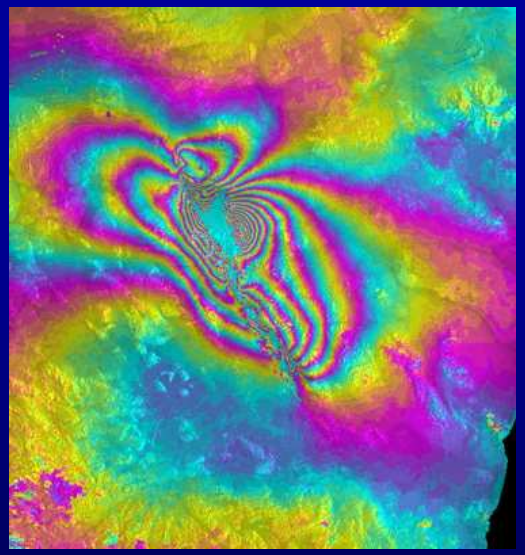


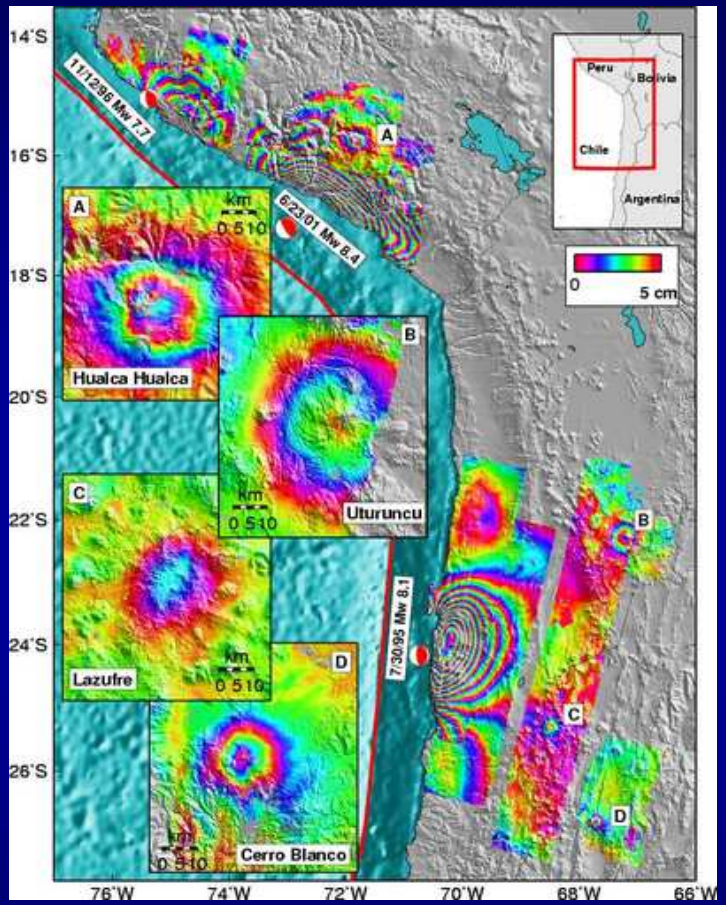
→ Combination GNSS / seismology

Theme 2: Displacement/Deformation Service
InSAR for Densification of Earth‘s Geometry



Hector Mine earthquake
(Courtesy G. Peltzer, UCLA)





Volcanoes in the Andes
(Pritchard & Simons, 2002)

→ **Combination GNSS / InSAR**

Combination and Integration

- Combination is the essence of GGOS: better reliability / accuracy
- Combination within the IGS:
  - Generation of daily SINEX files and combination thereof
  - Converge on common standards for troposphere modeling and estimation to allow for a combination of the troposphere parameters
  - Height inconsistencies not absorbed by the troposphere parameters
- Combination with other space-geodetic techniques:
  - Combination of daily SINEX files with VLBI, DORIS, SLR: site coordinates, ERPs, troposphere parameters, …
- One common clock for GNSS, VLBI and …
  - Clocks getting more and more accurate (GIOVE-B, …)
  - GGOS core sites should establish a unique time reference at the site
  - “Local ties” for geometry, troposphere and time for combination
- Unified Analysis Workshops (UAW): next planned in 2013

IGS Products for GGOS (Earth Observation)

IGS extremely important for GGOS, contributing a large variety of observational data and relevant products

Direct IGS Products (global): → products ready for users

- Reference frame contribution, ITRF realization
- Global site coordinates, velocities and displacements → **simple format for time series**
- GNSS orbits and clocks; **DCBs and ISBs**
- Earth rotation parameters
- Atmosphere: global water vapor (meteorology and climatology) and electron density (space weather) → **provide integrated water vapor**

Indirect Products made possible by IGS (regional/local):

- Regional reference frames, earthquake deformation, early warning systems (tsunami, volcanoes, land slides) → **provide displacements, high-rate data**
- LEO orbits for gravity, altimetry, InSAR and other missions
- Local/regional atmosphere sounding and monitoring

GGOS Portal (BKG): Main Page

Global Geodetic Observing System

GGOS Portal

Topics | Discovery | Viewer | GGOS Products

NATURAL HAZARDS | SCIENCE APPLICATIONS | GEODETIC APPLICATIONS | SATELLITE MISSIONS | TECHNIQUES | SERVICES

Science Applications

More ...

Deformation | Water Storage Change | Sea Level Change | Disaster Monitoring

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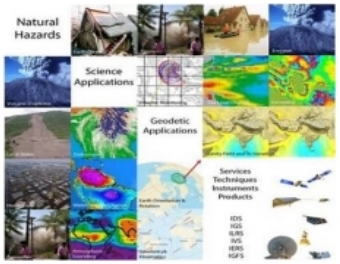
The Global Geodetic Observing System Portal (GGOS Portal)

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 geoportal components 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 Dezember 2009 and a first basic version of the portal will be available in the beginning of 2010.



Source: A. Helm (GFZ)

Source: BKG

News

- GGOS Retreat 2010 and 17th GGOS Steering Committee Meeting
- GGOS 2020 Book published
- More

Meetings

- GGOS Retreat 2010
- 17-th Meeting of the GGOS Steering Committee
- Regional Coastal Zone Community of Practice (CZCP) and UNESCO's International Hydrological Program (IHP) Workshop
- More

Print | Recommend page

Modification date: 20 Jan 2010

GGOS Portal (BKG): Metadata is crucial

FILENAME	DGF07063L7_b03.snx.gz
TITLE	GGOS-D DGFI SLR solution 2nd iteration version b03 (GFZ)
ALTERNATETITLE	GGOS-D DGFI SLR solution
ABSTRACT	Weekly SINEX file of DGFI SLR solution for GGOS-D (single technique solution).
	Standards, models and parameterization are choosen with
	respect to the GGOS-D conventions for the 2nd iteration.
	With the strict use of common standards within GGOS-D
	a consistent reprocessing and combination of the space
	geodetic techniques should be achieved.
IDENTIFIER	DGF07063L7_b03
STATUS	completed
LANGUAGE	en
CHARSET	8859part2
DATE	2007-11-13 13:46:18
DATETYPE	creation
FORMATNAME	SINEX
FOMATVERSION	2.00
MEDIUMNAME	onLine
LINKAGE	ftp://ftp.ggos-d.de/data/test/2004/GFZ/GFZ07063L7_b03.snx.gz
TOPICCATEGORY	Geoscientific Information
THESAURUSNAME	GCMD Keywords
THESAURUSDATE	2008-02-07 17:44:52
THESAURUSLINKAGE	http://gcmd.gsfc.nasa.gov/Resources/valids/archives/keyword_list.html
THESAURUSORGNAME	NASA Goddard Space Flight Center
KEYWORDS	Solid Earth > Geodetics/Gravity > Gravitational Field,
	Solid Earth > Geodetics/Gravity > Polar Motion,
	Solid Earth > Geodetics/Gravity > Reference Systems,
	Solid Earth > Geodetics/Gravity > Rotational Variations,
	Solid Earth > Geodetics/Gravity > Satellite Orbits,
	SLR > Satellite Laser Ranging
FEES	

GGOS → IGS

How does IGS benefit from GGOS ?

- Higher visibility through the GGOS umbrella and the GGOS portal
- Coordination of the IAG Services: common goal, synergies, …
- Connections to high-level international institutions like
  - Group on Earth Observation (GEO) with GEOSS: IAG/GGOS is member
  - Committee on Earth Observation Satellites (CEOS): GGOS is member now
  - Other global observing systems: GTOS, GCOS, GOOS, IOC, …
- Improved fund rising potential (example GGOS core sites, VLBI)

  → Renewal of IGS infrastructure, PBO, EPOS, Australia, …

Example: GGOS Core Sites

Positive Developments:

First really new infrastructure since about 15 years:

→ IAG Services (e.g., VLBI2010, SLR)

→ Argumentation with GGOS

Wettzell: twin telescopes and new SLR

New GGOS Core Sites:

- Austrialia/New Zealand: 4 new core sites
- Wettzell, Germany: new twin and SLR telescopes
- Spain/Portugal: 4 new VLBI sites funded
- Norway, Finland, Sweden: proposals
- NASA: prototype site; proposal for 10 sites planned
- Russia, China, Korea: several sites planned

Conclusions

- A better Earth monitoring is required to understand the Earth as a system
- GGOS is the geodetic contribution to GEO and to GEOSS
- GGOS components in place, organizational structure improved, work on implementation
- IGS contributes a very large variety of direct and indirect products
- IGS challenges important for GGOS:
  - Very efficient reprocessing capabilities
  - Real-time products for early warning systems, etc.
  - Further steps in combination work
  - Availability of metadata and user-friendly access to products

Thank you for your attention !

Global Geodetic Observing System
International Association of Geodesy