Global Geodetic Observing System (GGOS)

http://www.ggos.org

Chair of the GGOS Coordinating Board: **H. Kutterer** (Germany)
Acting Vice-Chair of the GGOS Coordinating Board: **R. Neilan** (USA)
Director of the GGOS Coordinating Office: **G. Bianco** (Italy)

Preamble

The proposal for the Global Geodetic Observing System (GGOS) was developed by the GGOS planning group between 2001 and 2003 according to the Bylaws of the International Association of Geodesy (IAG). The proposal was accepted by the IAG Executive Committee and the IAG Council at their meetings during the XXIII IUGG General Assembly in Sapporo in July 2003. GGOS was endorsed by the IUGG through Resolution No. 3 at the same General Assembly.

Changes in the IAG Bylaws in 2007 resulted in GGOS being recognized as an integral component of IAG along with Services and Commissions. As a historical note, this transformed the status of GGOS from that of an IAG Project to an IAG component. Specific to the GGOS is IAG Bylaw numbers 1(d) and 15.

During 2009-2011, revisions to the structure of GGOS were discussed leading to these 2011 Terms of Reference, primarily to streamline the organizational structure of GGOS.

In February 2011, GGOS Executive Committee, with additional participants, conducted a strategic planning retreat that led to defining the vision, mission, goals and tasks of GGOS for the coming five years. In parallel, the GGOS Terms of Reference were being revised primarily to streamline the governance structure of GGOS. Both documents were approved by the GGOS Steering Committee at its meeting in Melbourne, Australia during the XXV General Assembly of IUGG, July 2011. The IAG Executive Committee then approved the new Terms of Reference (ToR) at its business meetings during IUGG. The ToR are located at http://www.ggos.org.

Vision of GGOS

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

Mission of GGOS

We live on a dynamic planet in constant motion that requires long-term continuous quantification of its changes in a truly stable frame of reference.

The mission of GGOS is:

1. To provide the observations needed to monitor, map and understand changes in the Earth's shape, rotation and mass distribution.
2. 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.
3. To benefit science and society by providing the foundation upon which advances in Earth and planetary system science and applications are built.

Recent Activities

With the approval of the new GGOS ToR, we are in the process of implementing the new structure and establishing the necessary elements according to the ToR (Figure 1). As part of this transition, a GGOS retreat is planned for early 2012. One focus of this retreat will be to consider further the role of GGOS within IAG and how to develop the integration of IAG elements within GGOS.

The former GGOS Executive Committee is supporting the newly appointed Chair during this transition period until the GGOS Coordinating Board (CB) is fully established. This is expected to take another six months. During this time, the GGOS Consortium members are being identified. The GGOS consortium then will nominate and elect six open positions on the CB. Once these are filled, the CB will then elect three Members-at-Large to balance the CB for geography and expertise. Once the CB approves those members, then the election of the Vice-Chair can take place and the Chair will then propose the new GGOS Executive Committee.

The plan is to harmonize the GGOS structure and schedule with the IAG schedule of elections every four years. Note that the appointment of the GGOS Chair remains a responsibility of the IAG EC in consultation with the GGOS CB.

The three themes of GGOS: Unified Height System, Geohazards and Sea Level Variability will be a primary focus

for GGOS over the coming four years as these were identified in 2010 as themes that require cross-cutting disciplines and techniques with GGOS, as well as potentials for new partnerships.

The Committee on Earth Observation Satellites (CEOS) met during the week of November 7, 2011, in Lucca, Italy. GGOS made an application to become an associate member of CEOS and was unanimously accepted. GGOS principals are now exploring how best to engage with CEOS and what areas are of mutual benefit between CEOS and GGOS components.

GGOS is also looking towards establishing links with strategic partners and broadening the outreach and development of GGOS. This is demonstrated in one example through our participation and exhibit at the Group on Earth Observations VIII in Istanbul, Turkey Nov. 15-17, 2011. The Chair made a statement to the plenary on the recent activities and directions of GGOS, while a new GGOS exhibit was well received by the attendees.

Key Goals and Tasks of GGOS

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.

In order to accomplish its mission and goals, GGOS depends on the IAG Services and Commissions. The Services provide the infrastructure and products on which all contributions of GGOS are based. The IAG Commissions provide expertise and support for the scientific development within GGOS. In summary, GGOS is IAG's central interface to the scientific community and to society in general.

IAG is a Participating Organization of the Group on Earth Observations (GEO). GGOS acts on behalf of the IAG in GEO and actively contributes to the Global Earth Observation System of Systems (GEOSS).

GGOS addresses relevant science issues related to geodesy and geodynamics in the 21st century, but also issues relevant to society (including but not limited to management of natural resources, natural hazards, global risk management, monitoring of climate change and related phenomena, ocean forecasting and sea level projections, early warning of severe storms, tsunamis, other hazards, and space weather). It is an ambitious program of a dimension that goes beyond IAG, requiring a strong cooperation within the geodetic and Earth science communities, and externally, to related endeavours and communities.

Tasks of Goal 1:

To be the primary source for all global geodetic information and expertise serving society and Earth system science.

a. Identify the components and themes of GGOS needed to plan and meeting evolving user requirements and to provide crucial data and information to the user.
b. Define and implement internal and external interfaces needed for technical and organizational efficiency.
c. Evaluate and review the current GGOS organization and structure.
d. Develop mechanisms for regular review of GGOS quality and performance, including that of its data and products.
e. Expand and broaden user communities by conducting impact studies and organizing joint workshops and symposia.
f. Provide a unique point of access to the user community by creating and maintaining the GGOS portal.

Tasks of Goal 2:

To actively promote, sustain, improve and evolve the global geodetic infrastructure needed to meeting Earth science and societal requirements.

a. Provide the scientific basis for the necessary global geodetic infrastructure, including establishing requirements for station distribution and data quality.
b. Provide a forum for inter-service communication and exchange of information about current activities, infrastructure performance and future plans.
c. Identify major infrastructure deficiencies and propose remedies to the geodetic and user communities and appropriate entitles including the GGOS Interagency Committee (GIAC).
d. Support requests of stations, agencies and other organizations for resources.
e. Advocate for the establishment of geodetic fundamental stations with potential sponsors.
f. Advocate for relevant space-based components including operational chains of geodetic missions like gravity, altimetry, and SAR missions to provide spatial and temporal coverage of continuous and episodic changes in the dynamic Earth system.

Tasks of Goal 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.

a. Improve the interaction and communication amongst GGOS, and IAG Services and Commissions by defining appropriate linkages, organizing inter-Service workshops and, when appropriate, holding joint or co-located GGOS EC and Service GB/DB meetings.
b. Reform the GGOS governance structure in order to facilitate the execution of the Science Themes, manage the relationships between the IAG Executive, GGOS EC, the Services and the Commissions, fulfil GGOS's role in outreach, represent GGOS at forums such as GEO, and other activities as may be tasked.
c. Identify data and product gaps, integrated products, additional Service and Commission components and, if necessary, new Services and Commissions that are needed to fully address the requirements of the GGOS Science Themes.
d. Establish and promote the use of reference frames, common standards and models, open data access, geodetic expertise and information, and even methodologies where appropriate, so as to ensure reliable, consistent and high-quality data and products for the geoscientific community.
e. Promote combination analyses and integrated product generation across Services and Commissions, especially from co-located geodetic sites, in order to address the requirements of the GGOS Science Themes.
f. Promote a culture of continuous quality improvement of the geodetic infrastructure, analysis centre operations, effectiveness of the GGOS structural components, and of the generated GGOS data and products.

Tasks of Goal 4:

To communicate and advocate the benefits of GGOS to user communities, policy makers, funding organizations, and society.

a. Organize meetings about GGOS activities and participate in GEO meetings, user community events, conferences, workshops, symposia, etc.
b. Identify GGOS requirements in terms of infrastructure and workforce and interact with funding authorities, national and international and space agencies to advocate the importance of meeting these requirements.
c. Promote the development and submittal to funding agencies of proposals that advance the goals of GGOS.
d. Involve young scientists by means of GGOS scholarships and grants through national and international projects.
e. Foster geodetic educational programs within universities, schools and research organizations.
f. Strengthen outreach capabilities demonstrating GGOS benefits by means of case studies and success stories; release a short GGOS movie to be presented and distributed for educational purposes.
g. Review the respective roles of GGOS and the GIAC.
h. Improve the recognition and visibility of GGOS within GEO, ICSU, COPUOS, CEOS, COSPAR and other organizations.

Overview of GGOS Structural Elements

The organizational structure of GGOS is comprised of the following key elements:

1. **GGOS Consortium** – is the collective voice for all GGOS matters. It will meet annually as possible. The elements of GGOS have the flexibility to determine and designate two representatives to the GGOS Consortium as each (Service, Commission, or other entity) decides. The Consortium is to be comprised of the Chairs of Services and the Directors of the Service's central offices or Central Bureaus; Presidents and Vice-Presidents of IAG Commissions, and other entities essential to GGOS as determined by the Consortium. The GGOS Consortium is the nominating and electing body of elected positions on the GGOS Coordinating Board as noted below. The Chair of GGOS shall act as the Chair of the GGOS Consortium.
2. **GGOS Coordinating Board** – is the central oversight and decision-making body and represents the IAG Services, Commissions and other entities (see below).
3. **GGOS Executive Committee** – serves at the direction of the Coordinating Board to accomplish day-to-day activities of GGOS tasks.
4. **GGOS Science Panel** – advises the Coordinating Board and represents the geodetic and geoscience community.
5. **IAG Services, Commissions and relevant Inter-Commission Committees** – are the fundamental elements comprising GGOS.
6. **GGOS Working Groups and Themes** – address overarching issues common to several or all IAG components, and are a mechanism to bring the various activities of the Services and Commissions together, or to link GGOS to external organizations. Themes are cross-disciplinary and address specific areas where GGOS contributors work together to address broader and critical issues.
7. **GGOS Coordinating Office** – coordinates the work within GGOS and supports the Chairs, the Executive Committee and the Coordinating Board**.**
8. **Bureau for Standards and Conventions** – tracks, reviews, examines, evaluates all actual standards, constants, resolutions and conventions adopted by IAG or its components and recommends their further use or proposes the necessary updates.
9. **Bureau for Networks and Communications** – develops a strategy to design, integrate and maintain the fundamental geodetic infrastructure including communication and data flow.

Details of the Structure of GGOS

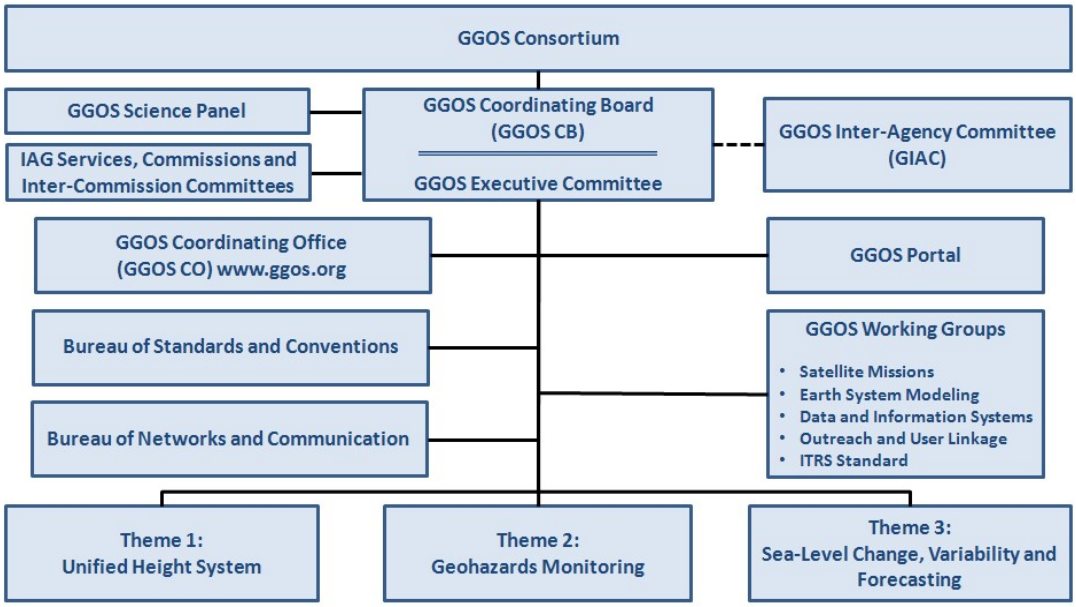

Figure 1: GGOS Organization Chart 2011

1. GGOS Consortium

The GGOS Consortium is the voice and essentially the large steering committee of GGOS. It reviews the GGOS progress, activities, and nominates and votes for the candidates for the elected positions on the GGOS Coordinating Board.

The GGOS Consortium is comprised of two designated representatives from each IAG component, which designate their representatives. The Chair of the Service Governing or Directing Board, and the Director of the Central Bureau or Coordinating Office, the Commission Presidents and Vice Presidents may be those designated members, however, no person can represent two components (but no one may have more than one vote). The Chair of the GGOS Consortium is the presiding Chair of GGOS. GGOS Consortium decisions are based on consensus. Decisions requiring a vote are decided by simple majority of the votes cast. The quorum is when at least one half of members are present, but electronic voting is acceptable provided a quorum responds.

The process for elections to the GGOS Coordinating Board will coincide with IAG's schedule for elections, calling for nominations and elections 3 months prior to the four-year IAG General Assembly, which takes place during the IUGG General Assembly (see IAG Bylaws). Candidates nominated to serve on the CB must be members of the GGOS Consortium. However, the GGOS Chair is appointed by the IAG Executive Committee in consultation with the GGOS Coordinating Board, and is not appointed by the IAG Council (see IAG Bylaws: 15 (d) and 31-a-ii).

2. GGOS Coordinating Board

The Coordinating Board is the decision making body of GGOS. Decisions, to the extent possible, are based on consensus. Decisions requiring a vote are decided by simple majority of the votes cast. The quorum for a valid vote is participation of one half of the voting members of the Coordinating Board. Votes may be held at meetings or by appropriate electronic means at the discretion of the GGOS Executive Committee. The Coordinating Board will meet at least once yearly, although twice yearly is preferable.

Coordinating Board Members (voting members):

• GGOS Chair (ex-officio, votes in case of a tie)	1
• GGOS Vice-Chair (ex-officio)	1
• Chair of GGOS Science Panel (ex-officio)	1
• Head, Coordinating Office (ex-officio)	1
• Directors of GGOS Bureaus (ex-officio)	2
• IAG President or design. representative (ex-officio)	1
• Service Representatives (elected by Consortium)	4
• Commissions Representatives (elected by Consort.)	2
• Members-at-Large (elected by GGOS CB)	3
Total Voting Members	16

Coordinating Board Members (non-voting members):

• Chairs of GGOS Working Groups + (or more, ex-officio)	1
• Theme Chairs (ex-officio)	3
• GGOS Portal Manager (ex-officio)	1
• Immediate Past Chair of the CB (ex-officio)	1
• Representative of the GIAC/GIC (ex-officio)	1
Total Non-Voting Members	7
Total Membership of the Coordinating Board (plus any approved observers)	23

The chair of the GGOS Coordinating Board is determined according to the IAG Bylaws (IAG Bylaw 15 (d)). The Chair of the GGOS CB is also known as the GGOS Chair. The CB elects the Vice-Chair of the GGOS CB.

The Members-at-large are to balance the Coordinating Board with regard to geographical region or unique capability. The Chair, with the assistance of the Coordinating Office, appoints an Election Committee to organize the voting process and to ensure availability of the nominated candidates. The Election Committee presents the final list of nominations for the Members-at-large to the CB for a vote.

3. GGOS Executive Committee

The GGOS Executive Committee (EC) is composed of the following members:

• GGOS Chair	1
• Vice-Chair	1
• Voting Members of the CB selected for the EC	3
Total	5

The GGOS Chair biennially submits his/her list of the three GGOS members for the EC to the GGOS CB for approval. EC candidates recommended by the Chair must be voting members of the CB.

The immediate Past Chair of GGOS, Director of the Coordinating Office, the Chair of the GGOS Science Panel, and the President of IAG are permanent guests at meetings of the Executive Committee. Other observers may be invited to attend EC meetings (usually teleconferences) as needed.

4. GGOS Science Panel

The GGOS Science Panel is an independent and multi-disciplinary advisory board that provides scientific support to the GGOS steering and coordination entities.

The GGOS Science Panel is composed of up to 7-12 members. Members are based on recommendations from the GGOS community and candidates are approved by the CB.

The Science Panel will elect its own Chair to be approved by the CB.

5. Services, Commissions, Inter-Commission Committees

GGOS works with these IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and global change research. GGOS respects the by-laws and terms of reference for these essential components. GGOS is built on the existing IAG Services and their products. GGOS is not taking over tasks of the existing, and well working IAG Services. GGOS will provide a framework for existing or future Services and strive to ensure their long-term stability.

6. GGOS Working Groups and Themes

GGOS Working Groups (WG) are established by the Coordinating Board as needed. The Coordinating Board appoints the chair of any WG. A charter for each WG will be prepared and approved by the GGOS Coordinating Board. The members of WGs are nominated by the WG Chair and confirmed by the Coordinating Board. GGOS Working Groups can be set up for limited periods of time or as standing Working Groups. Themes are cross-disciplinary and meant to consider gaps and needed future GGOS products. The GGOS CB approves the themes. The CB appoints theme chairs. Themes outline their purpose and propose a work plan to address any noted gap to be addressed by the particular theme focus.

7. GGOS Coordinating Office

The GGOS Coordinating Office (CO) performs the day-to-day activities in support of GGOS, the Executive Committee, the Coordinating Board and the Science Panel, and ensures coordination of the activities of the various components. The CO ensures information flow, maintains documentation of the GGOS activities and manages specific assistance functions that enhance the coordination across all areas of GGOS, including inter-services coordination and support for workshops. The CO in its long-term coordination role ensures that the GGOS components contribute to GGOS in a consistent and continuous manner and adhere to GGOS standards. The CO also maintains, manages and coordinates the GGOS Web presence.

The GGOS Portal is an important additional web presence that provides a unique access to all GGOS data sets and products.

8. Bureau for Standards and Conventions

The Bureau for Standards and Conventions keeps track of the strict observations of adopted geodetic standards, standardized units, fundamental physical constants, resolutions and conventions in all official products provided by the geodetic community. It reviews, examines and evaluates all actual standards, constants, resolutions and conventions adopted by IAG or its components, and recommends further use or proposes the necessary updates. It identifies eventual gaps in standards and conventions and initiates steps to close them with, e.g., resolutions by the IUGG and/or IAG Councils.

9. Bureau for Networks and Communications

The Bureau for Networks and Communications develops a strategy to design, integrate and maintain the fundamental infrastructure in a sustainable way to satisfy the long-term (10 - 20 years) requirements identified by the GGOS Science Panel. Primary emphasis must be on sustaining the

infrastructure needed to maintain the evolving global reference frames, while at the same time ensuring the broader support of the scientific applications of the collected data. Coordinating and implementing the GGOS co-located station network is a key focus for 2010-2020.

10. GGOS Inter-Agency Committee (GIAC)

The purpose of the GIAC is to provide a forum for coordination and support for the development, implementation and operation of those components of the GGOS, whose infrastructure is operated by governmental institutions.

The GIAC supports the IAG Services, particularly those involved in the establishment, maintenance and enhancement of the geodetic infrastructure, observing systems and the International Terrestrial Reference Frame (ITRF) in a sustainable and a cost-efficient way. Furthermore, GIAC members underpin geodetic research activities coordinated by the GGOS Science Committee by providing world class geodetic infrastructure.

The GIAC is a forum that seeks to generate a unified voice to communicate with Governments and Intergovernmental organisations (GEO, UN bodies) in all matters of global and regional spatial reference frames and GGOS research and applications.

According to its Terms of Reference the GIAC coordinates the common efforts of its governmental member organisations to meet the requirements of global geodetic programs, in particular, the terrestrial reference frame, IAG services and capacity building. It supports members to obtain the resources needed for their geodetic observing infrastructure and it maintains liaison with IAG/GGOS regarding GGOS application and research needs.

The GIAC takes into account the special needs and interests of developing countries, including in particular the need to further the capabilities of these countries in geodetic observations for the realization and sustainability of global and regional spatial reference frames and related technology. In the perspective, the GIAC works on the creation of a GGOS Intergovernmental Committee and to explore possibilities to join existing international organisations to serve common interests.

Program of Activities

Working Groups

WG 0.1 Satellite Missions

Chairs: Isabelle Panet (France), Roland Pail (Germany)

The GGOS Satellite Mission Working Group was established in December 2008 with its primary objectives to investigate rationale and interest from the geodetic community to establish a GGOS Bureau of Satellite Missions. An initial Terms of Reference has been drafted. Since early 2011, there are 20 members (see at the end of this section), including the Chairs, I. Panet and R. Pail.

Key objectives

- To assess the satellite mission infrastructure at an international level relevant for achieving the goals of GGOS and make recommendations for needed missions,
- To advise and support proposed missions relevant to GGOS,
- To advocate new satellite mission proposals appropriate to advance GGOS objectives,
- To provide outreach for geodetic satellite missions,
- To facilitate the use of satellite products for users,
- To interface with the other entities, including IAG, GGOS, CEOS, GEO and space agencies, with regard to promoting satellite missions and their data products for scientific and public use.

The working group at present will address only Earth observation missions relevant for the GGOS goals.

Actions 2011 – 2015

- Analysis of satellite infrastructure
  - Identification of observational gaps for critical satellites
  - Proposing needed concepts for future missions
- Focus particular types of satellite mission for advocacy
- Realization of the access to satellite products for users
  - Historical data access
  - Documentation, links to complementary datasets
  - Thematic pages
  - Provide Working Group information to GGOS portal
- Provide inputs on the scientific relevance of proposed missions in the context of GGOS goals
- Plan and continue to undertake setting up of interfaces to CEOS and other relevant organisations
- Rationalizing the possible establishment of the Bureau of Satellite Missions

Members

- Bettadpur Srinivas (USA)
- Biancale Richard (France)
- Chao Benjamin (China - Taipei)
- Cho Sungki (Korea)
- Flechtner Frank (Germany)
- Fotopoulos Georgia (Canada)
- Fukuda Yoichi (Japan)
- Hwang Cheinwey (China - Taipei)
- Knudsen Per (Denmark)
- Matsumoto Koji (Japan)
- Müller Jürgen (Germany)
- Nerem R. Steve (USA)
- Pail Roland (Germany; co-chair)
- Panet Isabelle (France; co-chair)
- Ping Jinsong (China)
- Shum C.K. (USA)
- Sideris M. (Canada)
- Sneeuw Nico (Germany)
- Joong-Sun Won (Korea)
- Min Zhong (China)

WG 0.2 Earth System Modelling

Chair: Maik Thomas (Germany)

The major goal of the Working Group is the preparation of a physically consistent unconstrained numerical Earth system model focussing on near-surface fluid dynamics. This modular model is expected to allow a homogeneous processing, interpretation, and prediction of geodetic parameters, i.e., Earth rotation, gravity field and deformation, and, thus, to finally contribute to a deeper understanding of dynamical processes in the Earth system reflected in geodetic observables.

Tasks 2011 – 2015

- Selection of appropriate models for the representation of dynamics of the individual near-surface sub-systems, such as atmosphere, oceans, continental hydrosphere, cryosphere, and lithosphere;
- Development of a strategy to ensure physical consistency, in particular mass balance;
- Definition and implementation of standard modules to derive individual contributions to variations of geodetic quantities;
- Identification of relevant interactions among sub-systems as well as of appropriate parameterizations for their numerical consideration.

Objectives 2011 – 2015

Within the period 2011-2015, the main objective is to prepare an unconstrained version of a modular Earth system model of near-surface dynamics. The system model approach has to be designed in such a way that it

- ensures consistent (passive) interactions and physical fluxes among sub-systems,
- is applicable to all geodetic quantities (rotation, gravity field, surface geometry),
- allows self-consistent predictions of geodetic parameters,
- can be used for interpretation and cross-validation of different data sets.

WG 0.3 Data and Information Systems

Chair: Bernd Richter (Germany)

The tasks for data and information (D/I) handling, management and the GGOS Portal fall under the purview of the GGOS Data and Information Working Group. This action plan will address actions for populating and maintaining the portal and metadata standards for capturing information from contributing data centres.

Objectives

The main objective of the D/I handling and management activity is to implement and maintain the GGOS Portal, the access point for all GGOS products.

Actions 2011 – 2015

- Review the proposed portal structure and in particular the list of topics and their associated sub items. Provide text (both brief and long descriptive text) and illustrations for each topic. (GGOS Steering Committee, Science Panel);
- Identify key personnel to coordinate input for these sections of the portal. (GGOS Steering Committee, Science Panel, IAG Services);
- Complete draft of GGOS metadata catalogue, review, and distribute to GGOS Steering Committee. (DIWG)
- Conduct monthly Data and Information Working Group telecons to coordinate activities and address actions. (DIWG);
- Implement metadata structures at GGOS contributing data centres (e.g., CDDIS, etc.) and fill the GGOS Portal metadata base for search and other applications. (IAG services);
- Ensure currency of GGOS Portal by continued review and update. (DIWG, SC, SP);
- Implement web features at the GGOS Portal when necessary, e.g. WMS, WFS (DIWG, Portal Manager).

WG 0.4 Outreach and User Linkage

Chair: Giuseppe Bianco (Italy)

The GGOS Component "Outreach" [OR] is chaired by the GGOS Coordinating Office (CO) and managed by the Working Group on Outreach and Education (WG on O&E), approved during the GGOS Steering Committee meeting held in San Francisco on December 11th, 2010; its scope and duties have been discussed during the GGOS Retreat held in Zurich, February 2-4, 2011.

Objectives

Objectives of the Outreach component must take into account GGOS 2020 Recommendation 1.3 (GGOS 2020, p. 283):

"Recognizing that society to a large extent is not aware of the vital role played by geodesy for realizing a sustainable development, and that educational aspects are extremely important (because they have the greatest implication on societal behaviour) in order to prepare future generations to make use of the full benefits of geodesy, it is recommended that IAG and GGOS make dedicated outreach efforts to science and society at large with the goal to promote geodesy's role in reaching sustainable development and to integrate this role of geodesy appropriately into education."

Actions 2011 – 2015

Short term actions

- Finalization of the GGOS Outreach Document:
- Planning and design of GGOS Monographs, possibly finalizing the first prototype
- GGOS web site updating (continuous)

GGOS Monographs are short yet complete documents, targeted to non-specialized public, designed to clearly describe the role of geodesy in reaching sustainable development. Monographs may be devoted to specific earth science fields, such as oceanography, crustal deformations, and so on, or to societal issues such as hazard mitigation, water scarcity, global warming, and so on.

Mid-term actions:

- Multimedial monographs production
- Approach and collaboration with international science magazines, TV channels, to promote geodesy
- Approaching ministries of education/research to promote geodesy into curricula of all levels

WG 0.5 ITRS Standard

Chair: Claude Boucher (France)

This Working Group develops a concept for a potential ISO Standard concerning the global geodetic reference system, with ITRS being a prime candidate. It also provides experts to its actual implementation within ISO

Objectives 2011-2015

- Support to the drafting of an ISO standard related to ITRS
- Contribute to the report on geodetic references to be written within ISO TC211 "Geographic information/ Geomatics" following a NWIP submitted by France
- Support of the formal NWIP related to the ITRS standard to be submitted to TC211 in due time.

Bureau for Standards and Conventions

Chair: Detlef Angermann (Germany)

The Bureau for Standards and Conventions (BSC) supports GGOS in its goal to obtain products of highest accuracy, consistency, temporal and spatial resolutions, and referring to a unique reference frame stable over decades.

Objectives

The overall goal is to ensure consistency between products generated by the different IAG services, especially between geometric and gravimetric products, by defining common standards and conventions and consistent modelling, parameterization and analysis strategies. Main objectives of the BSC are:

- Evaluate the geodetic standards and conventions currently in use by all the IAG Services for the generation of geodetic/geophysical products;
- Propagate all geodetic standards and conventions to geodetic and general scientific communities and urge their common use;
- Maintain regular contact with all internal and external institutions involved in the adoption of standards, resolutions and conventions;
- Perform administrative tasks, communications and web support in cooperation with the GGOS Coordinating Office.
- Report regularly to the GGOS Coordinating Board and to the IAG Executive Committee, and – if necessary or appropriate – to the IUGG Executive Committee.

Actions 2011 – 2015

- Numerical standards: Compilation of numerical and processing standards currently used.
- Inconsistencies: Removal of inconsistencies in the IAG/ IERS conventions.
- Metadata: Develop – together with the GGOS Portal – consistent metadata for all products describing underlying standards and conventions.
- Software routines: Make available a set of validated software routines for transformation between tide systems and time systems.
- Standards and Conventions: Development of homogeneous consistent models and standards for the integration of data to combine geometric positioning with physical heights and Earth gravity field parameters.
- IGSN: An extension of standardization activities to a new International Gravity Standardization Network (IGSN) shall be considered.
- Global Geophysical Fluids: Investigations regarding geophysical background models (e.g., loading, dealiasing) shall be carried out in cooperation with the GGFC.

New GRS: Development of a new Geodetic Reference System (GRS) based on a consistent system of best estimates of major parameters related to a geocentric equipotential ellipsoid.

Bureau of Networks and Communication

Chair: Mike Pearlman (USA)

The Bureau provides oversight, coordination, and guidance for the development, implementation and operation of the GGOS Network of Core Sites. Elements of this role are:

- Promote communication and integration among Services;
- Develop and maintain a ground network station information base and data product directory;
- Monitor the development of prototype ground systems to understand performance and availability;
- Monitor network performance and advocate for maximum participation to maintain reference frame and other data product quality;
- Advocate the continued support and maintenance of the current geodetic networks and the implementation of upgraded and new field systems;
- Define the network requirements and scope the size and geometry of gravimetry and tide gauge ground networks; advocate for continued support, upgrade and expansion;
- Interface with upcoming missions to advocate for the best satellite technology to support the reference frame tasks;
- Advocate for reference frame connections through GNSS to other geodetic instruments including tide gauges, gravimeters, etc.
- Promote the formation of key partnerships to establish stations in present network gaps,
- Exploit synergistic opportunities to better integrate or co-locate stations with the infrastructure and communications networks of the many other Earth Observation disciplines.

Actions 2011 – 2015

- Continue development by the Services (VLBI2010, NGSLR, new generation GNSS receivers, modern DORIS ground systems and new satellites; retro arrays on GPS, etc;
- Continue outreach
  - Give presentations; meet with potential participants;
  - Pursue the "American Networks Concept" in the first half of 2011 (1 year);
  - Need to do something about Africa;
- Complete the simulation to scope the GNSS network (1 year);
- Develop Site Specification Document (1 year);
  - Complicated by lack of configuration uniformity;
- Work on the technical and operational issues;
  - Work with IERS WG on Inter-system vectors (co-location);
  - Communications requirement;
  - Multi-instrument control systems;
- Issue the CFP in concert with the GIAC (1 year);
- Strengthen our connection with the non-geometry geodesy techniques
- Characterize performance and trade-offs as the network builds up
- Implement the network

Themes

Theme 1: Unified Height System

Chairs: M. G. Sideris (Canada) and J. Ihde (Germany)

The objective of Theme 1 is the unification of the existing vertical reference systems around the world. This will be achieved through the definition and realization of a global vertical reference system that

- will support geometrical (ellipsoidal) and physical (normal, orthometric, geoidal) heights world-wide with centimetre precision (10^{-9}) in a global frame;
- will enable the unification of all existing physical height systems (i.e., all geopotential differences shall be referred to one and the same reference equipotential surface with potential W_o); and

- will provide high-accuracy and long-term stability of the temporal height changes (dh/dt, dH/dt, dN/dt) with 10^{-9} precision.

A World Height System (WHS) shall be realized with a global combined network, which will integrates at set of terrestrial reference stations high-precision absolute and relative gravity, leveling with gravity reductions, and GNSS and tide gauge observations. For this purpose, it will use contributions from all IAG Commissions, and the available databases, standards and infrastructure of the IAG/GGOS Services.

Planned activities

Short-Term:
Establish a global vertical reference surface and its geopotential value W_o.

1. Refinement of standards and conventions for the definition and realization of a WHS, including unification of standards and conventions that are used by the "geometric" and "gravity" Services of the IAG.
2. Establishment of a global vertical reference level. The work will be carried out by analysis centres for determining and monitoring the relationship between a conventional W_o and the potential of the level surface closely approximating the mean sea surface.

Medium-Term:
Develop GGOS products for the realization of a WHS.

3. Recommendation for a global vertical reference frame.
4. Guidelines/procedures for height system unification.
5. Development of a registry (metadata) containing the existing local/regional height systems and their connections to the global one.

Long-Term:
Maintain and use in practice the WHS.

6. Determination and modeling of the temporal changes of the vertical reference frame.
7. Update the Unified Global Height System definition and realization as needed, based on future improvements in geodetic theory and observations.
8. Servicing the vertical datum needs of other geosciences such as, e.g., hydrography and oceanography.

Efforts are currently underway to establish working groups and processing centres that will focus on one or more of the action items above. One such group is the already established JWG 0.1.1, whose program of activities is outlined below.

Joint Working Group of Theme 1

JWG 0.1.1: Vertical Datum Standardization

(joint with Commissions 1 and 2, and IGFS)

Chair: L. Sánchez (Germany)

Terms of Reference

During the last decades, many initiatives related to vertical datum unification have been developed in IAG. They are oriented to define and realize a global reference level and to determine the connection (transformation) of the local height datums to the global one, i.e. all physical heights (or geo-potential numbers) worldwide shall be referred to only one reference surface that is realized globally.
The main objective in the present period is to provide a reliable W_0 value to be introduced as the conventional reference level for the realization of the Global Height System. Although any W_0 value can arbitrarily be chosen, it is expected that this value is consistent with other defining parameters of geometric and physical models of the Earth. Activities will be based on the state-of-the-art data and methodologies, especially on the available representations of the Earth's surface and gravity field. Computations carried out will be documented in detail in order to guarantee the repeatability and reliability of the results. This documentation shall support the adoption of the obtained W_0 value as official IAG/GGOS convention. Another objective is to provide guidance on the usage of W_0 in practice, in particular for vertical datum unification.

Program of activities

1. To coordinate all individual initiatives for a unified W_0 determination: Groups working on the estimation of a global W_0 value shall be brought together in order to elaborate an inventory describing the methodologies, conventions, standards, and models presently applied in W_0 computations.
2. To refine the W_0 estimation: Each group shall perform a new W_0 computation following its own methodologies, but applying recent models (e.g. GOCE/GRACE gravity models, sea surface models derived from calibrated and combined satellite altimetry observations, etc.). This analysis shall also include an investigation about the time-dependence of W_0.
3. To propose a IAG/GGOS convention on W_0: It is expected that results obtained after applying the different methodologies considered in the previous item are very similar. After a rigorous reliability evaluation, a best estimate of W_0 shall be recommended.
4. To provide a standard about the usage of W_0 in the vertical datum unification: Based on the interchange of experiences within the WG, it is expected to generate a document describing the most appropriate strategy to connect (unify, transform) any local height system with the global W_0 reference level.

Members

- L. Sánchez (Germany), Chair
- J. Agreen (Sweden)
- R. Čunderlík (Slovakia)
- N. Dayoub (Syria)
- Z. Faskova (Slovakia)
- J. Huang (Canada).
- K. Mikula (Slovakia)
- P. Moore (United Kingdom)
- D. Roman (USA)
- Z. Šima (Czech Republic)
- V. Vatrt (Czech Republic)
- M. Vojtiskova (Czech Republic)
- Y. Wang (USA)

Theme 2: Geohazards Monitoring

Mitigating the impact on human life and property of natural hazards such as earthquakes, volcanic eruptions, debris flows, landslides, land subsidence, tsunamis, floods, storm surges, hurricanes and extreme weather is an important scientific task to which GGOS can make fundamental contributions. GNSS and InSAR can be used to monitor the pre-eruptive deformation of volcanoes and the preseismic deformation of earthquake fault zones, aiding in the issuance of volcanic eruption and earthquake warnings. GNSS can also be used to rapidly estimate earthquake fault motion, aiding in the modeling of tsunami genesis and the issuance of tsunami warnings. Gravity measurements can be used to track mass motion within volcanic conduits; and gravity and altimetric measurements can be used to track floodwaters in river basins.

Geodetic observations are essential for understanding the processes causing the hazard, for assessing the risks of the hazard, for monitoring the development of the hazard, for deciding whether or not to issue an early warning, and to support rescue and damage assessment activities.

The objective of Theme 2 is to improve the effectiveness of the geodetic community in supporting natural hazard identification, assessment, prioritization, prediction, and early warning. As an international organization, GGOS can be very effective as an advocate for the role of geodesy in understanding and mitigating natural hazards. GGOS can be an effective advocate for improving the geodetic data needed for natural hazards research including better spatial coverage, higher sampling rate, lower latency, and wider data availability, particularly of SAR and GNSS data. Finally, improved public outreach is needed to better educate and inform the public about the benefits of geodesy for geohazards monitoring.

Joint Working Group of Theme 2

JWG 0.2.1: New technologies for disaster monitoring and management

(joint with Commission 4)

Chair: I.D. Doukas (Greece)

Terms of Reference

United Nations International Strategy for Disaster Reduction (UNISDR) offers the following definition: “Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources”.

These facts demand actions and therefore they make indispensable the existence of dedicated methodologies and practices that serve for the prevention of environmental risks (in terms of protecting the citizens against the effects resulting from a disaster). So, these facts trigger off the launch of many initiatives throughout the world. Many related serious undertakings have targets such as: the assessment and reduction of urban vulnerability, the boost of information and knowledge exchange concerning the numerous topics and parameters involved into the extremely complicated domain of disasters.

Consequently, there is a very wide and dynamic field for investigation, studying and testing of available technologies, sensors, geosensors, methods, information systems, techniques etc., with a lot of potential.

Objectives

- To gather and register all kinds of disasters, either natural or man-made as a preparation to obtain a final reference base of study.
- To investigate, study and test any kind of available technologies, sensors, geosensors, methods, information systems (web-based or not), techniques etc. that could relate with Disaster Monitoring and risk management.
- To explore both the "Disaster Cycle" (Preparedness, Response, Recovery, Mitigation, Prevention) and the risk management domains, in order to detect where, how and what kind of the above mentioned new technologies could be infused to these domains.
- To dynamically record and register internationally existing disaster management systems, in order to have up-to-date information about the scene, the sophistication and the general advances in this field.
- To experiment with existing or new ideas, for ground based, water/marine based or airborne solutions, into

"standard fields" (Information Technology, Communication Technology, Space Technology).
- To experiment with new ideas into other fields that could appear as unconventional even as "exotic" (e.g. artificial intelligence, Simultaneous Localization and Mapping (SLAM), Simultaneous Localization, Mapping and Moving Object Tracking (SLAMMOT) etc.).
- To use Web-tools (web-site, social networks, blog etc.) in relation to the transmission, communication and propagation of information concerning risks, disasters.
- To attract most interesting cooperation with a variety of other scientific and/or professional institutes, organizations, groups.

Program of activities

- To use Web-tools (Web-site, social networks, blog etc.) in order to provide information about related bibliography, Web-links, events, and other activities of the group.
- To diffuse and promote research and collaboration (also by attracting interdisciplinary aspects), to disseminate of information, to organize and to participate in workshops, meetings, seminars, conferences, symposia (academic, public, professional domains).
- To support ICCT activities.

Members

- Ioannis (John) D. Doukas (Greece), chair
- Günther Retscher (Austria)
- Cheng Wang (China)
- Allison Kealy (Australia)
- Gyula Mentes (Hungary)
- Mikhail Kanevski (Switzerland)
- Melinda Laituri (USA)
- Jonathan Li (USA)
- Beniamino Murgante (Italy)
- Clement A. Ogaja (USA)
- Urbano Fra Paleo (Spain)

Theme 3: Sea-Level Change, Variability and Forecasting

Sea level rise and its impact on human habitats and economic well being have received considerable attention in recent years by the general public, engineers, and policy makers. A GGOS retreat in 2010 has identified sea level change as one of the cross-cutting themes for geodesy. The primary focus is to demonstrate the value of geodetic techniques to mitigation of sea level rise including studies of the impacts of its change over the world's coastal regions and islands, and to support practical applications such as sustainability. Theme 3 interacts with the other two Themes as well as with related GGOS Working Groups. Close cooperation will also be established with groups and organizations working in related fields. One major topic is the identification of gaps in geodetic observing techniques and to advocate additions in the GGOS monitoring network and Services where necessary.

Activities

Through a Call for Participation Theme 3 will progress with the following tasks:
- Identification or (re)-definition of the requirements for a proper understanding of global and regional/local sea-level rise and its variability especially in so far as they relate to geodetic monitoring provided by the GGOS infrastructure, and their current links to external organizations (e.g., GEO, CEOS, and other observing systems).
- Identification of organizations or individuals who can take forward each requirement, or act as points of contact for each requirement where they are primarily the responsibility of bodies not related to GGOS.
- Identification of a preliminary set of practical (as opposed to scientific) pilot projects, which will demonstrate the viability, and the importance of geodetic measurements to mitigation of sea-level rise at a local or regional level. This identification will be followed by construction of proposals for pilot projects and their undertaking.
- The immediate action and pending on the outcomes of the Call for Participation, will be to identify, establish or reaffirm leadership and members of the Theme.
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In the long-term, the aim is to support forecasting of global and regional sea level for the 21st century. Special emphasis will be given to local and regional projects which are relevant to coastal communities, and which depend on the global perspective of GGOS.

Members

- T. Schöne (Germany)
- M. Tamisea (UK)
- C.K. Shum (USA)
- P. Woodworth (UK)