EGU2015-7420

The GGOS Bureau of Networks and Observations and an Update on the Space Geodesy Networks

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Abstract: The GGOS Bureau of Networks and Communications is being reorganized into the Bureau of Networks and Observations. Although the GGOS Bureau of Networks and Communication was the Bureau of the Services, it focused primarily on the geometric techniques (VLBI, SLR, GNSS, and DORIS) that provided the foundation for the development and maintenance of the International Terrestrial Reference Frame. Over the course of the last several years the Space Geodesy networks have grown; new systems are in the process of deployment, new sites are being established following the GGOS concept of "core" sites and new technologies are implemented to enhance performance in data yield as well as accuracy. In particular, several groups are undertaking initiatives and seeking partnerships to update existing sites and expand the networks in geographic areas void of coverage. It has also been long recognized that new data products generated by entities within and outside of GGOS will require integration with those of the geometric and non-geometric service data in order to produce new and improved products such as a Unified Height System, improved tide and ocean models, and better hazard assessment tools. The role of the new Bureau is now being expanded to better integrate the non-geometric Services (Gravity Service, tide gauge networks, etc.) and to strengthen communications with the space missions, the simulation activities to project network capability, and some of the data gathering functions. The expanded Bureau will include the GGOS Working Groups on Missions, Simulations, Data and Information Systems, and it will be tightly linked to the IERS Working Group on Survey and Co-location. The reorganized Bureau will now become the GGOS Bureau of Networks and Observations. This poster will outline the plan for the new Bureau and will give an update on the status of the ground networks that will participate as well as its other components.

GGOS Bureau of Networks and Observations: Overview

Role of the Bureau: To advocate and encourage implementation of the Core and Co-location Network to satisfy GGOS requirements, to monitor the status of the network and project its future condition, and to support and advocate for infrastructure critical for the development of data products essential to GGOS.

Objectives: The current objective is the deployment of a globally distributed network of 32, new technology core sites with VLBI, SLR, GNSS and DORIS to achieve reference that will permit mm accuracy at 0.1 mm/year stability over decades. The new role of the Bureau is now being expanded to better integrate the non-geometric Services (Gravity Service, Tide gauge networks, etc.) and to strengthen communications with the space missions, the simulation activities to project network capability, and some of the data gathering functions.

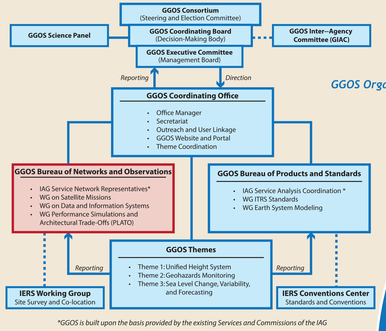
Reality: Site deployment and upgrade will occur over many years, and some sites for economic and political reasons will not be in the ideal locations. Co-location sites (non-core sites) will continue to play a vital role in our data products. The utility of our output will be the product of network Core Sites, Co-location sites, mix of technologies, adherence to proper operational and engineering procedures, and making best use of the data once it leaves the field.

Organizational Elements:

- Services Networks:
  - IGS, IVS, ILRS, IDS, IGFS, tide gauges, etc.
- Working Groups:
  - Missions
  - Performance Simulations & Architectural Trade-Offs (PLATO)
  - Data and Information Systems
  - Ground Survey and Co-location (IERS WG)

GGOS Organization: Elements within Bureau are intended to work as an integrated team whose main focus is to ensure that the networks required to collect the data that will support the GGOS products are in place and produce these data.

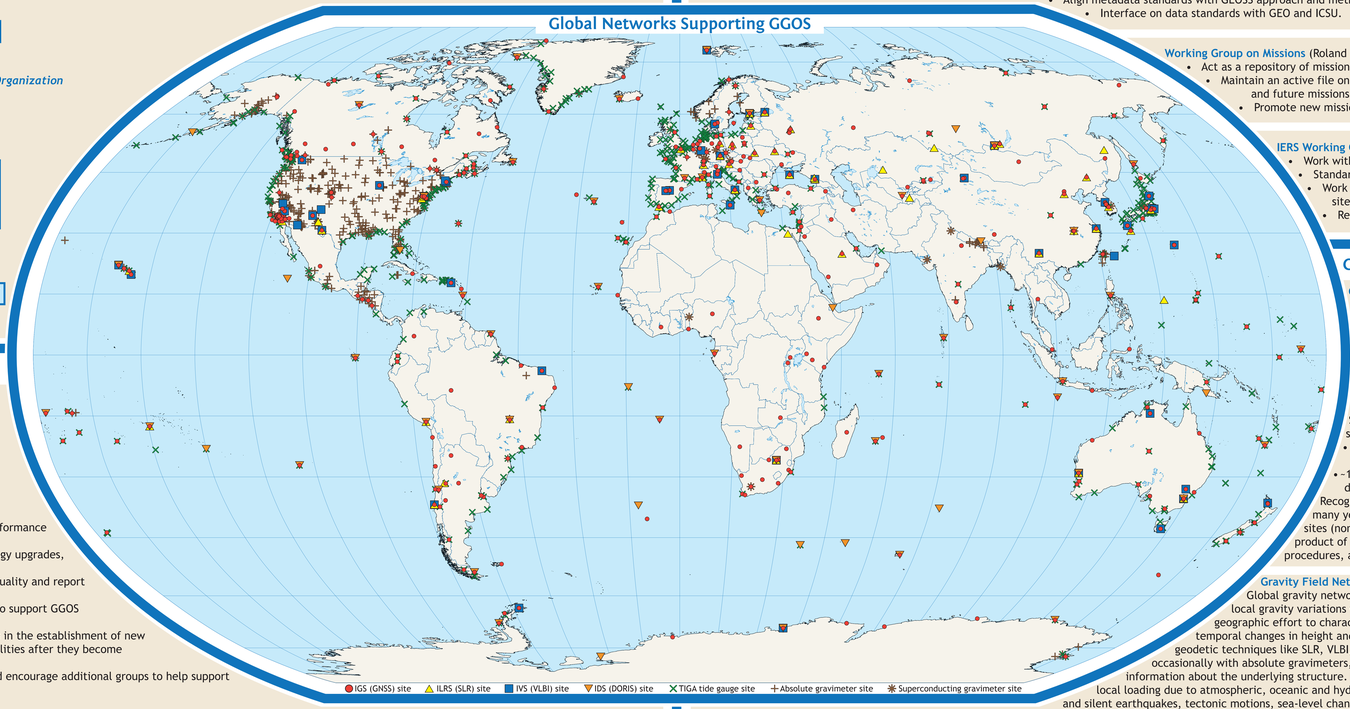
Bureau Leadership: Board made up of a Director, Secretary, Analysis Coordinator, a representative from each Network Service and Working Group.



GGOS Organization

*GGOS is built upon the basis provided by the existing Services and Commissions of the IAG

Global Networks Supporting GGOS



GGOS Bureau of Networks and Observations: Tasks and Plans

All of the Services will focus on their respective network coordination, data acquisition, and data analysis to generate products for science and societal needs articulated by GGOS. The Services will constantly strive to improve the robustness and quality of their data and the results through improved procedures, technologies and modeling.

In its role to support the Services and better serve the users, the GGOS Bureau of Networks and Observations will:

- Advocate for implementation of the global space geodesy network of sufficient capability to achieve data products essential for GGOS;
- Provide a forum for the Services and Working Groups to meet, discuss status and plans, and examine common interests and requirements;
- Update Site Requirements Document (with the IAG Services) (July 30, 2015);
- Monitor and project the status and evolution of the GGOS space geodesy network in terms of location and performance (with the IAG Services);
- Project future network capability and examine trade-off options for station deployment and closure, technology upgrades, impact of site ties, etc. (PLATO WG);
- Coordinate the effort of the services to implement procedures to provide test-based estimates of their data quality and report (first discussion at Bureau meeting at EGU 2015);
- Facilitate efforts to integrate other ground networks (gravity field, tide gauges, etc) into the GGOS Network to support GGOS requirements (Progress report at EGU 2016);
- Support the technical services on the promotion of recommended technologies/configurations and procedures in the establishment of new sites and the upgrading of current sites, and in the evaluation of performance of new stations and new capabilities after they become operational;
- Standardize site-tie measurement, archiving, and analysis procedures, maintain a current site-tie archive, and encourage additional groups to help support the network site-tie task (IERS Survey and Co-location WG and the Data Centers);
- Develop a metadata strategy for all ground-based measurement techniques (WG on Data and Information);
- Improve coordination and information exchange with the Missions for better ground-based network response to mission requirements and space-segment adequacy for the realization of GGOS goals (Missions WG);
- Support GGOS submissions to GEO, CEOS and other international organizations.

The evolution of the networks will be a long-term endeavor (10 – 20 years), but the evolution in the networks and the associated modeling and analyses will provide steady and very useful improvements in the data products. The evolving data and data products will be a major driver for developing and validating new models and analysis techniques.

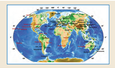





GGOS Bureau of Networks and Observations: Working Groups

Working Group on Performance Simulations & Architectural Trade-Offs (Daniela Thaller, Richard Gross)

- Use simulation techniques to assess impact on data products of: network configuration, system performance, technique and technology mix, co-location conditions and site ties, and external ties (added spacecraft, etc);
- Make recommendations on network and system options and trade-offs.

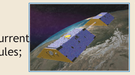


Working Group on Data and Information (Bernd Richter, Carey Noll)

- Promote the use of metadata standards and conventions and recommend implementations of metadata management for GGOS in the pursuit of a metadata policy;
- Promote interoperability among participating data centers with other databases and services;
- Develop strategies to protect the intellectual properties on data and products;
  - Align metadata standards with GEOSS approach and methodology;
  - Interface on data standards with GEO and ICSU.


Working Group on Missions (Roland Pail, Juergen Mueller)

- Act as a repository of mission information including key contacts and links;
- Maintain an active file on the GGOS web page to keep the community informed of current and future missions of interests, their configuration, requirements, and schedules;
- Promote new mission concepts.



IERS Working Group on Survey and Co-location (Sten Bergstrand)

- Work with the IGN to maintain a comprehensive site survey and site tie database;
- Standardize site-tie measurement procedures, standards and analyses techniques;
- Work with the IERS, the Services and GGOS to encourage more groups to gain site tie survey and analysis capability;
- Recommend site tie measurement priorities.


GGOS Bureau of Networks and Observations: IAG Services

Geometric Space Geodesy Network

The reference frame baseline requirements are levied by the GGOS 2020 document. The most stringent requirement comes from sea level rise:

- Accuracy of 1 mm, and stability at 0.1 mm/yr., factor 10-20 beyond current capability;
- Accessibility: 24 hours/day; worldwide;
- The Space Segment is currently defined by LAGEOS-1 and -2, LARES, GNSS, DORIS and the quasars;
- The Ground Segment is defines by a global distributed network of "modern technology", co-located SLR, VLBI, GNSS, DORIS stations locally tied together with accurate site ties;
- A dense network of GNSS ground stations to distribute the reference frame globally to the users;

Simulations to date performed by Erricos Pavlis/UMBC have translated this requirement into a network-size specification:

- ~32 globally distributed, well positioned, new technology, co-location sites will be required to define and maintain the reference frame;
- ~16 of these co-location stations must track GNSS satellites with SLR to calibrate the GNSS orbits, which are used to distribute the reference frame.

Recognizing that many sites will not be at ideal locations nor have ideal conditions, core site deployment will occur over many years, and that we will have a mix of new and legacy technologies for many years: we can assume that co-location sites (non-core sites) will continue to play a vital role in our data products and that the quality of our output will be the product of network Core Sites, Co-location sites, mix of technologies, adherence to proper operational and engineering procedures, and making best use of the data once it leaves the field;

Gravity Field Network (IGFS)

Global gravity networks include sites with (1) fixed instruments (usually superconducting gravimeters) for continuous monitoring of local gravity variations with extremely high precision and (2) sites occupied infrequently by absolute gravimeters as part of a broader geographic effort to characterize the regional or global gravity field. High precision, continuous monitoring can reveal information about temporal changes in height and the forces that cause these changes. Co-location of continuous monitoring instruments with the geometric space geodetic techniques like SLR, VLBI, GNSS, can greatly enhance the study of the local static and temporally changing environment. Sites occupied occasionally with absolute gravimeters, are usually established as part of national or agency programs to map the regional gravity field, which can tell us information about the underlying structure. Data from both fixed and occupied sites are used to study the Earth's gravity field structure, variations caused by local loading due to atmospheric, oceanic and hydrological loads, Earth's response to various phenomena, e.g. the Chandler wobble, internal gravity waves, slow and silent earthquakes, tectonic motions, sea-level changes, post-glacial rebound and Earth's normal modes following moderate to large earthquakes. Surface gravimetry measurements also used to validate spacecraft data derived models from missions such as CHAMP, GRACE, and GOCE.

Tide Gauge Network

Tide gauge data are being used to develop ocean circulation models, tidal models, warnings of hazards from tsunami, monitoring long-term sea level changes, and help calibrate and validate satellite ocean surface altimeters. The two main issues with tide gauge networks are 1. the large number of gauges that do not have local GNSS receivers for accurate and continuous geolocation in the geodetic reference frame and 2. the gaps over large coastal and oceanic expanses due to either inoperative units or lack of instrumentation entirely. The IGS has established the TIGA Project to derive geocentric coordinates and time series of vertical motion for a large set of globally distributed tide gauges co-located with GNSS stations in support of climate studies. The tasks within GGOS are to help encourage the geodetic community to properly deploy GNSS receivers where they are not already in close proximity to existing tide gauges, to make the resulting tide gauge and GNSS data publicly available within international data archives sanctioned by GLOSS, IGS, GGOS, etc., and to advocate for placement of tide gauges in regions void of such systems but of great scientific and societal interest.

GGOS:	http://www.ggos.org	IAG:	http://www.iag-aig.org
IERS:	http://www.iers.org	IVS:	http://ivscc.gsfc.nasa.gov
IGS:	http://www.igs.org	TIGA:	http://adsc.gfz-potsdam.de/tiga/
ILRS:	http://ilrs.gsfc.nasa.gov	IDS:	http://www.ids-doris.org
IGFS:	http://www.ggos-portal.org/lang_en/GGOS-Portal/EN/Topics/Services/IGFS/IGFS.html		