

# GGOS

## Bureau of Networks and Observations

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### GLOBAL GEODETIC OBSERVING SYSTEM

#### 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

- Standing Committees: (Performance Simulations and Architectural Trade-Offs/PLATO, Data and Information Systems, Missions, IERS WG on Site Survey and Co-location)
- Services networks (IGS, IVS, ILRS, IDS, IGFS, tide gauges, etc.)

**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.

#### Standing Committees

##### Standing Committee on Performance simulations & Architectural TradeOffs (PLATO)/D. Thaller, B. Männel)

- Examining trade-off options for station deployment and closure, technology upgrades, impact of site ties, etc.
- Simulation studies “ground” underway to assess impact on reference frame products of: network configuration, system performance, technique and technology mix, co-location conditions, site ties;
- Simulation studies “space” underway to assess impact on reference frame products of: co-location in space, space ties, available satellites;
- Project future network capability over the next 5 and 10 year periods using projected network configuration in new system implementation;
- Develop improved analysis methods for reference frame products by including all existing data and available co-locations;
- Analysis campaign with exchanged simulated observations.

##### Standing Committee on Satellite Missions (CSM)/J. Müller, R. Pail

- CSM section on the GGOS website with major CSM activities and results created for public access;
- Inventory/repository of the GGOS satellite infrastructure prepared and will be updated;
- List of satellite contributions to fulfil the GGOS 2020 goals prepared and will be updated;
- Advocating for new satellite missions such as in the frame of ESA and NASA calls;
- Exchange with PLATO will be expanded, e.g., dedicated simulations to better understand and overcome shortcomings with respect to the GGOS 2020 goals.

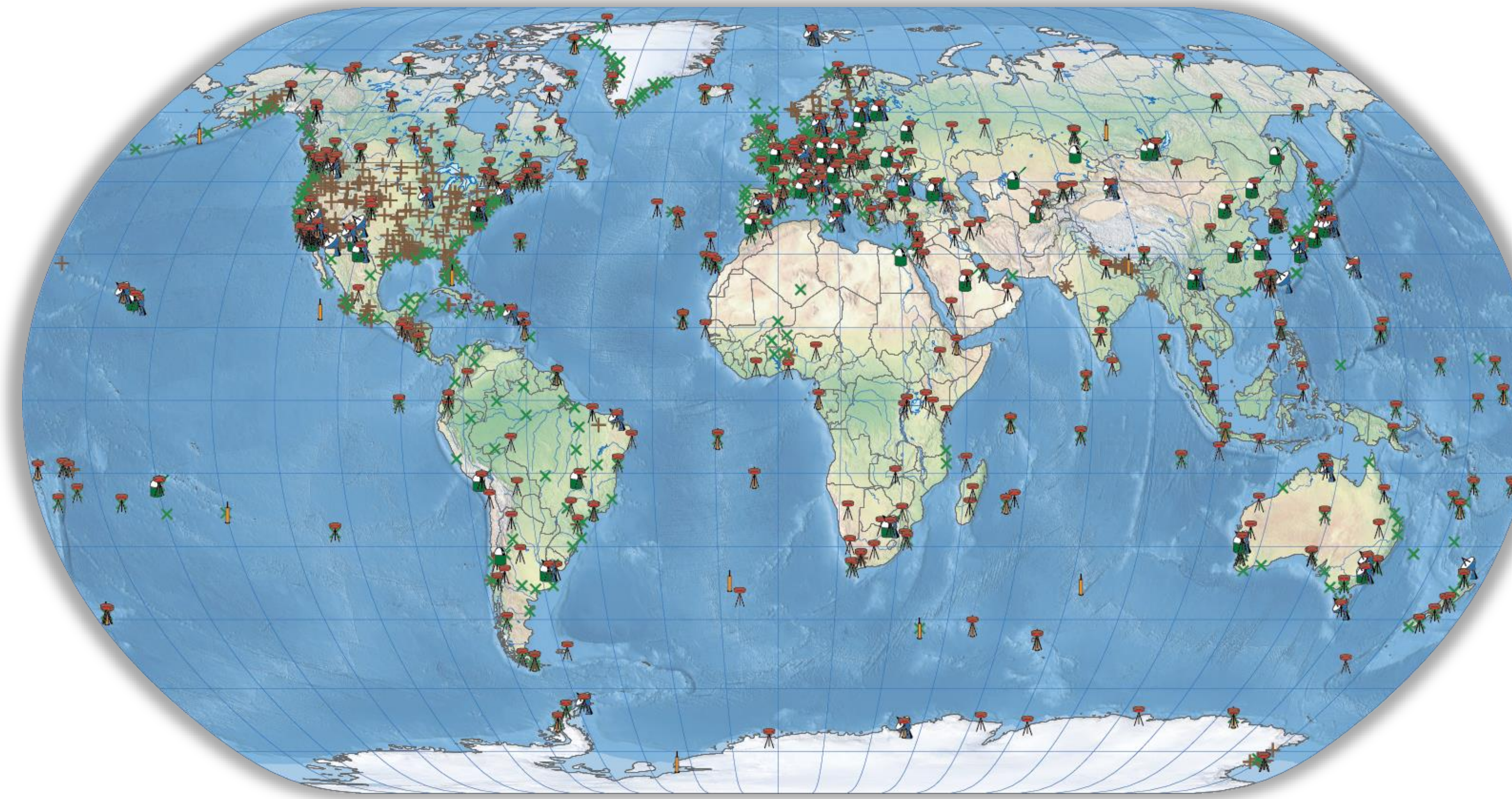
##### Standing Committee on Data and Information System/M. Madzak, C. Noll

- Adopt and implement a metadata system to provide access to GGOS relevant data products (2018);
- Adopt and implement a full metadata system including site information and relevant tools and capability (e.g., the Australian GL scheme):
  - Definition of the requirements; definition of Phase 1;
  - Resolve issues and applicability of the Australian GL scheme and recommend schema;
  - Metadata implementation plan including definition of tasks, roles, and distribution of tasks, and plans for integration of components;
  - Demonstration of Phase 1 prototype.

##### IERS Working Group on Site Survey and Co-location Tasks/S. Bergstrand

- Systematic technique errors rather than local tie surveys are dominant error sources in discrepancies between ties and solutions. Differences between analytic solutions and local ties are thus primarily indicators of systematic errors of the techniques on the site, not of the local ties.
- Annual site surveys are not necessary unless there are indications of instabilities or survey problems.
- ITRS Center released “IGN best practice for surveying instrument reference points at co-location sites” (IERS Tech. Note 39).
- Development of an *in situ* GNSS antenna calibration method is a high priority; and especially important to commission at GNSS sites with long history.
- In a choice between surveying on the one hand sites with and the other hand without existing local ties, sites without local ties should be prioritized.

#### Global Networks Supporting GGOS



#### IAG Services

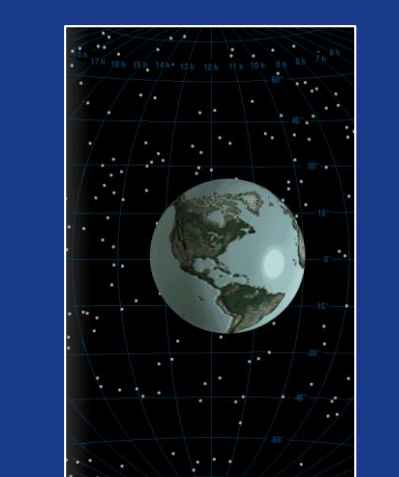
##### International GNSS Service (IGS)

- The IGS adopted a new reference frame (IGS14) on January 29, 2017. An updated set of satellite and ground antenna absolute type mean calibrations were also implemented. The antenna updates include robot calibrations for additional ground antenna types, increasing the percentage of IGS ground stations with absolute calibrations to over 90%.
- The GB agreed to adopt the official RINEX V3.04 format, handling the ability for 9-character ID and fixing the definition of GNSS reference time scales. The IGS White Paper on Satellite and Operations Information for Generation of Precise GNSS Orbit and Clock Products is now an official sanctioned IGS paper.
- The IGS analysis centers are currently focused on understanding and improving the modelling of systematic errors in GNSS observations. For orbit modelling, they seek to further understand the discrepancy in the modelling of solar radiation pressure models obtained from the different analysis centers for GPS satellites, and to improve the gravitational force modelling through the introduction of time variable low order harmonic terms.
- The IGS is actively encouraging research into station specific effects that can distort the antenna calibrated values which can introduce biases into the position estimates.
- Wuhan University is now the fifth IGS Global Data Center; the GB officially endorsed fully-weighted adoption of Wuhan Rapid products.
- The next IGS Workshop is scheduled for October 20 - November 2, 2018 in Wuhan, China.



##### International VLBI Service for Geodesy and Astrometry (IVS)

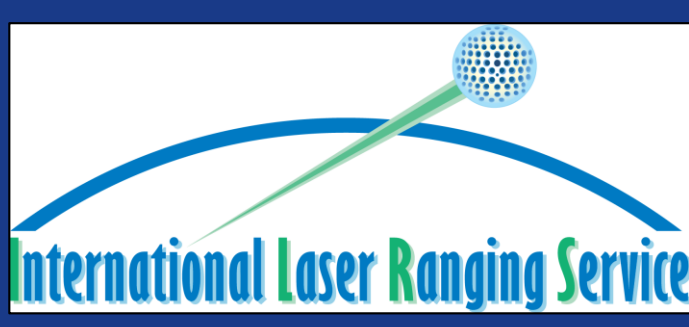
- The IVS supported the 3<sup>rd</sup> realization of the International Celestial Reference Frame (ICRF3) and will include catalogs at S/X, K band (24GHz) and Ka/X band (32/8 GHz).
- IVS Working Group 8 on Galactic Aberration studied issues related to incorporating the effect of solar system rotation around the galactic center. IVS WG8 recommends that this effect—which can be as large as 5-7 $\mu$ as/year—be included in VLBI analysis.
- The 15-day CONT17 (November 28-December 12, 2017) experiment included two independent legacy S/X networks of 14 globally distributed stations. In addition, a 6-station VGOS broadband network took data for 5 days.
- During 2017 VGOS observing made important strides towards becoming operational. In addition to VGOS-CONT17 there were 18 24-hour VGOS sessions involving 5-6 stations: GGAO12M, Westford, Kokee12M, YEBES13M, WETT13S, Ishioka.
- The Onsala Twin Telescopes were inaugurated on May 18, 2017 as part of the European VLBI Group for Geodesy and Astrometry meeting. They obtained broadband fringes toward the end of the year.
- New VGOS are under construction at Ny-Ålesund (Norway), Hartebeesthoek (South Africa), Metsähovi (Finland), and Shanghai (China). The Australian AuScope antennas at Hobart, Katherine, and Yarragadee are scheduled to be upgraded to a VGOS broadband systems.



#### IAG Services

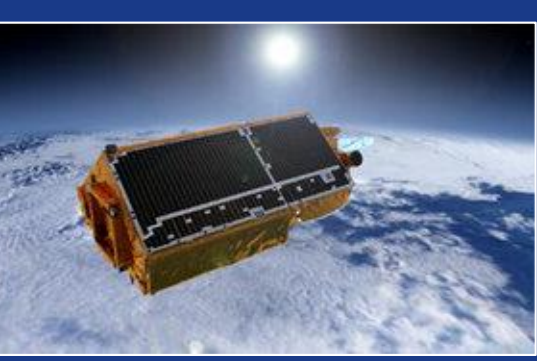
##### International Laser Ranging Service (ILRS)

- ILRS tracks over 90 targets including LEO, HEO, GNSS, GEO, and lunar arrays; several targets require restricted tracking to avoid damaging optically sensitive payloads;
- New stations established or in process by Russian Federation, NASA, BKG, ISRO, China, Finland, Norway, etc.; spatial gaps still exist in Africa, Central America, Oceania, etc.; some remote stations being outfitted with a second SLR system to relieve the tracking load;
- ASC has implemented the new ITRF2014 in its operational products; the Systematic Error Monitoring PP is evolving into an operational tool; the next PP will seek to introduce LARES as a fifth target and deliver weekly estimates of low-degree gravitational harmonics as a new ILRS product;
- Quality Control Board (QCB) monthly telecons held to address laser ranging data quality issues;
- The updated ILRS TOR includes two new at-large members to the ILRS Governing Board;
- The 2017 ILRS Technical Workshop was held in Riga, Latvia in October 2017; next International Workshop on Laser Ranging will be held in Canberra, Australia, November 05-09, 2018;
- Call for papers for Journal of Geodesy Special Issue on Laser Ranging is still open and a final extension of the submission deadline was recently granted (May 31, 2018).



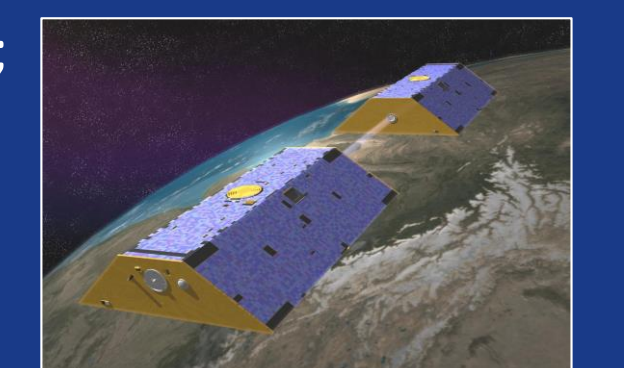
##### International DORIS Service (IDS)

- Six DORIS-equipped satellites currently contribute to IDS; 8 to 10 future missions are expected by 2030 with Sentinel-3B to be launched April 2018);
- Specifications for co-located DORIS and VLBI were established based on RF compatibility tests performed at Greenbelt, MD USA; Wettzell, Germany; Papenoo, and French Polynesia;
- New stations in Mangilao, Guam Island and San Juan, Argentina to be installed in the April-May 2018 timeframe;
- DORIS station at Rothera, Antarctica moved to the IGS “ROTH” station;
- Prototype 4<sup>th</sup> generation DORIS beacon in testing phase for mid-2019 deployment; Twelve stations out of 55 now equipped with new ground antenna (Starec type C) with the 2GHz phase center location defined to  $\pm 1$  mm;
- DPOD (DORIS extension of the ITRF for Precise Orbit Determination) now released twice a year and based on the latest DORIS position and velocity cumulative solution;
- An IDS survey is currently underway to prepare for the IDS Retreat scheduled for June 2018 in order to define the activities of the service for the next decade;
- IDS 2018 Workshop will be held in Ponta Delgada (Azores, Portugal) September 24-26, 2018 as part of the 25 Years of Progress in Radar Altimetry Symposium (OSTST).



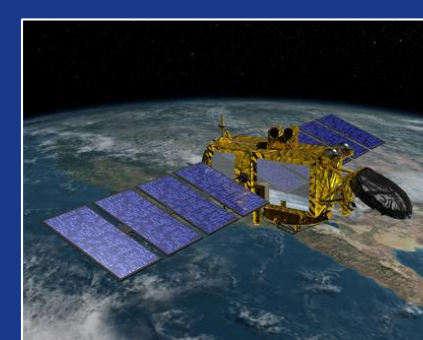
##### International Gravity Field Service (IGFS)

- Promoting establishment of the Global Geodetic Reference System/Frame (GGRS/GGRF) and the International Height Reference System/Frame (IHRF/IHRS);
- Implementing new IGFS webpage at the IGFS CB;
- Defining new metadata standards for absolute and relative gravity data;
- Participating to the establishment of the new absolute gravity reference system/frame;
- Estimating time-variable global gravity models through COST-G, the IGFS Combination Service for Time-variable Gravity Field Solutions.



##### Permanent Service for Mean Sea Level (PSMSL)

- Provided training to tide gauge operators in Central America and the Caribbean as part of an IOC / UNESCO programme;
- Updated the PSMSL trends webpage, adding visualisations of the fitted seasonal cycles and estimates of the period of time needed to reach uncertainties of 1.0, 0.5 and 0.1 mm/yr in the fitted trend at individual sites;
- Refactored database to allow storage of more complex metadata – this will allow more metadata to be passed to users, and make it easier to implement metadata standards;
- Developed new files for the PSMSL dataset in netCDF format, implementing the Climate and Forecast and ACDD conventions. These are being distributed for testing and public comment, and may well be changed to implement further improvements;
- Holding a ‘Sea Level Futures’ meeting in July to celebrate the 85<sup>th</sup> anniversary of PSM.



#### For Further Information:

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