

# GGOS

GLOBAL GEODETIC OBSERVING SYSTEM

# Current Activities and Plans of the Bureau of Networks and Observations

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IUGG



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. and project future network capability using projected network configuration in new system implementation;
- Conducting simulations to assess impact on reference frame products of: network configuration (e.g., new and additional sites), system performance (e.g., SLR station performance), technique and technology mix, co-location conditions, site ties;
- Conducting simulation studies to assess impact on reference frame products of: co-location in space, space ties, available satellites (e.g., tracking priorities for LAGEOS and Etalon);
- Developing improved analysis methods for reference frame products by including all existing data and available co-locations (e.g., consistent processing of LEO and ground-based observations);
- Conducting ongoing analysis campaign with exchanged simulated observations.

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

- List of satellite contributions to fulfill the GGOS 2020 goals (1 mm / 0.1 mm/yr) has been prepared and will be regularly updated;
- Inventory of the GGOS satellite infrastructure has been prepared and will be regularly updated;
- Both lists are published at the CSM section of the GGOS website;
- ESA's Earth Explorer 10 call: CSM has contributed to proposal MOBILE (future gravity satellite mission) – not selected;
- Exchange with PLATO has been initiated by identifying joint interests and possible collaborations.

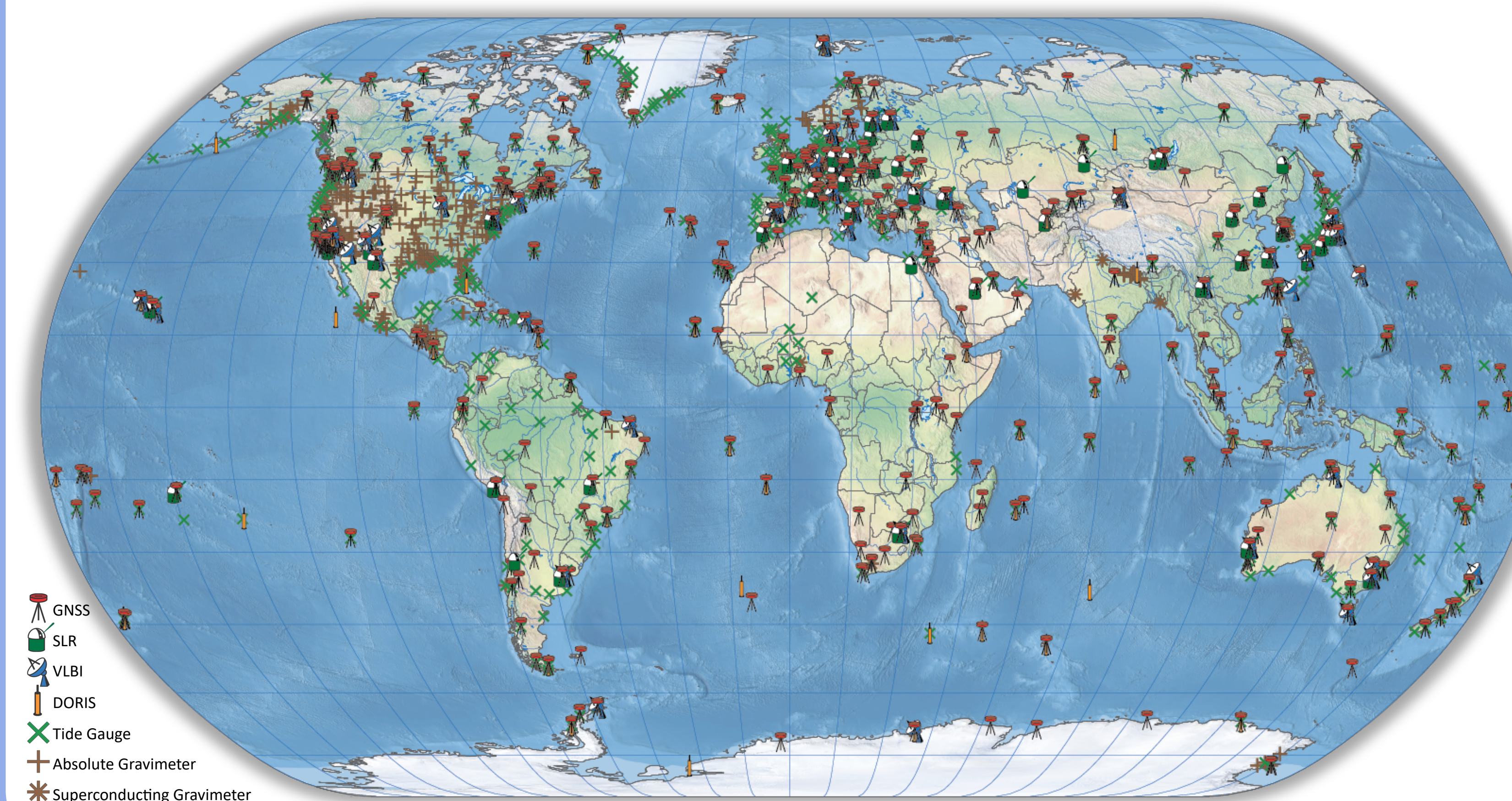
### Standing Committee on Data and Information System/H. Titz, C. Noll

- Adopting and implementing a metadata system to provide access to GGOS relevant data products;
- Work continues at CDDIS on collection-level metadata efforts;
- Developing a full metadata system including site information and relevant tools and capability (e.g., the Australian GL scheme):
  - Definition of the requirements;
  - 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.

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

- Geometric VLBI telescope deformation measurements have been shown to isolate apparent reference point movements that hitherto have been aliased into space geodetic processing at an order of several millimeters;
- High priority to have such measurements done at legacy VLBI telescopes before they are decommissioned to provide the best possible time series for future International Terrestrial Reference frames (ITRFs);
- Starting mid-2019, the GeoMetre Project (18SIB01) has been granted three years European Commission funding in the European Metrology Programme for Innovation and Research (EMPIR) to improve traceable long-distance measurements and local tie research.

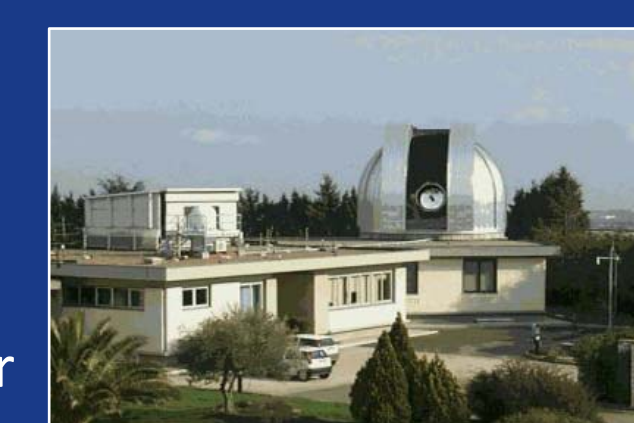
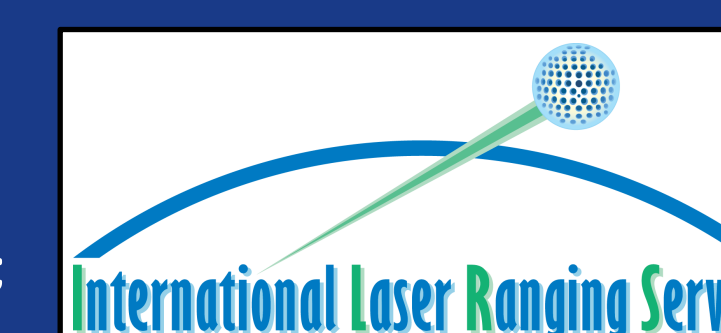
## Global Networks Supporting GGOS



## IAG Services

### International Laser Ranging Service (ILRS)

- ILRS tracks over 100 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 Russia, 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 ILRS operational products and is now preparing for the re-analysis to contribute to the development of ITRF2020; the Systematic Error Monitoring PP is evolving into an operational tool and the mode of re-analysis for the ITRF2020; 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;
- Two GNSS tracking campaigns held in 2018 to examine tracking strategies for improving coverage of the GNSS satellite constellations;
- Etalon tracking campaign now underway to evaluate the effect of increased observations in improving determination of EOPs and low-degree gravitational harmonics;
- New ILRS Governing Board in session for 2018-2019; Toshi Otsubo elected as chair;
- 21<sup>st</sup> International Workshop on Laser Ranging held in Canberra Australia in November 2018; the 2019 ILRS Technical Workshop "Laser ranging: To improve economy, performance, and adoption for new applications" will be held in Stuttgart Germany in October 2019;
- Journal of Geodesy Special Issue on Laser Ranging currently in process; ten papers published online and several in review.



### International DORIS Service (IDS)

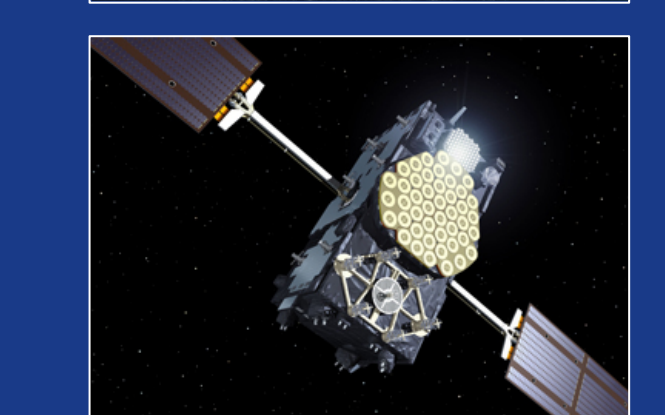
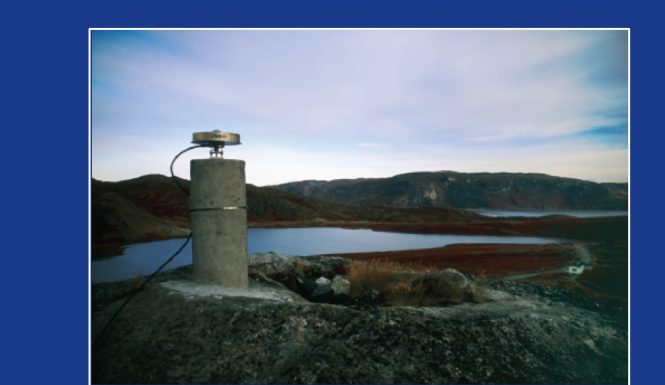
- Seven DORIS-equipped satellites currently contribute to IDS; future satellites: HY-C, HY-D, and Jason-CS-A in 2020;
- New stations in Manglao, Guam Island and San Juan, Argentina into service in April and September 2018 respectively; ongoing negotiation with China for a new station at Changchun (GNSS and SLR co-location);
- Station relocation in Ny-Ålesund, Svalbard, Norway in October 2018 to co-locate DORIS with the other IERS techniques within the new geodetic observatory inaugurated June 2018;
- Production models of the 4<sup>th</sup> generation DORIS beacon are underway for mid-2019 deployment; 15 stations now equipped with new ground antenna (Starec type C) with the 2GHz phase center location defined to  $\pm 1$  mm;
- New setting for the preprocessing of the IDS ACs series in order to improve the combined series contributing to the ITRF;
- An analysis of the ITRF2014 tie vector discrepancies at the DORIS sites is currently being conducted;
- Following the June 2018 IDS Retreat, an IDS strategic plan for the next decade is under preparation;
- IDS Analysis Working Group met in Munich in April 2019 in order to prepare the IDS contribution to ITRF2020.



## IAG Services

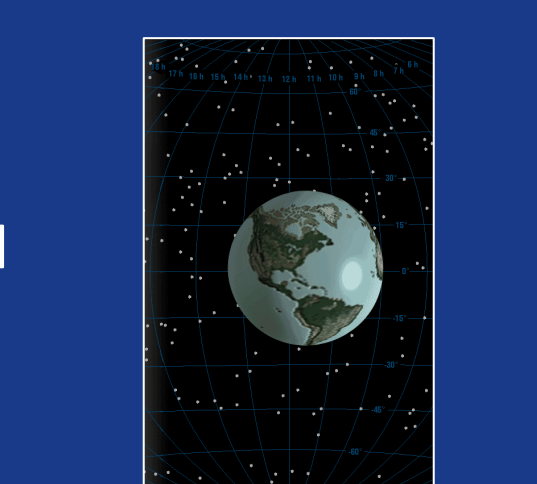
### International GNSS Service (IGS)

- The IGS Analysis Centers continue to develop processing standards for the "repro3" effort for the IGS contribution to ITRF2020;
- The ACs working on integer phase bias products to support precise point positioning (PPP) processing;
- IGS Analysis Center Coordinator (ACC) developing multi-GNSS combinations;
- 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; efforts include developing an estimation of L5 antenna calibrations;
- The IGS analysis centers are currently focused on understanding and improving the modelling of systematic errors in GNSS observations; the ACs are comparing orbit results using ocean tidal loading models;
- The 2018 IGS Workshop "Multi-GNSS Through Global Cooperation" was held October 20 - November 2, 2018 in Wuhan; material from the workshop posted on the IGS website.



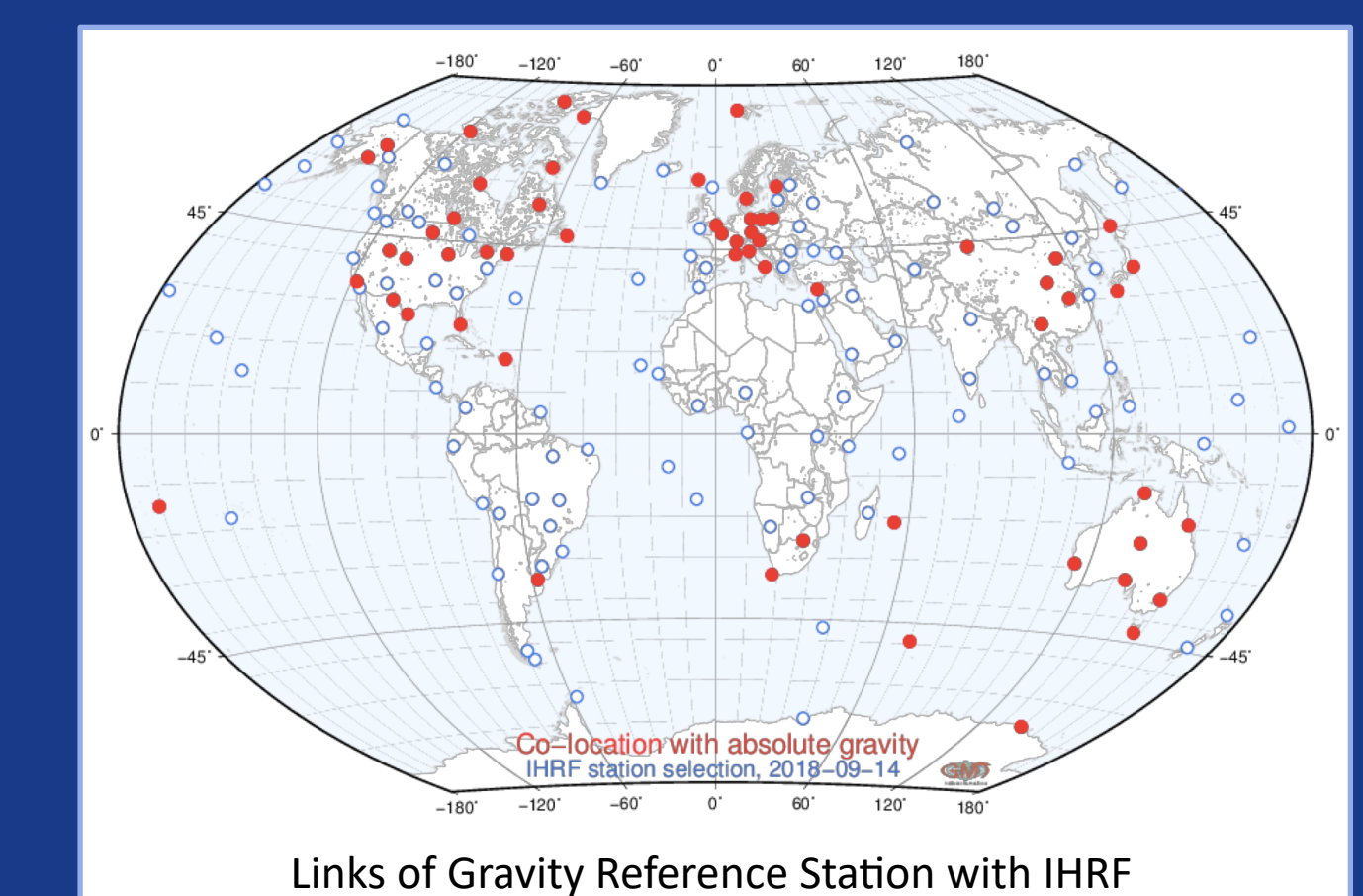
### International VLBI Service for Geodesy and Astrometry (IVS)

- The IVS supported the work on the third realization of the International Celestial Reference Frame (ICRF3). The new frame was adopted at the IAU General Assembly in Vienna, Austria on August 30, 2018 under Resolution B2. ICRF3 contains positions of more than 4000 extragalactic radio sources at three frequencies and became the Fundamental Astrometric Reference Frame on 01 January 2019.
- The IVS continued an observing program to determine the alignment of the current radio frame (ICRF3) with the future *Gaia* optical frame by observing ICRF3-*Gaia* transfer sources.
- The IVS held its 10<sup>th</sup> General Meeting in Longyearbyen, Svalbard, Norway in June 2018 with about one hundred participants; a proceedings volume of the event is under preparation.
- The IVS organized the 3<sup>rd</sup> VLBI Training School in Las Palmas, Gran Canaria, Spain in the period March 14–16, 2019 with about 70 participants.
- The IVS established an Office for Outreach and Communications (OOC) at MIT Haystack Observatory in late 2018. The aim is to enhance public relations work to institutions as well as the general public and to increase the visibility of the VLBI technique and the service work of the IVS.
- Progress was made in achieving operational readiness of the next-generation VLBI system, the VLBI Global Observing System (VGOS). A network of 6 to 7 stations regularly participated in 24-hour sessions about every two weeks. These sessions were used to improve the operational stability of the stations, data transport mechanisms, and the correlation and post-processing of the data.



### International Gravity Field Service (IGFS)

- Co-operating in the establishment of the International Height Reference System/Frame (IHRF/IHRF);
- 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;
- Participating in the Colorado geoid computation test.



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

- Reached its 85<sup>th</sup> anniversary in 2018, and celebrated our long history of providing mean sea level records from tide gauges by hosting an international meeting on the future of sea level science.
- Created Matlab code for automatic first level quality control of sea level data.
- Participated in training courses for tide gauge operators, port authorities and other interested parties in the Caribbean.
- Expanded information on website linking tide gauges to GNSS receivers and national vertical datums.
- Will assign a digital object identifier (DOI) for the PSMSL database.
- Will assess whether PSMSL follows FAIR data principles (Findable, Accessible, Interoperable, Reusable), and improve areas where we do not.



## For Further Information:

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