

GGOS

GLOBAL GEODETIC OBSERVING SYSTEM

Current Activities and Plans of the Bureau of Networks and Observations

Michael Pearlman, Dirk Behrend, Allison Craddock, Carey Noll, Erricos Pavlis, Jérôme Saunier, Andrew Matthews, Riccardo Barzaghi, Daniela Thaller, Benjamin Maennel, Sten Bergstrand, Jürgen Müller



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.

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.

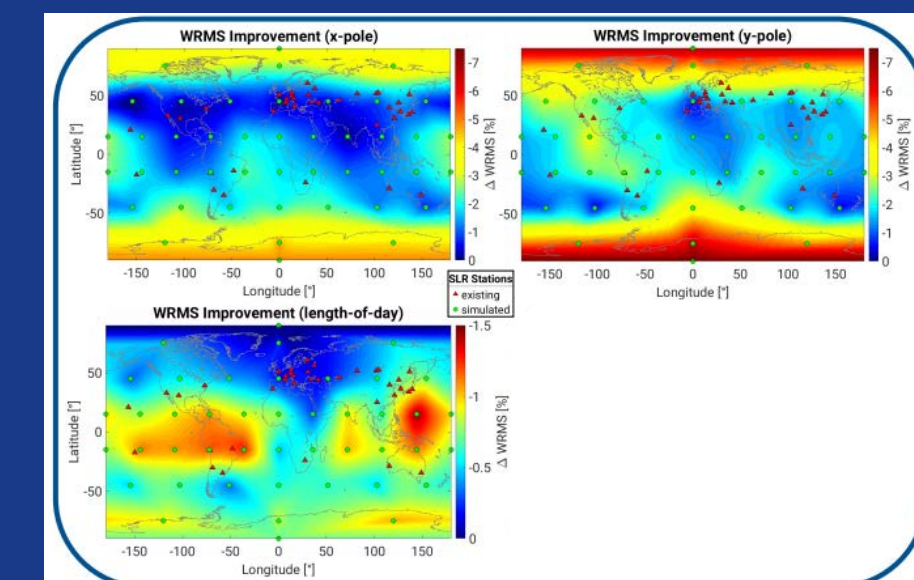
Recent News: Several changes in the organization have recently occurred. They are now the point of contact for their sections in this poster.

- Elizabeth Bradshaw <elizb@bodc.ac.uk>/NOC (replaces Andrew Matthews)
- Ryan Hippenstiel <ryan.hippenstiel@noaa.gov>/NOAA (replaces Sten Bergstrand)
- C.K. Shum <shum.3@osu.edu>/OSU (replaces Juergen Mueller)
- Nicholas Brown <Nicholas.Brown@ga.gov.au>/GA (replaces Martin Sehna)

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, the impact of site ties, etc. and project future network capability based on network configuration projected by the BNO or relevant IAG services (IGS, ILRS, IVS, IDS);
- Investigating the impact of improved SLR tracking scenarios including spherical satellites, LEOs, and GNSS satellites and VLBI satellite tracking on reference frame products;
- Identifying technique systematics by analyzing short baselines, data from new observation concepts, and available co-locations (e.g., consistent processing of LEO and ground-based observations);
- Investigating the best-practice methods for co-location in space and assessing the impact of co-location in space on reference frame products based on existing satellites and by simulation studies for proposed missions.



Improvement of Earth Rotation Parameters due to the addition of potential new SLR stations (green markers) to the existing SLR network (red markers). The WRMS of the resulting ERP time series is analysed, and improvements of the WRMS w.r.t. a solution based on the existing SLR network is color-coded here.

Standing Committee on Satellite Missions (CSM)/R. Pail, C.K. Shum

- Committee now under new leadership;
- Continue maintenance of table of GGOS satellite mission infrastructure (existing missions and projection to the near future);
- Continue maintaining and updating the inventory of the GGOS satellite mission infrastructure;
- Continue maintenance and updates of list of satellite contributions to fulfill the GGOS 2020 goals;
- Support preparation of future gravity field missions by different space agencies;
- Increase exchange with PLATO to strengthen the analysis component in the mission evaluation and planning activity.

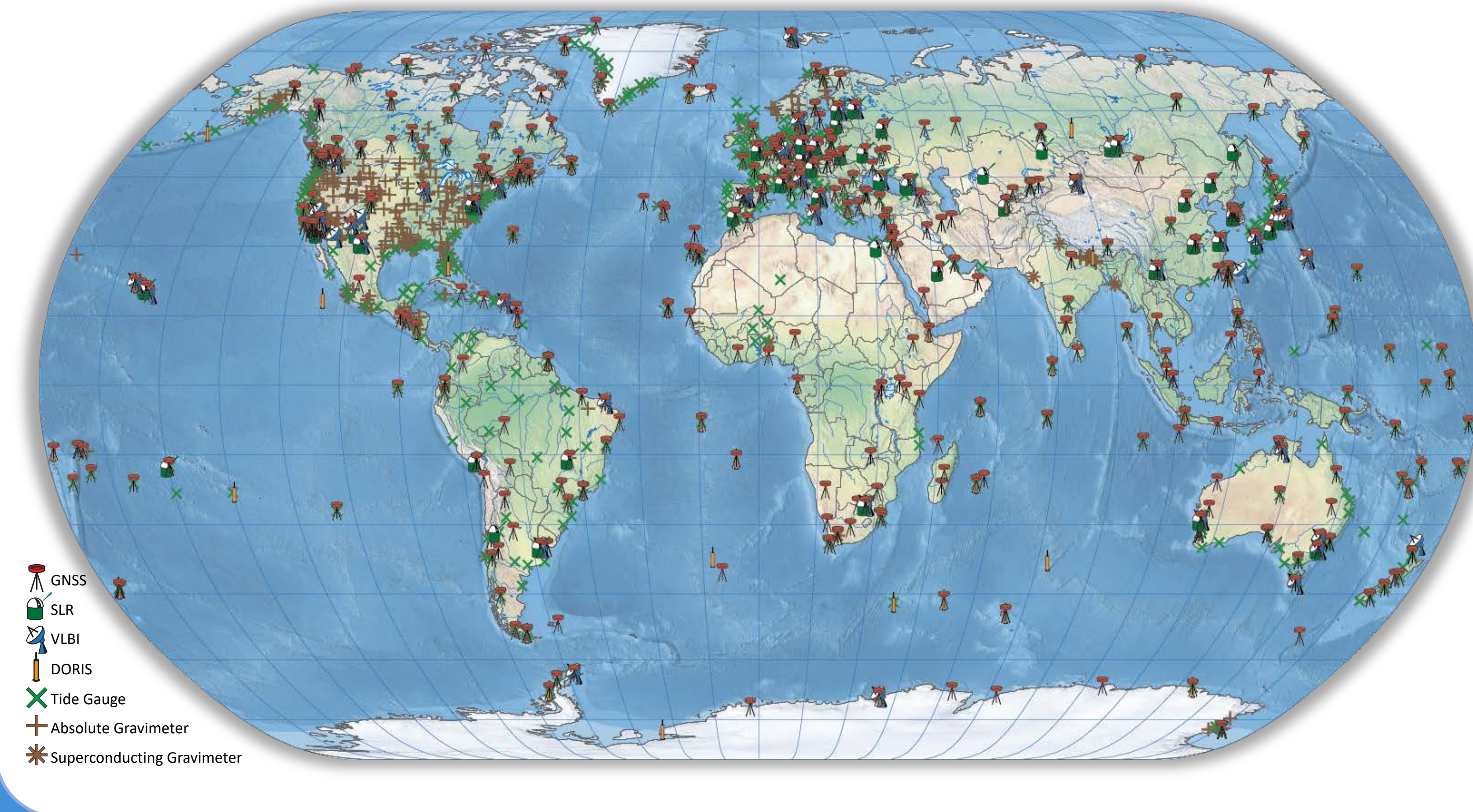
Standing Committee on Data and Information System/N. Brown, C. Noll

- Geoscience Australia leading a global initiative to identify and meet user requirements for Findable, Accessible, Interoperable and Reusable (FAIR) geodetic data. This initiative is paying particular attention to ensuring the new and emerging user base of positioning information (e.g. location based services and intelligent transport services) have FAIR geodetic data.
- Work continues at CDDIS on collection-level metadata efforts;
- Continue development of metadata system including site information, relevant tools and capability (e.g., eGeodesy):
 - Definition of the requirements;
 - Metadata implementation plan including definition of tasks, roles, distribution of tasks, and plans for integration of components.

IERS Working Group on Site Survey and Co-location Tasks/R. Hippenstiel

- Improvements made to standardizing report and data submissions of local tie surveys to provide consistency across all agencies. Additional website enhancements for storage of survey data and reports is underway;
- Additional standard operating procedures being authored to account for new routines and laser tracking instrumentation being used in recent local tie surveys;
- Local tie surveys recently completed at Table Mountain Geophysical Observatory (Colorado, USA), Midway Naval Research Lab's Optical Test Facility (Virginia, USA), and the National Radio Astronomy Observatory (Hawaii, USA).

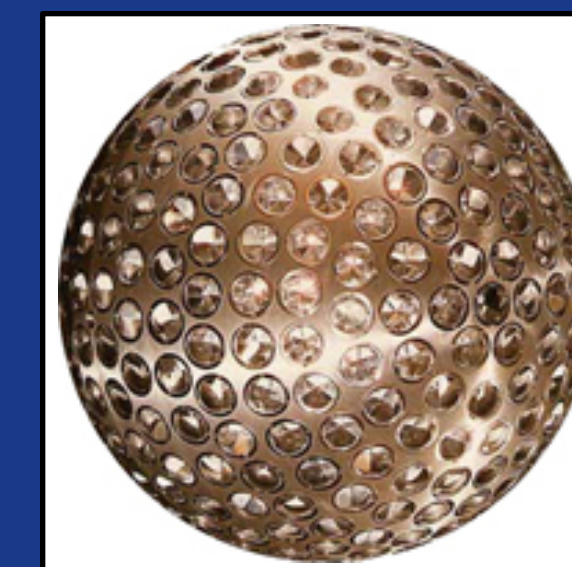
Global Networks Supporting GGOS



IAG Services

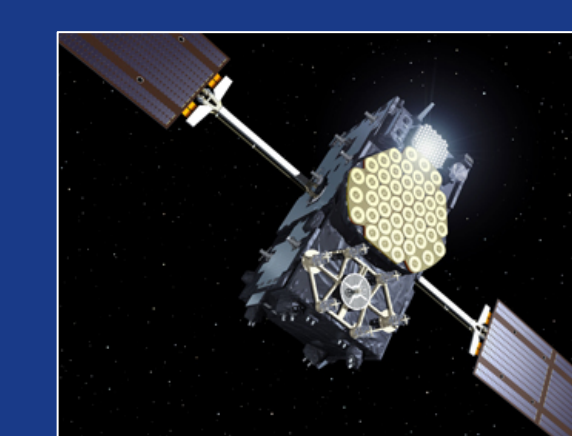
International Laser Ranging Service (ILRS)/Erricos Pavlis

- 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 preparing for the data re-analysis for ITRF2020; the Systematic Error Monitoring Pilot Project is completed, soon evolving into an operational tool; the mode of re-analysis for the ITRF2020 will become the standard for operational products; the next PP will introduce LARES as a 5th target and deliver weekly estimates of low-degree gravitational harmonics as a new ILRS product;
- Implementation of improved Satellite Center of Mass values for geodetic satellites and new systematic error modeling have reduced difference in scale between SLR and VLBI to ~.25ppb;
- Increased data level on Etalon from tracking campaign resulted in improved EOP, data still sparse;
- The 2019 ILRS Technical Workshop "Laser ranging: To improve economy, performance, and adoption for new applications" held in Stuttgart, Germany in October 2019; the 22nd International Workshop on Laser Ranging is planned for November 04-12, 2020 in Kunming China;
- The first Satellite Laser Ranging School was held in Stuttgart prior to the 2019 ILRS Technical Workshop, attracting about 40 students from around the world;
- Journal of Geodesy Special Issue on Laser Ranging was completed and published (20 articles).



International GNSS Service (IGS)/Allison Craddock

- IGS Analysis Centers (ACs) submitting test solutions to confirm the correct application of "repro3" processing standards for the IGS contribution to ITRF2020;
- ACs working on integer phase bias products to support precise point positioning with ambiguity resolution (PPP-AR) processing and a clock combination procedure to see if it can be used for repro3 and the subsequent operational products;
- IGS Analysis Center Coordinator (ACC) is developing multi-GNSS combinations;
- IGS submitting its own estimate of scale of the reference frame – made possible due to the release of Galileo Satellite Phase center values and the availability of receiver antennas that are calibrated for Galileo frequencies;
- IGS will include Galileo in addition to GPS and GLONASS for its contribution to the ITRF2020. The disclosure of the Galileo metadata, including satellite antenna calibrations, and the availability of receiver antenna calibrations for Galileo allows for the first time to contribute to the scale estimation of the reference frame;
- The IGS 2020 Workshop, "Science from Earth to Space" has been postponed to early March 2021
- IGS.org will be transitioning to an HTTPS-only file transfer system on 31 August. More information available here: bit.ly/IGSweb2.



IAG Services

International DORIS Service (IDS)/Jérôme Saunier

- Six DORIS-equipped satellites currently contribute to IDS; next to be launched in the coming months: Jason-CSA, HY-C, HY-D;
- Start of the deployment of 4th generation DORIS beacon from June 2019: seven sites already equipped;
- Preventive maintenance and improvement work regularly performed on-site to maintain a good level of service of the network: re-installation at St-John's, Santa-Cruz and La-Réunion (all co-located with IGS stations);
- Following IDS Retreat in 2018, the IDS strategic plan for the next decade was presented at the end of 2019 to stakeholders (CNES and IGN); network densification is one of the 20 recommendations under discussion;
- The progressive ACs delivery (3 time spans) for the IDS contribution to ITRF2020 is expected in 2020 in order to provide the DORIS combined solution (1993.0-2020.0) to the IERS in March 2021;
- IDS 2020 Workshop will be held in Venice (Italy) October 19-23, 2020 as part of the "Continued, enhanced ocean altimetry and climate monitoring from space" conference (OSTST);
- A DORIS Day aiming at introducing the DORIS technique and at fostering the use of the IDS routine products was initially planned in conjunction with the EGU General Assembly 2020 and is postponed to a later date.



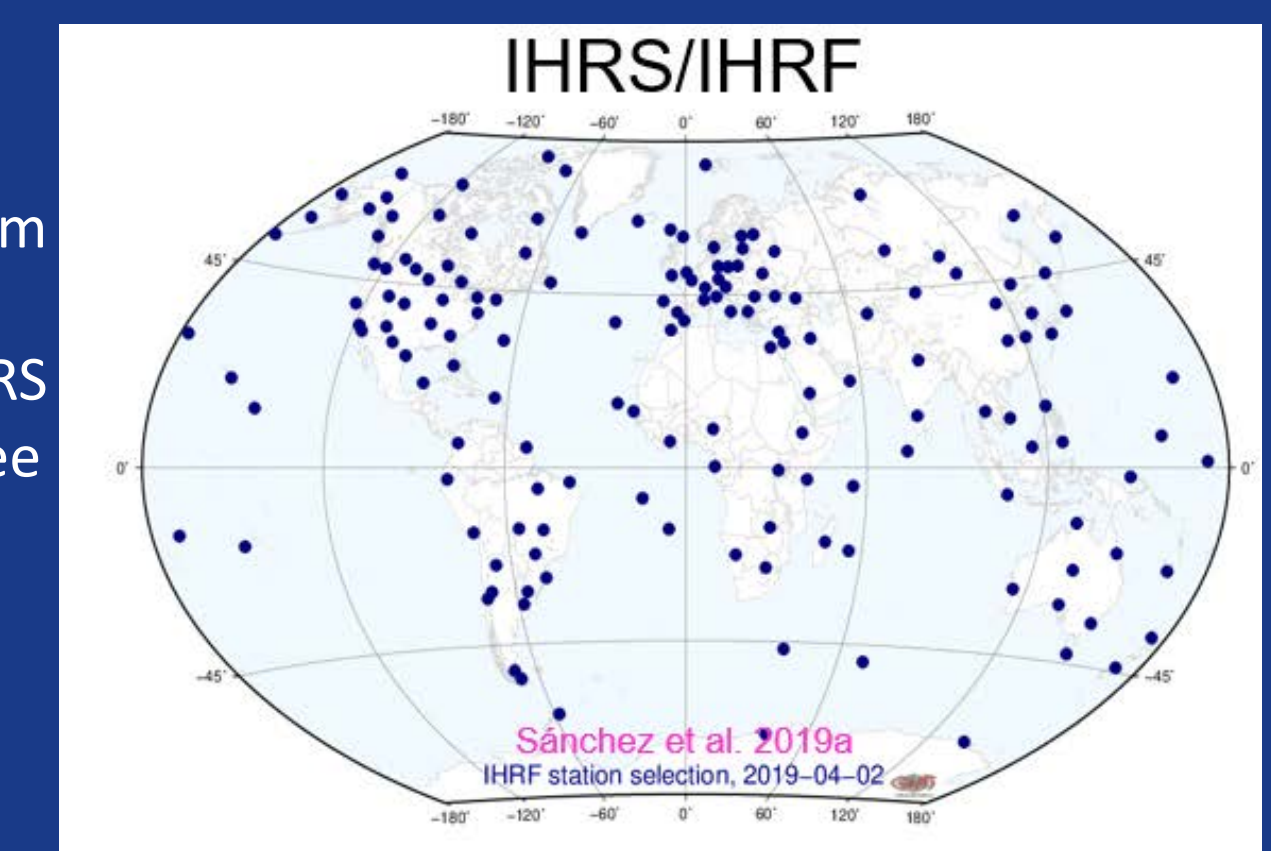
International VLBI Service for Geodesy and Astrometry (IVS)/Dirk Behrend

- The IVS Office for Outreach and Communications (OOC) established an outreach Web site at <https://vlbi.org/>. A new IVS logo replaced the old one on 1 January 2020.;
- The next-generation VLBI system, the VLBI Global Observing System (VGOS), has reached a reasonable level of maturity, allowing to observe a limited number of operational VGOS sessions in 2020 with a network of up to 8 stations. The main limiting factors are the raw data transport and storage;
- The IVS Working Group 8 on Galactic Aberration completed its work and was officially closed. A final report of the WG findings is published in Astronomy & Astrophysics (A&A) (DOI: 10.1051/0004-6361/201935379);
- 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 organized the 10th IVS Operations Workshop (TOW) for hands-on training of the station personnel at MIT Haystack Observatory in Westford, MA, USA in the period May 5–9, 2019 with about 75 participants. The TOW was augmented by a VGOS Correlation Workshop for correlator personnel to effect knowledge transfer of VGOS correlation to other IVS correlation centers.
- The IVS prepared for its 11th General Meeting plus several splinter meetings in Annapolis, MD, USA in the last week of March 2020. The events, however, had to be cancelled shortly before their implementation due to the coronavirus outbreak.



International Gravity Field Service (IGFS)/ Riccardo Barzaghi

- Implementation of the IHRS/IHRF: network design, theory and methods for estimating W(P) (co-operation with GGOS Focus Area on Unified Height System and GGOS BNO);
- Definition of a consistent set of parameters for the establishment of a new GRS (co-operation GGOS BPS, Commissions 1, Commission 2, ICCT, IERS Committee on EGV);
- Geoid/Quasi-geoid modelling for the realization of the geopotential height datum (co-operation with Commission2, GGOS, ICCT);
- Theory and methods for the combination of high-resolution topographic/bathymetric models in geodetic applications (co-operation with ICCT, IDEMS).



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Permanent Service for Mean Sea Level (PSMSL)/Elizabeth Bradshaw

- Set up a website to preserve and deliver GNSS-IR sea level data with funding from the European Union Horizon 2020 EuroSea project;
- Helped organise GLOSS/IHO/IUGG/IAPSO Sea Level Data Archaeology Workshop;
- Developing a Citizen Science project to digitise handwritten tide gauge ledgers;
- Will develop protocols concerning how sea level data recovered from historical records can be incorporated into the PSMSL dataset;
- Will form a working group on Tidal Analysis comparison and look for funding to host workshop;
- We will display more information on the PSMSL website about links between tide gauge datums and national datums and ellipsoids;
- We will deliver our data in a NetCDF format using the Climate and Forecast (CF) standard metadata conventions commonly used in Oceanography, Meteorology and Climatology and better lineage metadata with more structure: a proper history of what happened at a site.



For Further Information:

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