IUGG resolution: Sustained Terrestrial Water Storage (TWS) Monitoring by Dedicated Gravity Satellite Constellations

The International Union of Geodesy and Geophysics,

Considering,

- The interest of the IUGG scientific community to understand the processes of changes in global Terrestrial Water Storage (TWS), comprising all the water storage on the Earth's continental areas in frozen and liquid state, including ice caps, glaciers, snow cover, soil moisture, groundwater and the storage in surface water bodies and the interaction with ocean mass and sea-level,
- That satellite gravimetry missions are a unique observing system to directly measure TWS on a regional to global scale,
- The ongoing efforts of national and international institutions and space agencies to extend the GRACE/GRACE-FO program of record that runs already for more than two decades and enhance it with improved satellite gravimetry products,
- The significant efforts of the International Association of Geodesy (IAG) in developing and maintaining fundamental geodetic products, in particular snapshots of the Earth's time-variable gravity field providing TWS maps, for scientific and societal benefits,

Acknowledging,

- The adoption by the IUGG of Resolution 2 in Prague 2015 of Future Satellite Gravity and Magnetic Mission Constellations, and the adoption of TWS as a new Essential Climate Variable (ECV) in the implementation plan 2022 of the Global Climate Observing System (GCOS),

Noting,

- That satellite gravimetry missions such as GRACE and GRACE-FO successfully demonstrated the ability to globally observe the spatial and temporal variations of TWS from time-variable gravity with medium resolution on all continental areas of the Earth,
- That improved temporal and spatial resolution and significantly increased accuracy are urgently needed by the user community and by operational services for, e.g., flood and drought monitoring and forecasting and water resources management,
- That new technologies have been developed (such as laser ranging interferometry) or are currently being investigated (such as quantum gravimetry)

Urges,

National and international space agencies and decision makers to

- Implement and maintain long-term sustained observing systems of the Earth's time-variable gravity field realized by dedicated gravity satellite constellations with improved measurement technology to enable advanced science and applications of enormous societal benefit,
- Evolve them into sustainable operational services in the longer term.

IUGG resolution: Improve protection of geodetic observatories from active radio sources

The International Union of Geodesy and Geophysics,

Considering,

- that the United Nations General Assembly Resolution 69/266 “A global geodetic reference frame for sustainable development” invites member states “to commit to improving and maintaining appropriate national geodetic infrastructure as an essential means to enhance the global geodetic reference frame”,
- that the “Global Geodetic Observing System (GGOS)” of the International Association of Geodesy is based on geodetic observatories employing radio telescopes for the method of Very Long Baseline Interferometry (VLBI) which is fundamental for global geodetic reference frames (GGRF),

Acknowledging,

- that a multi-national best-effort endeavour to provide the needed products has been carried out by the International VLBI Service for Geodesy and Astrometry (IVS) since 1999,
- that the IVS is developing a new observing system, the “VLBI Global Observing System” (VGOS), to improve and enhance the global network capabilities in order to meet the accuracy goals needed for geodesy in the context of sustainable development,

Noting,

- that the use of electromagnetic spectrum is administrated globally by the International Telecommunication Union depending on inputs from national administrations,
- that the electromagnetic spectrum is a limited resource and the increasing number of ground and space based transmitters endanger the undisturbed VLBI observations of cosmic radio sources in the universe, and hence endanger the GGRF,
- that there is no supra-national administration for the protection of global networks such as the global network of geodetic observatories,

Urges,

- the affiliated scientific associations to advocate spectrum management issues at national, regional and international administration levels for the protection of their interests in the use of the electromagnetic spectrum,

Resolves,

- to support the introduction and conservation of local radio quiet zones or local coordination zones around the VLBI global network stations, and
- to bring this Resolution to the attention of the Director of the United Nations Statistical Commission (UNSC), to the Director of the United Nations Office for Outer Space Affairs (UNOOSA) and to the Secretary General of the International Telecommunication Union (ITU).

IAG resolution for the International Terrestrial Gravity Reference System (ITGRS)

The International Association of Geodesy,

Noting,

- The importance of an International Terrestrial Gravity Reference System (ITGRS) for geodesy and geosciences,
- That with state-of-the-art absolute gravimeters a relative accuracy of 10^{-8} and better is achievable ;

Acknowledging,

- The IAG resolution No. 9.2 and 16.3 adopted at the 18th IUGG General Assembly in Hamburg in August 1983, recommending the use of a common standard atmosphere and the zero-tide concept;
- The IAG Resolution No. 2 for the establishment of a global absolute gravity reference system adopted at the 26th IUGG General Assembly in Prague in July 2015,
- The IAG Resolution No. 4 on the establishment of the Infrastructure for the International Terrestrial Gravity Reference Frame, adopted at the 27th IUGG General Assembly in Montreal in July 2019,

Resolves,

- That the definition of the ITGRS be based on the instantaneous acceleration of free-fall expressed in SI and related to the zero-tide concept, a standard atmosphere, and Earth orientation in the ITRS (International Terrestrial Reference System),

Recommends,

- That the ITGRS be adopted as the reference system for gravity acceleration in geosciences and metrology,

Requests,

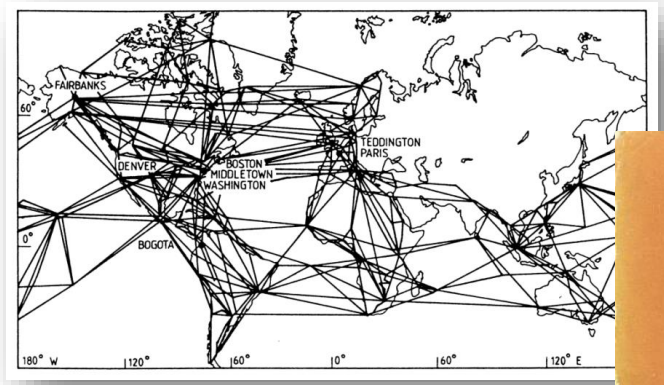
- That Commission 2 together with IGFS, BGI and IGETS prepare and disseminate guidelines and conventions for the establishment of the International Terrestrial Gravity Reference Frame (ITGRF) as the realization of the ITGRS.

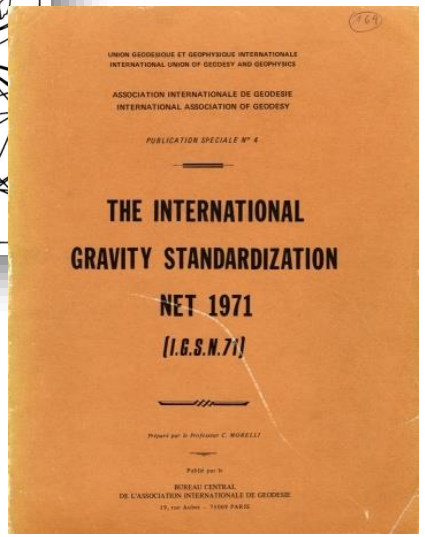
Backup Slide: Gravity Reference System of IAG

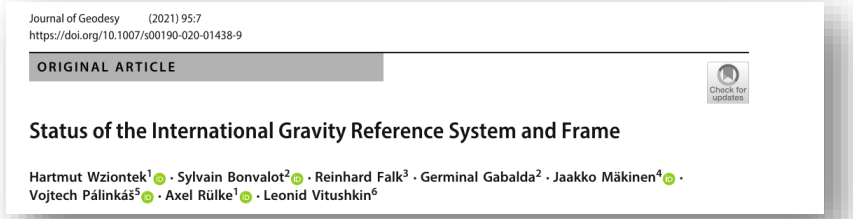
IGSN71 still official gravity reference system of IAG

- Accuracy of a single station:
  ±1 µm/s² (±100 µGal)
- Today, absolute gravity is observed at the µGal level
  → *IGSN71 doesn't fulfil todays requirements*

- **2015: IAG Resolution No. 2** for the establishment of a global absolute gravity reference system
- IAG Sub-Commission 2.1:
  JWG 2.1.1: Establishment of the International Gravity Reference Frame
- **2019: IAG Resolution No. 4**: Establishment of the Infrastructure for the International Gravity Reference Frame
- **2021: Concept for a gravity reference system/frame** and conventional gravity corrections published by JWG 2.1.1 [https://doi.org/10.1007/s00190-020-01438-9]



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ORIGINAL ARTICLE

Check for updates

Status of the International Gravity Reference System and Frame

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Backup Slide: Concept for a gravity reference system and frame

Gravity Reference **System**

- Describes the fundamental principles
- Ensures a long-term stable definition of gravity
- Measurand: **Instantaneous acceleration of free-fall**, expressed in the International System of Units (SI)
- **Constant components** of conventional models to correct for time dependent gravity effects: zero-tide system, reference air pressure, IERS reference pole for polar motion
- Compatible with IAGBN processing standards used since 1983 in absolute gravimetry

Proposed IAG resolution focuses on the system definition, which should serve as basis for the realization of the frame

Gravity Reference **Frame**

- Based on **Absolute gravity measurements** traceable to the International System of Units (SI) (time and frequency)
- **Common absolute gravity reference level** and traceability to the SI ensured: Comparisons / Monitoring of absolute gravimeters
- **Realization by a global set of reference stations** with reliable absolute gravity values with a relative accuracy of 10^{-8} and better and monitoring capabilities for temporal changes