Federal Agency for Cartography and Geodesy

On the Realization of the Absolute Gravity Reference System

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IUGG

IAG AIG International Association of Geodesy

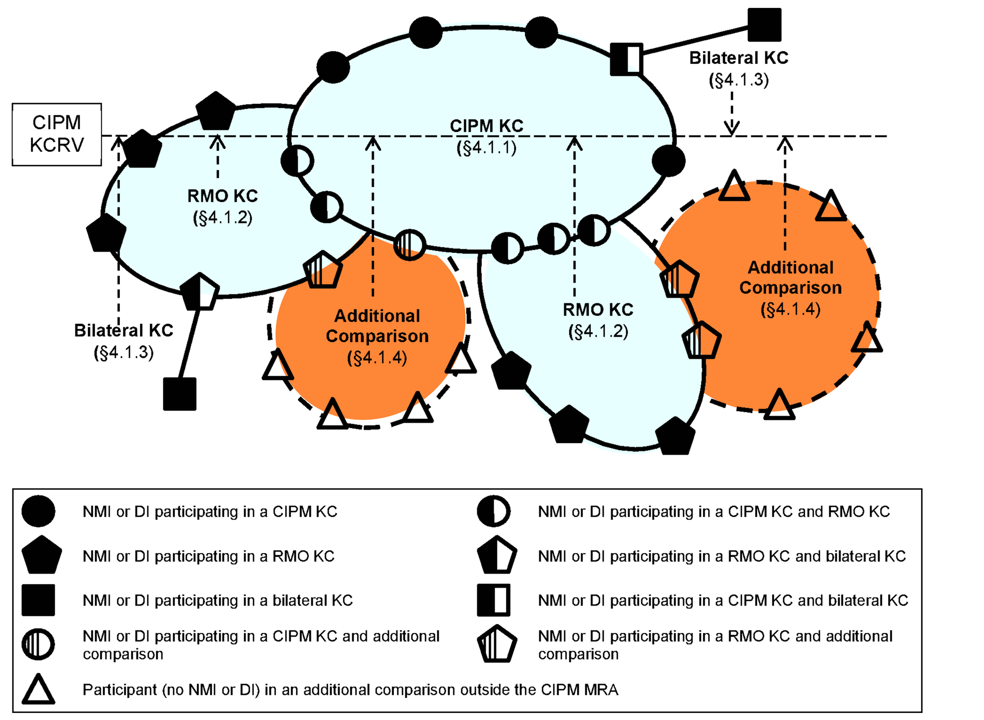
Comparisons of absolute gravimeters: Basis for the future Global Absolute Gravity Reference System

On the need to consider all Absolute Gravimeters (AG) in comparisons

- Absolute gravity measurements are independent from each other, a traditional network is not necessary.
- Homogeneity of a future gravity system depends on the stability of each contributing absolute gravimeter (AG).
- Demand in regular instrument comparisons, in international as well as regional frame.
- Best metrological realization: International comparisons of absolute gravimeters under the auspices of International Committee for Weights and Measures (CIPM).
- Participation at CIPM or Regional Metrology Organization (RMO) KC is restricted to AG from National Metrology Institutes (NMI) or Designated Institutes (DI).
- Other AG e.g. from geoscience community are only included in a Pilot Study (PS) or Additional Comparisons.
- Only the comparison results of Key Comparisons are stored in Key Comparison Database (KCDB) of BIPM.

Acronyms:

BIPM	International Bureau of Weights and Measures (Bureau International des Poids et Mesures)
CIPM	International Committee for Weights and Measures
CMC	Calibration Measurement Capabilities
KC	Key Comparison
KCDB	Key Comparison Database
RMO	Regional Metrology Organization



Relationship between Key Comparisons and other comparisons. The results from CIPM-KCRV are transferred to Regional and Additional comparisons. CIPM-KC and RMO-KC (light blue) are documented in the KCDB of BIPM, but Additional comparisons (orange) not.

Different kind of comparisons

CIPM Key Comparisons (CIPM KC):

Validation of the declared CMCs published in the Key Comparison Database (KCDB) of the BIPM. These comparisons serve as a technical basis for the CIPM MRA.

Regional Key Comparisons (RMO KC):

Validation of the CMCs published in the KCDB of the BIPM through links to the CIPM KC. This is especially important for participants who could not be accommodated in the CIPM KC. The RMO KCs must be linked to the corresponding CIPM key comparisons by means of common participants. This is mandatory to demonstrate global equivalence. To achieve this, it is recommended that at least two of the participants in the preceding CIPM KC participate also in the RMO KC.

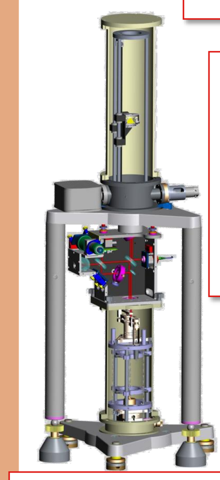
Additional Comparisons

Additional Comparisons outside the scope of the CIPM MRA could be organized by anyone at any time; the participation is open. In order to guarantee traceability to the SI, the additional comparison must be linked to the corresponding CIPM or RMO KC by means of joint participants. This is mandatory to demonstrate global equivalence.

Reference: CCM – IAG Strategy for Metrology in Absolute Gravimetry
http://www.bipm.org/wg/CCM/CCM-WGG/Allowed/2015-meeting/CCM_IAG_Strategy.pdf

Proposed Components of a Global Absolute Gravity Reference System

Absolute Gravimeters

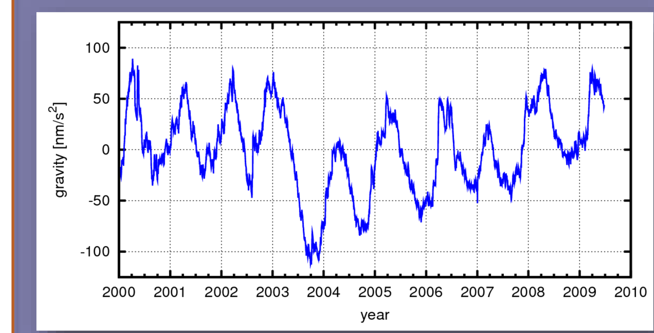


Intercomparisons:
CCM-KC, RMO-KC
Geodetic Comparisons
with linked CRF

Definition of standard correction models
(Tides, Atmosphere, Polar Motion, Hydro)

Superconducting Gravimeters

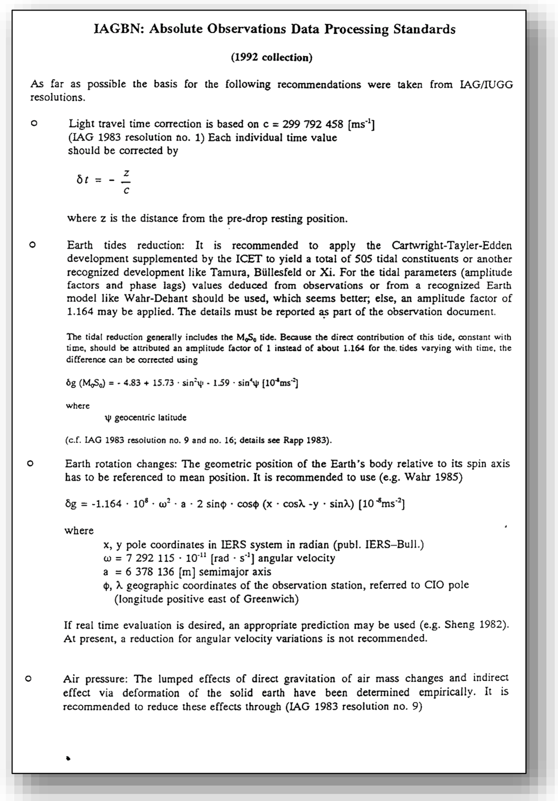
Continuously operated most stable relative gravimeters (SG)



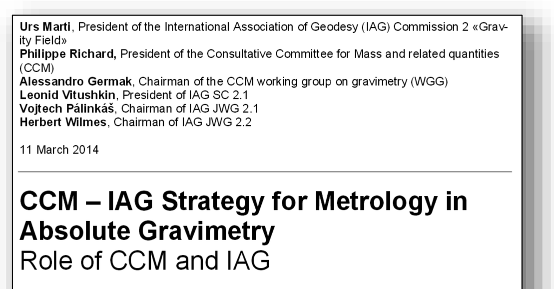
IAG Resolution 2015 (No. 2) for the establishment of a global absolute gravity reference system:

- to establish a gravity reference frame by globally distributed reference stations linked to the international comparisons of absolute gravimeters where precise gravity reference is available at any time,

Update of the IAGBN Processing Standards



- Accommodation to IERS Conventions / Recommendations of the GGOS Bureau of Standards and Conventions (BPS)
- Update of constants
- Update of tidal models: Including permanent tide and elastic parameters
- Atmospheric corrections, based on physical (not GNSS) heights and DIN ISO 2533
- Treatment of Ocean tide loading



AGrav Forum:

http://agrav.bkg.bund.de/forum

International Geodynamics and Earth Tides Service (IGETS)

IGETS Stations 2018

- Potential Reference stations for AG
- Monitoring of temporal gravity variations
- 37 SG Stations included in the IGETS database, hosted at ISDC GFZ Potsdam: http://isdc.gfz-potsdam.de/igets-data-base/

Aspects of the Realization

Long term stable **Reference Level**: Absolute gravimeters monitored at reference stations

- Repeated comparisons (monitoring of AG) at international/regional level
- **Reference stations** with continuous reference function (Superconducting/ Quantum Gravimeter) preferred but no exclusive
- **Comparison site**: reference station with extended facilities for comparisons
- **Core station**: Link to space geodetic techniques (GNSS, SLR; VLBI)
- Accuracy: A few µGal range)

Infrastructure: Accessibility of the system by a global set of stations, compatible with the reference level

- To replace IGSN71, the system (frame) must be accessible for any user, including those not operating an AG!
- Compatibility: Comparisons (Additional comparisons) for all AG, e.g. A10, at reference stations (at any time → SG / IGETS)
- The new infrastructure needs the support and collaboration with National agencies

System vs. Frame?

Reference System:

The principles how the numbers are obtained

- Basis: Observation of the acceleration of free fall and the International System of Units (SI)
- Compatibility of the observations and its processing, including systematic effects
- Tide system (zero tide)
- Conventional models to correct temporal gravity variations

Reference Frame:

The realization of the system: the numbers actually obtained

- Observations with absolute gravimeters and documentation (AGrav) Comparisons of absolute gravimeters are essential
- Traceability of the measurements to SI → comparison of absolute gravimeters
- Establishment of a compatible infrastructure (markers, points) and documentation (AGrav)

Central Inventory: AGrav database by BGI/BKG

http://bgi.omp.obs-mip.fr

http://agrav.bkg.bund.de

Current status and updates: See Poster X3.145 EGU2018-14758

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