IAG Scientific Assembly 2025:
Geodesy for a changing environment

Symposium G03: Gravity Field – Technology and Techniques

Conveners: Srinivas Bettadpur, Tao Jiang

G03-1: Next Generation Technologies

Conveners: David Wiese, Luca Massotti, Jürgen Müller, Derek van Westrum

Knowledge of the static and time-varying gravity fields of planetary bodies, in particular our home planet Earth, has exploded in the 21st century. This rapid advancement has largely been made possible through advancements in technology, and their application in terrestrial, airborne, shipborne, and satellite measurement campaigns. Further advancements in technology are on the horizon and promise to improve precision, stability, and accuracy of geodetic and inertial measurements that can be exploited to improve knowledge of gravity field spatial and temporal variations. For satellite gravimetry, near-term planned missions such at GRACE-C, NGGM, GRATTIS, CARIOQA, and QGGPf plan to utilize and/or demonstrate technological advancements in laser ranging interferometry, electrostatic accelerometry, gravitational reference sensors, optomechanical inertial sensors, drag compensation systems, and quantum sensing. Low cost and low SWaP (size, weight, and power) sensors and instruments with sufficient precision are additionally appealing if they can enable distributed, flexible, and redundant observing systems that rely on constellations or networks of platforms to make the measurements required for gravity field determination. Further on the horizon, ultra-sensitive quantum sensors and optical clocks offer pathways to replace traditional sensors for probing gravity field variations for both terrestrial and spaceborne platforms. This session solicits contributions on next generation technologies with application to gravity field determination, including, but not limited to, the above discussion.

G03-2: Terrestrial Gravimetry

Conveners: Przemyslaw Dykowski, Ezequiel Antokoletz, Sylvain Bonvalot, Derek van Westrum, Vojtech Palinkas, Neda Darbeheshti

Geodesists, geophysicists as well as the metrological community utilize gravity datasets from a wide variety of sources: local relative gravity campaigns, pointwise absolute gravity observations, gravity variations in time at fixed locations, and regional scale observations from marine and airborne platforms. These observations need to be consistent with each other, consistent with satellite-based results, and have well defined accuracy/uncertainty determinations. The International Terrestrial Gravity Reference Frame (ITGRF) will be implemented by IAG to provide high precision and long-term stable reference for terrestrial gravimetry, based on absolute gravity observations. It is therefore essential to monitor absolute gravimeters and verify new technologies. Comparisons of absolute gravimeters at different levels prove their equivalence. Investigation of systematic instrumental effects of gravimeters is also an important aspect, independent of the applied technology.

Developments in gravity and gravity gradiometry measurements from airborne and ground-based moving platforms are in continuous development. Alongside conventional spring-based systems, sensors now include micro-electromechanical systems (MEMS), inertial measurement units (IMUs), and quantum technology. In addition to ships and fixed-wing aircraft, mobile platforms now also include drones.

This session aims to bring together scientists from all over the globe that are interested in the instruments, techniques, and analysis of terrestrial, marine and airborne gravity measurements.

The following topics are welcome, but not limited: establishing long-term stable gravity reference function by combination of relative and absolute gravimeters (AG), monitoring of AGs performance, comparisons of AGs, new and/or updated measurement strategies, evaluation of systematic instrumental effects, measurements on all types of moving platforms, emerging technologies and methods of gravity data processing and collection.

G03-3: Spaceborne Gravimetry

Conveners: João Encarnação, Adrian Jäggi, Aleš Bezděk, Nadège Pie

In the spaceborne gravimetry session, we will explore next-generation gravimetric satellite mission concepts, focusing on their scientific potential rather than technological details. It aims to provide insight into the future direction of the field, foster collaboration, and stimulate the development of new mission concepts. We will be looking at space gravimetry in the context of the operational NASA/DLR’s GRACE-C and ESA's NGGM (soon to be renamed) constellation, as well as afterwards when the space geodetic community faces exciting new opportunities to advance spaceborne gravimetry.

Presentations will address innovative mission architectures and measurement concepts, including novel formations and constellations. We encourage addressing the feasibility and scientific impact of new measurement techniques, notably Cold-Atom Interferometry and others, from the point of view of space geodesy. An additional possible topic is related to exploiting non-dedicated satellites to contribute to monitoring Earth’s surface mass changes, e.g., in the context of massive LEO constellations and addressing the temporal aliasing problem.

G03-4: Analysis, Algorithms, and Models

Conveners: Athina Peidou, Khosro Ghobadi-Far, Rebecca McGirr, Sinem Ince

The first generation of dedicated satellite gravity missions, namely Challenging Minisatellite Payload (CHAMP), Gravity Recovery and Climate Experiment (GRACE), its follow-on mission (GRACE-FO), and Gravity field and steady-state Ocean Circulation Explorer (GOCE), provided a long record of data, benefiting studying of the Earth's static and time-variable gravity field. This session focuses on processing of satellite observations from the dedicated missions as well the gravity data measured by terrestrial and airborne sensors, namely absolute, relative and mobile gravimeters of different generations on the Earth and other planetary bodies. The session solicits abstracts focused on

a) data analysis and noise assessment;

b) analysis of the measurement system and instrumental drift;

c) filtering techniques used for different sensors;

c) extraction of satellite gravimetry signals along-the-track;

d) noise and performance simulations of future satellite missions; and

e) algorithms that include modern advances in data sciences and optimization techniques (e.g., machine learning).