IAG Scientific Assembly 2025:
Geodesy for a changing environment

Symposium G02: Gravity Field - Science Inference

Conveners: Srinivas Bettadpur, Tao Jiang

G02-1: Gravity Field and Reference Systems in Physical Geodesy

Conveners: George Vergos, Tao Jiang, Ismael Foroughi, Hartmut Wziontek, Hussein Abd-Elmotaal, Daniela Carrion

Physical reference systems and frames for geoid and physical heights on the one hand and for gravity on the other, are fundamental components of geodesy. Major breakthroughs for the gravity and geoid community include the definitions of the International Height Reference System (IHRS) and the International Terrestrial Gravity Reference System (ITGRS) and their practical realizations, the International Height Reference Frame (IHRF) and the International Terrestrial Gravity Reference Frame (ITGRF).

New concepts for gravity field modelling, geoid determination, and potential theory are developed and tested to provide a roadmap for the definition and realization of physical heights in a worldwide frame. Such definitions link the local vertical and gravity datums to a global reference which are fundamental for monitoring sea level variations and for application in engineering, hydrological, and cryosphere studies. On the other hand, a precise and global reference for terrestrial gravimetry is the basis founded using observations from absolute gravimeters controlled at reference stations.

Improved concepts and approaches along with new terrestrial, airborne, and satellite instrumentation and missions provide also the prospect for evaluation and practical realization of the temporal evolution of both gravity and physical heights and their respective reference frames. They improve our understanding of the Earth system, its subsystems, and their interconnections to provide the building blocks for innovative theoretical and practical investigations of the solid Earth and reveal insights into the dynamics of the Earth's crust, mantle, and their temporal variations.

This session welcomes contributions on local, regional and global high-resolution geoid modelling, both in terms of developments in theory, processing methods, collocation with satellite, airborne, altimetry and shipborne data, etc. It further addresses the implementation of the ITGRF, in particular the establishment of gravity reference and comparison stations worldwide and compatible first order gravity networks and the collection and dissemination of absolute gravity data. Moreover, we invite contributions to solutions to various formulations of geodetic boundary-value problems with the aim of gravity field modelling on global, regional, and local scales. Contributions describing recent developments in data

integration, and software development are particularly welcome. Additionally, the session focuses on the unification of the national height systems and gravity networks, the realization of the IHRF, possible refinements of standards and conventions for the definition and implementation of the height reference system, regional vertical datum and their unification, strategies for collocation of vertical reference stations with existing reference frames (GGOS core stations, ITRF, gravity stations, existing levelling networks, etc.) and studies on the temporal evolution of the IHRF. In particular, a link between IHRF and ITGRF stations is important in order to unify gravity data for local geoid computation.

G02-2: Hydrological and Cryospheric Applications from Gravity and Satellite Altimetry

Conveners: Wei Feng, Shin-Chan Han, Eva Boergens, Tyler Sutterley, Jiangjun Ran

Multiple geodetic observations techniques, including gravity, altimetry, GNSS and InSAR, enable the study of mass transport and surface deformation/subsidence related to the Earth's hydrosphere and cryosphere in the Earth system from local to global scales. The Gravity Recovery and Climate Experiment (GRACE) mission, GRACE-Follow-On, the planned Mass-Change and Geosciences International Constellation (MAGIC), and other satellite gravity missions provide essential and unique insights into long-term changes in terms of liquid and solid water storage, including surface water, soil moisture, groundwater, mountain glaciers, and polar ice sheets. The advent of new wide-swath SWOT altimeter offers a unique opportunity to monitor surface water storage changes and river discharge with unprecedented spatio-temporal resolutions. SWOT significantly expands the abilities of satellite altimetry for monitoring hydrological processes. At the same time, CryoSat-2 and ICESat-2 provide invaluable measurements of the polar ice regions. Additionally, GNSS and InSAR deliver high spatio-temporal resolution measurement of crustal deformation or subsidence, particularly related to mass loading and aquifer compaction. This session invites interdisciplinary contributions, including, but not limited to, (1) data processing methodologies and fusion strategies of various space, airborne, and surface geodetic and remote sensing observations, (2) cross-disciplinary hydrologic and cryospheric applications using multiple geodetic observations at various spatiotemporal scales, and (3) future mission concepts and processing strategies aimed at enhancing the resolution and accuracy of geodetic observations for hydrological and cryospheric processes.

G02-3: Oceanography and Solid Earth Science from Gravity and Satellite Altimetry

Conveners: Cheinway Hwang, Robert Tenzer, Mirko Reguzzoni, Daocheng Yu, Lan Zhang

Satellite altimetry and gravimetry have significantly transformed the study of both oceanography and solid Earth science, offering critical insights into sea surface height variations, marine gravity fields, and the geoid. This session welcomes contributions that use gravity and altimetry data to deepen our

understanding of oceanographic processes such as sea level variability, ocean circulation, eddy dynamics, and tides. We are also interested in studies that explore innovative applications in solid Earth science, including investigations into land subsidence, glacial isostatic adjustment, seismic events, volcanisms, and in general investigations into the lithospheric structure and dynamics, particularly in regions where these processes have significant societal and environmental impacts. With the advent of advanced satellite missions like the wide-swath SWOT altimeter, producing unprecedented high-resolution data, this session aims to show cutting-edge methods and refined data processing techniques that maximize the value of these observations. We encourage papers that push the boundaries of how these datasets can be applied to practical challenges, such as improving coastal geoid models, enhancing bathymetric mapping, and providing new insights into marine geophysics. By bringing together experts from geodesy, oceanography, and related disciplines, this session seeks to foster interdisciplinary collaboration and innovation to address contemporary scientific challenges. We particularly encourage contributions from both established researchers and early-career scientists, promoting diverse perspectives and novel approaches. Through this session, we aim to advance our collective understanding of the oceans and the solid Earth system, driving future developments in these critical fields.