



IAG Scientific Assembly 2025: Geodesy for a changing environment

Symposium G06: Global Geodetic Observing System

Conveners: Laura Sánchez, José Rodríguez, Detlef Angermann

The Global Geodetic Observing System (GGOS) is the response of the international geodetic community, organised under the umbrella of the International Association of Geodesy (IAG), to the need to continuously monitor changes in the Earth system. Geodesy contributes to Earth observation not only by providing the reference frames needed for all position-dependent observations, the basis for most Earth observations, but also by measuring changes in the Earth's geometry, gravity field and rotation over time and space. Ensuring a coherent and reliable Earth observation system requires an evenly distributed geodetic infrastructure for both ground-based and space-based techniques, data analysis based on common standards, and consistent approaches to the representation and parameterisation of key geodetic parameters that describe changes within and between the different components of the Earth system. This symposium will focus on progress in the consistent scientific integration of Earth geometry, rotation and gravity observations and related numerical and geophysical models as the basis for reliable Earth observation. Presentations that address (1) the improvement of the geodetic infrastructure at global and regional scales, (2) the standardisation, processing, combination and interpretation of geodetic data and parameters, (3) the implementation of new geodetic products consistent with recent developments in geodesy and emerging societal needs, and (4) the contribution of geodesy to climate, ocean and environmental observing systems are welcome.

G06-1: Contribution of geodesy to Earth observation

Conveners: Laura Sánchez, Richard Gross, Hansjörg Kutterer

The Earth is subject to a wide range of external and internal processes that change its shape (including continental, oceanic and ice-covered areas), affect the distribution of mass between and within its components (geosphere, biosphere, cryosphere, hydrosphere and atmosphere), and modify its rotation and orientation in space. Since the task of geodesy is to determine the Earth's shape, gravity field and rotation as a function of space and time, it is necessarily involved in the detection, analysis and modelling of signals emitted by the Earth system, in particular those recorded by geodetic measurements/observations. Thus, in addition to the reference frames that are indispensable for locating any kind of geospatial and Earth observation data, geodesy is undoubtedly capable of providing valuable information on the state and dynamics of the Earth and its environment. This session will focus on the key parameters provided by geodesy that are crucial for monitoring and understanding changes and interactions within and between the components of the Earth system. This is not limited to 'pure' geodetic parameters, but also includes the essential variables provided by geodesy to support other global observing systems, such as the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the Global Earth Observation System of Systems (GEOSS). Particular attention will be given to the definition of the Essential Geodetic Variables

(EGVs) and their interaction with the Essential Climate Variables (ECVs) of GCOS and the Essential Ocean Variables (EOVs) of GOOS. Together, these essential variables frame a comprehensive picture of the Earth's dynamic system, supporting research, monitoring and informed decision-making related to environmental sustainability, disaster management and climate adaptation.

G06-2: Global geodetic infrastructure for Earth System Monitoring

Conveners: José Rodríguez, Martin Lidberg, Lucia McCallum, Cornelia Eschelbach

The Global Geodetic Observing System (GGOS) of the IAG provides measurements of the static and time-varying shape, orientation and gravity field of the Earth, using geodetic instrumentation located on the ground and onboard spacecraft. The deployment of the observing networks, technological developments, multi-technique integration, and improvements in modelling capabilities have all led to geodesy being able to provide critical contributions, both scientifically and for wide societal benefit. The refinement in the applications and use cases that depend on geodetic products, especially in science areas concerned with global change (e.g. global water cycle, sea level, climate change), or the monitoring and early warning of geohazards, impose stringent requirements on the products provided by GGOS. What makes this all possible, i.e. the set of observatories, analysis, data and combination centres, and the human resources involved, is what the United Nations Global Geodesy Centre of Excellence calls the Global Geodesy Supply Chain. The infrastructure part of this supply chain, at the GGOS level, is overseen by the GGOS Bureau of Networks and Observations. Among the most prominent products of the geodesy supply chain are the various reference frames (geometry, height, gravity) required to provide a common link in space and time for scientific observations, as well as for applications such as positioning and navigation on land, sea, air and space. Other than the constant upkeep and modernisation of the geodetic supply chain, the increasing demands in precision, accuracy and consistency make it paramount that any systematic errors within and between the techniques be identified and resolved, paving the way to the GGOS requirements of 1 mm and 0.1 mm/yr (or equivalent). In this session, we solicit contributions on the infrastructure aspects of the global geodetic observing system, such as:

- Advances in space geodesy technology
- Progress and updates of the networks of the IAG Services, including national networks
- New space missions with geodetic relevance and related supporting infrastructure
- Infrastructure for the realisation of the height and gravity reference systems
- Local geodetic surveys and progress on space ties
- Detection and mitigation of systematic errors
- Simulation results showing pathways to achieve the GGOS goals

G06-3: Standardisation, integration and optimisation of geodetic products

Conveners: Detlef Angermann, Robert Heinkelmann, Nicholas Stamatakos, George Vergos

The generation of geodetic products is making use of various geometric and gravimetric observation techniques located on the ground and in space. To fully benefit from the technological progress of global Earth observation systems and sensors during the last decades, common standards, conventions and models are essential for the data analysis and the creation of high-quality science data products. This is of crucial importance to obtain highly accurate and consistent products for the geometric shape of land, ice and ocean surfaces, and the Earth's orientation in space, rotation and gravity field as global functions of space and time, as well as for the generation of highly accurate and long-term stable reference frames as a fundamental basis. Towards reaching this aim, a key objective of IAG's Global Geodetic Observing System (GGOS), with the support of other IAG components, is the integration of the Earth's geometry, rotation and gravity field observations, to provide consistent products for Earth system research and for reliable monitoring global change phenomena (e.g., sea level variations, melting of ice sheets, continental water storage changes). This session will focus on recent activities towards the development of common standards and improved geophysical models, the integration of different observation techniques, and the generation of combined and consistent products needed for Earth system research and to address emerging societal needs.

This session solicits contributions focusing on aspects of:

- Development of common standards for the generation of consistent geodetic products
- Development of improved geophysical models for the data analysis
- Integration of geometric and gravimetric observations
- Developments towards enhanced geodetic products needed for Earth sciences and to address emerging societal needs

G06-4: Enhancement of GGOS collaboration at regional level

Conveners: Claudia Tocho, Esther Azcue Infanzón, Aletha de Witt

Interaction with observation coordination groups involved in the implementation of regional geodetic infrastructure is a key component of the Global Geodetic Observing System (GGOS). The promotion of regional alliances is an effective strategy to identify, enable and develop sustainable geodetic observations, products and services according to regional and national priorities in line with the global objectives of the GGOS. In this framework, GGOS Affiliates are national or regional geodesy-related organisations that facilitate collaboration across regions, communities and new technologies, and promote geodetic capacity building in their countries. This session is open to regional/national initiatives focusing on the provision of geodetic infrastructure, services and capacity building that ensure the availability of robust reference frames as essential components of public infrastructure for sustainable development and reliable services for daily life and can contribute to Earth observation with geodesy.