Symposium 3: Earth Rotation and Geodynamics

Organizer: Janusz Bogusz President of Commission 3
Co-organizers: IAG Commission 3 with International Association of Seismology and Physics of the Earth's Interior (IASPEI), International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), International Association of Cryospheric Sciences (IACS), and International Astronomical Union (IAU)

Abstract: Earthquakes, tsunamis, volcanism, landslides, and many others are defined as geohazards. They involve long- and short-term processes of small features or huge dimensions, impacting local and regional socio-economy to a large extent. For many years, multiple geodetic observations were employed and analyzed in terms of deriving a reliable information and prediction of geohazards, appearing as long-term of abrupt processes in various time resolutions. This session covers a wide variety of topics of involving geodesy into monitoring of geohazards. We invite all contributions which focus on observations, modelling and prediction of geohazards driven by mass transport and mass redistribution within the Earth geophysical fluids system, including the atmosphere, hydrosphere, ocean, cryosphere, mantle, and cores. Invited are also numerous presentations on observations and modelling of cryosphere changes with the response of the solid Earth. Of great importance are also observations collected in tectonically active areas, characterized by an abrupt deformation on land and seafloor associated with plate motion, stress accumulation around the fault, slow slip events, earthquake, volcanic processes, as well as observations and modelling of global phenomena including Earth rotation variation, gravity change etc.

Key-words: fluid envelope, earthquakes, tsunamis, volcanism, cryosphere, Earth rotation.

Symposium 3, Session 1: Earth rotation, low-degree gravitational change and mass transport in geophysical fluids

(Organized by: Sub-Commission 3.3 Earth Rotation and Geophysical Fluids and Joint Working Group 3.1 Theory of Earth Rotation and Validation with IAU)

Convener: Jianli Chen, University of Texas at Austin, USA
Co-conveners: José Ferrándiz, University of Alicante, Spain
Richard Gross, NASA's Jet Propulsion Laboratory, USA
Michael Schindelegger, University of Bonn, Germany
Henryk Dobslaw, GFZ, Germany

Abstract

Earth rotation is driven by mass transport and redistribution within the Earth geophysical fluids system, including the atmosphere, hydrosphere, ocean, cryosphere, mantle, and core. Global large-scale mass transport also introduces long wavelength (i.e., low-degree) gravitational change (including geocenter motion). Although relatively small, Earth rotation and low-degree gravitational changes have been measured by space geodetic techniques with increasing, unprecedented accuracy, opening up important new avenues of research that will lead to a better understanding of global mass transport processes and of the Earth's dynamic response. This session solicits contributions ranging from theories and models of the Earth's rotation, prediction of the Earth orientation parameters (EOP), geophysical interpretations of observed Earth rotation and low-degree gravitational change using advance numerical models estimates, in situ measurements, and space geodetic measurements, to geophysical applications of observed Earth rotation and low-degree gravitational change in improving the understanding of the Earth geodynamic change and global mass transport and redistribution. We also welcome contributions on recent advances in theoretical approach and empirical modeling of the celestial pole offsets (CPO), including both classic precession-nutation series and treatment of the free core nutation (FCN), in the light of the conclusions of the 2019 GGOS/IERS Unified Analysis Workshop and the update of the IERS Conventions. Fundamental questions concerning the consistency of EOP set definitions and realizations, as well as their relationship with other geodetic products or ancillary models, also falls in the scope of this session.

This session solicits contributions focusing on aspects of:

- Earth rotation theories and models,
- geophysical interpretations of Earth rotation,
- low-degree gravitational change: observations and interpretations,
- global mass transport and redistribution,
- theoretical and empirical modeling of the celestial pole offsets,
- EOP definitions and realizations.

Keywords: Earth rotation, low-degree gravity change, mass transport, EOP, geophysical models, CPO.

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Symposium 3, Session 2: Observations and modeling of deformation related to changing ice loads
(Organized by: Joint Sub-Commission 3.4 "Cryospheric Deformation" with IACS, Joint Study Group 3.1 "Recent modeling of Glacial Isostatic Adjustment with geodetic techniques" with C1, C2 and IASPEI)

Convener: Jeff Freymueller, Michigan State University, East Lansing, Michigan, USA
Co-Conveners: Natalya Gomez, McGill University, Montreal, Quebec, Canada
Erik R. Ivins, Jet Propulsion Lab., California Institute of Technology, Pasadena, USA
Rebbeka Steffen, Lantmäteriet, Gävle, Sweden
Bert Wouters, Utrecht University, Utrecht, Netherlands/Delft University of Technology, Delft, Netherlands

Abstract:
The isostatic response to the changing cryosphere leads to changes in the Earth's gravitational, stress and surface displacement fields, and sea level. The movement of ice and meltwater can cause erosion and alter the shape and properties of the ice-bedrock interface, which in turn influences ice dynamics. These processes act on different time scales, as short as a few seconds when earthquakes are induced, and from years and up to several thousands of years for sea level change and redistribution, and longer for erosion and associated landscape evolution. Modelling of the feedback between the cryosphere and solid-Earth requires a diverse suite of observations, knowledge of earth and ice rheology as well as the interactions between these processes. We invite contributions that present observations and/or modelling of cryospheric changes and the response of the solid earth. In addition, we welcome abstracts about the earth structure within formerly and currently glaciated regions, and how variations in earth structure affect model predictions.

This session solicits contributions focusing on aspects of:

- Geodetic and related observations of cryospheric changes and their impacts
- Modeling methods and improvements
- Earth structure beneath formerly and currently glaciated regions, and hos this effects model predictions of geodetic observables
- Feedbacks between solid earth and cryospheric processes

Keywords: GIA, loading, cryosphere, earth structure and rheology

Symposium 3, Session 3: Geodetic observations in volcanic and tectonically active areas
(Organized by: Joint Sub-Commission 3.5 "Seismo-Geodesy" with IASPEI. Joint Sub-Commission 3.2 "Volcano Geodesy" with IAVCEI.)

Convener: Alessandro Bonforte, Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania – Osservatorio Etneo, Catania, Italy
Co-Conveners: Emily Montgomery-Brown, U.S. Geological Survey – California Volcano Observatory
Takuya Nishimura, Kyoto University, Uji, Japan
Jean-Mathieu Nocquet, Université Côte D'Azur, IRD, CNRS, OCA & Institut de Physique du Globe de Paris
Chengli Huang, China

Abstract:
Geodetic observations quantify deformation and gravity changes on the solid Earth in a wide range of space and time. Deformation is concentrated in tectonically active areas hosting earthquakes and volcanoes, mostly but not only in plate boundary zones. Development and integration of multiple geodetic observations reveal secular, seasonal, transient, and abrupt deformation on land and seafloor associated with plate motion, stress accumulation around the fault, slow slip events, earthquake, and volcanic processes. Volcanoes form and develop in very active geodynamic contexts and represent very quickly evolving environments, with their lively magmatic, structural and morphological evolution. Deformation observations are a critical component of monitoring of volcano and fault processes, yet used in isolation, they can raise many unanswerable questions about, for example, the type and density of fluids causing deformation and triggering fault slip, rheological and material heterogeneity of subsurface material, or the total volume of eruptible magma. For this session, we seek presentations focused on tectonic and volcanic deformation that integrate geological, geophysical or geochemical data, or conceptual, experimental, analytical or numerical modeling to reduce the ambiguities of interpreting deformation alone. We also encourage contributions investigating time variable source processes and source evolution constrained by non-geodetic observations, or formally integrating data from multiple disciplines (new observation technique, joint inversions, physics-based modeling, machine learning). Of interest are also investigations into the performance and trade-offs between simple analytical and more realistic and complex source models in time-constrained monitoring or rapid-response settings that analyze impacts of model-biases on interpretations, evaluation of earthquake potential, and eruption forecast.

This session solicits contributions focusing on aspects of:

- data integration,
- source modeling,
- new observation technique.

Keywords: GNSS, SAR, ground deformation, gravity.