PhD Course in

Earth Science, Fluid Mechanics and Mathematics Interactions and Methods

Seminar Series 2019

October 3rd, 2019, 15.00-16.00
Department of Mathematics and Geosciences
Aula C, Palazzina C, Via Weiss, 1

"New Approaches to the interpretation of gravity field data"

Dr. Mikhail K Kaban
Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences

Abstract
Density heterogeneity of the Earth, associated with thermal and compositional variations or with deflected boundaries separating layers of different density, is one of the main factors that control dynamic processes and deformations at both shallow and deep levels. Therefore, interpretation of the gravity anomalies or gravity modeling is one of the principal methods, which help to understand nature and origin of the tectonic processes and the Earth's dynamics. On the other hand, gravity field is very sensitive to shallow heterogeneities, in particular related to mineral deposits. For this reason, gravity modeling is an important tool for both fundamental and practical purposes. Unfortunately, the problem of gravity data inversion is generally ill posed. It is necessary to use some special techniques to overcome this problem. In this presentation I will describe 2 methods, which were recently developed to interpret both, crustal and mantle structures.
In the first part, it is demonstrated using the so-called decompensative gravity anomalies for studying of the upper crust and, in particularly, sedimentary basins. Gravity anomalies are often used to study these features. However, the effect of the upper crust is largely reduced by compensating masses, e.g., according to the Airy isostatic model. This effect appears in all conventional types of the gravity anomalies, e.g. free air, Bouguer or isostatic ones. To eliminate this effect, we apply so-called decompensative correction to the isostatic anomalies. This technique is illustrated by the study of Antarctica.
In recent years, it has been developed a new integrative technique for construction of 3D density models of the upper mantle. In addition to the gravity anomalies and seismic tomography, this method employs the residual topography that is the topography, which is dynamically supported by the mantle density heterogeneity. The residual gravity and topography are controlled by the same factors but in a different way (e.g., depending on depth and horizontal dimension of the heterogeneity). This enables us to locate the position of main density anomalies in the upper mantle. An example of the application of this method is shown for North America.