GOCE was launched in 2009 in order to measure the Earth's gravitational field and geoid with an unprecedented accuracy and spatial resolution. To that end, the GOCE satellite is equipped with a unique Satellite Gravity Gradiometer (SGG) that measures (primarily) diagonal elements of the matrix of the second derivatives of the gravitational potential, as well as with a GPS receiver of geodetic quality. Processing of the collected data (particularly, SGG data) is a challenging task due to: (i) a huge number of data; (ii) a large number of gravitational field parameters that have to be estimated on the basis of the collected data; and (iii) presence of coloured (frequency-dependent) noise in the data.

We present the major elements of our computational methodology developed for the GOCE data processing. We address, in particular, proper handling of coloured noise in the data and discuss the sensitivity of the results to the stochastic model of noise. To assess the quality of produced static gravitational field models, we make use of the K-Band Ranging (KBR) data acquired by the GRACE satellite mission. GRACE KBR data are forecasted on the basis of alternative gravitational field models and compared with the actual ones. We demonstrate that the extraordinary high sensitivity of the GRACE KBR data allows deficiencies of gravitational field models to be sensed up to spherical harmonic degree 180 and even higher. More traditional ways of model validation are used as well, including a direct comparison with independent state-of-the-art models.