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Hydrological effects on absolute gravity measurements using the model GLDAS

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The absolute gravity measurements are very accurate (< 1 μGal) in present day and they can be used for the monitoring of geodynamic processes in the studied area. The observed absolute gravity values, however, hold the information that are not of interest in studies of geodynamic processes. Standard corrections such as the tide, the atmospheric, and the correction resulting from the polar motion are applied to the absolute gravity measurements. After removing the above-mentioned effects, the absolute gravity measurements show a strong periodic variation. A significant proportion of this variation may be caused by hydrological effects. To remove these effects, it is necessary to dispose of hydrological models. For the purposes of this paper was used the global hydrological model Global Land Data Assimilation System (GLDAS). This model indicates hydrological parameters on continents with a space resolution of 0.25 degrees (approximately 27 km) and time resolution of one month. The hydrological variation affecting the gravity measurements can be divided into direct effect and indirect effect resulting from the deformation of the earth's surface. The Green's formula and the formula for calculation of the Newton attraction of simple bodies were used for the purpose of this study. The amplitude of the variation resulting from hydrological effect can achieved in the region of Central Europe values of 6 μGal approximately. The strongest impact of the hydrology comes from the nearest surrounding of the site. In this case the hydrology effect was calculated in three steps, i.e. the global hydrological effect (> 100 km from the site), the regional effect (from 2 km up to 100 km from the site) and local effect (< 2 km from the site).
The results obtained in this study were compared with FG5 absolute gravity measurements in the area of Slovakia realized in the frame of the UNIGRACE project (Unification of Gravity Systems in Central and Eastern Europe), the CERGOP - 2/Environment project (A Multipurpose and Interdisciplinary Sensor Array for Environmental Research in Central Europe) and VEGA Project (Scientific Grant Agency Ministry of Education of Slovak Republic and Slovak Academy of Science).