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Detection of rainfall response by a gPhone gravimeter installed at 100 meters under the ground

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The absolute gravity measurement is the instrumentation which can monitor underground density variation one after another even if the generation of the operator and the device change. However, for the argument of the microGal-order, the disturbance caused by atmospheric/oceanic and hydrological variations can easily mask signals from the deep underground. The former has become able to discuss microGal-order by recent improvements of global/regional physical model, the latter model must be constructed properly at each observation point. We have started to wrestle with the establishment of the correction method by parallel gravity measurements both underground and on the ground. In the beginning, we have installed the gPhone gravimeter (serial number 90) in the depth 100 m stage of MIzunami Underground laboratory (MIU) and then tried to detect gravity response by rainfall. The past pore water pressure data observed in the MSB-3 borehole showed that no pressure change by rainfall occurs at the depth the gPhone installed (in the main part of Toki Lignite-bearing Formation, Mizunami Group), on the contrary the pore water pressure in near surface (in the main part of Akeyo Formation, Mizunami Group) shows clear fluctuations by rainfall. Therefore, the gPhone should observe gravity decrease when it rains heavily because mass excess occurs in its overhead. In the first observation term (Jul~Nov 2010) we succeeded in detection of several rainfall responses about 1 microGal amplitude, but some problems, such as the gravity disturbance result from instability of the floor face under the gPhone sensor and from abrupt air temperature change and the way of evaluation of non-linear drift fated to spring sensor, became clear. In the planned second observation term, we will improve the gPhone sensor setting floor face and then aim at the simultaneous detection of rainfall response with an absolute gravimeter. If it is proved that the validity of this correction method, we can promote the development of borehole-type relative gravimeter which can run long term stably and propose it as an infrastructure for hydrological gravity correction.

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