Calibration of portable relative gravimeters toward the detection of gravity signals accompanied by slow slip events

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During these two decades, slow slip events (SSEs) have been found with crustal deformation monitoring around the Pacific Rim. These observations have revealed the diverse spatiotemporal behaviors of the slip distribution on the plate interface. However, the obtained kinematic slip distributions do not necessarily give information about a possible interaction between slip and high-pressure fluids which are suggested by laboratory experiments and numerical simulations. Revealing the interaction is important to understand the generation of SSEs. Recently, gravity changes of a few microGals associated with the long-term SSEs in the Tokai area have been detected for the first time, by annual absolute gravity observations over a time span of 20 years. This result suggests that high-pressure fluids migrate upward along the plate interface. The duration of the Tokai SSEs are long (4-5 years), but those in other areas are generally shorter (e.g. 1 month in Ishigaki Island in the Ryukyu Trench). So, in order to confirm such a gravity change can be seen in other slow slip areas, the temporal resolution of the observation must be improved. For this purpose, we use a portable g-Phone X relative gravimeter which is suitable for continuous observation. To evaluate its instrumental characteristics, we made a test measurement in the Mizusawa VLBI observatory in NE Japan, where the superconducting gravimeter (SG) with a higher precision is in operation. The comparison for 3 months shows that the transient gravity changes observed by both gravimeters agree with each other within approximately 1 microGal in standard deviation. The gravity changes with amplitude of a few microGals and durations of about 1 month were detected by the g-Phone and the SG, reflecting the groundwater level change. This implies that, if similar gravity changes are caused by SSEs, they are detectable by the portable gravimeter. We initiated the observation in the Ishigaki Island Local Meteorological Observatory from January 2020 to detect biannual SSEs.

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