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Comparison of Superconducting and Spring Gravimeters at the Mizusawa VLBI Observatory of the National Astronomical Observatory of Japan

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Continuous microgravity monitoring is utilized to gain new insights into changes in the subsurface distribution of magma and/or fluid that commonly occur beneath active volcanoes. Rather new superconducting and spring gravimeters, iGrav#003 and gPhone#136 are collocated with a superconducting gravimeter, TT#70 at the Mizusawa VLBI Observatory of the National Astronomical Observatory of Japan, since the end of September, 2016 in order to evaluate those performances before field deployment planned in 2017.

Calibration of iGrav#003 was carried out by collocation with an absolute gravimeter FG5 of the Earthquake Research Institute, University of Tokyo (Okubo, 2016, personal comm.) at a Fundamental Gravity Station in Sendai in July, 2016. Based on the scale factors of iGrav#003 obtained by the calibration and of gPhone#136 provided by the manufacturer (Micro-g LaCoste, Inc.), tidal analyses are performed by means of BAYTAP-G (Tamura et al., 1991, GJI). Amplitudes and phases of each major tidal constituent mutually agree well within ± 4 % and ± 3 degrees, respectively.

The instrumental drift rate of iGrav#003 is very low, about 5 micro-Gal/month, whereas that of gPhone#136 is very high, about 500 micro-Gal/month. The high drift rate of gPhone#136, however, is well approximated by a quadratic function at present and can be removed. The detrended time series of gPhone#136 shows good agreement with iGrav#003 time series in the overall feature: gravity fluctuations with amplitudes of about a few micro-Gal and with durations of a few days, which may be due to variations in the moisture content of the topmost unsaturated sedimentary layer and the water table height. It suggests that both instruments may capture volcanic signals associated with pressure changes in magma chambers, dike intrusion/withdrawing, and so on.

iGrav#003 will be installed in the Zao volcanological observatory of Tohoku University located at about 3 km from the summit crater, and gPhone#136 will be deployed in the Jododaira Astronomical Observatory located at about 0.5 km from Oana crater of Azumayama volcano in the spring of 2017. Both of the volcanoes, Zao and Azumayama show minor volcanic activity with frequent shallow earthquakes, changes in the total magnetic force, pressure changes at depth, and so on in 2014 and 2015.