

Effect of horizontal acceleration on the superconducting gravimeter at Ishigakijima

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In 2012, we started gravity observations using a superconducting gravimeter (SG) at Ishigakijima island, near the East China Sea, with the main purpose being detection of possible gravity changes associated with the long-term slow slip events beneath the Yaeyama Islands. Since then we have been faced with various kinds of unexpected problems, which may be peculiar to the natural conditions of such an oceanic island. Among them is the apparent correlation between the ground noise level and the DC offsets of gravity. The amount of gravity changes, as typically observed when typhoons approach the island, reaches about 2 microgals (gravity increasing), comparable to (or larger than) the possible magnitude of slow slip signals. Here we try to interpret this phenomenon not as true gravity signals but as apparent changes originating from nonlinear responses of the gravity sensor. The site is a VLBI station belonging to National Astronomical Observatory Japan, and movements of the 20-meter antenna cause almost monochromatic (~5 Hz) ground noise. Such an event is accompanied with a positive offset of gravity signals in the SG. Analysis of records of seismometers we installed at the same station revealed that gravity changes are proportional to the spectral power of horizontal components of ground motion. This fact indicates that a crosstalk between the vertical and horizontal components of the gravity sensor becomes evident when the level of ground motions is extremely high. A similar mechanism may be applicable to the effect of the enhanced level of 5-second period ground motions on gravity in very bad weather conditions.

Keywords: superconducting gravimeter, slow slip, Ishigakijima, horizontal acceleration