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Gravity change associated with local land-water redistributions: its observations and modeling at Isawa Fan

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Gravity observation is one of the powerful tools in detecting mass redistributions in the solid earth, such as earthquake deformations and magma transfer in volcanoes. Many previous studies have detected the above solid-earth gravity signals, by correcting ”hydrological disturbances” (i.e. gravity change associated with spatiotemporal land water redistributions) with empirical models in advance. However, physical hydrology should be taken into account in order to correct the hydrological disturbances with high accuracy. We were thus motivated to utilize a physical groundwater flow solver ”Gwater-1D” (Kazama, 2010) to model the hydrological disturbance observed by a superconducting gravimeter at Isawa Fan (Iwate Prefecture). We found the following results:

(1) The local soil moisture change can be reproduced within the observation error, if soil parameters observed by soil tests are applied to Gwater-1D.

(2) The hydrological disturbance during 50 days (amplitude: 5 micro-gals) can be reproduced within about 0.4 micro-gals in RMS, because Gwater-1D models the local-scale groundwater distribution and the consequent short-term (˜< several months) gravity change.

(3) The annual component of the hydrological disturbance (amplitude: about 1.3 micro-gals) cannot be reproduced, because Gwater-1D does not model regional and/or global land water redistributions, such as snow loading and ocean height change.

In the coming presentation, we will explain details about estimating the hydrological disturbance, and discuss how to reproduce hydrological disturbances with higher accuracy.

Keywords: gravity change, Isawa Fan, superconducting gravimeter, groundwater, soil water, snow cover