Gravity correction through hydrological approaches for predictions of volcanic eruptions

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We observed absolute gravity changes during the 2004 eruption of Asama volcano. In September, we could clearly observe gravity signal by as large as 5 microgals associated with magmatic movement. In October, however, it was severely masked by hydrological disturbances: rainfalls and groundwater movements (+20 and -10 microgals each). In order to recover the gravity change from volcanic origins, we estimated gravity caused by water transport with the aid of hydrological equations.

In the case of Mt. Asama, we find that the hydrological gravity change is mostly governed by unsaturated groundwater flow, implying evapotranspiration and saturated groundwater variation have little effect on gravity change. We also find that synthetic gravity changes are most consistent with observations when hydraulic conductivity, Ks, which defines the infiltration speed, is around 1mm/s.

Our method of gravity correction is applicable to gravity observations at any place we like. In addition, the method enables us to ”forecast” gravity variations by water movements, if we have precipitation data and reasonable hydrological underground structure. Continuous gravity monitoring with our correction method may enable us to predict volcanic eruptions, tracing the location of magma head in real time.