Hydrological correction of groundwater disturbance in gravity data: Application to Sakurajima volcano, southern Japan

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Gravity observation is one of the most powerful tools to detect mass movements involved in volcanism (e.g., Furuya et al., 2003; Okubo, 2005). At Sakurajima volcano, for example, we observed a gravity change by 10 micro-gal at most, associated with magma rise in the volcanic vent in April to May 2008 (Kazama et al., 2008). In the following five months, however, the gravity signal was overridden by groundwater disturbance by as much as 20 micro-gal, arising from rainfalls and consequent groundwater transfer.

In recent years, the groundwater disturbances have been corrected with empirical models (e.g., Imanishi et al., 2006) and/or 1-D water transfer estimations (e.g., Abe et al., 2006). These correction methods, however, may over- or under-estimate the disturbances, because they do not reproduce actual 3-D water distribution and its transfer.

We thus estimated the groundwater disturbance to gravity with hydrological modeling as follows (Kazama and Okubo, submitted). (1) We estimated a steady-state groundwater distribution in Sakurajima Island, assuming a homogeneous groundwater model of Shirasu soil in the whole area of the island. (2) We put observed rainfall at Sakurajima in 2007-2008 into the ground surface of the model, and solved hydrological equations for three dimensional groundwater distributions inside the island at each time. (3) We calculated a gravity value at each time with integrations of the estimated groundwater disturbances.

In this presentation, we will present the estimation on the groundwater variations and the related gravity disturbance. We will additionally eliminate the disturbance from the observed gravity data, and discuss eruption processes of Sakurajima volcano from the corrected gravity variation.

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