# Ground deformation at Asamayama volcano since 2008 revealed with tropospheric correction by using the JMA numerical weather model

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Electro-optical distance measurement (EDM) and GPS observation are applied to monitor precise time variation of the ground deformation at active volcanoes. But observations, by using electromagnetic waves such as these means, are accompanied by errors caused by inhomogeneity of refractive index along the propagation path in atmosphere. Especially the inhompgeneity in troposphere makes the accuracy of positioning worse. The improved analysis process was developed, based on the JMA's operational meso-scale numerical weather analysis (MANAL).

At Asamayam volcano, very small eruptions occurred in August 2008, since the latest 2004 eruption, and then a small eruption occurred in February 2009. According to the GPS observation by GSI and JMA, the baseline between both receiver sites north and west from Asamayama has extended since July 2008. But the vertical component of time variation of the baseline by the single-frequency-type GPS observation, the baseline having large vertical length, included large noise caused by inhomogeneity in troposphere. As a result of the analysis adapted this method, uplift of 2 cm was detected at observation sites western from Asamayama by January 2009.

The slope distances to summit reflectors from the reference point by EDM were corrected by using MANAL in the same way. Though five EDM observation sites on the summit have deflated at a rate of 1 - 7 cm per year since the 2004 eruptions, ground deformation turned over to inflation in August 2008, and slope distances extended to 2 - 5 cm by January 2009. Fluctuation like this was observed during the 2004 eruption, but quantity of variation at this time has reached to only half of the previous change.

By GPS observation of this time, one of pressure sources is estimated to be northwest from Asamayama, where was the inflation source at the 2004 eruption. At the same time, another source by EDM is guessed to be shallow beneath the summit. Then we tried to estimate a Mogi source that explains variation of slope distances observed by EDM. Assuming the source to be beneath the summit crater, depth of the source was searched to be at a height of 2380 m above sea level (200m under the summit) and increasing volume was to be 15,300 $m^3$. In the same way, the source was searched by extension of slope distances after the 2004 eruption; consequently the point of the same depth beneath the crater has deflated at the rate of 4,100 $m^3$ per year. In other words, it is highly possible that the pressure source at inflation period and one at deflation period exist in the same point where is beneath the crater.

It is known that volcanic activity of Asamayama is concerned with the inflation at northwest deep area from Asamayama. Additionally, it was clear that the activity of shallow source beneath the summit concerns. But no deformations, which estimate the pressure source to be a transient area between the deep and the shallow sources, have been detected. In the future, to more clear the eruption system of Asamayama volcano, we have to study the physical mechanism that reveals the ground deformation from deep area to shallow area.