Crustal deformation derived from a single-frequency analysis of a dense GPS network in Izu-Oshima island

Shigeru Nakao[1]; Yuichi Morita[2]

[1] Kagoshima Univ.; [2] E.R.I. Univ. of Tokyo

A dense GPS network observed crustal deformation due to study precursory process of an eruption in Izu-Oshima Volcano. Morita et al. (2004) reported that there is a strong correlation between episodic deformations and seismic activities in the last 8 yeas, and they proposed that the episodic deformations are caused by magma intrusion beneath the volcano. However, they did not discuss on height changes obtained from the GPS network because their estimations scattered more than the horizontal ones. However, the height component is also important to estimate the magma intrusion process. To improve the precision in the height estimates, we can analyze a single frequency phase data with the ionospheric correction calculated from dual frequency data, and propose the improvement of the estimation.

BERNESE GPS Software Ver. 5.0 with BPE is used with IGS precise ephemeredes. The GPS site 93051 is fixed in this analysis. A local single layer ionosphere model whose height is assumed at 450km was estimated every 2hours by L1-L2 combination at the fixed site. Repeatabilities for the following of five analysis strategies are calculated in the period from 170 to 179 in 2005 and they are compared each other. Those are (1) an ionosphere-free linear combination analysis with estimated troposphere parameters every hour, (2) a single frequency analysis with no ionosphere model and troposphere parameters estimated every hour relative to the fixed site where troposphere parameters are calculated using the standard atmosphere model. (3) a single frequency analysis with a local ionosphere model and troposphere estimated by the same as (2). (4) a single frequency analysis with a local ionosphere model and troposphere estimated by the same as (3), but at the fixed site the troposphere variation estimated by (1) is used. (5) a single frequency analysis with a global ionosphere model provide by CODE and troposphere estimated by the same as (4).

Repeatability of the L1 analysis reduces 53 % in vertical component. There is no systematic improvement in NS and EW components. Repeatability of all L1 analysis (i.e. case (2), (3), (4), (5)) is almost same each other. In the case that crustal deformation is discussed, the strategy (4) is recommended because troposphere parameters are estimated relative to estimated ones at fixed site by the strategy (1) and estimated local ionosphere models are adapted. The strategy (4) uses the best approximation atmospheric model (troposphere and ionosphere) in these strategies.

As the pointed out previous section L1 analysis with a local ionosphere model is adequate for height change of the dense GPS network, and we apply this strategy to the data in the period from April 2003 to December 2005. We analyzed GPS data every three days. From these analysis, downward displacement in the caldera (EMHR and 019054) constantly goes on and no distinct changes are found in the southern part of the network except a downward displacement at a south eastern station (EYKW). On the other hand, stable upward displacements are observed in northeastern part of the island (ESNZ, EKMU and 960594). In northwestern part of the island (ETBT, OVO, ENST, EGJK and 960595) an upward episodic occurred in January, 2004. Height changes in Izu-Oshima island can be detected by the method proposed here, and it will be a powerful tool for investigate precursory process to the eruption in the volcano.