GPS baseline solution with tropospheric correction by using the JMA numerical weather model

Akimichi Takagi[1]; Keiichi Fukui[1]; Hitoshi Yamasato[1]; Yoshinori Shoji[2]

[1] MRI; [2] Second Lab of Forecast Dep., MRI

Japan Meteorological Agency (JMA) has installed and is operating GPS networks around major active volcanoes since 2001 in order to monitor volcanic activities. At present, 22 volcanoes are observed with about 100 GPS stations. Single-frequency receivers are adopted in consideration of power saving and mobility inrugged environments.

GPS baseline solution includes errors of position estimation by variation of slant troposphere delays caused by inhomogeneity of atmosphere. Generally, computation of a baseline solution is done by using a simple atmospheric model which assumes horizontal homogeneity of atmosphere. But if the adopted model is not consistent with the actual atmosphere, proper delays cannot be estimated and positioning cannot be precise. Especially with regard to volcanoes observations, errors in vertical component of the baseline become large according to the large troposphere errors. In the case of large vertical difference between both receiver sites, time variation of vertical length is superposed by the seasonal noise caused by spatial and temporal variation of weather. For accurate monitoring of volcanic activities, improvement of precise vertical positioning has desired by using the analysis method with more accurate atmospheric model.

For this purpose, the improved analysis process is now on development, based on the JMA's operational meso-scale numerical weather analysis (MANAL). MANAL is applied to daily meso-scale numerical weather prediction (MSM) as initial field. Generally in the differential analysis process of positioning, zenith tropospheric delay (ZTD) is estimated by least-squares method together with the positioning. In this case, initial value of ZTD is given from a simple atmosphere model. In our approach, ZTD between both receiver sites is calculated from MANAL, and then the conventional analysis process is done fixing ZTD between sites. In calculation, analysis software package Bernese Ver. 5.0 was used, the program modifying personally.

In this study, this correction strategy using MANAL was applied to the baseline analysis of Asamayama volcano, where ground deformation has been observed accompanied with the eruption activity from 2008 to 2009. Consequently we could approximately eliminate the vertical seasonal noise at a baseline which has 1.5 km vertical difference. This approach is so convenient and effective for GPS observation at local and steep areas such as volcanoes.