The software to assist ground deformation and geomagnetic change analysis at volcano area (2)

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We developed the software to evaluate the magmatic activity from ground deformation data and geomagnetic changes observed at volcano. This software can handles both geodetic and geomagnetic data, and can analyze through trial and error by using GUI on Windows PC.

This software handles the following data, 1) GPS (X,Y, Z, latitude, longitude, and ellipsoid high), 2) displacement (also leveling data), 3) tilt, 4) magnetic total intensity, 5) atmospheric pressure, temperature, humidity, precipitation, and 6) hypocenter. DEM data (GSI DEM or user's DEM) are used for the modeling and drawing the topography. And also users can use the vector data to display the lake shore and fault, etc.

It is possible that plot data in any combination of observation items as time series graph and as map graph. Map graph plots marks and vectors on observation points, or draws as color map created from interpolated grid data. GPS and displacement data in map graph create from a difference between two period or displacement speed calculated from data within the designated period. The effect of the regional stress field can be removed from GPS and displacement data. The principal strain in triangulation net and the components of strain can plot in map for GPS and displacement data, and the locus vector diagram of tilt data can plot in a map graph.

For the modeling of observation data, the following models are used, 1) Mogi model, Okada model (Okada, 1992), and composite source for ground deformation, 2) thermal demagnetization model for sphere, column, conical, box, and composite source, 3) piezo magnetism which makes the multiple Mogi models. The optimum model is estimated by grid search or inverse analysis, and estimated result and error are displayed and outputted in a text file. It is also possible to estimate the optimum model by combining different observation item in giving the weight on every observation item. Demagnetize or magnetize model are used the equal shape for Mogi model and Okada model, when the geomagnetic data is combined with geodetic data. Calculations for ground deformation and geomagnetic model are considered the altitude of sites, such as the elevation-modified Mogi model (Fukui et al., 2003). Calculated values at observation point, grid points at designated elevation, and grid points at the ground surface, are possible to plot in the various graphs as plot of observation data, and it is possible to draw by superimposing on the observed value. It has some options in modeling, whether the reference point for GPS is fixed, whether it considers the regional stress field, selection of component from horizontal vector, horizontal scalar, vertical movement, three-dimensional vector, and three-dimensional scalar, selection of observation point.

Reference
Churei, M., K. Fukui, T. Yamamoto, K. Fujiwara, A. Takagi, T. Sakai, and A. Akasaka (2002) The software to assist crustal deformation and geomagnetic change analysis at volcano area. Programme and Abstracts, The Volcanological Society of Japan, 2002 No.2, 164.
Fukui, K., T. Sakai, T. Yamamoto, K. Fujiwara, A. Takagi, and M. Churei (2003) Availability and limitations of an elevation-modified Mogi model to estimate the pressure source from volcanic crustal deformation. Programme and Abstracts, The Volcanological Society of Japan, 2003, 35.