# The software to assist ground deformation and geomagnetic change analysis at volcano area (3) -Upgrade for EDM and InSAR

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We developed the MaGCAP-V (Magnetic and Geodetic data Computer Analysis Program for Volcano) to evaluate the magmatic activity from ground deformation data and geomagnetic changes observed at volcano. MaGCAP-V can handles both geodetic and geomagnetic data, and can do modeling the source of change through trial and error or inversion method by using GUI on Windows PC (Churei et al., 2002; Fukui et al., 2005).
MaGCAP-V Version 1.1 (released in 2005) handles the following data, 1) GPS (X,Y, Z), 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 lakeshore, fault, and etc.
Time series graph and map graph is possible to plot the various observation data on a sheet. Map graph plots marks, vectors on observation points, or draws as color map created from interpolated grid data. The effect of the regional stress field can be removed from GPS and displacement data. The following models are used, 1) Mogi model, dislocation model, 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. In order to reduce the effect of topography, we use a simple mode such as the modified Mogi model (Fukui et al., 2003). And modelings of volcano deformation by using a FEM simulation database (Fukui et al., 2006) are used to remove the effect of topography, heterogeneity structure and the shape of source.

MaGCAP-V was upgraded for the application to electro-optical distance measurement (EDM) data, interferometric SAR (InSAR) data and analysis of dynamic process.

EDM data is defined from a pair of instrument point and reflector point. Plot and modeling is possible as GPS and geomagnetic data. Baseline vector was added to the plot variable of GPS data.
InSAR data constitutes from the pair of a header file and a geocoded unwrapped data file. Satellite, geographical parameters are in the header file. MaGCAP-V does resampling and clipping from InSAR data. Plot and modeling is possible as EDM data. Cyclic color map is available for InSAR data. Baseline vectors from the satellite were added to the plot variable of GPS data, then we can compare with GPS data and InSAR data in directly.
For the analysis of dynamic process, MaGCAP-V is possible semi-automatic analysis for the series of analysis period, which was maked-up in MaGCAP-V.

We have a future plan in the development of MaGCAP-V as following
1) adopt gravity and strain data,
2) built-in the spheroidal model (Sakai et al., 2008),
3) improve performance through the programming technique for multi-threading CPU and others.