MaGCAP-V: Windows-based software to analyze ground deformation and geomagnetic change in volcanic areas

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MaGCAP-V is Windows-based software to evaluate volcanic activity from ground deformation and geomagnetic changes observed at volcanoes. That has been developed by Meteorological Research Institute, Japan Meteorological Agency since 2000. Recently, we can use many kinds of advanced technology for volcano monitoring, such as dense GNSS networks, distance measurements by using automated EDM, borehole tiltmeters installed near the crater, InSAR technique, precise gravity observations, geomagnetic observations by using the Overhauser magnetometers. And the development of a convenient analysis tool is required to interpret the volcanic activities from these various kinds of data. In order to meet this requirement, MRI started to develop MaGCAP-V in 2000. Over the past ten years, JMA has adopted these technologies and has operated the monitoring system consist of seismometers, monitoring camera, infrasonic microphones, borehole tiltmeters, and GNSS network at 47 active volcanoes in Japan. Furthermore, JMA has routinely carried out the repeated GNSS and geomagnetic observations at the summit areas of active volcanoes since 2000. These geodetic and geomagnetic data are analyzed by JMA using MaGCAP-V. The estimated source models are used to evaluate the volcanic activities and reported to the Coordinating Committee for Prediction of Volcanic Eruption.

Overview of MaGCAP-V

Observation data: 1) GNSS data, 2) displacements (including leveling data), 3) tiltmeter data, 4) EDM data, 5) InSAR data, 6) strainmeter data, 7) gravity change, 8) magnetic total intensity.

Auxiliary data: 1) Hypocenter data, 2) Gridded digital elevation data for modeling and drawing the topography, 3) Vector data (e.g., shorelines or faults).

Data visualization: 1) Time series plot, 2) Space distribution plot on map and cross sections (marks, vectors, and bars style plots at observation points or colored distribution map, contour map), 3) Overlay plots with any combination of plot styles and kinds of observations.

Source model: 1) Mogi, Okada, and spheroidal source model (Sakai et al, 2008) for ground deformation, 2) Gravity change due to Mogi and Okada model, and the mass movements for gravity data, 3) Thermal demagnetization in sphere, column, conical, box, and spheroidal for geomagnetic data, 4) Piezo magnetism for geomagnetic data, 5) Sources for the combined analysis using different kinds of observations, 6) FEM-DB model for ground deformation. FEM-DB is a data set of ground surface displacement vectors calculated by 3D finite element method for various pressure sources. A source model is selected from the models in DB or interpolated from the DB.

Method to determine optimum sources: Grid search or inverse analysis.

Semi-automatic analysis: Semi-automatically execute the process of modeling and creating of image files.