



## **dMODELS: A software package for modeling volcanic deformation**

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dMODELS is a software package that includes the most common source models used to interpret deformation measurements near active volcanic centers. The emphasis is on estimating the parameters of analytical models of deformation by inverting data from the Global Positioning System (GPS), Interferometric Synthetic Aperture Radar (InSAR), tiltmeters and strainmeters. Source models include: (a) pressurized spherical, ellipsoidal and sill-like magma chambers in an elastic, homogeneous, flat half-space; (b) pressurized spherical magma chambers with topography corrections; and (c) the solutions for a dislocation (fracture) in an elastic, homogeneous, flat half-space. All of the equations have been extended to include deformation and strain within the Earth's crust (as opposed to only at the Earth's surface) and verified against finite element models. Although actual volcanic sources are not embedded cavities of simple shape, we assume that these models may reproduce the stress field created by the actual magma intrusion or hydrothermal fluid injection. The dMODELS software employs a nonlinear inversion algorithm to determine the best-fit parameters for the deformation source by searching for the minimum of the cost function  $\chi_v^2$  (chi square per degrees of freedom). The non-linear inversion algorithm is a combination of local optimization (interior-point method) and random search. This approach is more efficient for hyper-parameter optimization than trials on a grid. The software has been developed using MATLAB, but compiled versions that can be run using the free MATLAB Compiler Runtime (MCR) module are available for Windows 64-bit operating systems. The MATLAB scripts and compiled files are open source and intended for teaching and research. The software package includes both functions for forward modeling and scripts for data inversion. A software demonstration will be available during the meeting. You are welcome to contact the author at [mbattaglia@usgs.gov](mailto:mbattaglia@usgs.gov) for additional information, and the software can be downloaded from the USGS website at [pubs.usgs.gov/tm/13/b1/](http://pubs.usgs.gov/tm/13/b1/).