iTACFEM-3D: アダプティブ四面体メッシュを用いた CSEM 三次元インバージョンコードの開発

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iTACFEM-3D: Three-dimensional inversion with tetrahedral mesh adaption for CSEM problems associated with volcano sounding

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Controlled-source EM methods are important in monitoring volcanic activities for its steady source power. To promote the use of CSEM methods for volcano monitoring, I am now developing an open-source CSEM inversion code using tetrahedral mesh adaption based on the finite element method (FEM), currently dealing only with electric grounded-wire sources. I named the code iTACFEM-3D (inversion using Tetrahedral-mesh Adaption for Controlled-source EM problems based on FEM). Since the code is developed using Fortran90, it is easy to handle and modify for scientific communities. The inversion can refine the mesh suitably for updated models through iterations, where the finer mesh is achieved around conductive anomalies emerged. The inversion code adopts the Gauss-Newton scheme and a direct solver, PARDISO, from Intel MKL library. The inversion allows us to choose either of fixed or decreasing trade-off parameters for the regularization. The former is for L-curve inversions while the latter for the cooling strategies (e.g. Schwarzbach and Haber 2009). The inversion code has been already applied to the real CSEMS data obtained by the ACTIVE system (Utada et al. 2007) at Aso volcano, Japan, in 2014 to 2015, without its adaptive feature (Minami et al. 2018).

In this study, I apply the inversion code to seek effective observation network of the ACTIVE system for volcano monitoring. So far, our numerical experiments revealed that more than one source with a circular induction-coil receiver network around the crater can clearly image the top of upwelling magma 200 m beneath the active crater when Aso volcano is assumed. In the presentation, I share results of further investigation about feasibility of several ACTIVE networks for detecting a variety of temporal variations in the resistivity structure, using iTACFEM-3D.