Modifications of WSINV3DMT to applying for OBEM data: sensitivity calculations and divergence corrections

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We conducted seafloor electromagnetic (EM) survey in the Philippine Sea in order to image electromagnetic feature of a stagnated slab and the surrounding mantle. Ocean bottom electromagnetometers (OBEMs) were deployed at 18 sites at intervals of about 3 degrees in about 17,000-km square area. The observed data allow us to estimate the three-dimensional (3-D) conductivity structure. However, useful 3-D magnetotelluric (MT) inversion code for our seafloor data does not exist. Thus we are modifying 3-D MT inversion code, the WSINV3DMT (Siripunvaraporn et al., 2005), which can treat only flat topography and land data, to apply complex topography and seafloor data. Hereafter, the former code and the later code are called the original WSINV3DMT code and the modified WSINV3DMT code, respectively.

We have completed the modification of the forward part of the WSINV3DMT code. A major point of the modification is calculation procedure of vectors, which transform electric fields computed at staggered grid into electric or magnetic field at an observation point. MT responses calculated for a bathymetry / topography model using the modified WSINV3DMT code are similar enough to those calculating the FS3D (Baba and Seama, 2002). This result indicates that the modified WSINV3DMT code can model the topographic effect correctly.

The next step of modification is for the inversion part of the WSINV3DMT code, especially sensitivity calculations and divergence corrections. The sensitivity is a measure of the extent by which a change in a model parameter results in a change in the MT response. Because the transform vectors mentioned above are changed from the original WSINV3DMT code, coefficients related the sensitivities also have to be modified. The computation of sensitivity needs four forward modeling which have a different source field each other. A point source is put at an observation points in two of these forward modeling. And a value of the point source depends on the transform vectors. The divergence corrections of electric currents have to be conducted as an important step of the forward modeling. Because the solution of the second order system of the Maxwell's equations in electric field does not satisfy the non-divergence free electric current explicitly, the divergence correction of electric current is used to accelerate a convergence rate.

In this presentation, we will show importance of the sensitivity calculations and the divergence corrections, and explain the way of modifying these for the WSINV3DMT code which treats electric fields on staggered grid.