Research report for the ERI visit from April 1 to June 8, 2019

Dr. Tao YE (Now in *Institute of Crustal Dynamics, China Earthquake Administration*)

Host: Prof. Makoto UYESHIMA (*Earthquake Prediction center, ERI*)

My propose of my stay at ERI was to initial a research on electrical anisotropy effect on MT response by using COMSOL simulation tool. First, I preliminary investigate the grid discretization accuracy of 3-D anisotropic MT forward modeling on homogenous half spaces. We used tetrahedral elements to discrete the models in COMSOL. If MT apparent resistivities at all forward frequencies are the same as the resistivity value of half space (100 Ωm), we think the mesh used for modeling is suitable to the frequencies. After some tests for meshing, we verified that the fine mesh is specific to higher frequencies and the coarse mesh is specific to lower frequencies. Therefore, the theoretic model may should be re-meshed for different frequencies band. Based on the mesh strategy, half space model has been replaced by electrical anisotropic geometry in COMSOL and have been carried out 3-D forward modelling. We evaluated the MT response from anisotropic model in apparent resistivity and impedance phase, and the tipper data.

Figure 1 is an anisotropic model that a isotropic conductive anomalous (10 Ωm) embed in a resistive background (100 Ωm). The model has been added an air layer with a resistivity value of 10e-7 s/m. The conductive body was replaced by anisotropic ones with different anisotropic strikes. In the cases of 0° and 45° anisotropic strikes, the apparent resistivity, impedance phases and tipper from the two anisotropic cases were investigated in horizontal pseudo-section. The results were shown as Figure 2 and Figure 3. Figure 2 shows the comparisons of apparent resistivity, impedance tensor and Parkinson real inductions in isotropic case and anisotropic case with 0 degree. Figure 3 shows the comparisons of apparent resistivity, impedance tensor and Parkinson real inductions in isotropic case and anisotropic case with 45 degree. From figures 2 and 3, we can find that when the principal axis of electrical anisotropy is 0°, the apparent resistivity and phase calculated by the magnetic field component induced by the current in the direction of maximum conductivity are not affected by anisotropic medium (e.g., XY and YX components). However, when the electrical anisotropic strike has a certain angle with x-axis (e.g., 45°), four components of apparent resistivity and phase are affected by anisotropic effect. In addition, the horizontal pseudo-section of the diagonal components (XY and YX) can reflect the orientation of the anisotropic strike. In anisotropic media, the real induction vector points in the same direction and is perpendicular to the anisotropic principal axis. The real induction vector direction is probably the most effective index to determine the orientation of the principal axis of electrical anisotropy.

Other research activities:

- During my stay in ERI I have presented my research on Yunnan MT survey in EM induction seminar on April, 16;
- During May, 12-18, I joined in the Miyakejima MT field survey together with Prof. Uyeshima and other participators;
- After the Miyakejiama survey, I attended the 2019 JpGU workshop at Chiba from May 26- May 30.

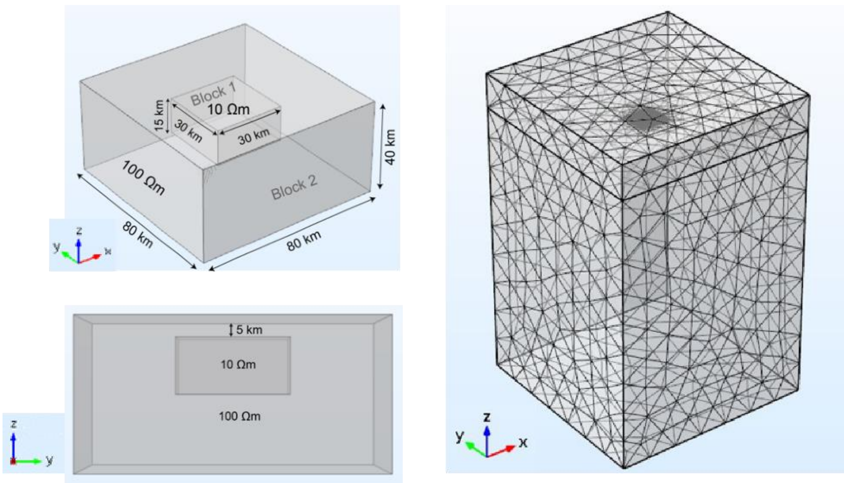

Figure 1. An meshed anisotropic model that a 10 Ωm conductive body embed in a half space. An air layer has been added on top of the model.

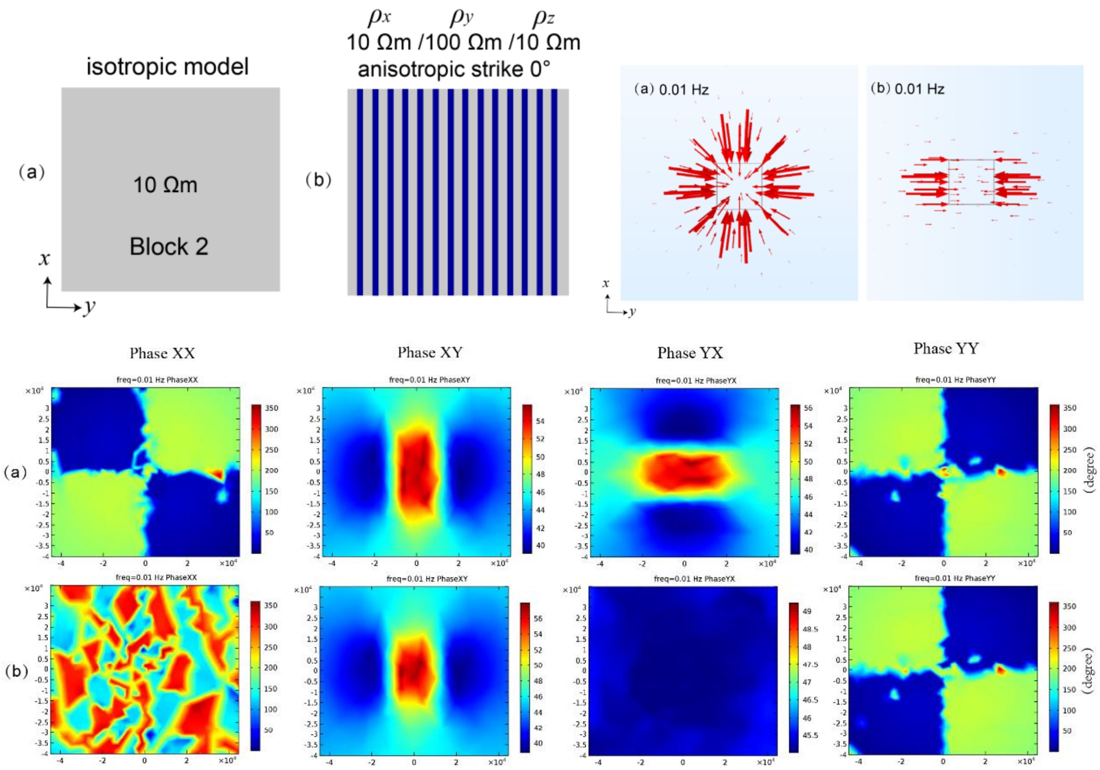

Figure 2. Comparisons of results of isotropic case (a) and anisotropic case (b) in apparent resistivity, impedance tensor and Parkinson real inductions. The anisotropic strike is 0 degree.

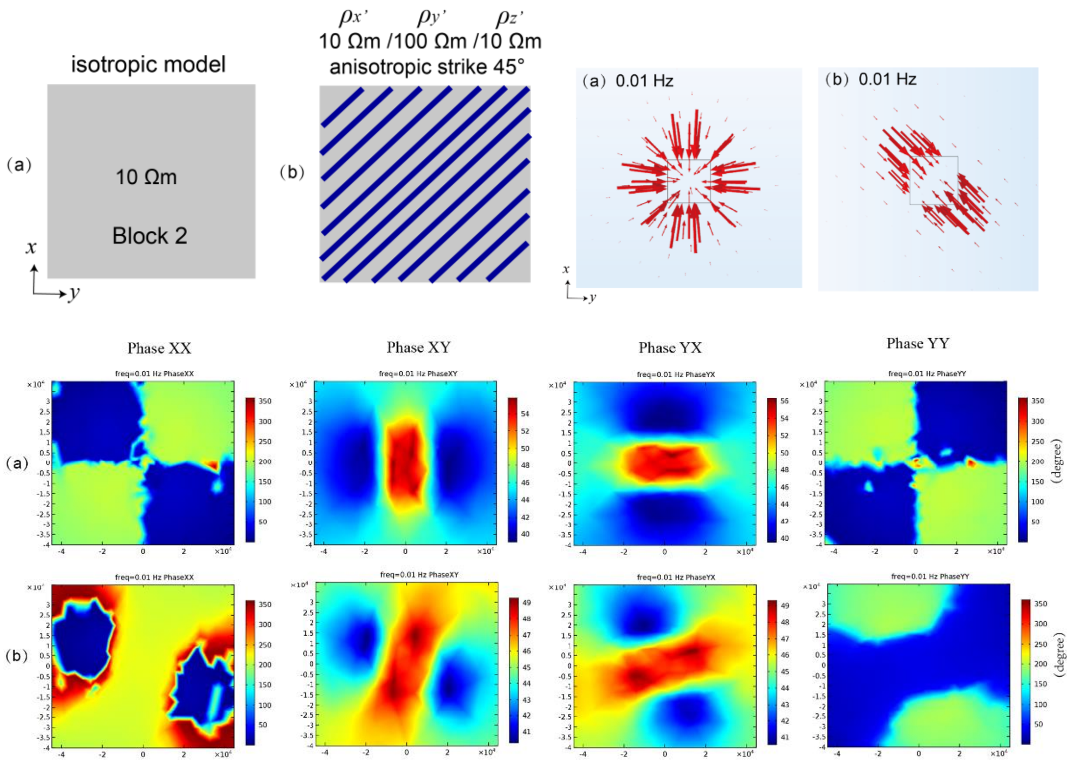

Figure 3. Comparisons of results of isotropic case (a) and anisotropic case (b) in apparent resistivity, impedance tensor and Parkinson real inductions. The anisotropic strike is 45 degree.

Acknowledgement

I would like to deeply thanks for my host, Prof. Uyeshima, for his patient discussion and sharing his experience and ideas with me. I am grateful to Ms. Teruhara and all other staffs in ERI International Office for their kind and considerate help during the two month enjoyable visit.