



3D inversion of test data sets

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Objective function

$$U = \left\| \mathbf{W}(\mathbf{d} - \mathbf{f}(\mathbf{m}^{(k)})) - \mathbf{J}\Delta\mathbf{m}^{(k+1)} \right\|^2 + \lambda^2 \left\| \mathbf{C}(\mathbf{m}^{(k)} + \Delta\mathbf{m}^{(k+1)}) \right\|^2 \rightarrow \min$$

Matrix equation to be solved

$$\begin{bmatrix} \mathbf{WJ} \\ \lambda\mathbf{C} \end{bmatrix} \Delta\mathbf{m}^{(k+1)} = \begin{Bmatrix} \mathbf{W}(\mathbf{d} - \mathbf{f}(\mathbf{m}^{(k)})) \\ -\lambda\mathbf{C}\mathbf{m}^{(k)} \end{Bmatrix}$$

Sensitivities of E and H fields

$$\frac{\partial \mathbf{E}_x}{\partial \sigma_k} = \int \tilde{\mathbf{E}} \cdot \mathbf{E}^{Jx} dv$$

$$\frac{\partial \mathbf{H}_x}{\partial \sigma_k} = \int \tilde{\mathbf{E}} \cdot \mathbf{E}^{Mx} dv$$

\mathbf{E}^{Jx} : \mathbf{E} field due to an electric dipole source

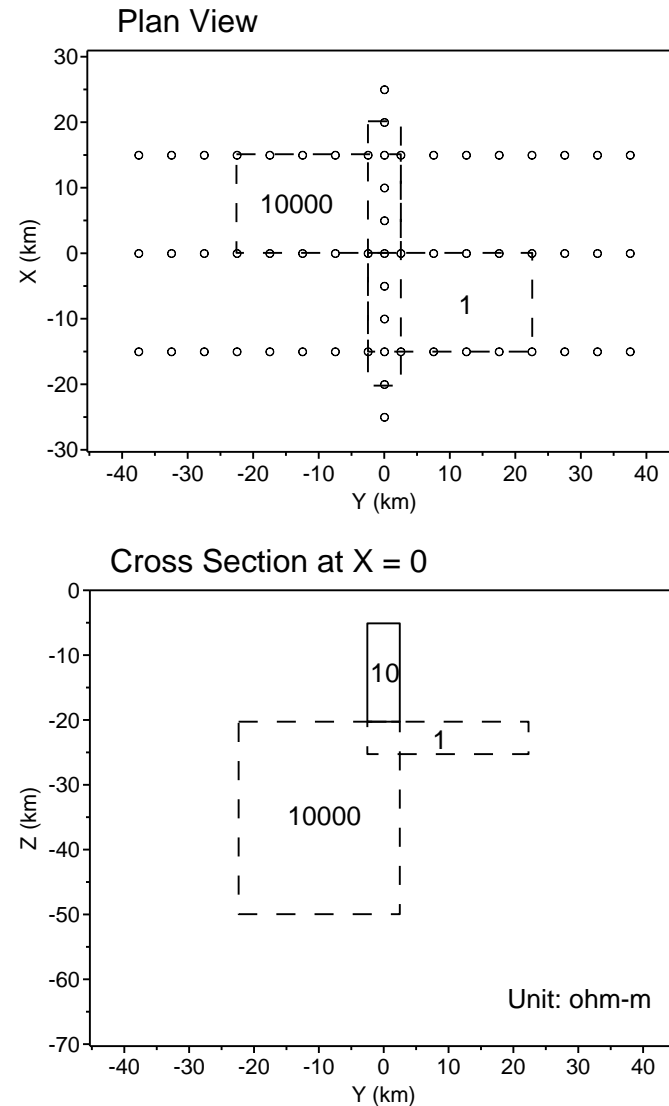
\mathbf{E}^{Mx} : \mathbf{E} field due to a magnetic dipole source

Test 1

Data used:

Zxy and Zyx
at 17 periods
(0.1 – 1000 s)

59 stations

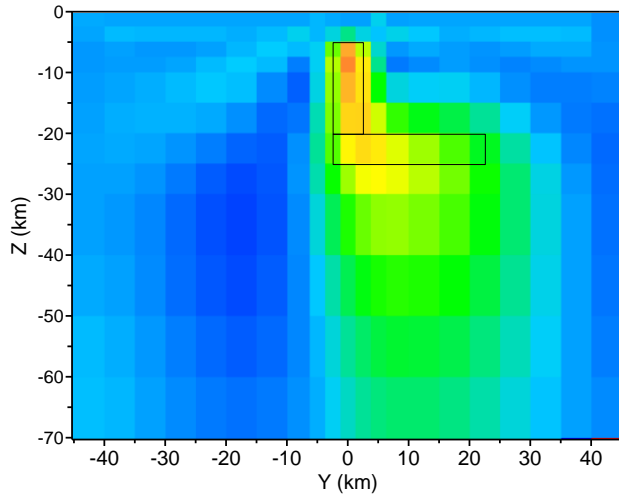


Inversion details for Test 1

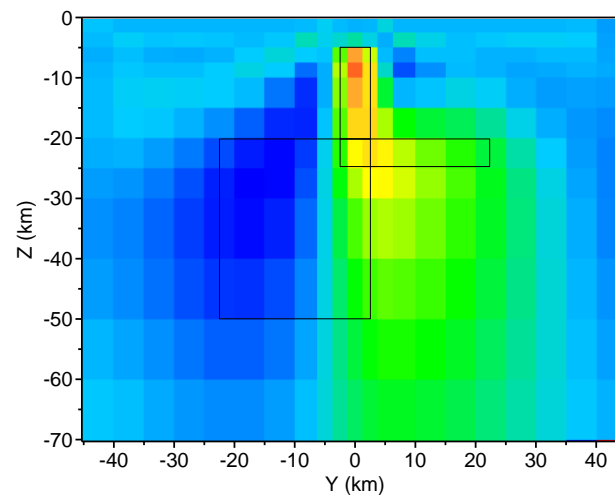
- Grid used for forward calculation:
40 x 58 x 36 (= 83 520)
- The number of unknowns:
13 x 21 x 13 (= 3549)
- Constrained used:
smoothness (Laplacian filter)
- Iteration number:
5
- Final *rms* data misfit:
1.8 % for apparent resistivity
0.33 degrees for phase
- CPU time:
18 hr on PC (Xeon 5160, 4GB memory)

Vertical slices of inversion model

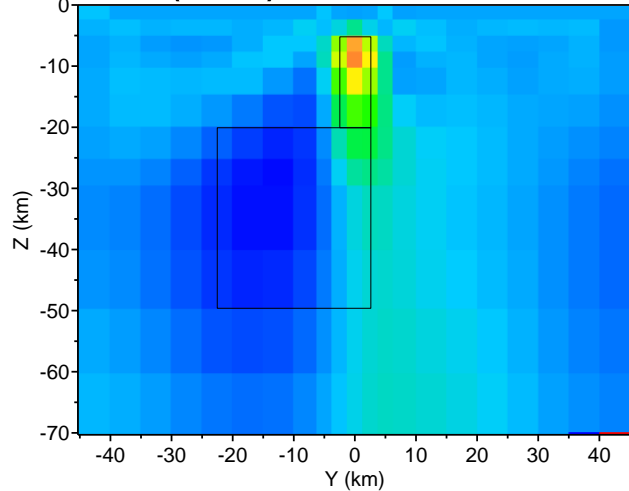
(Y-Z) $X = -15$ km



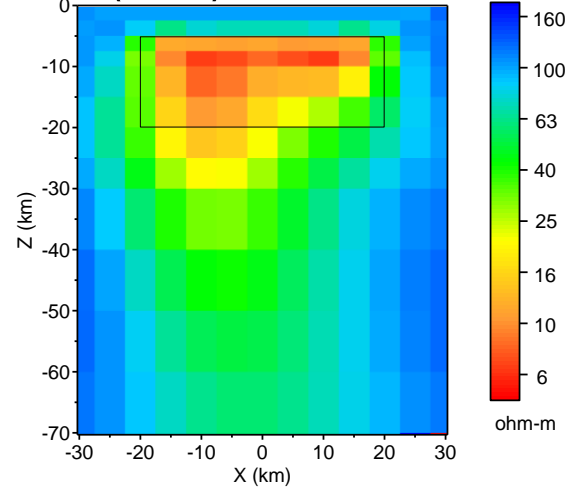
(Y-Z) $X = 0$ km



(Y-Z) $X = 15$ km

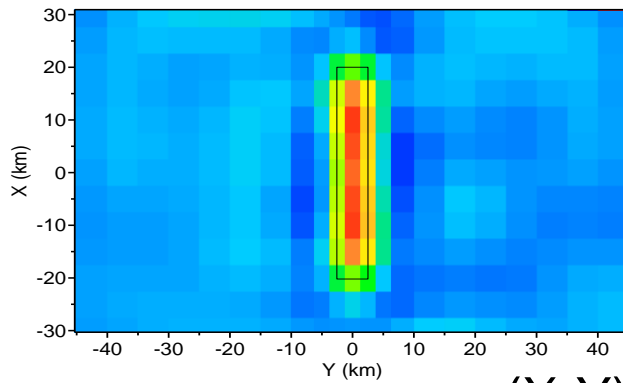


(X-Z) $Y = 0$ km

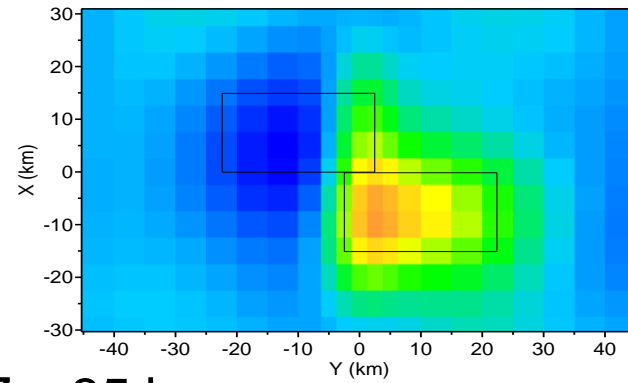


Horizontal slices of inversion model

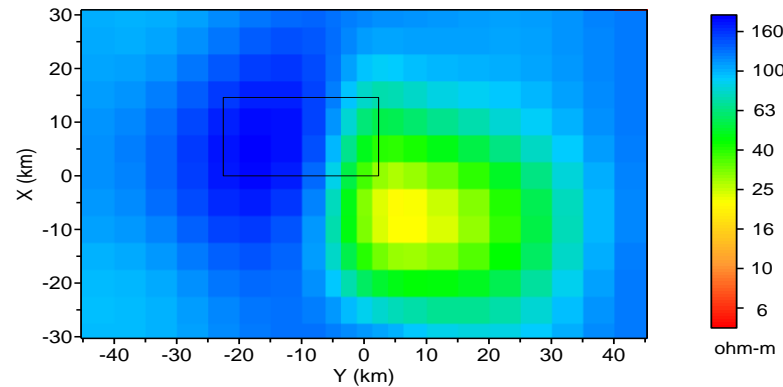
(X-Y) $Z = 9$ km



(X-Y) $Z = 23$ km



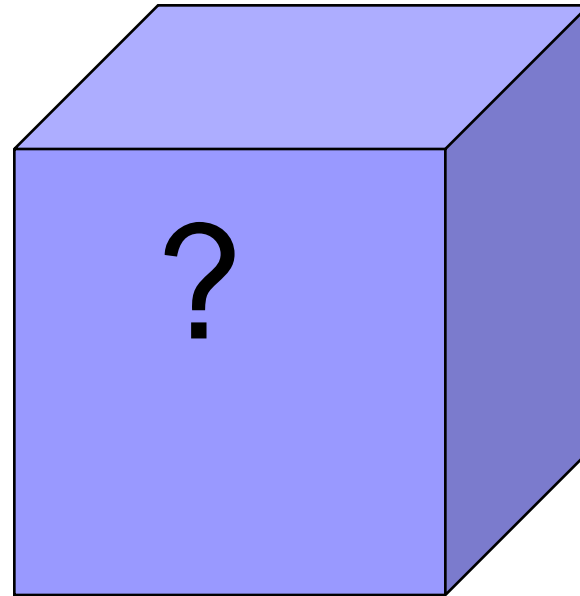
(X-Y) $Z = 35$ km



Test 2

Data used:
Zxy and Zyx
at 14 periods
(0.56 – 1000 s)
100 stations

Model



Inversion details for Test 2

- Grid used for forward calculation:
62 x 62 x 36 (= 138 384)
- The number of unknowns:
16 x 16 x 13 (= 3328)
- Constrained used:
smoothness (Laplacian filter)
- Iteration number:
5
- Final *rms* data misfit:
12 % for apparent resistivity
2.8 degrees for phase
- CPU time:
64 hr on PC (Xeon 5160, 4GB memory)

Vertical slices of inversion model

