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Electrical Resistivity Method

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February 18, 2026

Electrical Resistivity Method: Theory

- The method is based on injecting current into the ground through electrodes to measure the resulting voltage drop between the electrodes.
- Due to uneven subsurface, we measure the apparent resistivity which is a weighted average of the volume of earth the current passes through.

Forward Model

Modeling the sub surface resistivity map using RES2DMOD is achieved with the following steps.

- Define the background resistivity.
- Specify the geometry.
- Simulate the acquisition and export it to RES2DINV compatible file.

The exported data represents the raw data that would be collected in the field.

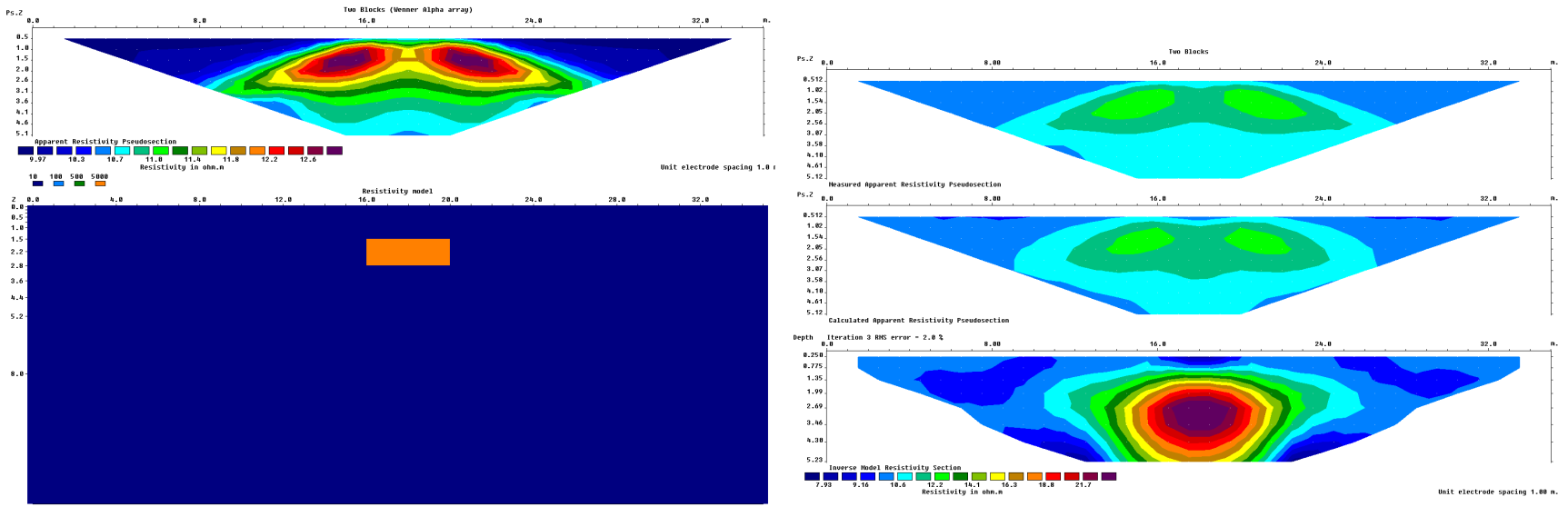
Inversion Result

- Inversion of the data using Least-Squares Inversion is performed to reconstruct the true resistivity of the sub-surface structures.
- Simulation of three sub-surface structures were performed.
  - High resistivity region under the surface
  - Two layers of different resistivity
  - High conductivity region under the surface

All the simulations are performed with the below parameters,

- Number of electrodes is 36
- Number of apparent resistivity levels is 10
- Electrode spacing is $1[m]$
- Number of nodes per Electrode spacing is 4

High Resistivity Region Under the Surface



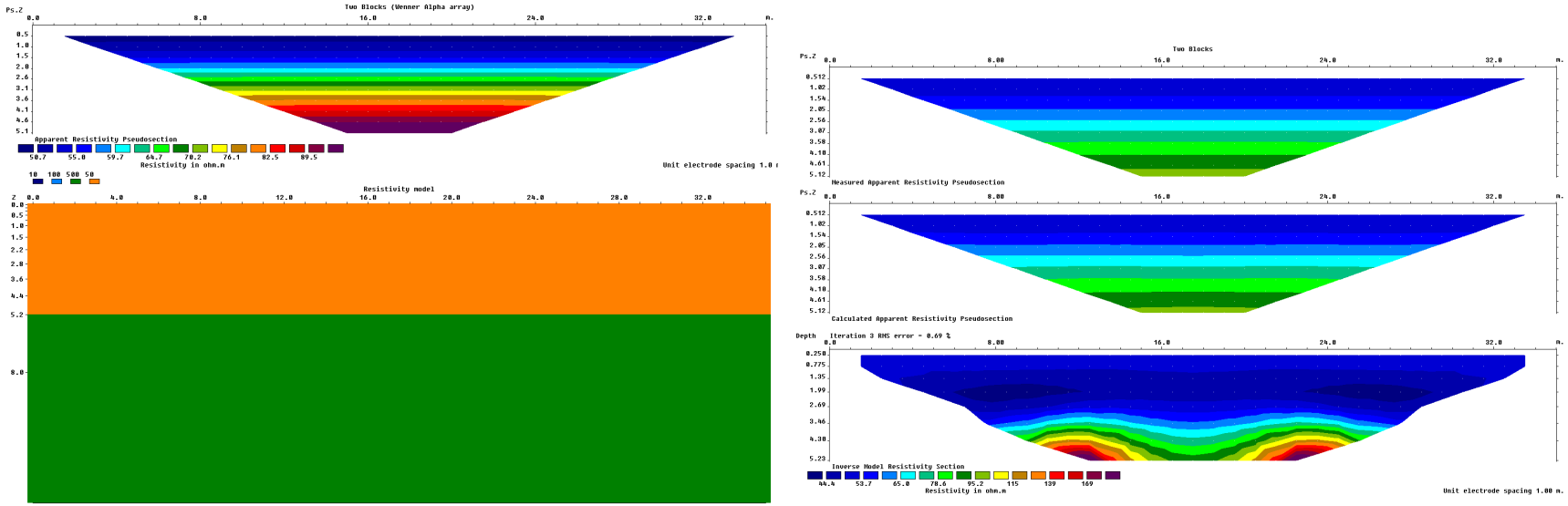
(a) (b)

Figure: (a) Output of the forward model from RES2DMOD (b) output of the inversion model from RES2DINV

High Resistivity Region Under the Surface

- The model is able to inverse the forward model output with about 2% RMS error.
- The sharp corners and edges of the forward model gets smoothened out in the inversion model due to the nature of the inversion process.
  - Edges and corners represent high frequency data and the loss of high frequency data in the inversion model causes the smoothing of the edges.
  - The least square inversion model used typically involves a smoothening constraint.
  - The sensitivity of the array decreases with increase of depth.

Two Layers of Different Resistivity



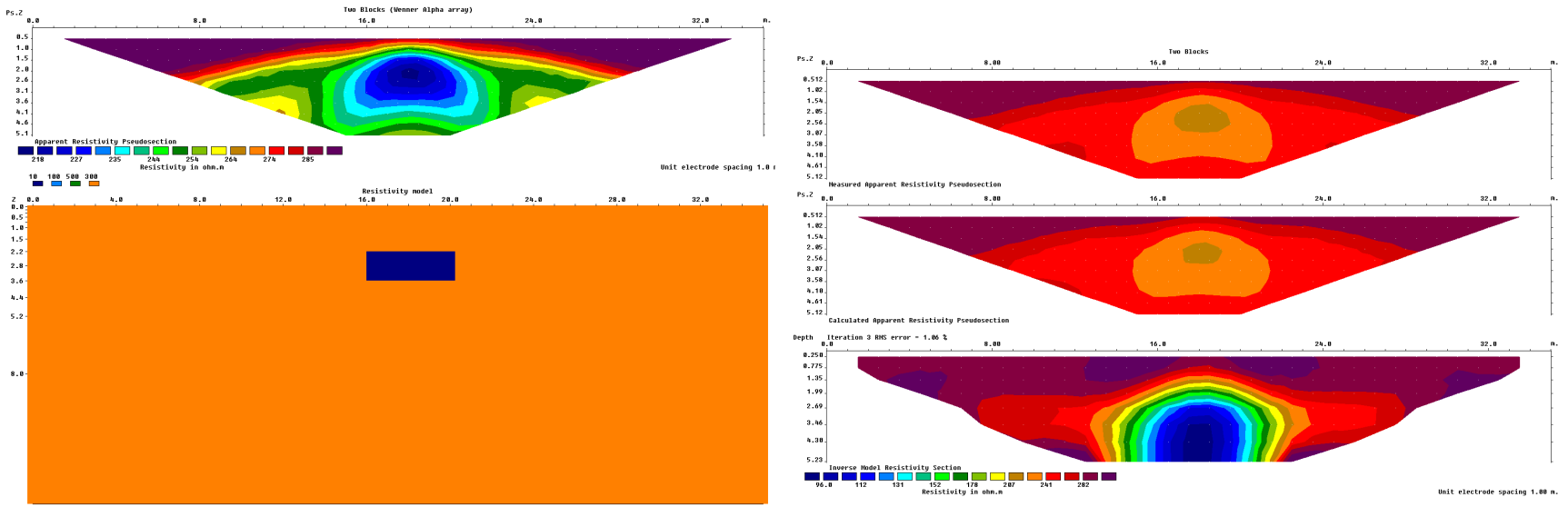
(a) (b)

Figure: (a) Output of the forward model from RES2DMOD (b) output of the inversion model from RES2DINV

Two Layers of Different Resistivity

- The model is able to inverse the forward model output with about 0.69% RMS error.
- Here we have modeled a two layer structure, where the deeper layer has higher resistance.

High conductivity region under the surface



(a) (b)

Figure: (a) Output of the forward model from RES2DMOD (b) output of the inversion model from RES2DINV

High conductivity region under the surface

- The model is able to inverse the forward model output with about 1.06% RMS error.
- Here we have modeled a low resistivity region under the surface with high resistivity background.

Thank you!