Inverse Problems in Geophysics
Report 2: Magnetotelluric inversion

2. MGPY+MGIN

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Tasks (1)

1. Generate synthetic data based on a three-layer model (e.g. with a conductor in the middle or at depth)
2. Add Gaussian noise with a relative error of 5% (ρ^a) and an absolute error of 1° (phases)
3. Display the sounding curves and interpret them visually
4. Generate a function to compute the Jacobian matrix for logarithmized (apparent) resistivities
5. Run Occam-type inversion (Smoothness constraints) of the ρ^a data

Tasks (2)

5. Occam inversion

- scale with the errors and compute the χ^2 error
- determine regularization strength such that data are fitted within noise
- plot the forward response along with the data and the misfit

6. Compute the model resolution matrix and the data resolution matrix

- Display both matrices as well as their diagonals (like data & model)
- Interpretation of model and resolution measures

Tasks (3)

7. Extend the inversion to phase data by concatenation

- concatenate amplitude and phase data
- generate error vectors and concatenate
- write/extend function for Jacobian matrix computation
- scale data and Jacobian by error and repeat inversion
- have a look at resolution matrix like in 6.

Tasks (4)

8. Run a Marquardt type inversion with 3 layers (5 parameters)

- start with homogeneous model of median ρ^a values
- use a damping scheme and reduce damping parameter in every iteration
- compute model resolution matrix and interpret