Geophysics 699 - Magnotellurics and Continental dynamics
Assignment 3 – Numerical solutions to the MT forward problem

(1) Papers to read

These papers can be reviewed quite quickly. Focus on the main points and numerical results. What are the limitations and inadequacies of the methods?

Aprea, C., J. R. Booker, and J. T. Smith, The forward problem of electromagnetic induction: accurate finite-difference approximations for two-dimensional discrete boundaries with arbitrary geometry, *Geophys. J. Int.*, **129**, 29-40, 1997.

Brewitt-Taylor, C.R., J.T. Weaver, On the finite difference solution of two-dimensional induction problems, *Geophys.* J. R. *astr. Soc., 47, 375-396,* 1976.

Wannamaker, P.E., J.A. Stodt and L. Rijo, A stable finite element solution for 2-D magnetotelluric modelling, *GJRAS*, 88, 277-296, 1987.

(2) Computation

(a) Derive a finite difference solution to the 1-D MT forward problem in terms of the horizontal electric field (E_x)

Compare your solution to that derived in Assignment 1.

Model to use	0-1 km	100 ohm-m
	1-2 km	10 ohm-m
	Halfspace	1000 ohm-m

Frequency band 100 – 0.001 Hz

Use approximately N = 50 nodes with a spacing that increases with depth.

Explain how you chose the smallest spacing at z = 0

Explain how you choose the total depth to which the mesh should extend.

(b) Investigate the convergence of your solution by decreasing the node spacing so that N =100, 200, 400. Compute the **percentage error** in apparent resistivity, and **absolute error** in phase, as compared to the analytic solution in Assignment 1.

Display results with **pcolor.m** for all values of frequency and N

(c) Now investigate the effect of varying the **mesh size**. Solve for the electric field for mesh range from 5 km to 1000 km.

Again, plot errors compared to the analytical solution with **pcolor.m**

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