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

(1) Paper to read

These papers describe some of the first papers on 2-D numerical solutions in MT for the finite-element and finite difference methods. The Wannamaker solution is still widely used as it handles sloping interfaces without resorting to a series of steps (as needed in finite difference codes such as the NLCG6 inversion.

Jones, F.W. and A.T Price, The perturbations of alternating geomagnetic fields by conductivity anomalies, *Geophys. J. R. Astro. Soc*., 20, 317-334, 1970.

Wannamaker, P.E., J.A. Stodt and L. Rijo, A stable finite element solution for 2-D magnetotelluric modelling, *Geophys. J. R. Astro. Soc*., 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 numerical solution to the analytical solution, by using the MATLAB code provided for Assignment 1.

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

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**

MJU March 2011