ABSTRACT

The finite-difference time-domain (FDTD) method is a robust method that solves Maxwell's equations in time and over a spatial grid. Our research group has developed FDTD models of electromagnetic waves propagating globally around the world in the Earth-ionosphere waveguide [2] and through the ionosphere [3]. This poster provides an overview of our modeling capabilities, and it highlights a recent research activity relating to power line emissions (PLE) and harmonic radiation (PLHR) propagating into and through the ionosphere.

INTRODUCTION

Finite-Difference Time-Domain (FDTD) Method

- Solves Maxwell's equations
- May be applied across the electromagnetic spectrum
- Introduced in 1966 by Kane Yee
- 1000's of FDTD-related papers published each year
- 10's of commercial FDTD solvers available

Example Applications:
1) Remote-sensing of localized ionospheric anomalies
2) Geolocation
3) Space weather effects on the operation of electric power grids
4) Scintillation in the Ionosphere

METHODS

There are three generations of models (1) a latitude-longitude grid; (2) a geodesic (hexagonal-pentagonal) grid; and (3) a Cartesian-based grid. A magnetized ionospheric plasma model has been incorporated into these grids.

CONCLUSIONS

- Our model may account for arbitrary source time-waveforms (as could occur from man-made antennas as well as naturally occurring ionospheric currents or lightning strikes) and complex 3-D geometries (e.g. variable ground topography and 3-D lithosphere/ionosphere compositions).
- We are starting to obtain results for the coupling of PLRs into the ionosphere. This will help science missions by helping them better identify and remove PLHR signatures from their measured data.

REFERENCES