MODELING THE EARTH-IONOSPHERE CAVITY USING FDTD

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The cavity formed by the earths surface and the lower ionospheric layers (D,E) allows for an efficient propagation of VLF (3-30 kHz), ELF (3-3000 Hz) and ULF (< 3Hz) signals of natural or man made origin. Comparing experimental reception data from lightnings (sferics) as well as from VLF transmitters with model calculations allows to infer structure parameters of the cavity boundaries, for example permittivity and conductivity of the earths surface and electron density distributions of the lower ionosphere – the latter especially also in the day-night terminator regions. For long distances from the source it is well known that mode theory is sufficient. Modeling near source and extremely low frequency behaviour however a full solution of Maxwell's equations is appropriate. Finite Difference Time Domain (FDTD) algorithms provide a suitable framework for computer based modeling in this case. Numerical calculations and their validation with recorded subionospheric impulsive and non-impulsive VLF/ELF-reception data are presented.

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