RADIATION BELT ENERGIZATION VIA INTERACTION WITH ULF WAVES: MHD SIMULATIONS OF MAGNETOSPHERIC ULF ACTIVITY

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The outer zone radiation belts are largely field-aligned structures, with equatorial crossing distances of approximately 3-7 Earth radii. This region of space is of particular significance due to the large number of spacecraft operating at these altitudes, and global society's increasing reliance on space-based platforms for communications, navigation, weather prediction, and a variety of other economic and geopolitical purposes. Energetic electron fluxes in the outer zone can vary orders of magnitude over a variety of time scales, and spacecraft operating here have sometimes been found susceptible to "anomalies" related to changes in the local radiation environment.

Magnetospheric ULF waves, electric and magnetic fluctuations with characteristic frequencies in the mHz range, can efficiently transport and accelerate energetic electrons in the outer zone radiation belts. Magnetohydrodynamic (MHD) simulations of the solar wind/magnetospheric system are capable of modeling ULF waves resulting from a variety of processes, including those resulting from pressure impulses in the solar wind, shear waves along the magnetopause flanks, and large-scale changes in the convective motion of the magnetosphere. In this work, we analyze results from the Lyon-Fedder-Mobarry MHD model, which provides a global, 3d picture of the solar wind's interactions with the Earth's magnetosphere and ionosphere. Using varying solar wind driving conditions, we investigate the spatial and spectral characteristics of ULF waves occurring in the model, including the radial and azimuthal extent of the waves, as well as the wave mode structure and temporal power spectral density. Implications of the model results for energetic particle acceleration in the magnetosphere will be discussed in terms of the range of time scales and regions over which ULF-induced acceleration will occur under various solar wind conditions.