The Impacts ULF Waves on the Dynamics of the Earth's Van Allen Belts

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We review the impacts ultra-low frequency (ULF) wave power on the dynamics of ultra-relativistic electrons in the Van Allen belts. We place emphasis on the significance of using properly characterised time-series of ULF waves for properly estimating their impacts for both acceleration and loss. Specifically we compare results derived from observed wave power with those from more standard approaches using statistical characterisations based on geomagnetic indices such as Kp, revealing the importance of properly characterising the waves through the course of the main and recovery phases of geomagnetic storm-time Van Allen radiation belt dynamics. We find using the observed ULF wave power presents a remarkable explanation for the overall dynamics of the belts in terms of the impacts of inward and outward radial diffusion in association with plasmasheet sources and magnetopause shadowing. At ultra-relativistic energies the resulting dynamics demonstrate a remarkable simplicity which is controlled by the ULF wave power. Especially at ultra-relativistic energies, ULF wave power can explain all of the morphologies of the Van Allen belts at in the form of either one, two or three belts.