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Simulation of Bounce Resonance ULF Wave-Particle Interactions

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Poloidal mode ultra-low-frequency (ULF) waves with high azimuthal mode number (high-m) are common throughout Earth's magnetosphere. It is speculated that substantial electric fields in these waves, on the order of tens of millivolts per metre, can energize ions and electrons efficiently via drift- and drift-bounce-resonance wave-particle interactions. We present test-particle simulations of drift-bounce resonance using a new numerical model of ULF waves. The model can use an arbitrary magnetic field and includes a realistic ionosphere with height-resolved Pedersen and Hall conductivity. An interesting finding is that fundamental mode poloidal waves in the ULF model rapidly transform into toroidal mode waves. Second harmonic high-m waves do not exhibit this behaviour. It is demonstrated that second-harmonic poloidal mode waves are very efficient at energizing ions. The test-particle simulations of bounce-resonance 2nd-harmonic wave-particle interactions are shown to produce particle signatures that reproduce ion flux oscillations observed by satellites from the Cluster mission. The expected significance of the results in the context current satellite missions such as the Van Allen Probes and up-coming ERG satellite mission will be briefly discussed.