Geophysical Research Abstracts
Vol. 20, EGU2018-17137, 2018
EGU General Assembly 2018

Three Dimensional Simulations of ULF Wave Particle Interactions: Van Allen Probes Observations

Robert Rankin (1), Chengrui Wang (1), Yongfu Wang (2), Quigang Zong (2), and Xuzhi Zhou (2)

(1) University of Alberta, University of Alberta, Physics, Edmonton, Canada (rrankin@ualberta.ca) Institute of Space Physics and, (2) Institute of Space Physics and Applied Technology,Peking University, Beijing, China.

Three-dimensional simulations of the interaction of ULF waves with test particle ions and electrons in Earth's outer radiation belt are used to understand the evolution of distribution functions observed by the Van Allen Probes spacecraft. The phase space density (PSD) of H^+ and O^+ evolved using a full Lorentz force test particle model that resolves gyromotion, while relativistic electron dynamics is determined using a guiding center formalism. The test particle models are coupled with an ideal MHD model of poloidal mode waves to specify electric and magnetic fields within which charged particles evolve. This combination of models reproduces to a remarkable extent the signatures of drift resonance observed by the Van Allen Probes. Trajectories of ions and electrons are traced backward in time to locations on the equatorial plane before waves are present. With an assumed form of the distribution function, Liouville's theorem is used to reconstruct PSD at the spacecraft location as a function of time. Two representative ULF wave events are used to demonstrate that the models reproduce the pitch angle dependence of PSD as it evolves in response to the action of ULF waves. An important new aspect of the simulation study is the prediction of "butterfly" ion distributions that emerge naturally from the pitch angle dependence of the ion drift resonance energy. The simulation results from the two events presented is discussed in the context of processes controlling inner magnetosphere particle energization and transport.