Analysis of Whistler Waves Detected by the Van Allen Probes In Earth's Radiation Belts

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On December 3rd, 2012, Van Allen Probe A (RBSP A) detected multiple whistler mode wave events between 800 and 1000 hours. All of the events were of short duration (between four and five minutes) and coincided with noticeable peaks in the spectrogram readings of both the electric and magnetic fields. For every event, there was an enhancement in the electron field density, also known as high density ducting. The wave characteristics are discovered using the data taken from Van Allen Probe A. We then use this data to determine parameters for use in an electron magnetohydrodynamic (MHD) simulation for modeling propagation of the whistler waves within the enhancement duct. These simulations will show that whistler-mode waves become trapped inside of density structures (which we call ducting); In enhancement ducts, whistlers will experience "leaking" and will lose strength. This is true unless the whistler possesses a frequency less than half of the local electron gyrofrequency. In comparison, inside low density ducts, whistler waves are almost lossless in strength. The explanation for this is that in both cases the waves contained within the duct consist of a coupled superposition of two waves of the same frequency and axial wavelength but with two different perpendicular wavelengths. These waves then couple with other waves outside of the duct; however, in low density ducts both of the exterior waves are evanescent, so the energy within the channel is contained (hence, lossless). These density ducts are what cause the whistler waves to build up and propagate inside of the radiation belts surrounding Earth. The goal of this work is to gain a deeper knowledge of the density ducts that guide whistler waves within the Van Allen Radiation Belts. This research will help contribute to any future efforts to "clean" the radiation belts of the energetic particles within, reducing the dangers of radiation to satellites and any manned space missions.