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ULF waves and radiation belts: earthward penetration of Pc 4-5 waves and energetic electron flux enhancements during geospace magnetic storms

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Energetic particle fluxes in the outer radiation belt can vary over orders of magnitude on time scales ranging from minutes, to days and years. Geospace magnetic storms when sufficiently strong to exceed key thresholds of the Dst index may either increase or decrease the fluxes of energetic electrons. We examine the responses of energetic electrons to nine moderate, intense and weak magnetic storms, which occurred at different phases of the solar cycle, and compare these with concurrent variations of ULF wave power.

Pc 4-5 waves with frequencies in the range of a few mHz may be generated internally in the magnetosphere by low frequency instabilities of ring current ions and externally by shear instabilities at the magnetopause flanks, or compressive variations in the solar wind. Here, we present multipoint observations from ground-based magnetometer arrays collocated with electron drift orbits, which are complemented and measurements by conjugate multi-point satellites, such as CHAMP, Cluster, GOES and THEMIS. We discuss the excitation, growth and decay characteristics of Pc 4-5 waves during the different phases of the magnetic storms with particular emphasis on the distribution of Pc 4-5 wave power over a variety of L shells.

We investigate whether Pc 4-5 wave power penetrates to lower L shell values during periods of relatively intense geomagnetic activity as compared to weak magnetic storms. Structural changes of the magnetosphere during intense geomagnetic storms can play an important role in the generation and penetration of Pc 4-5 waves deep into the inner magnetosphere, which in turn is of significance for the wave-particle interactions contributing to the acceleration, transport and loss of electrons in the outer radiation belt. We present preliminary statistics of Pc 4-5 waves observed during magnetic storms of varying intensity, which occurred over the course of the previous solar cycle.

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