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Storm-time fingerprints of Pc 4-5 waves on energetic electron flux at geosynchronous orbit

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Geospace magnetic storms, associated with either coronal mass ejections (CMEs) or high speed solar streams, involve global variations of the geomagnetic field as well as acceleration of charged particles in the magnetosphere. Ultra low frequency (ULF) waves with frequencies in the range of a few mHz (Pc 4-5 waves) can be generated externally by compressive variations in the solar wind or shear flow along the magnetopause unstable to the Kelvin-Helmholtz effect. Furthermore, low frequency instabilities of ring current ions are also considered as a possible internal driver of ULF wave growth.

We examine power enhancements of ULF waves during four successive magnetic storms, which occurred in July 2004 and were characterized by a decreasing minimum of the Dst index, from -76 nT down to -197 nT. During the course of the magnetic storms, ULF wave power variations have been observed nearly simultaneously at different magnetic latitudes and longitudes by the ground-based CARISMA, IMAGE, 210 MM and SAMBA magnetometer networks. Nonetheless, stronger magnetic storms were accompanied by greater ULF wave power enhancements tending to be more pronounced at magnetic stations located at lower L shells.

Furthermore, the generation and penetration of ULF wave power deep into the inner magnetosphere seems to be contributing to the energization and transport of relativistic electrons. Except for the magnetic storm on 25 July 2000, the three magnetic storms on 17, 23 and 27 July 2004 were characterized by a significant increase in the flux of electrons with energies higher than 1 MeV, as measured by GOES-10 and -12 during the recovery phase of each storm. On the other hand, when looking at the magnetic storm on 17 August 2001, the initial decrease was followed by an increase six days after the commencement of the storm. The electron flux decrease was more than two orders of magnitude and remained low after the recovery of the Dst index.

These observations provided us the basis for studying the dependence of energetic electron flux in outer zone radiation belt on power enhancement in the ULF frequencies during active magnetospheric conditions. We present statistical maps of Pc 4-5 waves characteristics (in terms of frequency, mean wave power, azimuthal wave number), which have been compiled over moderate and intense magnetic storms that have occurred at different phases of the previous solar cycle 23.

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