VLF WAVE ACTIVITY IN THE OUTER RADIATION BELT DURING MAGNETIC STORM

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INTRODUCTION

Global mapping of spatial and temporal distributions of plasma wave in the magnetosphere is useful not only in deriving the energy distribution of the plasma waves but also in studying the energy transfer processes between waves and particles. In the outer radiation belt during magnetic storms, drastic changes of relativistic electron population have been observed by many satellites. The relativistic electron flux decreases during the main phase of the storm and increases to the prestorm level during the recovery phase. One of the plausible mechanisms of the relativistic electron enhancement is the wave-particle resonant diffusion by whistler mode waves. In the present paper, we introduce wave activity associated with magnetic storms, and discuss roles of plasma waves in the outer radiation belt.

DATA ANALYSIS

Akebono was launched in 1989 into a semi-polar orbit with an altitude range between 300km and 10,000km, and has been operated successfully for about 13 years. Using the datasets of VLF waves obtained by Akebono, we statistically investigated the time variation and spatial distribution of VLF waves in the inner magnetosphere. Our statistical study clarified that the wave above 1kHz in the vicinity of the outer radiation belt is dominantly chorus emission. During the recovery phase of magnetic storms the wave intensity is enhanced and the distribution region of the chorus is firstly located around the inner edge of the outer radiation belt and gradually shifts toward the outer L-shell region. Direction finding analysis clarified that the chorus basically propagates toward lower altitude region from equatorial region along geomagnetic field line with a large wave normal angle.

In order to evaluate how large the wave energy is and how much the wave contributes to the generation of relativistic electrons in the outer radiation belt, we roughly estimated the total energy of chorus emissions generated during a storm-recovery. We compared the wave energy with the energy increase of relativistic electrons generated during the storm-recovery and found that the order of both energies is comparable.

CONCLUSION

The statistical study and direction finding of the chorus observed by Akebono enabled us to estimate the total energy of the chorus generated in the inner magnetosphere during a storm-recovery. According to our estimation in the present study, the energy of VLF wave might not be large enough to generate relativistic electrons alone considering the conversion rate of the energy from VLF wave to relativistic electrons, but the wave energy is not negligible in the acceleration process of relativistic electrons.

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