Energetic electron flux enhancements during geospace magnetic storms associated with earthward penetration of Pc 4 and 5 waves?

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Abstract

ULF waves with frequencies of a few millihertz (mHz) have been associated with changes in the flux levels of relativistic electrons comprising the outer zone of the radiation belts. In particular, these fluxes of electrons with energies of a few hundred keV are strongly modulated during geospace magnetic storms. For all storms studied by Reeves et al. (2003) only about half of them led to wave-particle interaction. The asymmetry of the Earth’s magnetic field between the dayside and nightside, as the satellite passes through different local times, is based on data from different magnetometer station arrays. These include time series of magnetic field measurements from the THEMIS and DMSP satellites. Using the Statistical Asynchronous regression (SAR) method proposed by O’Brien et al. (2001) to determine the relationship between geospace magnetic storms and ULF waves with frequencies of a few mHz, we have obtained a measure of the wavelet power at Pc 4 and Pc 5 waves. This method has been used to estimate the time-frequency distributions of ULF waves with frequencies of a few mHz in the equatorial region and in situ energetic electron fluxes. The level of geomagnetic activity for each storm is defined as the minimum of the Dst index, the maximum mean wave amplitude (MWA) and the interplanetary magnetic field (IMF) Bz.

Data and their analysis

We focus on energetic electron flux enhancements during geospace magnetic storms that occurred between 2000 and 2006, a period that covers the main and declining phase of solar cycle 23. Each storm is defined by a storm maximum in the IMF Bz index, falling below -50 nT. All measurements were obtained from the THEMIS and DMSP satellites. Using the Statistical Asynchronous regression (SAR) method proposed by O’Brien et al. (2001) to determine the relationship between geospace magnetic storms and ULF waves with frequencies of a few mHz, we have obtained a measure of the wavelet power at Pc 4 and Pc 5 waves. This method has been used to estimate the time-frequency distributions of ULF waves with frequencies of a few mHz in the equatorial region and in situ energetic electron fluxes. The level of geomagnetic activity for each storm is defined as the minimum of the Dst index, the maximum mean wave amplitude (MWA) and the interplanetary magnetic field (IMF) Bz.

Discussion

During the five total magnetic storms that we have studied, enhancements in the wavelet power at Pc 4 and 5 waves, on the order of a few mHz, have been observed simultaneously at different magnetic latitudes and longitudes. These enhancements are shown in the lower panels, they were observed simultaneously in all stations of the IMAGE and CARISMA arrays. During the course of the five storms, enhancements in the wavelet power at Pc 4 and 5 waves were observed at the geomagnetic equator. These enhancements are shown in the lower panels. They were observed simultaneously in all stations of the IMAGE and CARISMA arrays.