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Ground observation of the modulation of electromagnetic ion cyclotron waves by short and long periodicities and associated particle loss in the Earth's inner magnetosphere

Amar Kakad*(1), Bharati Kakad(1), Yoshiharu Omura(2), Ashwini K. Sinha(1), Aditi Upadhyay(1), and Rahul Rawat(1)

(1) Indian Institute of Geomagnetism, New Panvel (West), Navi Mumbai, India.

(2) Research Institute for Sustainable Humanosphere, Kyoto University, Kyoto, Japan.

Electromagnetic ion cyclotron (EMIC) wave activity observed on the ground is occasionally structured in the time domain, showing either well developed wave packets consisting of rising tone frequency emissions or more chaotic bursts. We present the ground observation of the modulation of electromagnetic ion cyclotron (EMIC) emissions by short and long periodicities at Indian Antarctic station, Maitri. The signatures of these waves were evident in the magnetic field variations recorded by an induction coil magnetometer during the interval 4.7-7.2 UT on 17 September 2011, a moderately disturbed day. These waves preceded by a gradual increase in the solar wind dynamic pressure, which started at 3.88 UT. The discrete rising tone EMIC waves were observed in the Pc1 frequency band (0.5-0.9 Hz). The investigation of the periodicities of the observed wave spectrogram shows the presence of short (2.9-3.2 minute) and long (42-83 minute) periodicities. Our analysis shows that the short periodicities are associated with the Pc5 ULF waves generated by magnetic field line oscillations, while long periodicities are associated with the ring current drifting ions. We computed the sweep rates of the discrete EMIC rising tones in the observed EMIC band. For a given EMIC discrete emission, a sweep rate is defined as the rate of change of frequency in a given time interval. A new method, based on the cross-correlation technique is adopted to determine sweep rates of the discrete rising tones. The average sweep rates estimated in the range of 0.44-1.9 mHz/s are relatively low as compared to the past reports of sweep rates derived from the satellite observations of EMIC waves (tens-hundreds mHz/s), which is attributed to the propagational effect. We found that the sweep rate varies with time, and the higher sweep rates are associated with the stronger EMIC waves on the ground, which is in agreement with the theoretical studies. This suggests that the theoretically proposed dependence of sweep rate on strength of EMIC wave in the generation region is retained even during the propagation of these waves on the ground. To investigate the role of modulated EMIC emissions in particle precipitation, we examined the ground observations at Maitri in conjunction with the electron count observations from GOES-13 (74.8^{o}E) and GOES-15 (89.6^{o}E). It is observed that the electron count in the MeV range decreased during the period of EMIC wave activity. In view of the potential role of EMIC rising tone emissions in the loss of MeV electrons from the radiation belts, the ICM observations from the Indian Antarctic station Maitri are crucial for deciphering the inner magnetospheric dynamics.