R006-30
Zoom meeting B ：11/2 AM2 (10:45-12:30)
11:00〜11:15

地上-衛星観測によるIPDPタイプEMIC波動の周波数上昇に関するイベント解析

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The mechanism of frequency increase of IPDP type EMIC waves: event analysis of ground and satellite observations

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Electromagnetic ion cyclotron (EMIC) waves are Pc1-2 waves excited near the magnetic equator by anisotropic ring current ions. EMIC waves have been thought as one of the mechanisms to cause the loss of the electrons in the outer radiation belt. Intervals of pulsations of diminishing periods (IPDP) are one of the EMIC waves observed by ground-based magnetometers. Previous studies suggest that IPDP type EMIC waves are likely to cause electron precipitation more efficiently than other EMIC waves. IPDP events are characterized by an increase in frequency during the event of about half an hour to a few hours. They occur in the dusk sector during substorms. Injected ring current ions are the source of EMIC waves and play a major role in the increase in frequency of IPDP. Two mechanisms for frequency increase relate to drift of ring current ions; one is radial inward drift. Since the magnetic field becomes larger in lower L shell, the local ion gyrofrequency increases as the ring current ions drift inward. This results in generation of waves with rising frequency (Gendrin et al., 1967). The other is energy dispersion of ions in the course of westward drift. High-energy ions drift westward faster and arrive earlier at the meridian of a fixed ground site than low-energy ions. Since wave frequency depends on energy of resonant ions, energy dispersion causes an increase in frequency (Fukunishi, 1969). However, it is still not clear which mechanisms prefer to explain the frequency increase. In this study, we investigate IPDP type EMIC wave event to understand how frequency of IPDP increases. EMIC waves were observed by Van Allen Probe A and ground-based induction magnetometers in 02:30-06:05 UT on 19 April 2017. The event occurred in a substorm during main and early recovery phase of small geomagnetic storm. Van Allen Probe A observed EMIC waves in hot proton populations inside plasmapause in dusk sector. The footprint of Van Allen Probe A was located in North America during the wave activity. Simultaneously, IPDP type EMIC waves were observed at several induction magnetometer stations of the “Study of dynamical variation of Particles and Waves in the Inner magnetosphere using Ground-based network observations (PWING)” project and the Canadian Array for Realtime Investigations of Magnetic Activity (CARISMA). Energetic electron precipitation was detected by subionospheric VLF radio waves received at Athabasca, Canada and POES satellites. The VLF radio wave propagation paths were close to the footprint of Van Allen Probe A and ground-based magnetometers during EMIC wave activity. This suggests that detected electron precipitation was driven by EMIC waves. POES detected 13 electron precipitation events in North America and conjugated region in 0-6 UT. We found that the location of electron precipitation moved to lower L shell. The slope is -0.4 L/hour. Energetic charged particles scattered by EMIC waves precipitate along the magnetic field lines. The location of electron precipitation should reflect the source region of EMIC waves in the magnetic equatorial plane. The result suggests that source region of EMIC waves moved to lower L shell and this motion of the source corresponds to radial inward drift as the mechanism of an increase in frequency of IPDP. The westward drift velocities of the source region were calculated from EMIC waves observed at three stations separated longitudinally. We found that westward drift velocities are independent of the wave frequency. In case of the scenario of energy dispersion, higher-energy ions excite low frequency waves. As the energy of ions that excite EMIC waves decreases, wave frequency increases. If energy dispersion of ions contributes an increase in frequency of IPDP, westward drift velocities indicate different values in each frequency. The result suggests that westward drift of the source region did not cause an increase in frequency.