

## Properties of EMIC waves observed by Van Allen Probes and ground-based magnetometers during relativistic electron precipitation

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Electromagnetic ion cyclotron (EMIC) waves are observed as Pc1-2 pulsations in the Earth's magnetosphere. They are excited due to the temperature anisotropy of ring current ions, and scatter the pitch angle of relativistic electrons through cyclotron resonance. This process is considered as one of the mechanisms to cause the loss of the outer radiation belt. There still remain questions about the amount of the contribution from the EMIC waves to the overall loss of radiation belt electrons. In order to estimate quantitatively the electron loss from the outer radiation belt, we need to estimate the spatial extent and temporal evolution of the source region of EMIC waves. We investigated EMIC waves observed by Van Allen Probes and ground magnetometers in North America in 02:30-06:05UT on 19 April 2017. This 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 plasmopause. The footprint of Van Allen Probe A was located in North America during the wave activity observed by Van Allen probes. Simultaneously, Pc1 pulsations were observed at some stations of induction magnetometers from "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 waves propagate near 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. From satellite and ground-based magnetometer data, we estimated the local time extent of source region of ~6.8 hour and L shell extent of ~2.2. Pc1 pulsations started to be observed by east side stations on the ground. The time lag and difference of longitude between stations suggest that the source region of EMIC waves move westward and to low latitude.