あらせ衛星－地上連携観測で観測された孤立型サブストームの総合解析

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A comprehensive analysis of an isolated substorm observed during the first coordinated Arase and ground-based observations

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We present results of a comprehensive analysis of an isolated substorm observed at 4-6 UT on March 21, 2017, during the first campaign of Arase (ERG) satellite and ground-based coordinated observations. This is a rare case study of the coupling between the solar wind, magnetosphere, ionosphere, and mesosphere using the satellite and ground-based observational data during the substorm. The isolated substorm occurred around 4:00 UT associated with a southward Bz excursion during the arrival of a corotating interaction region (CIR) and diffuse/pulsating auroras were observed from 04:30 UT to the sunrise at Husafell (HUS; 65.5-degree MLAT and UT ˜MLT at HUS), Iceland. At the same time, cosmic noise absorption (CNA), which is caused by the energetic electron precipitation (E >several tens of keV), was detected with the riometers at HUS and its geomagnetic conjugate station, Syowa (SYO), Antarctica. In addition, polar mesosphere winter echoes (PMWEs) was simultaneously observed around 75 km altitude with the PANSY radar at SYO. Pc 1 magnetic pulsations were also observed by the world-wide induction magnetometer network before and after the substorm onset. The Arase satellite, which was located at the geomagnetic conjugate to HUS and SYO but near the magnetic equator in the magnetosphere, observed whistler-mode chorus waves at 04:45-06:45 UT in the frequency range of 0.3 - 3 kHz. The measurement was made coinciding with diffuse/pulsating auroras, CNA, and PMWEs.

We suggest a possible scenario for the sequence of the substorm, shown as follows. The substorm occurred during the arrival of the CIR and the energetic ions/electrons were injected into the inner magnetosphere, resulting in generation of the chorus waves on the morning side and the electromagnetic ion cyclotron (EMIC) waves mainly on the evening side, that are associated with Pc 1 pulsations on the ground. The energetic electrons were precipitated to the polar ionosphere in the morning sector by the pitch angle scattering due to the chorus wave - particle interaction then caused the diffuse/pulsating auroras and CNAs in the ionosphere and PMWEs in the mesosphere. In the presentation, we discuss whether this scenario can explain the observed data quantitatively.