

# **An isolated substorm and associated phenomena observed during the first coordinated Arase and ground-based observations**

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We investigated an isolated substorm observed during the first campaign of Arase (ERG) satellite and ground-based coordinated observations. This is a rare and valuable case study of the simultaneous conjugate observation of whistler-mode chorus waves in the magnetosphere, diffuse/pulsating auroras and cosmic noise absorption (CNA) in the ionosphere, and polar mesosphere winter echoes (PMWEs) in the mesosphere. The isolated substorm started around 04:00 UT on March 21, 2017 in association with a southward Bz excursion during the arrival of a corotating interaction region (CIR) and several phenomena related to the substorm were observed with various instruments on board the Arase satellite and on the ground at Husafell (HUS; 65.5-degree MLAT and UT ~ MLT at HUS), Iceland, and its geomagnetic conjugate station, Syowa (SYO), Antarctica. The diffuse and pulsating auroras were observed from 04:30 UT to the sunrise with an all-sky imager at HUS. CNA, which is generally generated in the ionospheric D region due to the energetic electron precipitation ( $E > \text{several tens of keV}$ ), was simultaneously detected with the riometers at both HUS and SYO. Pc 5 pulsations were also observed by the fluxgate magnetometer network at HUS and SYO. At the same time, polar mesosphere winter echoes (PMWEs) were observed around 75 km altitude with the PANSY radar at SYO. In the magnetosphere near the magnetic equator, the whistler-mode chorus waves were detected at 04:45-06:45 UT in the frequency range of 0.3 - 3 kHz at Arase. We discuss possible scenarios to quantitatively explain these phenomena observed during the substorm in terms of the coupling among solar wind, magnetosphere, ionosphere, and mesosphere.