On the simultaneity of substorm onset between two hemispheres

A. Morioka[1], Y. Miyoshi[2], F. Tsuchiya[1], H. Misawa[1], Y. Kasaba[3], T. Asozu[1, 4], S. Okano[1], A. Kadokura[5], N. Sato[5], H. Miyaoka[5], and K. Yumoto[6]

[1]*Planetary Plasma and Atmospheric Research Center, Tohoku University, Sendai, Japan*
[2]*Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan*
[3]*Geophysical Institute , Tohoku University, Sendai, Japan*
[4]*Japan Atomic Energy Agency, Ibaraki, Japan*
[5]*National Institute of Polar Research, Tokyo, Japan*
[6]*Space Environment Research Center, Kyushu University, Fukuoka, Japan*

Simultaneous observations of auroral kilometric radiation (AKR) from the northern and southern hemispheres showed some cases in which the build-up of field-aligned acceleration occurred only in one hemisphere at the substorm onset (Figure 1). This indicates that a substorm does not always complete the current system by connecting the cross-tail current with both northern and southern ionospheric currents. Conjugate auroral observations showed that in one case, the auroral breakup in the northern and southern hemispheres was not simultaneous; rather, they occurred a few minutes apart. This time difference in the breakup between two hemispheres suggests that the local auroral ionosphere controls auroral breakup in each hemisphere independently. The evidence in this study may indicate that the build-up of the field-aligned acceleration region at the auroral breakup does not result only from the magnetospheric process and that the auroral ionosphere finally controls and/or ignites the substorm onset, i.e., the auroral breakup.

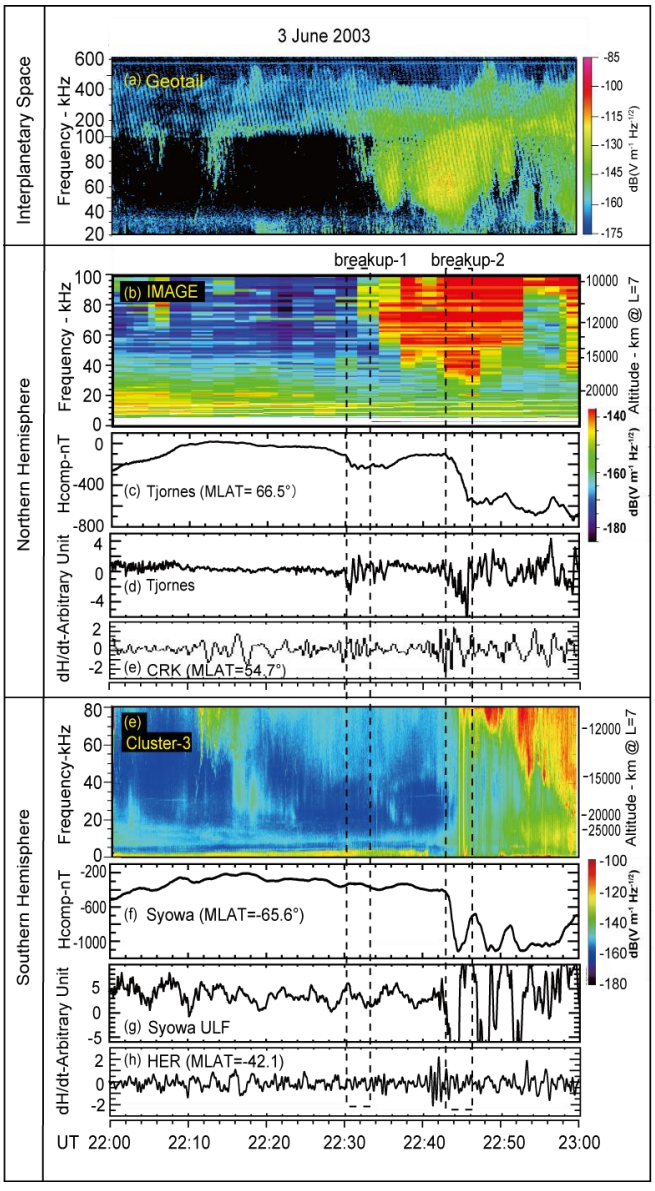

Figure4.. One-sided substorm in the northern hemisphere (vertical dashed rectangle labeled “breakup-1”) and interhemispheric substorms (vertical dashed rectangle labeled “breakup-2”) on 3 June 2003. (a): spectrogram from Geotail. (b): spectrogram from IMAGE in the northern hemisphere. Spectra above 30 kHz are AKR. The right ordinate shows the source altitude of AKR along the L=7 field line. (c): H-component magnetic field at Tjornes (d): geomagnetic pulsation at Tjornes. (e): northern mid-latitude geomagnetic pulsation at CRK. (f): spectrogram from Cluster-3 in the southern hemisphere. (g): H-component magnetic field at Syowa (h) geomagnetic pulsation at Syowa. (i): southern mid-latitude geomagnetic pulsation at HER.