A statistical study of the near-Earth magnetotail evolution duing substorms and pseudosubstorms with themis data

*Kento Fukui[1], Shinobu Machida[1], Yukinaga Miyashita[1], Akimasa Ieda[1], Yoshizumi Miyoshi[1], Angelopoulos Vassilis[2]

1. Institute for Space-Earth Environmental Research. Nagoya university, 2. University of California, Los Angeles

Substorms and pseudosubstorms (pseudobreakups) are very similar phenomena. In terms of auroral morphology, pseudosubstorms are generally more localized and more short-lived, compared with substorms, and are not accompanied by poleward expansion. We examined auroral development for events from November 2007 through April 2010, using data from THEMIS all-sky imagers. We defined events accompanied and not accompanied by poleward expansion as substorms and pseudosubstorms, respectively. To understand the cause of auroral development, we investigated temporal and spatial development of the near-Earth magnetotail during substorms and pseudosubstorms, based on superposed epoch analysis of THEMIS data. We find that Vx begins to increase at -9.5 >X(GSM)>-11.5 Re around onset for both substorms and pseudosubstorms. This seems to be due to earthward flows caused by magnetic reconnection. Bz also increase around onset at -9.5 >X>-11.5 Re both substorms and pseudosubstorms. The amount and rate of Bz change are larger for substorms than for pseudosubstorms. In the earthward (-7.5 >X>-9.5 Re) and tailward (-11.5 >X>-15.5 Re) regions, Bz increases substantially for substorms, whereas it does not increase very much for pseudosubstorms. These results indicate that dipolarization is weaker for pseudosubstorms than for substorms, and the dipolarization region does not spread extensively for pseudosubstorms. In addition, Brms begins to increase at -6.5>X>-11.5 Re around onset both substorms and pseudosubstorms. The amount of Brms change is larger for substorms than for pseudosubstorms, indicating that waves are strongly induced for substorms. These waves are considered to be caused by instability, and the instability takes place in more for substorms and not in pseudosubstorms. We, therefore, suggest that the occurrence of the instability develops tailward to form the current disruption region and causes auroral poleward expansion. Meanwhile, the plasma and magnetic pressures increase at -6.5 >X>-7.5 Re after onset in association with dipolarization, particularly for substorms. The total pressure (the sum of the plasma and magnetic pressures) prior to the onset is larger in that region for substorms than for pseudosubstorms. At -7.5 >X>-9.5 Re the total pressure hardly differ between substorms and pseudosubstorms. Thus we conclude that the spatial gradient of the total pressure is a key that determines whether the current disruption take place, that is, whether initial activation develops into a substorm or into a subsiding pseudosubstorm.

Keywords: substorm