Differences in Near-Earth Magnetotail Evolution Between Pseudosubstorms and Substorms

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Pseudosubstorms (pseudobreakups) are similar to substorms during the early stage of auroral development but differ in the later stage. That is, pseudosubstorms are not accompanied by poleward expansion, while substorms are. To understand what causes this difference, we statistically studied temporal and spatial development of the near-Earth magnetotail at X=-7 to -11 Re around pseudosubstorm and substorm onsets, based on THEMIS data. We find that near-Earth reconnection occurs before onset for both pseudosubstorms and substorms, but the earthward flow generated by reconnection is slower for pseudosubstorms than for substorms. Dipolarization, together with magnetic field fluctuations, occurs at X=-8 Re for both cases, but it is weaker at other distances for pseudosubstorms than for substorms. This result suggests that the current disruption related to dipolarization does not expand tailward and hence auroral poleward expansion does not occur for pseudosubstorms. Furthermore, the total pressure is larger at X=-8 to -11 Re for several minutes before onset for substorms than for pseudosubstorms. The total pressure gradient increases more largely after onset for substorms than for pseudosubstorms. We suggest that these differences are important factors for determining whether ballooning instability causing current disruption grows in a wide area, that is, whether the initial action develops into a substorm or subsides as a pseudosubstorm.

Keywords: substorm, pseudosubstorm, pseudobreakup, magnetotail, ballooning instability, THEMIS

