Evolution of the near-Earth magnetotail associated with substorm expansion onsets

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We have statistically studied substorm-associated evolution of the magnetotail to understand the triggering mechanism of the substorm expansion onset. In the present study we used ion and magnetic field data from Geotail and magnetic field data from Polar and GOES to cover not only the near-Earth magnetotail but also the inner magnetosphere. Approximately 6000 substorm events were determined from auroral breakups observed by the Polar UVI and IMAGE FUV auroral imagers. Just before onset, the total pressure starts to decrease first in the premidnight tail at X~-18 Re; electric and magnetic field fluctuations also seem to occur there. This location corresponds to the tailward edge of the region of strong magnetic field line stretching, which extends from X~-8 Re. At expansion onset, the plasmoid starts to substantially evolve at X<-20 Re; it is simultaneous with the beginning of the dipolarization at X~-8 to -9 Re. The dipolarization region then expands tailward as well as in the dawn-dusk direction and earthward. These observations suggest that the magnetic reconnection occurs first in the premidnight tail, on average, at X~-18 Re just before expansion onset to trigger the onset processes.