PLASMA SHEET PRESSURE EVOLUTION RELATED TO SUBSTORMS

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We have investigated the inner equatorial plasma sheet plasma pressure evolution associated with substorm onsets using the five THEMIS spacecraft data during the 2008 and 2009 tail seasons. The central plasma sheet thermal pressure is estimated from the thermal and magnetic pressure based on pressure balance. The results show that for a majority of substorm events, the plasma pressure enhances after onset earthward of ~12 R_E radial distance, and remarkably decreases beyond ~14 R_E near onset. During the recovery phase, the pressure gradually returns to its original level. These results indicate that during the substorm expansion phase, the current wedge usually expands tailward of ~14 R_E, and has an inner edge earthward of this radial distance. The pressure increase earthward of ~12 R_E could be associated with an increase of cross-tail current, though this is not necessarily so due to the non-tail-like magnetic field geometry after dipolarization. For a minority of events, the pressure fluctuates without net change or reduces at ~11 R_E. During these events, the ground magnetic perturbations and the estimated center of the westward electrojet extend further equatorward than for the pressure increase cases. There is also evidence that aurora breakup occurs further equatorward when there is a pressure reduction, indicating a more earthward penetration of the plasma sheet. During these cases, the current wedge represented by pressure reduction is clearly observed earthward to ~11 R_E. The relationship between the auroral break up arc, which is believed to map to ~10 R_E, and may be associated with a precursor pressure enhancement, and the inner plasma sheet pressure and current evolution near onset warrants more careful analysis.

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