Substorm currents observed by GEOTAIL

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Three examples of magnetic-field dipolarization events observed by GEOTAIL in the near-Earth magnetotail, R = 10 - 18 Re, are studied. Ground magnetograms indicate that the expansion onsets of substorms occurred around the dipolarization onsets at GEOTAIL. Not steplike but transitory negative perturbations in the By component are observed just after the boundary crossings of the spacecraft from the tail lobe to the plasma sheet. This implies the existence of a pair of earthward and tailward field-aligned sheet currents with the earthward current on the poleward side. Assuming the earthward electric field in the equatorial tail region, a new Cowling channel model is proposed, which consists of a double-sheet current system accompanied with the substorm wedge current system.

Three examples of magnetic-field dipolarization events observed by the GEOTAIL spacecraft in the near-Earth magnetotail, R = 10 - 18 Re, are studied. GEOTAIL was located in the premidnight, midnight, or postmidnight sectors in the southern hemisphere during each of the three events. Ground magnetograms indicate that the expansion onsets of substorms occurred around the dipolarization onsets at GEOTAIL. Not steplike but transitory negative perturbations in the By component are observed just after the boundary crossings of the spacecraft from the tail lobe (or the plasma sheet boundary layer) to the plasma sheet. This implies the existence of a pair of earthward and tailward field-aligned sheet currents with the earthward current on the poleward side. This current configuration is consistent with what previous observations have shown; namely the "double sheet current," in the vicinity of geosynchronous orbit. Examining ground-based magnetograms, it is found that the positions of GEOTAIL at the time of these events are mapped down to the west to the demarcation meridian between positive and negative perturbations in the D component. Assuming the earthward electric field in the equatorial region of the mid-magnetotail, a new Cowling channel model is proposed, which consists of a double-sheet current system accompanied with the substorm wedge current system. The model can account for various types of earlier observations about field-aligned currents during substorms both on the ground and in space.