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MMS observations of small-scale field-aligned currents in the plasma sheet boundary layer during storm-time substorms

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During major substorms at 0315 and 0505 UT on June 23 2015, the four MMS spacecraft, located near the center of the current wedge, enabled us to resolve detailed properties of the field-aligned currents in the plasma sheet boundary layer during its thinning and expansion. In particular, during the expansion of the plasma sheet, transient small-scale field-aligned currents were detected near the large-scale separatrix region. In this study we analyze their temporal and spatial evolution based on multi-point measurements of fields and plasma. We found ion-scale downward field-aligned currents, which are well correlated with the field-aligned upward electron beams. These upward electrons are most likely accelerated between the ionosphere and the spacecraft, and are associated with the intensified reconnection jets that cause the expansion of the plasma sheet.