Development of auroral acceleration regions at substorm onsets

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The vertical structure and its dynamics of the AKR source region prior to and during a substorm were investigated using the Polar/PWI data. Dual AKR sources at substorm onset were identified: a low-altitude one and a high-altitude one. The low-altitude source appears in the substorm growth phase at 4000 to 5000 km, and its intensity increases a few minutes prior to substorm onset. The high-altitude source abruptly appears at substorm onset in the altitude range of 6000 to 12,000 km with a remarkably fast growth rate. These AKR features at substorms were discussed in relation to the development of the auroral acceleration region. It was suggested that the low-altitude AKR source is related to the large-scale inverted-V acceleration region that would be generated through the self-consistent distribution of the magnetospheric plasma in the M-I coupling region. The high-altitude AKR source which is an indicator of a substorm onset would be generated from the local field-aligned acceleration due to the current-driven instability or the Alfvenic acceleration caused by substorm-associated short wavelength Alfven waves.