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FAST/THEMIS observations of the westward traveling surge field-aligned currents and their relationship to the substorm current wedge

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A substorm was observed on March 23, 2007 by the THEMIS spacecraft. Shortly after substorm onset the FAST spacecraft passed through the post-dusk auroral zone (~ 20 MLT). At this time the THEMIS spacecraft were around 21 MLT, and slightly below the ecliptic plane. As FAST passed through the auroral zone it also passed near the northern hemisphere footpoint of the THEMIS spacecraft. THEMIS and FAST both observed signatures of the Westward Traveling Surge (WTS). At THEMIS the WTS was associated with both a dipolarization of the magnetic field and the passage of pair of field-aligned currents (FACs) past the spacecraft. At FAST a pair of FACs bracketing a strong westward flow channel was observed. Global magnetohydrodynamic (MHD) simulations support the inference that the FACs are related to the WTS. Furthermore, the FAST data indicate that while most of the field-aligned current closes locally, with the Pedersen closure current providing the Lorentz force to push ionospheric plasma westward through the neutral atmosphere, the currents are not exactly balanced. The net current is upwards, consistent with the westward portion of the substorm current wedge. Thus the combination of high altitude (THEMIS) observations, low altitude (FAST) observations and the global MHD model provides a powerful tool to deconvolve temporal and spatial structure, and also relate meso-scale

structures such as the WTS FACs to the larger-scale substorm current wedge.