



Substorm current wedge driven by plasma flow vortices: THEMIS observations

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A multipoint analysis of magnetospheric plasma flow vortices and conjugate ionospheric flow vortices during the formation of the substorm current wedge (SCW) is presented. During the substorm, the THEMIS spacecraft were engulfed by a clockwise flow vortex and a counterclockwise flow vortex, corresponding to a downward and an upward field-aligned current (FAC), respectively. Using the THEMIS ground network of magnetometers, a pair of flow vortices with opposite rotational sense simultaneously appeared in the ionosphere as inferred from equivalent ionospheric currents (EICs). We demonstrate that the space vortices generated the field-aligned current of the SCW at the beginning of the substorm expansion phase and coupled to the ionosphere causing the ionospheric flow vortices. In addition to physical properties such as radius, velocity and current density of the forming flow vortices, we show model calculations of the FACs associated with the SCW based on midlatitude ground magnetometer data.