A Study of the Fine Structure of Polar Field-Aligned Currents: Early Results From the Newmag Experiment Onboard Fedsat

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Abstract.

High precision vector magnetic field measurements using the Newmag magnetometer onboard the Australian research micro satellite Fedsat, are being used to investigate the fine structure of polar field-aligned currents (FAC) including cusp currents, polar cap and substorm current systems during both geomagnetically quiet and storm-time conditions. Being in a polar Low-Earth Orbit (LEO), and with a burst mode sample rate of 100 vector samples/second Fedsat is capable of identifying spatial structures within FAC regions with scale sizes down to 75 m, and is thus ideally placed to investigate FAC fine structure. In addition to Fedsat magnetometer data, Ørsted magnetic field measurements (also with a burst sampling rate of 100Hz) at times of conjunction between the two satellites are being used to resolve the ambiguity that arises in single-satellite magnetic field measurements when attempting to distinguish between spatial and temporal variations. This research aims to address a number of outstanding questions:

(1) Are the rapid variations observed in single satellite magnetometer data spatial or temporal variations, and how can we distinguish between the two.
(2) What is the distribution of FAC intensity as a function of spatial scale.
(3) What determines where and when extremely thin and intense current structures occur, and how are they affected by geomagnetic storms.
(4) Finally, the outcomes of this research are also of practical importance, quantifying the effect of intense localised current systems on Low Earth Orbiting satellites such as Fedsat.

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