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Electrojet estimates from mesospheric magnetic field measurements

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The auroral electrojet is traditionally measured remotely with magnetometers on ground or in low Earth orbit (LEO). The sparse spatial coverage of measurements, combined with a vertical distance (~100 km to ground and typically >300 km to LEO satellites) means that smaller scale sizes cannot be detected. Because of this, our understanding of the spatiotemporal characteristics of the electrojet is incomplete. Recent advances in measurement technology allow us to overcome these limitations by multi-point remote detections of the magnetic field in the mesosphere, very close to the electrojet. We present a theoretical prediction of the magnitude of these disturbances, inferred from the spatiotemporal characteristics of magnetic field-aligned currents. We further discuss how the Electrojet Zeeman Imaging Explorer (EZIE) satellites that will carry Zeeman magnetic field sensors will be used to essentially image the equivalent current at unprecedented spatial resolution. The electrojet imaging is demonstrated by combining carefully simulated measurements with a spherical elementary current representation using a novel inversion scheme. This new capability will allow us to finally resolve long-standing controversies such as – what is the substorm current wedge configuration?