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## Geomagnetically induced currents in Alberta, Canada during the May 10-12, 2024 Gannon storm

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Severe geomagnetic disturbances (GMDs) caused by intense solar storms can induce geomagnetically induced currents (GICs) in the Earth and within long conductive infrastructure, possibly posing significant risks to electricity transmission systems. Though no outages or damages were documented, transformer neutral-toground current measurements, provided by AltaLink L.P., recorded GICs exceeding 150 A through three transformer neutrals during the geomagnetic storm on May 10-13th, 2024. We investigate the solar wind conditions and magnetospheric processes responsible for the two most significant GIC events observed in Alberta during the storm, focusing on the period from 08:00 to 11:00 UT on May 11, 2024. The first GIC event, around 8:50 UT, reached a maximum amplitude of ~20 A measured on the transformer neutral at a substation in southern Alberta and was driven by substorm-related activity with an onset at mid latitudes. The second GIC event at approximately 9:40 UT resulted from magnetospheric compression triggered by a rapid increase in solar wind density, leading to a stronger global response and a peak GIC amplitude of ~165 A in central Alberta. A high-fidelity DC-equivalent network model, data-driven by the observed GMD, estimated a maximum GIC of approximately 150 A at a transformer substation in central Alberta west of Edmonton around 9:40 UT with the total peak lasting ~12 minutes. The correlation between observed GICs and those from the model was 0.84. Additionally, GIC estimates derived from the differential magnetometer measurement technique indicated a short-lived peak of ~100 A in central Alberta at 11:00 UT, which was not captured in transformer neutral-toground measurements. This difference between GIC measured on the transformer neutral and in the power line is presumably due to the slower inertial timescale of induced currents in the network and highlights the complexity of the power network itself. Here, observations along the space weather chain highlight key storm features of varying temporal and spatial scales relevant to GICs during the May 2024 geomagnetic storm. Further, the complexity of the electric power grid response is underscored by comparison of GIC on different network elements.

## Keyword-1

GeomagneticallyinducedCurrents

## Keyword-2

May 2024 geomagnetic storm

## Keyword-3

space weather impacts

Author: PARRY, Hannah (University of Alberta)

**Co-authors:** CORDELL, Darcy (University of Alberta); MANN, Ian (University of Alberta); MACMULLIN, Ryan (AltaLink L.P.); BABU, Sneha (University of Alberta)

**Presenter:** PARRY, Hannah (University of Alberta)

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