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Poster
In the United States, Geomagnetically induced current (GIC) measurements have historically been limited. Following a 2014 directive from the Federal Energy Regulatory Commission (FERC) to address geomagnetic disturbance risks to the power grid, the North American Electric Reliability Corporation (NERC) established a publicly accessible GIC monitoring database providing operational measurements during space weather events. Using this dataset, we analyze 29 geomagnetic storms from 2015–2024 recorded at a mid-latitude NERC station in Virginia, USA. Because the operational data are of mixed quality, quality-assessment algorithms were developed to identify research-grade intervals. This study presents the first climatological survey of two GIC waveform types: Large-Amplitude Short-Duration (LASD) and Moderate-Amplitude Long-Duration (MALD) disturbances. These patterns are important for grid resilience because impulsive GIC spikes (LASD disturbances) can cause voltage instability and thermal hotspots, while sustained currents (MALD disturbances) may lead to transformer core saturation and overheating. Waveforms are quantified using frequency-band integrated wavelet power derived from the continuous wavelet transform. Three bands are analyzed—Pi2 (<150 s), Pc5 (<10 min), and Ps6 (>10 min)—to examine associations with magnetospheric drivers. Results show that GIC spikes and long-duration disturbances exhibit distinct local-time and storm-phase preferences, consistent with ultra-low-frequency statistical studies from magnetometers and inner-magnetosphere observations. Understanding when and where different GIC waveforms occur near a region hosting critical national infrastructure and the world’s largest concentration of data centers is important and timely. These results are directly relevant for power-system operators and space weather forecasters.
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