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Investigating the spatial scales of GIC-driving geomagnetic disturbances (GMD) with the BEAR and CARISMA arrays

Stavros Dimitrakoudis, David K. Milling, Ian R. Mann, Leonid Olifer, and Andy Kale
University of Alberta, Faculty of Science, Department of Physics, Edmonton, Canada (dimitrak@ualberta.ca)

Magnetic field changes in the coupled magnetosphere-ionosphere-ground system can induce electric fields that drive geomagnetically-induced currents (GIC) in terrestrial electric power grids and other conductive infrastructure. Since ground dB/dt can be used as a GIC proxy, arrays of ground magnetometers can therefore be used to study their temporal and spatial evolution and to examine both the spatio-temporal scales of the disturbances and their connection to drivers in geospace. Here we study the spatial scales of large dB/dt events using data from two complementary magnetometer arrays: The temporarily deployed very dense Baltic Electromagnetic Array Research (BEAR) Project in Scandinavia and the continent scale permanently deployed Canadian Array for Realtime Investigations of Magnetic Activity (CARISMA) array in North America. We analyse a number of nightside substorms, revealing a large amplitude but small $\sim$ 100 km scale geomagnetic disturbances (GMD) which may pose a GIC risk. We further identify and analyse large dB/dt events on the flanks, a local time region which has so far been neglected as a region of GIC risk, and propose that the drivers of these flank GMD are connected to magnetopause and/or large scale auroral disturbances such as omega-bands especially in the dawn sector. Analysis of the spatio-temporal characteristics specifically allows a determination of the optimal distance between magnetometers, in latitude and longitude, for future instrument deployments targeting the monitoring of GMD associated with large GIC impacts in the electric power grid.