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The regional variability of dB/dt as a function of ICME parameters and solar wind conditions and their relevance to GICs

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Geomagnetically Induced Currents (GICs) that flow in large ground conducting infrastructures (e.g. power lines, telecommunication lines, pipelines) are an end link of the extensive space weather chain, and are the culmination of multiple coupled domains and nonlinear processes. GICs are created by a geoelectric field resulting from temporal variations in the geomagnetic field (dB/dt), and the conductive properties of the ground. As a result, the geoelectric field can experience large regional variability (few hundred km) due to localised spatiotemporal ionospheric current sources and/or local complex geological features. However, the relevant magnetosphere-ionosphere coupling processes and key external driving conditions leading to large regional variability of the geoelectric field are not completely understood.

We statistically investigate the regional variability of dB/dt during different Interplanetary Coronal Mass Ejections (ICMEs) and as a function of upstream solar wind criteria. The variability is assessed using the IMAGE magnetometer array in regions where the radial distance between stations is of the order of 100-200km. To compliment the statistical results, we also study the geomagnetic activity resulting from two ICME events which have contrasting physical properties resulting in contrasting geomagnetic activity. The observations are also compared with runs from global magnetospheric models to assess the model performance and capability for these events. We also investigate the importance of capturing localised dB/dt features by comparing the geoelectric field derived using a 3D ground conductivity model excited by ionospheric equivalent currents, and a 1D model during intervals when we observed high regional variability.