New long-period magnetotelluric measurements to improve ground electric field modelling in the UK during geomagnetic storms

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SUMMARY

To assess the hazard posed by space weather events to grounded technological infrastructure, such as Geomagnetically Induced Currents (GICs) in the UK and Irish power transmission networks, a key component is to accurately model how the ground electric field varies during geomagnetic storms. A model of electrical conductivity of the subsurface based on magnetotelluric data can be used for this purpose. For the UK-funded SWIMMR-SAGE (N4) project, we are currently planning to collect long-period MT data at more than 45 sites across England, Southern Scotland and Wales with ∼50 km grid spacing over two years between 2021 and 2023. Measurements of up to six weeks at each site are made using a rolling deployment of five LEMI-417 systems.

The measured magnetotelluric impedances provide a reliable method to compute the ground electric fields necessary for the elucidation of GIC estimates in the high voltage power grid model of Britain. Geoelectric fields can also be used to infer risk to pipelines and rail line infrastructure. Results from some of the 30 sites collected so far are presented, including magnetotelluric impedances, ground electric field data measured during large space weather events between May 2021 and June 2022, and improvements to the modelled geoelectric field at sites across the UK. Future work in the SWIMMR-SAGE project includes using the improved model of electrical conductivity of the subsurface and modelled geoelectric fields to provide nowcast and forecasts of the space weather impacts on ground-level infrastructure in Britain.

Keywords: Magnetotellurics, Space Weather