Predicting Geomagnetically Induced Currents using Machine Learning

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Abstract

Prediction of ground magnetic fluctuations is a first step towards risk assessment and forecasting of geomagnetically induced currents (GICs), which can pose a substantial risk to power lines and other conductors mostly at high and mid-latitudes. Direct GIC measurements are rarely available or heavily restricted, and when available, they tend to be very limited in their spatial coverage. The MAGICIAN (Machine Learning Algorithms for Geomagnetically Induced Currents in Alaska and New Hampshire) team has developed over the past years a series of machine-learning based models to predict the occurrence of strong geomagnetic fluctuations using mostly solar wind data as input, as the continuous measurements of solar wind parameters by monitors located at the L1 point provide a near-real time data stream that anticipates the arrival of the solar wind by approximately 20-40 minutes to the Earth, making it ideal for early warning tools. In this work, using different deep learning techniques we show our results in predicting near-real time ground magnetic fluctuations 30 minutes into the future for different magnetometer stations located between 40-60° magnetic latitude. We will discuss our choices regarding the selection of parameters to use when forecasting as well as the model tuning, when using measurements provided by the SuperMag initiative to compare against. Additionally, we will discuss the merits of using additional data from ground or low altitude observatories to improve our current predictions and our recent advances in finding metrics and evaluation tools that are appropriate in the context of GICs.