Forecasting hazardous geomagnetically induced currents for Spanish critical infrastructures

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In the last decades, our society has become more interdependent and complex than ever before. Local impacts can cause global issues, as the current pandemic clearly shows, affecting the health of millions of human beings. It is also highly dependent on relevant technological structures, such as communications, transport, or power distribution networks, which can be very vulnerable to the effects of Space Weather. The latter has its origin in solar activity and their associated events, such as solar flares and coronal mass ejections, which may provoke disturbances, interruptions, and even long-term damage to these technical infrastructures, with drastic social, economic and even politic impacts. However, these phenomena and their effects are not yet well understood, and their forecast is still in the early stages of development.

This training project, that uses a multidisciplinary approach, aims to understand and forecast, in an unprecedented way in our country, the effects of Space Weather on the Earth's surface, and particularly the geomagnetically induced currents (GICs) that flow in long earthed conductors like communications, transport, or power transmission networks. The ultimate goal is to provide a real-time prediction of the GICs from extreme geomagnetic storms on the Spanish critical infrastructures. To achieve this, we use real-time warnings of solar storms from the ACE space probe at the L1 point in space, which leads to disruptions on Earth some 30-45 minutes later. Using deep learning and mathematical models, we study how data from ACE would translate into changes on the induced underground currents and their effects on the power grid. We will specialise on the modelling of the Iberian Peninsula, providing an early warning system.