MAG-GIC: Geomagnetically Induced Currents risk hazard in the Portuguese power network

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The MAG-GIC project has as a main goal to produce the chart of Geomagnetically Induced Currents (GIC) risk hazard in the distribution power network of Portugal mainland.

The study of GICs is important as they represent a threat for infrastructures such as power grids, pipelines, telecommunication cables, and railway systems. A deeper insight into GICs hazard may help in planning and designing more resilient transmission systems and help with criteria for equipment selection.

GICs are a result of variations in the ionospheric and magnetospheric electric currents, that cause changes in the Earth's magnetic field. The Coimbra magnetic observatory (COI) is one of the oldest observatories in operation in the world and the only one in Portugal mainland. It has been (almost) continuously monitoring the geomagnetic field variations since 1866, and in particular, it has registered the imprint of geomagnetic storms during solar cycle 24. Besides the geomagnetic storm signal, which represents the GICs driver, the crust and upper mantle electrical conductivities determine the amplitude and geometry of the induced electric fields.

To present a better approximation of the Earth's conductivity structure below the Portuguese power network, we initiated a campaign to acquire magnetotelluric (MT) data in a grid of 50x50 km all over the territory. Nonetheless, there already exist enough MT data to create a realistic 3D conductivity model in the south of Portugal.

The other important input is the electric circuit for the network grid. We benefit from the collaboration of the Portuguese high voltage power network (REN) company, in providing the grid parameters as resistances and transformer locations, thus allowing us to construct a more precise model. In particular, we implement in our model the effect of shield wires and shunt reactors resistances.

In this study, we present the results of GIC calculations for the south of Portugal for some of the strongest geomagnetic storms in the 20015-17 period recorded at COI during solar cycle 24. We will focus on the sensitivity of results concerning two different conductivity models and different
values of the shielding circuit parameters and shunt reactors devices.