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# Towards an improved proxy for geomagnetically induced currents (GICs)

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The irregular variation of geomagnetic activity caused by the solar wind interaction with the magnetosphere/ionosphere (space weather) occurs in wide temporal and amplitude ranges. Major geomagnetic storms can induce geoelectric fields in the Earth conducting layers (through the lithosphere and down to the mantle), which may, in turn, be responsible for generating geomagnetically induced currents (GICs). The vulnerability of grounded conducting infrastructures, particularly electrical power transmission systems, to GICs, makes it important to understand the relation between the varying geomagnetic field components and the generated GICs, as well as the role of the local conductivity, i.e., geology, on the inducing process. Looking for proxies that better translate this relation is an open matter of debate.

In this work, we present a comprehensive study of several possible candidates for GIC proxies. We use geomagnetic time series from the Portuguese mid-latitude Coimbra observatory (COI) to calculate geomagnetic indices considering different periods (whole-storm duration, 3-h, 1-h and 1-min), with different focuses on the field components or their derivatives, and discuss their advantages and limitations. We compare the computed indices with both GIC simulations of the Portuguese mainland high voltage power network (150, 220 and 400 kV) (Alves Ribeiro et al., 2021), and observations from a Hall effect sensor based system installed at a power transformer located in the vicinity of Coimbra.
We then propose a better GIC proxy, an index obtained from geomagnetic field components filtered by convolution with a uniform conductivity Earth model filter (EGIC index), based on previous work by Marshall et al (2010,2011). We search for empirical parameters that may contain information on local conductivity effects and power network geometry.

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