**The Directional Statistics of Extreme Geomagnetic Field Variations**

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**Abstract**

Understanding the statistics of large and rapid changes in the horizontal component of the geomagnetic field (dB/dt) is important in modelling the probabilities of geomagnetically induced currents (GIC) in ground infrastructure. In a study of |dB/dt| measured at 125 magnetometers worldwide over several decades, extreme value theory (Coles 2001) was used to predict the magnitudes of such events for return periods up to 200 years. These were modelled as a function of geomagnetic latitude, magnetic local time, season, solar activity, and the orientation of the interplanetary magnetic field. Patterns of occurrence relate closely to the known statistics of ionospheric and magnetospheric current systems associated with Sudden Commencements, Pc5 ULF waves, and auroral substorm onsets.

Directionality is an important consideration when assessing the risk of GICs affecting long cables and networks. We have therefore examined the directional statistics of the field fluctuations, drawing on methods developed for other environmental datasets (extreme sea currents, wind speeds, etc.) The modal directions of dB/dt are associated with the principal current systems driving the field fluctuations and also depend on the time-scale (dt) of the fluctuation.

**Reference**:

S. Coles, An introduction to Statistical Modeling of Extreme Values, Springer-Verlag London ltd, 2001.