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Geomagnetically induced currents in Brazil over the solar cycles 23 and 24

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Geomagnetically induced currents (GIC) are a space weather effect, which affects ground-based technological structures at all latitudes on the Earth's surface. GIC occurrence and amplitudes have been monitored in power grids located at high and middle latitudes since 1970s and 1980s, respectively. This monitoring provides information about the GIC intensity and the frequency of occurrence during geomagnetic storms. In this work, we investigate GIC occurrence in a power network at central Brazilian region during the solar cycles 23 and 24. Calculated and measured GIC data, and are compared for the most intense and moderate geomagnetic storms (i.e., -150 < Dst < -50 nT) of the solar cycle 24. The results obtained from this comparison show a good agreement. The success of the model employed for the calculation of GIC led to the possibility to determine GIC for events during the solar cycle 23 as well. Calculated GIC reached ca. 30 A during the "Halloween storm" in 2003 whilst most frequent intensities lie below 10 A. The normalized inverse cumulative frequency for GIC data was calculated for the solar cycle 23 in order to perform a statistical analysis. It was found that a q-exponential Tsallis distribution fits the calculated GIC frequency distribution for more than 99% of the data. This analysis provides an overview of the long term GIC monitoring at low latitudes and suggests new insight into critical phenomena involved in the GIC generation.

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An econometric investigation of the sunspot number record since the year 1700 and its prediction into the 22nd century

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Solar activity, as measured by the yearly revisited time series of sunspot numbers (SSN) for the period 1700-2014 (Clette et al., 2014), undergoes a triple statistical and econometric checkup in this paper. The conclusions are that the SSN sequence: (1) is best modeled as a signal that features nonlinearity in mean and variance, long memory, mean reversion, 'threshold' symmetry, and stationarity; (2) is best described as a discrete damped harmonic oscillator which linearly approximates the flux-transport dynamo model; (3) its prediction well into the 22nd century testifies of a substantial fall of the SSN centered around the year 2030. In addition, the first and last Gleissberg cycles show almost the same peak number and height during the period considered, yet the former slightly prevails when measured by means of the estimated smoother. All of these conclusions are achieved by making use of modern tools developed in the field of financial econometrics and of two new proposed procedures for signal smoothing and prediction.

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