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Study about geomagnetic variations from data recorded at Surlari Geomagnetic Observatory

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This paper presents statistical and spectral analysis of data from Surlari Geomagnetic Observatory that contributing to study of geomagnetic variations.
Thus were highlighted, for long series of records over several solar cycles, periodicities of 22 years and 11 years. Following the same procedures for medium recording series (multi-annual) have highlighted annual, seasonal and monthly periodicities. For shorter data series, we highlighted diurnal, semidiurnal, 8 hours and even lower periodicities. For very short series with a high sample rate and for few magnetotellurics records, we highlight different types of pulsations (Pc2 - Pc5 and Pi 2).
Geomagnetic signals are the convolution product of the atomic stationary signals mono-frequential of different amplitudes associated to phenomena with a very broad band of periodicities and nondeterministic signals associated with geomagnetic disturbances and non-periodic phenomena.
Among analysis processes used for discrete series of geomagnetic data with different lengths and sampling rates, can conclude the following:
Moving average works as a low pass filter in frequency or high pass in time. By eliminating high frequency components (depending on mobile window size used) can be studied preferential periodicities greater than a given value.
Signal linearization (using least squares) provides information on linear trend of the entire series analyzed. Thus, for the very long data series (several decades) we extracted the secular variation slope for each geomagnetic component, separately.
The numeric derivative of signal versus time proved to be a very reliable indicator for geomagnetic disturbed periods. Thus, the derivative value may be increased by several orders of magnitude during periods of agitation in comparisons to calm periods.
The correlation factor shows significant increases when between two time series a causal relationship exists. Variation of the correlation factor, calculated for a mobile window containing k pairs of values (xi, yi), moving across the signal with p step, shows with great accuracy, the moments for which can appreciate a common cause for two series of values.
Spectral analysis provides important information to obtain the periodicities of the geomagnetic data series. However, the constraints imposed by Fourier transform calculation determine the severe limitations of frequency resolution, limitations that are unacceptable if it is necessary to analyze signals of short duration.
Analyses of time - frequency allow identify the frequency characteristics of the signal at a time. For this choose a mobile window, moving along the signal, were analyzed the frequency content of each window, finally obtaining the frequency spectrum well localized in time.
The advantage of the wavelet transformations versus the Fourier transform is the possibility to analyze discrete data sets that have some gaps or irregular variations, as the geomagnetic data.
An important advantage offered by wavelets is given by the ability to analyze a localized area in a larger signal and reveal aspects about correlation between analyzed signal and some basic functions with known physical properties.