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Multifractal, nonlinear, and chaotic nature of earthquake and global temperature

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Abstract

Earthquake is a major geographical phenomenon being investigated for a long time using the examination of various geological events. Since the beginning of the eighteenth century, there has been a gradual change in global temperature, which has affected the Earth's atmosphere and crust. A correlation between these two dynamics has been suggested but not experimentally verified. This unique work aims to consider the magnitude of globally occurred earthquakes and global temperature as a monthly time series, analyze its characteristics, and determine the co-relationship. The multifractal detrended fluctuation analysis (MFDFA) and wavelet transform modulus maxima (WTMM) have been carried out for the two signals, which reveals Generalized Hurst component $h(q) <$ 0.5 that signifies both the dynamics are complex

nonlinear and nonstationary. Further investigation has been made to find the degree of nonlinearity, quantified by *RMSE* value using delay vector variance (DVV) analysis. The analysis indicates that the global temperature time series (*RMSE* = 0.55) exhibit more nonlinearity than the magnitude of the earthquake time series (*RMSE* = 0.27). Further study shows the deterministic chaotic feature of both dynamics using information entropy (where $I(n) > 0$) and zero-one test (where $K \rightarrow 1$). To find the casual relationship, Granger causality test has been applied, which reveals that both the dynamics are interrelated. Finally, Pearson correlation analysis establishes the degree of association between global temperature fluctuation and the frequency of global earthquake occurrences. A small case study of Alaska region has been considered to validate the experimental results.

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Availability of data and material

The datasets generated during and/or analyzed during the current study are available from the

corresponding author on reasonable request.

Code availability

All codes for data cleaning and analysis associated with the current submission are available from the corresponding author on reasonable request.

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Contributions

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Ethics declarations

Conflict of interest

The authors declare no competing interests.

Additional information

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