Measurement of disorder in time series and applications in Earth's dynamics

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One of the fundamental questions in science is how to quantify relevant properties of time series derived from chaotic or (un)correlated stochastic phenomena, particularly as experimental data are often obscured by noise and irregular behavior. This work presents a novel approach to measuring disorder in time series via recurrence analysis. Using concepts from Group Theory and Information Theory, we construct an algebraic framework through recurrence microstates. Our method proves effective at detecting and distinguishing between chaotic, correlated, and uncorrelated stochastic signals, even in short and noisy time series. Applying this technique to real-world data from the Cenozoic period, we show that measuring disorder over time reveals critical transitions during this era, associated with the driving forces of the Earth's system. This approach, therefore, provides a robust theoretical foundation for quantifying and interpreting complex phenomena through experimental data.

References

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