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Complexity parameters of solar wind magnetic fluctuations at 1 AU during SC23 and SC24

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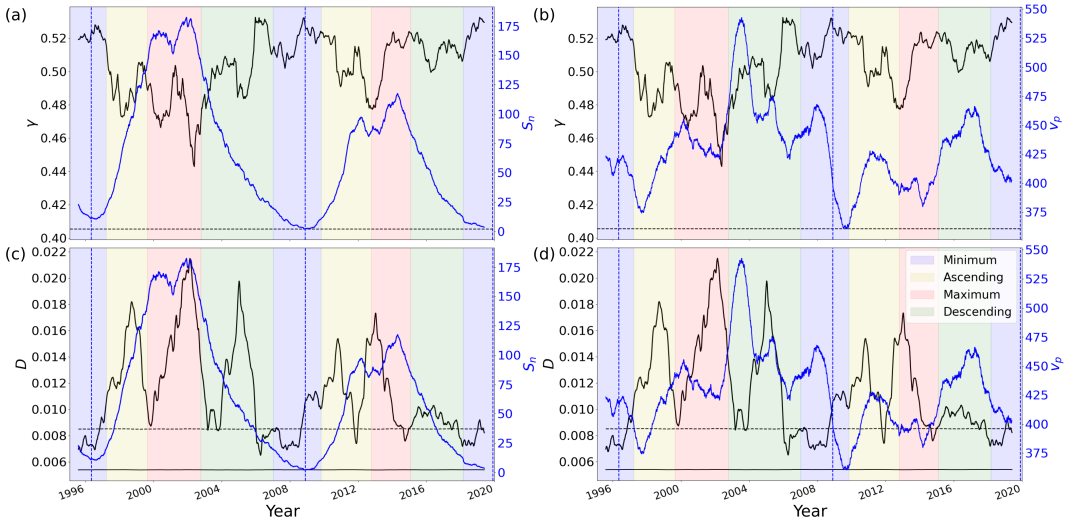
Introducción

From the point of view that considers the presence of turbulence in the plasma as a complex system [1], turbulence in the solar wind has been used to research different models from systems science analysis, which provides the opportunity to obtain preliminary information even before all the physics can be identified. We have modeled magnetic fluctuations time series at 1 AU (from Wind mission) as a complex system to characterize the behavior of the solar wind during solar cycles 23 and 24. We applied the method known as Horizontal Visibility Graph (HVG) [2] to calculate the evolution of measures Kullback-Leibler Divergence (KLD) and the characteristic exponent γ over time. By contrasting our complexity parameters with the solar activity represented in the number of sunspots and the solar wind speed, we have obtained significant intercorrelations (positives and negatives) during both cycles and throughout ascending, descending, minimum and maximum phases. We have found that the results generated by the HVG method are consistent with the complex nature of solar wind turbulence.

Desarrollo

Degree distributions provide γ-exponent and D-divergence. The degree distribution for undirected degrees have an exponential behavior of the form $P(k) \sim \exp(-\gamma k)$. The KLD between the two directed degree distributions functions is defined as $D[P_{\text{out}}(k)||P_{\text{in}}(k)] = \sum_k P_{\text{out}}(k) \log \frac{P_{\text{out}}(k)}{P_{\text{in}}(k)}$.



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Referencias

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