

## Characterizing the Solar Activity using the Visibility Graph Method

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In this work, the Sun and its behavior are studied by means of complex networks. The complex network was built using the Visibility Graph (VG) algorithm. This method maps time series into graphs in which every element of the time series is considered as a node and a visibility criterion is defined in order to connect them [1]. The VG method has been widely used to analyze various systems such as pulsating variable stars [2], solar activity [3,4] and blazars [5]. Using this method, we construct complex networks for magnetic field and sunspots time series encompassing four solar cycles, and various measures such as degree, clustering coefficient, mean path length, betweenness centrality, eigenvector centrality and decay exponents were calculated. In order to study the system in several time scales, we perform both a global, where the network contains information on the four solar cycles, and a local analysis, involving moving windows. Some metrics correlate with solar activity, while others do not. Interestingly, those metrics which seem to respond to varying levels of solar activity in the global analysis, also do in the moving windows analysis. Our results suggest that complex networks can provide a useful way to follow solar activity, and reveal new features on solar cycles.

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