



Long-term changes in the North-South asymmetry of solar activity: a nonlinear dynamics characterization using visibility graphs

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Solar activity is characterized by complex dynamics superimposed to an almost periodic, about 11-years cycle. One of its main features is the presence of a marked, time-varying hemispheric asymmetry, the deeper reasons of which have not yet been completely uncovered. Traditionally, this asymmetry has been studied by considering amplitude and phase differences. Here, we use visibility graphs, a novel tool of nonlinear time series analysis, to obtain complementary information on hemispheric asymmetries in dynamical properties. Our analysis provides deep insights into the potentials and limitations of this method, revealing a complex interplay between factors relating to statistical and dynamical properties, i.e. effects due to the probability distribution and the regularity of observed fluctuations. We demonstrate that temporal changes in the hemispheric predominance of the graph properties lag those directly associated with the total hemispheric sunspot areas. Our findings open a new dynamical perspective on studying the North-South sunspot asymmetry, which is to be further explored in future work.