

# **Study of Solar Activity Using Complex Networks**

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**Abstract:** We build monthly complex networks based on solar magnetograms for the complete 23rd solar cycle. [3] We use a binarization, noise filtering, and then image recognition algorithms to determine the centroids of the sunspots. Results for sunspots number are consistent with previously published works. [1,4,5] Then, monthly complex networks are built using the temporal sequence of the sunspots coordinates, and various metrics are calculated. Some of them correlate, others anticorrelate, and others do not correlate at all with solar activity.

Our results suggest that the complex network for solar magnetograms, built as described here, contains information on solar activity. [2] The usefulness of this method to make predictions on when will the next solar maximum occur, and how intense it will be, is currently being investigated.

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## **References:**

- [1] M. Domínguez, V. Muñoz, and J. A. Valdivia, *J. Geophys. Res.* 119, 3585-3603 (2014)
- [2] E. Flández: Study of sunspots by means of complex networks. Master's thesis, U. Chile (2021)
- [3] Solar Oscillations Investigations (SOI) project: <http://soi.stanford.edu/general/>
- [4] F. Watson, L. Fletcher, S. Marshall, *Astron. Astrophys.* 533, A 14 (2011)
- [5] M. Zorondo, V. Muñoz, In: Proceedings XIX Simposio Chileno de Física, Universidad de Concepción, Concepción, Chile, 26-28 Noviembre 2014. (2014)

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