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Joint multifractal approach to characterize nonlinear relationships of climate and cereal growth in semiarid

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Rainfed crops as cereals in the semiarid are common and extensive land cover in which climate, soils and atmosphere interact trough nonlinear relationships. Earth Observations coupled to ground monitoring network allow to improve the understanding of these relationships during each cropping season. However, novel analysis is required to understand these relationships in larger periods to improve sustainability and suitability of the productive areas in the semiarid.

The aim of this work is to use a joint multifractal approach using vegetation indices, precipitation, and temperatures to analyze atmosphere-plant nonlinear relationships. For this, time series of 20 cropping seasons were used to characterize these relationships in central Spain. The Generalized Structure Function and the derived Generalized Hurst Exponent analysis were implemented to investigate precipitation, vegetation indices and temperature time series. For this, an exhaustive selection based on land use and a land cover change analysis was performed to detect plots in which cereal crop sequences are dedicated to barley and wheat over the period 2000 to 2020.

As a result, two agro zones were characterized by different multifractal properties. Precipitation series show antipersistent characteristics and fractal properties between zones while original vegetation indices show trending behavior but shifted between analyzed zones. Nonetheless, soils and rainfall events can vary interannual conditions in which the crop is developing. For vegetation indices long-term series the trend is persistent. Even so, the dynamics of vegetation indices also provide more information when annual patterns are extracted from the series, exhibiting fractal properties mainly from rainfall pattern of each zone. Finally, in this case, the joint multifractal analysis served to characterize agro zones using earth observation and climate data for extensive cereals in Central Spain.

Reference

Rivas-Tabares D., Tarquis A.M. (2021) Towards Understanding Complex Interactions of Normalized Difference Vegetation Index Measurements Network and Precipitation Gauges of Cereal Growth System. In: Benito R.M., Cherifi C., Cherifi H., Moro E., Rocha L.M., Sales-Pardo M. (eds) Complex Networks & Their Applications IX. COMPLEX NETWORKS 2020 2020. Studies in Computational Intelligence, vol 943. Springer, Cham. https://doi.org/10.1007/978-3-030-65347-7_51

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