

*Title:* Applications of Spatial Permutation Entropy to the study of spatially extended ecosystems

*Abstract:*

Understanding and predicting abrupt ecological shifts in spatially extended ecosystems are vital for environmental management. Ecosystems like those in the North Atlantic Ocean and semiarid regions can undergo significant transitions due to rapid changes in key indicators. Previous research highlights the utility of spatial correlation in forecasting these tipping points, but early identification remains challenging due to factors like data resolution and noise.

It has been shown that the spatial permutation entropy (PE) can detect early warning signals in spatiotemporal data. Here, by analyzing the temporal variability of spatial indicators, specifically spatial correlation and PE, we aim to identify patterns signaling ecological shifts. We apply our approach to North Atlantic chlorophyll levels and semiarid vegetation data, along with model simulations.