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Using complex networks to predict abrupt changes in oscillatory systems

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Functional networks are powerful tools to study statistical interdependency structures in extended systems. They have been used to get insights into the structure and dynamics of complex systems in various areas of science. In particular, several studies have suggested the use of precursors based on percolation transitions in correlation networks to forecast El Niño events.

Our aim is to provide a better understanding of the potential of such percolation precursors for the prediction of episodic events in generic systems presenting chaotic oscillations. To this end, we study the behavior of the precursors in a spatially extended stochastic Vallis model, an asymmetric Lorenz-63 type model for the El Niño-Southern Oscillation (ENSO). Our results demonstrate the ability of the largest connected component of the network to anticipate abrupt changes associated with the system's oscillatory dynamics.

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