



Percolation-based precursors of transitions in dynamical systems

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Transitions in complex dynamical systems are ubiquitous in nature. Finding leading indicators in such systems is a fundamental task in many areas of science, such as financial markets, the extinction of species or climate change studies. Here we propose a new framework to study systems close to a bifurcation point by analyzing topological properties, based on clusters and percolation, of functional networks defined from the time series. The use of networks allows us for a global parametrization of the system going far beyond simple two-point relations (classical correlations). The generality and versatility of the cluster-based method to forecast transitions is shown in two different kinds of data. In one hand, three theoretical dynamical systems displaying very different transitions and crossovers were used as a test bed. On the other hand, we have used the field of surface air temperature in the NINO 3.4 zone. In this new approach, critical transitions are identified before they occur.