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Similarities in Precursory Features in Strong Seismic Shocks and Magnetic Storms

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An important question in geophysics is whether earthquakes (EQs) can be anticipated prior to their occurrence. Pre-seismic electromagnetic (EM) emissions provide a promising window through which the dynamics of EQ preparation can be investigated. However, the existence of precursory features in pre-seismic EM emissions is still debatable: in principle, it is difficult to prove associations between events separated in time, such as EQs and their EM precursors. The scope of this paper is the investigation of the pre-seismic EM activity in terms of complexity. A basic reason for our interest in complexity is the striking similarity in behaviour close to irreversible phase transitions among systems that are otherwise quite different in nature. Motivated by this hypothesis, we evaluate the capability of linear and non-linear techniques to extract common features predictive of strong magnetic storms and EQs respectively. We show that common distinctive alterations in scaling parameters of precursory EM tine series and D_{st} index time series occur as a strong EQ / magnetic storm approaches. These alterations reveal a gradual reduction of complexity as the catastrophic event approaches. The increase of the susceptibility coupled with the transition from anti-persistent to persistent behaviour may indicate that the onset of a severe shock is imminent. The results suggest that a unified theory may exist for the ways in which the corresponding activated units organize themselves to produce a large crisis, while the preparation of a large EQ or strong magnetic storm could be studied in terms of "Intermittent Criticality". The striking similarity in the temporal evolution of dynamical parameters in both cases strongly supports the seismogenic origin of the detected preseismic time-series in the context of complexity.