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Early Warning Signals For Climate Tipping Points: Beyond White Noise

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Tipping points in the Earth System could present challenges for society and ecosystems. The existence of tipping points also provides a major challenge for science, as the global warming thresholds at which they are triggered is highly uncertain. A theory of 'Early Warning Signals' has been developed to

warn of approaching tipping points. Although this theory uses generic features of a system approaching a Tipping Point, the conventional application of it relies on an implicit assumption that the system experiences white noise forcing. In the Earth system, this assumption is frequently invalid.

Here, we extend the theory of early warning signals to a system additively forced by an autocorrelated process. We do this by considering the spectral properties of both the system and also of the forcing. We test our method on a simple dynamical system, before applying our method to a particular example from the Earth System: Amazon rainforest dieback. Using our new approach, we successfully forewarn of modelled rainforest collapse in a state-of-the-art CMIP6 Earth System Model.