EGU22-5500
https://doi.org/10.5194/egusphere-egu22-5500
EGU General Assembly 2022

Conditions for detecting early warning of tipping.

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The warning of tipping to an undesired state in a complex system, such as the climate, when a control parameter slowly approaching a critical value ($\lambda(t) \rightarrow \lambda_0$) relies on detecting early warning signals (EWS) in observations of the system. The primary EWS are increase in variance, due to loss of resilience, and increased autocorrelation due to critical slow down. They are statistical in nature, which implies that the reliability and statistical significance of the detection depends on the sample size in observations and the magnitude of the change away from the base value prior to the approach to the tipping point. Thus the possibility of providing useful early warning depends on the relative magnitude of several interdependent time scales in the problem. These are (a) the time before the critical value λ_c is reached, (b) the (inverse) rate of approach to the bifurcation point (c) The size of the time window required to detect a significant change in the EWS and finally, (d) The escape time for noise-induced transition (prior to the bifurcation). Here we investigate under which conditions early warning of tipping can be provided.