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False alarms: How early warning signals falsely predict abrupt sea ice loss

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Uncovering universal early warning signals for critical transitions has become a coveted goal in diverse scientific disciplines, ranging from climate science to financial mathematics. There has been a flurry of recent research proposing such signals, with increasing autocorrelation and increasing variance being among the most widely discussed candidates. A number of studies have suggested that increasing autocorrelation alone may suffice to signal an impending transition, although some others have questioned this. Here we consider variance and autocorrelation in the context of sea ice loss in an idealized model of the global climate system. The model features no bifurcation, nor increased rate of retreat, as the ice disappears. Nonetheless, the autocorrelation of summer sea ice area is found to increase in a global warming scenario. The variance, by contrast, decreases. A simple physical mechanism is proposed to explain the occurrence of increasing autocorrelation but not variance when there is no approaching bifurcation. Additionally, a similar mechanism is shown to allow an increase in both indicators with no physically attainable bifurcation. This implies that relying on autocorrelation and variance as early warning signals can raise false alarms in the climate system, warning of "tipping points" that are not actually there.