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Can kurtosis be an early warning signal for abrupt climate change?

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The climate system occasionally experiences an abrupt change. However, it is very difficult to predict this change based on the existing capability. Fortunately, some generic properties have been revealed before several different types of dynamic system near their own critical thresholds. These properties provide a possible way to give an early warning for an impending abrupt climate change. Therefore, it is important to evaluate the performance of an early warning signal. On the basis of several simple fold modes, we have systematically investigated the performance of the kurtosis coefficient as an early warning signal for upcoming abrupt climate change. The testing results indicate that the kurtosis coefficient is a reliable warning indicator in most of cases whether for a critical control parameter or for external forcing approaches a critical point, which has a strong anti-noise ability. However, the strong noise can greatly shorten the effective warning time, and also can result in the reduction of the changing magnitude of kurtosis coefficient when a dynamic system is close to the critical threshold. The missing data has almost no effect on the kurtosis coefficient in all of tests, even when the missing data accounted for 20% of the total sample. We also found that the kurtosis coefficient does not work in some cases, which means that the kurtosis coefficient is universal and it is good way to consider multiple early warning signals for a relatively reliable warning. The testing results indicate that the kurtosis coefficient is a reliable warning indicator in most of cases whether for a critical control parameter or for external forcing approaches a critical point, which has a strong anti-noise ability. However, the strong noise can greatly shorten the effective warning time, and also can result in the reduction of the changing magnitude of kurtosis coefficient when a dynamic system is close to the critical threshold. The missing data has almost no effect on the kurtosis coefficient in all of tests, even when the missing data accounted for 20% of the total sample. We also found that the kurtosis coefficient does not work in some cases, which means that the kurtosis coefficient is universal and it is good way to consider multiple early warning signals for a relatively reliable warning.