Title: Sea ice stability and early warning signals

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Abstract: The retreat of Arctic sea ice is one of the most dramatic signals of recent climate change in the observational record. It involves an amplifying feedback associated with surface albedo changes, which suggests the possibility of unstable climate states and "tipping points". Previous studies have identified such instabilities in a range of idealized models but not in comprehensive global climate models (GCMs). In the first part of the talk, I will propose a physical explanation for this discrepancy, drawing on a model we developed to bridge the gap between low-order models and GCMs. The results help constrain whether such instabilities should be expected in nature. The second part of the talk concerns a phenomenon called "critical slowing down", which has been suggested as an early warning signal to predict the approach of abrupt climate changes. I will show that a model that simulates a constant rate of sea ice retreat under global warming, with no acceleration, nonetheless shows the standard features of critical slowing down. We find that the slowing down occurs due to the change in effective heat capacity as the polar oceans become increasingly ice-free, rather than an approaching bifurcation. This implies that relying on features of critical slowing down to predict abrupt climate changes can raise false alarms, warning of tipping points that are not actually there.