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**J. S. Wettlaufer\*** ([john.wettlaufer@yale.edu](mailto:john.wettlaufer@yale.edu)), Yale University, 210 Whitney Avenue, New Haven, CT 06520-8109. *Nonlinear threshold behavior during the loss of Arctic sea ice.*

In light of the rapid recent retreat of Arctic sea ice, a number of studies have discussed the possibility of a critical threshold beyond which the ice–albedo feedback causes the ice cover to melt away in an irreversible process. The focus has typically been centered on the annual minimum (September) ice cover, which is often seen as particularly susceptible to destabilization by the ice–albedo feedback. Here, we examine the central physical processes associated with the transition from ice-covered to ice-free Arctic Ocean conditions. We show that although the ice–albedo feedback promotes the existence of multiple ice-cover states, the stabilizing thermodynamic effects of sea ice mitigate this when the Arctic Ocean is ice covered during a sufficiently large fraction of the year. These results suggest that critical threshold behavior is unlikely during the approach from current perennial sea-ice conditions to seasonally ice-free conditions. In a further warmed climate, however, we find that a critical threshold associated with the sudden loss of the remaining wintertime-only sea ice cover may be likely. Comments concerning the connections with ergodic theory are made. (Received February 27, 2009)