



A recent bifurcation in Arctic sea-ice cover

V. N. Livina (1) and T.M. Lenton (2)

(1) University of East Anglia, School of Environmental Sciences, Norwich, United Kingdom (v.livina@uea.ac.uk), (2) College of Life and Environmental Sciences, University of Exeter, UK

Arctic sea-ice has experienced striking reductions in areal coverage, especially in recent summers, and summer ice cover is forecast to disappear later this century. This has fuelled debate over whether Arctic sea-ice has already passed a 'tipping point', or whether it will do so in future, with several recent model studies arguing that there is no bifurcation involved because the loss of summer sea ice is highly reversible. Recently developed methods can detect and sometimes forewarn of bifurcations in time-series data, hence we applied them to satellite data for Arctic sea-ice area. Here we show that a new low ice cover state has appeared from 2007 onwards, which is distinct from the normal state of seasonal sea ice variation, indicating a bifurcation has occurred (from one attractor to two). There was no robust early warning signal of critical slowing down prior to this bifurcation, indeed the normal state of sea-ice cover became more stable in the decade beforehand. Internal climate variability is likely responsible for recent transitions between the two ice cover states. However, there are signals of increasing instability since 2007. Several positive feedbacks between the atmosphere, ocean and sea-ice cover could be contributing to separating the two states for Arctic sea-ice cover, as they have done at a regional scale in the past. Our results provide direct evidence of a recent bifurcation in Arctic sea-ice cover and the ongoing destabilisation suggests that further abrupt changes may lie ahead.

References: [1] Livina & Lenton, GRL 2007; [2] Lenton et al, PNAS 2008; [3] Livina et al, Climate of the Past 2010; [4] Livina et al, Climate Dynamics 2010; [5] Livina et al, Physica A 2010; [6] Lenton et al, Phil Trans Royal Soc A, in press; [7] Livina & Lenton, submitted.