Response on

'On the relationship between early warning signals

and critical transitions in complex ecosystems' by

Weaver & Dyke, Version August 12, 2016

Hermann Held

Sep 20, 2016

The ms underwent significant changes. From my point of view as Editor, it is highly likely that it could be published with only minor changes. However due to degree the ms has been changed and the in part fundamental level of criticism by the reviewers, I would like to ask the reviewers for some final comments on the current version.

Furthermore the authors undertook a significant effort to give proper credit to those colleagues who developed the early warning idea and / or implemented it prior to the current ms. Given the high level of ambition also in that regard as displayed in the ms, here I would like to see some crucial innovations further clarified and added as outlined the following. (As this in part refers to former work of my own group, this would imply a conflict of interest with my role as Editor, for what reason I hand back the supervision of this ms to the Editor-in-Chief level to clarify this point which is not central to the ms' key message.)

1. Wiesenfeld (1985) was the first to demonstrate early warning of bifurcations on an abstract physical toy model within Theoretical Physics. This was done by inspecting power spectra. Only indirectly this implies the detection of critical slowing down.
2. Kleinen et al. (2003) implemented this idea of inspecting power spectra for a toy model of the collapse of the thermohaline circulation of the North Atlantic (in fact they re-invented the above idea, being unaware of Wiesenfeld's paper).
3. Held & Kleinen (2004) made this approach applicable for complex systems (demonstrated for CLIMBER2 (Ganopolski et al., 2001), a climate model consisting of thousands of ordinary differential equations) and also provided a more parsimonious statistic to directly extract the critical time scale. This makes the critical slowing down directly observable. In view of Weaver's & Dyke's ms it has to be stated, though, that Held & Kleinen – in spite of CLIMBER's complexity – investigated a still elementary bifurcation structure in the sense of a single, isolated saddle-node bifurcation.

To my taste, lines 52-55 and 335-336 should be rewritten in a more precise manner accordingly:

- Lines 52-55 should mention Wiesenfeld and clarify the spectral domain / time domain issue.

- Lines 335-336 should clarify the complexity issue – in what sense was already worked on non-toy models such as CLIMBER2 and what does Weaver's and Dyke's ms add?

References

Ganopolski, A., V. Petoukhov, S. Rahmstorf, V. Brovkin, M. Claussen, A. Eliseev, and C. Kubatzki, CLIMBER-2: A climate system model of intermediate complexity: II. Model sensitivity, Clim. Dyn., 17, 735– 751, 2001.

Held, H. and Kleinen, T.: Detection of climate system bifurcations by degenerate fingerprinting, Geophysical Research Letters, 31, L23 207, doi:10.1029/2004GL020972, 2004.

Kleinen, T., Held, H., and Petschel-Held, G.: The potential role of spectral properties in detecting thresholds in the Earth system: application to the thermohaline circulation, Ocean Dynamics, 53, 53–63, doi:10.1007/s10236-002-0023-6, 2003.

Wiesenfeld, K.: Virtual Hopf phenomenon: A new precursor of period-doubling bifurcations, Phys. Rev. A 32, 1744-1751, 1985.