

# ***Interactive comment on “Numerical Bifurcation Methods applied to Climate Models: Analysis beyond Simulation” by Henk A. Dijkstra***

## **Anonymous Referee #2**

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The author, one of the main developers of this approach, reviews and discuss what has been attained with the use of bifurcation methods of climate models of increasing complexity. Although personal in style, I find the overview quite complete and illustrative of the state of the field, providing adequate background and references, and identifying remaining challenges.

I recommend publication of the paper. I just point out some minor points that the author can correct in the final version:

- In Eq. (6), the state vector  $X_t$  should be replaced by the difference with the deterministic steady state, say  $Y_t$ , defined as  $Y_t = X_t - x^*_{\lambda}$

-Define MOC before it appears first (in page 6). What has been defined in page 5 is

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AMOC. The relationship between the two acronyms would be quite evident for most readers, but could be confusing for the ones less familiar with this type of circulation.

- Page 7: principle component -> principal component

- Page 5: '... only four bifurcations can occur GENERICALLY when a single ...'

- I am not happy with the nomenclature of 'critical transitions'. The reason is that the expanding tendency in environmental applications is to use it in the sense of 'abrupt', 'discontinuous', which is exactly the contrary of the much older use of the word in several fields of physics, qualifying phase transitions. Perhaps a less ambiguous name would be 'dangerous transition' (Thompson et al. (1994) Phys. Rev. E 49, 1019 ; Int. J. Bif. Chaos (2011) 21, 399). I understand that the use of 'critical' is now prominent in many fields of science and I do not request the author to correct all the paper with this respect. But there is one place, the sentence '... the saddle-node is a critical transition, the Hopf bifurcation is not ...' in page 5, in which changing 'critical' to 'discontinuous' or some related word would make it less strange to readers with some particular backgrounds.

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