

Interactive comment on “Potential analysis reveals changing number of climate states during the last 60 kyr” by V. N. Livina et al.

Anonymous Referee #1

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Livina et al. suggest a novel and promising method to analyze abrupt changes recorded in geological archives. They use a simple dynamical system as a tool and test reliability of their approach using artificial data set. They apply the method for analysis of d18O record of Greenland ice cores and present results about the climate system dynamics during the last 60 kyrs which are qualitatively in line with climate model studies.

My main suggestion for improvement of this short paper is to discuss assumptions and limitations of the method in more details, especially because the reference papers by Kwasniok and Lohmann (in press) were not available during the review. In particular, the following method aspects are important to discuss:

- By taking the Langevin equation (1) as a conceptual model, what are the limitations

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imposed on the system dynamics? What kind of system dynamics is excluded by choosing this particular model, for example, by using the white noise term?

- Sometimes, the glacial cycles are treated as oscillations (e.g. Ghil et al., 1987). Are limited cycles excluded from the analysis by Livina et al. by definition? If so, is there a way to further develop the dynamic framework to account for oscillation behavior?
- Estimation of empirical probably density using the Gaussian kernel estimator needs more discussion. Again, what are limitations of this method?

Ghil M, Mullhaupt A, Pestiaux P (1987) Deep water formation and Quaternary glaciations. *Climate Dyn.*, 2, 1-10.

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