

Interactive comment on “Why could ice ages be unpredictable?” by M. Crucifix

Anonymous Referee #2

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This work investigates the capability of mathematical models involving nonlinear coupled ordinary differential equations, such as the van der Pol oscillator, to model past glacial-interglacial cycles. The discussion is carried using the concept of generalized synchronization and analyzing the existence of multiple minima. I found this paper pedagogical and interesting in explaining the specific dynamics, periodic forcing and synchronization of this class of systems. Nevertheless, I think that the following two remarks should be addressed.

1) Most of the material for the methodological analysis, including i.e. Arnold's tongues, has been presented in a previous work (involving the author) entitled "Is the astronomical forcing a reliable and unique pacemaker for climate? A conceptual model study" [De Saedeleer et al. 2012]. Most of Section 2 appears as a more pedagogical presentation of the concepts presented there and some analytical tools (such as Lyapunov exponents) have been dropped. Furthermore, the two topics are very similar. A clearer

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positioning of the actual paper, in terms of novelty of methodology and results, thus appears necessary.

2) As stated in the abstract a multi-model analysis is addressed but at the end this inter-comparison is limited to the numerical evaluation of the number of solutions. Decisive conclusions appear to be difficult to obtain with the proposed tools, as we get very different responses to variations on the two normalized parameters (tau and gamma). More specific tools for such an analysis would be expected. For example, could the models be characterized/analyzed in terms of: a- sensitivity to the parameters? b- size of the region of attraction? c- number of adjustable parameters? (are they all meaningful?) d- linearized behavior during glaciation/deglaciation? Also, can we distinguish some generic properties when comparing continuous and hybrid models?

Interactive comment on Clim. Past Discuss., 9, 1053, 2013.