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Earth System Dynamics
Discussions

Interactive comment on "A Theory of Pleistocene Glacial Rhythmicity" *by* Mikhail Y. Verbitsky et al.

Anonymous Referee #2

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This paper presents a three variable system of the glacial climate and models its response to astronomical forcing. The system sensitivity to 8 parameters is evaluated using a V-number, which measures the relative intensity of 'ocean' feedbacks on the system. When ocean feedbacks are weak, the system shows glacial cycles with a period of 40kyr, when ocean feedbacks strengthen glacial cycles shift to a period of 100 kyr. This increase in length of glacial cycles is consistent with the transition across the mid-Pleistocene transition.

This paper follows in the path of previous simplified models of the Pleistocene glacial cycles, but has many novel aspects. I have no major criticisms but have a few suggestions to improve the clarity of the manuscript. Overall this is an excellent and insightful paper and I recommend it for publication.

Minor points:

1) The ω variable is called 'ocean temperature' although is a combination of all aspects of the climate system outside of the ice sheet itself. The ocean is probably the largest component but this could be misleading to casual readers. I do not have a better suggestion for what to call this, but suggest the authors consider changing it. Although there are many warnings about this throughout the manuscript.

2) In the introduction it would be useful to include a more detailed summary of the model, the three variables and the 8 parameters varied in the later analysis (similar to the useful reminder around P20, L8). The 11 parameters and the values used for the steady state solution could be moved to a table.

3) P13, L1: It would be useful to introduce the 400kyr/Stage 11 problem when the model misfit around 400 kyr is mentioned. This is especially relevant given the later discussion of double obliquity periodicity.

4) P15, L7 and Fig 6: The four astronomical 'challenges' are precession cycles?

5) Fig 6. I suggest including a version of this figure for the other modes as well. You could also include the LR04 derivative, similar to Roe (2006).

6) I'm not sure of the need for the double obliquity model here; the full model seems able to explain the 100 kyr period. More justification is needed, i.e. is it to explain the Stage 11 problem?

Typos etc:

1) P2, L25. Change 'resort to' as may appear derogatory 2) Units are missing from several figure axes: Fig 3, 4, 7, 8, 9, 10, 11, 12. Also check label on Fig 8 right bottom. 3) P15, L7, 'Force' to 'Forcing'.

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