

Interactive comment on “Mending Milankovitch theory: obliquity amplification by surface feedbacks” by C. R. Tabor et al.

Anonymous Referee #2

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Tabor et al.'s paper presents an interesting view on the fact that in spite of strong precessional forcing of ice-sheets, precessional peaks seem to be absent in benthic $d_{18}O$ -based ice volume estimates. This is particularly evident in reconstructions of early Pleistocene ice-sheet variability which show prominent obliquity pacing. The key results of the paper are based on a series of idealized modeling experiments using an asynchronously coupled version of the GENESIS-Penn State ice-sheet model. The paper concludes that important climate feedbacks amplify the obliquity signal over the precessional response.

The analysis helps to quantify the relative ratios of precession and obliquity components in ice-volume variations. The paper would benefit from a comparison of these model-based ratios with those obtained from benthic $d_{18}O$ stacks. I have the impres-

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sion that in comparison to the paleo-data the model still generates too much precessional variability over the obliquity component (Figure 3a,c). It needs to be explicitly stated that the proposed climate feedback mechanism provide a means to enhance the obliquity signal over the precessional signal, but that this enhancement is still far away from the complete muting of precessional variability during e.g. the Early Pleistocene.

There are several minor more editorial points that need to be addressed:

- Abstract "power by" should be "powered by"
- "...these differences cause obliquity to have a greater effect than precession on integrated summer energy amplitude above an ice-melt threshold". As far as I remember this was already shown in a paper by Andre Berger. Please cite appropriately. Unfortunately, I do not have his reference handy.
- Why is the sea level lowered everywhere by 275m? This seems quite arbitrary. Please provide more explanation.
- For the "asynchronous technique" please cite G. E. Birchfield, J. Weertman, A. T. Lunde, Quaternary Research 15, 126, (1981).
- "resulting in a larger sea-ice feedback" should be "resulting in a larger sea-ice response"
- "(see Supplement)" - there is no supplement in this paper, as far as I could see. I guess, you are referring to Figure 2a, correct?
- What is missing in this paper is a discussion of how the annual mean covariance between anomalous seasonal cycle of solar radiation multiplied with the average and anomalous seasonal cycle of albedo looks like [$\langle Q'(t) (1 - \bar{a}(t) - a'(t)) \rangle$]. After all this is the the effective annual mean shortwave forcing. In this case, clouds will also play an important role. Please discuss the role of cloud-albedo feedbacks versus sea-ice albedo feedbacks in amplifying the obliquity cycle.

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- "Our findings support; high latitude summer insolation forcing remains the largest single factor for determining ice-sheet volume response" - this is absolutely not obvious in the figures. What do you mean by "high-latitude summer insolation forcing"? Is this referring to the integrated summer insolation, or peak summer? Please clarify. Is this statement referring to Figure 3b? If yes, the precessional forcing is perhaps 15

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