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Climate of the Past Discussions

Interactive comment on "The 405 kyr and 2.4 Myr eccentricity components in Cenozoic carbon isotope records" *by* Ilja J. Kocken et al.

Anonymous Referee #1

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General comments:

This paper explores the relationship between orbital forcing and global carbon cycles across different timescales. For this purpose, the authors simulated the response of several key components of the carbon cycles to the orbital forcing using the LOSCAR model and compared those to the composite benthic foraminiferal d13C and d18O records covering the Eocene to Miocene. They highlighted the potential dominance of 2.4 Myr eccentricity cycle in the model results and argue that this cycle maybe overshadowed by the long-term changes in the composite records.

Overall, the structure of this paper is well shaped and data are clearly presented. However, I have two main concerns that need to be clarified by the authors: As suggested by the authors in the introduction of this paper, the co-occurrence of 405 and 100 kyr

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eccentricity maxima and relatively negative d13C and d18O values is still elusive, and different mechanisms, such as organic carbon burial linked to weathering controlled clay deposition, variations of global exogenic carbon pool, submarine methane hydrate dynamics, etc, have been suggested to address this. However, without any further discussion of these different mechanisms in the latter part of this paper, it seems to me that the authors already think the organic carbon burial plays a very important role in this co-occurrence before testing it, which doesn't make sense to me. Moreover, the authors argue that the continental shelves are very important for the organic carbon storage over astronomical time scales, which leads them to linearly force the Corg burial in marine sediment with astronomical forcing in their modelling. This doesn't make sense to me as both aspects, on the one hand, how astronomical cycles force the changes in the continental shelves, what the role of weathering has played, and why it is linear relationship between them, on the other hand, how burial of organic matter is regulated in the continental shelves, are still open questions. The authors found strong 2.4 Myr cyclicity in their model output but no signal in the composite records based on the MTM spectral analysis, which they argue the 2.4 Myr cyclicity may act purely as amplitude modulator, not as a true cycle. To me it is very important to address why 2.4 Myr cyclicity is dominant in the model output but act as an AM in the composite records as this is the key to understand the questions raised by the authors. Although the author expect to evaluate this with high-resolution proxy records in the future, I feel this part is under-discussed since this is certainly the highlight of this manuscript.

I also have a few technical comments:

1) Labels for Figure 2 are missing. 2) In model-data comparison, the authors said 'the lag of d13C to the 405 kyr eccentricity cycle is ~190 kyer, which is much higher than the 40 to 60 kyr during the Paleocene', it would be better for the authors to address the phase relationship between different records using cross spectral analysis, such as 'Application of the cross wavelet transform and wavelet coherence to geophysical time series' by Grinsted et al., 2004. 3) For Figure 4, I recommend using the wavelet analy-

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sis to assess whether this lead-lag relationship is constant through time, see Grinsted et al., 2004 for details.

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