Clim. Past Discuss.,
https://doi.org/10.5194/cp-2018-42-AC1, 2018

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

Ilja J. Kocken et al.

i.j.kocken@uu.nl

Received and published: 19 July 2018

Response to reviewer 1

We thank the reviewer for his/her feedback on the manuscript.

Below, we first address the two main concerns, and then reply to the technical comments.

First, the linear forcing. We introduce many possible mechanisms for the co-occurrence of the 405 and 100 kyr eccentricity maxima in climate records, since they are still poorly understood. We then dive into one of the possible mechanisms, using a relatively simple forcing scheme – linear forcing of organic carbon (OC) burial in the continental shelves. Since the mechanisms are largely unknown, but we do know that they must

link astronomical forcing to changes in δ^{13}C and δ^{18}O, we decide to force OC burial directly, and linearly, as a first approximation. OC burial is the product of sediment accumulation and organic carbon contents (corrected for porosity) and is thus linearly related to sediment accumulation, which in turn is approximately linearly related to sediment delivery to the ocean in the absence of major changes in sea level. Other factors governing OC burial (oxygen etc.) are secondary to sediment deposition. Moreover, we believe that our linear approach is preferred as a starting point, and find that it is quite capable of explaining some of the patterns we observe in climate records. We shall make this clearer in the manuscript's Results and Discussion.

Secondly, we shall elaborate on the significance between the discrepancy between model output (2.4 Myr as a cycle) and data composite (2.4 Myr as amplitude modulation (AM)). Mainly, we do not expect to find AM in the model output, since there is no mechanism in the model that would introduce such forcing and there is no reason to expect it to show as an emergent property. This means that in the real world, a certain process or processes causes the 2.4 Myr cycle to be present as an AM of the shorter eccentricity cycles, that we apparently do not incorporate in this simple carbon cycle model. At this point, with the available information, it is difficult to speculate regarding the exact causes of this result although we very much agree with the reviewer that it is an important result.

Regarding the technical comments:

1) We will add the a–d labels.

2) Indeed, we do use cross-spectral analysis using the Blackman-Tukey (BT) method from Analyseries to calculate this 190 kyr lag in the model. Using the suggested wavelet-based analysis would allow us to estimate changes in this relationship through time. However, we have no reason to suspect that the model output will show different phases in different time-slices, since it is forced with a simple cyclic input. If we look at the model output time-series, there is also no reason to suspect temporal changes in

the phasing. The estimates of 40–60 kyr for the lag in the data are from the literature.

We are open to applying cross-wavelet analysis, but we do not see the added value. We tried to access the Cross-Wavelet matlab script the reviewer pointed us to (from http://www.pol.ac.uk/home/research/waveletcoherence/) but this script was not accessible.

3) We could attempt to perform Cross-Wavelet analysis using the R-package WaveletComp (http://www.hs-stat.com/projects/WaveletComp/WaveletComp_guided_tour.pdf), but as mentioned before, we do not see the added value and are open to further editorial advice on this particular issue.

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2018-42, 2018.