Sinnesael et al. appreciate the review and suggestions for the discussion paper "Astronomical component estimation (ACEv.1) by time-variant sinusoidal modeling" by two anonymous referees.

In this document we provide a point-by-point answer to the interactive comments. These comments will be taken into account while preparing the final version of this manuscript.

Anonymous Referee #1

***Specific comments**

1/ My main concern in the proposed approach is the lack of any measure of uncertainty associated with the estimation procedure. Error bars for the parameters estimated by linear least squares should be easily obtainable, and included in the derived instantaneous amplitude and frequency results.

Providing a measure for uncertainty on the estimations is the main concern for both referees. We recognize that in the current version of the algorithm- uncertainties related to the sinusoidal fitting procedure are not taken into account. We want to meet this concern by discussing it in the methodology and by implementing a measure for the uncertainty in the ACEv.1 MATLAB routines. We are currently exploring different techniques to estimate that uncertainty and to translate this uncertainty into sedimentation rate (and thus geologic time).

A first possibility to address this would be to use the uncertainties (standard deviations from the least-squares) off the parameters that are used to estimate the waveforms. However, the non-linear relationship between the parameters and instantaneous frequency (sedimentation rate), implies no closed-form solution for the uncertainties. For a single data record, the number of parameters to estimate = (Number of orbital components) x (Polynomial order + 1) x 2 x (Number of analysis frames). Combining all uncertainties of the parameters with error propagation and in our case of overlapping (analysis frames) would be computationally expensive.

Therefore, we will adopt a more time-efficient and equally elegant alternative approach. This approach consists of Monte-Carlo simulations of the jitter on proxy measurements, as well as on the depth/time scale. Such approach allow for the evaluation of the robustness of the sinusoidal fit.

2/ Fig. 1 (b) - the role of the "frame" in the figure is not clear

We will redraft Fig. 1b so that the different concepts illustrated are more readily clear to the reader (for example the role of the "frame", which is called the "analysis frame" in the text of the manuscript). Moreover, we will make sure that the words "analysis frame" and "window" are consistently used throughout the whole manuscript, so to improve clarity.

3/ Fig. 3 (G) - the width of the line representing 41 kyr is not consistent

We agree it makes more sense to have the 41 kyr line thinner and thicken the line representing the averaged (500 point) sedimentation rates which were derived from the LR04 age model. We will adopt this suggestion.

***Technical corrections**

Thank you, these will be corrected.

Anonymous Referee #2

***Specific comments**

1/ As also mentionned by the first reviewer, I believe it is critical to provide and discuss the uncertainties associated with the fitting procedure, and try to translate them into error bars in the final age models or sedimentation rates.

See the written answer for "1/ Anonymous Referee #1", same remark.

2/ I am also a bit frustrated by the lack of discussion on the results obtained with the ODP846 record (basically Fig.3G) which is only presented by the sentence : " Except for a small difference between 70 and 100m the match is close". How large is the mismatch in terms of absolute age ? Where does this mismatch actually come from ? There is a lower signal amplitude at 41kyr at this time (Fig.3D), but this is also the case below 150m where the agreement with LR04 is rather good … The LR04 sedimentation rate is rather flat, so there is (a priori) no strong change in the record at this time. The explanations given in the conclusion (page 13 lines 10-16) are therefore not fully convincing for this particular case study.

Reviewer #2 wishes for more discussion of the technical aspects of the ODP846 case study. We recognize that in the original version of the manuscript, this discussion is rather limited, and we intend to elaborate on this topic in the revised version. Below, we break down the comment into pieces and provide a point-by-point answer.

I am also a bit frustrated by the lack of discussion on the results obtained with the ODP846 record (basically Fig.3G) which is only presented by the sentence : " Except for a small difference between 70 and 100m the match is close".

The mismatch is also discussed in the conclusions, however it is indeed better to rearrange the text and provide more in-depth information in the discussion itself and less in the concluding chapter. Hence, a restructuring of this discussion is planned for the revised version of the manuscript. See more in the points below.

How large is the mismatch in terms of absolute age ?

This depends on the position down the core. Sometimes the 41 kyr estimate derived sedimentation rates will be higher than the LR04 sedimentation rates, sometimes lower. This also means over-and underestimations cancel each other out throughout. We will discuss the difference in total duration of both approaches, as well as the maximum and minimum discrepancy, in the discussion of the manuscript.

Where does this mismatch actually come from ?

This is mentioned in the conclusions, but should already be addressed in the results and discussions chapter:

"(a) the ACE v.1 model in its current form cannot deal with fast changes in sedimentation rate (b) the signal to- noise-ratio of the LR04 ***(age model [should be added])*** *is superior to the ratio of a single record and (c) no other a priori information* ***(in the ACEv.1 analysis contrary to the LR04 stack [should be added])*** *coming from other geological constraints is included as that the obliquity band should be in a certain frequency range*

There is a lower signal amplitude at 41kyr at this time (Fig.3D), but this is also the case below 150m where the agreement with LR04 is rather good …

This is an excellent observation. Between 60-90 m there is indeed a lower signal amplitude, as well as below 150 m. The difference is however that around 70-80m there is an elevated signal amplitude around the frequency of 0.5 cycle m^{-1} (with the 41 kyr component mainly around 0.6 cycle m^{-1}) whereas there are no other elevated amplitude signals near the obliquity frequency below 150 m. This is also illustrated in a small drop (instead of rise) in sedimentation rate between 70-80 m in Figure 3G, potentially giving a hint that the lower boundary in the selected frequency range for the component estimation should be increased. This will be included in the discussion as well as the used frequency range for the component estimation (as is mentioned in the two other case studies).

The LR04 sedimentation rate is rather flat, so there is (a priori) no strong change in the record at this time.

The original LR04 sedimentation rate is not flat. It seems flat because we use a 500-point moving average. This is mentioned in the heading of the Figure but can be added for clarity purposes to the legend in the Figure. Additionally we can plot the non-averaged derived sedimentation rates too.

The explanations given in the conclusion (page 13 lines 10-16) are therefore not fully convincing for this particular case study.

We believe that with additional discussion and the rearrangement of our interpretation the analysis and its results should be clearer. However, the ACEv.1 model in its current form has its limitations. But these are also well illustrated with this specific case study. Therefore we believe it is and stays very valuable for the quality of the manuscript.

3/ Clearly, the Danian record is the best example of the added value of the method (since there are little stratigraphic constraints except cyclostratigraphy). The advantages of the new method are discussed in the text (page 13, lines 17-25) but not well illustrated on the figures. It would be quite easy, and very helpful, to add on Figure 4F indications of alternative sedimentation rates (traditionnal tuning by Sinnesael et al 2016, …) somewhat equivalent to Figure 3G.

We follow the helpful suggestion that adding the alternative sedimentation rates (Galeotti et al., 2015 and Sinnesael et al., 2016) into Figure 4F, would enhance the illustrative power of the Figure. In analogy with Figure 3G (and 3/ AR #1) we will take care to be consistent in the use of the appropriate format for the added lines.

Next to the feedback of both reviewers we foresee the possibility to make esthetical changes in the provided MATLAB scripts, this based on user feedback. These would include a relaxation of the preconditions of the format of the input data and the implementation of a basic graphic output. Furthermore the equation numbering in the Appendix will be corrected.