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Climate of the Past Discussions

Interactive comment on "Two distinct decadal and centennial cyclicities forced marine upwelling intensity and precipitation during the late Early Miocene in Central Europe" *by* G. Auer et al.

G. Auer et al.

gerald.auer@uni-graz.at

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There were two important questions raised in the comment of Referee 1, which we would like to address in appropriate detail:

Referee 1: "The major weakness of this study is that it lacks an accurate estimate of the sedimentation rate. They employ a best fit model to tweak the sedimentation rate so that their periodicities are more in line with numbers seen in the literature. I believe they do their due diligence in: showing that the sedimentation rate is within the range of other similar sites, that all periodicities were consistently higher, and their use of process based reasoning."

Just as the Referee we are well aware of the problems with this approach, and we again want to state in this comment, that this always needs to be considered when dealing with this type of analyses. However, this is a widely used standard that originated in orbital tuning used to correlate Milankovitch cycles and calculate absolute sedimentation rates in deep sea drill cores (e.g.: Kern et al., 2012; Zeeden et al., 2013).

Referee 1: “P8L08 "a continuous sedimentation rate was assumed" This section could be ameliorated by the inclusion of a justification for this assumption. Is this assumption adopted in the absence of any available information? How well does a constant sedimentation model fit for this depositional setting?”

This was caused to a large part by unfortunate phrasing and obviously led to some confusion.

To clarify: we do not consider the sedimentation rates ‘constant’ in the strict sense of the word, as perfectly constant sedimentation rates obviously do not exist. They are, however, on average assumed to be consistent enough in their variability as to not adversely affect the used spectral analysis methods. REDFIT actually shows so-called ‘broadened’ peaks, indicating random variations in the sedimentation rate. This is a well-known effect in time series analysis (see Weedon, 2003 for an extensive discussion on the subject). However, as long as changes in sedimentation rate do not follow a certain trend (getting progressively higher or lower with time), they do not obscure cycles. They just cause the cycles to get slightly ‘blurry’ which smears their frequency component along a spectrum, and this actually causes the aforementioned broadening of the peaks.

It can be safely assumed that any change in sedimentation rate in the outcrop data is random or at least quasi-random, since it must be considered as having periodic changes with random amounts of change. This does not affect the methods in a detrimental way, as the broadened peak is still, more or less, centered at the actual frequency of the periodicity. Linear increases or decreases would, however, cause the

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frequency peaks to shift to either higher or lower frequencies (Weedon, 2003).

To conclude, we fully agree with Referee 1 and will revise this section to more accurately reflect our intended meaning.

Referee 1: “P9L16 "Significant periodicities" Although the significance levels are included in Table 3 the authors do not state at which level they consider to be significant. I would assume that only those periodicities >95

Again this was caused by poor phrasing on our part, and will be revised to more accurately reflect the used approach: We considered only peaks >95

This approach was used to account for the obviously quite noisy data we are dealing with in this work (see our reply to the previous comment).

Technical corrections

We incorporated all technical corrections into the manuscript and would like to thank the Referee for pointing them out.

References

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