

Peer Review Report

Review Report on Global mean and relative sea-level changes over the past 66 Myr: Implications for Early Eocene ice sheets

Original Research, Earth Sci. Syst. Soc.

Reviewer: Douwe George Van Der Meer

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EVALUATION

Q 1 Please summarize the main findings of the study.

Using new Mg/Ca data from the Pacific, it is argued that there is significant glacio-eustasy ongoing during the early Eocene, a time that is thought to be ice-free. In addition comparisons are made with global mean sea level, based on the New Jersey shelf and from Haq 1987.

Q 2 Please highlight the limitations and strengths.

The strength is new Mg/Ca data and a useful comparison with various Cenozoic datasets. The limitations is that there are a multitude of conversions possible that are needed to convert this to global mean sea level. The manuscript would also benefit from incorporating some recent literature.

Q 3 Please comment on the methods, results and data interpretation. If there are any objective errors, or if the conclusions are not supported, you should detail your concerns.

The introduction is very much all about the presence or absence of continental ice. However, there is no introduction figure to illustrate any qualitative or quantitative comparison between various studies. This would be a great help to have, especially when the final results are discussed.

The tectonic correction is very much under-discussed here, despite the fact that it is the most significant factor that is needed to be able to compare the barystatic curve derived here to global mean sea level comparisons.

Q 4 Check List

Is the English language of sufficient quality?

Yes.

Is the quality of the figures and tables satisfactory?

Yes.

Does the reference list cover the relevant literature adequately and in an unbiased manner?

No.

Are the statistical methods valid and correctly applied? (e.g. sample size, choice of test)

Yes.

If relevant, are the methods sufficiently documented to allow replication studies?

Yes.

Are the data underlying the study available in either the article, supplement, or deposited in a repository? (Sequence/expression data, protein/molecule characterizations, annotations, and taxonomy data are required to be deposited in public repositories prior to publication)

Yes.

Does the study adhere to ethical standards including ethics committee approval and consent procedure?

Yes.

If relevant, have standard biosecurity and institutional safety procedures been adhered to?

Not Applicable.

Q 5 Please provide your detailed review report to the editor and authors (including any comments on the Q4 Check List):

In the introduction/background section, add a figure on paleo-ice estimates through time to date as a starting point.

I recommend incorporating recent work on warmer/colder periods / paleo-temperatures of Scotese et al. (2021) and Sluijs et al. for the Paleo-Eocene and on ocean basin volumes, ice volumes and global mean sea level (Van der Meer et al. (2022).

I found at times the number of abbreviations (especially in paragraph titles and figure captions) and jargon to be hampering my speed of comprehending the manuscript. Are all abbreviations needed?

Why use barystatic, but avoid using glacio-eustatic? Thermosteric vs. thermal expansion? Above/below floatation vs land ice or ice sheets grounded on the sea bed?

When referred to temperature, specify which kind of paleo-temperature more clearly. Presumably only bottom deep sea, or global average sea surface?

Are there any more recent stratigraphically derived alternatives than the ancient Haq 1987? Haq & Qahtani (2005)? Snedden & Liu (2010)?

45-onwards: Re-write chronologically, Cretaceous to Present.

117-129: I don't think it is needed to have all figures here back-to-back. Just a brief description of the approach will be sufficient. The figures can be extensively described later.

173-188: Most in this paragraph is duplicated from above. Delete.

198-208: It is unclear why Atlantic data was excluded, what the benefit is of using Pacific data only.

257: How was 0.13 promille derived? The source article advocates 0.1 promille. This is not explained here, nor satisfactorily in 605-621.

392-395: Expand the description and discussion on the tectonic correction. This is one-two orders more important than the thermosteric correction. At the very minimum explain which plate model underpins Wright et al. 2020 and consider alternatives.

400: Why is the section on CO₂ relevant? Remove?

701: previously documented... Add reference.

527 Explain why the ice-free BSL matters upfront. i.e. for providing an upper limit for the BSL reconstruction. (543)

537: How could the continent of Antarctica have been bigger? Are you referring to land mass (probably) or continental crust extent?

721-722: Rowley (2002)'s statement only applies to approaches using plate models.

716-725. incorporate the strontium-based estimates of Van der Meer et al. (2017, 2022) which overcomes the lack of preserved oceanic crust in plate tectonic reconstructions.

884-885 I prefer this to be stated as ... in agreement with evidence from Antarctica...

Figure 2: I assume these plots represent sea level relative to Present-Day. Shouldn't the thick blue lines therefore start at 0 m sea level at Present? Otherwise an ice-free world would seemingly be +140m higher than Present-day.

Figure 2 & 3: can these be combined, thereby reducing the overlaps, and highlighting any differences?

Figure 4: is the ice-free line needed here?

Figure 5: what is the purpose of showing the CO₂ data in this manuscript?

Figure 9: Add a visual aid to compare with the ice vs. ice-free hypotheses from the proposed early introduction figure on paleo-ice reconstruction.

Figure 10: for completeness, expand plots to Present-Day.

Fig 10 caption: add age range for Miocene. Or add Geological timescale to the Figure.

QUALITY ASSESSMENT

Q 6 → Originality	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Q 7 → Rigor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 8 → Significance to the field	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Q 9 → Interest to a general audience	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 10 → Quality of the writing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 11 → Overall quality of the study	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>