

Interactive comment on “Effects of CO₂, continental distribution, topography and vegetation changes on the climate at the Middle Miocene: a model study” by A.-J. Henrot et al.

Anonymous Referee #2

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Overall this is an interesting study packed with many good things. It is comprehensive in its scope and I like the way the sensitivity of Miocene climate is explored through the suite of sensitivity runs. It is certainly suitable for inclusion in CP.

I certainly have sympathy with the major conclusion of the paper, that higher than pre-industrial concentrations of CO₂ are most likely required to reconcile Miocene climate simulations with appropriate proxy climate records. The decoupling of Miocene climate and CO₂ hypothesis has always seemed to me to be unlikely even at just an intuitive level. An Occam's razor approach is required. What is more likely, that climate and CO₂ were indeed decoupled during the Miocene or our knowledge of geochemical CO₂

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proxies in incomplete? The answer to that is obvious. The decoupling hypothesis is now crumbling under the combined attack of palaeoclimate modelling and independent techniques used for CO₂ estimation.

That said I do concur with the majority of what the first reviewer has raised and feel that those aspects should indeed be addressed; although I estimate that the corrections will not necessarily take that long to implement and so I would estimate that the paper requires only moderate revision (but that is not an option I can tick).

On top of that I have my own list of suggestions that would enable this study to be shown in its best light - given the good work that has been done it certainly deserves that.

I think that what is new in this study could be better (more clearly) stated. The literature on previous Miocene climate modelling studies requires a more concise critical evaluation.

I would like to see some demonstration of how the Planet Earth Simulator compares to simulations produced by other EMICS - what are its known climatological biases that might affect the palaeo-simulation. What is the models climate sensitivity, this is critical if we are to perhaps understand why the model appears to underestimate temperatures compared to data.

Determination of ocean heat flux for the Miocene could be described more fully. A reference is made to a previous simulation but how realistic was that simulation itself?

The process of biome translation is very unclear and needs further clarification. If the same was done for the control experiment what impact would it have on the simulation of the control experiment?

I think the supplementary information in the Pagani et al (2010) paper includes a revision of the Miocene alkenone-based CO₂ records that bring the geochemical proxy results closer to the estimates based on stomatal density.

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With regard to bias in SSTs estimates based on oxygen isotopes in the Miocene the authors could also cite the paper by Williams et al. that discusses this for a period in the Miocene in some detail.

Williams, M et al. (2005) Evaluating the efficacy of planktonic foraminifer calcite $\delta^{18}\text{O}$ data for sea surface temperature reconstruction for the Late Miocene, *Geobios*, 38 (6), pp843-863.

The experimental set up section is quite hard work to follow. To understand fully what has been done it requires careful examination of the many other papers which are cited. I think this section could be more clearly constructed to enable readers to quickly understand how the model has been set up. Perhaps break it down in to sections (Miocene Control - SSTs, heat transport, veg, Ice etc). Then state how the sensitivity runs differ.

Is it worth stating what the orbital parameters and solar constant were since these can differ between models?

I am not too keen on the structure of the results section. Lumping the description of Miocene simulations together rather than clearly separating them out makes the paper a challenge to read and critically quite hard to pull out the most important aspects of the science out of the paper.

I am pretty confident though that when these changes are made it will make a great contribution in CP!

Interactive comment on *Clim. Past Discuss.*, 6, 489, 2010.

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