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Climate of the Past Discussions

Interactive comment on "Warm Paleocene/Eocene climate as simulated in ECHAM5/MPI-OM" *by* M. Heinemann et al.

Anonymous Referee #2

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Review of Warm Paleocene/Eocene climate as simulated in ECHAM5/MPI-OM

First of all, I did not read the other review related to this paper until after I had written the majority of my review, so my review is independent.

The paper is very well written and addresses a critical topic – the inability of models to simulate polar warmth in agreement with proxy records in the Early Eocene. The analysis is also carried out well, making use of a 0D Energy Balance Model (EBM) to assess the relative importance of different processes in determining the global mean temperature.

Major comments:

What is the effect of using homogenous vegetation in the Eocene run? This is hinted

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at in the Discussion section but I feel it is critical, and accounts for a large proportion of the polar warmth. Some assessment could be made by including a more realistic Eocene albedo in the EBM.

For the comparison with SST data (section 3.2), I would like to see more data sites included here, e.g. from New Zealand. Also, in figure 5 you should compare the data with the local gridbox in the model (or average of closest few gridboxes), rather than with the zonal mean. These points should be plotted in Figure 5. Also, these sites should be plotted in Figure 4, including the croccidilian data, and maybe the 278.7K contour in the model (for comparison with croc data).

WHY is this run relatively more successful than previous attempts? The work implies it is the albedo change, or water-vapour feedback in this particular model. I know it is hard to conjecture about model-model differences when you only have access to a single run, but maybe some conjecture towards the end would be nice.

The EBM analysis is interesting, but can only really tell us about the causes of global mean temp change. Would it be possible to use a 1-D EBM (ie introduce latitude dependency), given the meridional heat fluxes from the GCM, to really get a handle on the causes of the change in latitudinal gradients? I would not insist on this, but it may give some useful insights and improve the paper further.

Specific Comments:

P1299, line 14 – more refs for modeling attempts which have failed to produce low pole-equator gradients.

P1303, line 1. Are the SSO parameteristion switched off in both the present-day and Eocene runs? Mentioned p1305, line 21, but also include here please.

Section 2.1 Boundary conditions – I assume you remove all ice sheets for the Eocene run? Please confirm in this section.

P1305, line 14: Fig 3 – can you add another part (b) which shows the arctic spinup?

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How about the trend in the arctic surface temps?

Section 2.1,2.2 – need to make clear, when including changes in Eocene run, what is done in the preindustrial control, e.g. vegetation, orbit, positioning of poles in ocean model etc.

P1305, line 27 – what time period does PR run over in terms of orbit? 2000BP to modern? Or into the future?

P1306, line 14. Give the modified PR a new name – e.g. PR'. Please make clear what the differences are now between PR' and PE. Is it just land-sea mask, topography, bathymetry and co2? What about veg? I think more could be made of this run in the paper.

Section 3.3, Figure 5b. Here, the big changes seen at high latitudes are due to the presence of seaice, and in particular the fact that the seaice surface cen get very cold, even if the air above is a low warmer. Of more interest is the SST change itself (which is shown, but due to the vertical scale is hard to see) - I would like to see the 2m air temp change, as I think this will be lower at high latitudes and is more climatically relevant in my view.

P1311, line 6 – can you give reasons why the EBM gives (slightly) different surface temps to the GCM? Is it the effect of orography in the GCM?

P1311, line 11 – also cloud differences. This seems more important than surface albedo diffs in the tropics (which are small in zonal mean) if you look at figure 9a.

P1313, line 18 – CH4 and N2O are different in PE and PR.

Section 4.5 – this is rather weak. Can you tell from your other pre-industrial simulation (PR') the affect of orbit? Also, you mention solar irradiance here so maybe change the title of section 4.5.

P1316, line 22 – statement about orography not affecting global mean temperature –

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actually it can affect global mean temp as the orography change can induce albedo changes, for example if orography rises above the snow accumulation line.

Conclusions – Here you are really talkig about the relative contribution of the different factors to Eocene warmth. But in some cases you use W/m2 and some K, so please be more consistent. A table might be useful for comparison here.

Minor comments:

P1298, line 4: delete warm. Use °C instead of K? also other places e.g. p1306, line 23.

P1299, line 23 – clarify here you are talking about taking the $data$ at face value.

P1303, line 13 – surface geopotential.

Fig 1 – remove black gridcell outlines.

P1307, line 22 – reference for seasonal bias in proxies?

P1309, line 4 – 25

P1311, line 11 – according to table 2 this should be 0.040 ?

P1312, line 5 – increase relative to what?

Interactive comment on Clim. Past Discuss., 5, 1297, 2009.