

Review of the manuscript “The effect of low ancient greenhouse climate temperature gradients on the ocean’s overturning circulation”, by W. P. Sijp and M. H. England

General comments

In this paper, Sijp and England investigate changes in ocean overturning circulation as consequence of a reduction in: i) pole to equator temperature difference; and ii) wind strength. In order to do so, the authors use a coupled climate model (UVic model) with an altered radiative balance in the atmosphere. Unexpectedly, the authors find that meridional overturning circulation remains relatively stable when the pole-equator temperature gradient and wind strength are reduced. I think that the authors present some very interesting results. Because the conditions investigated in this paper are typical of a greenhouse-type of climate, the authors choose to run their simulation using a Cretaceous geography. Considering that the Cretaceous is a time period characterized by a greenhouse climate and by a geography similar to the Paleocene-Eocene one, the results of this study can be applied to explain overturning changes during a wider geological timeframe than the one discussed in this paper. In addition, understanding changes in ocean circulation as consequence of a low pole-to-equator temperature gradient is a really important step to gain insight on how ocean overturning might change as consequence of modern and future climate changes. I recommend the publication of this paper in “Climate of the Past” after few minor revisions.

Specific comments:

I agree with the comments already provided by Reviewer #1. Below are few additional suggestions.

Model and experimental design. Figure 4 is cited before Figures 1, 2 and 3.

Discussion. Because this paper will be read by many paleoceanographers, I think that the discussion would greatly benefit by the comparison among the results obtained by the authors and previously published data based on paleoceanographic proxies.

Figure 3. Should depth be in km rather than m?